Appendix 13:

Pollution Survey Report

PROJECT FOR CAPACITY DEVELOPMENT IN BASIC WATER ENVIRONMENT MANAGEMENT AND EIA SYSTEM IN THE REPUBLIC OF THE UNION OF MYANMAR

POLLUTION SOURCE SURVEY REPORT

June 2018

PREPARED BY:

ENVIRONMENTAL CONSERVATION DEPARTMENT, MINISTRY OF NATURAL RESOURCES AND ENVIRONMENTAL CONSERVATION

YANGON CITY DEVELOPMENT COMMITTEE

MANDALAY CITY DEVELOPMENT COMMITTEE

JICA EXPERT TEAM

PREFACE

This report summarizes the results of the pollution source survey implemented in August – October 2016 and August – September 2017 as part of the bilateral technical cooperation project between Myanmar and Japan entitled "Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar". In total 200 factories in industrial zones in Yangon and Mandalay were surveyed using a questionnaire. In addition, wastewaters from 50 factories were collected and analyzed both in 2016 and 2017. We hope this report will help environmental authorities review the current status of environmental management in manufacturing and subsequently develop and enforce effective water environment management policies.

JICA Expert Team

Table of Contents

List of Tables

List of Figures

List of Abbreviations

BOD	Biochemical Oxygen Demand
C/P	Counterpart
COD	Chemical Oxygen Demand
DISI	Directorate of Industrial Supervision and Inspection
DO	Dissolved Oxygen
EC	Electrical Conductivity
ECD	Environmental Conservation Department
EIA	Environment Impact Assessment
GIS	Geographic Information System
GPS	Global Positioning System
IZ	Industrial Zone
IZMC	Industrial Zone Management Committee
JET	JICA Expert Team
JICA	Japan International Cooperation Agency
MCDC	Mandalay City Development Committee
MOECAF	Ministry of Environmental Conservation and Forestry
MOI	Ministry of Industry
MONREC	Ministry of Natural Resources and Environmental Conservation
SS	Suspended Solid
USEPA	United States Environmental Protection Agency
YCDC	Yangon City Development Committee

EXECUTIVE SUMMARY

In order to understand the current status of water environment especially the impact of industrial wastewater in Myanmar, the pollution source survey was implemented in 2016 (Period 1) and 2017 (Period 2). Industrial Zones in the Hlaing River basin in Yangon and the Doke Hta Waddy River basin in Mandalay were selected as the pilot area, and questionnaire survey and wastewater sampling were implemented.

A questionnaire survey of 200 factories and sampling and analysis of wastewaters of 50 factories were conducted in 2016. The results provided valuable insight into the current status of environmental control at factories in the target areas. However, some of the results, such as the analytical results of total nitrogen, were deemed not reliable. Thus, a follow-up survey consisting of effluent sampling and analysis at 50 factories, of which 33 factories overlapped with the ones in 2016 survey, was implemented from August to September 2017. In the follow-up survey, some effluent samples were analyzed not only in Myanmar and Thailand but also in Japan to confirm data reliability.

- Purpose: To collect information of pollution source
- Survey Area: Hlaing River basin in Yangon and the Doke Hta Waddy River basin in Mandalay
- Scope (1): Questionnaire survey for 200 factories in 2016
- Scope (2): Wastewater sampling for 50 factories each in 2016 and 2017
    - Target parameter of water quality analysis were decided based on the National Environmental Quality Emission Guideline (NEQEG) in 2015.
    - All samples were analyzed in Myanmar/Thailand.
    - 18 samples out of 50 were analyzed in Japan in 2017.

(1) **Outline of Existing/Target Factories in Survey Area**

The outline of existing/target factories in the survey areas were investigated through the data collection and questionnaire survey in 2016. The examples are described as follows.

- There are 1,083 factories in the target river basin in Yangon and 1,228 factories in Mandalay according to the list prepared by Directorate of Industrial Supervision and Inspection (DISI), Ministry of Industry (MOI) and/or Industrial Zone Management Committee (IZMC).
- In terms of the number of factories, food and beverage sector is the leading sector, accounting for 415 factories, followed by domestic materials (178), clothing (167) and accommodation (106) in Yangon. On the other hand, general mechanics sector such as “mechanics and welding business” and “car workshop” is the leading sector accounting for 592 factories, followed by minerals (224) and food and beverages (178) in Mandalay.
- In terms of the number of employees, in total, there are 90,105 employees in Yangon, of which 63% are employed by the clothing sector. On the other hand, there are total 16,150 employees in Mandalay, of which 24.1% are employed by the food and beverage sector, followed by general mechanics (16.6%), accommodation (13.0%), domestic materials (11.9%) and clothing (11.7%).

(2) **Environmental Management by Target Factories**

The questionnaire survey in 2016 revealed different aspects of environmental management by the target factories.

- With respect to measures to minimize pollution, it was found that only 10% of factories in Yangon and 2% in Mandalay were equipped with water meters to monitor water usage. Apparently, many factories are not aware of how much water they are consuming. On the other hand, about a half of the 200 factories replied that they are trying to minimize solid waste from entering wastewater stream.
- Roughly half of the 200 factories investigated replied that they have no wastewater treatment.
- With respect to primary treatment, 54% of 100 factories surveyed in the Hlaing River basin replied that they were equipped with some kind of primary treatment facilities. In Pyi Gyi Tagon IZ, only 35% of the factories said they were equipped with a primary treatment facility. Screens to remove large solids and settling basin to remove settleable solids are among the most common wastewater treatment facilities in these factories.
- With respect to secondary treatment to remove organic matter, 6% of the factories in IZs in Hlaing River basin were equipped with facilities. In Pyi Gyi Tagon IZ in Mandalay, 5 % of factories were equipped with such facilities.
- With respect to the difficulties factories are facing to install an adequate wastewater treatment plant (WWTP), the results of questionnaire survey in the Hlaing River basin were mixed and none of the reasons stood out as the main reasons common to most factories. In Mandalay, lack of expertise, unrealistic regulation and limited land appeared to be the main difficulties factories are facing to install treatment facilities.

(3) **Comparison Result of Wastewater with NEQEG (2015)**

National Environmental Quality Emission Guidelines (NEQEG) were established in December 2015 by Ministry of Environmental Conservation and Forestry (MOECAF) which was reorganized as Ministry of Natural Resources and Environmental Conservation (MONREC). Though they are not legally-binding at the moment, these guidelines define the required value of each parameter for each sector, and the results of wastewater analysis were compared against the requirements of NEQEG (2015).

- According to the results of the wastewater analysis in 2017, many of the wastewaters did not meet the guideline values for different parameters (e.g. 89% for BOD, 64% for COD, 43% for Total Nitrogen and 45% for Total Phosphorus, etc.). This is largely because these factories are not equipped with adequate wastewater treatment facilities. Most likely, these factories have to improve their wastewater treatment in near future.
- With respect to toxic substances, lead (4.3 mg/L), zinc (168 mg/L), mercury (0.014 mg/L) fluoride (5.2-16 mg/L) were found from battery factories in 2017 at levels higher than the NEQEG (2015). Similarly, phenols (1.0 - 8.4 mg/L) and total chromium (3.2 mg/L) from some of tanning factories were higher than NEQEG (2015). Zinc (3.0 mg/L) was also detected from a textile factory and phenols (0.96 mg/L) from a pharmaceutical company.
- It should be noted that a concentration of pollutant in industrial effluent is highly dependent on production and wastewater treatment processes at the time of sampling. Thus, a one or two-time survey is not enough to evaluate compliance with NEQEG (2015).

To evaluate compliance, regular monitoring is essential (the guidelines require the values to be satisfied in 95% of operation time). Another difficulty encountered was the reliability of laboratory data. This issue is discussed in (5) below.

(4) **Difference of Water Quality by Sector**

Due to the limited number of samples, variabilities within a sector, and uncertainties of some analytical data, it has been difficult to clarify differences in water qualities by sector. Nevertheless, the general observation, based on analytical results of 18 factories in a certified laboratory in Japan, are as follows.

- There is a trend that "Breweries and Distilleries", "Tanning and Leather Finishing" and "Pulp and / or Paper Mills" sectors have higher COD concentration than other sectors.
- "Tanning and Leather Finishing" and "Fish Processing" sectors have higher TN than other sectors. In addition, both two factories of these sectors have similar value.
- "Fish Processing" sector also has higher TP concentration. "Breweries and Distilleries", "Food and Beverage Processing" and "Tanning and Leather Finishing" also have higher TP concentration, however, results in each sector varied in wide range.
- As explained above, elevated levels of phenols, sulfate, and total chromium were detected from "Tanning and Leather Finishing" factories. It was noted that many tanneries in Myanmar employ vegetable tanning method. Lead, zinc and mercury were detected from the wastewaters of battery factories. Zinc was also detected from a "Textiles Manufacturing" factory and phenols from a pharmaceutical factory.

(5) **Reliability of Laboratory Data**

Reliability of analytical data was one of the main concerns in the Period 1 (2016) survey. Thus, the follow-up survey was designed in such way that some target factories of wastewater sampling and analysis in Period 1 and Period 2 (2017) overlap in order to compare analytical results in Period 1 in Myanmar/Thailand, Period 2 in Myanmar/Thailand, and Period 2 in Japan. The results can be summarized as follows:

- Generally speaking, there are still significant differences between the laboratory results in Myanmar and those in Japan. While COD and TP data are more consistent than TN data, closer examination of each data reveal that variability is significant even for COD and TP. Differences in analytical methodologies and analytical quality control practice appeared to be the most important reasons for the variability.
- The results of toxic substances in Japan and Thailand were more or less consistent, but further investigation is needed to ensure reliability.
- In order to regulate industrial wastewater using an effluent standard, these issues should be resolved first. Environmental authorities are suggested to standardize the analytical methodologies, introduce a laboratory certification system, and have all certified environmental laboratories to practice a set of QA/QC procedures.

(6) **Pollution Load from Industrial Wastewater in Survey Areas**

It was noted that a majority of factories are not significant dischargers of pollution load (amount of pollutant discharged a day = concentration x flow rate), though there are factories that account for a significant amount of pollution load.

- Both the concentration factor and the flow rate factor are important. Distilleries are among the main dischargers of organic pollution in Yangon and Mandalay. Wastewater from a distillery usually contains very high concentrations of organic matter (BOD and COD), and many of them use a sizable amount of water. However, the situation might change once they introduce efficient wastewater treatment systems, typically UASB + aerobic process. Some of food and beverage factories, rubber factories, etc., are also important sources of organic pollution.
- For conventional pollutants, such as BOD, COD, T-N and T-P, one should be aware of the importance of other pollution sources, such as domestic wastewater (sewage) and non-point sources (e.g., agricultural field).
- In order to compute a pollution load associated with a factory, both concentration of pollutant and wastewater flow rate have to be evaluated. Unfortunately, both entail significant uncertainties. The uncertainty associated with wastewater flow may be even larger than the one associated with concentration, as most factories in Myanmar are not monitoring water usage.

(7) General Recommendations/Suggestions

1) Gathering Information from Factories

Issues: Right now, environmental authorities generally do not have detailed information about factories required for environmental management, such as production volume, water usage, pollution prevention and control measures taken, use of toxic substances, monitoring results, environmental issues encountered, emergency plan, etc. Such information is not contained in the data set of DISI and/or IZMCs. Without such information, it is difficult to know which factories are subject to different requirements or which factories should be considered environmental priorities.

Suggestions: Environmental authorities should collect such information from factories in relation to ECC and/or business licensing/registration. As MONREC has already issued an order to factories in nine priority sectors to submit EMPs, an EMP is a good place to start. However, basic information should be collected every year, as the situation of factories could change. Thus, submission of such information should be incorporated into the reporting requirements of ECC and/or business licensing/registration. If gathering information through EMPs takes too much time, it is suggested to implement a questionnaire survey, similar to the one implemented in this project.

2) Development of Database of Pollution Sources

Issues: As demonstrated in this project, an electronic database is very useful for managing environmental information. However, the pollution source database developed in this project was designed largely to analyze the current situation of pollution sources, and was not designed specifically for ECC and business licensing/registration. Thus, once the frameworks of environmental requirements related to ECC and business licensing/registration are set, a new database should be designed.

Suggestions: In principle, they should be designed considering the licensing scheme, and end use of the database, e.g., tracking official and unofficial correspondence, managing inspection activities, managing information submitted by factories, and analyzing information to prepare reports to top management. For ECC, perhaps it is more appropriate to expand the EIA database, rather than developing a new database. It is important to note that digitizing of non-digitized information is very labor intensive. Thus, for the time being, it is probably wise to limit the information to be managed by a database, and manage other information in hard copies. In the future, perhaps the regulated communities can submit information in electronic format.

3) Improving Reliability of Measurement of Water Usage and Wastewater Qualities

Issues: Volume of wastewater and concentrations of pollutants in wastewater are among the most important parameters in managing water pollution, but the project encountered serious difficulties in measuring these parameters. Water usage in a factory is known to fluctuate significantly during production, and one or two-time on-site measurement does not give accurate estimate of water usage (and wastewater volume). Less than 10% of factories are equipped with flow meters to measure water usage, and very often water usage had to be estimated based on the size of water tanks and other means. As for water quality, laboratory data were not always reliable, and this problem necessitated the project to analyze wastewater samples in Japan. This issue should also be considered serious because environmental authorities are going to regulate pollution based on water quality data.

Suggestions: With respect to water usage, installation of water meters and measurement of water usage should be incorporated into the requirements of ECC and/or business licensing/registration, at least for major dischargers. As for reliability of laboratory data, environmental authorities should standardize the analytical methodologies, introduce a system of certification of environmental laboratories, and also make certified laboratories to regularly practice quality assurance/quality control measures. See section on Output 2.

4) Improving Environmental Measures by Factories

Issues: The pollution source surveys revealed a glimpse of primitive environmental management by many pollution sources in Myanmar. Most factories lack secondary treatment. Moreover, the whole management of resources, including water and other raw materials, seems rudimentary.

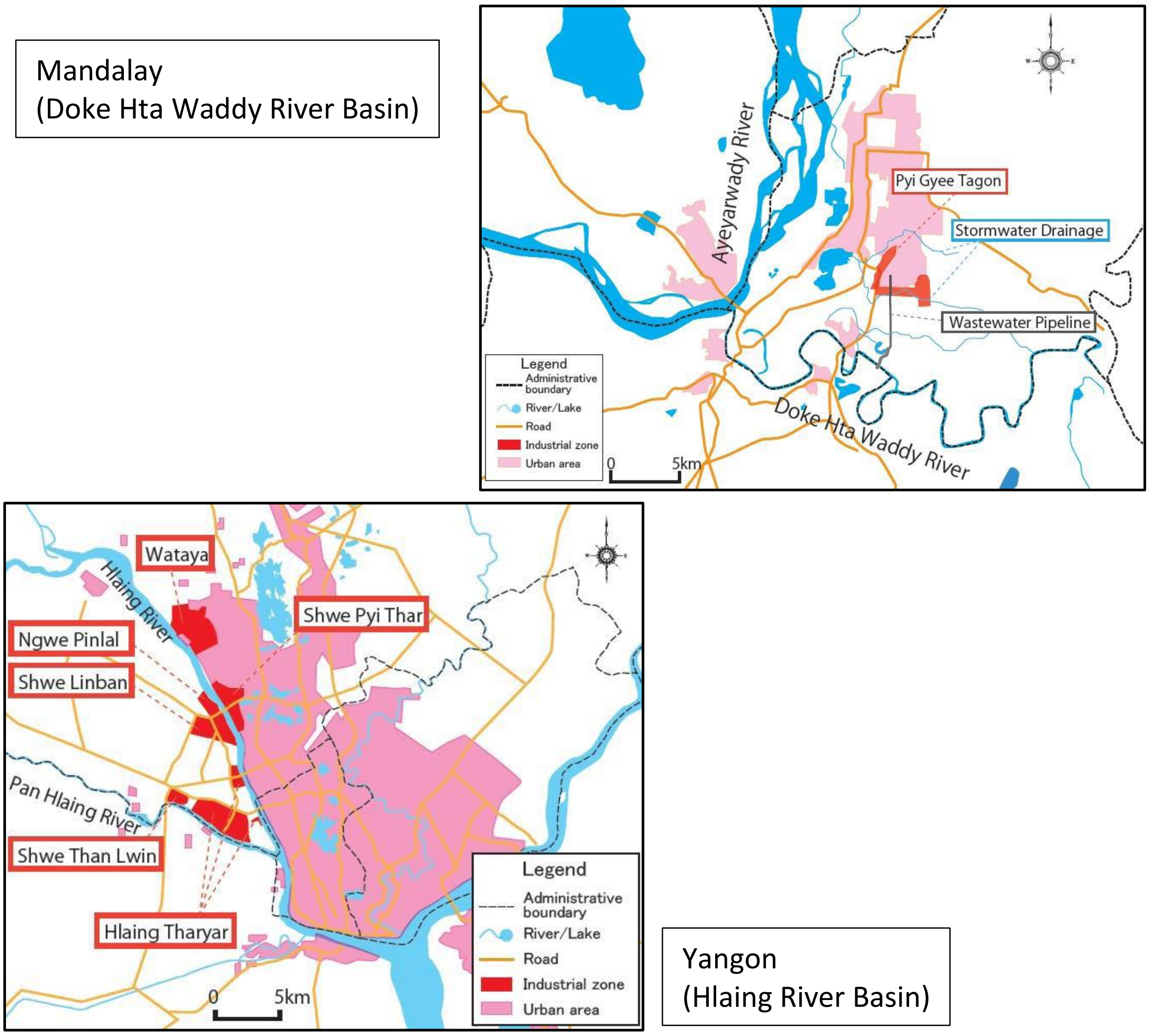
Suggestions: To control pollution, the environmental authorities should impose realistic regulations and support measures, perhaps based on sector studies. These are discussed elsewhere, and are not repeated here. In addition, regulation of water usage, especially groundwater usage seems necessary. In Yangon region, saltwater intrusion is a concern, and uncontrolled withdrawal of groundwater should be controlled. Aside from these government-side regulations, the industry side should also implement some studies about their management of resources and environment in order not only to control pollution, but also to improve efficiency of production and to make the workplace safe. Such studies may be spearheaded by MOI and/or industrial associations.

1. INTRODUCTION

This report summarizes the results of the pollution source survey implemented in industrial zones in Yangon and Mandalay (Period 1 in August – November 2016 and Period 2 in August – September 2017) as part of "Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar" (hereinafter "Project"). The survey was designed by Environmental Conservation Dept. (ECD) of Ministry of Natural Resources and Environmental Conservation (MONREC), Yangon City Development Committee (YCDC), Mandalay City Development Committee (MCDC) and the JICA Expert Team (JET), and under the support and supervision of these organizations. The survey in Period 1 was implemented by Resource and Environment Myanmar Ltd. (REM) and that in Period 2 was done by Supreme Water Doctor Co., Ltd. (Supreme). This report was prepared by JET based on the report of the sub-contract work prepared by REM and Supreme.

1.1. Survey Areas

The survey area includes 6 Industrial Zones in Yangon (Hlaing Tharyar, Shwe Linban, Shwe Pyi Thar, Wataya, Shwe Than Lwin and Ngwe Pinlal) and 1 Industrial Zone in Mandalay (Pyi Gyee Tagon), which have been selected as the pilot areas for the Project.



Source: JET

Figure 1.1-1 Location Maps of Industrial Zones in Target River Basins

1.2. Objectives

The objectives of the survey were:

i. To obtain data and information concerning wastewater discharged from factories located in six Industrial Zones in the Hlaing River basin, one Industrial Zone in the Doke Hta Waddy River basin and other major pollution sources located outside of the Industrial Zones and,

ii. To develop pollution source database based on the data and information collected above for water pollution control management activities by ECD, YCDC and MCDC.

In order to achieve the objectives, a questionnaire survey of, in total, 200 factories as well as sampling and analysis of wastewater from 100 factories (each 50 factories in Period 1 and Period 2) located in these industrial zones in Yangon and Mandalay, were implemented.

1.3. Methodology

Pollution source survey was implemented as Period 1 (2016) and Period 2 (2017). The summary of the survey and collected data type are described in the below tables.

Table 1.3-1 Summary of Pollution Source Survey

Item	Period 1 (2016)	Period 2 (2017)
Purpose /Activity	To collect additional information of pollution source (especially factories in Industrial Zones in target river basin)	Same as Period 1
Survey Area	- Hlaing River Basin in Yangon - Doke Hta Waddy River Basin in Mandalay	Same as Period 1
Scope	- Questionnaire Survey: total 200 factories (each 100 factories in Yangon and Mandalay) - Wastewater Sampling and Analysis: total 50 factories (each 25 factories in Yangon and Mandalay) *Wastewater samples were analyzed in Myanmar or Thailand *All target factories of wastewater sampling and analysis are included in the target factories of questionnaire survey.	- On-site investigation of wastewater management: total 50 factories (each 25 factories in Yangon and Mandalay) - Estimation of wastewater flow rate: total 50 factories (each 25 factories in Yangon and Mandalay, same factories of on-site investigation) - Wastewater Sampling and Analysis: total 50 factories (each 25 factories in Yangon and Mandalay, same factories of on-site investigation) *18 wastewater samples out of 50 were analyzed not only in Myanmar nor Thailand but in Japan. *Some target factories are overlapped with those in Period 1.
Schedule	− June to 1st half of August 2016: Finalization of Questionnaire and Terms of Reference (TOR) for Sub-Contract Work − 2nd half of August to 1st half of Nov 2016: Implementation of Survey (both Questionnaire Survey and Wastewater Sampling)	− Jul 2017: Finalization of Terms of Reference (TOR) for Sub-Contract Work − 2nd half of August to Sep 2017: Implementation of Survey
Attendance	− Yangon: Staff from PCCD-YCDC and ECD Yangon − Mandalay: Staff from WSD-MCDC, ECD Mandalay	Same as Period 1
Others	Workshops for explanation and prior announcement to target factories were held as follows. In Yangon, PCCD in YCDC, ECD Yangon, each Industrial Zone Management Committee and JET, on the other hand, in Mandalay, WSD in MCDC, ECD Mandalay, Industrial Zone Management Committee and JET. [Yangon] − 24 Aug 2016 for Shwe Pyi Tar and Wataya Industrial Zone − 5 Sept 2016 for Hlaing Tharyar and other Industrial Zone [Mandalay]	Workshops for explanation and prior announcement to target factories were held as follows. In Yangon, PCCD in YCDC, ECD Yangon, each Industrial Zone Management Committee and JET, on the other hand, in Mandalay, WSD in MCDC, ECD Mandalay, Industrial Zone Management Committee and JET. [Yangon] − 10 Aug 2017 for all target factories in Yangon [Mandalay] − 15 Aug 2017 for all target factories in Mandalay

Item	Period 1 (2016)	Period 2 (2017)
	– 23 Aug 2016 for all target factories in Mandalay	

Source: JET

Table 1.3-2 Data Type of Pollution Source Survey

Data Type	Number of Data (Factory / Sample)					Remarks
	Total	Yangon		Mandalay		
		Period 1	Period 2	Period 1	Period 2	
(i) Basic Information collected by Questionnaire Survey[1)]	202	100	0	100	2	Two additional factories were selected as target in Mandalay in Period 2.
(ii)-1 Wastewater Analysis Result by Wastewater Sampling and Analysis (Myanmar/Thailand)	100	25	25	25	25	33 factories (17 factories in Yangon and 16 factories in Mandalay) are overlapped..
(ii)-2 Wastewater Analysis Result by Wastewater Sampling and Analysis (Japan)	18	0	9	0	9	18 factories out of 50 were selected in Period 2.

Source: JET

1.3.1. Questionnaire Survey (Period 1)

The questionnaire survey was carried out by using a questionnaire in Myanmar language, prepared jointly by relevant authorities, JET and the Norwegian project for hazardous waste management. The Norwegian project had different objectives, but many of the questions to factories were the same, and both projects decided to use a common questionnaire in order to avoid unnecessary duplication of work and to maximize the coverage of pollution sources among the two projects. Before developing the questionnaire, JET reviewed the inspection forms of ECD, YCDC, MCDC and DISI, and most of items in these forms were incorporated into the questionnaire so that information pertinent to environmental management by these organizations become available in the results. In addition, JET and the Norwegian team added a broad range of questions considering the objectives of each project.

In the questionnaire, there are about 47 questions in 6 categories as follows:

- Basic Information (15 questions)
- Raw Materials and Utility (4 questions)
- Layout of Factory and Manufacturing Process (2 questions)
- Wastewater (9 questions)
- Solid Waste (4 questions)
- Environmental Management (13 questions)

The English version of the questionnaire is attached to this report (Attachment 1). In accordance with local practice, English units, such as acre and UK gallon, were used in the survey.

The questionnaire was hand-delivered to each of the target 200 factories, answered by the management of each factory, and collected during the visit to each factory by the joint team of REM, ECD, YCDC, MCDC and JET. During the visit, the answers were confirmed by interviewing the managers or operators of the factory. In addition, a GIS coordinate of each factory was recorded. The collected data and information were then digitized and the answers were translated into English for analysis.

Source: JET

Figure 1.3-1 Questionnaire Survey with Representatives of Target Factories

The Norwegian team implemented essentially the same survey using the same questionnaire, but their results are not reported in this report.

1.3.2. Wastewater Sampling and Analysis (Period 1 and 2)

Wastewater samples from 50 factories located in the survey areas were collected both in the Period 1 (2016) and the Period 2 (2017). Most of the target factories were selected from the 200 target factories of the questionnaire survey in Period 1. Incidentally, some distillery factories both in Yangon and Mandalay were ordered to stop operation by the government in the summer of 2017. Therefore, the number of distillery factories were limited in the Period 2.

On-site measurement of some parameters, such as flow rate, pH and DO, was performed in addition to the laboratory analysis of pollutants. According to NEQEG (2015), the guideline value should be achieved at least 95 percent of the operation time. However, NEQEG (2015) does not specify how to obtain 95 percent data, and to obtain 95 percent data, multiple data over a long time should be collected. As time and other resources were limited, a composite method was applied for wastewater sampling, where samples were collected in Period 1 (every 30 minutes for up to 4 times) and in Period 2 (every 1 hour for up to 2 times), and then mixed homogenously as one composite sample. The result may be lower than the 95 percent value, but it represents an average value over around 2 hours. Laboratory parameters were selected for each sector based on the NEQEG (2015), and those were analyzed in Period 1 at the REM-UAE Laboratory (Myanmar) and the UAE Consultant Co., Ltd. (Thailand) and that in Period 2 was analyzed by Supreme Laboratory (Myanmar), UAE Consultant Co., Ltd. (Thailand) and Laboratory in Japan. The instruments and methodologies were utilized for on-site measurement and laboratory analysis in Period 1 and Period 2 were mentioned in the attachments.

Source: JET

Figure 1.3-2 Wastewater Sampling and In-situ Measurement in Target Factories

Table 1.3-3 Field Equipment for Wastewater Sampling and Analysis

No.	Equipment	Manufacturer	Originate Country	Model
1	Dissolved Oxygen	YSI	USA	YSI 550A
2	Salinity, Conductivity and Temperature	YSI	USA	YSI Model 30
3	Portable pH, mV and Temperature	Eco Sense	USA	PH 100 A
4	Turbidity	Eutech Instruments	Netherlands	TN-100
5	Flow meter	Global Water	USA	FP111
6	ORP meter	HANNA Instrument	USA	HI 9125

Source: JET based on information from REM

Table 1.3-4 Methodologies for On-site and Laboratory Analysis

Category	No.	Analytical Items	Test Method (for laboratory analysis)	Detection Limit (for laboratory analysis)	LOQ
On-site	1	On-site measurement (pH/EC/Salinity/Turbidity/Water temperature/ORP/DO)		-	-
	2	Flow rate		-	-
Laboratory	3	1,2-Dichloroethane	Purge and Trap and Gas Chromatographic /Mass Spectrometric Method (SM 2012:6200 B)	< 0.0005 mg/L	0.0020
	4	5-day Biochemical oxygen demand	Membrane Electrode Method (SM 2012:5210 B and 4500-O G)	< 1.0 mg/L	-
	5	Ammonia	Kjeldahl Method (SM 2012:4500-NH_3 B and C)	< 2.0 mg/L	< 2.0 mg/L
	6	Arsenic	Hydride Generation AAS Method (SM 2012:3114 C)	< 0.0003 mg/L	< 0.0010 mg/L
	7	Benzene	Purge and Trap and Gas Chromatographic /Mass Spectrometric Method (SM 2012:6200 B)	< 0.0005 mg/L	< 0.0020mg/L
	8	Cadmium	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.006 mg/L	≥ 0.006 AND < 0.020 mg/L
	9	Chemical oxygen demand	Closed Reflux, Colourimetric Method (SM 2012:5220 D)	< 25.0 mg/L	-
	10	Chromium (hexavalent)	Colourimetric Method (SM 2012: 3500-Cr B)	< 0.006 mg/L	< 0.010 mg/L
	11	Chromium (total)	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.010 mg/L	≥ 0.010 AND < 0.100 mg/L
	12	Chlorobenzene	Purge and Trap and Gas Chromatographic /Mass Spectrometric Method (SM 2012:6200 B)	< 0.0010 mg/L	< 0.0050 mg/L
	13	Chloroform	Purge and Trap and Gas Chromatographic /Mass Spectrometric Method (SM 2012:6232 C)	< 0.0010 mg/L	< 0.0033 mg/L
	14	Copper	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.006 mg/L	≥ 0.006 AND < 0.020 mg/L
	15	Cyanides (free)	Pyridine-Barbituric Acid Method (SM 2012: 4500-CN- C and 4500-CN- E)	< 0.005 mg/L	< 0.020 mg/L
	16	Cyanides (total)	Distillation and Pyridine-Barbituric Acid Method (SM 2012: 4500-CN- C and 4500-CN- E)	< 0.005 mg/L	< 0.020 mg/L

Category	No.	Analytical Items	Test Method (for laboratory analysis)	Detection Limit (for laboratory analysis)	LOQ
	17	Fluorides	Ion Selective Electrode (SM 2012:4500- F C)	< 0.04 mg/L	< 0.02 mg/L
	18	Lead	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.031 mg/L	$\geq$ 0.031 AND < 0.150 mg/L
	19	Mercury	Cold Vapour-AAS Method (SM 2012:3112 B)	< 0.0005 mg/L	< 0.0010 mg/L
	20	Methylene chloride	Purge and Trap and Gas Chromatographic /Mass Spectrometric Method (SM 2012:6200 B)	< 0.0005 mg/L	< 0.0017 mg/L
	21	Nickel	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.020 mg/L	$\geq$ 0.020 AND < 0.100 mg/L
	22	Oil and grease	Partition-Gravimetric Method (SM 2012:5520 B)	<1 mg/L	$\geq$ 1 AND < 3 mg/L
	23	Organochlorine Pesticide	Liquid-Liquid Extraction and Gas Chromatographic (ECD) Method (SM 2012:6630 C)	< 0.00002 mg/L	< 0.00010 mg/L
	24	Organophosphate Pesticide	Liquid-Liquid Extraction and Gas Chromatographic (PFPD) Method (U.S. EPA 1996:3510 C and U.S. EPA 2007:8141 B)	< 0.02 mg/L	< 0.10 mg/L
	25	Phenol	Distillation, 4-Aminoantipyrine Method (SM 2012:5530 B and 5530 D)	< 0.1 mg/L	< 0.1 mg/L
	26	Sulfate	Turbidimetric Method (SM 2012:4500-SO_4^{2-} E) or Gravimetric with Ignition of Residue Method (SM 2012:4500-SO_4^{2-}C)	< 0.3 mg/L	< 0.3 mg/L
	27	Sulfide	Iodometric Method (SM 2012:4500-S^{2-} F)	< 0.13 mg/L	< 0.13 mg/L
	28	Total coliform bacteria	Multiple Tube Fermentation Technique (SM 2012:9221 B)	< 1.8 MPN/100 mL	< 1.8 MPN/100 mL
	29	Total nitrogen	Persulphate Method (SM 2012:4500-N C)	< 0.02 mg/L	< 0.10 mg/L
	30	Total phosphorus	Persulphate Digestion and Ascorbic Method (SM 2012:4500-P E)	< 0.01 mg/L	< 0.25 mg/L
	31	Total suspended solids	Total Suspended Solids Dried at 103-105 oC (SM 2012:2540 D)	< 2.4 mg/L	$\geq$ 2.4 AND < 5.0 mg/L
	32	Zinc	Nitric Acid and Hydrochloric Acid Digestion and Inductively Coupled Plasma (ICP) Method (SM 2012:3030 F and 3120 B)	< 0.007 mg/L	$\geq$ 0.007 AND < 0.050 mg/L

Source: JET based on information from REM and Supreme

1.4. Survey Periods

Both the questionnaire survey and the wastewater sampling survey in the Period 1 in Yangon and Mandalay were conducted during August to November 2016. The wastewater sampling survey in the Period 2 was conducted during July to September 2017.

Table 1.4-1 Field Survey Schedule in Industrial Zones in Yangon and Mandalay

Period	Type of Survey	Industrial Zones in Yangon	Industrial Zones in Mandalay
Period 1 (2016)	Questionnaire survey	29-8-2016 to 13-102016	23-8-2016 to 15-9-2016
Period 1 (2016)	Wastewater sampling survey	31-10-2016 to 5-11-2016	11-10-2016 to 15-10-2016
Period 2 (2017)	Wastewater sampling survey	23-8-2017 to 31-8-2017	16-8-2017 to 22-9-2017

Source: JET

1.5. Quality Control

1.5.1. General Quality Control

In order to ensure data quality and to minimize errors, the following quality control measures were taken.

Table 1.5-1 Risks and Measures for Quality Control

No.	Risk	Measure	
Questionnaire Survey		Period 1 (2016)	Period 2 (2017)
1-1	Data and information provided by the factories are not highly reliable because those who answer the questionnaire are not experts. This is probably true for the following items - Usage of water, details of wastewater treatment facility, wastewater qualities, usage of hazardous substances	Surveyor will explain detail about questionnaire to the responsible person of each factory to get the reliable answer. If needed, surveyor will ask the factory to provide the necessary documents and confirm it.	Surveyor will confirm about questionnaire to the responsible person during site visit (only for target 50 factories in Period 2).
1-2	Factory does not provide enough information saying it is classified (e.g., layout of factory, information on raw material)	Surveyor will observe the operation of factory to get the adequate information, as well as mark the GPS coordinate of each building/facilities to prepare the factory layout.	Some factories have only permanent workers but some have part- time workers. Surveyor will record the employee of each factory especially for calculation of pollution load. Surveyor will observe the operation of wastewater treatment system and mark GPS coordinate for final discharge point.
1-3	Mix up in units causes confusion	All data will be carefully recorded during every step, and	Same as Period 1

No.	**Risk**	**Measure**	
Questionnaire Survey		Period 1 (2016)	Period 2 (2017)
		team manager will check and approve the data.	
1-4	Data of factories in the same sector do not match (e.g., water usage of garment industry varies significantly from factory to factory)	Surveyor will record carefully the questionnaire during interview survey with the factory for same sector, and confirm the data/information shall be matched each other.	Same as Period 1
Wastewater sampling			
2-1	Fail to take a representative sample because quality and quantity of wastewater fluctuate significantly	Composite method will be applied for wastewater sampling. Wastewater will be collected every 30 minutes or 1 hour, 4 times. Each composite sample will be mixed homogeneously as 1 sample.	Both Composite and Grab method will be applied for wastewater sampling in Period 2. Wastewater will be collected directly for grab and every 1 hours, 2 times for composite. Each composite sample will be mixed homogeneously as 1 sample.
2-2	Use of poorly calibrated equipment on site	Prior each field sampling, the equipment will be calibrated with QC standards.	Same as Period 1
2-3	Settling matter in wastewater causes large difference in the result (issue of how to take wastewater sample that contains settling matter at the site and whether to thoroughly mix the collected sample before the analysis or take only supernatant)	Before any analysis, wastewater samples will be mixed homogeneously using stirrer.	Before any analysis, wastewater samples will be mixed homogeneously using glass stick.
2-4	Collected sample is left in the field for a long time, because it is not possible to transport each sample immediately after it is collected	Specific parameters, such as BOD and TCB, will be collected in separate containers, kept at 0-6 ^{o}C using ice or ice pack all the time, and sent to the laboratory as soon as possible.	Specific parameters, such as BOD, TCB and Heavy metals, will be collected in separate containers, adjustment of pH for heavy metals with additional primary Preservation.
2-5	Problem in data consistency (e.g., NH4-N > T-N, Cr (VI) > Total Cr, BOD is a lot higher than COD)	Survey information will be considered to know characteristics of wastewater before sampling. Interferences, if any, will be removed interferences using the reference standard method before analysis. The quality control standard will be also used to check the accuracy.	Same as Period 1

No.	Risk	Measure	
Questionnaire Survey		Period 1 (2016)	Period 2 (2017)
2-6	Problem in measurement of flow rate (flow meter)		Surveyor will measure the wastewater flow rate using the flow meter at the final discharge point. Some discharge points are narrow and not able to use the flow meter for measurement. In that case, wastewater discharge volume was calculated on the final tank of treatment system and operation hours of each factory.
2-7	Mix up of samples during analysis and mix up in analytical result (e.g., a relatively clean sample exhibits unusually high pollution level)	Quality control (QC) in field and laboratory will be performed carefully. - In the field, sampling equipment will be cleaned and rinsed with the sample as indicated in the reference standard method. - In the laboratory, new method blank will be prepared and rechecked when analyzing samples with high concentration.	Same as Period 1
2-7	Errors in reporting unit (e.g., confusion between ug and mg, mS/cm and mS/m, etc.)	Sampling team leader will check and approve recording data for every sample. The method of converting units will be demonstrated in the data worksheet.	JET also checked and recorded the data for every sample.
2-8	Difficulty in tracing the problem (e.g., original laboratory notebook not available)	All data will be recorded for every step from the beginning to the end of the process (field sampling to analysis reporting). Technical management and quality manager will approve all data. Client can request to see all data. All electronic file will be backed up regularly to prevent data loss.	Same as Period 1

Source: JET based on information from REM and Supreme

1.5.2. Comparison between the Analysis Results in Period 1 and 2

Wastewater quality was analyzed both in Period 1 (2016) and Period 2 (2017) as follows:

Table 1.5-2 Water Quality Analysis in Period 1 and 2

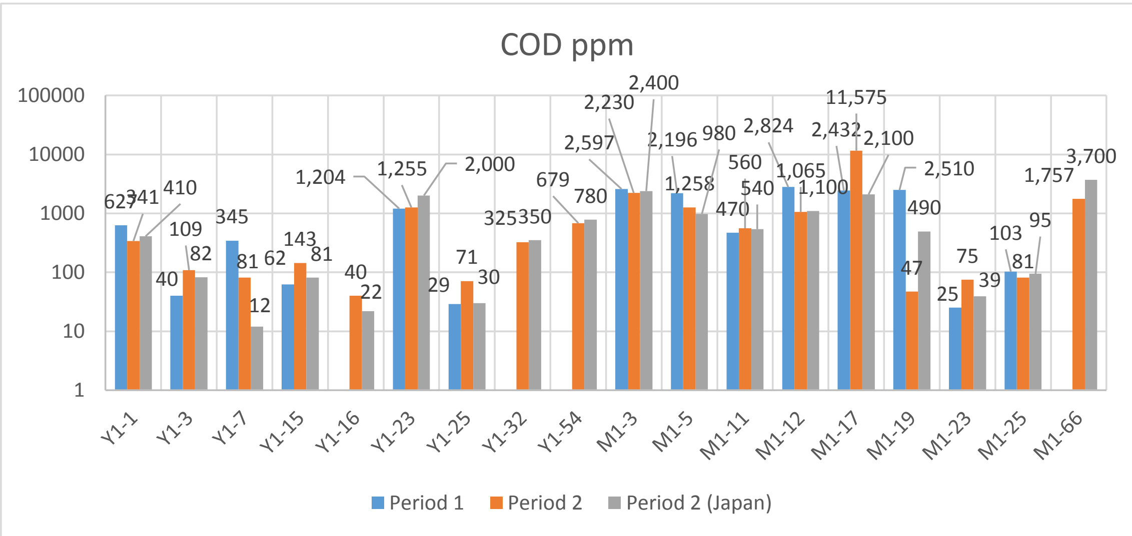
Period	Type of Survey	Laboratory	Remarks
Period 1 (2016)	50 factories (25 factories each in Yangon and Mandalay)	Myanmar / Thailand	-

Period 2 (2017)	50 factories (25 factories each in Yangon and Mandalay)	Myanmar / Thailand	Some factories are overlapped those in Period 1
	18 factories (9 factories each in Yangon and Mandalay)	Japan	18 factories out of 50 are excluded

Source: JET

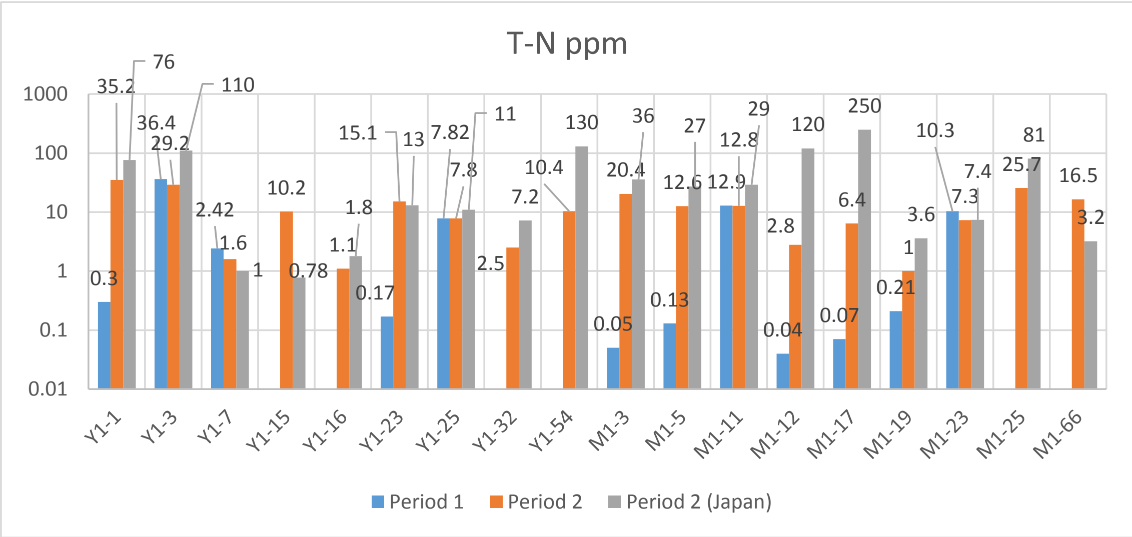
Reliability of analytical data was one of the main concerns in the survey in 2016. Thus, the follow-up survey was designed in such a way that some target factories of wastewater sampling and analysis in 2016 and 2017 overlap so that the analytical results in 2016 in Myanmar/Thailand, those in 2017 in Myanmar/Thailand, and those in 2017 in Japan could be compared. Figure 1.5-1 to Figure 1.5-3 present the results of COD, Total Nitrogen (TN) and Total Phosphorus (TP). Please note that concentrations are shown on logarithmic scale as the data span orders of magnitude.

While COD and TP data are more consistent than TN data, closer examination reveals that variability is significant even for COD and TP. Differences in analytical methodologies and practices of analytical quality control appeared to be the most important reasons for the variability. In order to regulate industrial wastewater using effluent standard, these issues should be resolved first.



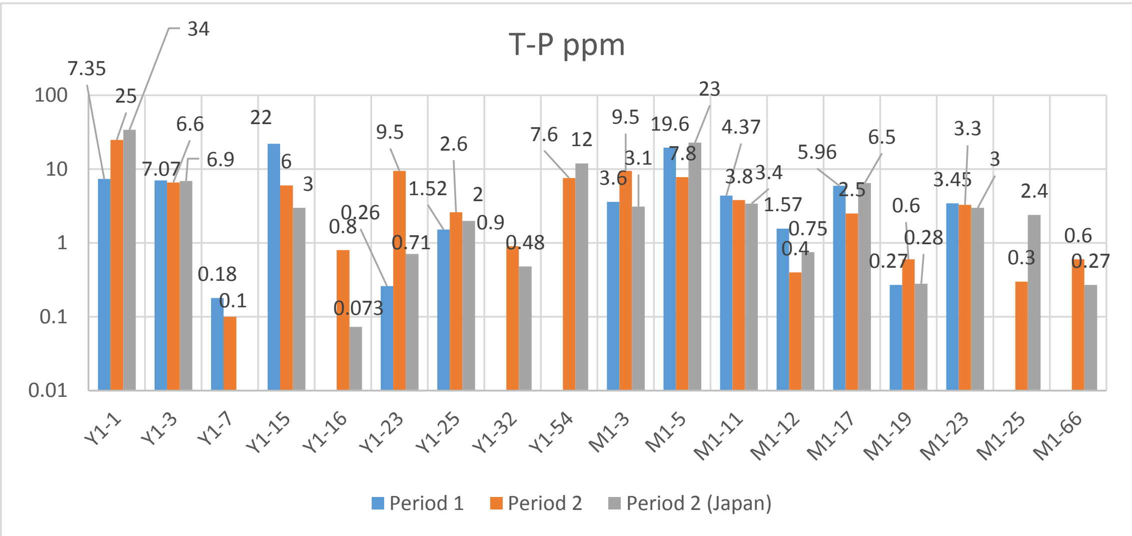
Source: JET

Figure 1.5-1 Results Comparison (COD)



Source: JET

Figure 1.5-2 Results Comparison Result (TN)



Source: JET

Figure 1.5-3 Results Comparison (TP)

Table 1.5-3 lists the results of analyses of toxic substances in Japan and Thailand. Only the data above NEQEG (2015) are listed. It seems the results were comparable, though more formal assessment is needed as the number of samples was limited.

Table 1.5-3 Comparison of Results of Toxic Substances in Japan and Thailand

Code	Product	Pollutant	Unit	Japan	Thailand
Y1-16	Battery	Lead	mg/L	6.8	4.09
M1-11	Garment/Textile	Zinc	mg/L	2.7	2.97
M1-12	Leather Tanning	Phenols	mg/L	4.6	3.97
M1-17	Leather Tanning	Phenols	mg/L	9.6	8.43
M1-17	Leather Tanning	Chromium (Total)	mg/L	4.5	3.22
M1-25	Battery	Zinc	mg/L	170	166

Source: JET

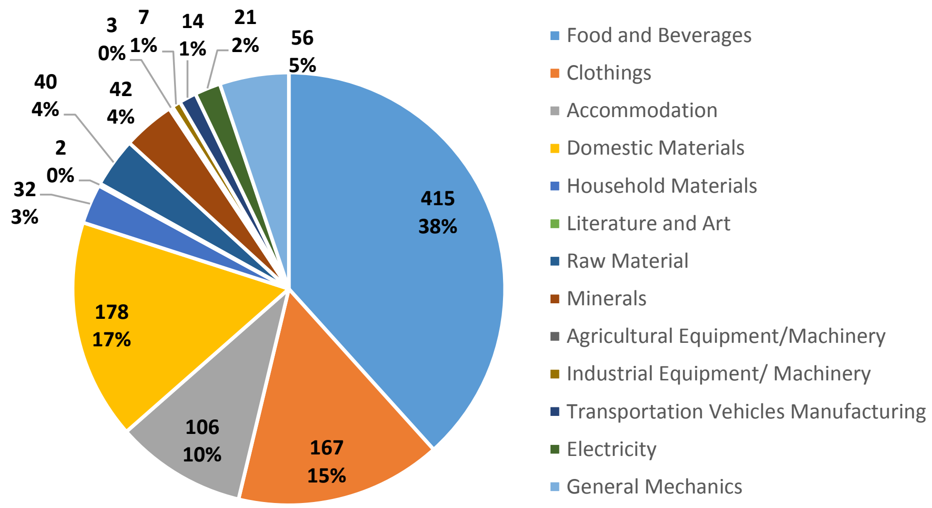
2. SURVEY RESULTS

2.1. Hlaing River Basin

2.1.1. Questionnaire Survey in 2016

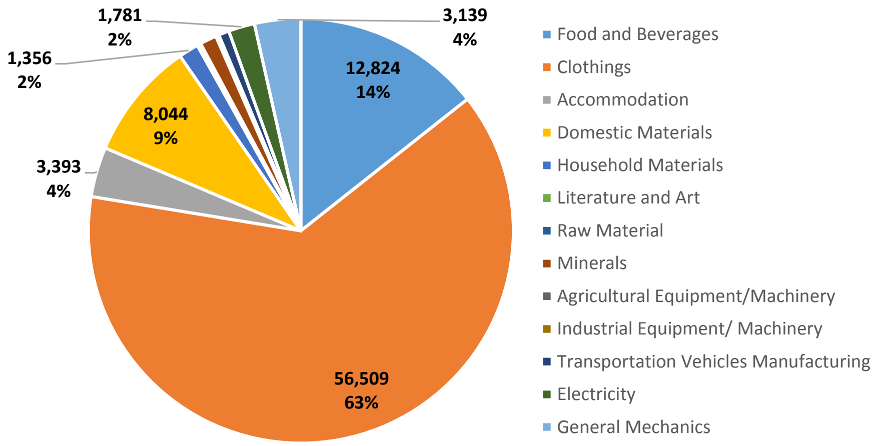
(1) Target Factories

In Yangon, there exist as many as 3,500 factories under control of YCDC, and according to the data from DISI, there are 1,083 factories in the six target IZs (Hlaing Thar Yar, Shwe Than Lwin, Shwe Linban, Ngwe Pinlal, Shwe Pyi Tar and Wataya IZs) in the Hlaing River basin. According to DISI's categorization, 943 of them are large-sized firms, 127 are medium-sized firms and 13 are small-sized firms. In terms of the number of factories, food and beverage sector is the leading sector, accounting for 415 factories, followed by domestic materials (178), clothing (167) and accommodation (106). In terms of the number of employees, in total, there are 90,105 employees in these six IZs, of which 63% are employed by the clothing sector. Concerning yearly production value (annual sales), the average is around 2,845 million Kyats (about 2 million USD), but 54% of factories earn less than 100 million Kyats (about 70 thousand USD), according to DISI's data.



Source: JET based on information from DISI around 2016

Figure 2.1-1 Sectors of Factories in Hlaing River Basin in Yangon



Source: JET based on information from DISI around 2016

Figure 2.1-2 Number of Employees of Factories in Hlaing River Basin in Yangon by Sector

In order to find the current situation of the industrial zones in the Hlaing River basin in Yangon, the questionnaire survey for 200 factories (each 100 factories in Yangon and Mandalay) were implemented in 2016. Below table shows the summary of the result.

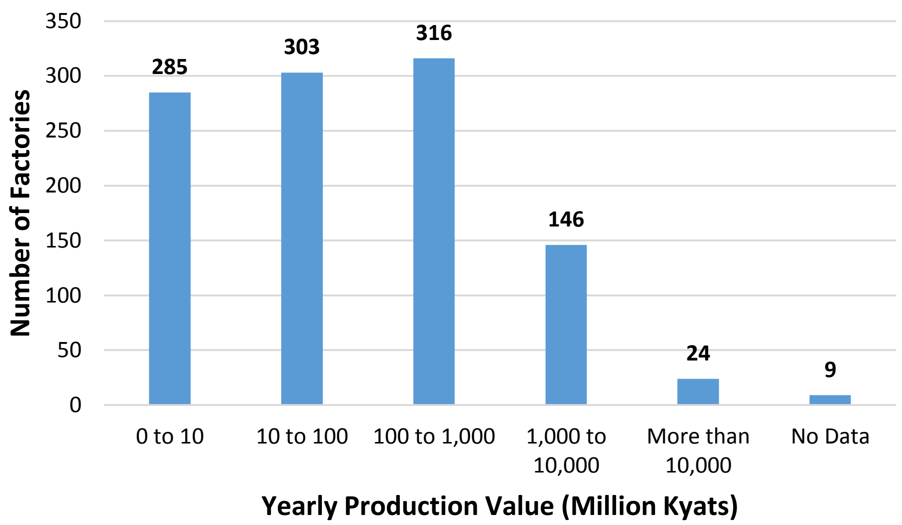
Table 2.1-1 Summary of Results for Questionnaire Survey in Yangon (2016)

No.	Categories	Summary of Results (Yangon)	Figures
1	Size of Target factories (DISI's Classification)	80% (80 out of 100 factories) are large size 9% (9 out of 100 factories) are medium size **11% (11 out of 100 factories) are small size**	**2.1-6**
2	Number of employee	35% of the factories use 10-49 employees >50 % of the factories employ less than 100 employees. In Japan, less than 300 employees are small and medium-sized In Europe, less than 10 are micro-level,10-50 staff (small enterprise), 50-250 (medium enterprise), more than 250 staff (large enterprise) *Note: Most of the factories are not very large scaled. On average,* ***factories in Yangon are larger than those in Mandalay.***	**2.1-7**
3	Land area	Average land size of the factory- 2.57 acre (1.0 ha) **1.72 acre - building area.**	**2.1-8**
4	Water Usage	-10% (10 out of 100 factories) have water meters to monitor water usage -4% (4 out of 100 factories) have water meters to measure wastewater discharge rate -Average water usage per factory- about 15,000 gal/day (67 m^3/day) -73% (73 out of 100 factories) -less than 10,000 gal/day (43 m^3/day) -24% (24 out of 100 factories) -10,000 gal/day (43 m^3/day)	**2.1-9**
5	Sources of Water	92% of water used in the target factories is groundwater	**2.1-10**
6	Wastewater Discharge Rate	-Factory average discharge 7,500 gal/day (34 m^3/ day) -79% (79 out of 91 factories) discharge over 100,000 gal/day -87% discharge less than 10,000 gal/day (43 m^3/day)	**2.1-11**
7	Ratio of wastewater and water usage	Average water discharge – about 50% of average water usage *Note: Many factories reported small discharge compared to water usage. During the wastewater sampling, wastewater discharge was measured/ estimated independently.*	**2-1-12**
8	Wastewater Management	Flow meter (water usage)- 10 % Flow meter (wastewater)-4% Water recycling- 12% Separation of rain water- 2% Minimization of solid waste from wastewater stream- 44% Separation of toxic substances- 13%	**2.1-13**

No.	Categories	Summary of Results (Yangon)	Figures
		Other -1% *Note: The respondents to the questionnaires are not necessarily experts in different environmental measures.*	
9	Existence of Wastewater Treatment Facilities (%)	53% of the factories have wastewater treatment facilities. 47% of the factories does not have wastewater treatment facilities.	**2.1-14**
10	Regular Self-monitoring of Wastewater Quality	62% of the factories monitor wastewater qualities (once/year). *Note: Reported values were often different from the results of wastewater sampling carried out.*	**2.1-15**
11	Wastewater treatment	Primary treatment- removal of solid (screen, settling basin, oil separator, and chemical coagulation) 36% of the factories has screen 7% of the factories has equalization tank 50% of the factories has settling basin 9% of the factories has oil separator 4% of the factories has chemical coagulation 1% of the factories has other	**2.1-16**
		Secondary treatment – removal of biodegradable organic matter 1% - Septic tank 2% - Activated sludge 1%- UASB 2%- other biological	**2.1-17**
		Tertiary treatment – removal of nutrients, etc. 53% of the factories remove settle-able solid and floating waste 50% of the factories have settling basin/ sedimentation tank 4% of the factories remove biodegradable organic matter 1% of the factories have septic tank Some factories have screen and oil separator. Very few factories have modern biological treatment systems (activated sludge and UASB) *Note: Most of the factories have traditional system based on sand filter and charcoal.*	
12	Solid Waste Management	General garbage from office and canteen Most factories generate less than 2 ton/month (reported only solid waste is less than 0.1 ton/month) Garbage picked up by YCDC, some factories dispose waste in their own yard.	**2.1-18**
		Solid waste from production line Most factories generate less than 5 ton /month of solid waste Some factories generate over 100 tons/ month of waste (fish head from some cold storage factories) 50% of factories generate sludge. 50% of factories recycle and reuse solid waste (recycling of used paper and plastics). Methods of industrial waste disposal- landfilling and incineration by YCDC	**2.1-19**
13	Hazardous waste	14 % of the factories – produce hazardous wastes 10 % of the factories- sharp objects (broken glass, 2% of the factories- toxic and corrosive substances (lead, sulfuric acid and biocide) 1% of the factories- infectious waste (blood) 1% of the factories- other material (agricultural) *Note: The number of factories discharging hazardous waste is larger, and more detailed investigation is needed.* *Norwegian team is currently investigating situation of hazardous waste in Yangon and Mandalay.*	**2.1-20**

No.	Categories	Summary of Results (Yangon)	Figures
14	Environmental Management system and Enforcement	Answers to Questions on Environmental Management 11%- Submitted EMPs to ECD 10%-ISO 14001 or ISO9001 or FSSC22000 or similar 80%- Plans for emergency 74%- CSR 2%- Environmental accidents in last 3 years 3%- Environmental complaint in last 3 years	**2.1-21**
		Inspection by Relevant Authorities 75% of the factories- YCDC visited 17% of the factories- ECD visited 72% of the factories- DISI visited 22% of the factories- EI, MIC, Department of Health, ASEAN-OSHNET *Note: YCDC and DISI visited many of these factories in 2016 for renewing of business license and registration and they receive some basic instruction about environmental issues.*	**2.1-22**
		Adequacy of Environmental Management 58% of the factories- wastewater management is adequate 91% of the factories- waste management is adequate	**2.1.23**

Source: JET



Source: JET based on information from DISI

Figure 2.1-3 Yearly Production Value of Existing Factories in Yangon

Because this survey can cover only 100 factories within the six IZs in the Hlaing River basin, YCDC, ECD and JET decided to select the target factories for the survey based on the following criteria:

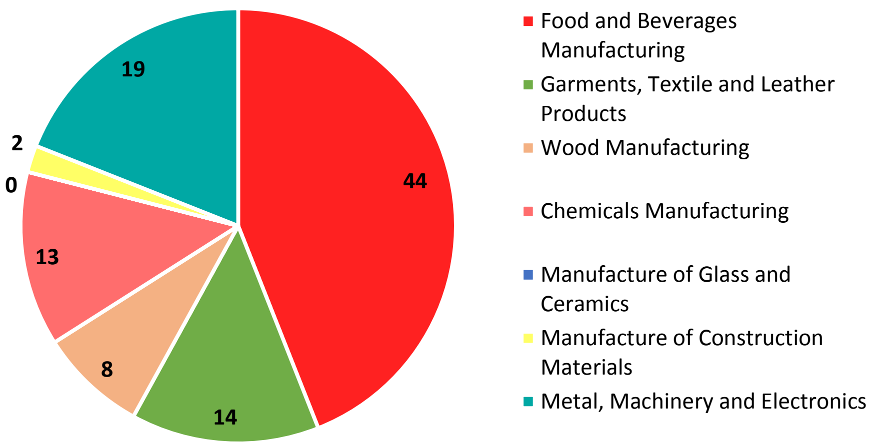
1) Factories whose sectors are representative of the area to see the overall picture of factories in the area
2) Major factories that discharge sizable volume of wastewater

Below table and figure summarize the sectoral composition of target factories. Roughly half of the factories investigated were in the food and beverage sector, as they are the most representative industries in the area. This sector is consisted of sub-sectors manufacturing all kinds of food and beverage products, such as alcohol, sea food, noodle, etc. Aside from the food and beverage, factories in diverse industrial sectors were selected as the targets. It was noted that DISI's classification system used for classification of industrial sectors is not consistent with neither the sector classification of NEQEG (2015) nor the system of International Standard Industrial Classification of All Economic Activities (ISIC) (It is suggested to re-organize the classification system based on ISIC system). Also, some of the industrial sectors were represented only by a few factories, or sometime by only one factory. Thus, the data should be interpreted with care.

Table 2.1-2 Sectors of Existing/Target Factories in Hlaing River Basin

No.	Sector	Remarks	Number on List from DISI	Number on List from YCDC	Number of Target Factories	
					Questionnaire Survey	Wastewater Sampling
1	Food and Beverages		415	54	41	12
		Bean	120	1	1	0
		Snack	57	1	1	0
		Rice/Noodle	35	8	4	1
		Cold Store	29	18	4	1
		Oil	15	1	1	1
		Water	15	1	1	1
		Beverage	14	3	4	2
		Distillery	11	7	5	2
		Feed	11	0	2	0
		Dairy	9	2	4	0
		Meat	9	1	3	1
		Bakery	3	0	1	0
		Cigarette	3	0	1	0
		Fish	3	3	3	1
		Canned Food	0	3	2	1
		Sesame	0	1	1	0
		Vinegar	0	1	1	0
		Sauce	0	3	2	1
		Others	81	0	0	0
2	Clothings		167	8	12	3
		Textile	117	1	1	1
		Shoes	19	0	1	0
		Embroidery	10	0	1	0
		Bag	5	0	1	0
		Dyeing	2	7	7	2
		Laundry	2	0	1	0
		Others	12	0	0	0
3	Accommodation		106	0	4	0
		Wood	45	0	1	0
		Zinc	15	0	1	0
		Concrete	15	0	1	0
		Iron	5	0	1	0
		Others	26	0	0	0
4	Domestic Materials		178	11	14	5
		Plastic	91	1	1	0
		Soap	11	0	1	0
		Printing (including Plastic Printing)	8	0	1	0
		Drug	7	2	2	1
		Detergent	6	3	3	2
		Cosmetic	4	2	2	1
		Toothpaste	2	0	1	0
		Leather	1	1	1	1
		Others	48	2	2	0
5	Household Materials		32	6	8	2
		Paper/Cardboard	21	6	6	2
		Painting	8	0	2	0
		Others	3	0	0	0
6	Literature and Art		2	0	1	0
		Paper and Stationary	1	0	0	0
		Printing	1	0	1	0
7	Raw Material		40	2	5	2
		Rubber	15	1	1	1
		Fertilizer	6	0	2	0
		Polystyrene	5	0	1	0
		Leather	1	1	1	1
		Others	13	0	0	0
8	Minerals		42	0	3	0
		Iron	17	0	1	0
		Aluminum	11	0	1	0
		Tin	5	0	1	0
		Others	9	0	0	0
9	Agricultural Equipment/Machinery		3	0	1	0
		Machinery for Agriculture	3	0	1	0
10	Industrial Equipment/ Machinery		7	0	3	0
		Machinery for Industry (e.g. generator, compressor, etc.)	7	0	3	0
11	Transportation Vehicles Manufacturing		14	0	3	0
		Vehicle	11	0	2	0
		Vessel	3	0	1	0
12	Electricity		21	0	4	0
		Transformer	5	0	2	0
		Battery	3	0	2	0
		Others	13	0	0	0
13	General Mechanics		56	1	1	1
		Vehicle	13	0	0	0
		Lathe	11	0	0	0
		Battery Clip/Sheet	5	1	1	1
		Others	27	0	0	0
Total			1,083	82	100	25

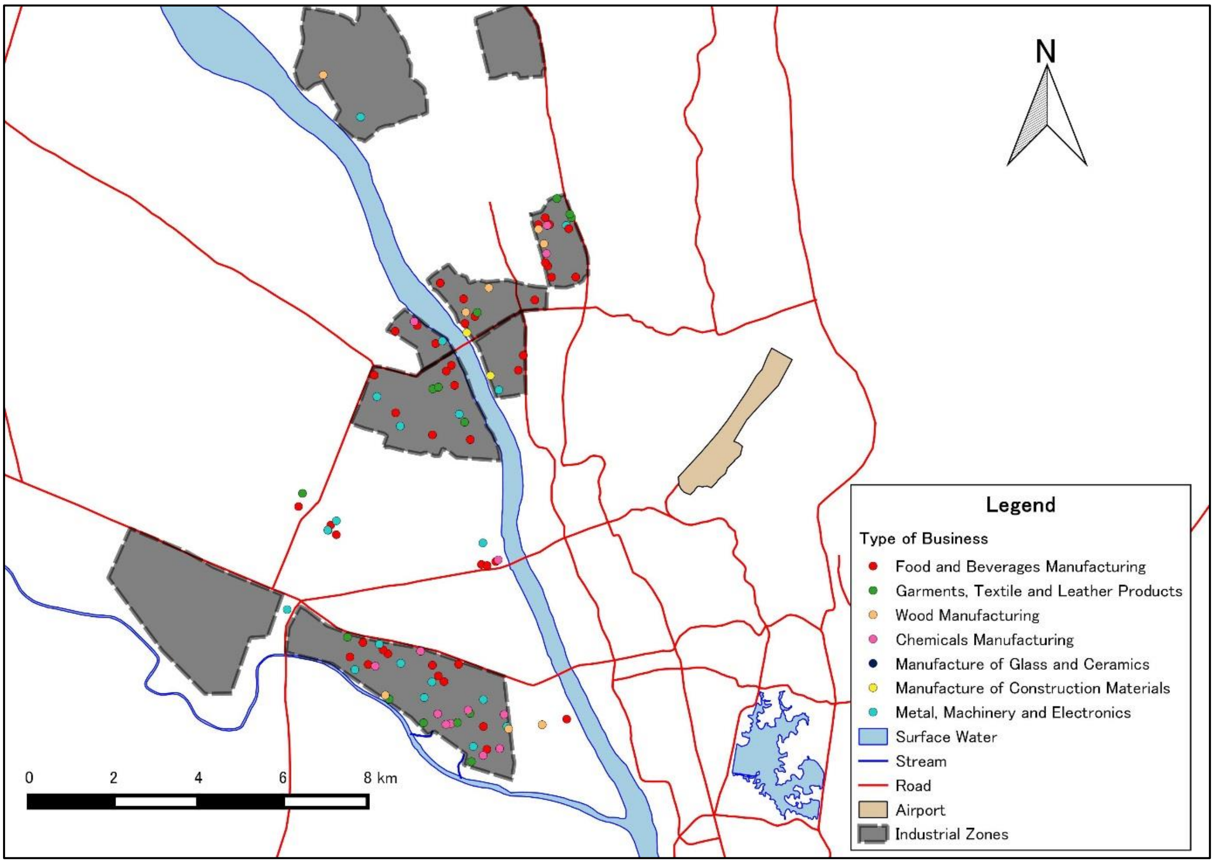
Source: JET



Source: JET

Figure 2.1-4 Sector of Target Factories for Questionnaire Survey in Yangon in 2016

The locations of the surveyed factories are shown in the following figure.

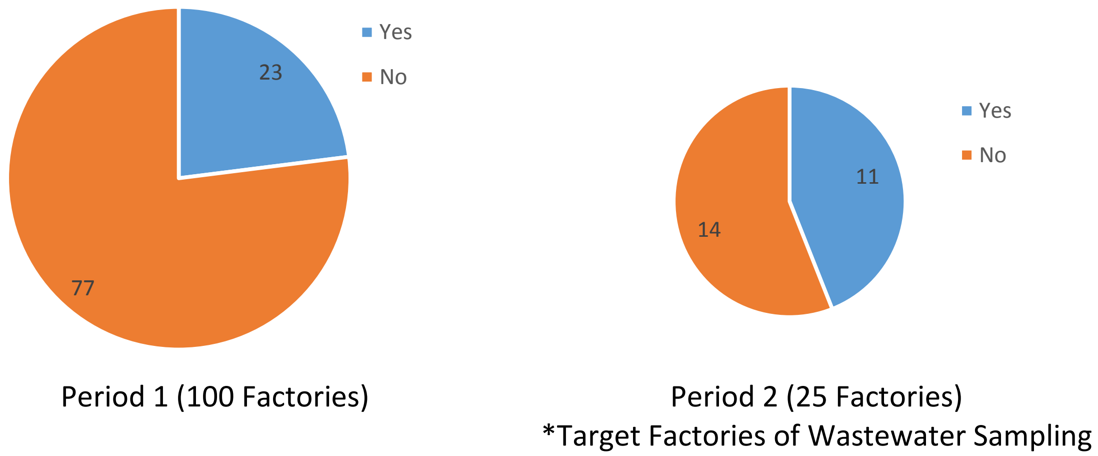


Source: JET

Figure 2.1-5 Location Map of 100 Target Factories for Questionnaire Survey in Yangon in 2016

Among the 100 target factories, eighty (80) % were of large-sized according to the DISI's classification, while 9% were medium-sized and 11% are small-sized, respectively.

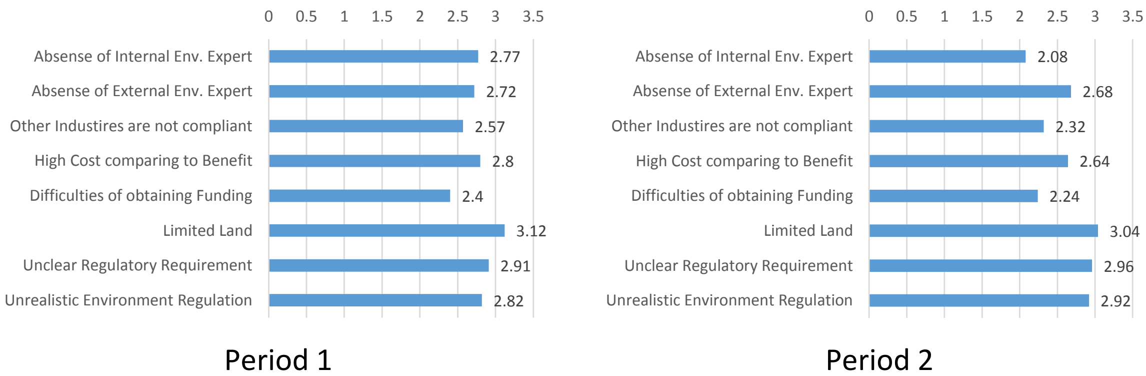
Regarding the awareness on NEQEG (2015), 77 % of the factories were not aware of the guideline among the 100 questionnaire factories in Yangon (Period 1, 2016). In Period 2 (2017), 56% (14 out of 25 factories were not aware the guideline. Apparently, the number of factories that are aware of the NEQEG (2015) increased in 2017, though the number of factories investigated in 2017 was limited.



Source: JET

Figure 2.1-6 Size of Target Factories According to DISI's Classification

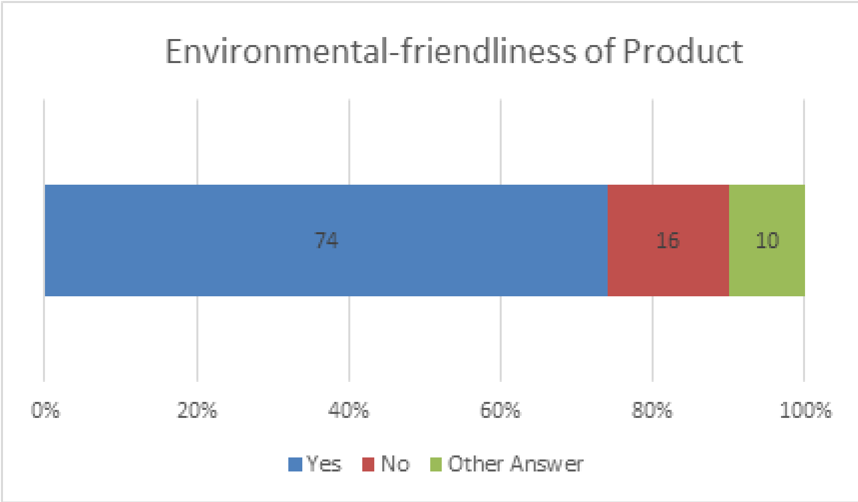
In order to develop and enforce regulations on wastewater management, it is important to understand difficulties factories are facing to improve their wastewater management. The reasons can be of technical, financial, institutional and/or organizational nature. The results of the question in Period 1 and Period 2, which asked the difficulties for installation of WWTP, are shown below. The score of "limited land" is slightly higher than others, but none of these reasons appears to be more significant than others.



Source: JET

Figure 2.1-7 Difficulties in Installing WWTP

Finally, the questionnaire asked whether the respondent thinks his/her product is more environmentally-friendly compared to similar products of competitors. A large number of respondents think their products are more environmentally-friendly pointing out that their products are produced systematically and in environmentally-sound manner. This was an interesting finding because these factories were well aware of the positive image of environmentally-friendly product, and this can drive them to improve their environmental management and quality control.



Source: JET

Figure 2.1-8 Environmental-Friendliness of Product

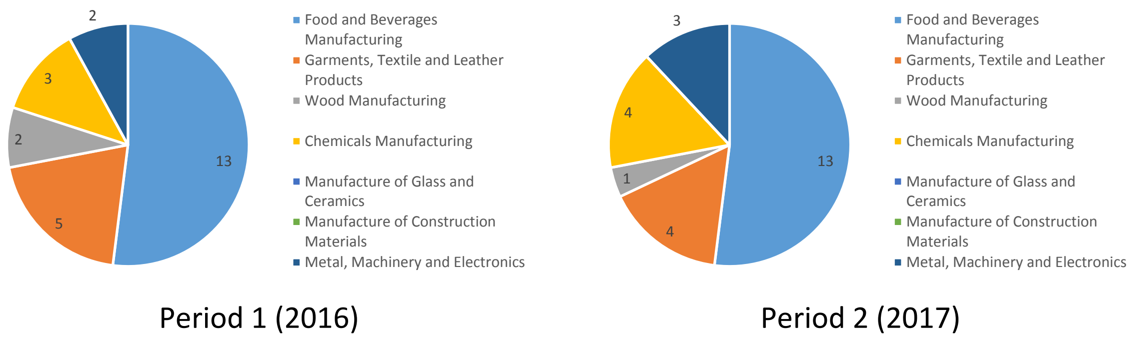
2.1.2. Wastewater Sampling and Analysis in Period 1 (2016) and Period 2 (2017)

(1) Target Factories

In 2016, in total 48 wastewater samples were collected from 25 target factories at the inlet and outlet of wastewater treatment system in each factory and analyzed in Myanmar and Thiland. The target factories were selected based on the following criteria:

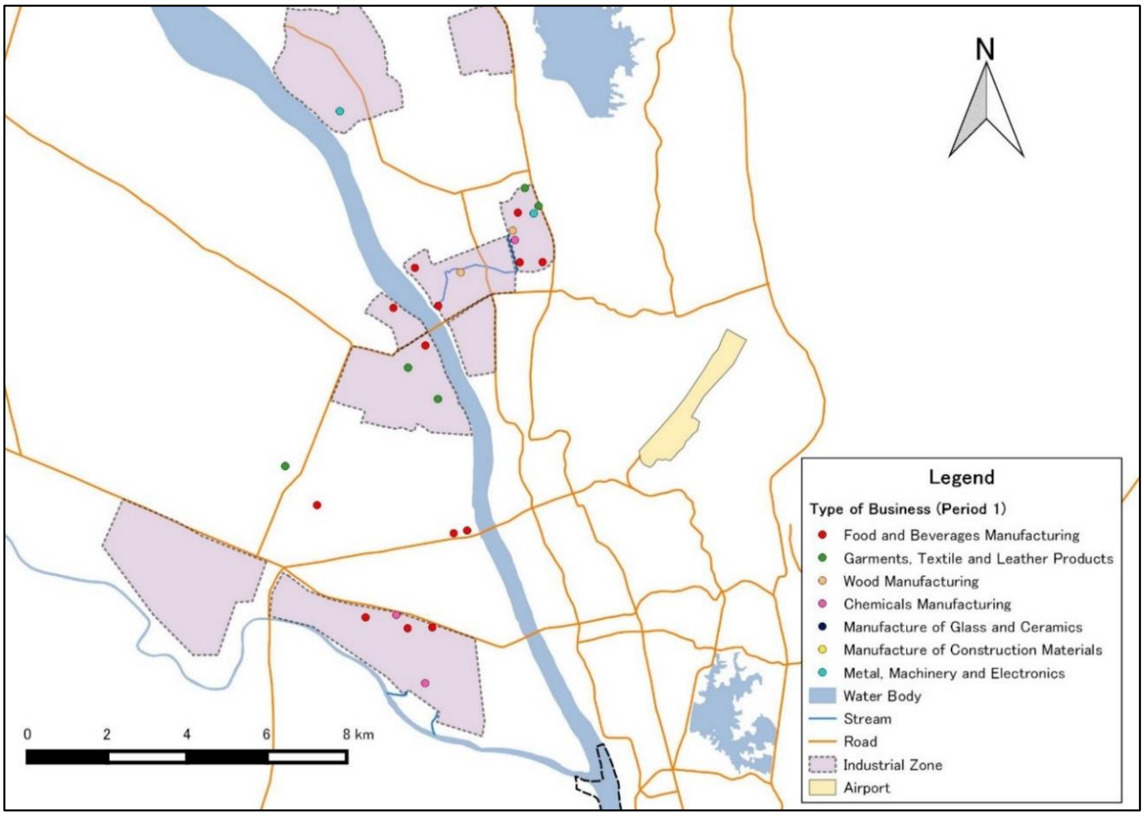
1) Target factories for Questionnaire Survey
2) Factories whose sectors are representative of the area to see the trend of the area
3) Factories whose wastewater may have significant environmental impact

A similar study was implemented in 2017 at 25 factories, but this time only the outlet samples were collected. The sectoral compositions and the location maps of the target factories are given in below figures.



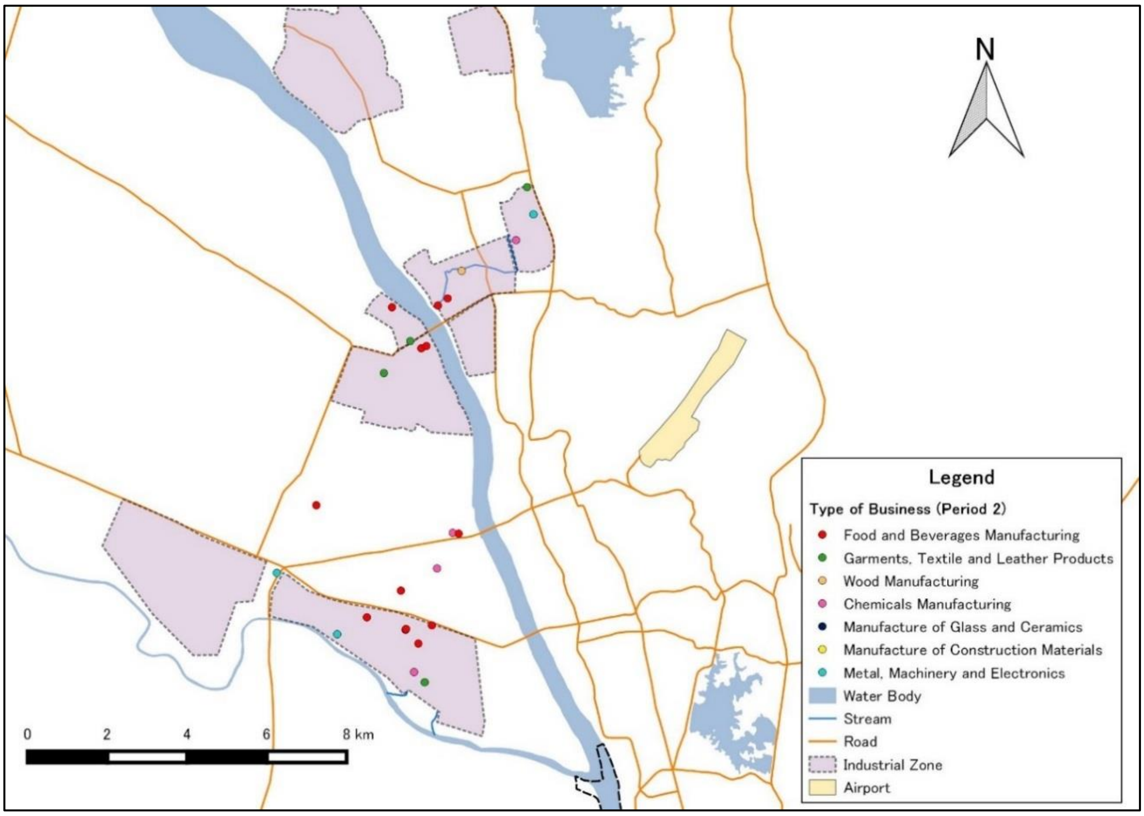
Source: JET

Figure 2.1-9 Sectors of Target Factories for Wastewater Sampling in Yangon



Source: JET

Figure 2.1-10 Location Map of Target Factories of Wastewater Sampling in Yangon (Period 1)



Source: JET

Figure 2.1-11 Location Map of Target Factories of Wastewater Sampling in Yangon (Period 2)

Some basic information on the target factories of wastewater sampling and analysis, including their classifications based on the NEQEG (2015), are summarized in the below tables. The results are to be compared with the guideline values of correspondent sectors in NEQEG (2015).

Table 2.1-3 Information on Target Factories of Wastewater Sampling in Yangon (Period 1)

No.	Industrial Zone	Sector	Sub-Sector	Products
Y1-01	Hlaing Tharyar Industrial Zone (2)	Food and Beverages Manufacturing	Fish Processing	Sea shrimps and crabs
Y1-02	Hlaing Tharyar Industrial Zone (2)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Toothpaste, soap
Y1-03	Hlaing Tharyar Industrial Zone (3)	Food and Beverages Manufacturing	Food and Beverage Processing	Soft drinks
Y1-04	Hlaing Tharyar Industrial Zone (3)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Organic herbal medicinal products
Y1-05	Shwe Linban Industrial Zone	Garments, Textile and Leather Products	Textiles Manufacturing	Cotton
Y1-06	Shwe Pyi Thar Industrial Zone (1)	Food and Beverages Manufacturing	Breweries and Distilleries	Alcohol
Y1-07	Hlaing Tharyar Industrial Zone (4)	Food and Beverages Manufacturing	Dairy Processing	Milk cream
Y1-08	Hlaing Tharyar Industrial Zone (5)	Food and Beverages Manufacturing	Fish Processing	Sardine can
Y1-09	Hlaing Tharyar Industrial Zone (5)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Cow, goat and sheep leather
Y1-10	Hlaing Tharyar Industrial Zone (7)	Food and Beverages Manufacturing	Food and Beverage Processing	Noodle
Y1-11	Hlaing Tharyar Industrial Zone (7)	Food and Beverages Manufacturing	Breweries and Distilleries	Ethanol alcohol
Y1-12	Shwe Pyi Thar Industrial Zone (1)	Food and Beverages Manufacturing	Food and Beverage Processing	Soft drink
Y1-13	Shwe Pyi Thar Industrial Zone (1)	Food and Beverages Manufacturing	Breweries and Distilleries	Bottle Cleansing/Storage
Y1-14	Shwe Pyi Thar Industrial Zone (1)	Garments, Textile and Leather Products	Printing	Printed cotton
Y1-15	Shwe Pyi Thar Industrial Zone (1)	Garments, Textile and Leather Products	Petroleum-based Polymers Manufacturing	Paints
Y1-16	Shwe Pyi Thar Industrial Zone (1)	Metal, Machinery and Electronics	Semiconductors and Other Electronics Manufacturing	Lead acid battery
Y1-17	Shwe Pyi Thar Industrial Zone (1)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Soap
Y1-18	Shwe Pyi Thar Industrial Zone (1)	Wood Manufacturing	Pulp and / or Paper Mills	Paper/tissue
Y1-19	Shwe Pyi Thar Industrial Zone (2)	Food and Beverages Manufacturing	Food and Beverage Processing	Spice powder
Y1-20	Shwe Pyi Thar Industrial Zone (3)	Food and Beverages Manufacturing	Fish Processing	Fresh and sea water fish and shrimp
Y1-21	Wataya Industrial Zone	Metal, Machinery and Electronics	Metal, Plastic and Rubber Products Manufacturing	Rubber
Y1-22	Shwe Linban Industrial Zone	Food and Beverages Manufacturing	Fish Processing	Sea fish and shrimp
Y1-23	Shwe Pyi Thar Industrial Zone (3)	Wood Manufacturing	Pulp and / or Paper Mills	Corrugated Paper, Test liner
Y1-24	Ngwe Pin Lal Industrial Zone	Food and Beverages Manufacturing	Fish Processing	Fish meal
Y1-25	Shwe Linban Industrial Zone	Garments, Textile and Leather Products	Textiles Manufacturing	Muffler, hat, glove

Source: JET

Table 2.1-4 Information on Target Factories of Wastewater Sampling in Yangon (Period 2)

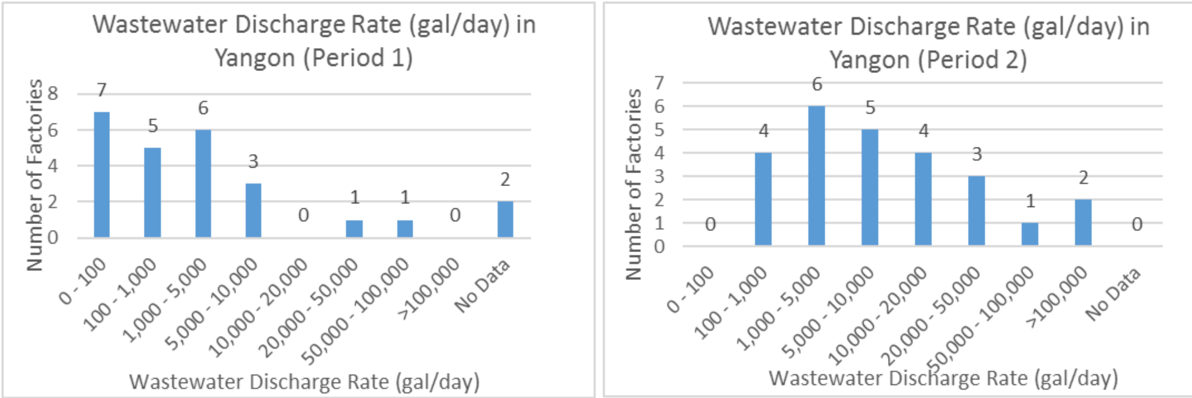
No.	Industrial Zone	Sector	Sub-Sector	Products
Y1-01	Hlaing Tharyar Industrial Zone (2)	Food and Beverages Manufacturing	Fish Processing	Sea shrimps and crabs
Y1-02	Hlaing Tharyar Industrial Zone (2)		Pharmaceuticals and Biotechnology Manufacturing	soap
Y1-03	Hlaing Tharyar Industrial Zone (3)	Food and Beverages Manufacturing	Food and Beverage Processing	Soft drinks
Y1-04	Hlaing Tharyar Industrial Zone (3)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Organic herbal medicinal products
Y1-05	Shwe Linban Industrial Zone	Garments, Textile and Leather Products	Textiles Manufacturing	Cotton
Y1-07	Hlaing Tharyar Industrial Zone (4)	Food and Beverages Manufacturing	Dairy Processing	Milk cream
Y1-08	Hlaing Tharyar Industrial Zone (7)	Food and Beverages Manufacturing	Fish Processing	Sardine can
Y1-10	Hlaing Tharyar Industrial Zone (5)	Food and Beverages Manufacturing	Food and Beverage Processing	Noodle
Y1-15	Shwe Pyi Thar Industrial Zone (1)	Garments, Textile and Leather Products	Petroleum-based Polymers Manufacturing	Paints
Y1-16	Shwe Pyi Thar Industrial Zone (1)	Metal, Machinery and Electronics	Semiconductors and Other Electronics Manufacturing	Lead acid battery
Y1-17	Shwe Pyi Thar Industrial Zone (1)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Soap
Y1-19	Shwe Pyi Thar Industrial Zone (2)	Food and Beverages Manufacturing	Food and Beverage Processing	Spice powder
Y1-20	Shwe Pyi Thar Industrial Zone (3)	Food and Beverages Manufacturing	Fish Processing	Fresh and sea water fish and shrimp
Y1-22	Shwe Linban Industrial Zone	Food and Beverages Manufacturing	Fish Processing	Sea fish and shrimp
Y1-23	Shwe Pyi Thar Industrial Zone (3)	Wood Manufacturing	Pulp and / or Paper Mills	Corrugated Paper, Test liner
Y1-24	Ngwe Pin Lal Industrial Zone	Food and Beverages Manufacturing	Fish Processing	Fish meal
Y1-25	Shwe Linban Industrial Zone	Garments, Textile and Leather Products	Textiles Manufacturing	Muffler, hat, glove
Y1-29	Hlaing Tharyar Industrial Zone (4)	Food and Beverages Manufacturing	Dairy Processing	Dairy Maid
Y1-32	Hlaing Tharyar Industrial Zone (7)	Food and Beverages Manufacturing	Food and Beverages Processing	Rice/others
Y1-42	Shwe Pyi Thar Industrial Zone (3)	Food and Beverages Manufacturing	Fish Processing	Fish sauce/ Golden Dragon Sauce
Y1-54	Hlaing Tharyar Industrial Zone (4)	Food and Beverages Manufacturing	Fish Processing	Shrimp
Y1-65	Hlaing Tharyar Industrial Zone (2)	Garments, Textile and Leather Products	Textiles Manufacturing	Textile
Y1-80	Shwe Than Lwin Industrial Zone	Metal, Plastic and Rubber Product Manufacturing	Others	Metal Product
Y1-81	Hlaing Tharyar Industrial Zone (4)	Metal, Plastic and Rubber Product Manufacturing	Others	Transformer
Y1-99	Hlaing Tharyar Industrial Zone (2)	Garments, Textile and Leather Products	Petroleum-based Polymers Manufacturing	Paints

Source: JET

(2) Wastewater Discharge Rate

Wastewater discharge rate was measured or estimated on site during the sampling (below figure). In Period 1 survey, discharge rates of 2 (9 %) out of 23 factories for which on site estimate was made were over 10,000 gal/ day while at 21 factories (91%), the flow rate was smaller than 10,000 gal/day.

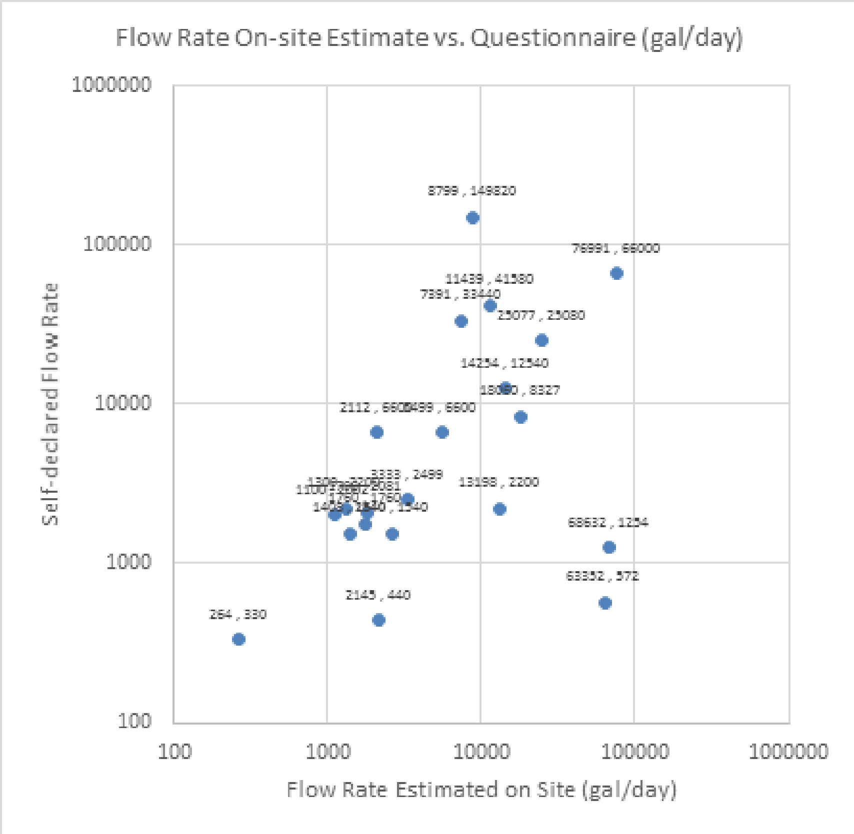
In Period 2 survey, discharge rates of 8 (35 %) out of 23 factories for which on site estimate was made were over 10,000 gal/day while at 15 factories (65%), the flow rate was smaller than 10,000 gal/day. It has to be pointed out that it was not easy to measure a representative flow rate on site. At many factories, water was nearly stagnant or flow rate was very small. At other factories, there was no place to measure flow in channel. Furthermore, in some factories the flow rate changed during sampling.



Source: JET

Figure 2.1-12 Wastewater Flow Rate Estimated on Site

Because wastewater flow rate was also reported in the questionnaire, the on-site estimate in 2016 and the reported value in 2016 were compared in the figure below in logarithmic scale. In many factories, there was a significant difference between the reported flow rate and the on-site estimate, though the reason for the difference was not clear. Flow rate often fluctuates significantly depending on factory's operational condition. To obtain reliable data, thus, flow should be measured under different operational conditions, but only very few factories (4 out of 100 factories according to the questionnaire survey) are equipped with a flow meter for wastewater. Most factories rely on groundwater, and they do not have strong incentive to monitor and minimize water usage and wastewater flow. It is possible that many factories simply have little idea about the amount of wastewater being discharged. Estimation of discharge rate should be considered as one of the main issues of wastewater management, especially if pollution load is used to prioritize factories to be controlled or to calculate fee for centralized wastewater treatment. Installation of a flow meter is highly recommended for all factories that have a sizable discharge.

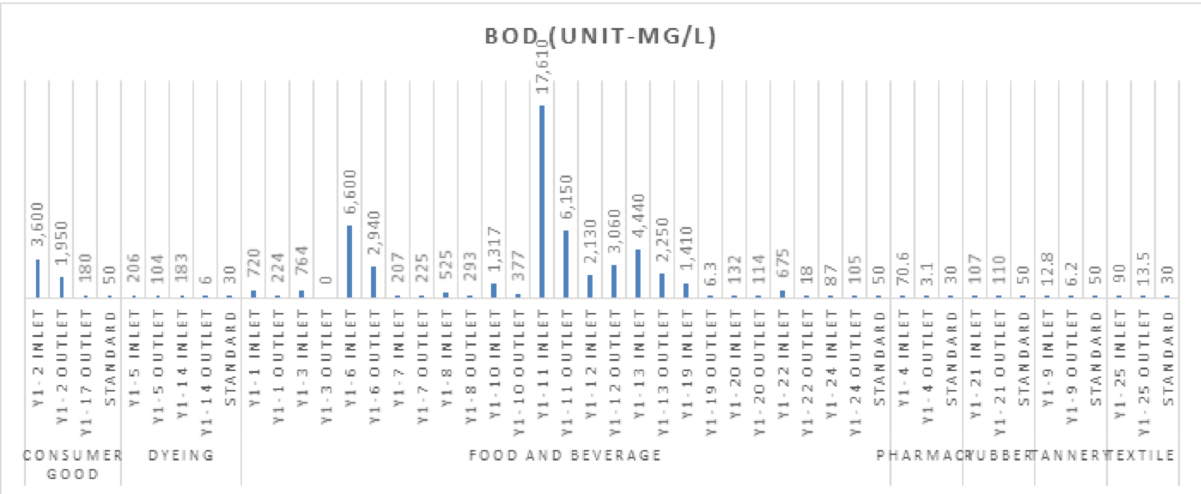


Source: JET

Figure 2.1-13 Comparison of Self-Declared Flow Rate and Flow Rate Estimated on Site

(3) BOD

Below figure shows the results of BOD analysis in 2016.



Source: JET

Figure 2.1-14 BOD Concentration of Target Factories in 2016

The distribution of outlet BOD concentration in Yangon in Period 1 (2016) and Period 2 (2017) are shown in the Figure 2.1-15. The results in 2016 were trimodal, i.e., these factories could be classified into three groups, i.e., (i) factories with very high outlet BOD level (often 1,000 mg/L or more), (ii) factories with medium outlet BOD level, comparable to raw domestic wastewater (around 250 mg/L), and (iii) factories with low outlet BOD level (equal or less than 50 mg/L). However, the results in 2017 did not show such characteristic. This is partly because distilleries (high conc. group) were not operating in 2017, but broader investigation is recommended as only 25 factories were investigated in each year.

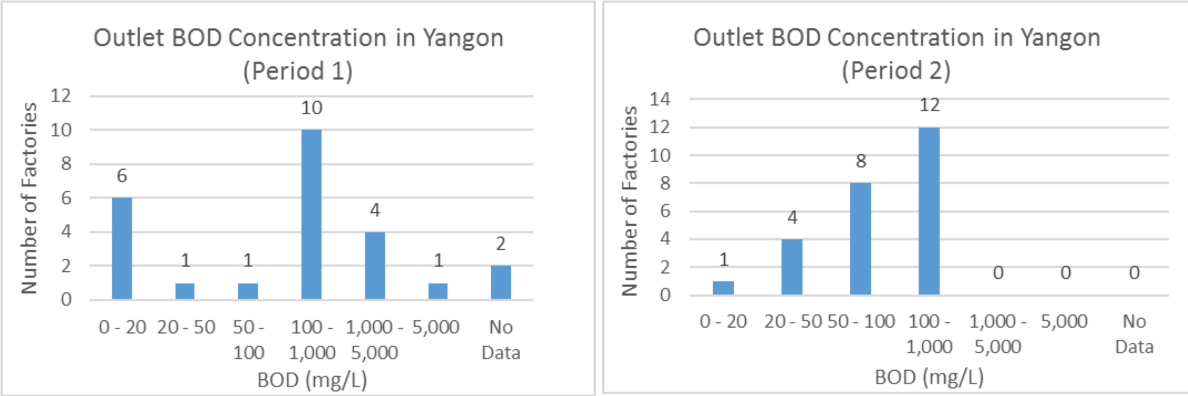
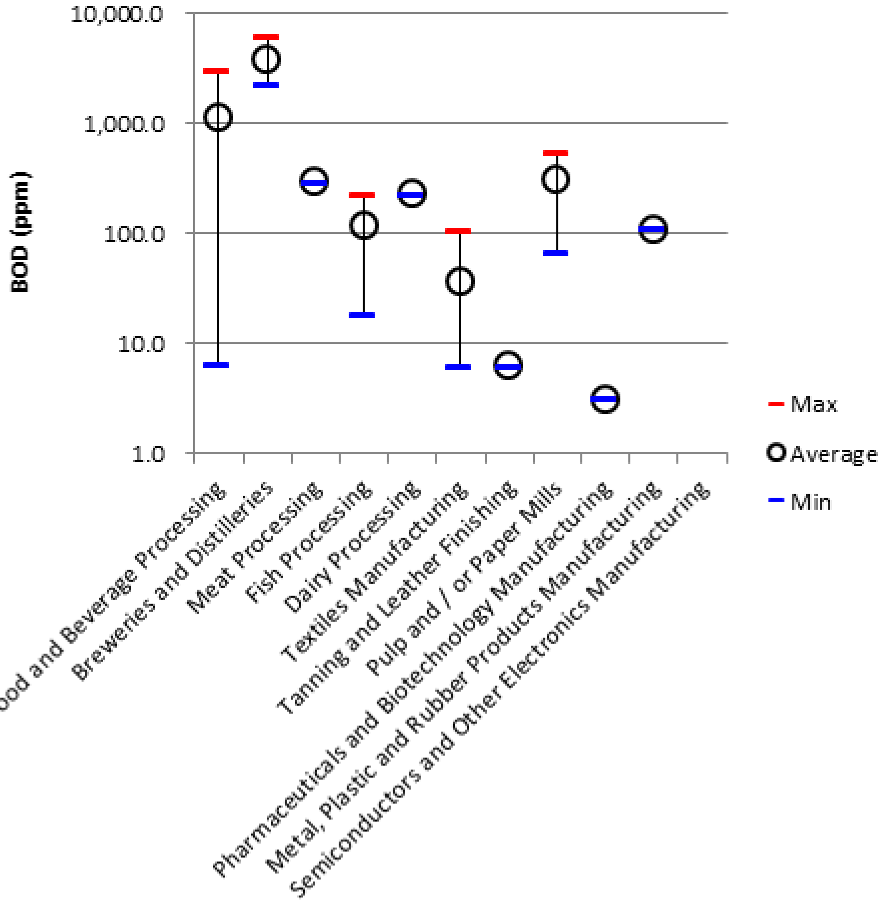


Figure 2.1-15 Distribution of Outlet BOD Concentrations

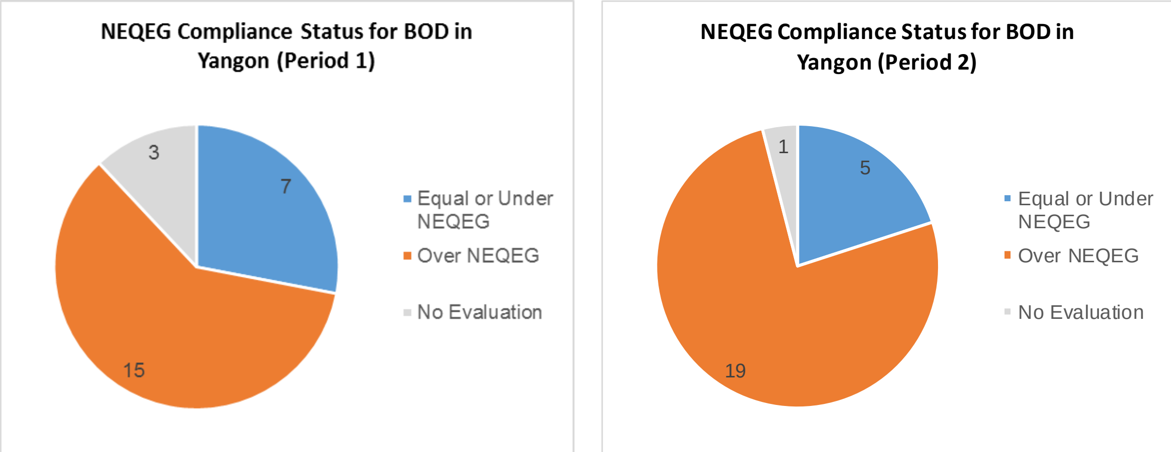
In the figure below, maximum, arithmetic average and minimum outlet concentrations are analyzed by sector based on 2016 data. Distilleries, some of the beverage factories, and paper mills are among industrial sectors that discharge high BOD effluents.



Source: JET

Figure 2.1-16 Outlet BOD Concentrations in Different Industrial Sectors in 2016

It was of interest to examine if the outlet concentrations of existing factories are satisfying the requirement of NEQEG (2015), which is 50 mg/L for all sectors except printing (30 mg/L) and pulp and paper mill sector (the guideline value is set per air dried metric ton of product), though currently the NEQEG (2015) is not legally-binding to these factories. The results showed that, among 22 factories for which both outlet BOD concentration and guideline value are available, 7 factories (32 %) are meeting the guideline value and 15 (68 %) are not meeting in 2016. In 2017, 5 factories out of 24 (22%) were meeting the value and 19 factories (79%) were not meeting the value.

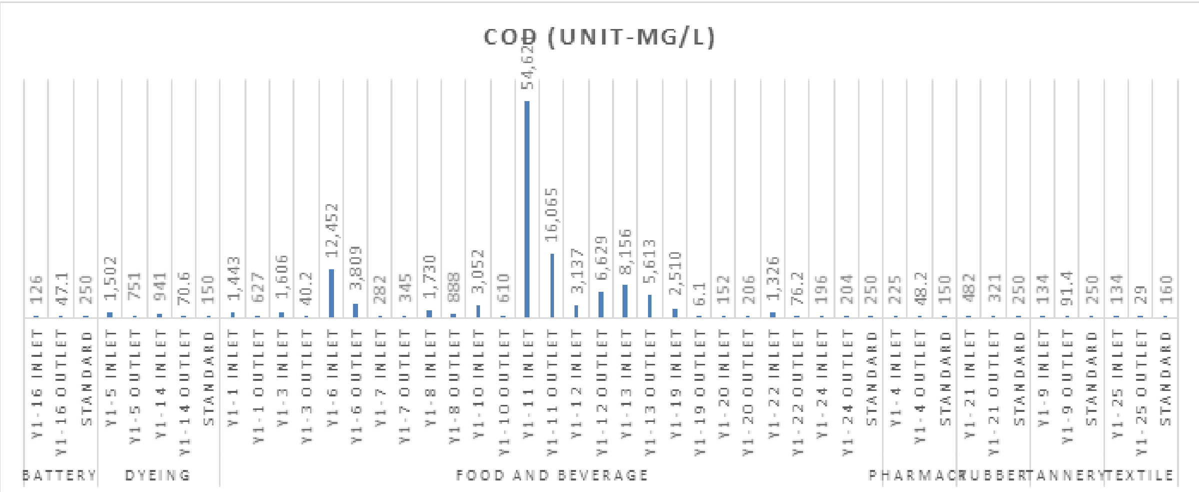


1) Some sector does not have the guideline value. In addition, "Pulp and / or Paper Mills" have NEQEG value with different unit as "kg/Air dried metric ton" and some sectors do not have NEQEG value for these parameters.
Source: JET

Figure 2.1-17 NEQEG Compliance Status for BOD

(4) COD

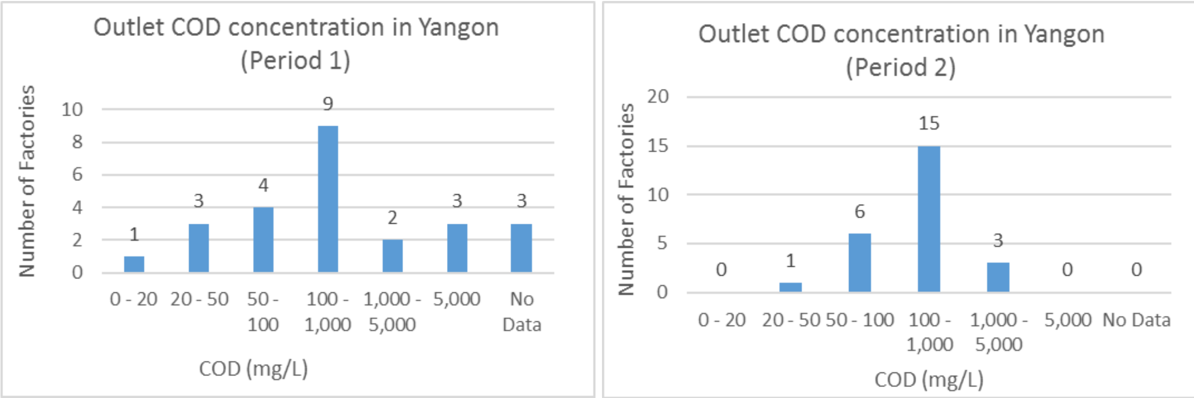
Below figure summarizes the results of the COD analysis in 2016.



Source: JET

Figure 2.1-18 COD Concentrations of Target Factories in 2016

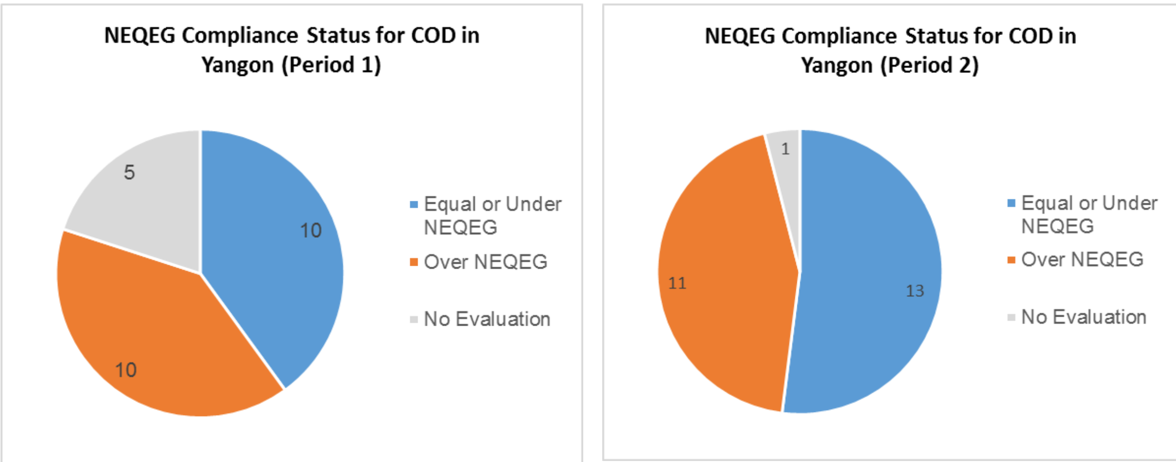
As expected, the situation is similar to BOD. There were factories with low outlet COD level (typically below 150 mg/L), medium outlet COD level (typically around 500 to 1,000 mg/L), and with high outlet COD level (typically over 2,000 mg/L). Some dyeing factories and food and beverage factories, in particular distilleries and some beverage factories, have extremely high COD concentration at their outlets. COD contents in other sectors such as paint, pharmacy, tannery and textile are generally low.



Source: JET

Figure 2.1-19 Distributions of Outlet COD Concentrations in 2016 and 2017

In 2016, 50 % (10 out of 20 for which data were available) of the target factories exceeded the guideline value for COD, while 57 % (13 out of 23) of the factories were below the guideline value, which ranges 150 to 250 mg/L depending on the sector. In 2017, the number of factories with outlet COD concentration below NEQEG (2015) increased slightly, but it should be borne in mind that factories investigated in both years are not the same (17 factories overlapped in both years).

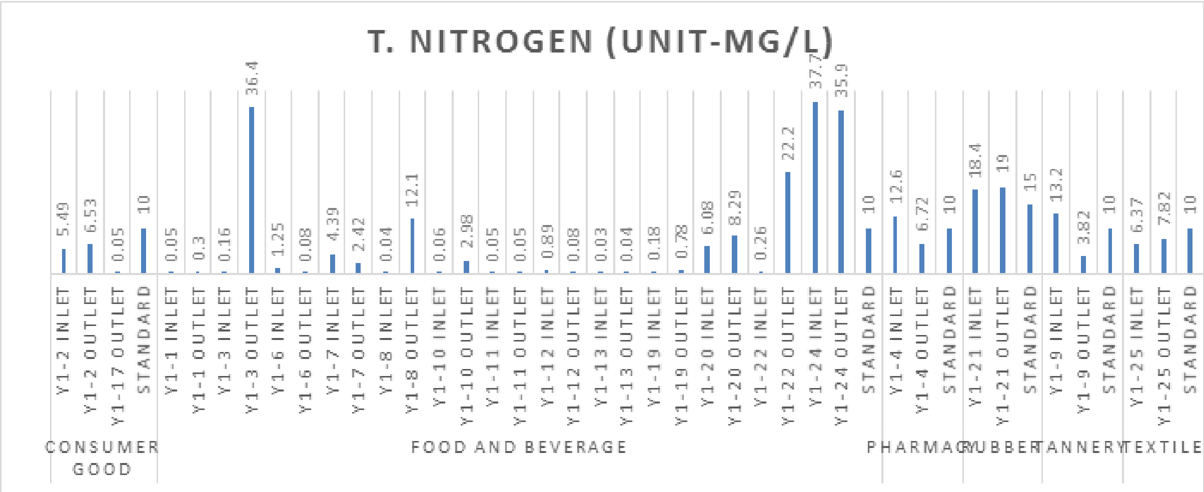


1) Some sector does not have the guideline value. In addition, "Pulp and / or Paper Mills" have NEQEG value with different unit as "kg/Air dried metric ton" and some sectors do not have NEQEG value for these parameters.
Source: JET

Figure 2.1-20 NEQEG Compliance Status for COD

(5) T-N

The results of T-N analysis in 2016 are shown in Figure 2.1-41. It was noted that the T-N results are generally too low considering the levels of BOD and COD. For example, a typical raw domestic sewage contains BOD of 110 - 400 mg/L, T-N of 20 - 85 mg/L and T-P of 4 - 15 mg/L (Metcalf and Eddy, 1991). Thus, a systematic analytical error was suspected.



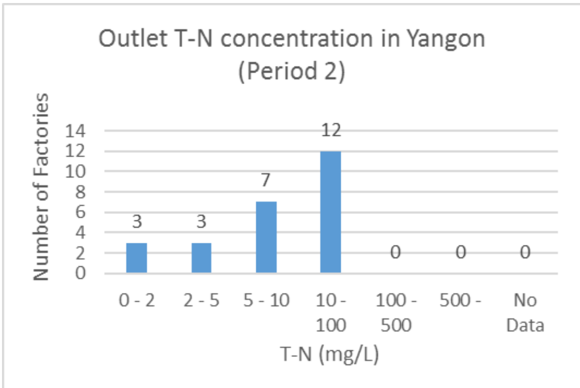
Source: JET

Figure 2.1-21 T-N Concentrations of Target Factories

Source: JET

Figure 2.1-22 shows the outlet TN concentrations in 2017. The outlet concentrations of many factories were over 10 mg-N/l.

T-N data in 2016 were considered not reliable.

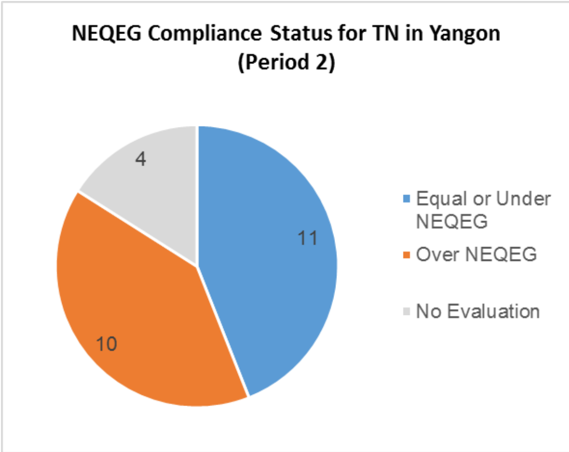


Source: JET

Figure 2.1-22 Distribution of Outlet TN Concentrations

In 2017, 58% (10 out of 21) of the factories exceeded NEQEG (2015), while 52% (11 out of 21) were below the NEQEG (2015).

The results of TN analysis in 2016 were not considered reliable.

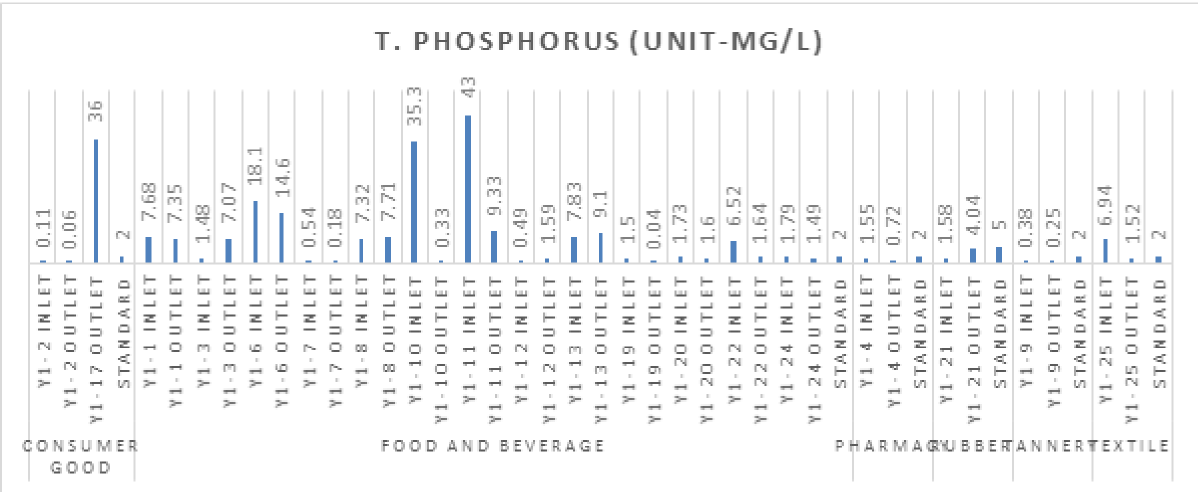


1) Some sector does not have the guideline value. In addition, "Pulp and / or Paper Mills" have NEQEG value with different unit as "kg/Air dried metric ton" and some sectors do not have NEQEG value for these parameters.
Source: JET

Figure 2.1-23 NEQEG Compliance Status for TN

(6) Total Phosphorus

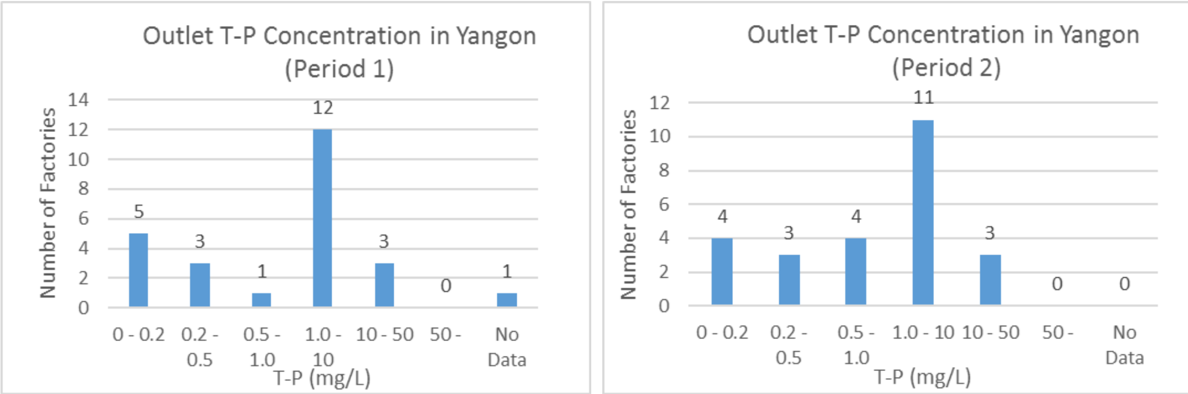
The results of T-P analysis in 2016 are shown in Figure 2.1-42.



Source: JET

Figure 2.1-24 T-P Concentrations of Target Factories

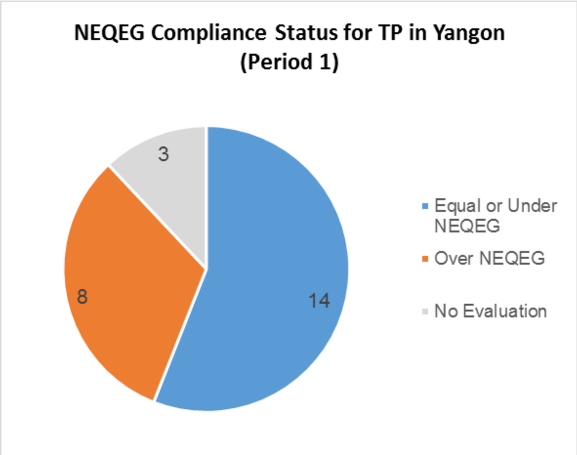
The distributions of outlet T-P concentrations in 2016 and 2017 are shown in Figure 2.1-43. The reliability of T-P analysis in 2016 was not clear. In 2017, 50% of factories released effluent with 2.0 – 10 mg-P/L.

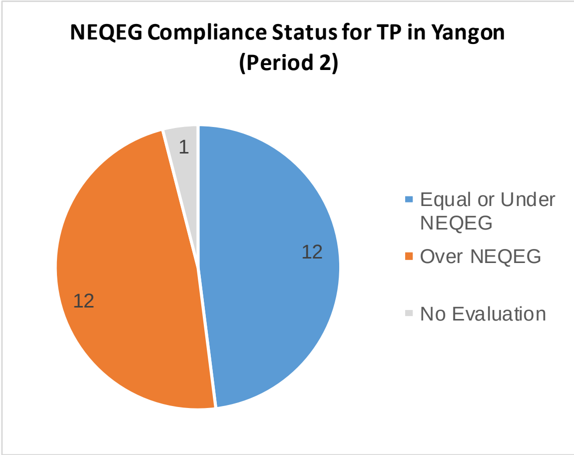


Source: JET

Figure 2.1-25 Distributions of Outlet T-P Concentrations

The T-P guideline value in NEQEG (2015) is 2 mg/L for many manufacturing sectors, but in some manufacturing sectors, such as manufacturing of metal, plastics and rubber, it is set at 5 mg/L. In 2017, outlet concentrations of 48% (12 out of 25) of factories exceeded NEQEG (2015).





1) Some sector does not have the guideline value. In addition, "Pulp and / or Paper Mills" have NEQEG value with different unit as "kg/Air dried metric ton" and some sectors do not have NEQEG value for these parameters.
Source: JET

Figure 2.1-26 NEQEG Compliance Status for TP

(7) Other Parameters

In the table below, the results of comparison of outlet concentration against their respective guideline values are summarized for selected parameters. In the survey, outlet concentrations of various ions, heavy metals and organic chemicals were determined for different sectors, such as textile, leather, printing, foundries, battery and pharmaceutical sectors. However, for such parameters, the numbers of data were too limited, often less than three data for each parameter, and most of the results were below limit of quantification. Thus, no detailed assessment was made for these parameters.

In 2017, phenols (0.96 mg/L, pharmaceutical), lead (4.28 mg/L, battery) and zinc (0.32 mg/L, textile), were detected at concentrations above the NEQEG (2015). However, more detailed investigation is suggested as the number of factories covered in this project was limited.

For these hazardous substances, more specific surveys targeting sectors known to have problems with hazardous substances, such as battery and semi-conductors, leather, chemical, foundry, etc., are recommended.

Table 2.1-5 Summary Table of Distribution of Outlet Concentrations of Selected Parameters and Comparison of Outlet Concentrations with Guideline Values

Parameter	Unit	Comparison with Guideline (Period 1)		Comparison with Guideline (Period 2)	
pH	-	Number of Data	25	Number of Data	25
		Meeting Guideline	17	Meeting Guideline	17
		Exceeding Guideline	8	Exceeding Guideline	8
		% Exceeding	32%	% Exceeding	32%
BOD	mg/L	Number of Data	22	Number of Data	24
		Meeting Guideline	7	Meeting Guideline	5
		Exceeding Guideline	15	Exceeding Guideline	19
		% Exceeding	68%	% Exceeding	79%
COD	mg/L	Number of Data	20	Number of Data	24
		Meeting Guideline	10	Meeting Guideline	13
		Exceeding Guideline	10	Exceeding Guideline	11
		% Exceeding	50%	% Exceeding	46%
T-N	mg/L	Number of Data	-	Number of Data	21
		Meeting Guideline	-	Meeting Guideline	11
		Exceeding Guideline	-	Exceeding Guideline	10

Parameter	Unit	Comparison with Guideline (Period 1)		Comparison with Guideline (Period 2)	
		% Exceeding	-	% Exceeding	48%
T-P	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	22 14 8 36%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	24 12 12 50%
Total Suspended Solid	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	23 10 13 57%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	24 6 18 75%
Oil and Grease	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	22 12 10 45%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	24 2 22 92%
Phenols	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	5 5 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	8 7 1 13%
Arsenic	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	2 2 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	6 6 0 0%
Chromium VI	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	7 7 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	11 11 0 0%
Chromium Total	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	6 5 1 17%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	8 8 0 0%
Copper	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	5 5 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	8 8 0 0%
Lead	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	2 1 1 50%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	4 3 1 25%
Mercury	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	2 2 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	7 7 0 0%
Zinc	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	5 5 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	8 7 1 13%

Source: JET

2.1.3. Summary

1) In Yangon, there exist as many as 3,500 factories under control of YCDC, and according to the data from DISI, there are 1,083 factories in the six target IZs in the Hlaing River basin employing some 90,000 people. Food and beverage sector is the leading sector in these IZs, followed by domestic materials, clothing, and accommodation sectors.

2) Among these 1,083 factories, 100 factories were selected for a questionnaire survey in 2016.

3) According to the results of the questionnaire survey, the average water usage per factory is about 15,000 gal/day (67 m3/day), but 73% of the factories use less than 10,000 gal/day (47 m3/day). The average wastewater discharge per factory is 7,500 gal/day (34 m3/day). Only 10% and 4% of factories are equipped with flow meters to monitor water usage and wastewater, respectively. Thus, there are significant uncertainties about the water usage and wastewater discharge data.

4) Only 53% of the factories replied that they have wastewater treatment facilities. Most of them are rudimentary primary treatment facilities, such as screen or sedimentation tank, to remove solid waste and settleable particles. Only several percent of factories are equipped with secondary treatment facilities to reduce level of organic matter, such as BOD and COD. Nine (9) % of the factories have oil separators.

5) Many factories believe their wastewater and solid waste management is adequate. Meanwhile, seventy-seven (77) % of factories were not aware of NEQEG (2015) in 2016.

6) Among the 100 target factories for the questionnaire survey, 25 factories were selected for wastewater sampling and analysis in 2016, and, in total, 48 samples from 25 target factories were collected and analyzed. In 2017, 25 samples from 25 factories were collected and analyzed.

7) The results of wastewater sampling and analysis in 2017 revealed that 79% (BOD), 46% (COD), 48% (TN), 50% (TP), 75% (TSS) and 92% (oil and grease) of the factories were not meeting the NEQEG (2015) requirements. Some factories are meeting the requirements, but this is largely because raw wastewaters of such factories (e.g., cold storage) are not very strong, and not because these factories are actively treating their wastewaters.

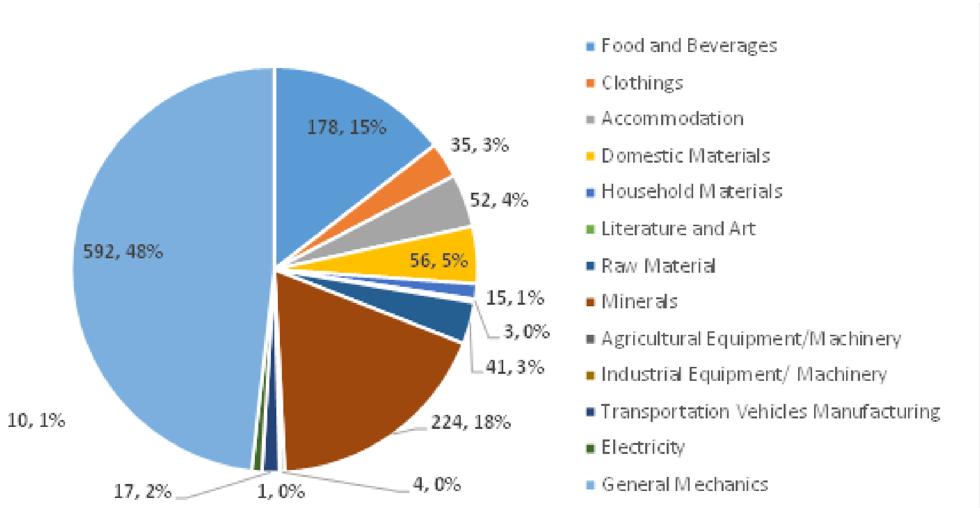
8) In 2017, phenols (0.96 mg/L, pharmaceutical), lead (4.28 mg/L, battery) and zinc (0.32 mg/L, textile), were detected at concentrations above the NEQEG (2015). Such sectors/factories should be monitored closely.

2.2. Doke Hta Waddy River Basin

2.2.1. Questionnaire Survey in 2016

(1) Target Factories

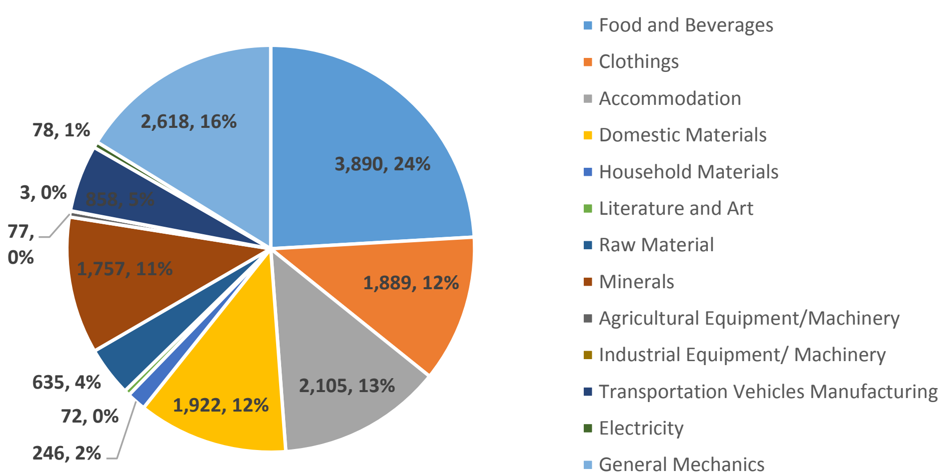
According to information from DISI (2017), there are 1,228 DISI-registered factories in Pyi GyeeTagon IZ, and the sectoral composition is markedly different from that of IZs in Hlaing River basin in Yangon. In the Pyi Gyee Tagon IZ, as many as 48% of the factories are in general mechanics sector, such as small machine shops.



Source: JET based on information from DISI

Figure 2.2-1 Sectors of Factories in Pyi Gyee Tagong IZ in Mandalay

The number of employees was also quite different in Mandalay. While the number of factories in Pyi Gyee Tagon IZ (1,228 factories) was similar to those in the Hlaing River basin in Yangon (1,083), only 16,150 people are employed by factories in Pyi GyeeTagon IZ, compared to 90,211 in Hlaing River basin. Factories in Pyi Gyee Tagon IZ are much small-scaled than those in IZs in Hlaing River basin.



Source: JET

Figure 2.2-2 Number of Employees of Factories in Pyi Gyee Tagong IZ in Mandalay by Sector

Because this questionnaire survey could cover only 100 factories in and around Pyi Gyee Tagon IZ, MCDC, ECD and JET decided to select the target factories based on the following criteria, which are same as the ones in Yangon:

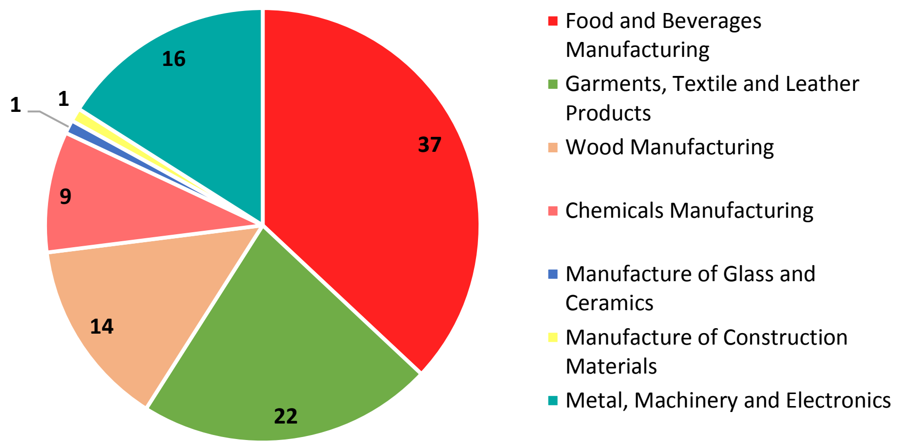
1) Factories whose sectors are representative of the area to see the trend of the area
2) Major factories that discharge sizable volume of wastewater

Table 2.2-1 summarizes the sectoral composition of the target factories of the questionnaire survey in Mandalay. Food and beverage sector, including distilleries, soft drinks, noodle, sesame seed, etc., is the most popular manufacturing sector investigated. Aside from the food and beverage sector, tanneries, consumer goods, foundries and paper production sectors were also included in the survey. Only limited numbers of factories were investigated in other sectors, such as battery, fertilizer, pharmacy, etc., and data for such sectors should be treated with care, as they may or may not be representative of each sector.

Table 2.2-1 Sectors of Target Factories in Questionnaire Survey in Mandalay in 2016

No.	Sector	Remarks	Number on List from IZMC	Number on List from MCDC	Number of Target Factories	
					Questionnaire Survey	Wastewater Sampling
1	Food and Beverages		186	35	36	11
		Bean/Seasame/Oil Mill	66	0	1	0
		Bean/ Bean Grinding/Cleansing	25	4	2	2
		Snack	16	1	1	1
		Wheat	16	0	0	0
		Sugar Mill	13	24	10	4
		Beverage/Drinking water/Juice	12	0	4	0
		Distillery	5	6	6	4
		Feed	5	0	1	0
		Rice Mill	4	0	1	0
		Alcohol Bottling	3	0	1	0
		Ice Cream	3	0	1	0
		Noodle	2	0	1	0
		Cold Store/ Meat	1	0	1	0
		Coffee	1	0	1	0
		Baking Powder	1	0	1	0
		Chilli	1	0	1	0
		Tea	1	0	1	0
		Cigarette	1	0	1	0
		Jelly	1	0	1	0
		Others	9	0	0	0
2	Clothings		34	2	4	2
		Cotton Mill	20	0	2	0
		Textile	9	2	2	2
		Others	5	0	0	0
3	Accommodation		40	0	5	0
		Wood Processing	25	0	3	0
		Iron Grid/Wire	5	0	1	0
		Concrete and Cement	3	0	1	0
		Others	7	0	0	0
4	Domestic Materials		66	2	14	2
		Plastic Goods	23	0	0	0
		Battery	10	0	3	0
		Detergent	5	2	2	2
		Pharmaceutical	4	0	4	0
		Candle	3	0	1	0
		Cosmetic	2	0	2	0
		Mosquito Coil	2	0	1	0
		Others	17	0	1	0
5	Household Materials		19	16	10	4
		Cardboard	11	0	2	0
		Paper Mill	8	16	8	4
6	Literature and Art		1	0	0	0
		Arts and Crafts	1	0	0	0
7	Raw Material		42	42	15	6
		Tannery	33	42	14	6
		Gas (Oxygen)	3	0	0	0
		Fertilizer	1	0	1	0
		Others	5	0	0	0
8	Minerals		181	0	12	0
		Iron Smelting	90	0	3	0
		Iron Stretching	39	0	1	0
		Metal Smelting	19	0	3	0
		Bronze Casting	17	0	1	0
		Fuel	7	0	1	0
		Iron Box	3	0	0	0
		Aluminum Mill/Casting	3	0	1	0
		Metal Casting	2	0	1	0
		Iron Casting	1	0	1	0
9	Agricultural Equipment/Machinery		1	0	0	0
		Agricultural Machine	1	0	0	0
10	Industrial Equipment/ Machinery		1	0	0	0
		Construction Machinery	1	0	0	0
11	Transportation Vehicles Manufacturing		2	0	0	0
		Motor Vehicle	2	0	0	0
12	Electricity		6	0	0	0
		Electrical Goods	4	0	0	0
		Satellite Receiver	2	0	0	0
13	General Mechanics		697	0	4	0
		Lathe/ Welding	388	0	3	0
		Car Workshop	138	0	1	0
		Iron Gates	24	0	0	0
		Car Assembly	17	0	0	0
		General Construction Materials	12	0	0	0
		Others	118	0	0	0
Total			1,276	97	100	25

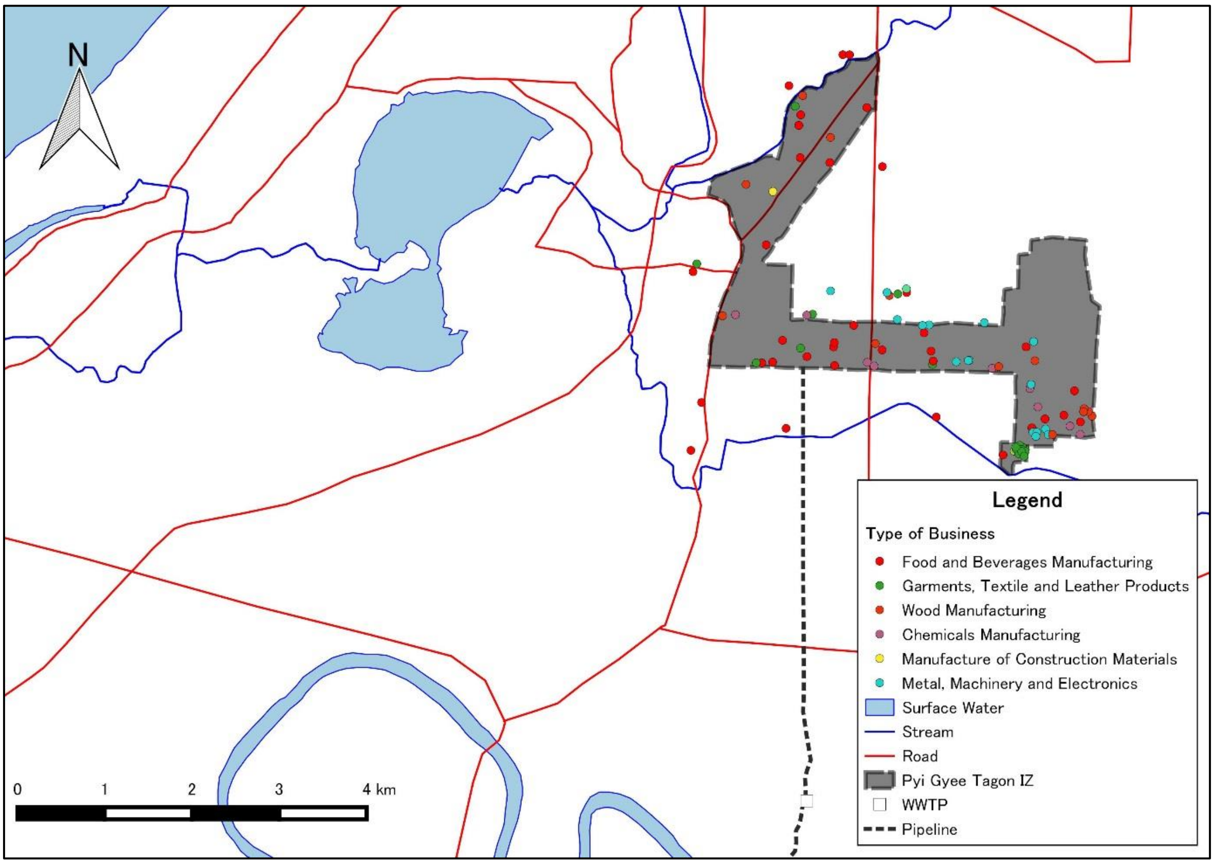
Source: JET



Source: JET

Figure 2.2-3 Sectors of Target Factories in Questionnaire Survey in Mandalay in 2016

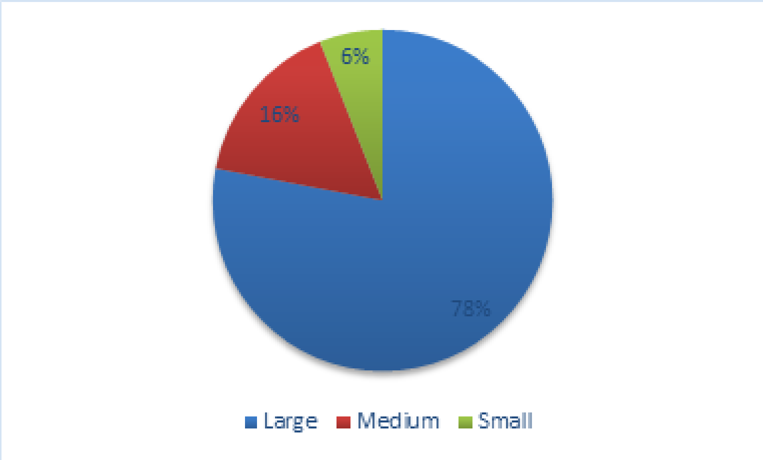
The locations of the surveyed factories are shown in Figure 2.2-3.



Source: JET

Figure 2.2-4 Location Map of 100 Target Factories of Questionnaire Survey in Mandalay

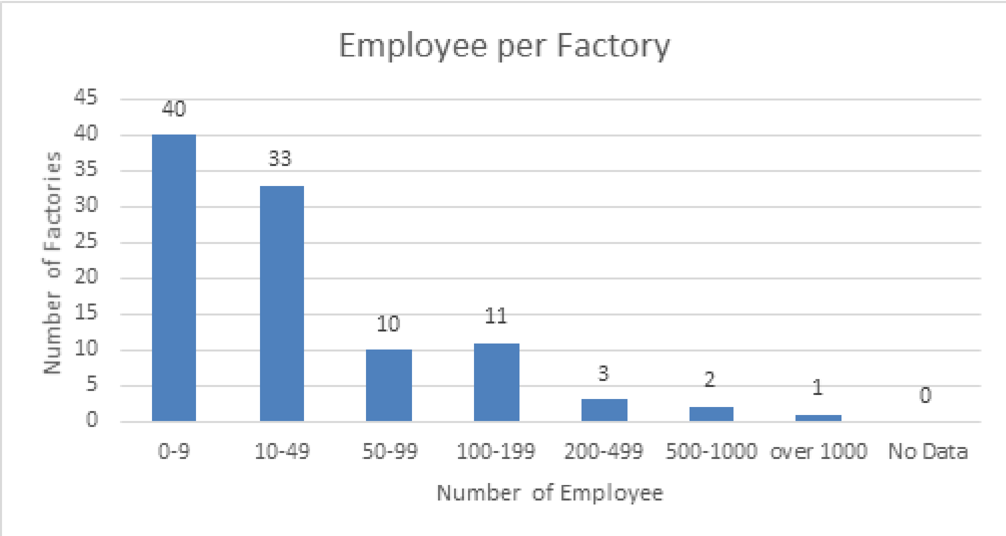
Seventy eight (78) % of the 100 factories investigated are of large-size category according to the DISI's classification, while medium is 16% and small is 6% respectively.



Source: JET

Figure 2.2-5 Size of Target Factories According to DISI's Classification

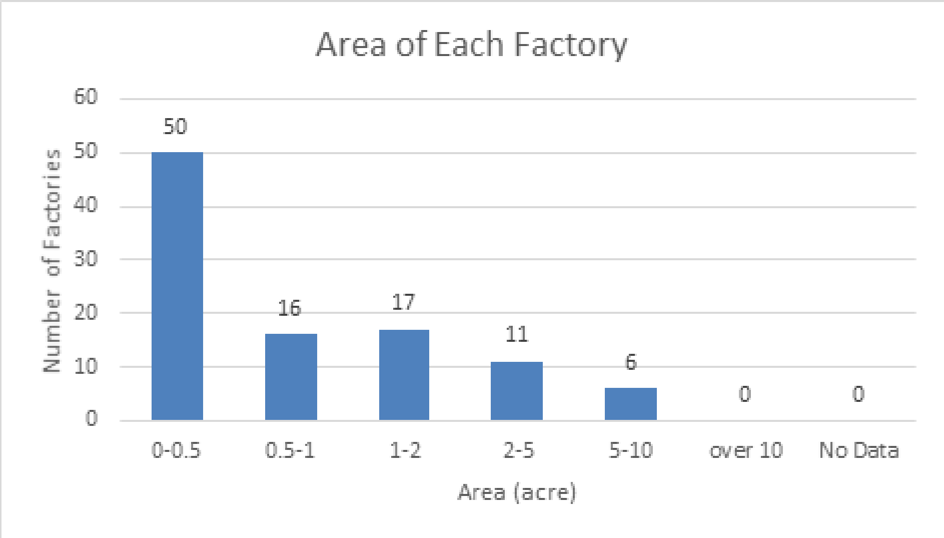
Figure 2.2-5 shows the distribution of employees by factory. While the majority of factories are categorized as large sized, 73% of the factories are operated by less than 50 employees, and 40% less than 10 employees. Overall, factories in Mandalay appear to be smaller in scale compared with those in Yangon.



Source: JET

Figure 2.2-6 Number of Employee in Target Factories

The results of the questionnaire survey showed that the average land size of a factory is 1.3 acres (0.53 ha), of which 0.87 acre is the building area. The average land area of factories in Mandalay is about 1/2 of that in Yangon, which is 2.57 acre (1.0 ha).

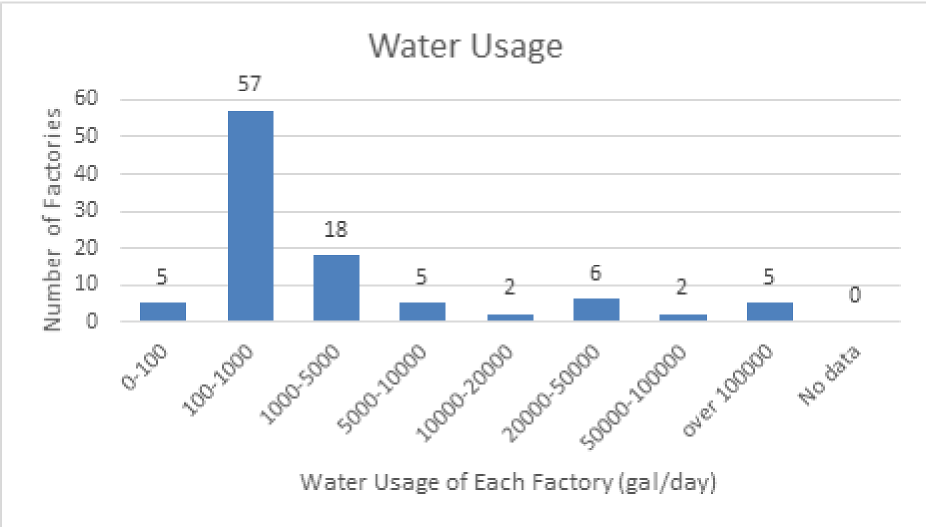


Source: JET

Figure 2.2-7 Land Area of Each Target Factory

(2) Water Usage

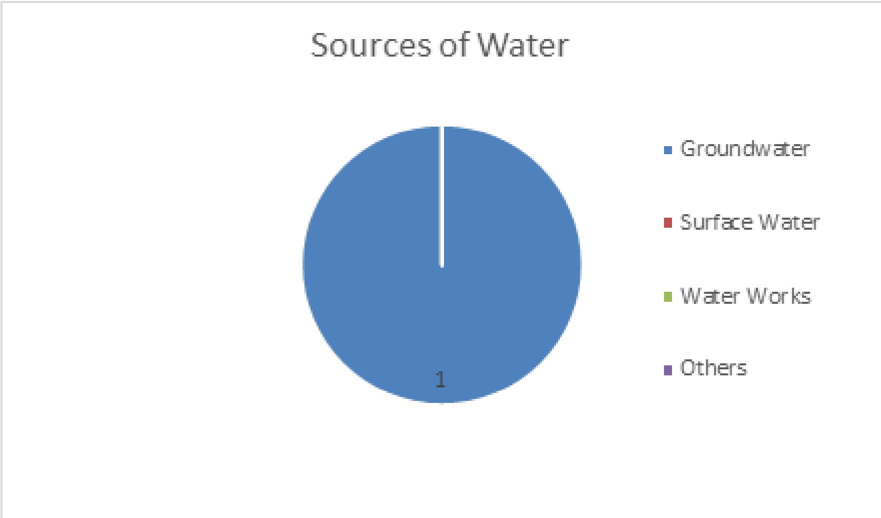
Water usage (sum of supplied water, groundwater, surface water and others) reported by the target factories is summarized in Figure 2.2-7. The average water usage per factory is 12,600 gal/day (57 m3/day). However, this is largely because some of the factories for purified water and soft drink use more than 100,000 gal/day (450 m3/day) of water as raw material. Water usage of most factories is limited, and 85% of the factories (85 out of 100 factories) use less than 10,000 gal/day (45 m3/day).



Source: JET

Figure 2.2-8 Water Usage of Each Factory

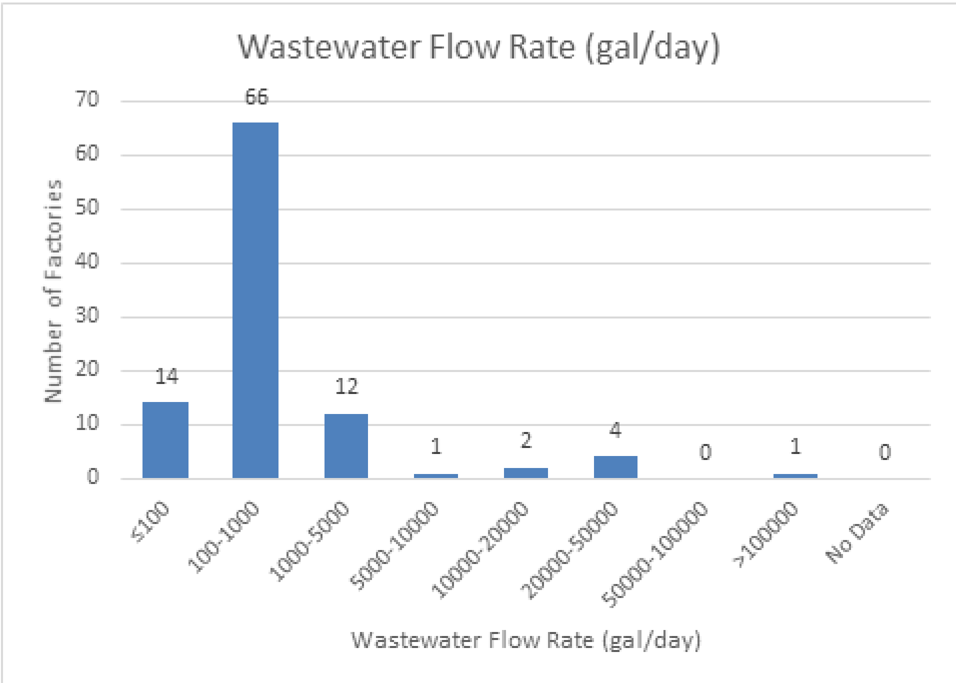
The questionnaire survey in Mandalay revealed that all 100 target factories (100%) use groundwater as their sources of water for operation.



Source: JET

Figure 2.2-9 Sources of Water

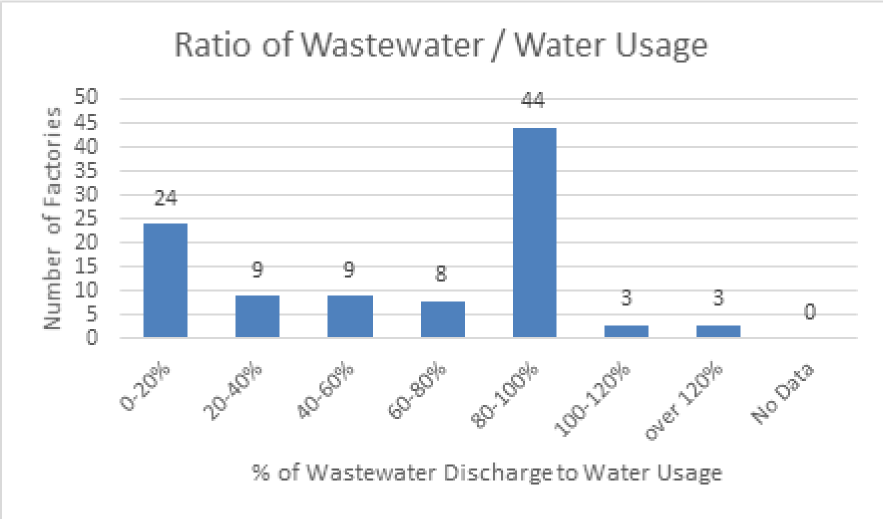
The next figure shows the amount of wastewater discharge per day per factory. On average a factory discharges 3,090 gal/day (14 m3/day) of wastewater. Eighty (80) % of factories discharge only equal or less than 1,000 gal/day (4.5 m3/day).



Source: JET

Figure 2.2-10 Wastewater Discharge Rate of Each Factory

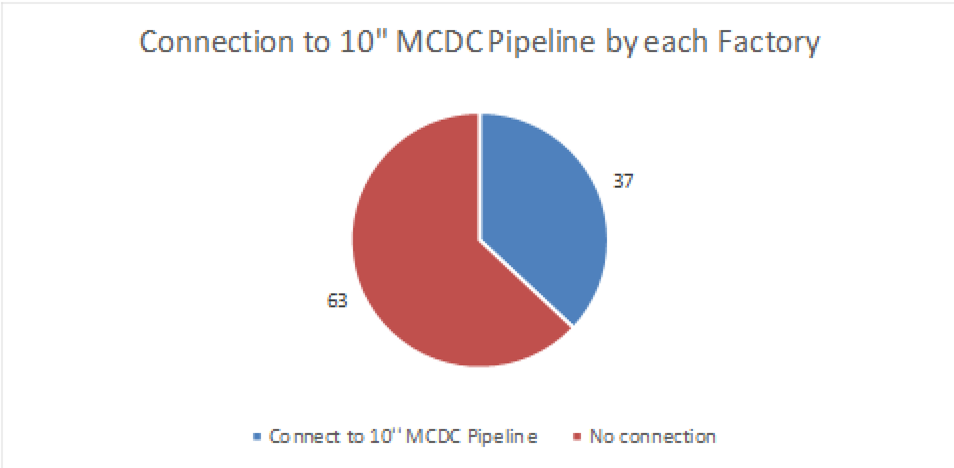
The following graph shows the ratio of reported wastewater to reported water usage of each factory. Wastewater flow rate is 80-120% of water usage, i.e., the amount of wastewater is about the same as the amount of water usage, at 47% of the factories. Some of the factories use water as main raw material (e.g., purified water, soft drink), and this explains low wastewater/water usage ratio of some factories. As discussed later, however, only two (2) out of 100 factories are equipped with flow meters to measure water usage and two (2) factories have flow meters to measure wastewater volume. Thus, it seems many factories do not have accurate data of water usage and wastewater discharge rate.



Source: JET

Figure 2.2-11 Ratio of Wastewater/ Water Usage of Each Factory

In Mandalay, MCDC has installed a 10"-diameter pipeline to collect wastewater from major factories. The result of the questionnaire survey showed that thirty-seven (37) of the 100 factories surveyed are connected to the pipeline. The total volume of reported wastewater discharged to the pipeline is 1,142 m3/day while the volume discharged to channels/drainages is 245 m3/day. Though not all factories in the area were investigated, most of large dischargers were included in the survey, and the result indicated that many of large dischargers have already been connected to the pipeline.



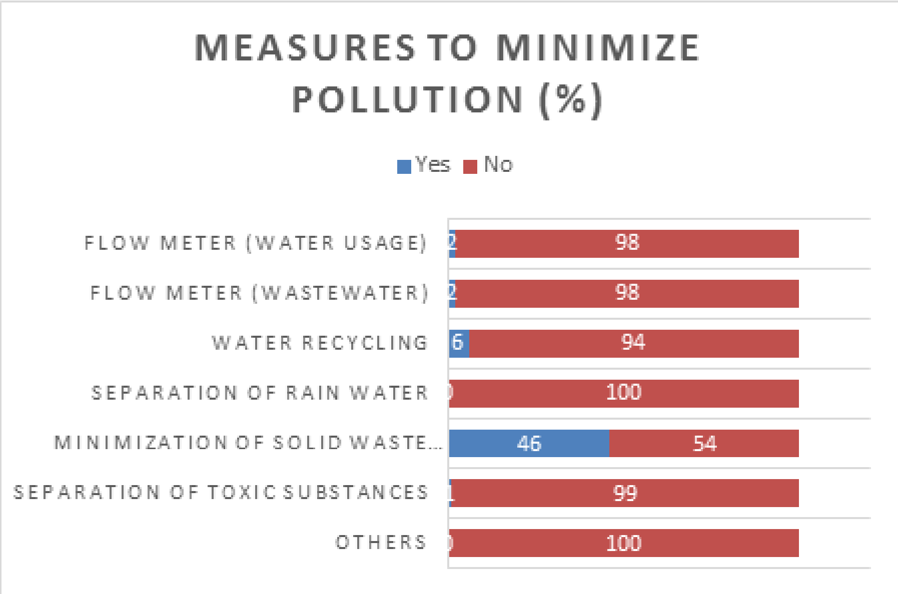
Source: JET

Figure 2.2-12 Connection to 10" MCDC Pipeline

(3) Wastewater Management

This section discusses various measures of target factories to minimize and treat wastewater. The following figure summarizes the situations of environmental measures to minimize water pollution before treatment.

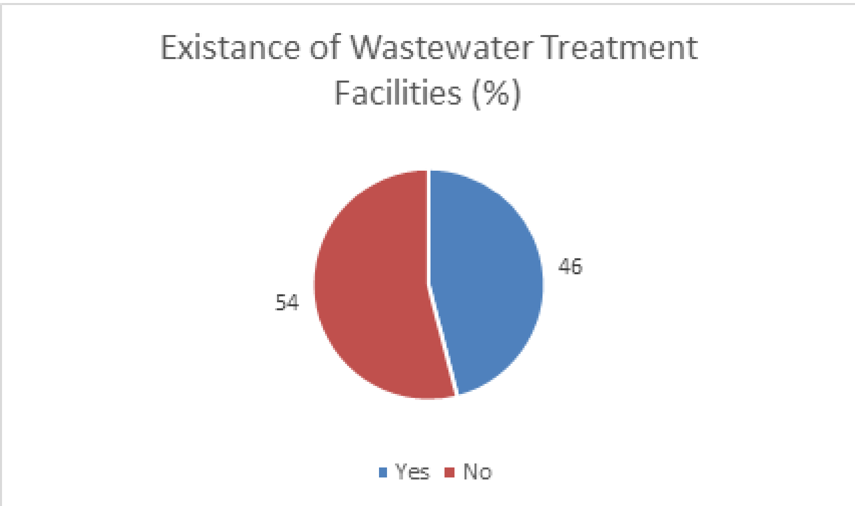
As mentioned above, only 2% of target factories are equipped with flow meters to measure water usage and wastewater discharge. Most factories have only limited mean to monitor and optimize use of water resources. It was noted that in Yangon, 10% of the factories are equipped with flow meters to measure water usage and 4% have flow meter to measure wastewater discharge. Forty-six (46)% of factories in Mandalay have their own measures to separate solid waste from entering wastewater stream; the same data for Yangon is 44%, and is about the same. With respect to water recycling, 6% and 13% of the factories perform water recycling in Mandalay and Yangon.



Source: JET

Figure 2.2-13 Measures to Minimize Pollution

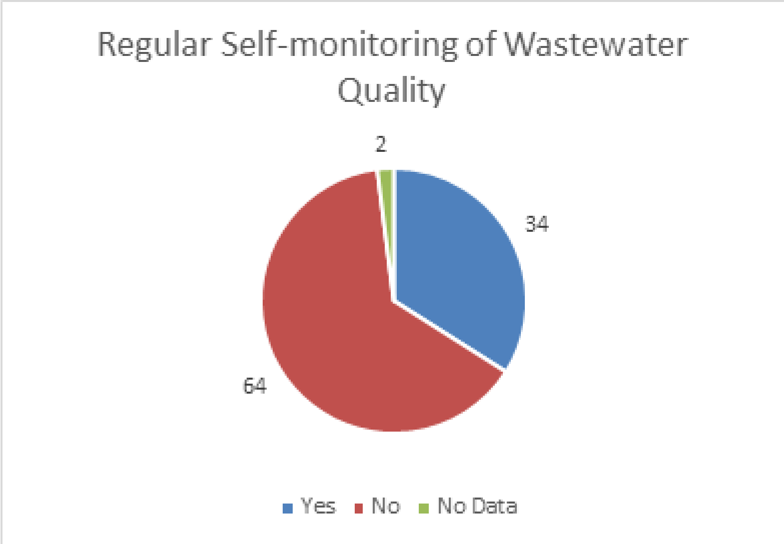
Only 46% of the factories have wastewater treatment facilities. The same statistics in Yangon was 53%, and not much different. It was noted that, 16 of 17 tanneries investigated this time use a joint wastewater treatment facility. Also, 37 factories are connected to MCDC's 10" pipe, as explained above. While wastewater discharged to this pipeline has not been treated, once the centralized wastewater treatment facility, which is under construction, becomes operational, wastewater collected by the pipeline will be treated.



Source: JET

Figure 2.2-14 Existence of Wastewater Treatment Facilities

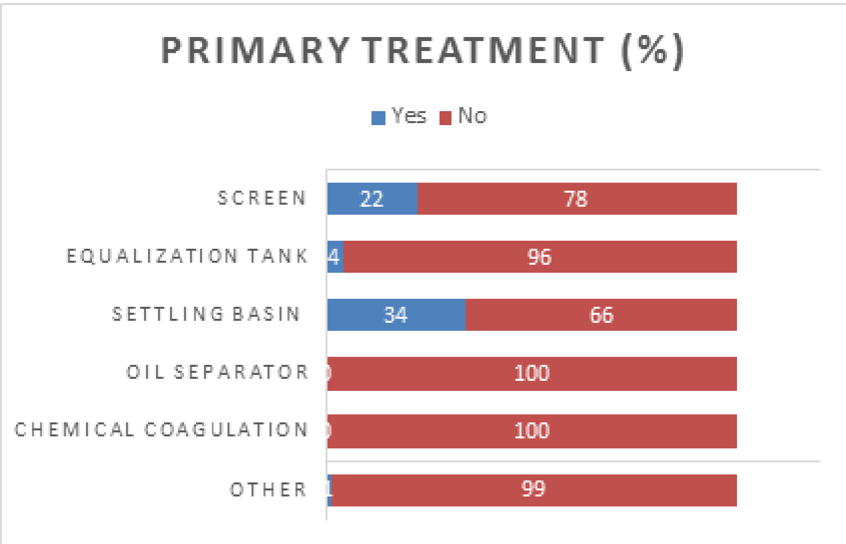
The following figure shows that only 34% of target factories regularly monitor wastewater qualities, but 22 factories out of those 34 have monitoring frequency of once per year. In Yangon, 62% of factories reported that they regularly monitor wastewater quality. This may be partially because YCDC has been requesting factories to report wastewater monitoring data. However, as discussed in the section for Yangon, there are large discrepancies between the self-monitoring data and the results of the wastewater survey.



Source: JET

Figure 2.2-15 Regular Self-Monitoring of Wastewater Quality by Factory

Next the situation of wastewater treatment was examined. The results of questionnaire survey showed that some factories are making effort to remove solid waste and large particles from wastewater stream with screens and settling basins (22% and 34% respectively). These measures are an important first step to minimize pollution. In Yangon, percentages of factories equipped with screen and settling basin are 36% and 50% respectively.

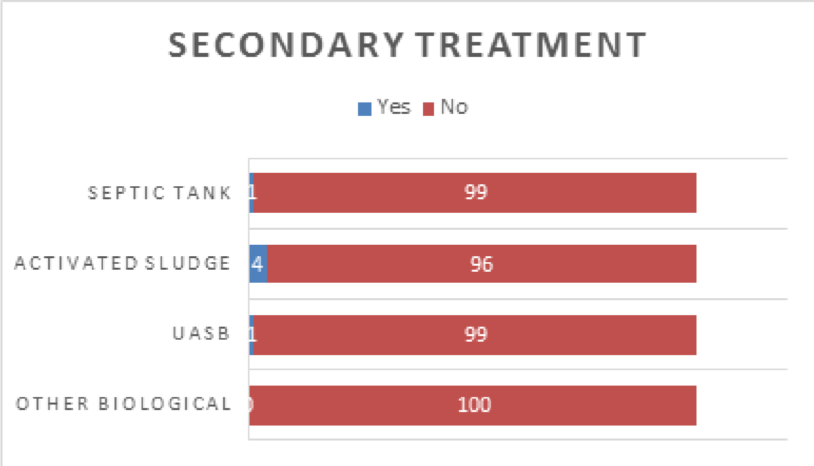


Source: JET

Figure 2.2-16 Primary Treatment

To remove organic matter, as represented by BOD and COD, secondary treatment is needed. According to the results, four factories (4) have activated sludge systems and one (1) factory has a

UASB. The situation is similar in Yangon, where two (2) factories have activated sludge systems and one (1) factory has a UASB.



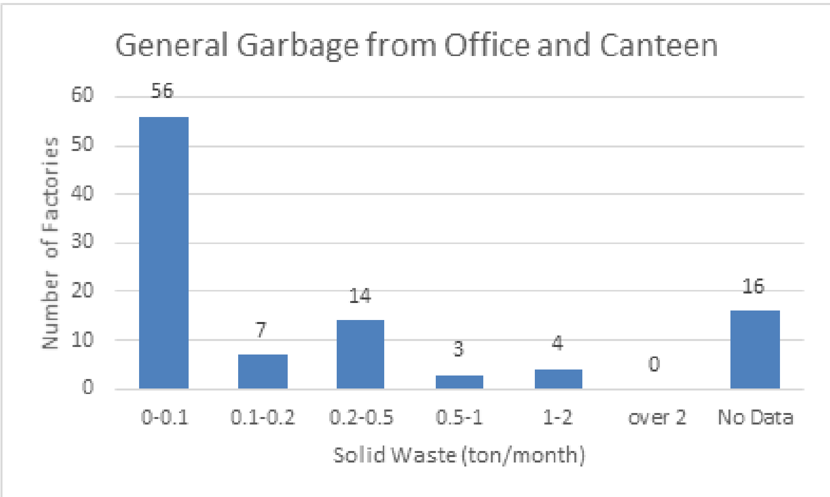
Source: JET

Figure 2.2-17 Secondary Treatment

These data showed that, as is the case in Yangon, most factories in Mandalay are not equipped with adequate wastewater treatment facilities. With this level of facilities, many factories are unable to meet the requirements of NEQEG (2015) unless the concentrations of pollutants in raw wastewater are already low. This issue is examined later in the section of wastewater sampling and analysis. It was noted that in 2017 some large distilleries installed sophisticated wastewater treatment facilities.

(4) Solid Waste Management

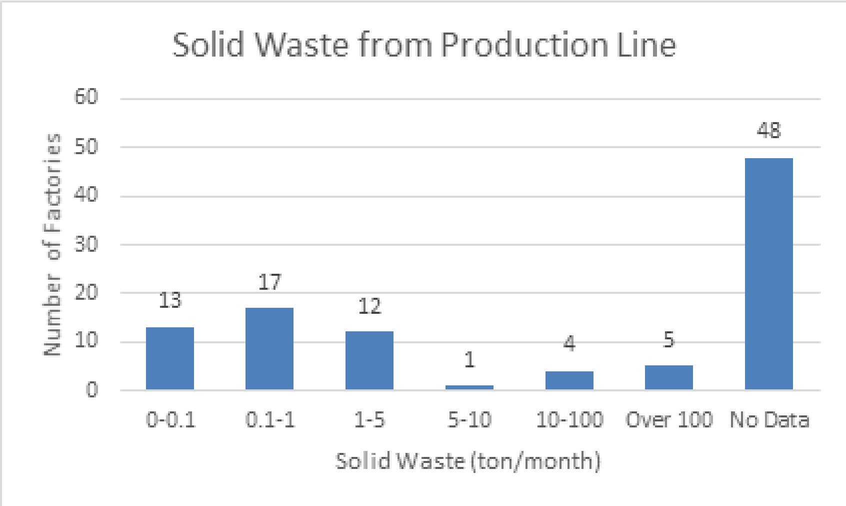
With respect to general garage from office and canteen, nearly 80% of target factories have generation rate of less than 0.5 ton per month. Fifty-six (56) % of the factories answered that less than 0.1 tons of solid wastes are generated each month. According to the result, garbage from a large number of factories is picked up by MCDC for landfilling, but there are still some factories who burn or dump wastes in their own yards.



Source: JET

Figure 2.2-18 Generation of General Garbage

With respect to solid waste from production line, 48% (nearly half) of the target factories did not provide their generation rate of solid wastes from production. Among the data collected, 42 factories out of 52 generate less than 5 ton/month of solid waste and 5 out of 52 factories generate over 100 tons/month. Twenty (20) factories out of 52 generate paper and plastic wastes.



Source: JET

Figure 2.2-19 Generation of Industrial Waste from Production Line

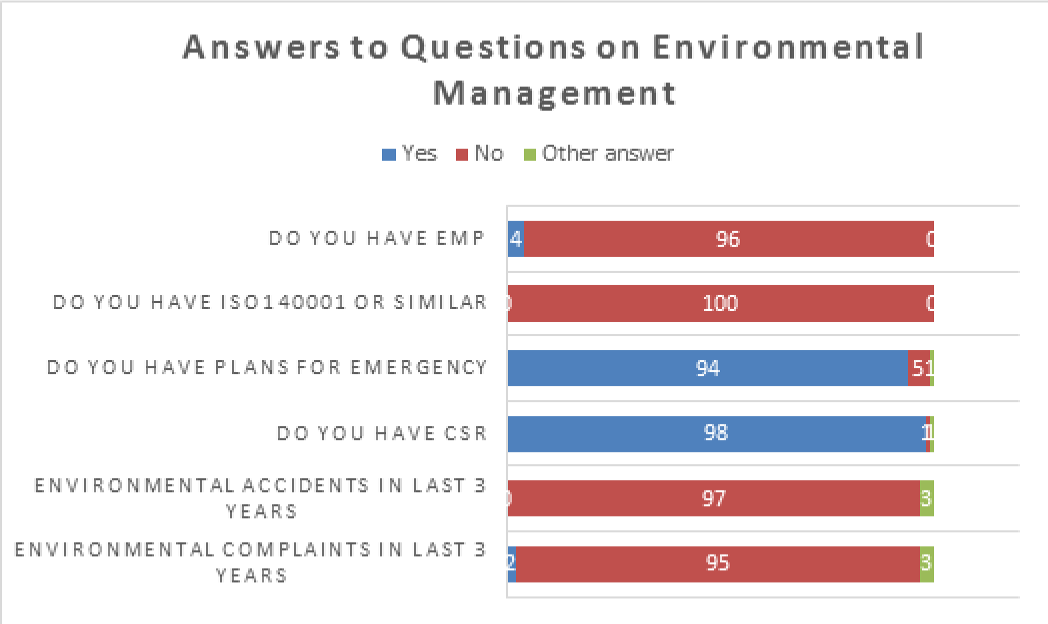
With respect to hazardous wastes, 3 factories reported that they produce hazardous wastes. Two (2) factories generate sharp objects such as glass bottle scraps and 1 generates corrosive, such as acid. It is possible that more factories are releasing hazardous waste, such as biocides to control bacteria and fungi, and more detailed investigation is needed. It was noted that some of the factories discharge wastewaters containing heavy metals (see section on wastewater sampling and analysis below).

Source: JET

Figure 2.2-20 Generation of Hazardous Waste

(5) Environmental Management System and Enforcement

This section examines the situation of various environmental management measures adopted by the target factories. The situations of environmental management plan (EMP) under Law on Environmental Conservation (2012) and other environmental management issues are summarized in the following figure.

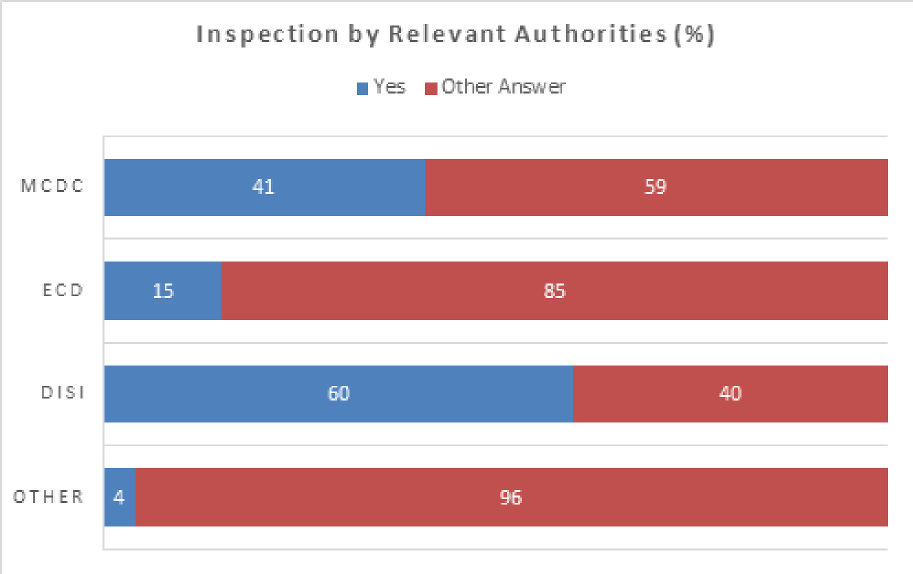


Source: JET

Figure 2.2-21 Factories' Answers to Questions Regarding Environmental Management System

According to the results, only 4% of factories reported they have EMPs, but the rest of 96% do not. In January 2017, MONREC instructed factories of 9 priority sectors to develop their own EMP and obtain Environmental Compliance Certificate (ECC) within 9 – 12 months. Many of the factories investigated this time have to develop EMPs in the future. All of the target factories (100%) reported that they do not have ISO 14001 or other similar certificates, though three (3) factories seem to have ISO9001. It was noted that over 90% of the factories have emergency plans and CSR Programs. As for CSR, donation and cooperation in local development, such as construction of roads and bridges, are the main form of the programs. Two factories reported they received environmental complaints in the last 3 years.

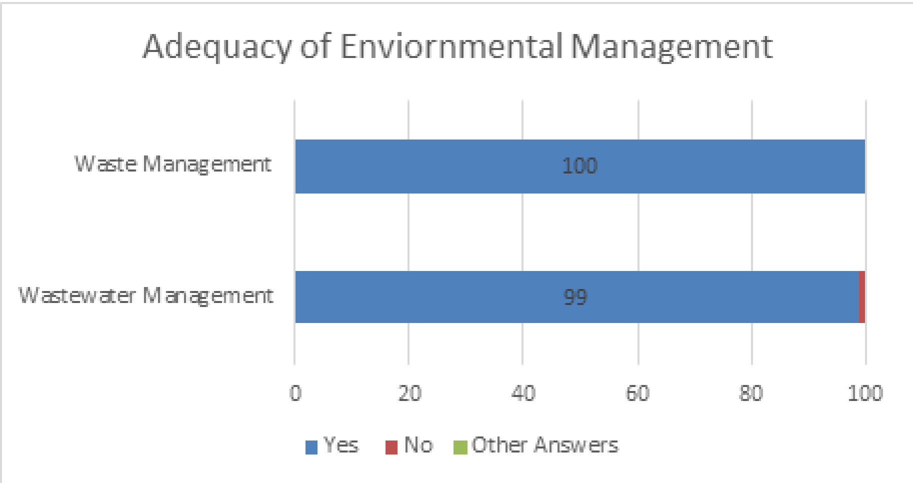
With respect to inspection by different authorities, MCDC visited 41% of factories in recent years, ECD 15%, DISI 60% and others 4%.



Source: JET

Figure 2.2-22 Recent Inspection by Relevant Authorities

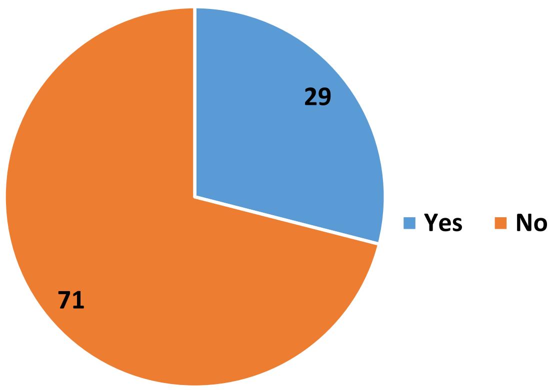
Regarding the answers for the self-assessment of environmental management, all target factories (100%) responded that their waste management is adequate and 99% for wastewater management. There may be some bias as the answer has potential to affect reputation of the factory.



Source: JET

Figure 2.2-23 Self-Assessment of Adequacy of Environmental Management

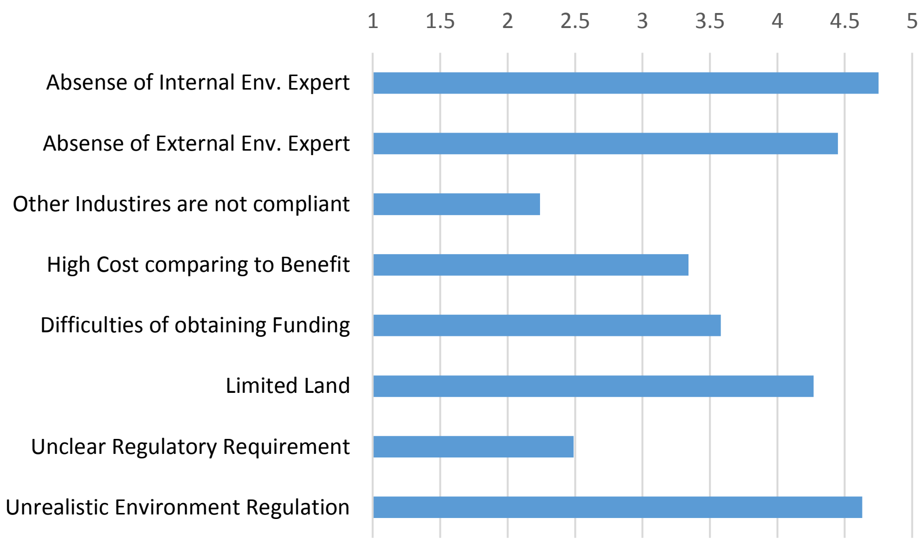
Regarding the awareness of NEQEG (2015), 71% of the factories were not aware of the guideline in 2016. The situation must be different now, but there is a need to raise environmental awareness of factory managers.



Source: JET

Figure 2.2-24 Awareness of National Environment Quality (Emission) Guideline

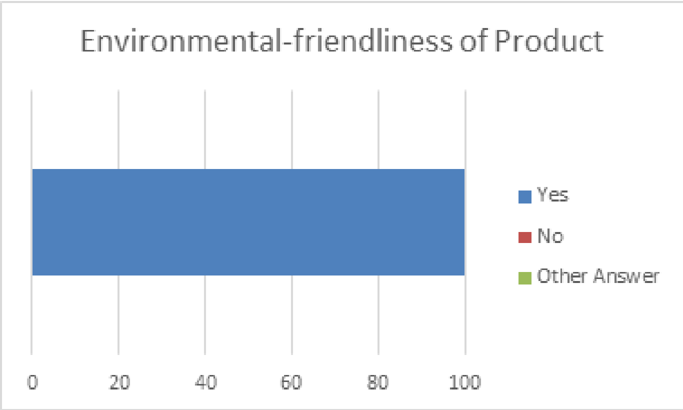
The results for the question which asked the difficulties for installation of WWTP are shown below. The score of “absence of internal environmental expert”, “absence of external environmental expert”, “limited land” and “unrealistic environment regulation” are higher than others. This is intriguing because in Yangon, none of the choices stood out as the main reasons of difficulties.



Source: JET

Figure 2.2-25 Difficulties in Installing WWTP

With respect to final question of whether the respondent thinks his/her product is more environmentally-friendly compared to similar products of competitors, all 100 target factories (100%) responded that their products are more environmentally-friendly pointing out that their products have very low environmental impacts without harmful chemicals, and they also apply measures to reduce pollution.



Source: JET

Figure 2.2-26 Environmental-Friendliness of Product

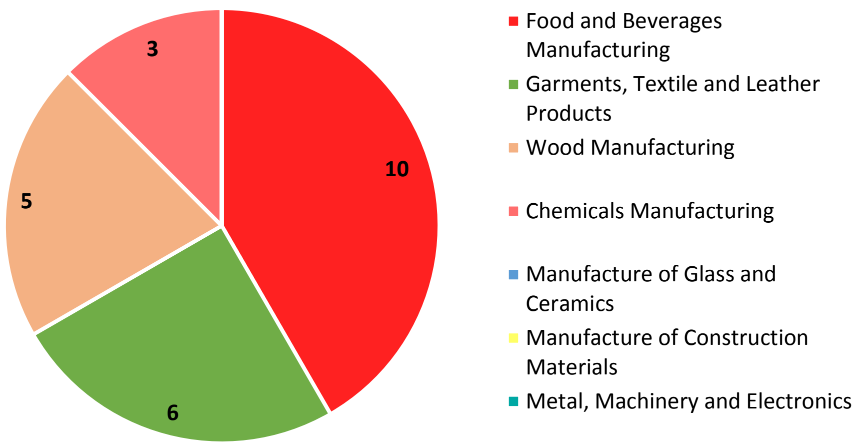
2.2.2. Wastewater Sampling and Analysis in Period 1 (2016) and Period 2 (2017)

(1) Target Factories

In 2016 (Period 1), wastewater samples were collected from 25 target factories at inlet and outlet of wastewater treatment system of each factory wherever possible. In total forty-one (41) samples from 25 target factories were collected and analyzed. The target factories were selected based on the following criteria.

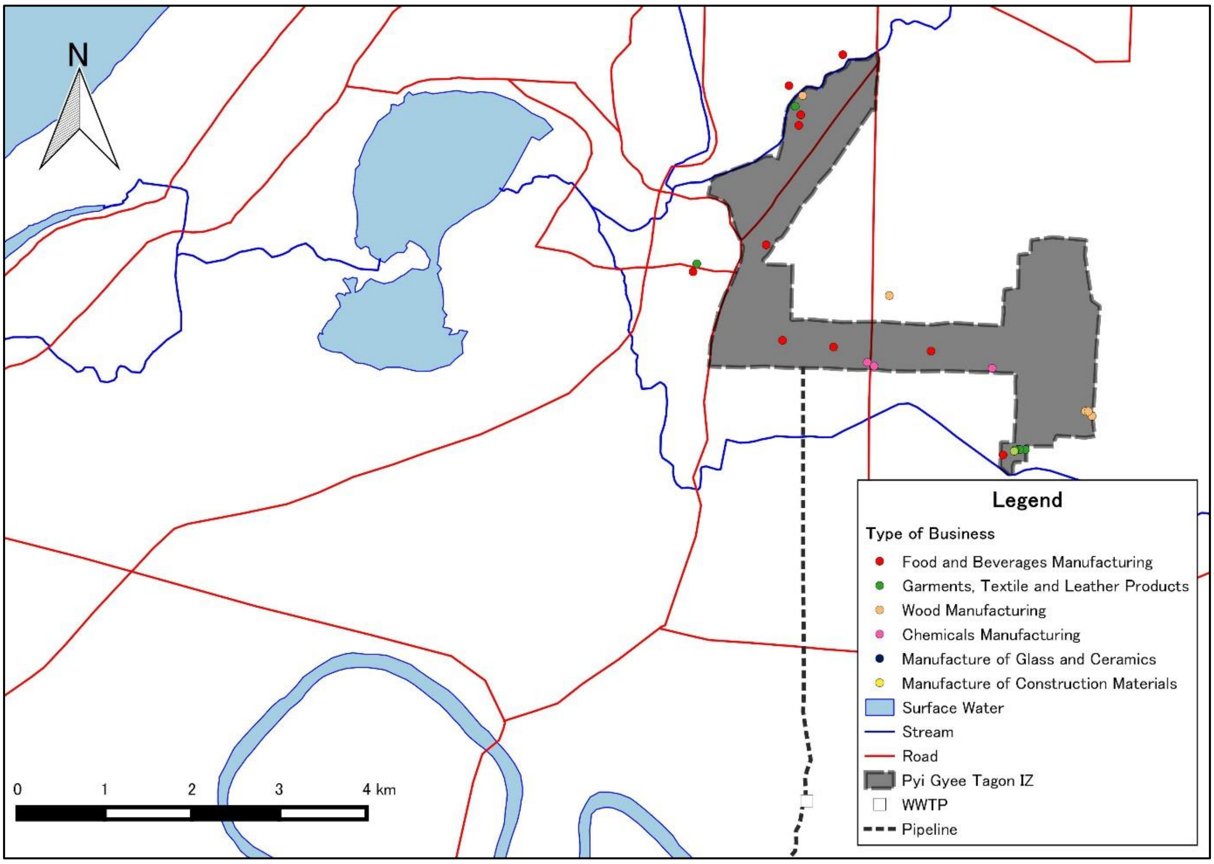
1) Target factories for Questionnaire Survey
2) Factories whose sectors are representative of the area to see the trend of the area
3) Factories whose wastewater may have significant environmental impact

The sectoral composition and the location map of the target factories are shown in Figure 2.2-27 and Figure 2.2-28.



Source: JET

Figure 2.2-27 Sector of Target Factories for Wastewater Sampling in Mandalay in 2016



Source: JET

Figure 2.2-28 Location Map of Target Factories of Wastewater Sampling in Mandalay in 2016

Some basic information about the target factories of wastewater sampling and analysis, including their classifications based on the NEQEG (2015), are summarized in Table 2.2-3. Analyzed results were compared with the guideline values of correspondent sectors in NEQEG (2015).

Table 2.2-2 Information about Target Factories of Wastewater Sampling and Analysis in Mandalay in 2016

No.	Industrial Zone	Sector	Sub-Sector	Products
M1-1	Pyi Gyee Tagon Industrial Zone (1)	Food and Beverage Manufacturing	Food and Beverage Processing	Soft Drink
M1-2	Pyi Gyee Tagon Industrial Zone (1)	Food and Beverage Manufacturing	Breweries and Distilleries	Distillery
M1-3	Ngwe Daw Gyi Gone Ward	Food and Beverage Manufacturing	Food and Beverage Processing	Sesame
M1-4	Pyi Gyee Tagon Industrial Zone (1)	Food and Beverage Manufacturing	Breweries and Distilleries	Distillery
M1-5	Pyi Gyee Tagon Industrial Zone (1)	Food and Beverage Manufacturing	Breweries and Distilleries	Distillery
M1-6	Pyi Gyee Tagon Industrial Zone (2)	Food and Beverage Manufacturing	Food and Beverage Processing	Sesame
M1-7	Htain Kone Ward	Food and Beverage Manufacturing	Food and Beverage Processing	Sweet
M1-8	Hta Hta	Food and Beverage Manufacturing	Food and Beverage Processing	Noddle
M1-9	Pyi Gyee Tagon Industrial Zone (1)	Food and Beverage Manufacturing	Food and Beverage Processing	Noddle
M1-10	Pyi Gyee Tagon Industrial Zone (2)	Food and Beverage Manufacturing	Breweries and Distilleries	Distillery
M1-11	Pyi Gyee Tagon	Garments, Textile and	Textiles Manufacturing	Textile

	Industrial Zone (1)	Leather Products		
M1-12	Pyi Gyee Tagon Industrial Zone (1)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Tannery
M1-13	Pyi Gyee Tagon Industrial Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Tannery
M1-14	Pyi Gyee Tagon Industrial Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Tannery
M1-15	Pyi Gyee Tagon Industrial Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Tannery
M1-16	Pyi Gyee Tagon Industrial Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Tannery
M1-17	Pyi Gyee Tagon Industrial Zone (2)	Wood Manufacturing	Tanning and Leather Finishing	-
M1-18	Pyi Gyee Tagon Industrial Zone (1)	Wood Manufacturing	Pulp and/or Paper Mills	Paper
M1-19	Pyi Gyee Tagon Industrial Zone (2)	Wood Manufacturing	Pulp and/or Paper Mills	Paper
M1-20	Pyi Gyee Tagon Industrial Zone (2)	Wood Manufacturing	Pulp and/or Paper Mills	Paper
M1-21	Pyi Gyee Tagon Industrial Zone (2)	Wood Manufacturing	Pulp and/or Paper Mills	Paper
M1-22	Pyi Gyee Tagon Industrial Zone (1)	Wood Manufacturing	Pulp and/or Paper Mills	Paper
M1-23	Pyi Gyee Tagon Industrial Zone (1)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Drug
M1-24	Pyi Gyee Tagon Industrial Zone (1)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Detergent
M1-25	Pyi Gyee Tagon Industrial Zone (1)	Metal, Machinery and Electronics	Semiconductors and Other Electronics Manufacturing	Battery (Dry cell)

Source: JET

Because some of the results in 2016, such as total nitrogen, were not reliable, it was decided to implement a follow-up survey in 2017. The survey in 2017 was implemented at the factories listed in Table 2.2-3. In total 25 factories were investigated. Efforts were made to take samples from the same factories investigated in 2016, and 16 factories are the same as the ones investigated in 2016. However, some of the factories investigated in 2016, such as some of distilleries, were not operating.

Table 2.2-3 Information about Target Factories of Wastewater Sampling and Analysis in Mandalay in 2017

No.	Industrial Zone	Sector	Sub-Sector	Products
M1-1	Zone (1)	Food and Beverages Manufacturing	Food and Beverage Processing	Soft Drink
M1-3	Zone (1)	Food and Beverages Manufacturing	Food and Beverage Processing	Sesame (white,brown,yellow)
M1-5	Zone (1)	Food and Beverages Manufacturing	Breweries and Distilleries	Distillery
M1-6	Zone (2)	Food and Beverages Manufacturing	Food and Beverage Processing	Sesame
M1-7	Zone (1)	Food and Beverages Manufacturing	Food and Beverage Processing	Sweets Peanut sweets Wafer
M1-8	Zone (1)	Food and Beverages Manufacturing	Meat Processing	Chicken

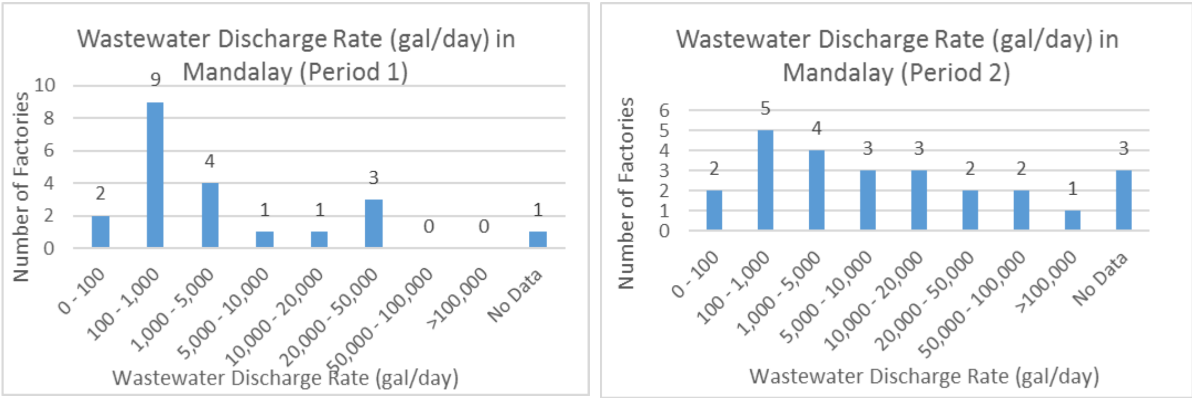
M1-9	Zone (1)	Food and Beverages Manufacturing	Food and Beverage Processing	Moakhinkhar(dry)
M1-11	Zone (1)	Garments, Textile and Leather Products	Textiles Manufacturing	Acrylic fibre
M1-12	Zone (1)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Sole Leather
M1-17		Garments, Textile and Leather Products	Tanning and Leather Finishing	-
M1-19	Zone (2)	Wood Manufacturing	Pulp and / or Paper Mills	Papers
M1-21	Zone (2)	Wood Manufacturing	Pulp and / or Paper Mills	Papers
M1-22	Zone (1)	Wood Manufacturing	Pulp and / or Paper Mills	Paper Carton box
M1-23	Zone (1)	Chemicals Manufacturing	Pharmaceuticals and Biotechnology Manufacturing	Medicine production
M1-24	Zone (1)	Chemicals Manufacturing	Oleochemicals Manufacturing	Soap
M1-25	Zone (1)	Chemicals Manufacturing	Semiconductors and Other Electronics Manufacturing	Battery
M1-49	Zone (2)	Wood Manufacturing	Pulp and / or Paper Mills	Papers
M1-60	Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Sole Leather
M1-64	Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Sole leather
M1-65	Zone (2)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Sole leather
M1-66	Zone (1)	Food and Beverages Manufacturing	Breweries and Distilleries	Kanyoetan(Rum), Wines, Shwe (purified alcohol)
M1-70	Zone (2)	Food and Beverages Manufacturing	Fish Processing	Fish Sauce
M1-83	Zone (1)	Garments, Textile and Leather Products	Tanning and Leather Finishing	Sole Leather
M1-102	Zone (2)	Food and Beverages Manufacturing	Food and Beverage Processing	Biscuit
M1-103	Zone (2)	Food and Beverages Manufacturing	Food and Beverage Processing	-

Source: JET

(2) Wastewater Discharge Rate

Wastewater discharge rate was measured or estimated during the sampling. The results in 2016 and 2017 are summarized in the following figure. Flow rates of 16 (67%) out of 24 factories for which on-site estimate was made were smaller than 45 m3/day (10,000 gal/day). In 2017, 14 (63%) out of 22 factories were discharging wastewater at rate smaller than 10,000 gal/day.

Measuring wastewater discharge rate is not trivial. In many factories, the flow rate is very small. In others, the flow rate is high, but intermittent. Evidently, one cannot estimate an average flow from one or two-time on-site measurement. It is also important to point out that some factories operate even at night, while others operate only day-hours, and some of them are seasonal (e.g., sugar manufacturing). Because of these difficulties, it is the best if wastewater flow rate could be estimated from the water usage, but most of factories are not equipped even with a flow meter to measure water usage, and not monitoring water usage. This is a serious issue in controlling industrial wastewater.

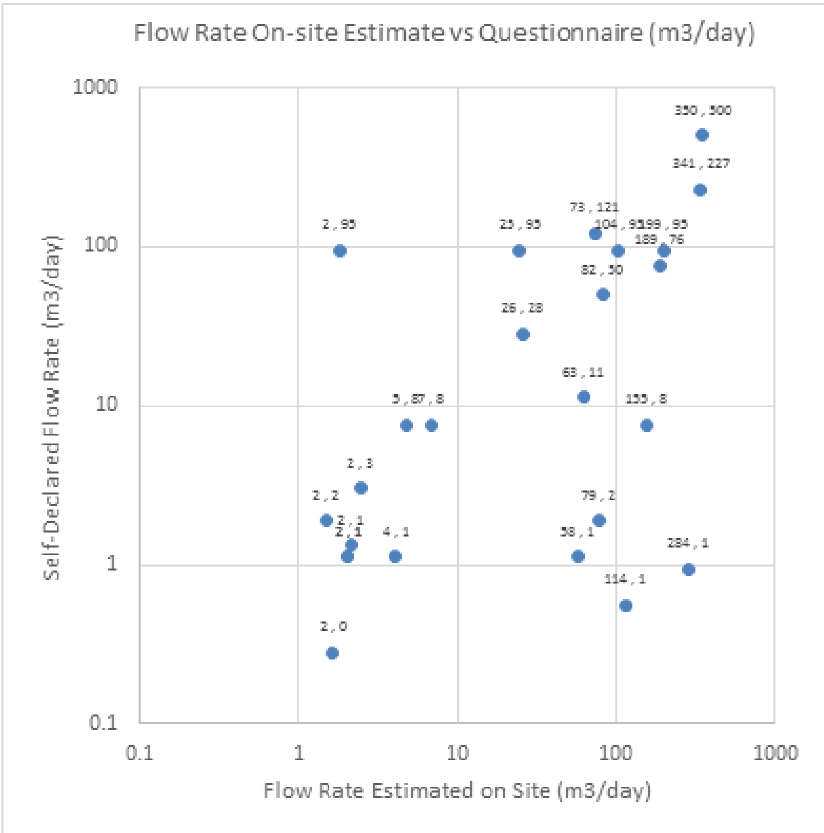


Source: JET

Figure 2.2-29 Wastewater Flow Rate Estimated on Site (2016)

Figure 2.2-29 compares the discharge data from the on-site measurement/estimate and the self-declared discharge rates from the questionnaire survey. Overall, the self-declared discharge rate tends to be smaller than the on-site estimate.

Flow rate becomes important if environmental priority is set based on pollution load or fee for centralized wastewater treatment is charged based on pollution load. All factories with sizable discharge rate should be equipped with flow meters to monitor discharge rate.

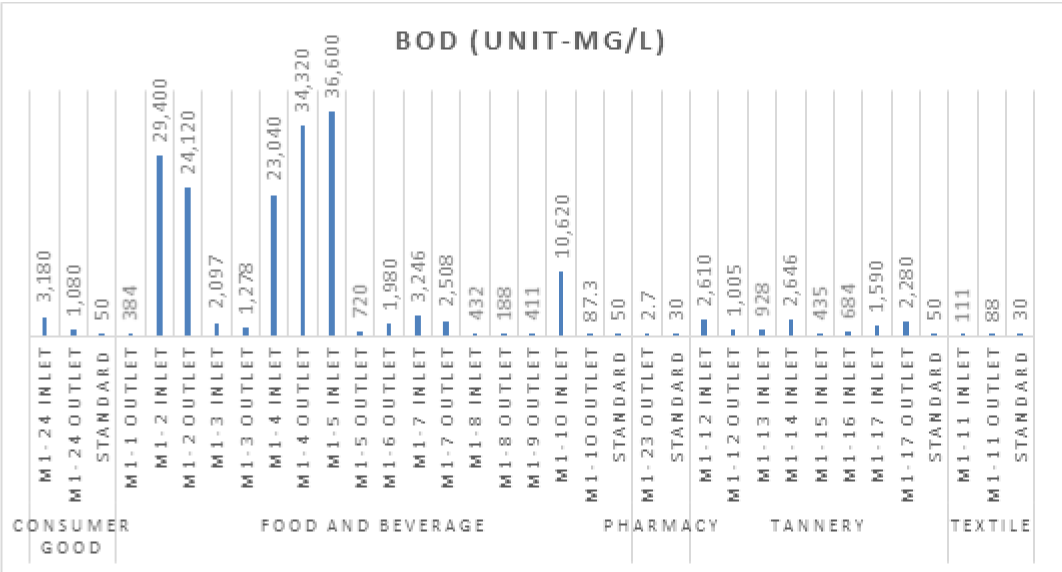


Source: JET

Figure 2.2-30 Comparison of Self-Declared Flow Rate and Flow Rate Estimated on Site (2016)

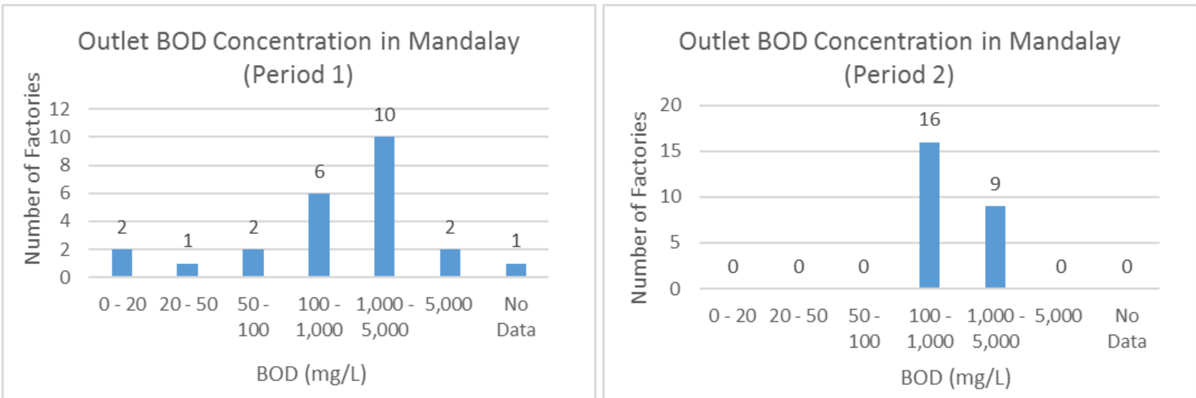
(3) BOD

Figure 2.2-31 summarizes the both inlet and outlet BOD concentrations of factories investigated in 2016. Some of the factories were discharging extremely concentrated wastewaters. Figure 2.2-31 summarizes the distributions of outlet BOD concentrations in 2016 and 2017. In 2016, BOD concentrations of only 3 factories were equal or lower than 50mg/L, and half of the 24 factories for which outlet data are available were discharging wastewater with more than 1,000 mg/L BOD. It was noted all the tanneries (M1-13 to M1-16), except M1-12, share a wastewater treatment facility with other tanneries in the area, and the outlet concentration of this joint facility, 2,280 mg/L, is treated as the outlet concentration of these tanneries. In 2017, the outlet concentrations of BOD were more than 100 mg/L at all factories. Meanwhile, there were no factories with over 5,000 mg/L BOD, as many of distilleries were not operating in the summer of 2017.



Source: JET

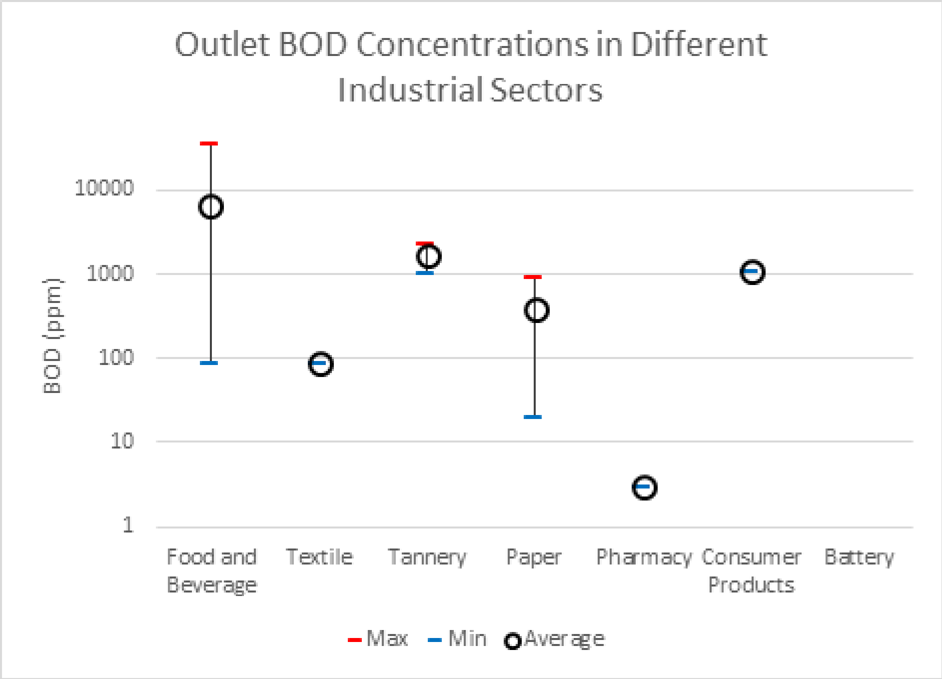
Figure 2.2-31 BOD Concentrations of Target Factories in 2016



Source: JET

Figure 2.2-32 Distribution of Outlet BOD Concentrations in 2016

In Figure 2.2-32, maximum, arithmetic average and minimum outlet concentrations are analyzed by sector. Some of the food and beverage factories (including distilleries) and tanning factories are among industrial sectors that discharge high BOD effluents.

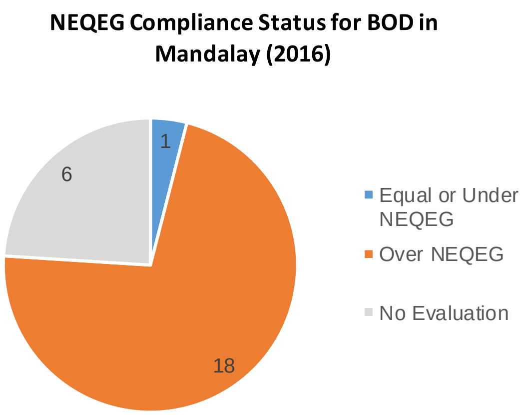


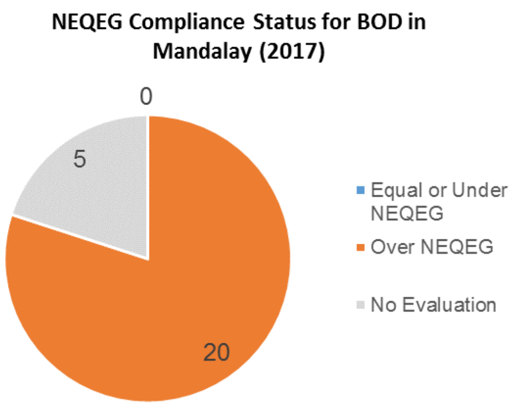
Source: JET

Figure 2.2-33 Comparison of Outlet BOD Concentration and Guideline Value in 2016

Source: JET

The following figure examines if the outlet concentrations of existing factories are satisfying the NEQEG (2015) requirements, which is 50 mg/L for all sectors except textile (30 mg/L) and pharmaceutical (30 mg/L). For paper industries, the guideline value is defined based on air-dried ton of product, and in this survey the results were not compared against the guideline value (1 kg/ADt). The results in 2016 showed that, among 20 factories for which both outlet BOD concentration and guideline values are available, only 1 factory (5%) is meeting the guideline value and the rest of the 19 factories (95%) are not meeting the guideline values. In 2017, none of the 20 factories were meeting the NEQEG (2015) requirement.

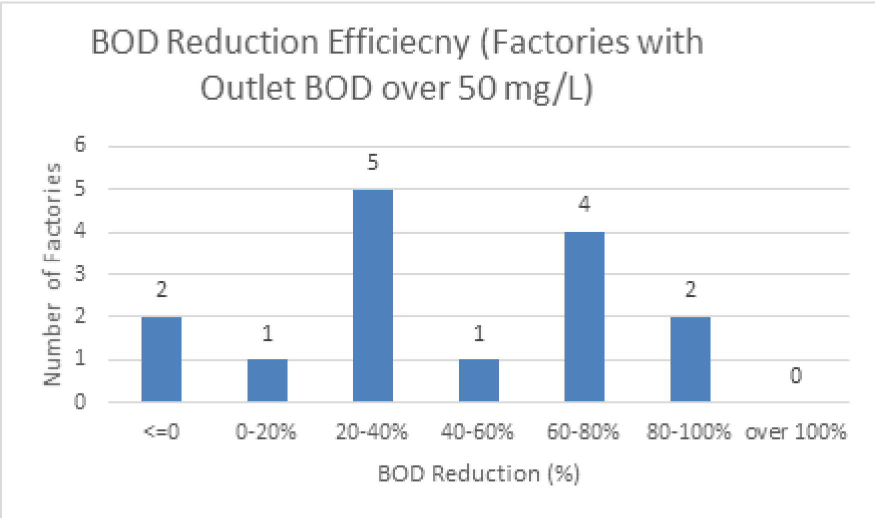




Source: JET

Figure 2.2-34 Comparison of Effluent BOD Concentrations and NEQEG (2015) in 2016 and 2017

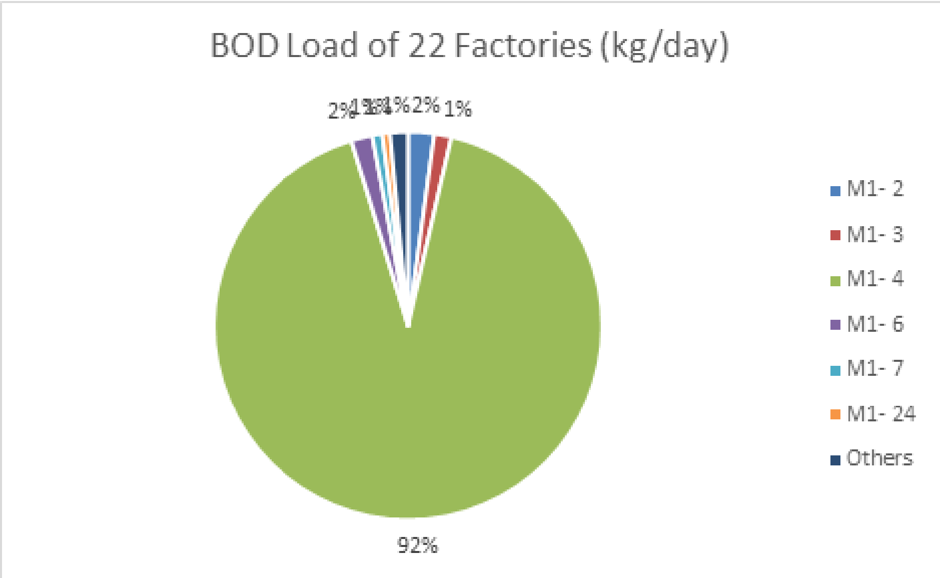
In 2016, both inlet and outlet BOD concentrations were measured at some factories, thus the efficiency of wastewater treatment facilities was examined. For this, inlet and outlet BOD concentrations of in total 15 factories whose inlet BOD concentration exceeded 50 mg/L were compared. While 2 factories (13%) were achieving more than 80% efficiency in BOD reduction, efficiency of the rest of 13 factories (87%) were below 80%. Individual tanneries that shares the joint wastewater treatment facility were excluded from the analysis, though the efficiency of the joint wastewater treatment facility was -43%, i.e., the BOD concentration of effluent was higher than that of the inlet. The reason was not clear at this point. In 2017, only the effluent samples were collected.



Source: JET

Figure 2.2-35 Efficiency of BOD Reduction by Wastewater Treatment Facilities in 2016

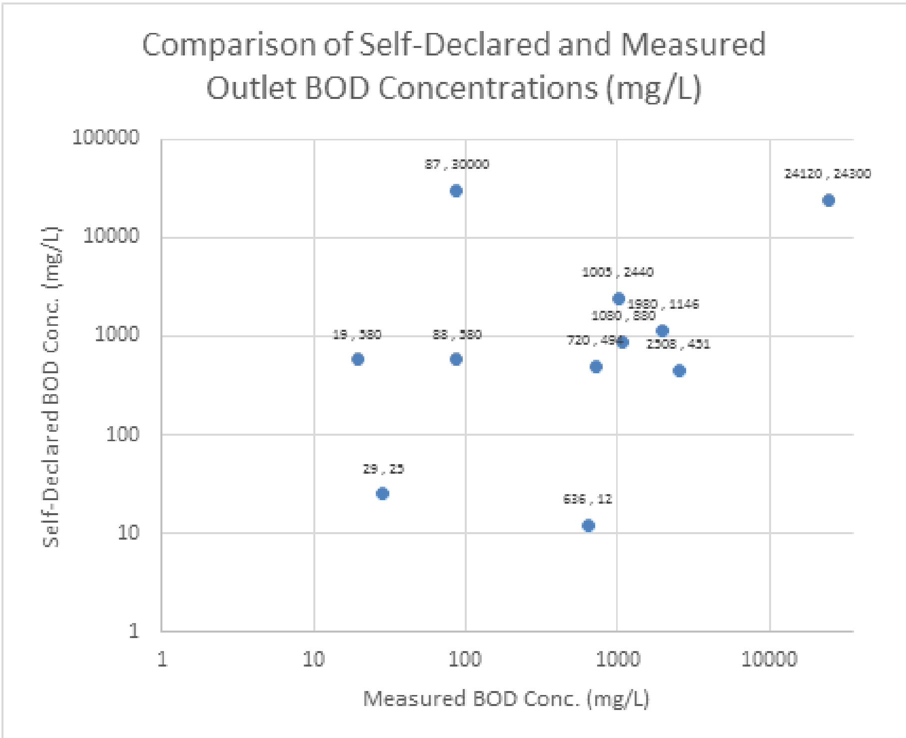
In 2016, pollution load of each factory was computed using the outlet BOD concentration and the self-declared wastewater discharge rate. The total pollution load was 8,500 kg-BOD/day for the 22 factories, for which both outlet BOD concentration data and wastewater flow rate data were available. This is roughly equivalent to pollution load of 200,000 people assuming BOD load per person is about 45 g/day/person. It was found that only one factory (M1-4) with the highest pollution load (7,790 kg-BOD/day), which is a distillery, is responsible for 92% of the total pollution load. Also, among the 25 factories investigated, 19 factories were connected to the 10” MCDC pipe, and 8,450 kg/day, or 99% of the BOD load discharged from the 25 factories investigated was diverted to the pipeline. M1-4 was not investigated in 2017 as it was not operating, but in 2017, it installed a sophisticated wastewater treatment facility. Thus, most likely a significant reduction of pollution load has been achieved in Mandalay in 2017.



Source: JET

Figure 2.2-36 Outlet BOD Load of Target Factories in 2016

Figure 2.2-36 compares the self-monitored outlet BOD concentrations from the questionnaire survey in 2016 against the measured outlet BOD concentrations from the wastewater sampling and analysis in 2016. Because the concentration ranges are wide, both axes are shown in logarithmic scale. As the data for each factory suggest, discrepancy between these values is often very wide, though both the self-monitored and the measured BOD concentrations appear to entail significant variabilities.

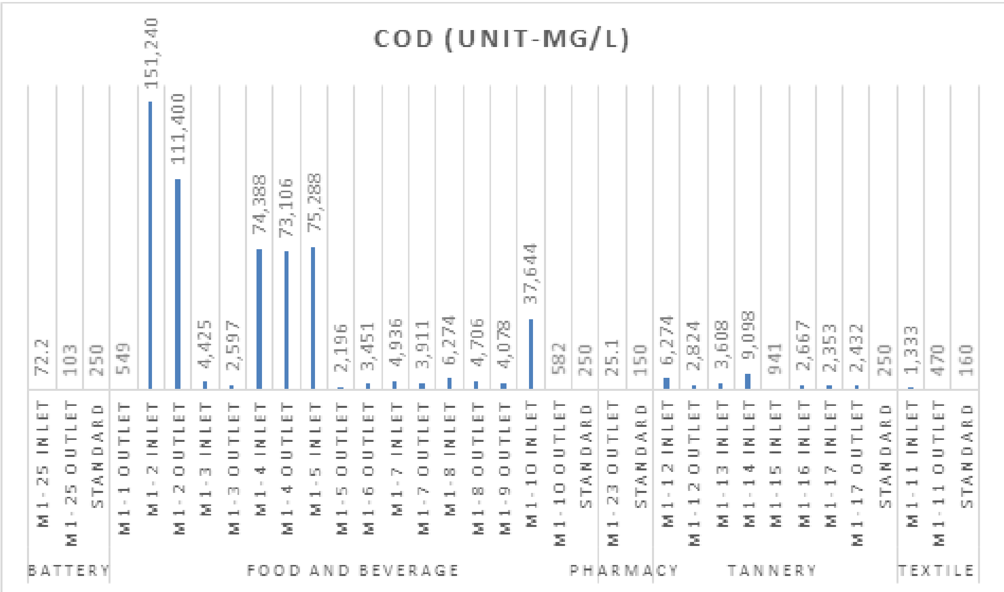


Source: JET

Figure 2.2-37 Comparison of Measured Outlet BOD Concentration and Self-Monitored BOD Concentration

(4) COD

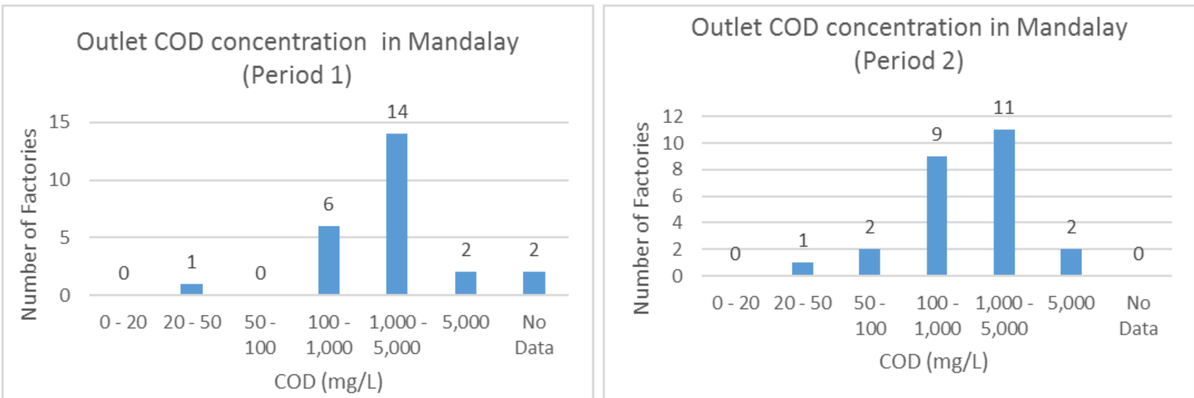
Figure 2.2-38 shows the results of COD concentrations of inlet and outlet of each factory in 2016. Similar to BOD, some factories were discharging extremely polluted wastewaters, while effluent COD contents of some sectors, such as battery and pharmacy, were relatively low.



Source: JET

Figure 2.2-38 COD Concentrations of Target Factories

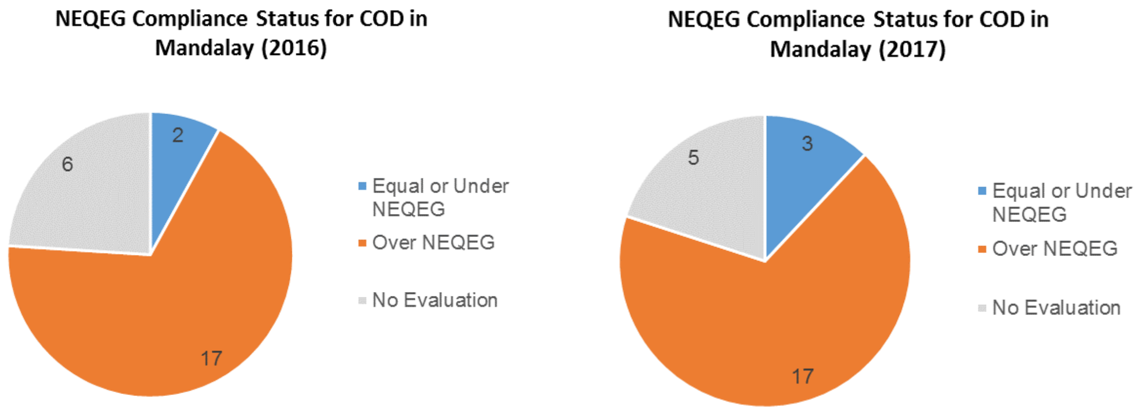
Figure 2.2-39 shows the distributions of outlet COD concentrations in 2016 and 2017. Many factories are discharging high COD effluents.



Source: JET

Figure 2.2-39 Outlet COD Concentrations of Target Factories in 2016 and 2017

Figure 2.2-40 compares the effluent COD concentrations with NEQEG (2015). In 2016, 89% (17 out of 19 for which data were available) of target factories exceeded the guideline values for COD, which ranges from 150 to 250 mg/L depending on sector, while 11% (2 out of 19) were below the guideline value. The trend was similar in 2017.



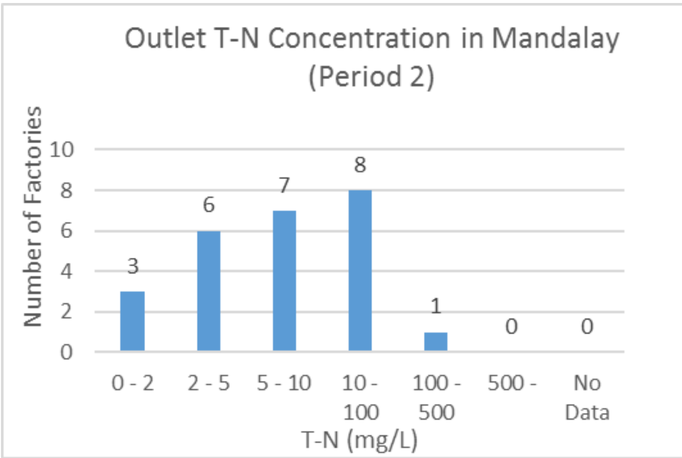
Source: JET

Figure 2.2-40 Comparison of Effluent COD Concentrations and NEQEG (2015) in 2016 and 2017

(5) Total Nitrogen

Figure 2.2-41 summarizes the outlet TN concentrations in Mandalay in 2017. The results in 2016 were suspiciously low considering the levels of BOD and COD, and not presented here. Out of 25 factories, 16 (64%) were discharging effluent with concentration of TN equal or lower than 10 mg-N/L

The TN data in 2016 were considered not reliable.

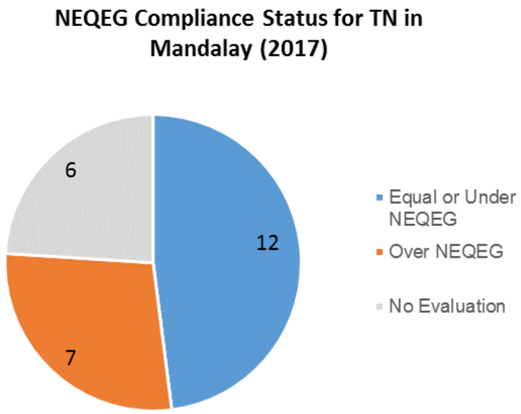


Source: JET

Figure 2.2-41 Outlet TN Concentrations of Target Factories in 2017

Figure 2.2-42 compares the effluent TN data and NEQEG (2015) based on 2017 data. According to the results, TN concentrations of 63% (12 out of 19) of factories were equal or below the NEQEG (2015) value, and remaining 37% were above the NEQEG (2015) value.

Effluent TN data in 2016 were not reliable

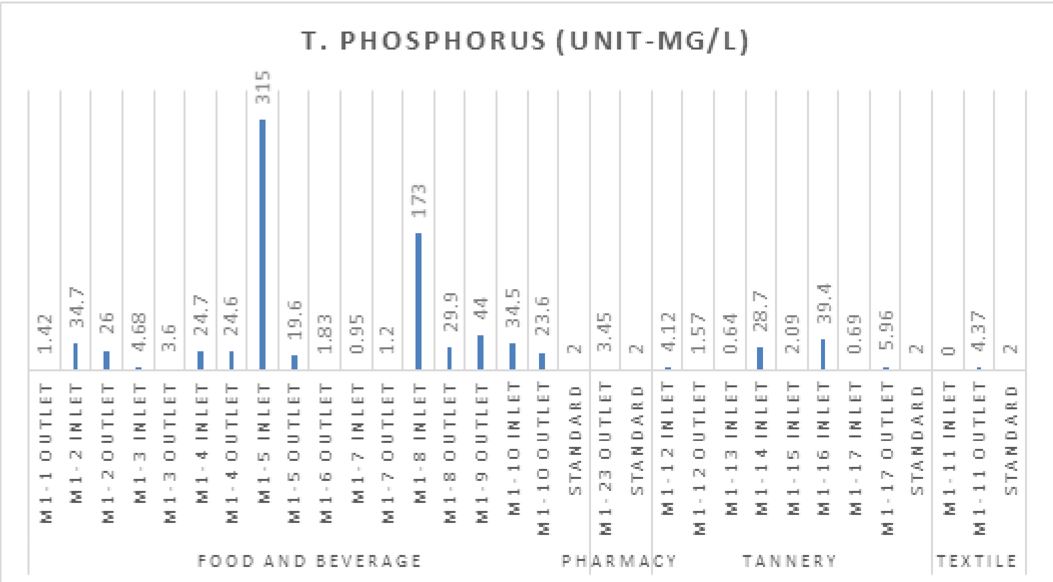


Source: JET

Figure 2.2-42 Comparison of Effluent TN Concentrations and NEQEG (2015) in 2017

(6) Total Phosphorus

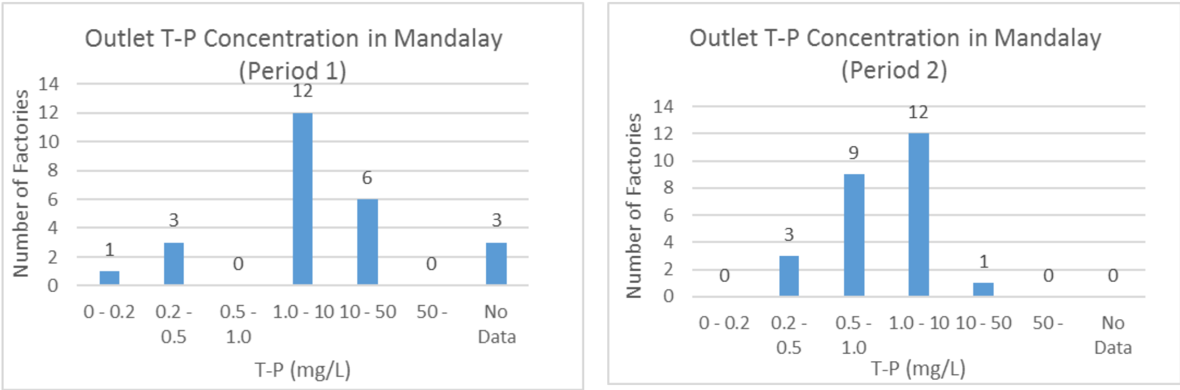
The results of T-P analysis in 2016 are shown in Figure 2.2-43.



Source: JET

Figure 2.2-43 Total Phosphorus Concentrations of Target Factories in 2016

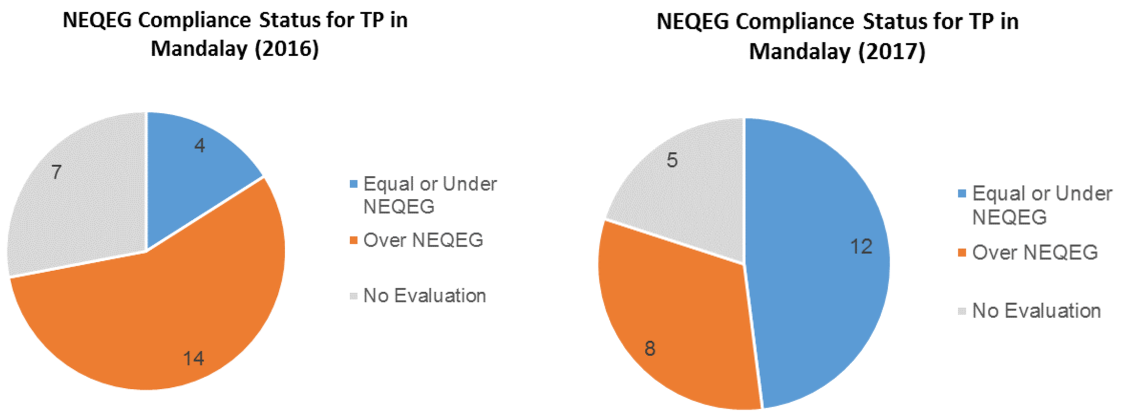
Figure 2.2-44 summarizes the effluent TP concentrations in Mandalay in 2016 and 2017. The concentration was generally high in food and beverage sector and tanneries, and low in paper and other sectors. T-N and T-P are important parameters to consider because to reduce the levels of these nutrients to a certain level, tertiary treatment may become necessary, and this will incur significant investment cost, though secondary treatment can achieve some reduction of these nutrients.



Source: JET

Figure 2.2-44 Outlet TP Concentrations of Target Factories in 2017

Figure 2.2-45 compares the effluent TP concentrations with the NEQEG (2015). The T-P limitation in NEQEG (2015) is 2 mg/L for many manufacturing sectors, but in some sectors, such as manufacturing of metal, plastics and rubber, it is set at 5 mg/L. In 2016, among the 18 factories for which data could be compared, 22% (4 out of 18) were meeting the guideline values, while 78% (14 out of 18) are not meeting the guideline values. In 2017, 60% (12 out of 20) of factories were meeting the NEQEG (2015) for TP, and 40% (8 out of 20) were not meeting the NEQEG (2015).



Source: JET

Figure 2.2-45 Comparisons of Effluent TP Concentrations and NEQEG (2015) in 2016 and 2017

(6) Other Parameters

In the table below, percentages of meeting the NEQEG (2015) are summarized for selected parameters. In 2017, over 70% of factories were not meeting the guideline values for BOD, COD, TSS, oil and grease.

Concentrations of heavy metals were generally low, but a high level of Zn (170 mg/L and 3 mg/L) was detected from a battery factory and a textile factory. Also, elevated levels of phenols (4.0, 8.4, 2.2, 1.04 mg/L), chromium (3.2 mg/L), and sulfate (258, 291, 296 mg/L) were detected from wastewaters of tanneries.

Overall the wastewater sampling and analysis revealed that many of the factories are not likely to meet the requirements of the NEQEG (2015) at the moment. This is an important finding considering the fact that many of these factories have to develop EMPs and obtain ECCs by the end of 2018.

Table 2.2-4 Summary Table of Distribution of Outlet Concentrations of Selected Parameters and Comparison of Outlet Concentrations with Guideline Values

Parameter	Unit	Comparison with Guideline (Period 1)		Comparison with Guideline (Period 2)	
pH	-	Number of Data	25	Number of Data	25
		Meeting Guideline	16	Meeting Guideline	17
		Exceeding Guideline	9	Exceeding Guideline	8
		% Exceeding	36%	% Exceeding	32%
BOD	mg/L	Number of Data	19	Number of Data	20
		Meeting Guideline	1	Meeting Guideline	0
		Exceeding Guideline	18	Exceeding Guideline	20
		% Exceeding	95%	% Exceeding	100%
COD	mg/L	Number of Data	19	Number of Data	20
		Meeting Guideline	2	Meeting Guideline	3
		Exceeding Guideline	17	Exceeding Guideline	17
		% Exceeding	89%	% Exceeding	85%
T-N	mg/L	Number of Data	-	Number of Data	19
		Meeting Guideline	-	Meeting Guideline	12
		Exceeding Guideline	-	Exceeding Guideline	7
		% Exceeding	-	% Exceeding	37%
T-P	mg/L	Number of Data	18	Number of Data	20
		Meeting Guideline	4	Meeting Guideline	12
		Exceeding Guideline	14	Exceeding Guideline	8
		% Exceeding	78%	% Exceeding	40%
Total Suspended Solid	mg/L	Number of Data	20	Number of Data	20
		Meeting Guideline	3	Meeting Guideline	5
		Exceeding Guideline	17	Exceeding Guideline	15
		% Exceeding	85%	% Exceeding	75%
Oil and Grease	mg/L	Number of Data	19	Number of Data	20
		Meeting Guideline	10	Meeting Guideline	2
		Exceeding Guideline	9	Exceeding Guideline	18
		% Exceeding	47%	% Exceeding	90%
Phenols	mg/L	Number of Data	8	Number of Data	7
		Meeting Guideline	2	Meeting Guideline	3
		Exceeding Guideline	6	Exceeding Guideline	4
		% Exceeding	75%	% Exceeding	57%
Arsenic	mg/L	Number of Data	1	Number of Data	2
		Meeting Guideline	1	Meeting Guideline	2
		Exceeding Guideline	0	Exceeding Guideline	0
		% Exceeding	0%	% Exceeding	0%
Chromium VI	mg/L	Number of Data	8	Number of Data	8
		Meeting Guideline	8	Meeting Guideline	8
		Exceeding Guideline	0	Exceeding Guideline	0
		% Exceeding	0%	% Exceeding	0%
Chromium Total	mg/L	Number of Data	7	Number of Data	7
		Meeting Guideline	7	Meeting Guideline	6
		Exceeding Guideline	0	Exceeding Guideline	1
		% Exceeding	0%	% Exceeding	14%
Copper	mg/L	Number of Data	1	Number of Data	2
		Meeting Guideline	1	Meeting Guideline	2
		Exceeding Guideline	0	Exceeding Guideline	0
		% Exceeding	0%	% Exceeding	0%
Lead	mg/L	Number of Data	1	Number of Data	1
		Meeting Guideline	1	Meeting Guideline	1
		Exceeding Guideline	0	Exceeding Guideline	0
		% Exceeding	0%	% Exceeding	0%
Mercury	mg/L	Number of Data	1	Number of Data	2
		Meeting Guideline	1	Meeting Guideline	1
		Exceeding Guideline	0	Exceeding Guideline	1
		% Exceeding	0%	% Exceeding	50%

Parameter	Unit	Comparison with Guideline (Period 1)		Comparison with Guideline (Period 2)	
Zinc	mg/L	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	1 1 0 0%	Number of Data Meeting Guideline Exceeding Guideline % Exceeding	2 0 2 100%

Source: JET

2.2.3. Summary

1) There are 1,228 factories in and around Pyi Gyee Tagon IZ in Mandalay. General mechanics sector, such as “mechanics and welding business” and “car workshop”, is the leading sector in the area, followed by food and beverages, and minerals (e.g., iron smelting). Overall, the factories in Pyi Gee Tagon IZ seem much smaller in scale than those in IZs in the Hlaing River basin in Yangon.
2) Among these factories, 100 factories were selected for a questionnaire survey in 2016.
3) According to the result of the questionnaire survey in 2016, the average water usage per factory was 12,600 gal/day (57 m3/day), but this was largely because some of the purified water and soft drink factories use more than 100,000 gal/day (450 m3/day) of water as raw material. Water usage of most factories was limited, and 85% of the factories was using less than 10,000 gal/day (45 m3/day). The average value of reported wastewater discharge was 3,090 gal/day (14 m3/day) per factory. Most factories were not equipped with water meters in 2016, and thus were not monitoring water usage. Thus, these data should be interpreted with care.
4) Only 46% of the factories reported in 2016 that they had wastewater treatment facilities. Most of them were primary treatment facilities, such as a screen or a settling tank, to remove solid waste and settleable particles. Only several % of factories have secondary treatment facilities, such as activated sludge or UASB, to treat organic matter and reduce BOD and COD in effluent. It was noted that most tanneries are using a joint wastewater treatment facility. Also, some of distilleries installed new wastewater treatment facilities in 2017.
5) Thirty-seven (37) % of the 100 factories investigated in 2016 were connected to the 10” diameter pipeline installed by MCDC. It seems the number of factories connected to the pipe is increasing, but no questionnaire survey was implemented in 2017, and the current situation has to be re-investigated.
6) Regarding difficulties in installing a wastewater treatment facility, lack of expertise, limited land, and unrealistic environmental regulations were among the main reasons in Mandalay.
7) One hundred (100) % and 99% of the factories believe their management is adequate for wastewater and solid waste, respectively.
8) Seventy-seven (77) % of the factories surveyed were not aware of the newly introduced NEQEG (2015) in 2016.
9) Among the target 100 factories of the questionnaire survey, 25 factories were selected for wastewater sampling and analysis in 2016 and 2017. In total forty-one (41) samples from 25 target factories were collected and analyzed in 2016. As some of the data in 2016 were not reliable, another wastewater sampling and analysis were implemented in 2017 as a follow up study.
10) In 2017, 100 % (BOD), 85% (COD), 37% (TN), 40% (TP), 75% (TSS) and 90% (oil and grease) of factories were not meeting the NEQEG (2015) requirements.
11) Only one factory out of 22 factories accounts for 92% of BOD load in 2016. The situation changed in 2017 as this factory installed a sophisticated wastewater treatment facility.

12) Concentrations of heavy metals and organic chemicals were generally low, but a high level of Zn (170 mg/L and 3 mg/L) was detected from a battery factory and a textile factory. Also, elevated levels of phenols (4.0, 8.4, 2.2, 1.04 mg/L), chromium (3.2 mg/L), and sulfate (258, 291, 296 mg/L) were detected from wastewaters of tanneries.

3. CONCLUSIONS AND RECOMMENDATIONS

A pollution source survey was implemented in industrial zones in the Hlaing River basin in Yangon and the Doke Hta Waddy River basin in Mandalay in order to develop a pollution source database for the Hlaing River basin and the Doke Hta Waddy River basin. The survey consisted of a questionnaire survey targeting 200 factories in 2016 and wastewater sampling and analysis at 50 factories in these basins in 2016 and 2017. While not all factories in these basins were investigated, the survey revealed overall picture of diverse environmental management issues of manufacturing industries in these areas. As improvement of water environment management is the main focus of this project, this section discusses the findings on the following issues:

- Current status of wastewater management at factories
- Comparison of effluent concentrations and requirements of NEQEG (2015)
- Sizes of factories, environmental impacts and capacity to improve environmental performance
- Awareness of factory managers about environmental requirements
- Issues in improving environmental performance

Then, at the end a set of recommendations are provided for environmental authorities, such as ECD, YCDC, MCDC and others.

3.1. Conclusions

(1) Current status of wastewater management at factories

- Overall only half of the factories, 53% in Yangon and 46% in Mandalay investigated in 2016, had wastewater treatment facilities. Most of such facilities were rudimentary primary treatment facilities to remove large particles and solid waste, such as screens and settling basins.
- Only several percent of factories (5% or less in both Yangon and Mandalay) in 2016 were equipped with modern secondary treatment facilities to remove biodegradable organic matter, such as activated sludge and UASB. Oil separator was available at 10 % of factories in Yangon and none in Mandalay. Essentially none of the factories were equipped with facilities specifically designed to remove nutrients (e.g., T-N and T-P). Similarly, most factories were not controlling other pollutants, such as coliform bacteria and toxic substances.
- Perhaps a more alarming fact was that in 2016 only 10% of the factories in Yangon and 2% of factories had flow meters to monitor water usage, and only 4% of factories in Yangon and 2% in Mandalay have flow meters to monitor wastewater flow rate. Majority of factories (92% in Yangon and 100% in Mandalay) were using groundwater (rather than supplied water) as the sources of water, and perhaps there was little incentive to optimize water usage and wastewater discharge.

(2) Comparison of effluent concentrations and requirements of NEQEG (2015)

- Because most of the factories were not equipped with adequate wastewater treatment facilities, it was not surprising that many of them were not meeting the effluent guideline values of NEQEG (2015), although NEQEG (2015) has not been legally mandated to most existing factories.
- In 2017, 79% (BOD), 46% (COD), 48% (TN), 50% (TP), 75% (TSS) and 92% (oil and grease) of factories in the Hlaing River basin in Yangon were not meeting the NEQEG (2015) requirements. In the same year, 100% (BOD), 85% (COD), 37% (TN), 40% (TP), 75% (TSS) and 90% (oil and grease) of factories in the Doke Hta Waddy River basin in Mandalay were again not meeting the NEQEG (2015) requirements. To meet the NEQEG (2015) requirements, these factories

probably have to newly install a primary and secondary treatment facilities. Some of them might need a tertiary treatment to remove nutrients.

- There are factories that were satisfying NEQEG (2015) requirements for many parameters. However, most of them were able to achieve this only because their raw wastewater is rather weak (e.g., some of the cold storage in Yangon), and not because they were actively and efficiently removing pollutants.
- Those sectors that discharge highly concentrated organic wastewater, such as distilleries, are expected to face serious difficulties in meeting the requirements, if the requirements are imposed.
- With respect to toxic substances, lead (4.3 mg/L), zinc (168 mg/L), mercury (0.014 mg/L) fluoride (5.2-16 mg/L) were found from battery factories in 2017 at levels higher than the NEQEG (2015). Similarly, phenols (1.0 - 8.4 mg/L) and total chromium (3.2 mg/L) from some of tanning factories were higher than NEQEG (2015). Zinc (3.0 mg/L) was also detected from a textile factory and phenols (0.96 mg/L) from a pharmaceutical company.

(3) Sizes of Factories, Environmental Impacts and Capacity of Factory to Improve Environmental Performance

- While most factories investigated this time were categorized as large factories according to DISI's classification, many of them are considered small to medium-scaled with respect to the number of employees and the amount of wastewater.
- Though effluents of many of these factories did not satisfy the concentration-based requirements of NEQEG (2015), only a small fraction of factories were responsible for the large part of industrial pollution load. In Yangon, three factories (distilleries and rubber) are responsible for 92% of BOD load discharged from the 25 factories investigated in 2016, and in Mandalay only one factory (distillery) was responsible for 92% of BOD load from the 25 factories investigated in 2016. Many of distilleries have been shut down and/or installed sophisticated wastewater treatment facilities in 2017. Thus, the situation has probably improved significantly.
- One should note that in order to estimate pollution load accurately, estimates of both wastewater flow rate and effluent concentration of pollutant should be accurate. However, there are significant variabilities and uncertainties in both estimates, and further investigation is needed.

(4) Awareness about Environmental Requirements

- Essentially all of the respondents in 2016 believed environmental performance of their factories was satisfactory and their products were environmentally-friendly. On the other hand, the survey revealed that 77% of factory managers in Yangon and 71% in Mandalay were not aware of the newly introduced NEQEG (2015).
- While many of the factory managers probably did not want to give answers that could attract attention of local authorities, it seems there is a significant gap in expectation of modern environmental management, as represented by NEQEG (2015), and awareness of many factory managers.

(5) Issues in Improving Environmental Performance

- If factories are required to improve environmental performance and satisfy requirements of NEQEG (2015), they might face various difficulties in technical, financial and organizational aspects. As an attempt to examine factory managers' view on such problems, especially on wastewater management, respondents were asked what would be the difficulties in installing a wastewater treatment plant.

- While respondents in both Yangon and Mandalay did not select cost as the main problem, cost is undoubtedly one of the most important problems. As discussed at the workshops on wastewater treatment, which was implemented after the questionnaire survey, installation of a new wastewater treatment facility would cost in the order of tens to hundreds of thousands of dollars for initial investment and operation cost of several to tens of thousand dollars in the first 10 years or so; actual cost is dependent on the volume and characteristics of wastewater. Large factories might be able to absorb such cost, but for smaller factories, whose annual sales is often less than 100 million MMK, it would be a significant cost.
- Limited land is another major concern for many factories both in Yangon and Mandalay. The problem is especially acute in small-scaled factories whose land area is often smaller than 0.5 acre (0.2 ha).
- Many factories in Mandalay pointed out lack of expertise, both in-house and external, is a major concern. Perhaps the demand for such expertise was limited in the past because effluent was not regulated strictly. However, to improve environmental performance, advices from experts on both technical and financial matters are essential.
- Some respondents commented that unrealistic environmental regulation is a concern. The requirements of NEQEG (2015) are very demanding, and many factories may not be able to satisfy the requirements, if NEQEG (2015) are mandated without adjustment.
- Discussions above have focused on installation of wastewater treatment facility as an end-of-pipe measure. However, these factories need to meet much broader environmental requirements, including air pollution control, noise control, waste management, hazardous substance management, resource conservation, emergency response, etc. To deal with such broad issues, an end-of-pipe approach is not sufficient. They have to go more strategic, adopt an environmental management system, and explore various options to improve efficiency of production and at the same time minimize pollution.

3.2. Recommendations

The following issues and suggestions were drawn from the experiences of the pollution source survey.

(1) Gathering Information from Factories

Issues: Right now, environmental authorities generally do not have detailed information about factories required for environmental management, such as production volume, water usage, pollution prevention and control measures taken, use of toxic substances, monitoring results, environmental issues encountered, emergency plan, etc. Such information is not contained in the data set of DISI and/or IZMCs. Without such information, it is difficult to know which factories are subject to different requirements or which factories should be considered environmental priorities.

Suggestions: Environmental authorities should collect such information from factories in relation to ECC and/or business licensing/registration. As MONREC has already issued an order to factories in nine priority sectors to submit EMPs, an EMP is a good place to start. However, basic information should be collected every year, as the situation of factories could change. Thus, submission of such information should be incorporated into the reporting requirements of ECC and/or business licensing/registration. If gathering information through EMPs takes too much time, it is suggested to implement a questionnaire survey, similar to the one implemented in this project.

(2) Development of Database of Pollution Sources

Issues: As demonstrated in this project, an electronic database is very useful for managing environmental information. However, the pollution source database developed in this project was designed largely to analyze the current situation of pollution sources, and was not designed specifically for ECC and business licensing/registration. Thus, once the frameworks of environmental requirements related to ECC and business licensing/registration are set, a new database should be designed.

Suggestions: In principle, they should be designed considering the licensing scheme, and end use of the database, e.g., tracking official and unofficial correspondence, managing inspection activities, managing information submitted by factories, and analyzing information to prepare reports to top management. For ECC, perhaps it is more appropriate to expand the EIA database, rather than developing a new database. It is important to note that digitizing of non-digitized information is very labor intensive. Thus, for the time being, it is probably wise to limit the information to be managed by a database, and manage other information in hard copies. In the future, perhaps the regulated communities can submit information in electronic format.

(3) Improving Reliability of Measurement of Water Usage and Wastewater Qualities

Issues: Volume of wastewater and concentrations of pollutants in wastewater are among the most important parameters in managing water pollution, but the project encountered serious difficulties in measuring these parameters. Water usage in a factory is known to fluctuate significantly during production, and one or two-time on-site measurement does not give accurate estimate of water usage (and wastewater volume). Less than 10% of factories are equipped with flow meters to measure water usage, and very often water usage had to be estimated based on the size of water tanks and other means. As for water quality, laboratory data were not always reliable, and this problem necessitated the project to analyze wastewater samples in Japan. This issue should also be considered serious because environmental authorities are going to regulate pollution based on water quality data.

Suggestions: With respect to water usage, installation of water meters and measurement of water usage should be incorporated into the requirements of ECC and/or business licensing/registration, at least for major dischargers. As for reliability of laboratory data, environmental authorities should standardize the analytical methodologies, introduce a system of certification of environmental laboratories, and also make certified laboratories to regularly practice quality assurance/quality control measures. See section on Output 2.

(4) Improving Environmental Measures by Factories

Issues: The pollution source surveys revealed a glimpse of primitive environmental management by many pollution sources in Myanmar. Most factories lack secondary treatment. Moreover, the whole management of resources, including water and other raw materials, seems rudimentary.

Suggestions: To control pollution, the environmental authorities should impose realistic regulations and support measures, perhaps based on sector studies. These are discussed elsewhere, and are not repeated here. In addition, regulation of water usage, especially groundwater usage seems necessary. In Yangon region, saltwater intrusion is a concern, and uncontrolled withdrawal of groundwater should be controlled. Aside from these government-side regulations, the industry side should also implement some studies about their management of resources and environment in order not only to control pollution, but also to improve efficiency of production and to make the workplace safe. Such studies may be spearheaded by MOI and/or industrial associations.

End of Document

ATTACHMENT 1

Questionnaire Form for Survey of Manufacturing Industries

1. Basic Information

(1) *Name of Factory:* ....

(2) *Owner: Name ( ) Contact ( )*

(3) *Address (see "Attachment 1"):* ....
....

(4) *Name of Industrial Zone:* ....

(5) *YCDC licensing number: No. Date of Issue*

(6) *DISI registration number: No. Date of Issue*

(7) *Size of business according to DISI's classification?: Large Medium Small*
....

(8) *Currently in operation?: Yes No*

(9) *Type of business/sector:*

(According to DISI's classification :)

(10) *Certification of the industry : ISO 9001.....ISO 14001.......ISO 18001......MRCC........Others.........*

(11) *Type and amount of products:*

Name of Products	Present Amount	Possible Future Expansion
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year

(12) *Area: Total acre (Building acre)*

(13) *Number of employees: Total (Male: Female:)*

(14) *Operation hours: Total hours (From am/pm, To am/pm)*

(15) *GPS coordinate of main office of the factory: Latitude ° ʻ " Longitude ° ʻ "*

2. Raw Materials and Utility

(1) *Main Raw Materials:*

Type of Main Raw Material	Amount (Unit)
	ton or gal /day
	ton or gal /day
	ton or gal /day
	ton or gal /day
	ton or gal /day

(2) *Water Usage:*

Water Source	Volume of Water Usage (gal/day)
Ground Water	gal/day
Surface Water	gal/day
Waterworks	gal/day
Others ( )	gal/day
Total	gal/day

(3) *Consumption of Electricity:* ....*kWh/day*

(4) *Fuel Usage*

Type	Fuel Usage (gal/day)
Heavy oil	gal/day
Coal	ton/day
Wood, saw dust	ton/day
Others ( )	

3. Layout of Factory and Manufacturing Process

(1) *Manufacturing Process Diagram*

Attach general process diagram (see the example, "Attachment-3").

(2) *Layout of the Factory*

Attach diagram showing layout of the factory.

- Please indicate the locations of main facilities
- Please also indicate the following items:
  - locations of storm water channels
  - locations of wastewater lines
  - discharging points to nearby river, channel or soak away points
  - location of smokestacks
  - stage at which waste is generated

4. Wastewater

(1) *Volume of Wastewater:*

Discharge Point after treatment	Volume of Wastewater (m3/day)
Natural River (Name:)	
Channel or creek (Name:)	
Pipeline (to central wastewater treatment facility; only in Mandalay)	
Others ( )	
Total	

(2) *Water Conservation and Minimization of Wastewater:*

Measures	Yes or No
Installation of flow meters to measure water usage	Yes ☐ No ☐
Installation of flow meter to measure wastewater volume	Yes ☐ No ☐
Recycling of water	Yes ☐ No ☐
Separation of rainwater from wastewater	Yes ☐ No ☐
Minimization of solid waste entering wastewater stream	Yes ☐ No ☐
Separation of wastewater containing toxic substance from regular wastewater stream	Yes ☐ No ☐
Others ( )	Yes ☐ No ☐

(3) *Did you know MONREC issued National Environmental Quality (Emission) Guideline in December 2015,which contains effluent guideline values for your industrial sector?: Yes ☐ No ☐*

(4) *Monitoring of Wastewater Quality*

Details	Answer
Do you regularly monitor wastewater quality?	Yes ☐ No ☐
How often do you monitor wastewater quality?	times/year
Name of laboratory that analyzes the wastewater?	Name: ( )
Do you submit your results to the following organization?	YCDC/MCDC Yes ☐ No ☐ ECD Yes ☐ No ☐ DISI Yes ☐ No ☐

(5) *Monitoring of Wastewater Quality*

The new Environmental Quality (Emission) Guideline list s effluent guideline values of the following parameters. If you have monitored effluent concentrations of any of these parameters, please provide the results.

Breweries and Distilleries

Parameter	Unit	Value	Parameter	Unit	Value

BOD (5-day Biochemical Oxygen Demand)	mg/L		Oil and Grease	mg/L	
COD (Chemical Oxygen Demand)	mg/L		Total Coliform Bacteria	100 mL	
TSS (Total Suspended Solid)	mg/L		Active ingredients / Antibiotics (to be determined on a case specific basis)		
TN (Total Nitrogen)	mg/L		pH	-	
TP (Total Phosphorus)	mg/L		Temperature increase	^{o}C	

(6) *Existence of wastewater treatment facility:*

Question	Source of wastewater	Answer
Do you have any wastewater treatment facility?		Yes ☐ No ☐
What type of wastewater is treated by your facility?	Sewage from canteen Sewage from toilet Wastewater from production Storm runoff	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐

(7) *Type and Capacity of Wastewater Treatment Facility:*

Type of Wastewater Treatment Facility	Yes or No	Capacity
Do you remove solid and floating waste from you wastewaer? if Yes, which of the following facilities do you have?	Yes ☐ No ☐	-
(i) Screen to remove large solid	Yes ☐ No ☐	gal/day
(ii) Equalization tank to regulate wastewater volume	Yes ☐ No ☐	gal/day
(iii) Settling basin to remove solid	Yes ☐ No ☐	gal/day
(iv) Oil separator to remove oil	Yes ☐ No ☐	gal/day
(v) Chemical coagulation	Yes ☐ No ☐	gal/day
(vi) Other facility	Yes ☐ No ☐	gal/day
Do you remove biodegradable organic matter from your wastewater? If Yes, which of the following facilities do you have?	Yes ☐ No ☐	-
(vii) Basic septic tank	Yes ☐ No ☐	gal/day
(viii) Activated sludge	Yes ☐ No ☐	gal/day
(ix) UASB	Yes ☐ No ☐	gal/day
(x) Other biological treatment	Yes ☐ No ☐	gal/day
Do you have other type of wastewater treatment? If Yes, what type of facility do you have?	Yes ☐ No ☐	-
(xi) Removal of toxic substance	Yes ☐ No ☐	gal/day
(xii) Other treatment	Yes ☐ No ☐	gal/day

(8) *Layout and Process of Discharge:*

Please attach the schematic diagram of your wastewater treatment facility.

(9) *Layout and Process of Discharge:*

Do you have any plan to improve your wastewater treatment facility within one year? Yes ☐ No ☐
If Yes, please explain your plan ( )

5. Solid Waste

(1) *Generation and disposal of solid waste*

Type of Solid Waste	Amount	Disposal Method (check box)
General garbage from office and canteen	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐
Solid waste from production line (describe:)	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐
Solid waste from production line (describe:)	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐
Waste oil from production line (describe:)	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐
Sludge from wastewater treatment	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐
Other solid waste ( )	ton/month	Picked up by CDC for landfilling ☐ Picked up by CDC for pit burial ☐ Picked up by CDC for incineration ☐ Dumping on site/outside ☐ Incinerated on site ☐ Other ( ) ☐

(2) *Possible Organic and Inorganic constituents in wastes*

Type of Solid Waste	Possible Organic Constituents	Possible Inorganic Constituents
General garbage from office and canteen		
Solid waste from production line (describe:)		
Solid waste from production line (describe:)		
Waste oil from production line (describe:)		
Sludge from wastewater treatment		
Other solid waste ( )		

(3) *Recycling*

If you recycle or reuse waste material, please describe briefly

Name of recycled/reused material	Method of recycle/reuse	Amount recycled (in ton)

(4) *Hazardous Materials*

If there are any hazardous materials that are dangerous to workers, animals and other living things, such as toxic substances (e.g., pesticides to control pest, heavy metals used in production line, chlorinated solvents to clean metal surface, PCBs in transformer, etc.), corrosive/reactive materials (e.g., strong acid, strong base, organic peroxides, etc.), ignitable/flammable materials (e.g., some degreaser, spent organic solvent that have low flash point, etc.), infectious materials (medical wastes), and sharp objects (e.g., glass, needles, etc.) in raw materials, products or waste, please input in the below table.

Type (toxic, corrosive/	Name of Hazardous Material	Amount	Disposal Method (check appropriate box)

reactive, ignitable/ flammable, infectious, sharp)				
		ton or gal/day	Picked up by CDC for landfilling Picked up by CDC for pit burial Picked up by CDC for incineration Dumping on site/outside Incinerated on site Other ( )	☐ ☐ ☐ ☐ ☐ ☐
		ton or gal/day	Picked up by CDC for landfilling Picked up by CDC for pit burial Picked up by CDC for incineration Dumping on site/outside Incinerated on site Other ( )	☐ ☐ ☐ ☐ ☐ ☐
		ton or gal/day	Picked up by CDC for landfilling Picked up by CDC for pit burial Picked up by CDC for incineration Dumping on site/outside Incinerated on site Other ( )	☐ ☐ ☐ ☐ ☐ ☐
		ton or gal/day	Picked up by CDC for landfilling Picked up by CDC for pit burial Picked up by CDC for incineration Dumping on site/outside Incinerated on site Other ( )	☐ ☐ ☐ ☐ ☐ ☐
		ton or gal/day	Picked up by CDC for landfilling Picked up by CDC for pit burial Picked up by CDC for incineration Dumping on site/outside Incinerated on site Other ( )	☐ ☐ ☐ ☐ ☐ ☐

6. Environmental Management

(1) *Do you have Environmental Management Plan (EMP) required under Environmental Conservation Law? Yes ☐ No ☐*

(If Yes, submission date of EMP to ECD: ....)

(2) *Do you have any environmental management system, such as ISO14001? Yes ☐ No ☐*

(If Yes, briefly explain: ....)

(3) *Do you have any plans for emergency (e.g. fire, accidental release of chemicals, explosion, etc.):*
Yes ☐ No ☐

(4) *Do you have any Corporate Social Responsibility (CSR) program? Yes ☐ No ☐*

(If Yes, briefly explain: ....)

(5) *Have you had any environmental accident, such as spill of hazardous substance, accidental discharge of highly contaminated wastewater, etc., in the last 3 years*
Yes ☐ No ☐

(If Yes, briefly explain: ....)

(6) *Have you received any environmental complain from local residents in the last 3 years? Yes ☐ No ☐*

(If Yes, briefly explain: ....)

(7) *When was the last time YCDC/ECD/DISI/other organization visited your factory for environmental inspection, and what was the result?*

Organization	Date	Results
YCDC		
ECD		
DISI		
Others		

(8) *Do you think your wastewater management is adequate? Yes ☐ No ☐*

(9) *Do you think your waste management is adequate? Yes ☐ No ☐*

(10) *Please tell us the difficulties you are facing regarding environmental*

management.

Question	Please rate on scale of 1 to 5 (1: not true to 5: very much so)
- We don't know how to deal with pollution problem because there are no environmental experts in the factory.	1 2 3 4 5
- We don't know how to deal with pollution problem because we don't know any external expert.	1 2 3 4 5
- Most industries in the same sector are not meeting the requirements of the regulations.	1 2 3 4 5
- The cost for controlling pollution is too high compared with the benefit.	1 2 3 4 5
- We are having difficulty in obtaining funding (e.g., bank loan) to install wastewater treatment facility and other pollution control facility.	1 2 3 4 5
- We have limited land to install pollution control facility.	1 2 3 4 5
- Regulatory requirements (e.g., effluent guideline values, other technical requirements on pollution control, reporting requirements) are not clear.	1 2 3 4 5
- Current environmental regulations are not realistic considering the financial, technical and other conditions of my factory.	1 2 3 4 5
- Other (please specify:)	1 2 3 4 5

(11) *Possible Environmental Impacts to Air, Water and Soil because of improper waste water and waste management- qualitative assessment*

To Soil	To Water	To Air

(12) *Do you think your products are more environmentally-friendly compared with the products of your competitors in Myanmar? Yes ☐ No ☐*

(If Yes, briefly explain why: ....)

(13) *If you have any comments, please describe below:*

(--

--)

Appendix 14:

Materials from Seminars and Workshops

INTRODUCTION of INDUSTRIAL WASTE WATER TRETAMENT PLANT

Toshiyuki Nishio

KOBELCO ECO-SOLUTIONS CO.,LTD.

2016/11/25

Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar

JICA Exert Team

Step for Industrial WWTP design, construction, operation

Government, Public sector

- Regulation for wastewater discharge limit of each pollutant parameters by regulation (pH ?, COD <?mg/l, BOD <?mg/l, T-N <?mg/l, T-P <?mg/l etc.)
- Check and approval of Environment Impact Assessment
- Inspection of WWTP before operation
- Inspection of discharge water qualities
- Check the report and give instruction if necessary

Investor (Private company)

- Plan for construction of new factory
- Estimate /Wastewater flow rate (m3/d) /Concentration of each pollutant parameters in wastewater (pH ?, COD ?mg/l, BOD ?mg/l, T-N ?mg/l, T-P ?mg/l etc.)
- Prepare Environment Impact Assessment
- Normal Operation. Monitor and report analysis results of discharge water periodically

Water treatment company

- Design Waste Water Treatment Plant based on wastewater information from investor and discharge limit. / Treatment Process flow, / Layout, / Investment cost, / Operation cost

Investor and Water treatment company

- Construction of factory, WWTP
- Test operation, Commissioning

The important steps for proper control of industrial wastewater treatment are,

1. Make clear the regulation of wastewater discharge limit.
   →by Government
2. Proper estimation of wastewater flow rate and pollutant matters (COD, BOD, T-N, T-P, Heavy metals) in wastewater for design of WWTP.
   →by Investor (factory)
3. Proper design of WWTP to treat each pollutant matters.
   →by Investor (factory), by Water treatment company
4. Proper operation of WWTP by skillful operators.
   →by Investor (factory)
5. Proper check and monitoring, proper instruction.
   →by Government

➡ 3. proper design of WWTP will be introduced from next page.

BASIC PROCESS DESIGN of WWTP

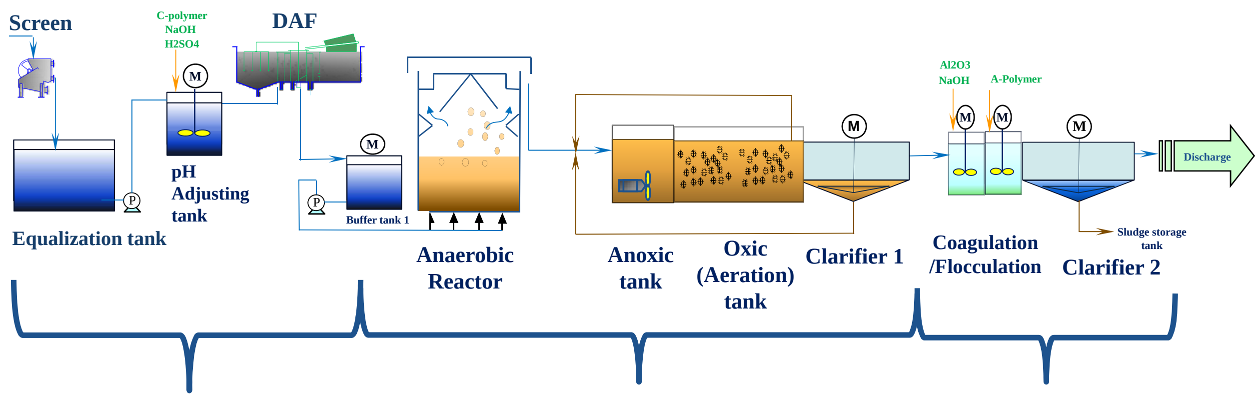
First of All, the most important work for design WWTP is to make clear and define
1. Wastewater flow rate (m^3/day, m^3/hr)
2. Inlet wastewater qualities
3. Required or target discharge water qualities

WASTEWATER CONDITIONS for WWTP DESIGN (For example)

Parameters	Unit	Inlet	Outlet (Discharge Limit)
Flow rate	m^3/day	8,500	-
COD	mg/l	≤ 5,000	250
BOD_5	mg/l	≤ 3,000	50
SS	mg/l	≤ 1000	50
Oil & grease	mg/l	≤ 200	10
T-N	mg/l	≤ 40	10
T-P	mg/l	≤ 15	2

COMBINATION of TREATMENT PROCESS

According to design conditions,
proper treatment processes are combined to meet target discharge qualities.



1. PRIMARY TREATMENT
SS, Oil&grease removal,
pH adjustment

2. MAIN TREATMENT
COD, BOD, T-N removal

3. TERTIARY TREATMENT
T-P, COD removal

WASTEWATER SAMPLE for EACH PROCESS

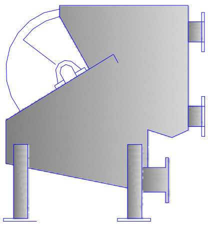
1. PRIMARY TREATMENT

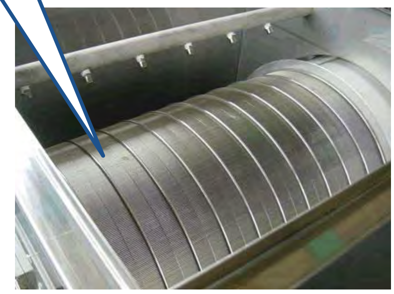
Screen

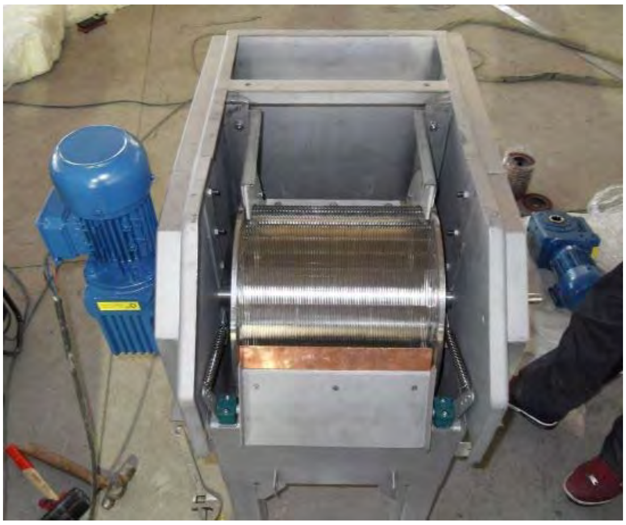
Function:

Remove big solid, garbage which cause troubles in later process, such as clogging in pump, accumulation on the bottom of tanks.

The gap between steel bars is around 1-2mm





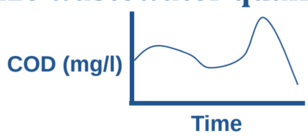


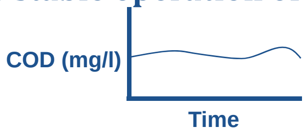
1. PRIMARY TREATMENT

– Equalization Tank

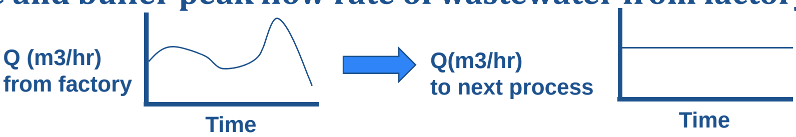
Function:

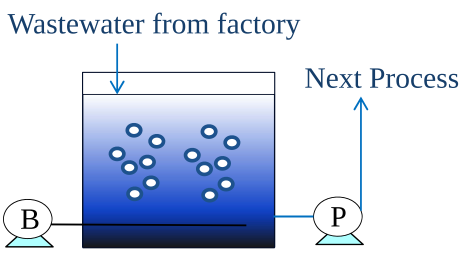
1. Receive and store wastewater from factory
2. Equalize wastewater qualities for stable operation of WWTS





3. Store and buffer peak flow rate of wastewater from factory



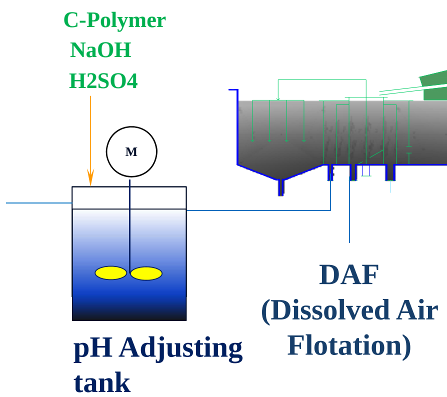


1. PRIMARY TREATMENT

pH Adjustment Tank, DAF

Function:

1. Neutralize pH (around 6.5 – 7.5) by acid and/or alkaline chemicals
2. Coagulation of SS and Oil&grease by coagulant chemical
   in pH Adjusting tank,
   and then removal of SS by flotation with small air babbles in DAF.



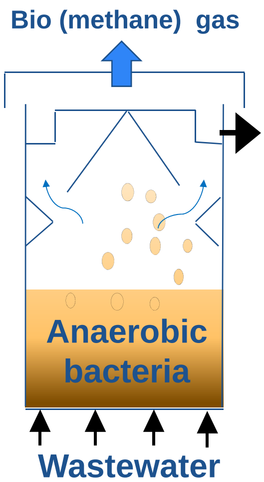
2. Main Treatment

Anaerobic Reactor -1

Anaerobic biological treatment is suitable for high COD (>2,000mg/l) wastewater treatment.

1. Function:

Remove COD, BOD at high removal speed by anaerobic bacteria.



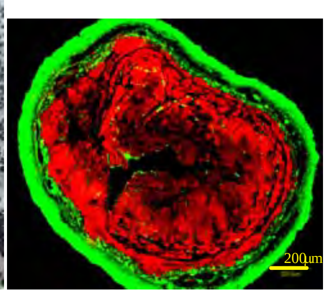
2. Main Treatment

Anaerobic Reactor -2

2. Mechanism of Anaerobic biological treatment

- Special pellet-shaped bacterial sludge is used for Anaerobic Reactor.
- The sludge is filled in reactor and contact with up-flow wastewater.
- COD in wastewater is decomposed into methane gas (CH_4), CO_2, and H_2O.

  "COD" → $CH_4 + CO_2 + H_2O$ +"bacteria"



2. Main Treatment

Anaerobic Reactor -3

3. Advantage of Anaerobic Biological Treatment (compared with Aerobic biological treatment (Aeration Tank))

1) Tank volume can be smaller (10 -20%) owing to high removal speed. ➽ **Lower investment cost**

2) Electrical consumption can be lower because aeration blower is not necessary. ➽ **Lower operation cost**

3) Excess generated sludge can be reduced (10%) ➽ **Lower operation cost**

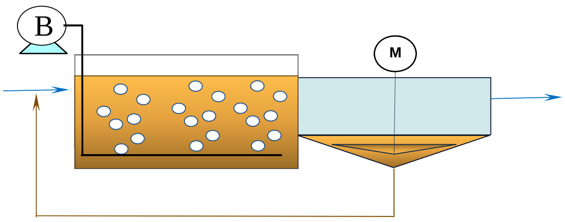
4) Generated bio-gas (CH4) can be recovered as fuel of boiler in factory. ➽ **Saving fuel**

Oxic (Aeration) Tank -1

Oxic (Aeration) Tank is the most common and conventional process for COD, BOD removal. (= Activated Sludge Process)

1. Function:

Remove BOD up to discharge limit by aerobic bacteria.

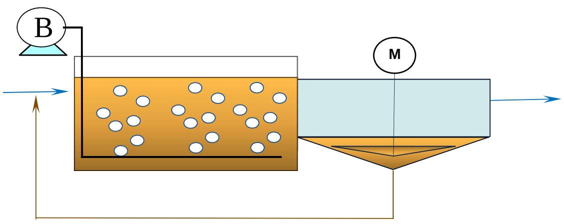


Aeration Tank   Clarifier 1

Oxic (Aeration) Tank -2

2. Mechanism of Aeration Tank treatment

- Activated bacterial sludge is used for Aeration Tank treatment.
- Wastewater and sludge are mixed together by air mixing and oxygen is fed by air blower.
- BOD in wastewater is decomposed into CO_2 and H_2O.
  "BOD" + $O_2 \rightarrow CO_2 + H_2O$ + "bacteria"
- After treatment, water and sludge move to clarifier and water is separated from sludge.
- Sludge (Bacteria) is returned to Aeration Tank from bottom of clarifier.



Oxic (Aeration) tank   Clarifier 1

Oxic (Aeration) Tank -3

<For reference>

MBBR Process

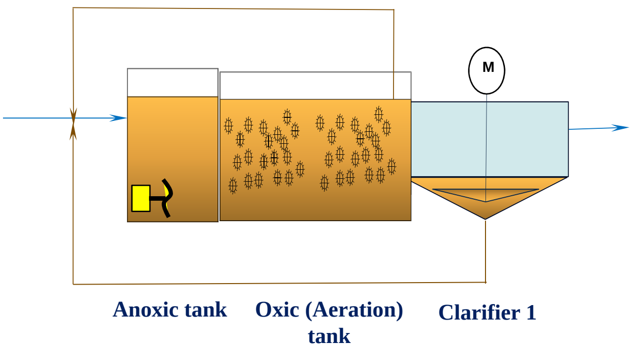
- MBBR (Mixed Bed Bio-Reactor) is one of advanced Aerobic Reactor.
- Plastic media is filled in Aeration Tank.
- Aerobic bacteria attach to media through operation.
- The BOD removal speed is about 2 times faster than conventional Aeration Tank.
- Bacterial sludge is kept on the surface of media so that sludge return from clarifier is not necessary.

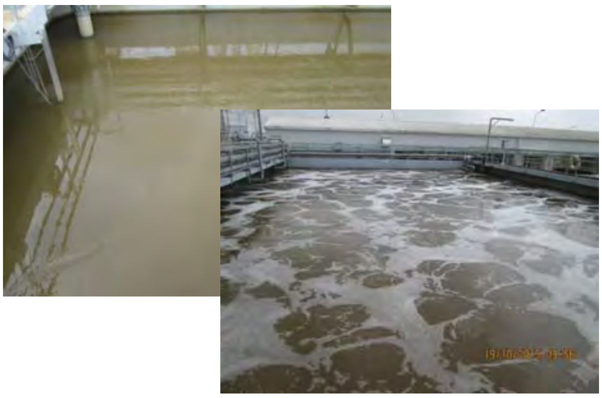
Anoxic – Oxic Tank -1

In case nitrogen is high in wastewater,
Anoxic – Oxic Tank is applied for BOD and nitrogen (T-N) removal biologically.

1. Function:

- Remove BOD up to discharge limit by aerobic bacteria.
- Remove nitrogen by nitrification bacteria and de- nitrification bacteria.

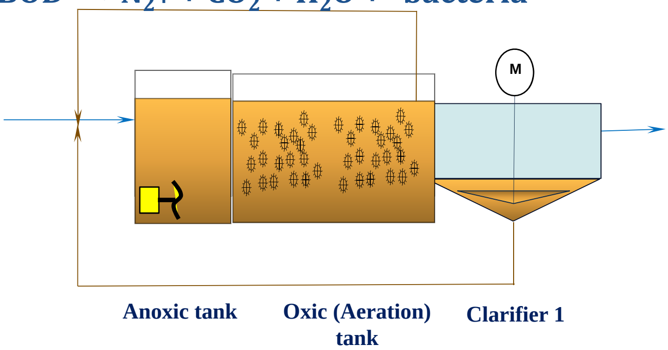




Anoxic – Oxic Tank -2

2. Mechanism of Aeration Tank treatment

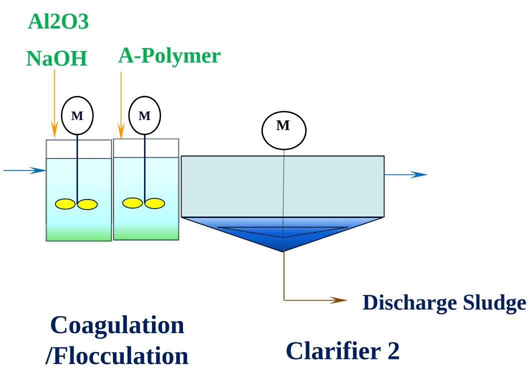
- Activated bacterial sludge is used for Anoix – Oxic tank treatment.
- In Oxic tank,
  BOD is decomposed into CO_2 and H_2O
  "BOD" + $O_2 \rightarrow CO_2 + H_2O$ + "bacteria"
  and organic nitrogen and ammonia are oxidized into nitrate (NO_3^-)
  $NH_3 + 2O_2 \rightarrow H^+ + NO_3^- + H_2O$ + "bacteria"
- In Anoxic tank,
  Nitrate (NO_3^-) is converted into nitrogen gas (N_2) and removed from wastewater .
  NO_3^- + "BOD" $\rightarrow N_2\uparrow + CO_2 + H_2O$ + "bacteria"



If treated water qualities can not meet discharge limit after Main Treatment, Tertiary treatment is necessary.

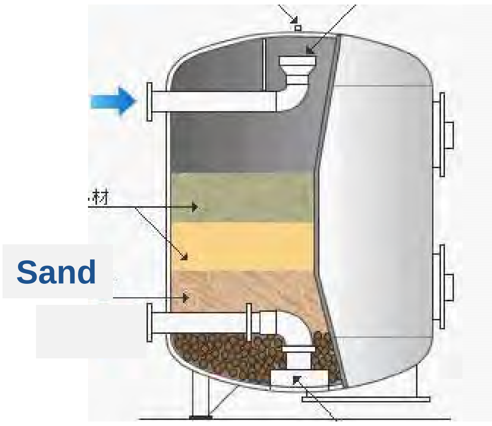
1. Coagulation/flocculation + Clarifier (Phosphorous Removal)

- In case Phosphorous is high in wastewater, phosphorous need to be removed by aluminum or ferric chemicals in Coagulation/Flocculation + Clarifier
  $Al^{3+} + PO_4^{3-} \rightarrow AlPO_4\downarrow$



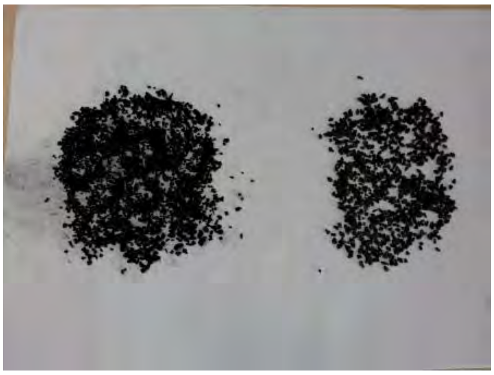
2. Sand filter (Suspended Solid Removal)

- SS is captured by sand and lower outlet SS (< 10mg/l) is obtained.
- Water come into Sand filter from top of the tank and penetrate through sand.
- Treated water goes out from bottom of Sand Filter.
- periodical backwash is necessary to washout captured SS.



3. Activated Carbon Filter (COD, Color Removal)

- In case COD, Color remains which is difficult to be removed by biological treatment, Activated Carbon Filter is used.
- COD, Color is adsorbed by activated carbon.
- Water come into the filter from top of the tank and penetrate through Carbon.
- Treated water goes out from bottom of activated carbon filter.
- Periodical backwash is necessary to washout captured SS.



TREATMENT PRECSS for EACH INDUSTRY

General Matrix of Treatment process - kind of industry

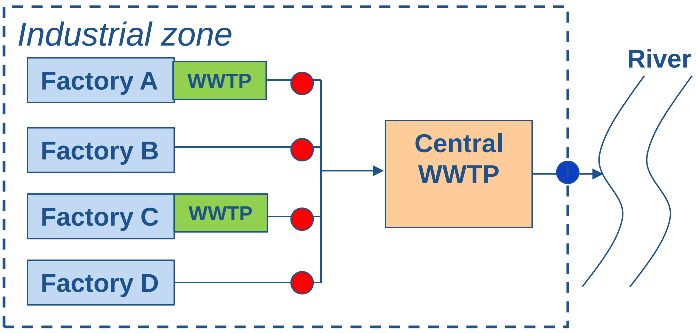
Category	Process	Function	Kind of Industry					
			Food/ Beverage	Brewery/ Distillery	Sugar	Paper mill	Lather/ Tanning	Textile/ Dyeing
Primary Treatment	Screen	big solid, garbage removal	○	○	○	○	○	○
	Equalization Tank	Equalization of wastewater	○	○	○	○	○	○
	DAF(Dissolved Air Flotation) or Sedimentation	SS, Oil& Grease removal	○	○	-	○	○	-
Main Treatment	Anaerobic Reactor	COD, BOD removal	○ (if COD >2,000mg/l)	○ (if COD >2,000mg/l)	○ (if COD >2,000mg/l)	○ (if COD >2,000mg/l)	-	-
	Oxic (Aeration) Tank	COD, BOD removal	○	○	○	○	○	○
	Anoxic Tank	T-N removal	○	○	-	-	○	-
Tertiary Treatment	Coagulation/Flocculation +Clarifier	T-P removal (COD,SS)	○	○	-	-	○	-
	Sand Filter	SS removal	-	-	○	○ (If COD, Color remain after Main Treatment)	○ (If coloring process is applied in production line)	○ (If COD, Color remain after Main Treatment)
	Activated carbon filter	COD, Color removal	-	-	-			

Remark) This list is just general recommendation.
Actual treatment process depends on actual wastewater characteristic (Raw materials, chemicals which are used in production line).

EXAMPLE of CENTRAL WWTP in INDUSTRIAL ZONE

Concept of wastewater treatment in Industrial zone

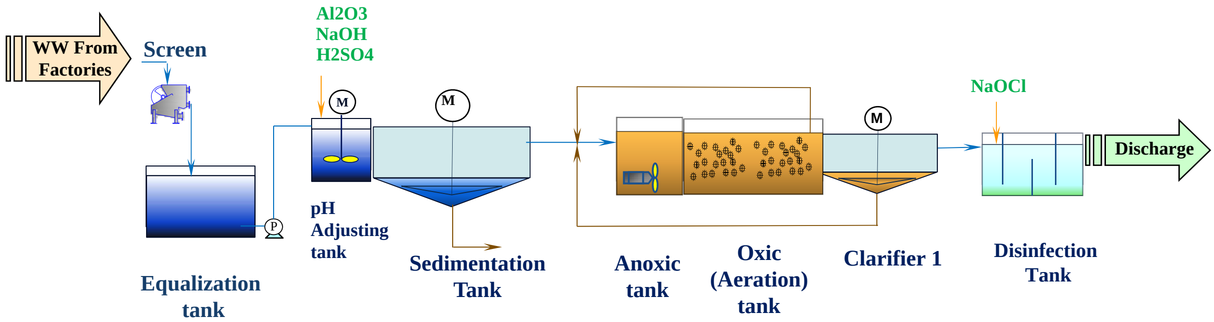
1. "Factory effluent limit" is defined by management of industrial zone.
2. If some pollutants from factory are over "Factory effluent limit", each factory needs to have his own WWTP to treat them.
3. Central WWTP have function to treat common and major pollutants like pH, COD, BOD, SS, Ammonia, T-N, T-P, Coliform up to discharge limit to environment.
4. Other pollutants like Heavy metals, Cyanide, Fluoride need to be treated by each factory up to discharge limit to environment, because these pollutants are not common for all factories and special treatment process is necessary.



Parameters	Unit	Factory effluent limit (●)	Discharge limit to environment (●)
pH	-	5.5-9.5	6-9
COD	mg/l	400	250
BOD_5	mg/l	300	50
SS	mg/l	300	50
Ammonia	mg/l	30	10
T-N	mg/l	30	10
T-P	mg/l	3	2
Coliform	/100ml	–	400
Heavy metals	mg/l	10	10
T-Cyanide	mg/l	1	1
Fluoride	mg/l	20	20

EXAMPLE of CENTRAL WWTP in INDUSTRIAL ZONE

Process flow for Central WWTP in Industrial zone



Photos for some WWTP

WWTP 1

Photos for some WWTP

WWTP 2

WWTP for BEER FACTRY
Capacity: 1,800CMD

Photos for some WWTP

WWTP 3

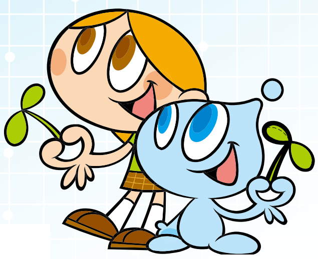
WWTP for SUGAR FACRORY
Capacity: 32 CMD

Photos for some WWTP

WWTP 4

WWTP for PAPER FACTORY
Capacity: 8,500 CMD

Thank You !



Ideas for Improvement of Industrial Zone Waste Water Treatment Plant

Toshiyuki Nishio

KOBELCO ECO-SOLUTIONS CO.,LTD.

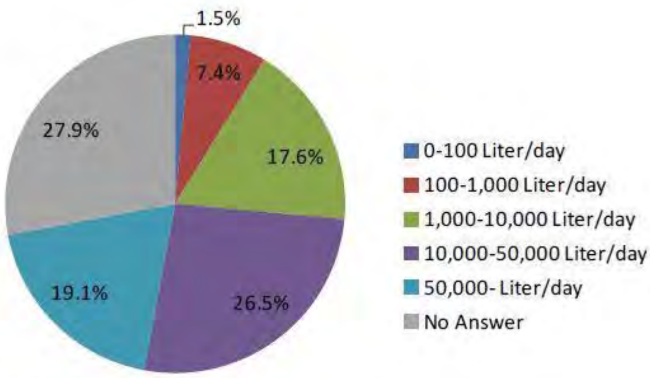
2017/ 1/10

Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar

JICA Expert Team

1.Current Situation -1

1. There are many existing small factories in IZ.
   The amount of water use is less than 50m3/day (50,000Liter/day) at most of these factories, which means the amount of waste water is same or less that 50m3/day.
   50 m3/day is generally very small scale for WWTP.



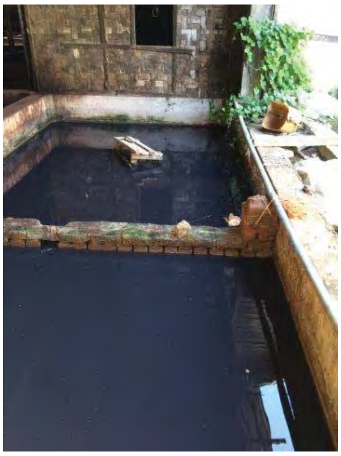
Source: JET

Figure 2.14 Percentage of Water Usage

70 important factories in Hlaing Thar Ya IZ, Shwe Lin Pan IZ and Pyi Thar IZ in Hlaing River Basin, Yangon city

1.Current Situation -2

2. 78% of factories in previous Figure 2.14 have its own WWTP according to the answer to questionnaire made by JET, YCDC.
   However, most of these WWTP seem to be insufficient to meet the qualities required in emission guidelines.



Treatment water by WWTP in some factories

1.Current Situation -3

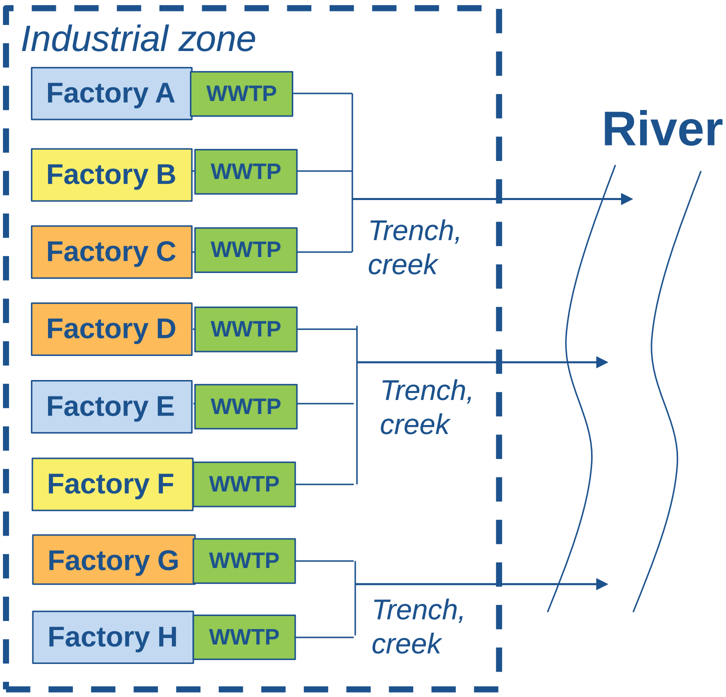
3. Polluted waste water is discharged to open trench, open creek at outside of factories.
   In the trench and creek, the polluted waste water causes anaerobic condition and generates back sludge, bad smell (H2S gas).

Trench, Creek at outside of factories.

2.Idea to improve Waste Water Treatment -1

CASE 1

Each of factories has WWTP (Small Scale) which can treat waste water up to emission guidelines.



Advantage

1) Connection ww pipe is not necessary. (utilize existing trench, creek)
2) WWTP can be designed one by one optimally for one specific kind of industry. .

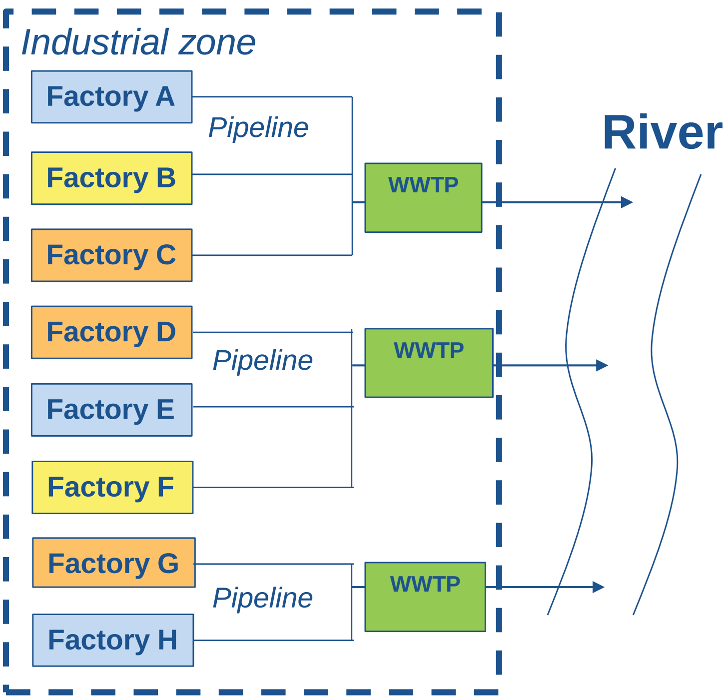
Disadvantage

1) Each WWTP is small so that the construction is costly compared with big-scale WWTP.
2) Each factory need to do operation and maintenance of WWTP properly.

2.Idea to improve Waste Water Treatment -2

CASE 2

Several neighbor factories combine their waste water together and treat ww in one common WWTP (Middle Scale).



Advantage

1) Connection ww pipe is not so long.
2) Each factory doesn't need to do operation and maintenance of WWTP by himself.(paying treatment fee)

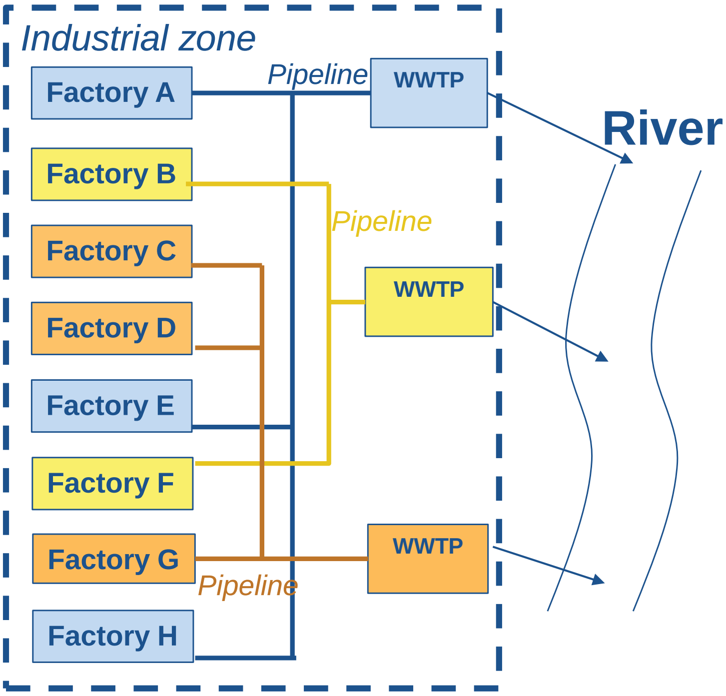
Disadvantage

1) Area for WWTP is required near factories.
2) WWTP cannot be designed one by one optimally because various kind of industry's ww are mixed together at inlet of WWTP.

2.Idea to improve Waste Water Treatment -3

CASE 3

Collect waste water from same kind of industry's factories and treat it by specific WWTP (Middle Scale)



Advantage

1) WWTP can be designed optimally for one specific kind of industry.
2) Each factory doesn't need to do operation and maintenance of WWTP by himself.(paying treatment fee)

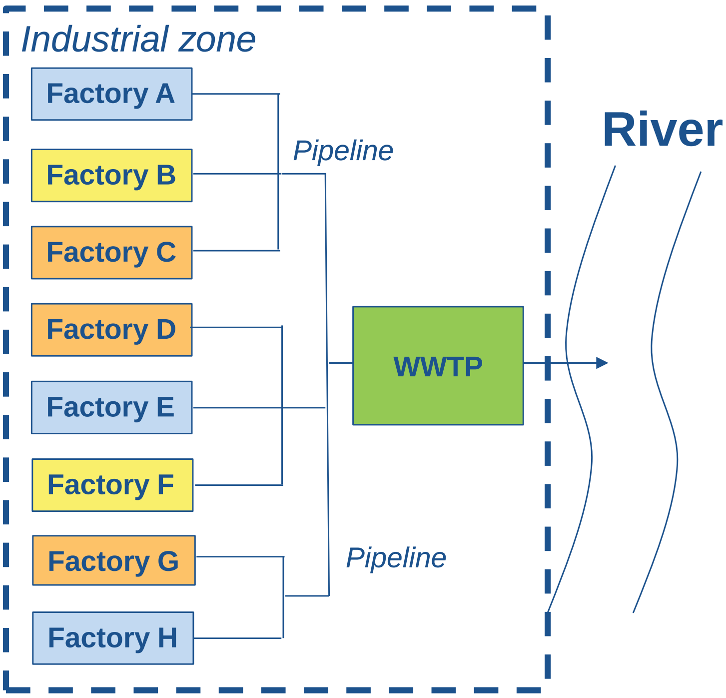
Disadvantage

1) Connection ww pipe is very long and very complicated.

2.Idea to improve Waste Water Treatment -4

CASE 4

Waste water from all factories come to one central WWTP (Large Scale) for IZ.



Advantage

1) Each factory doesn't need to do operation and maintenance of WWTP by himself.(paying treatment fee)

Disadvantage

1) Large area for WWTP is required inside of IZ.
2) WWTP cannot be designed one by one optimally because various kind of industry's ww are mixed together at inlet of WWTP.
3) Connection ww pipe is long.

Construction cost and operation fee for WWTP

Bigger capacity ⇒ Lower construction unit cost
One specific industry ⇒ Treatment process can be optimum
⇒ Lower investment and operation fee (Unit fee/m3ww)

Necessary treatment fee for each case of WWTP (for reference)

CASE	WWTP for	Capacity of WWTP (m3/day)	Treatment Process	Construction Cost (USD)	Operation and Maintenance Fee (USD/year)	Total Fee for 10 years (USD)	Unit Fee for 10 years (USD/m3ww)
1	Each factory	100	Optimum for specific industry	100,000	8,000	180,000	0.50
2	10 Neighbors	100 x 10 factories = 1,000	Common for various industries	650,000	100,000	1,650,000	0.46
3	10 factories of same industry	100 x 10 factories = 1,000	Optimum for specific industry	500,000	80,000	1,300,000	0.36
4	All (50) factories in IZ (Central WWTP)	100 x 50 factories = 5,000	Common for various industries	2,200,000	500,000	7,200,000	0.40

Note: 1) Costs and fees above are only for reference, based on cost in Vietnam. general example for foods, beverages and distilleries.
2) Connection pipe from factories to WWTP is not included in the costs above.

How to calculate?

1. Total Fee for 10 years (USD)
= Construction cost (USD)
+ 10 (years) x Yearly ope. and maintenance cost (USD/year)

For example, in case 1,
100,000 (USD) + 10 (years) x 8,000USD/year) = 180,000USD

3.Summary of some ideas-3

How to calculate?

2. Unit Treatment Fee for 10 Years (USD/m3ww)

= ① / ②

Inhere,

① Total Fee for 10 years

② Total waste water volume for 10 years.

For example, in case 1,

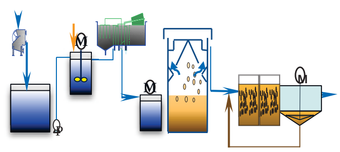
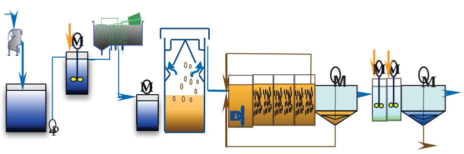
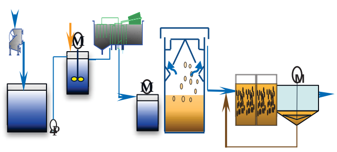
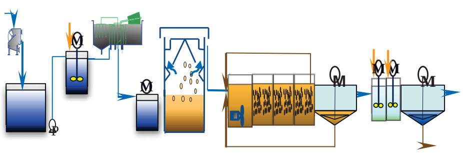
① = 180,000USD

② = 100m3/day x 360days/year x 10 years = 360,000 m3ww

So, Unit treatment fee for 10 years

= 180,000(USD) / 360,000 (m3ww) = 0.50 (USD/m3ww)

3.Summary of some ideas-4

CASE	WWTP for	Capacity of WWTP (m3/day)	Treatment Process		Unit Fee for 10 years (USD/m3ww)	Operation and Management of WWTP
1	Each factory	100	Optimum for specific industry		0.50	By each factory
2	10 Neighbors	100 x 10 factories = 1,000	Common for various industries		0.46	By Neighbor factories? By IZ committee?
3	10 factories of same industry	100 x 10 factories = 1,000	Optimum for specific industry		0.36	By IZ committee?
4	All (50) factories in IZ (Central WWTP)	100 x 50 factories = 5,000	Common for various industries		0.40	By IZ committee?

Thank You !

INTRODUCTION of INDUSTRIAL WASTE WATER TRETAMENT IN VIETAM

Nguyen Thi Huong Van
Sales & Business Development
KOBELCO ECO-SOLUTIONS VIETNAM CO.,LTD.

Jan 17th, 2017

The Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar (JICA)

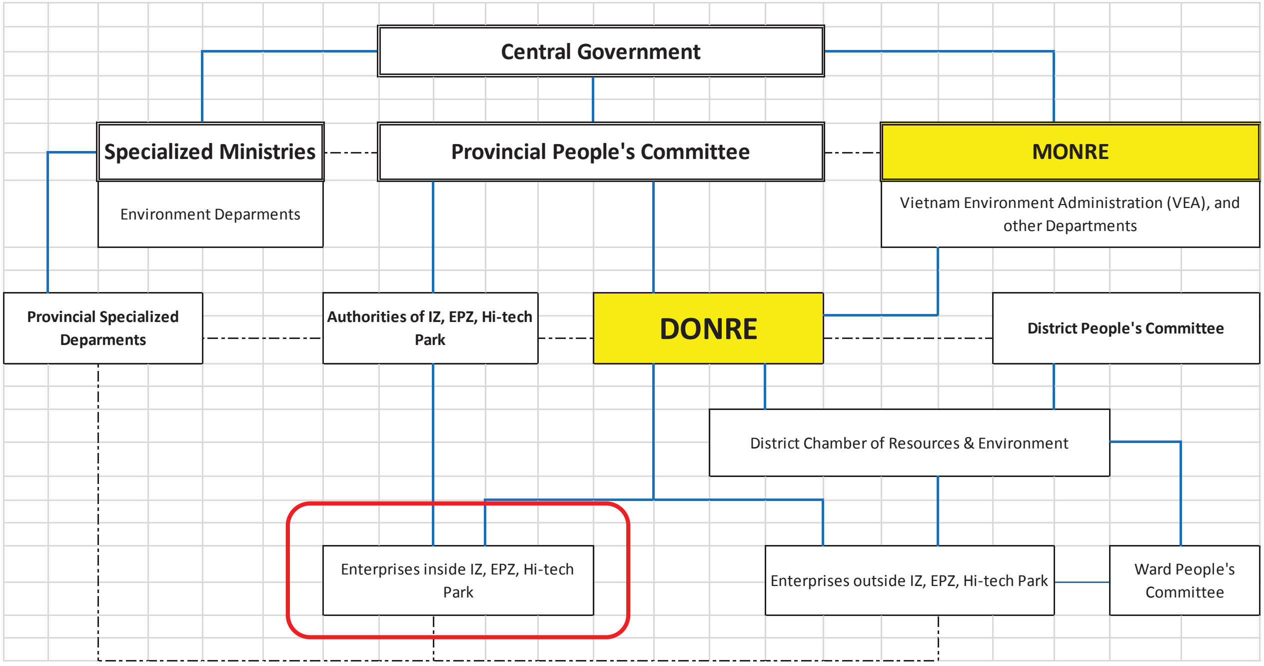
JICA Expert Team

Outline

1. State management for industrial waste water
2. Management of effluent industrial waste water
3. Serious environmental violations

State management for industrial waste water

Organization chart of State management for environment in Vietnam



: Management direction

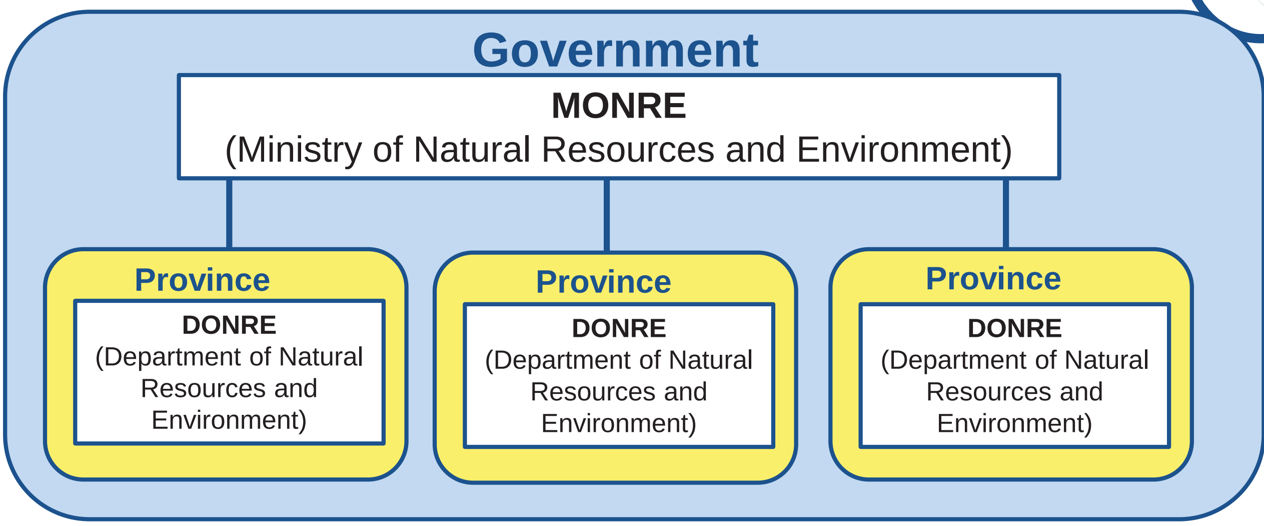
: Support direction

MONRE: Ministry of Natural Resources and Environment

DONRE: Department of Natural Resources and Environment

State management for industrial waste water

Major management departments related to water environment in Vietnam



What they mainly do?

- Issue Regulations and Standards of Environment
- Appraise and approve for E.I.A
- Grant, renew, and revoke the Permits or Certificates of environment
- Construct and manage environmental monitoring system

State management for industrial waste water

Technical National Regulation on Industrial Waste Water

Applicable Regulations:

1. TCVN 5945:1995
2. TCVN 5945:2005
3. QCVN 24:2009/BTNMT
4. QCVN 40:2011/BTNMT (Current)

Table 1: The C Value of pollution parameters in industrial wastewater

O. No	Parameter	Unit	C Value	
			A	B
1	Temperature	^{0}C	40	40
2	Colour	Pt/Co	50	150
3	pH	-	6-9	5,5-9
4	BOD_5 ($20^{0}C$)	mg/l	30	50
5	COD	mg/l	75	150
6	Suspended solids	mg/l	50	100
7	Arsenic	mg/l	0,05	0,1
8	Mercury	mg/l	0,005	0,01

(QCVN 40:2011/BTNMT_ An extracted sheet for reference)

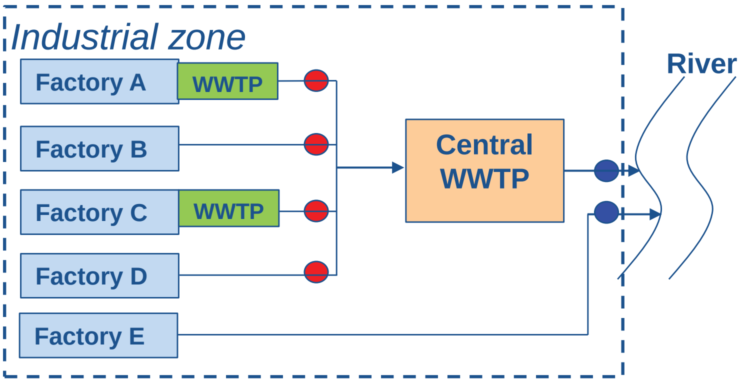
Where:

A: receiving facilities using for sources of domestic water supply;

B: receiving facilities not using for sources of domestic water supply

Management of effluent industrial waste water

General concept of IZ WWTP



Parameters	Unit	Factory effluent limit	Discharge limit to environment
pH	-	5.5-9.5	6-9
COD	mg/l	400	250
BOD_5	mg/l	300	50
SS	mg/l	300	50
Ammonia	mg/l	30	10
T-N	mg/l	30	10
T-P	mg/l	3	2
Coliform	/100ml	–	400
Heavy metals	mg/l	10	10
T-Cyanide	mg/l	1	1
Fluoride	mg/l	20	20

A centralized WWTP in IZ

Approval, License of Waste Water Treatment Plant

1. All factories and Centralized WWTPs which discharge industrial waste water must get approval of EIA from MONRE or DONRE.
2. All WWTPs which discharge waste water directly to nature (river, sea) must get discharge license from MONRE or DONRE
3. If the capacity of WWTP is over 5,000m3/d, Water quality monitoring system must be equipped and send data to DONRE.

	Conditions	Meeting with local committee and attach minute of meeting to EIA report	Approval of EIA by	Discharge License by	Monitoring system
WWTP of IZ	≧5000m3/d or IZ area is ≧200ha	○	MONRE	MONRE	○
	<5000m3/d and IZ area is <200ha	○	DONRE	DONRE	-
WWTP of private factory in IZ	≧5000m3/d	-	MONRE	-	○
	< 5000m3/d	-	DONRE	-	-

○: necessary

Environmental protection activities in IZs

For factories and IZs Developers

1. All factories must submit Periodically Environmental Monitoring Report (*including effluent wastewater quality*) to MoNRE or DoNRE periodically every 3-month or 6-month or 1 year.
2. In Centralized WWTPs, record daily/weekly/monthly/yearly operation data (flow-rate, effluent quality, power and chemical consumption, sludge amount)
3. IZs Developers install flow-meter for inlet wastewater, and install automatic monitoring system, and transmit recorded data to local DoNRE.
4. IZs Developers yearly send Report of monitoring and environmental protection to IZs' Authorities and DoNRE.

For Authorities of IZs and DoNRE

1. Authorities annually submit the report of environmental protection to Provincial People Committee and MONRE periodically 1 time/year.
2. DONRE visit WWTP and take water sample to check water qualities periodically 1 time/year .

Sanctioning in environmental violations

The sanctioning forms are provided by following manner:

1. Principal sanctioning forms, sanctioning levels

a. Caution (Warning letter);

b. Fine: USD44,000 for individuals and USD88,000 for organizations maximally.

2. Additional sanctioning forms:

a. Deprivation of the right to use of Environmental Certificates

b. Confiscation of material evidences and means used for commission of administrative violations

3. Other sanctioning forms besides above 1 & 2.

Serious environmental violations

"V" - Food Factory

1. Detect Violation

- Detected on 13 Sep, 2008
- Total 10 environmental violations *(effluent w/w is 10 times over standard, no application for E.I.A before construction, discharged pipe was installed in wrong position, etc.)*

2. Apply sanctioning

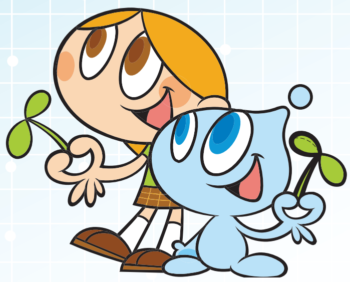
- Administrative Fine of USD15,300
- Fine of USD7,278,000 on environmental protection fee
- Remedy expense for violations: USD33,187,516 *(remove underground 2,200m pipelines, renovate current WWTP, newly construct WWTPs, install automatic monitoring system, renovate current production lines, etc.)*
- Compensate for the damage of economy and environment, and support surround citizens being affected by violations.

"F"- Steel making factory

1. Detect Violation
- Detected on 1st April, 2016
- Total 53 environmental violations *(arbitrarily change the production process without application of additional E.I.A, directly discharge w/w with very high Phenol, CN to sea, etc.)*
- Seriously affect to economy of 4 Central Provinces (fishery and tourism are the worst)

2. Apply sanctioning
- Fine of USD500,000,000
- Force to renovate the current WWTPs and current Production lines

Thank You !



INTRODUCTION of INDUSTRIAL WASTE WATER MANAGEMENT

Hoang Thi Thanh Dung
Sales & Business Development
KOBELCO ECO-SOLUTIONS VIETNAM CO.,LTD.

October, 2017

The Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar (JICA)
JICA Expert Team

Content

1. Overview of "A" IZ

"A" industrial zone

Investor:
3 private companies in Japan + 1 private company in Vietnam

Developer, Operation company:
"A" Investment Co., LTD.

Area: 270 ha (sale area: 202.5 ha).

Time of Operation: Middle of 2013

Occupancy: 70% (2017)

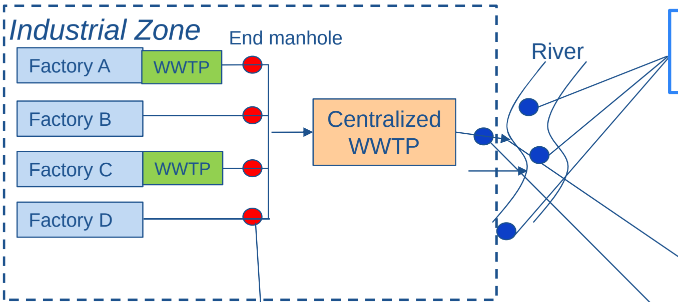
Tenant: 28 companies

Field: plating, manufacturing parts, components, packaging, chemicals, surfactants, fast food,…

Charging to tenants from operation company:

1) Land leasing fee
2) Management fee
3) Electricity fee
4) Water supply fee
5) Wastewater treatment fee

2. Discharge standard



QCVN 08:2008/BTNMT: *National technical regulation on surface water quality*

Control by government

No.	Parameters	Unit	Value
1	BOD_5	mg O_2/l	30
2	COD	mg O_2/l	75
3	SS	mg/l	50
4	N – NH3	mg/l	5
5	T - N	mg/l	20
6	T - P	mg/l	4
7	Coliform	MPN/100ml	3000

Total 33 parameters

QCVN 40:2011/BTNMT: ***National Technical Regulation on Industrial Wastewater***

Control by IZ owner

No.	Parameters	Unit	Value
1	BOD_5 (20°C)	mg/l	300
2	COD-Cr	mg/l	350
3	SS(Suspended Solid)	mg/l	300
4	N – NH3	mg/l	20
5	T - N	mg/l	30
6	T - P	mg/l	6
7	Coliform	MPN/100ml	—

Wastewater treatment plant of "A" IZ

1. Total capacity : 9,000 m3/day
2. Completion date : 8/2013
3. Influent : follow IZ owner regulation
4. Effluent : QCVN 40:2011/BTNMT, Column A

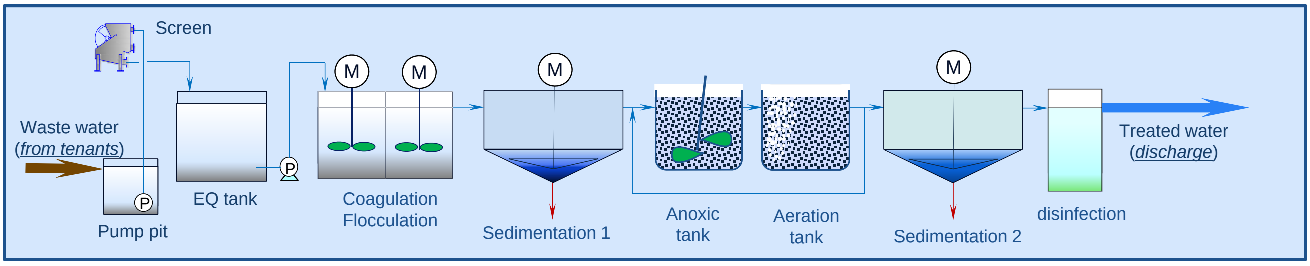
Water supply fee: 62 cent/m3

Waste water fee: 33 cent/m3

Waste water amount = 80% water supply for charging.

In Vietnam, tube well is not allowed inside IZ. So, IZ owner easily check water supply capacity which tenant use.

Flowsheet – Treatment process

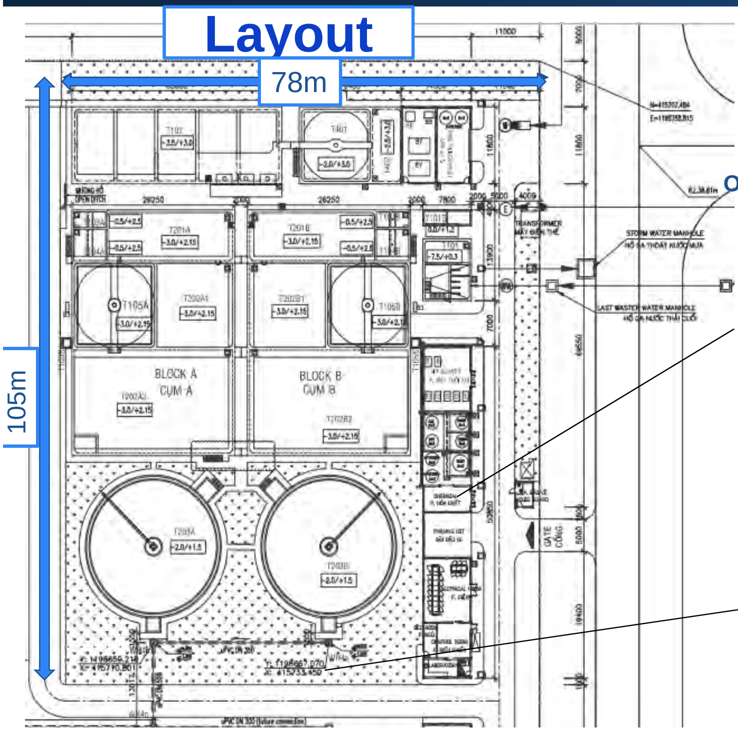


Because various industrial operations are carried out in the industrial estate, it is necessary to dispose of various kinds of wastewater.

It is necessary to stably and reliably process.

1. This WWTP can treat organic matter (BOD, COD) and phosphorous (P) and Nitrogen (N) stably.
2. Can economical operation by managing equipment based on WW amount and its pollution load.
3. In case of equipment trouble, stand by equipment starts run automatically and keep WWTP operation.

3. Centralized WWTP of "A" IZ



O&M Service & Electrical room

Outlet & Monitoring system

Design concept

Vietnamese government keen on protecting environment, accordingly environmental regulation of this country is more strict compare with other developing countries.

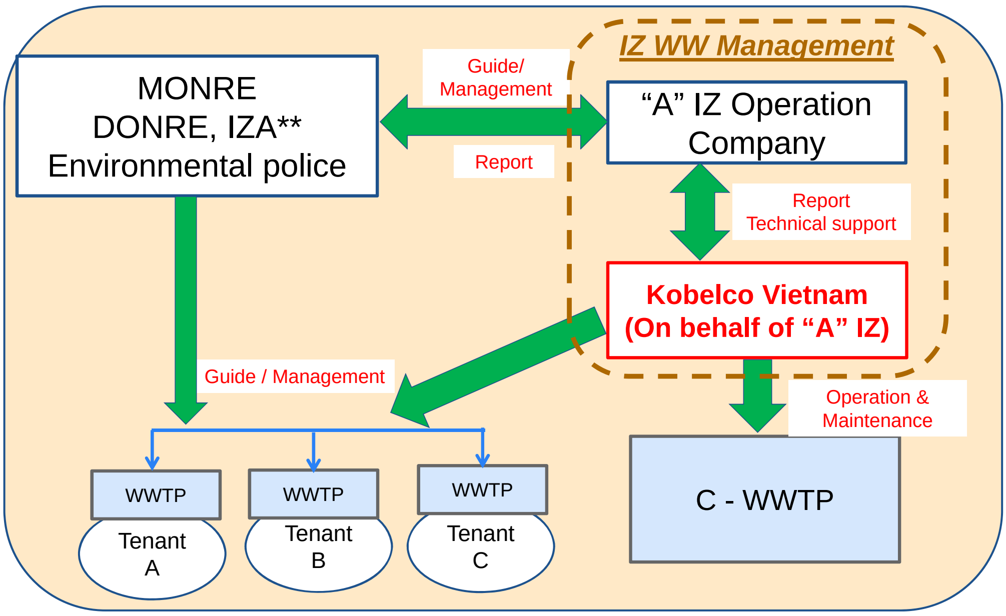
In "A" IZ, they apply KESV's high performance WWTP and running IZ with considering eco, environment friendly.

O&M

A IZ's WWTP is managed by KESV's specialized engineers, they optimize system operation, detect problem and fix it quickly, and conduct appropriate safety operation.

4. Control, tenant management waste water by IZ owner

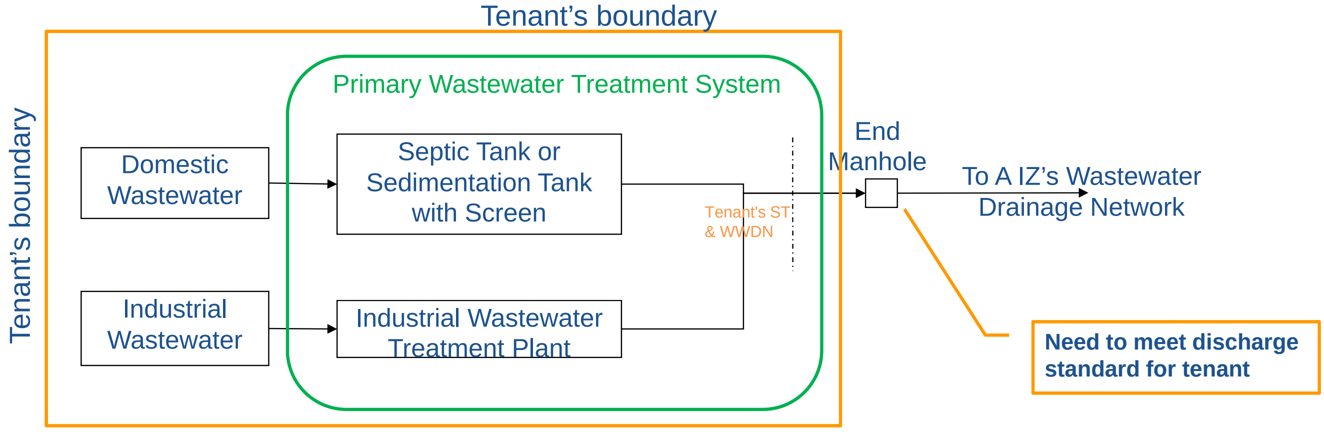
Wastewater management in IZ



**:
MONRE: Ministry of natural Resource and Environment
DONRE: Department of natural Resource and Environment
IZA: Industrial zone authority
KESV: Water treatment company. KESV manage C-WWTP, and tenant WWTP *on behalf of IZ owner* based on O&M service contract.

IZ owner manage and control wastewater of tenant by their Regulation from construction stage to discharging.

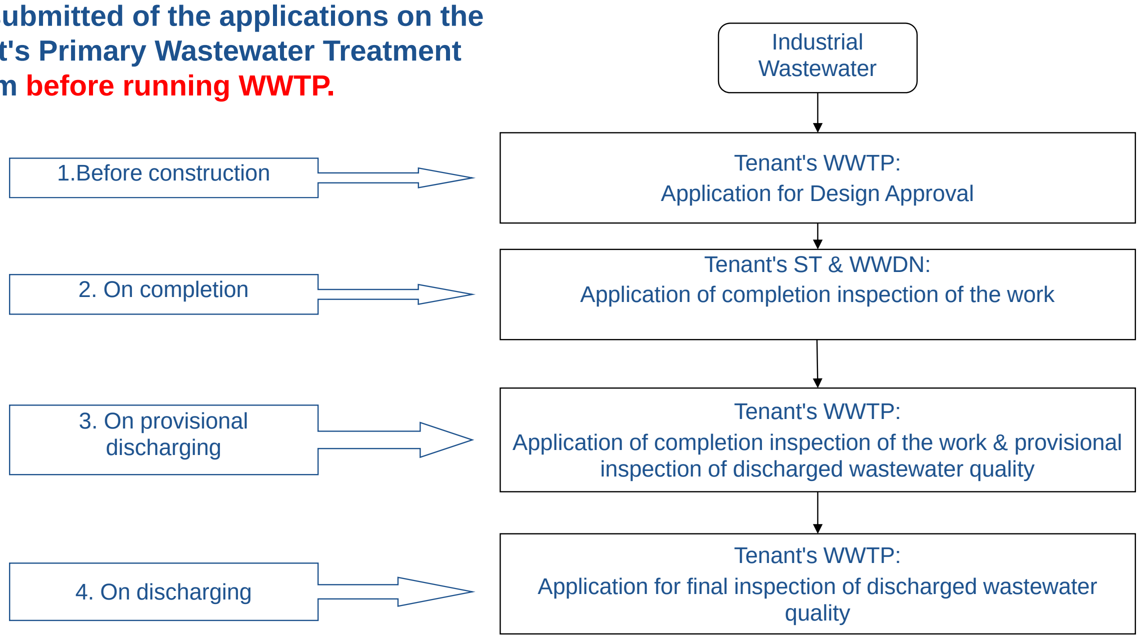
The diagram of the Tenant's Primary Wastewater Treatment System (Tenant's WWTP and Tenant's ST & WWDN) is shown below.



Note) In case of separating the treatment process between domestic and industrial wastewater.

4. Control, tenant management waste water by IZ owner

Date submitted of the applications on the Tenant's Primary Wastewater Treatment System before running WWTP.



4. Control, tenant management waste water by IZ owner

Tenant wastewater control by IZ owner.
Regulation of Self- maintenance and Self-measurement after running WWTP

(1) Summary of Self-maintenance/ Self - management

①Preparing an “Operation Manual for the Tenant’s WWTS”

②Submitting an “Operations and Maintenance Plan of the Tenant’s WWTS” to “A” IZ at the time of stage 3. on provisional discharging.

③Recording and retaining “Daily & Comprehensive Inspections”

②The Operations and Maintenance Plan:

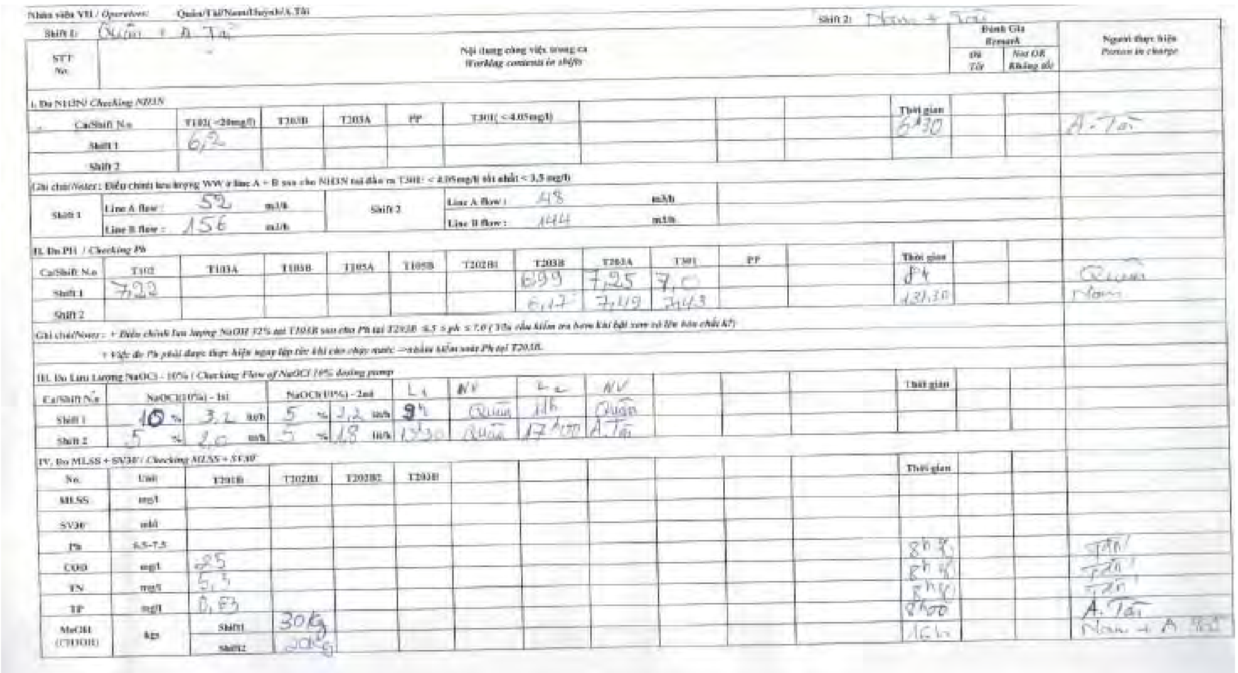
- Daily maintenance target values
- Daily inspection plan
- Comprehensive inspection plan
- Management organization

③Daily and Comprehensive Inspections

- Exterior appearance, operational & functional status
- Comprehensive inspections (two or more times annually) Water quality analysis by self-measurement
- Retain records for three years

4. Control, tenant management waste water by IZ owner

Sample for Daily inspection plan



4. Control, tenant management waste water by IZ owner

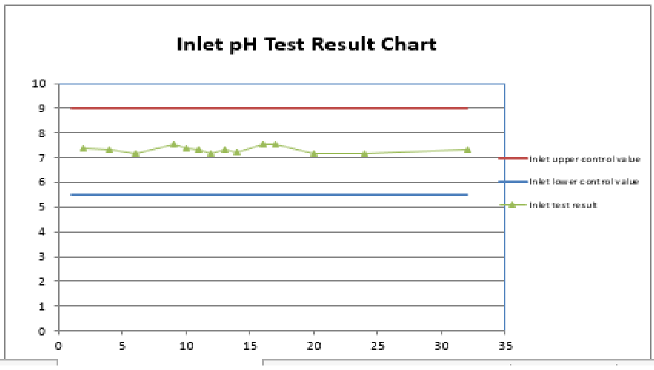
Sample for Comprehensive inspection.

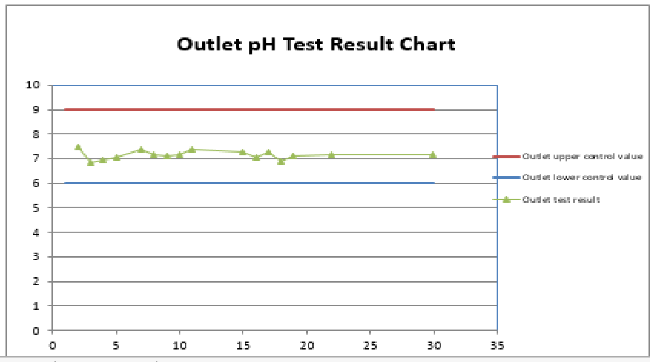
KOBELCO ECO-SOLUTIONS VIETNAM CO.,LTD. **MONTHLY REPORT**

Revision: 01
Ref No.:130007 - 2G-OM-MOR1701

		INTERNAL DELIVERY	Prepared	Checked	Approved
CLIENT	:	Issued date :February 1st, 17			
SYSTEM	: WASTE WATER TREATMENT PLANT	Revised date :			
CAPACI	: 8000 M3/DAY	Project Code : 130007			
ITEM	: OPERATION AND MAINTENANCE		T.T.T.Tam	T.V.Nhan	T.T.K.Ngan

Month	Position	pH	Jan.01	Jan.02	Jan.03	Jan.04	Jan.05	Jan.06	Jan.07	Jan.08	Jan.09	Jan.10	Jan.11	Jan.12	Jan.13	Jan.14	Jan.15	Jan.16	Jan.17	Jan.18	Jan.19	Jan.20	Jan.21	Jan.22	Jan.23	Jan.24	Jan.25	Jan.26	Jan.27	Jan.28	Jan.29	Jan.30	Jan.31	Average
7	Inlet	Upper control value	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
		Lower control value	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
		Test result		7.4		7.4		7.1			7.5	7.4	7.3	7.2	7.4	7.2		7.5	7.5			7.2				7.2								7.35
	Outlet	Upper control value	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
		Lower control value	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		Test result				7.5	6.9	7.0	7.1		7.4	7.2	7.1	7.2	7.4				7.3	7.0	7.3	6.9	7.1			7.2								7.15

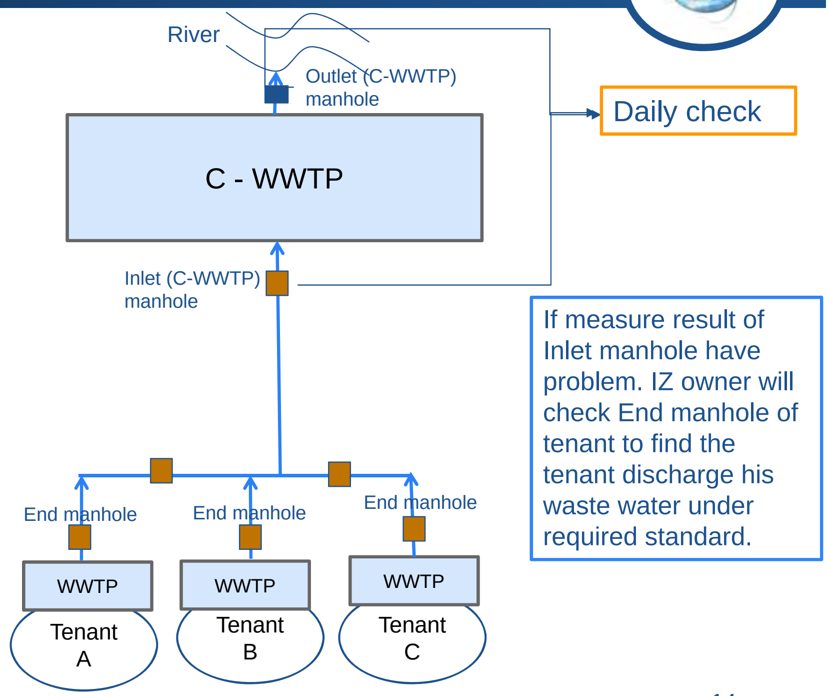




4. Control, tenant management waste water by IZ owner

[Addressing to Water Quality Violations]

- Modification of Tenant's WWTP: In response to "A" IZ's request for the modification, the Tenant's submission and implementing the modification scheme.
- The Tenant's committing the violation more than once: A IZ's Implementing closing water-stopper and suspending water supply.
- Required addressing any loss or damage rendered by the Tenant's water quality violations: The reimbursement of expenses should be borned by the Tenant.



5. Control, management of C-WWTP by government

For IZ owner, the process for self-maintenance and self-measurement is almost same. IZ need to report the result to IZA, DONRE, and MONRE. To manage IZ owner, beside of online monitoring system with camera at outlet, DONRE can go to take samples and analysis by themselves. The date of taking sample is not informed in advance. Environment police (E.Police) also can check the system.

IN "A" IZ					
	Frequency	**Take sample and measure by**	**Informed**	**Not Informed**	**Remarks**
C- WWTP	Daily	"A" IZ (self- measure)	x		IZ need to have diary of operation.
	Monthly	DONRE		x	
	Monthly	MONRE		x	
	Monthly	E. POLICE		x	
	3 monthly	IZA	x		"A" IZ submit test report to IZA & DONRE
	~ 6 monthly	MONRE	x		

5. Control, management of C-WWTP by government

PENALTIES FOR ADMINISTRATIVE VIOLATIONS

- **Article 13. Violations against regulations on discharge of wastewater containing non-hazardous environmental parameters into the environment**
- **Article 14. Violations against regulations on discharge of wastewater containing hazardous environmental parameters into the environment**

The amount of penalties depend on:

1) How many times the discharging wastewater parameters (COD, BOD5, pH, metal,…) in excess of the permissible limit (standard) prescribed in the technical regulation.
   - 1.1 times to less than 1.5 times
   - ….
   - 05 times to less than 10 times
   - 10 times or more

2) The volume of discharging of wastewater (24 hours) .
   - …. 3,000 m3/day to less than 4,500 m3/day
   - 4,500 m^3/day to less than 5,000 m^3/day
   - 5,000 m^3/day (24 hours) or above

For ex., if the IZ discharge with:
COD: 600 mg/L while standard is 75 mg/L. It means 8 times higher.

With capacity of 3,000 m3/day.
The penalty for them is: USD 30,800.

PENALTIES FOR ADMINISTRATIVE VIOLATIONS

- **Beside penalty by money, there are regulation for additional penalties and remedial measures:**

1) Additional penalties:

Suspend the activities of the business establishment or the concentration of producers, businesses and service providers which cause the environmental pollution for 03 – 12 months.

2) Remedial measures:

a) Enforce the application of remedial measures for environmental pollution
b) Enforce the transfer of illegal benefits obtained from any of the administrative violations;
c) Enforce the payment of costs for conducting inspection, assessment, measurement and analysis of environmental samples for discharging waste in excess of the permissible limits prescribed in technical regulations or *causing environmental pollution according to current norms and prices if any of the violations*.

EXAMPLE OF PENALTIES FOR ADMINISTRATIVE VIOLATIONS

- 09/10/2017: "VH" IZ (Taiwanese investor) got penalty of USD 860,000 by:
- Don't have discharge license. Penalty: USD 11,000
- Some parameters are over technical standard from 1.47 – 2.8 times with 24 hours capacity of 4,400m^3 . Penalty: USD 60.000 for 1st parameter over 2.8 times with capacity of 4,400m^3. From 2nd parameter +10 to 20% of each parameter. Total is USD 100,000
- USD 860,000 = USD 11,000 + USD 100,000 + USD 749,000 (Remedial measures)

→ The biggest penalty is Remedial measures.

5. Control, management of C-WWTP by government

EXAMPLE OF PENALTIES FOR ADMINISTRATIVE VIOLATIONS

"F"- Steel making factory

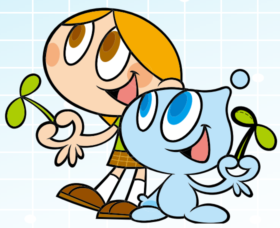
1. Detect Violation
- Detected on 1st April, 2016
- Total 53 environmental violations *(arbitrarily change the production process without application of additional E.I.A, directly discharge w/w with very high Phenol, CN to sea, etc.)*
- Seriously affect to economy of 4 Central Provinces (fishery and tourism are the worst)

2. Apply sanctioning
- Fine of USD500,000,000
- Force to renovate the current WWTPs and current Production lines



→ In this event, the biggest penalty is Remedial measures.

Thank You !



Options for Wastewater Treatment in Hlaing Thar Yar IZ

Toshiyuki Nishio KOBELCO ECO-SOLUTIONS CO.,LTD.
Aung Soe Oo SUPREME WATER DOCTOR CO.,LTD.

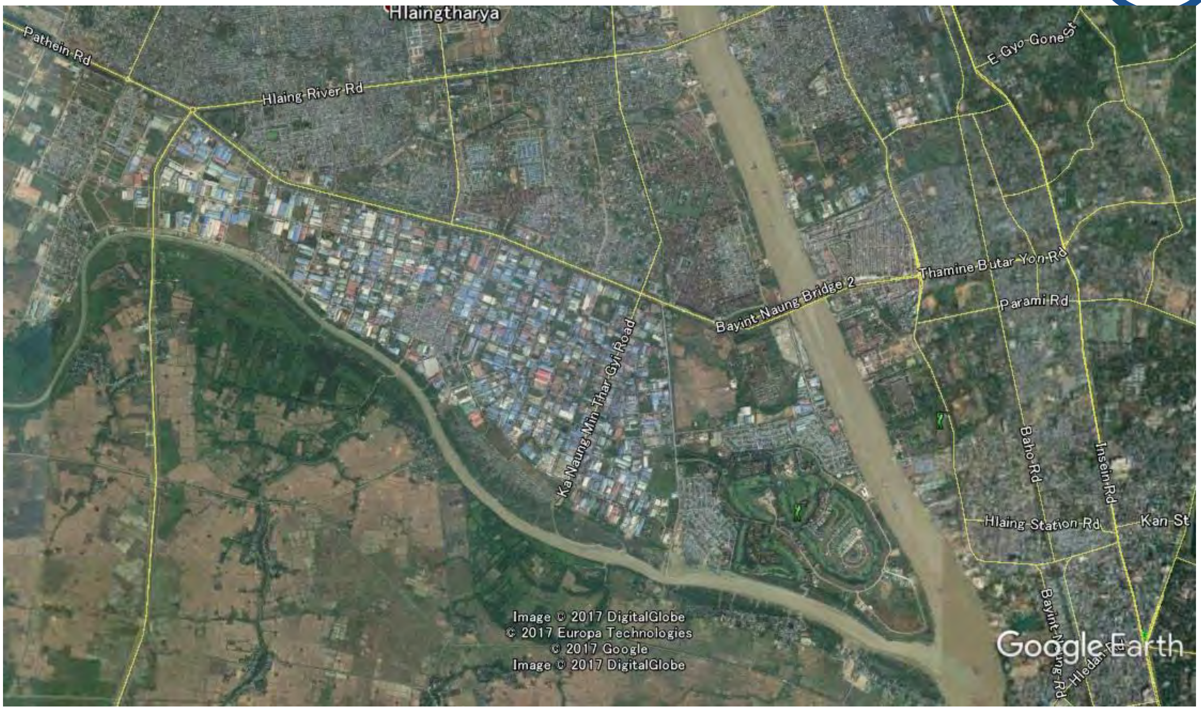
2017/ 10/30

Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar

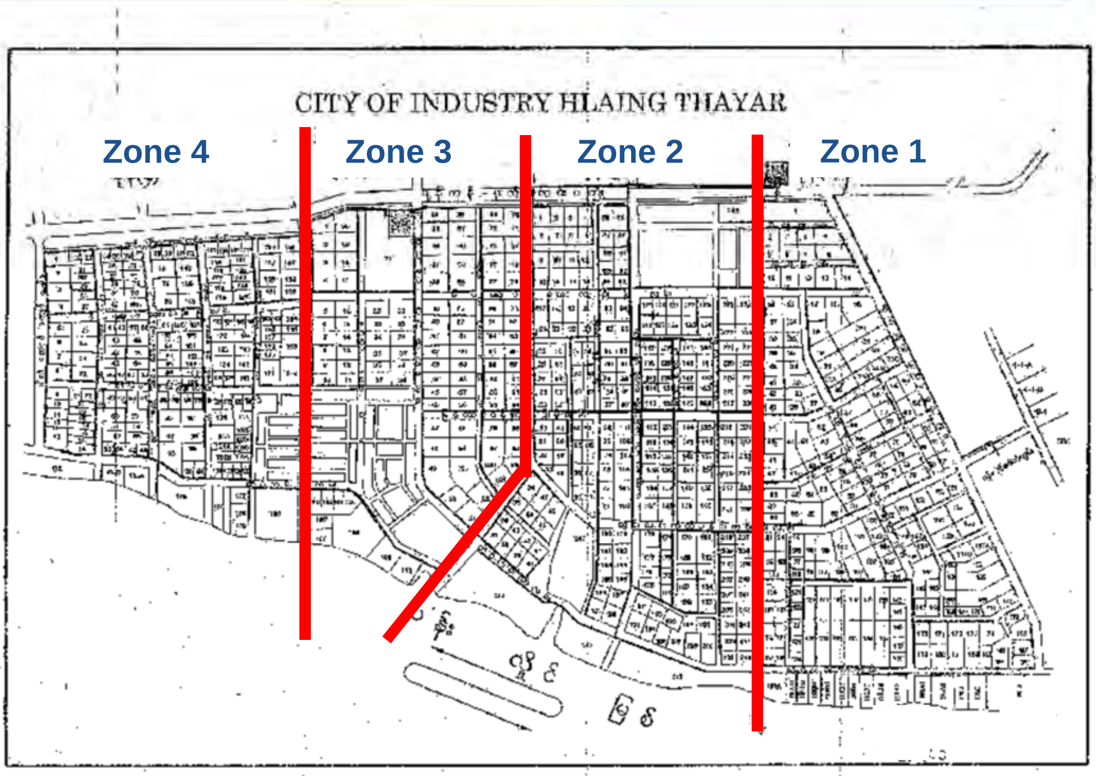
JICA Expert Team

Contents

1.Overview of Hlaing Thar Yar IZ -1



1.Overview of Hlaing Thar Yar IZ -2



1.Overview of Hlaing Thar Yar IZ -3

Number of factories and Occupied area

	Planning compartments	Occupied compartments	Occupancy rate	Occupied area (Acre)
Zone 1	190	157	83%	280
Zone 2	250	202	81%	376
Zone 3	110	82	75%	277
Zone 4	180	161	89%	243
Total	730	602	82%	1,176

Source: data from YCDC

1.Overview of Hlaing Thar Yar IZ -4

Current situation of discharging wastewater to environment

Wastewater is discharged to Pan Hlaing river through open trench, open creek.

Trench around factories

Creek

Discharging to river

2. Wastewater volume and qualities -1

- For examines and design of WWTP, first of all, it is necessary to know wastewater volume and qualities to be treated, and to know which factory is discharging wastewater to be treated in WWTP.
- In order to know them, investigation is necessary such as
  Volume - Measure wastewater flow rate from factories, or measure water usage in factories.
  Qualities- Take wastewater samples for analysis of qualities. (pH, BOD, COD, T-N, T-P etc.)
- However there are some difficulties in current situation to implement these investigation.
  - There is no flowmeter to measure wastewater from each factories.
  - Most of factories use well water in addition to supply water so that it is difficult to know total water usage in factories.
  - If wastewater sample is taken at trenches or creeks, wastewater contains rain water, which mean wastewater has been diluted.

2. Wastewater volume and qualities -2

- It is recommended to carry out each steps as follows for reliable investigation.

<Step1>

Connect wastewater pipe from each factory and combine all pipe together to 1 (or 2-3) pipe for discharging to river. (Piping network)

<Step 2>

Measure wastewater flowrate by flow meter which is installed at discharging pipe of each factory.

<Step 3>

Taking wastewater sample at discharging point of each factory and analyze qualities for several time. Representative waste water qualities for each factory can be known.

★Total wastewater volume and qualities to be treated in WWTP
★Target factories who are discharging wastewater to be treated
Can be known.

2. Wastewater volume and qualities -3

- Wastewater piping network is also beneficial
  - ★To separate wastewater from rain water in open trench, creek.
    In current situation
    - ・Wastewater in existing trench, creek generate bad odor and it affects badly to atmosphere in IZ.
    - ・When flood from trench, creek occurs due to heavy rain, rain water and wastewater flood together and then wastewater come into factory area. It would be not sound for employees and residents from sanitary point of view.
  - ★To connect to Centralized WWTP later.
  - ★To monitor and record wastewater flowrate from each factory by flowmeter for determining treatment fee.
- **For this proposal of WWTP, waste water volume and qualities are assumed based on IZ data from YCDC and KOBELCO experience in Vietnam.**

2. Wastewater volume and qualities -4

Summary of factory data in Hlaing Thar Yar zone 1

No	Kind of industry	Q'ty existing company	Q'ty plan company	Occupancy rate %	Employee	Existing Company area Acre
	Zone 1	**157**	**190**	**82%**	**13,540**	**280**
1	Garment	17			6,267	31
2	Dyeing	0			-	-
3	Ice storage	2			96	2
4	Chemical (Painting)	7			765	17
5	Chemical (Fertilizer)	0			-	-
6	Paper mill	3			223	3
7	Paper (no mill)	2			122	6
8	Food	13			654	23
9	Other					
	-People	29			3,060	45
	-Ware house	50			843	74
	-Electric	0			-	-
	-Forest	3			120	11
	-Bean	17			294	32
	-Construction	9			602	26
	-General	1			64	2
	-Machinery	4			430	7

Source: data from YCDC

2. Wastewater volume and qualities -5

Summary of factory data in Hlaing Thar Yar zone 1-4

No	Kind of industry	Q'ty existing company	Q'ty plan company	Occupancy rate %	Employee	Existing Company area Acre
	Zone 1+2+3+4	**602**	**730**	**82%**	**68,352**	**1,177**
1	Garment	87			36,656	156
2	Dyeing	6			409	9
3	Ice storage	14			1,771	22
4	Chemical (Painting)	15			1,221	41
5	Chemical (Fertilizer)	4			46	6.6
6	Paper mill	13			1,007	16
7	Paper (no mill)	2			122	6.3
8	Food	61			6,918	114
9	Other					
	-People	92			12,155	147
	-Ware house	158			2,100	260
	-Electric	8			721	22
	-Forest	17			602	32
	-Bean	54			1,047	105
	-Construction	37			1,993	96
	-General	21			915	124
	-Machinery	13			669	21

Source: data from YCDC

2. Wastewater volume and qualities -6

Wastewater volume and qualities

Mainly there are 7 kinds of wastewater in this area with difference characteristic.

- **Type 1: Domestic wastewater**
- **Type 2: Garment Industrial wastewater**
- **Type 3: Dyeing industrial wastewater**
- **Type 4: Ice storage industrial wastewater**
- **Type 5: Chemical industrial wastewater**
- **Type 6: Paper factory industrial wastewater (with and without paper mill)**
- **Type 7: Food industrial wastewater**

Wastewater volume and qualities for each type is assumed respectively.

2. Wastewater volume and qualities -7

Type 1: Domestic wastewater

Domestic WW : 80 l/person/day

No	Parameter	Factory domestic concentration With septic tank (mg/l)
1	COD	405
2	S-COD	182
3	BOD	225
4	SS	667
5	TN	64
6	TP	12
7	Oil and grease	125

Source: Vietnamese Department of Science and Technology

Quantity of employee in zone 1 = 13,540 → **WW in zone 1 = 1,083 m3/d**

Quantity of employee in 4 zones = 68,352 → **WW in 4 zones = 5,468 m3/d**

2. Wastewater volume and qualities -8

Type 2 + 3: Garment + Dyeing industrial wastewater

Garment WW = 103.7 m3/acre/day **(50% of garment factories discharge washing ww)**

Dyeing WW = 480 m3/acre/day

No	Parameter	Garment mg/l	Dyeing mg/l
1	COD	1,300	2,500
2	s-COD	1,040	2,000
3	BOD	260	1000
4	SS	61	200
5	TN	150	130
6	TP	5	10

Source: Vietnamese Garment + Dyeing factory

Garment factory area in zone 1 = 31 acre → **WW in zone 1 = 1,616 m3/d**

Garment factory in 4 zones = 156 acre → **WW in 4 zones = 8,062 m3/d**

Dyeing factory area in zone 1 = 0 acre → **WW in zone 1 = 0 m3/d**

Dyeing factory area in 4 zones = 9 acre → **WW in 4 zones = 4,325 m3/d**

2. Wastewater volume and qualities -9

Type 4: Ice storage industrial wastewater

Ice storage WW= 1.5 m3/employee/day

No	Parameter	mg/l
1	COD	2,000
2	s-COD	900
3	BOD	1500
4	SS	500
5	TN	100
6	TP	31

Source: Water usage and effluent treatment in the fish industrial - Sea fish report No.412 – J P MacNamara H Teepsoo

Ice factory people in zone 1 = 96 person — **WW in zone 1 = 144.7 m3/d**

Ice factory people in 4 zones = 1,771 person — **WW in 4 zones = 2,670 m3/d**

2. Wastewater volume and qualities -10

Type 5: Chemical (Painting, Fertilizer) industrial wastewater

Painting WW = 50 m3/acre/day

Fertilizer WW = 62.5 m3/acre/day

No	Parameter	Painting mg/l	Fertilizer mg/l
1	COD	3,000	355
2	s-COD	540	160
3	BOD	600	178
4	SS	2000	463
5	TN	50	200
6	TP	2	2

Source: Painting + fertilizer factory – Ho Chi Minh, Vietnam

Painting factory area in zone 1 = 17.4 acre — **WW in zone 1 = 871 m3/d**

Painting factory area in 4 zones = 40.8 acre — **WW in 4 zones = 2,038 m3/d**

Fertilizer factory area in zone 1 = 0 acre — **WW in zone 1 = 0 m3/d**

Fertilizer factory area in 4 zones = 6.6 acre — **WW in 4 zones = 415 m3/d**

2. Wastewater volume and qualities -11

Type 6: Paper (with and without paper mill) industrial wastewater

with paper mill WW= 206 m3/acre/day
w/o paper mill WW = 99.5 m3/acre/day

No	Parameter	Paper mill	w/o paper mill
		mg/l	mg/l
1	COD	5,500	500
2	s-COD	3,614	300
3	BOD	3000	300
4	SS	3000	450
5	TN	9	1
6	TP	2	0.1

Source: Paper factory – Binh Duong, Vietnam

Paper mill factory area in zone 1 = 3.4 acre → **WW in zone 1 = 697 m3/d**
Paper mill factory area in 4 zones = 16.3 acre → **WW in 4 zones = 3,362 m3/d**

Paper w/o mill factory area in zone 1 = 6.3 acre → **WW in zone 1 = 621.2 m3/d**
Paper w/o mill factory area in 4 zones = 6.3 acre → **WW in 4 zones = 621.2 m3/d**

2. Wastewater volume and qualities -12

Type 7: Food industrial wastewater

Food WW = 66.9 m3/acre/day

No	Parameter	mg/l
1	COD	1,880
2	s-COD	1,034
3	BOD	1176
4	SS	510
5	TN	35.6
6	TP	11.8

Source: Food factory – Binh Duong, Vietnam

Food factory area in zone 1 = 23.1 acre → **WW in zone 1 = 1,547 m3/d**
Food factory area in 4 zones = 114.3 acre → **WW in 4 zones = 7,650 m3/d**

2. Wastewater volume and qualities -13

Summary of assumed ww volume and qualities

No	Kind of industry	Design flowrate	Calculated flowrate	COD	s-COD	BOD	SS	TN	TP
		m3/d	m3/d	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
	Zone 1	**8,300**	**6,581**	**1,899**	**1,031**	**836**	**881**	**65.6**	**7.1**
1	Domestic		1083	405	182	225	667	64.1	12.0
2	Garment		1616	1,300	1,040	260	61	150	5.0
3	Dyeing			2,500	2,000	1,000	200	130	10.0
4	Ice storage		145	2,000	900	1,500	500	100	31.0
5	Chemical								
	Painting		871	3,000	540	600	2,000	50	2.0
	Fertilizer			355	160	178	463	200	2.0
6	Paper								
	Paper mill		697	5,500	3,614	3,000	3,000	9.0	2.0
	Without paper mill		621	500	300	300	450	1.0	0.1
7	Food		1548	1,880	1,034	1,176	510	35.6	11.8

Design flowrate = Calculated flowrate/0.8 (0.8 = Occupancy rate)

2. Wastewater volume and qualities -14

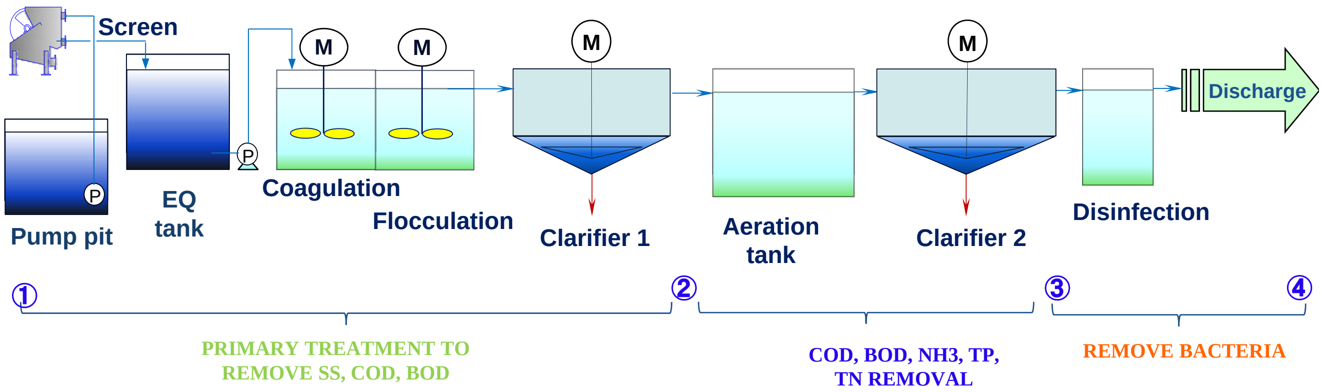
Summary of assumed ww volume and qualities

No	kind of industry	Design flowrate	Calculated flowrate	COD	s-COD	BOD	SS	TN	TP
		m3/d	m3/d	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
	Zone 1 +2+3+4	**43,300**	**34,614**	**1,973**	**1,209**	**931**	**719**	**83.1**	**9.6**
1	Domestic		5,468	405	182	225	667	64.1	12.0
2	Garment		8,062	1,300	1,040	260	61	150	5.0
3	Dyeing		4,325	2,500	2,000	1,000	200	130	10.0
4	Ice storage		2,670	2,000	900	1,500	500	100	31.0
5	Chemical								
	Painting		2,038	3,000	540	600	2,000	50	2.0
	Fertilizer		415	355	160	178	463	200	2.0
6	Paper								
	Paper mill		3,362	5,500	3,614	3,000	3,000	9.0	2.0
	Without paper mill		621	500	300	300	450	1.0	0.1
7	Food		7,650	1,880	1,034	1,176	510	35.6	11.8

Design flowrate = Calculated flowrate/0.8 (0.8 = Occupancy rate)

3. Proposed Treatment Process and Layout -1

Treatment Process

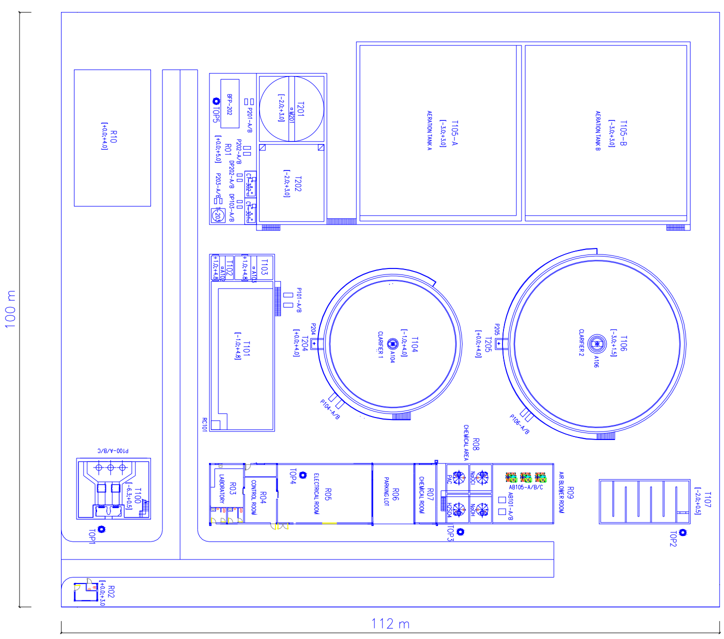


Parameter	Unit	Inlet ①			Outlet ④
COD	mg/l	1780 - 1800			< 250
BOD	mg/l	700 - 800			< 50
SS	mg/l	600 - 720			< 50
NH3-N	mg/l	80 - 95			< 10
TP	mg/l	6.5 - 9			< 2
Coliform	MPN/100 ml				< 400

Outlet Conform to Effluent levels for Wastewater Treatment Facilities in National Environmental Quality (emission) guidelines 22 Apr. 2015

3. Proposed Treatment Process and Layout -2

Layout for zone 1

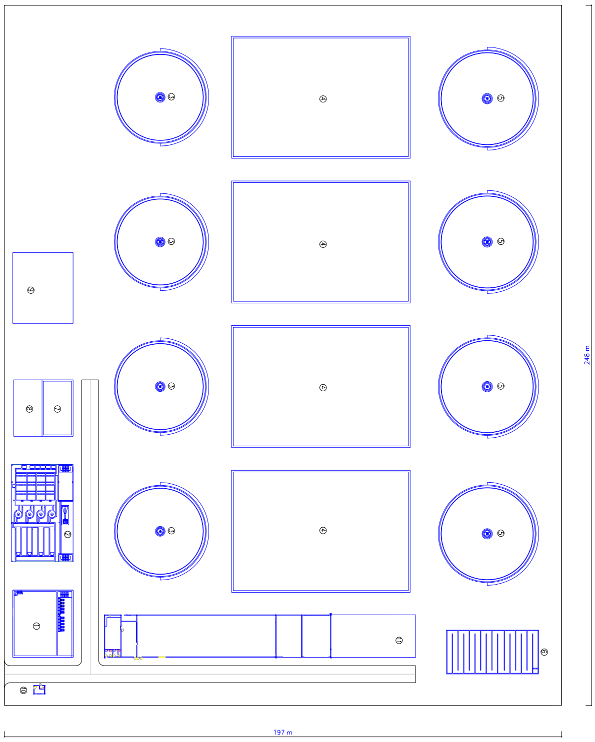


Capacity: 8,300 m3/d

Area 112 x 100 = 11,200 m2

3. Proposed Treatment Process and Layout -3

Layout for 4 zones



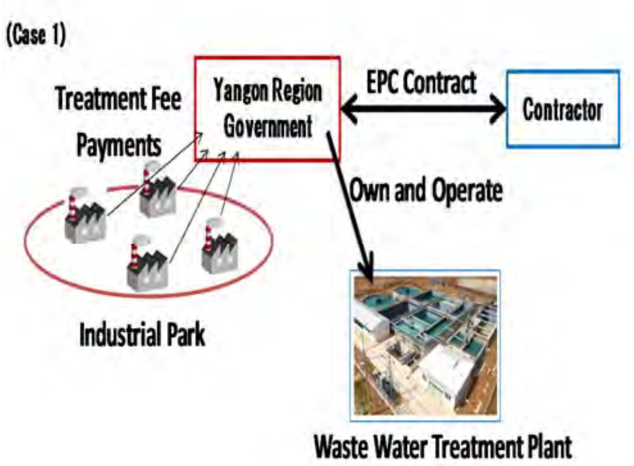
Capacity: 43,300 m3/d

Area 250 x 200 = 50,000 m2

4. Several options for Project Scheme -1

◆ Project Scheme : Government Owned

- The financing for project will be arranged by Yangon Region Government.
- In principle, Contractor carries out the works under EPC Contract (Case 1). If necessary, Yangon Region Government and Contractor may enter into O&M Contact in addition to EPC Contract (Case 2).



4. Several options for Project Scheme -2

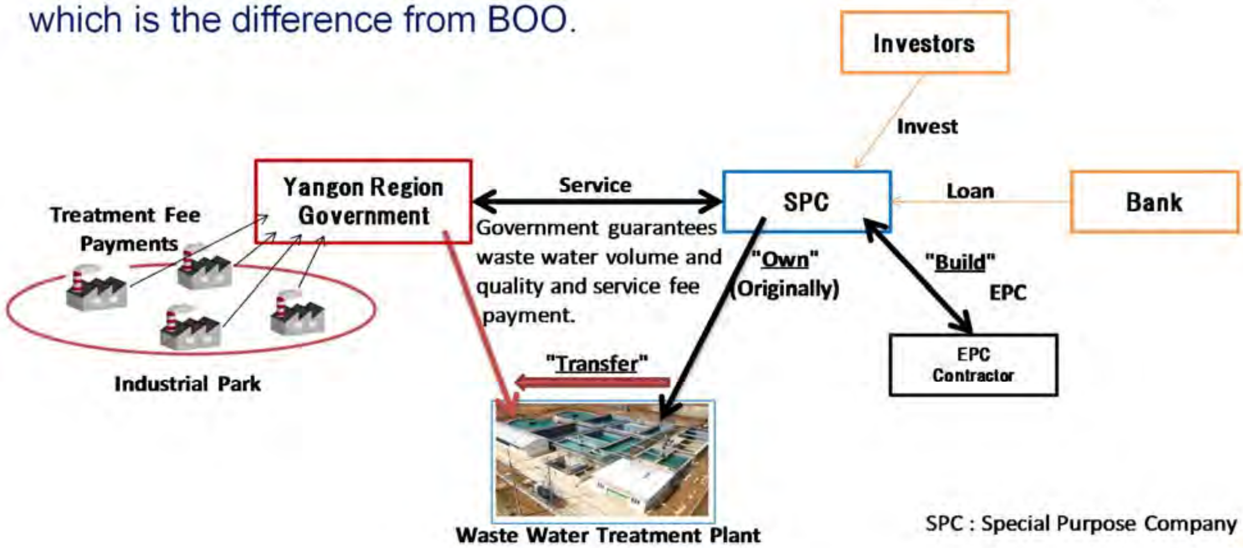
◆ Project Scheme : "BOO" (Build – Own – Operate)

- The financing for project will be arranged by Investor that sets up SPC. (Special Purpose Company)
- SPC builds and owns the Waste Water Treatment Plant and provides Yangon Region Government with services of treatment of waste water.

4. Several options for Project Scheme -3

◆ Project Scheme : "BOT" (Build – Operate – Transfer)

- The basic conditions such as financing, contract scheme, etc. are same as BOO.
- In BOT, the ownership of Waste Water Treatment Plant will be transferred after reasonable return of investment has been obtained by Investors, which is the difference from BOO.



4. Several options for Project Scheme -4

◆ Comparison

	Government Owned	Private Company Owned	
		BOO (Build-Own-Operate)	BOT (Build-Operate-Transfer)
Arrangement of Funds - CAPEX - OPEX	Government (Yangon Region Government)	SPC	
Payment by Government	- For Construction of Plant to EPC Contractor (Payment at the time of constrction) - For Operation and Maintenance (O&M) to Cotractor if it is outsourced.	- For Waste Water Treatment Service to SPC (Payment over the period of Waste Water Treatment Service)	
Source of Fund for Payment by Government	Own fund for construction of Plant (= Tax revenue or Loan) * Fund for construction of Plant and O&M will be collected from factories in the industrial zone (Tenants) over the period of plant operation.	Fee collected from factories in the industrial zone (Tenants) * It is recommended to set the Government's fee charged to Tenants higher than the fee paid to SPC in order to cover expenses of Government.	
Ownership of Waste Water Treatment Plant	Yangon Region Government	SPC	- Originally, SPC owns plant. - After reasonable return of investment has been obtained by Investors, ownership is transferred to Yangon Region Government.
Summary of role of Government	- Arrangement of fund - Operation and Maintenance of Plant - Colletion of fees from Tenants - Arrangement of land - Arrangement of resettlement (if required)	- Payment of waste water treatment service fee - Guarantee of waste water volume and quality - Collection of fee from Tenants - Arrangement of land - Arrangement of resettlement (if required)	

5. General Scope of work

General Scope of work (in case of BOO, BOT)

No.	Items	Gov. (IZ side)	SPC
1	Supply design wastewater volume and qualities for WWTP	○	
2	Basic design of WWTP (flow sheet, layout)		○
3	Supply necessary land according to WWTP layout	○	
4	Soil investigation	○	
5	Supply utilities (Electricity, Water) to the location of WWTP	○	
6	Piping network and flow meter inside of IZ	○	
7	Detail design of WWTP		○
8	Procurement of Equipment for WWTP		○
9	Construction of WWTP		○
10	Operation and maintenance of WWTP (Operators, Utilities consumption, chemicals, sludge treatment)		○
11	Collect treatment fee from each factory	○	
12	Payment of treatment fee to SPC	○	
13	Guarantee of minimum wastewater volume and qualities to be treated (min treatment fee)	○	

[shaded box] : these works can be "preliminary investigation PJ" before WWTP PJ

6. Current Issues and risks to be considered -1

Issues to be solved (in case of BOO, BOT)

There are some issued regarding government's scope of work.

No.	Items	Impact to
1	Make clear ww volume discharged from each factory	To whom treatment fee can be charged, Setting treatment fee to be charged
2	Make clear ww qualities discharged from each factory	
3	Make clear total ww volume to be treated by WWTP	Design capacity of WWTP
4	Make clear mixed ww qualities to be treated by WWTP	
5	Increasing ww volume due to future expansion of factory	
6	Location of WWTP, Soil data	Investment cost for WWTP (piling , piping)
7	Secure necessary land for WWTP	Construction of WWTP
8	Establish the method to check ww volume and qualities from factories for charging treatment fee	Proper collection of treatment fee
9	Establish the method how to calculate treatment fee	Recovering WWTP construction and operation cost
10	Make regulation for factories	Control of ww from factories for stable operation of WWTP
1)	- maximum acceptable concentration to discharge (BOD< ??? mg/l)	
2)	- request to monitor ww volume, qualities by factories	
3)	- warning, sanctioning in case factory discharge ww illegally	
11	How to raise money for inspectors who record ww volume, qualities of each factory.	Treatment fee
12	Explanation and agreement with factories regarding regulation, charging treatment fee	Troubles with factories in future

6. Current Issues and risks to be considered -2

Risks to occur possibly (in case of BOO, BOT)

There are some risks recommended to take into account in advance.

No.	Items	Impact to
1	Can not secure guaranteed minimum wastewater volume and quaities to be treated (min treatment fee)	Recovering WWTP construction and operation cost
2	Factories may construct their own WWTP and discharge treated ww directly.	
3	Factories may move to other IZ where there is no control of ww.	
4	Price fluctuations, exchange rate fluctuations	Increasing of treatment fee
5	Emission guideline is revised stricter in future.	Expansion of WWTP which causes increasing of treatment fee

It is important to know risks in advance and make countermeasures for them.

Thank You !

The Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar

(Water Environment Management Component)

17 May 2018
Itaru OKUDA
JICA Expert Team

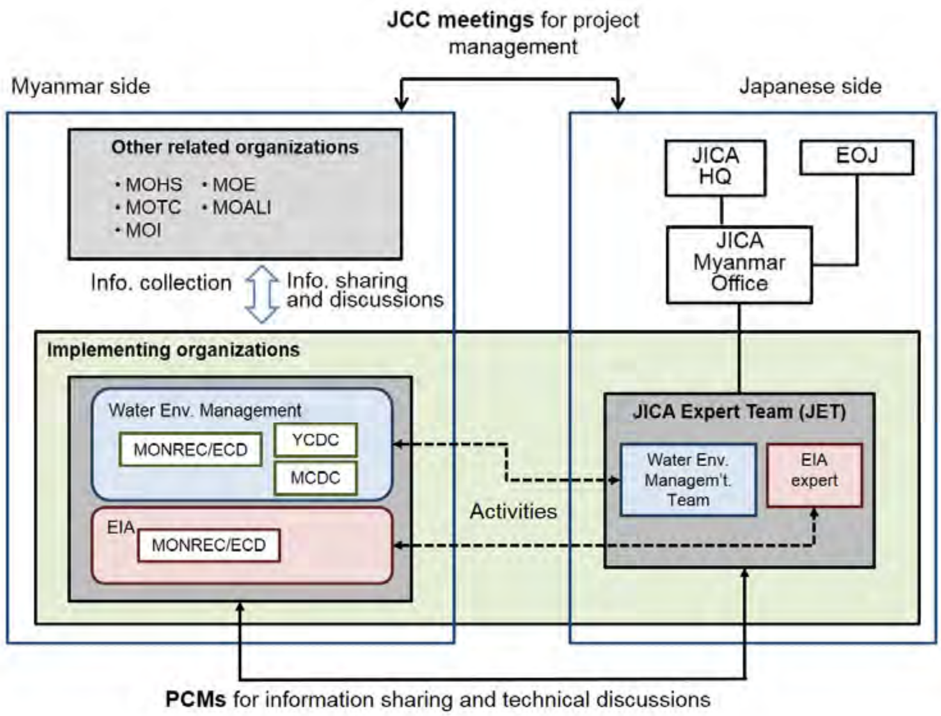
Overall Framework of the Project

- Bilateral cooperation project between Myanmar and Japan
- Based on Record of Discussions (R/D) singed by then MOECAF and JICA in December 2014
- June 2015 – May 2018 (3 years)
- Capacity development in two areas:
  - Water environment management (industrial wastewater management)
  - Environmental Impact Assessment
- Implementing organizations:
  - MONREC (ECD), MCDC and YCDC
- Project website
  - http://myanmar-waterenvironment.com

Overall Goal, Project Purpose and Outputs

Overall Goal	Impact of industrial effluents from industrial zones on river water quality is alleviated, and advanced EIA approach for complicated issues are taken into account.		
Project Purpose	Capacity for developing basic water pollution control measures based on obtained and interpreted information is enhanced and the institutional framework of the EIA review works is established.		
Outputs	Output 1	Inspection procedure is standardized.	Water environment management
	Output 2	Capacity for implementing water quality survey to obtain reliable information is enhanced.	Water environment management
	Output 3	Database of water pollution sources and river water quality is developed.	Water environment management
	Output 4	Capacity of interpreting the information for water pollution control measures is enhanced.	Water environment management
	Output 5	Necessary technical manuals and forms for the EIA review are developed.	EIA
	Output 6	Capacity of MONREC and the EIA Report Review Body on the EIA review is enhanced.	EIA

Organizational Structure of the Project



Organizational structure

JCC Meetings

No.	Date	Summary
No.1	8 Jul 2015	■ Kick-off JCC ■ Appointment of JCC Members
No.2	18 Dec 2015	■ Amendment of PDM and PO
No.3	9 Nov 2016	■ Mid-term Review ■ Amendment of PDM
No.4	22 Feb 2017	■ Terminal Evaluation
No.5	17 May 2018	■ Final JCC

Results of Terminal Evaluation

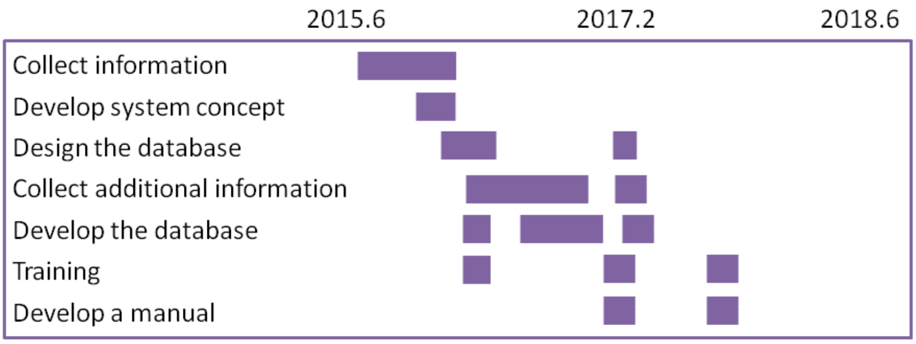
Criteria	Concept	Result	Reasons
Relevancy	Whether Project's design and approach are appropriate to key policies and beneficiary's needs	High	The project was consistent with policies and needs, and the project design was appropriate.
Effectiveness	Whether six outputs all together have achieved Project's primary objective	High	Given the context and achievements, the project was successful.
Efficiency	Whether inputs and activities are managed efficiently	Relatively High	Although the project lacked some inputs and coordination in the first year, the members were highly committed, and the project was managed well.
Impact	Impact over time and across sectors	Relatively High	Because the Overall Goals are likely to be achieved, and knowledge-sharing has been observed.
Sustainability	Whether activities and outcomes of this Project will last	Moderate	For some CPs, the mandate and the staff assignment still need to be clarified, and capacity development should continue.

Industrial Pollution Sources

Framework of Output 3 Activities

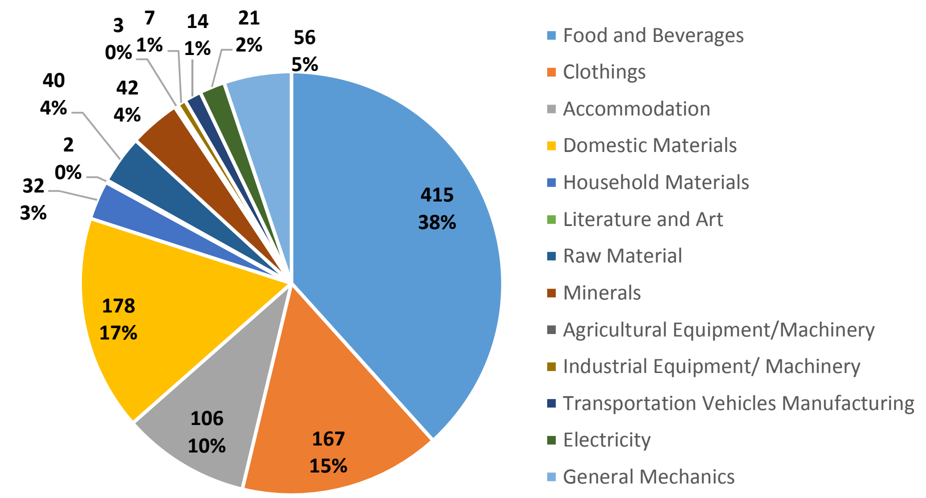
Output 3 - Database Development	
Output:	Database of water pollution sources and river water quality is developed.
Indicator:	✓ At least 150 factories' information is accessible on the database. ✓ Results of water quality survey is accessible on the database.

Output3: Database development



Sector Composition of Factories in Hlaing River Basin

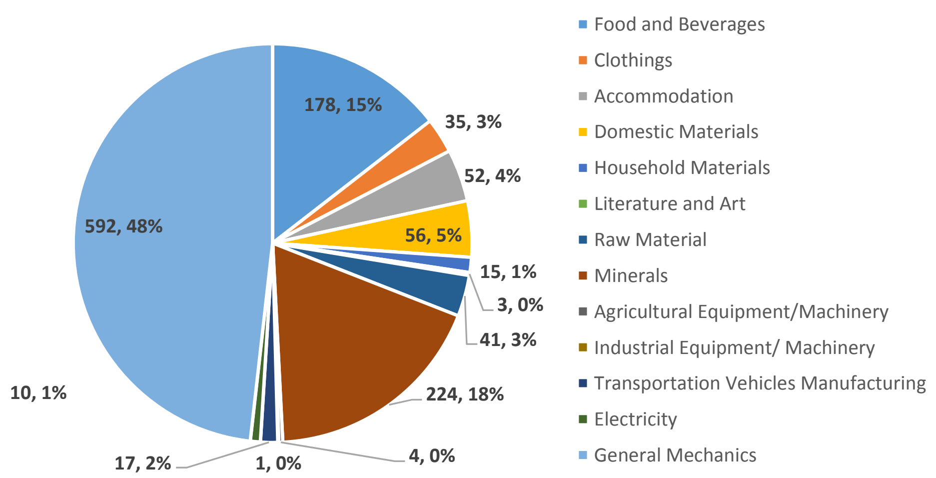
(1,083 factories; 90,211 employees)



Source: DISI as of 2017

Sector Composition of Factories in Pyi Gyi Tagon IZ

(1,228 factories, 16,150 people)

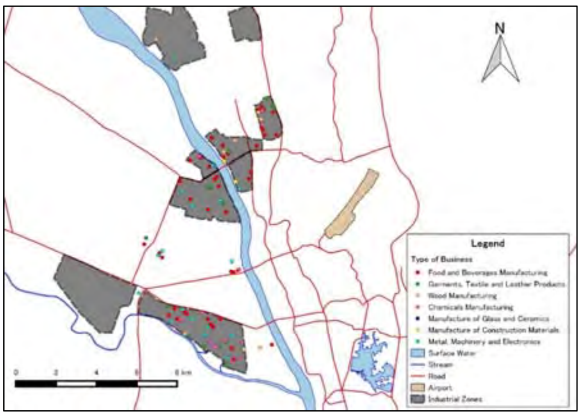


Source: DISI as of 2017

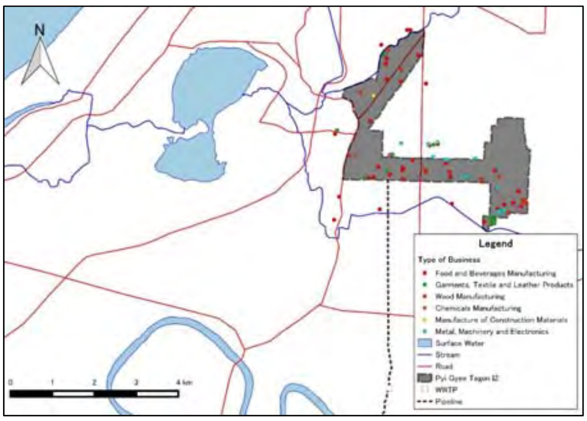
Pollution Source Surveys in 2016 and 2017

Category		Period 1 (2016)	Period 2 (2017)
Activity		To collect additional information required to develop database	
Survey Area		- Hlaing River Basin - Doke Hta Waddy River Basin	- Same as Period 1
Scope	Questionnaire Survey **[Basic Information]**	**200 factories** (100 factories each in Yangon & Mandalay)	**2 factories** (2 factories in Mandalay)
	Wastewater Sampling **[Water Quality]**	**50 Factories** (25 factories each in Yangon & Mandalay)	**50 Factories** (25 factories each in Yangon & Mandalay) • 18 samples out of 50 were analyzed not only in Myanmar/Thailand but also in Japan. • Some target factories were overlapped.
Period		- Aug to Nov 2016	- Aug to Sep 2017

Locations of Target Factories of Questionnaire Survey
(200 factories in 2016)



Hlaing River Basin



Doke Hta Waddy River Basin

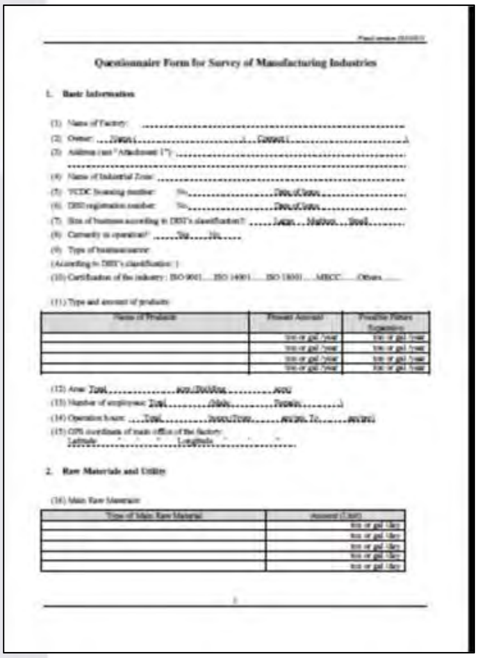
Source: JET

Pollution Source Survey (Activity 3-4)

Workshop in Yangon on 10th Aug. 2017 (left), and in Mandalay on 15th Aug. 2017

Wastewater Sampling (On-site Measurement)

Questionnaire Survey



Questionnaire Form for Survey of Manufacturing Industries

1. Basic Information

(1) Name of Factory:
(2) Owner: Name ( ) Contact ( )
(3) Address (see "Attachment 1"):
(4) Name of Industrial Zone:
(5) YCDC licensing number: No. Date of Issue
(6) DISI registration number: No. Date of Issue
(7) Size of business according to DISI's classification?: Large Medium Small
(8) Currently in operation?: Yes No
(9) Type of business/sector
(According to DISI's classification:)
(10) Certification of the industry: ISO 9001 ISO 14001 ISO 18001 MBCC Others

(11) Type and amount of products

Name of Products	Present Amount	Possible Future Expansion
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year
	ton or gal /year	ton or gal /year

(12) Area: Total acre (Building acre)
(13) Number of employees: Total (Male Female)
(14) Operation hours:
(15) GPS coordinates of main office of the factory:
Latitude Longitude

2. Raw Materials and Utility

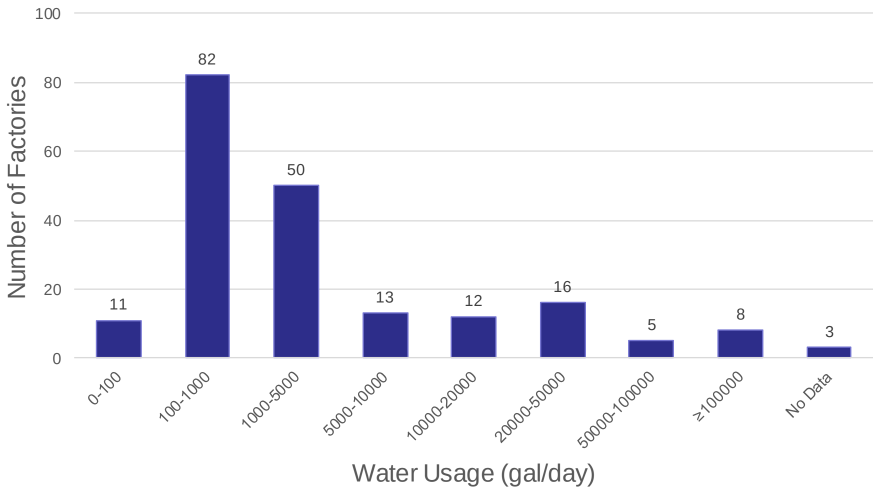
(16) Main Raw Materials

Type of Main Raw Material	Amount (Unit)
	ton or gal /day
	ton or gal /day
	ton or gal /day
	ton or gal /day
	ton or gal /day

In total about 47 questions:

- Basic information (15 questions)
  - Sector, products, land area, etc.
- Raw materials and utility (4 questions)
  - Raw materials, water usage, etc.
- Layout of factory and manufacturing process (2 questions)
- Wastewater (9 questions)
  - Wastewater volume, minimization of water usage, wastewater treatment, etc.
- Solid waste (4 questions)
  - Hazardous and non-hazardous waste
- Environmental management (13 questions)
  - EMP, emergency plan, etc.

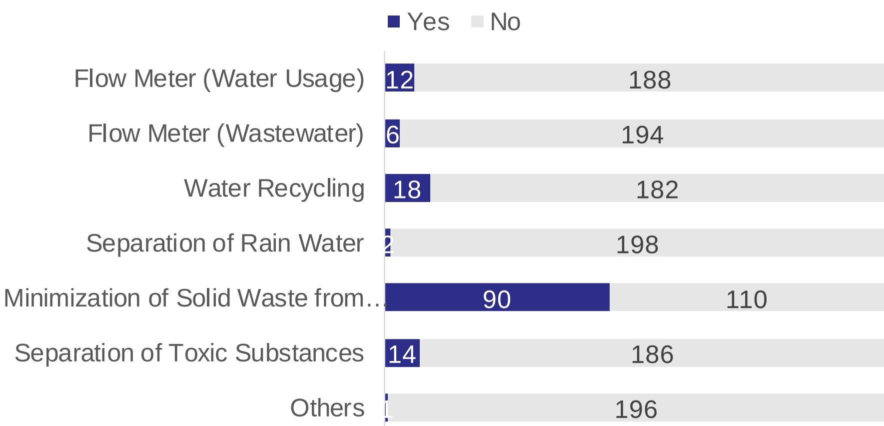
Water Usage in 2016
(200 factories in Yangon and Mandalay)



Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016.

- Most factories use little water, but there are some factories that use a lot of water.

Measures to Minimize Pollution in 2016
(200 factories in Yangon and Mandalay)

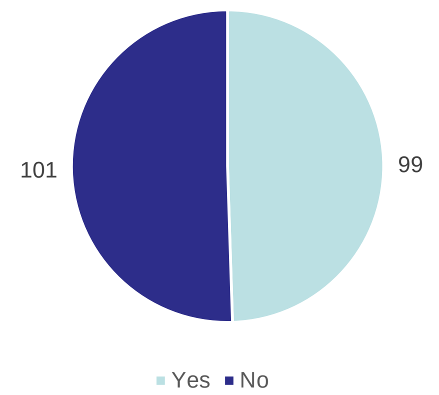


Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016.

- Most factories do not have accurate information about the amount of water they are using/discharging.
- There are some efforts to minimize pollution, but they are not implemented in a structured manner.

Existence of Wastewater Treatment Facilities in 2016

(200 factories in Yangon and Mandalay)

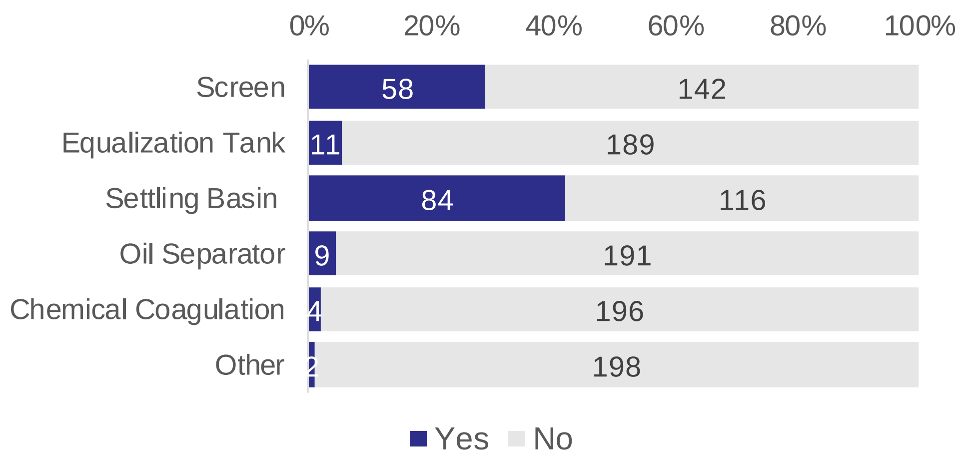


Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016.

- Only half of factories have wastewater treatment facilities.

Primary Treatment Facilities in 2016

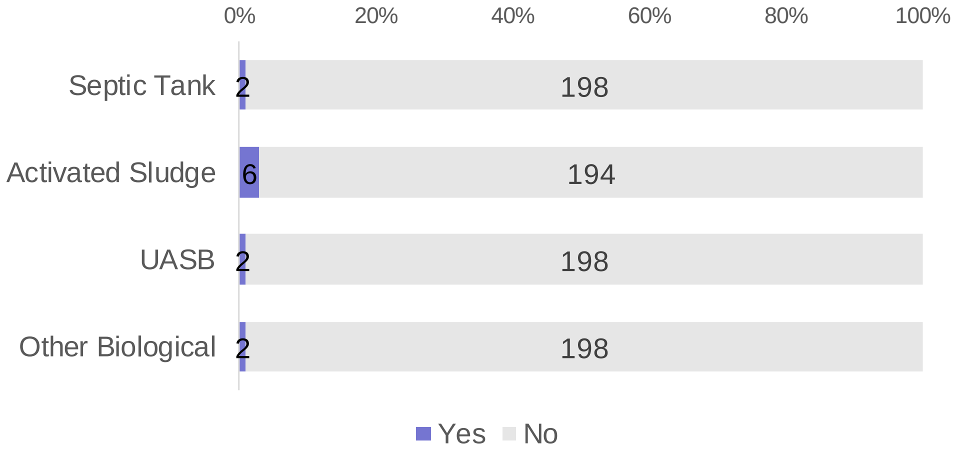
(200 factories in Yangon and Mandalay)



Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016.

- About half of factories have simple primary treatment facilities to remove solid waste and sludge.

Secondary Treatment Facilities in 2016
(200 factories in Yangon and Mandalay)



Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016.

- Few factories have secondary treatment facilities to biologically remove organic matter.

Effluent BOD and COD Concentrations in 2016 and 2017

BOD	1st Period			2nd Period		
	Yangon	Mandalay	Total	Yangon	Mandalay	Total
0 – 20 mg/L	6	2	8	1	0	1
20 – 50 mg/L	1	1	2	4	0	4
50 – 100 mg/L	1	2	3	8	0	8
100 – 1,000 mg/L	10	6	16	12	16	28
1,000 – mg/L	5	8	13	0	9	9
No Data	2	6	8	0	0	0
Total	25	25	50	25	25	50

COD	1st Period			2nd Period		
	Yangon	Mandalay	Total	Yangon	Mandalay	Total
0 – 100 mg/L	9	1	10	0	0	0
100 – 250 mg/L	2	2	4	1	1	2
250 – 1,000 mg/L	7	4	11	6	2	8
1,000 – 2,000 mg/L	1	1	2	15	9	24
2,000 – mg/L	4	11	15	3	13	16
No Data	2	6	8	0	0	0
Total	25	25	50	25	25	50

Source: JET, 2016 and 2017
Based on wastewater analysis of 50 factories
in Yangon and Mandalay in 2016 and 2017

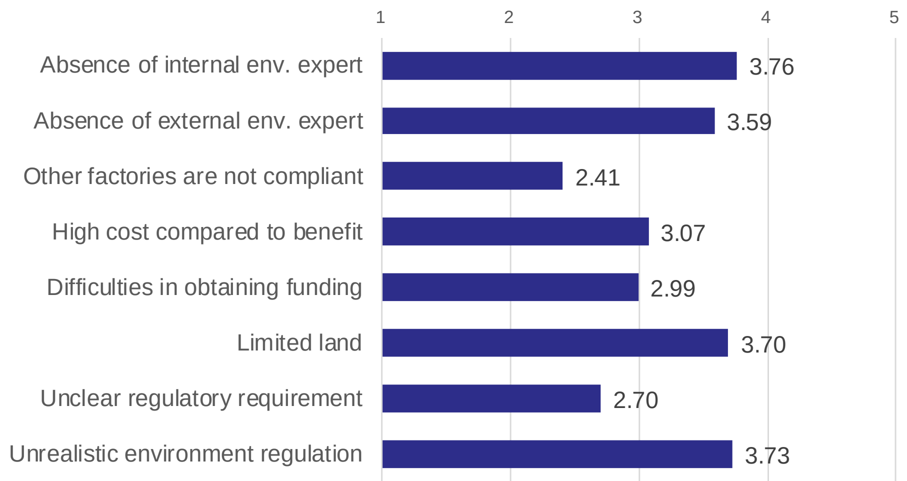
Effluent Concentrations vs. NEQEG (2015) Values in 2017

Category	BOD	COD	TN	TP
Equal to or Under NEQEG Value	5	16	23	24
Over NEQEG Values	39	28	17	20
No Evaluation[1)]	6	6	10	6
Total	50	50	50	50

1): Further information such as production volume is needed to collect for evaluation
Source: JET, 2017
Based on wastewater analysis of 50 factories in Yangon and Mandalay in 2017

- Many factories are not meeting the NEQEG values.

Difficulties in Installing Sophisticated WWTP in 2016 (200 factories in Yangon and Mandalay)



Source: JET, 2016
Based on questionnaire survey of 200 factories in Yangon and Mandalay in 2016

- It is important to understand what are preventing factories to install WWTPs.

Conclusions

- Many factories are yet to adopt more sophisticated environmental measures in line with their EMPs and ECCs:
  - Reduction of wastewater
  - Reduction of waste materials going into wastewater stream
  - Treatment of wastewater (including connection to 10-inch-pipeline)
  - Monitoring of wastewater quality and quantity
  - Other measures in line with EMP/ECC
- Factories will face various difficulties in meeting the requirements of EMPs and ECCs, and some support from the environmental authorities is desirable.
- It is important to promote centralized (or joint) wastewater treatment. This may be done by NECCCCC.

Thank you very much for your attention
and support to the project!

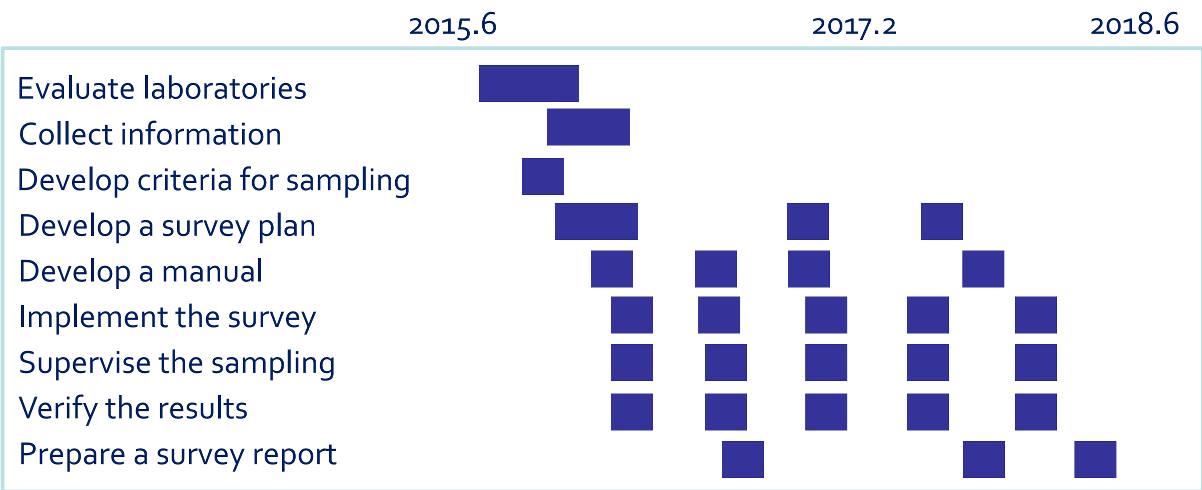
Japan International Cooperation Agency

Final Seminar in Nay Pyi Taw and JCC Meeting No. 5

Outputs of Project Activities
Output 2: Water Quality Survey

17 May 2018
Tomoe TAKEDA, JICA Expert Team

Framework of Output 2 Activities



Output : Capacity for implementing water quality survey to obtain reliable information is enhanced.

Indicator : Water quality survey reports are prepared in the pilot area by YCDC and MCDC

Japan International Cooperation Agency

Water Quality Surveys in 2016 and 2017

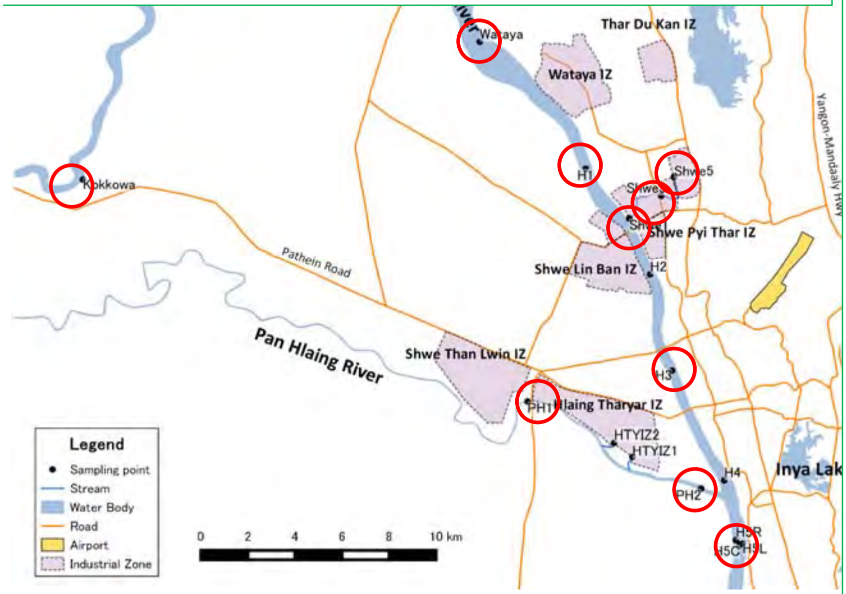
Category		Period 1 (2016 – early 2017)	Period 2 (late 2017 – early 2018)
Period		• 1st survey: Feb 2016 (dry season) • 2nd survey: Jun 2016 (rainy season) • 3rd survey: Jan - Feb 2017 (dry season)	• 4th survey: Sep - Oct 2017(rainy season) • 5th survey: Feb 2018 (dry season)
Scope	Hlaing River Basin	• 9-10 sampling points • 8 on-site-measurement parameters • 29 measurement parameters for lab analysis at max.	• 10 sampling points • 8 on-site-measurement parameters • 35 measurement parameters for lab analysis at max.
	Doke Hta Waddy River Basin	• 10-14 sampling points • 8 on-site-measurement parameters • 29 measurement parameters for lab analysis at max.	• 15 sampling points • 8 on-site-measurement parameters • 35 measurement parameters for lab analysis at max.

Japan International Cooperation Agency

Water Quality Survey in Hlaing River Basin

Survey Scope

- 4th survey (late Sep 2017) & 5th survey (middle Feb 2018) (spring tide period)
- In ebb tide time in Hlaing River
- 15 sampling points



[On site measurement]

- pH, EC, DO, TDS, salinity, turbidity, water temperature, ORP

[Lab analysis]

- TSS, BOD, COD, cyanide, oil and grease, phenols, total phosphorus and total nitrogen, for all points
- Total coliform, zinc, total chromium, hexavalent chromium, arsenic, copper, total mercury, cadmium, and lead for representative points
- 17 pesticides* and PCBs for one or two points

*Aldrin, atrazine, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan, endosulfan sulfate, endrin, HCH-alpha (benzene hexachloride-alpha), HCH-beta, HCH-delta, HCH-gamma(Lindane), alachlor, diazinon, chlorpyrifos, dimethoate and imidacloprid

Survey Questions

Survey Questions

1. What is the status of water quality in Hlaing River?
2. Does water quality in Hlaing River change from upstream to downstream?
3. Does water quality in Hlaing River change with season?
4. How is the pollution impact from IZs to Hlaing River?

(1) Classification of Water Quality in Hlaing River

Water Quality in Hlaing River

- Rainy season: Acceptable for conservation of aquatic lives, irrigation and water transportation except TSS and total coliform
- Dry season: Deteriorated at most points (high COD, slight oil and grease etc.)
- No elevated levels of toxic substances within the scope of survey

Unit: mg/L

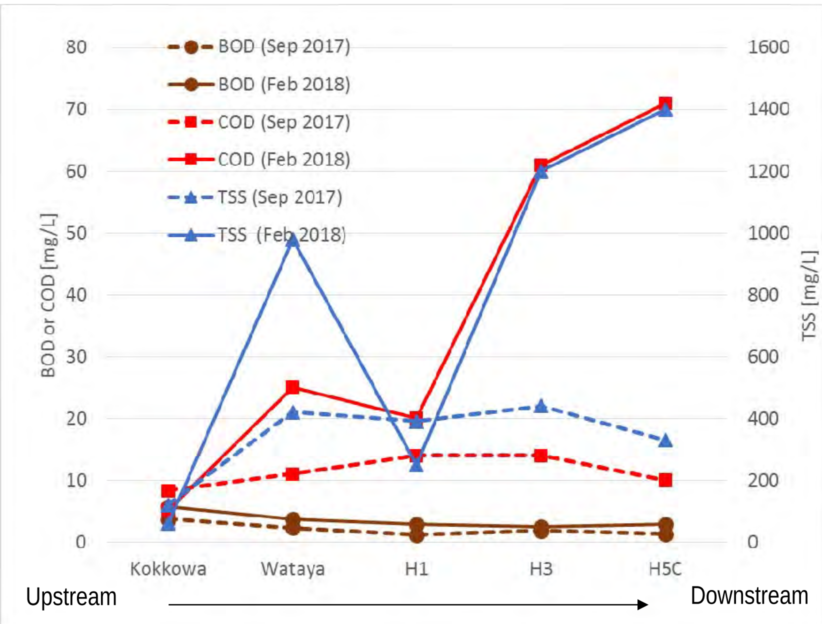
Target		BOD						COD					
		Rainy Season(Sep 2017)			Dry Season(Feb 2018)			Rainy Season(Sep 2017)			Dry Season(Feb 2018)		
		Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
River	Hlaing River	1.2	2.3	1.6	2.4	3.7	3.0	10	14	12	20	71	44
	Pan Hlaing River	0.7	1.6	1.1	3.8	44.6	24.2	12	14	13	63	3400	1732
	Kokkowa River	3.7			5.7			8.3			5.2		
Creek	Creek in Shwe Pyi Tar IZ	5.4	32	14	134	268	222	19	44	28	230	5700	3610

Vietnamese Environmental Standard(QCVN08:2015) for reference

Water Usage		BOD	COD
A1	For domestic water supply	4	10
A2	For domestic water supply with treatment and conservation of aquatic lives	6	15
B1	For irrigation	15	30
B2	For water transportation and other purposes with demand for low-quality water	25	50
Less than B2		>25	>50

(2) Spatial Distribution of WQ in Hlaing River

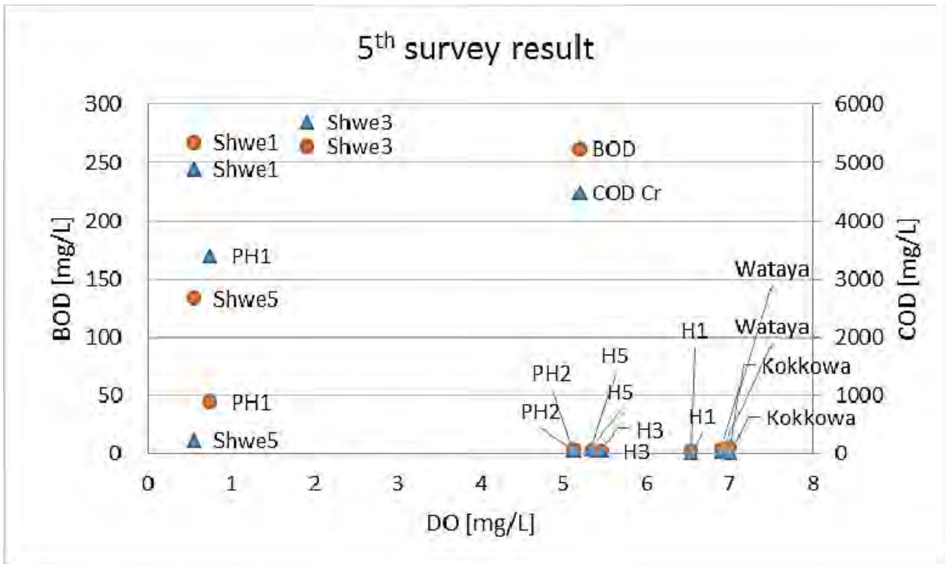
- Rainy season: Not significantly changes from upstream to downstream
- Dry season: COD increased in downstream probably caused by higher suspended solid.



(2) Spatial Distribution of WQ in Hlaing River

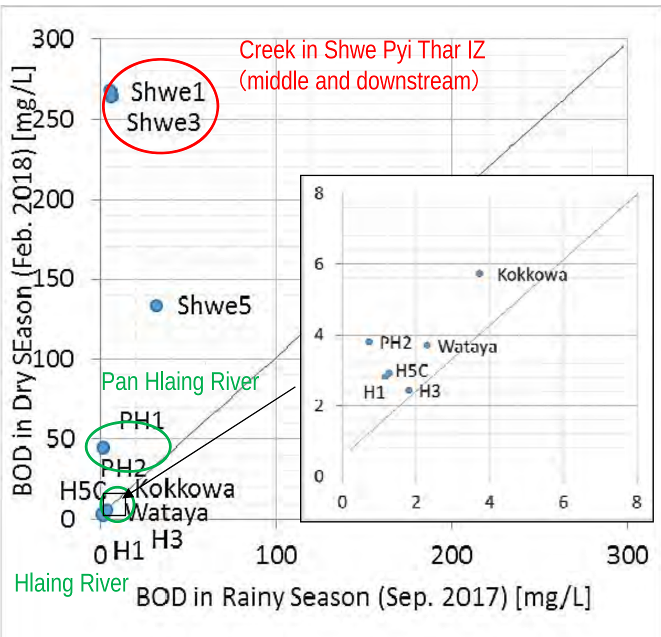
Water Quality in Pan Hlaing River

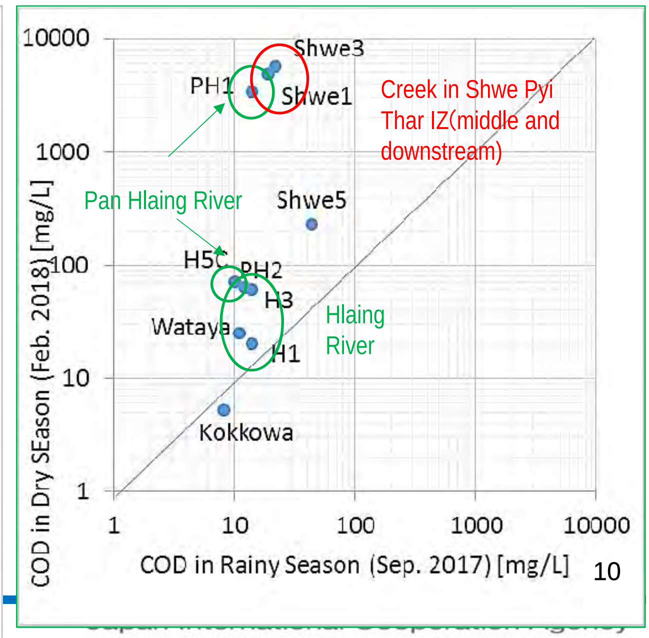
- Dry season : Could be dysoxic in some areas probably related with high TSS and organic matter



(3) Seasonal Changes

Concentrations of pollutants : rainy season < dry season
(Due to dilution by storm water in the rainy season)



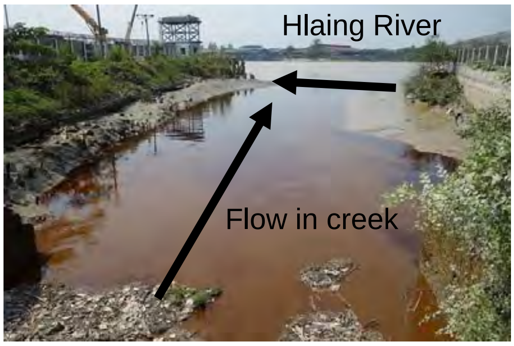


(4) Pollution Impact from IZs to Hlaing River

Water Quality in the Creek in Shwe Phy Thar IZ

- Highly deteriorated, as indicated by low pH, low DO, high organic matter and nutrients, oil and grease and slight phenols
- Hinges on the impact of wastewater from factories
  (Improved in 2017 after temporary shutdown of distilleries and again deteriorated in 2018 after new pipeline discharged wastewater)
- No harmful levels of heavy metals detected

Pollution plume from a pipeline discharging the wastewater



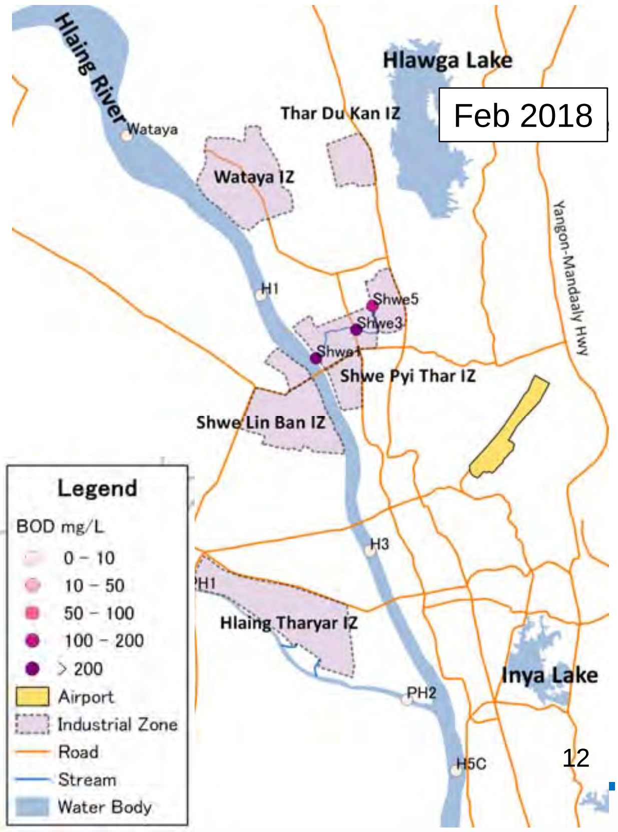
Brown-colored water flow in the creek to Hlaing River

Hlaing River Basin

(4) Pollution Impact from IZs to Hlaing River

Japan International Cooperation Agency

- Apparently not high pollution impact from Shwe Pyi Thar IZ due to high dilution effect of Hlaing River
- It is not clear how the pollutants travel upward and downward, settle and flocculate in the river.
- More monitoring data is required to clarify the state of water quality in tidal area



Key Conclusions in Hlaing River Basin

1. Pollution level in Hlaing River
   - Acceptable for conservation of aquatic lives, irrigation and water transportation for most parameters
   - Deterioration of water quality in the dry season
   - No harmful levels of toxic substances in the water environment
2. Spatial distribution of water quality
   - No clear deterioration from upstream to downstream in rainy season
   - COD was increased in the downstream in dry season but BOD was not increased and the mechanism is not exactly clear
3. Seasonal changes of water quality
   - Worse in dry season than in rainy season
4. Pollution impact from IZ
   - Highly polluted in the creek receiving the wastewater from distilleries
   - Apparently not high impact to Hlaing River observed within the scope of survey
   - Require more monitoring data to clarify the status of water quality in tidal area

4th Survey Result (1) : Oct 2017 : Basic parameters

No.	Location Name	pH	DO	BOD	Total Coliform	TSS	COD Cr	Total Cyanide	Oil and grease	Phenols
		-	mg/L	mg/L	MPN/100 ml	mg/L	mg/L	mg/L	mg/L	mg/L
1	Wataya	7.61	6.67	2.30	35000	420	11	< 0.1	< 1	< 0.005
2	H1	7.23	6.60	1.16	-	390	14	< 0.1	< 1	< 0.005
3	H3	7.62	8.92	1.80	-	440	14	< 0.1	< 1	< 0.005
4	H5	7.69	6.71	1.26	92000	330	10	< 0.1	< 1	< 0.005
5	PH1	7.15	4.69	1.57	-	230	14	< 0.1	< 1	< 0.005
6	PH2	7.43	5.30	0.72	54000	290	12	< 0.1	< 1	< 0.005
7	Shwe1	7.36	7.16	5.41	>160,000	180	19	< 0.1	< 1	< 0.005
8	Shwe3	7.00	8.84	5.94	>160,000	27	22	< 0.1	< 1	< 0.005
9	Shwe5	7.15	4.46	32.07	>160,000	25	44	< 0.1	1.3	< 0.005
10	Kokkowa	7.89	6.68	3.72	4600	120	8.3	< 0.1	< 1	< 0.005
Comparison with Vietnamese Environmental Standard for reference										
A1	For domestic water supply	6 - 8.5	≥6	4	2500	20	10	0.05	0.3	0.005
A2	For domestic water supply with treatment and conservation of aquatic lives	6 - 8.5	≥5	6	5000	30	15	0.05	0.5	0.005
B1	For irrigation	5.5 - 9	≥4	15	7500	50	30	0.05	1	0.01
B2	For water transportation and other purposes with demand for low-quality water	5.5 - 9	≥2	25	10000	100	50	0.05	1	0.02
Less than B2		<5.5, >9	<2	>25	>10000	>100	>50	>0.05	>1	>0.02

4th Survey Result (2) : Oct 2017 : Nutrients, Heavy Metals and PCBs

No.	Location Name	T-P	T-N	Zn	T-Cr	Cr 6+	As	Cu	T-Hg	Cd	Pb	PCBs
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	Wataya	0.16	1.0	0.054	0.048	< 0.005	0.0026	0.017	< 0.0005	< 0.001	0.0097	< 0.0005
2	H1	0.19	1.1	0.060	0.048	< 0.005	0.0028	0.019	< 0.0005	< 0.001	0.0098	-
3	H3	0.16	1.2	-	-	-	-	-	-	-	-	-
4	H5	0.14	1.1	0.049	0.038	< 0.005	0.0030	0.016	< 0.0005	< 0.001	0.0083	-
5	PH1	0.18	1.4	-	-	-	-	-	-	-	-	-
6	PH2	0.13	0.83	0.040	0.038	< 0.005	0.0020	0.020	< 0.0005	< 0.001	0.0070	-
7	Shwe1	0.18	1.3	0.032	0.024	< 0.005	0.0019	0.013	< 0.0005	< 0.001	< 0.005	-
8	Shwe3	0.22	2.0	0.021	< 0.005	< 0.005	0.0012	< 0.005	< 0.0005	< 0.001	< 0.005	-
9	Shwe5	0.65	4.9	0.042	0.010	< 0.005	0.0033	0.014	< 0.0005	< 0.001	< 0.005	-
10	Kokkowa	0.089	0.71	0.029	0.019	< 0.005	0.0016	0.010	< 0.0005	< 0.001	< 0.005	-
Comparison with Vietnamese Environmental Standard for reference												
A1	For domestic water supply	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	0.5	0.05	0.01	0.01	0.1	0.001	0.005	0.02	-
A2	For domestic water supply with treatment and conservation of aquatic lives	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.0	0.1	0.02	0.02	0.2	0.001	0.005	0.02	-
B1	For irrigation	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.5	0.5	0.04	0.05	0.5	0.001	0.01	0.05	-
B2	For water transportation and other purposes with demand for low-quality water	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	2	1	0.05	0.1	1	0.002	0.01	0.05	-
Less than B2		-	-	>2	>1	>0.05	>0.1	>1	>0.002	>0.01	>0.05	-

5th Survey Result (1) : Feb 2018 : Basic parameters

No.	Location Name	pH	DO	BOD	Total Coliform	TSS	COD Cr	Total Cyanide	Oil and grease	Phenols
		-	mg/L	mg/L	MPN/100 ml	mg/L	mg/L	mg/L	mg/L	mg/L
1	Wataya	8.21	6.9	3.7	610	980	25	< 0.1	1.2	< 0.005
2	H1	8.14	6.54	2.82	-	250	20	< 0.1	1.6	< 0.005
3	H3	8.34	5.46	2.44	-	1,200	61	< 0.1	1.3	< 0.005
4	H5	8.14	5.33	2.91	54,000	1,400	71	< 0.1	2.2	< 0.005
5	PH1	7.95	0.74	44.61	-	98,000	3,400	< 0.1	2.0	< 0.005
6	PH2	8.02	5.12	3.8	35,000	1,800	63	< 0.1	1.5	< 0.005
7	Shwe1	5.66	0.54	267.57	>160,000	2,400	4,900	< 0.1	4.8	1.1
8	Shwe3	4.98	1.91	264.37	>160,000	280	5,700	< 0.1	3.5	0.10
9	Shwe5	6.72	0.54	133.97	>160,000	12	230	< 0.1	2.1	0.021
10	Kokkowa	8.35	7.01	5.73	930	60	5.2	< 0.1	1.9	< 0.005
Comparison with Vietnamese Environmental Standard for reference (QCVN08:2015)										
A1	For domestic water supply	6 - 8.5	≥6	4	2,500	20	10	0.05	0.3	0.005
A2	For domestic water supply with treatment and conservation of aquatic lives	6 - 8.5	≥5	6	5,000	30	15	0.05	0.5	0.005
B1	For irrigation	5.5 - 9	≥4	15	7,500	50	30	0.05	1	0.01
B2	For water transportation and other purposes with demand for low-quality water	5.5 - 9	≥2	25	10,000	100	50	0.05	1	0.02
Less than B2		<5.5, >9	<2	>25	>10,000	>100	>50	>0.05	>1	>0.02

Hlaing River Basin

5th Survey Result (2) : Feb 2018 : Nutrients, Heavy Metals and PCBs

No.	Location Name	T-P	T-N	Zn	T-Cr	Cr 6+	As	Cu	T-Hg	Cd	Pb	PCBs
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	Wataya	0.19	0.92	0.13	0.11	< 0.005	0.011	0.045	< 0.0005	< 0.001	0.024	< 0.0005
2	H1	0.29	0.64	0.052	0.034	< 0.005	0.0051	0.014	< 0.0005	< 0.001	0.0066	-
3	H3	0.15	1.4	-	-	-	-	-	-	-	-	-
4	H5	0.32	1.2	0.21	0.17	< 0.005	0.024	0.071	< 0.0005	< 0.001	0.039	-
5	PH1	0.42	92	-	-	-	-	-	-	-	-	-
6	PH2	0.33	1.6	0.28	0.24	< 0.005	0.031	0.096	< 0.0005	< 0.001	0.058	-
7	Shwe1	9.7	130	0.46	0.24	< 0.005	0.038	0.18	< 0.0005	< 0.001	0.066	-
8	Shwe3	6.5	140	0.16	0.014	< 0.005	0.003	0.045	< 0.0005	< 0.001	< 0.005	-
9	Shwe5	1.4	19	0.022	< 0.005	< 0.005	0.0038	0.10	< 0.0005	< 0.001	< 0.005	-
10	Kokkowa	0.074	0.16	0.014	0.01	< 0.005	0.0015	0.0054	< 0.0005	< 0.001	< 0.005	-
Comparison with Vietnamese Environmental Standard for reference(QCVN08:2015)												
A1	For domestic water supply	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	0.5	0.05	0.01	0.01	0.1	0.001	0.005	0.02	-
A2	For domestic water supply with treatment and conservation of aquatic lives	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.0	0.1	0.02	0.02	0.2	0.001	0.005	0.02	-
B1	For irrigation	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.5	0.5	0.04	0.05	0.5	0.001	0.01	0.05	-
B2	For water transportation and other purposes with demand for low-quality water	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	2	1	0.05	0.1	1	0.002	0.01	0.05	-
Less than B2		-	-	>2	>1	>0.05	>0.1	>1	>0.002	>0.01	>0.05	-

Hlaing River Basin

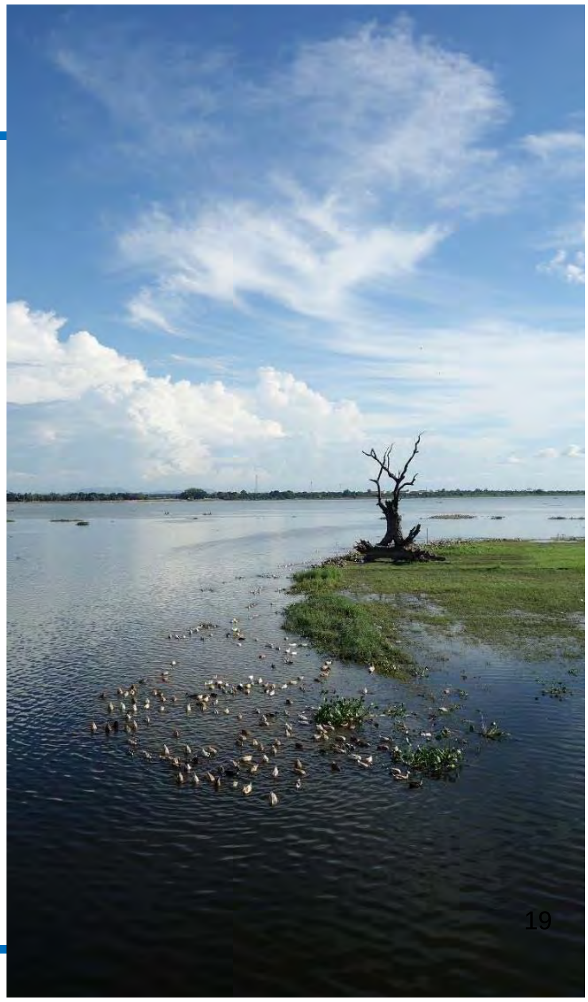
4th and 5th Survey Result : Pesticides

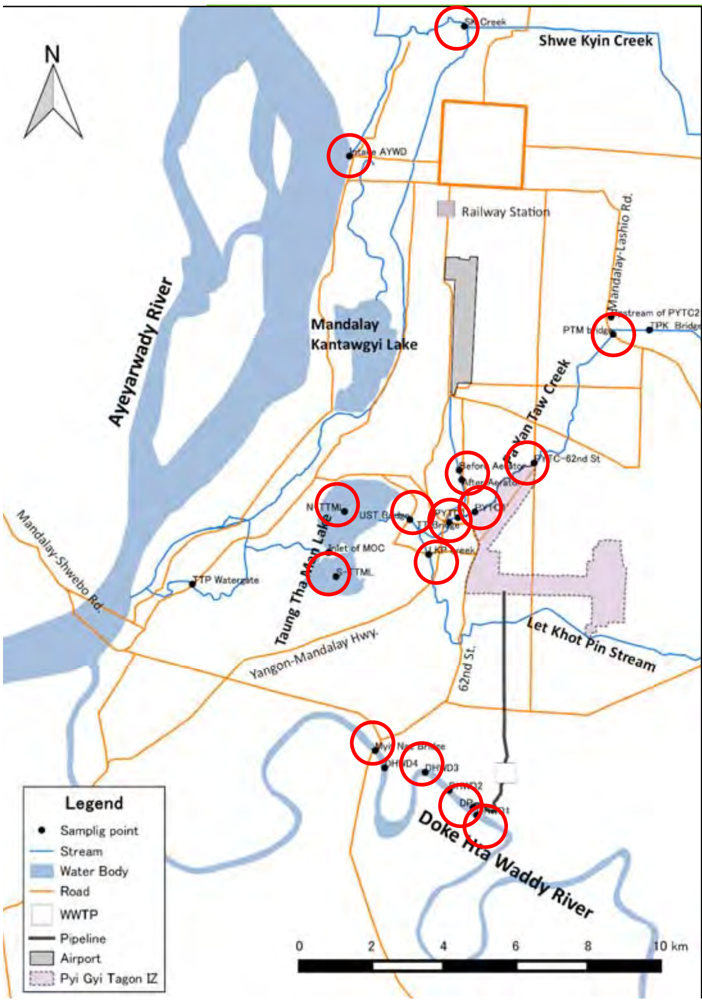
mg/L

No.	Parameter	Oct 2017		Feb 2018	
		Wataya	Kokkowa	Wataya	Kokkowa
1	Aldrin	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2	Atrazine	< 0.0005	< 0.0005	< 0.0005	< 0.0005
3	4,4'-DDD	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4	4,4'-DDE	< 0.0005	< 0.0005	< 0.0005	< 0.0005
5	4,4'-DDT	< 0.0005	< 0.0005	< 0.0005	< 0.0005
6	Endosulfan	< 0.0005	< 0.0005	< 0.0005	< 0.0005
7	Endosulfan sulfate	< 0.0005	< 0.0005	< 0.0005	< 0.0005
8	Endrin	< 0.0005	< 0.0005	< 0.0005	< 0.0005
9	HCH-alpha (benzene hexachloride-alpha)(alpha-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
10	HCH-beta(beta-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
11	HCH-delta(delta-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
12	HCH-gamma(Lindane)(ganma-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
13	Alachlor	< 0.0005	< 0.0005	< 0.0005	< 0.0005
14	Diazinon	< 0.0005	< 0.0005	< 0.0005	< 0.0005
15	Chlorpyrifos	< 0.0005	< 0.0005	< 0.0005	< 0.0005
16	Dimethoate	< 0.0005	< 0.0005	< 0.0005	< 0.0005
17	Imidacloprid	< 0.0005	< 0.0005	< 0.0005	< 0.0005

Japan International Cooperation Agency

Water Quality Survey in Doke Hta Waddy River Basin





Doke Hta Waddy River Basin

Sampling Points and Analytes

15 sampling points

in the 4th survey (2-3 Oct 2017) and 5th survey (26-27 Feb 2018)

[On site measurement]

- pH, EC, DO, TDS, salinity, turbidity, water temperature, ORP

[Lab analysis]

- TSS, BOD, COD for all points
- Cyanide, oil and grease, phenols, total phosphorus, and total nitrogen, total coliform, zinc, total chromium, hexavalent chromium, arsenic, copper, total mercury, cadmium, and lead for representative points
- 17 pesticides* and PCBs for one or two points

*Aldrin, atrazine, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan, endosulfan sulfate, endrin, HCH-alpha (benzene hexachloride-alpha), HCH-beta, HCH-delta, HCH-gamma(Lindane), alachlor, diazinon, chlorpyrifos, dimethoate and imidacloprid

Survey Questions

Survey Questions

1. What is the status of water quality in Doke Hta Waddy(DHW) River? How is the pollution impact from IZ to DHW River?
2. How is the pollution level in Taung Tha Man Lake?
3. Where do the pollutants come to TTML from?

(1) Classification of Water Quality in Target Water Body

Water Quality in Doke Hta Waddy River

- Adequate for domestic water supply with water treatment facility using filters and other ordinary means.
- Not dramatically vary in seasons or from point to point.
- No harmful substance detected within the scope of survey

Unit: mg/L

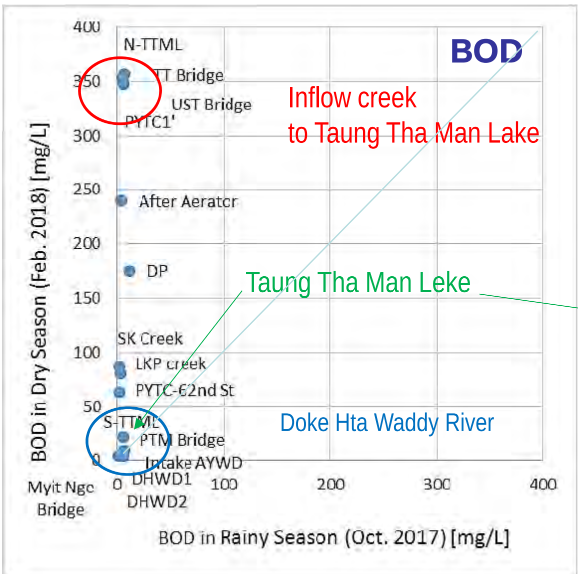
Target		BOD						COD					
		Rainy Season(Sep 2017)			Dry Season(Feb 2018)			Rainy Season(Sep 2017)			Dry Season(Feb 2018)		
		Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
River	Doke Hta Waddy River	1.1	5.4	3.7	4.7	5.7	5.0	4.2	6	5.2	2.8	5.2	3.6
	Ayeyarwaddy River	5.4			4.7			11			4.4		
Lake	Taung Tha Man Lake	5.4	6.0	5.7	23	357	190	28	28	28	130	280	205
Creek	Inflow to Taung Tha Man Lake (LKP Stream, UST Bridge, Pa Yan Taw Creek, Columbo Creek)	2.3	6.6	4.4	9.8	354	206	14	70	32	21	540	209

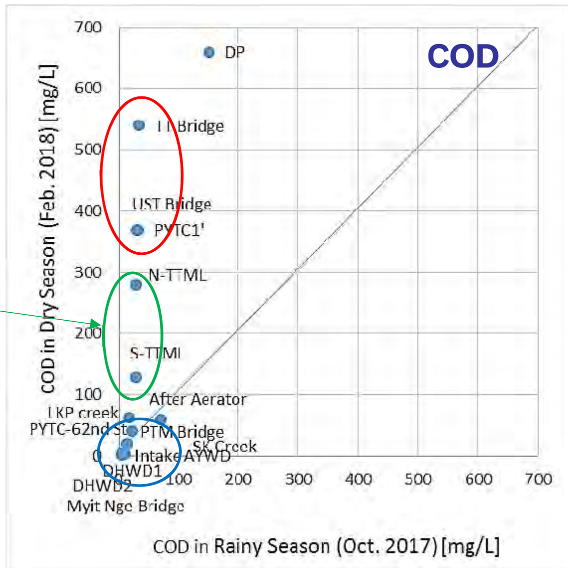
Vietnamese Environmental Standard(QCVN08:2015) for reference

Water Usage		BOD	COD
A1	For domestic water supply	4	10
A2	For domestic water supply with treatment and conservation of aquatic lives	6	15
B1	For irrigation	15	30
B2	For water transportation and other purposes with demand for low-quality water	25	50
Less than B2		>25	>50

(1) Seasonal Changes

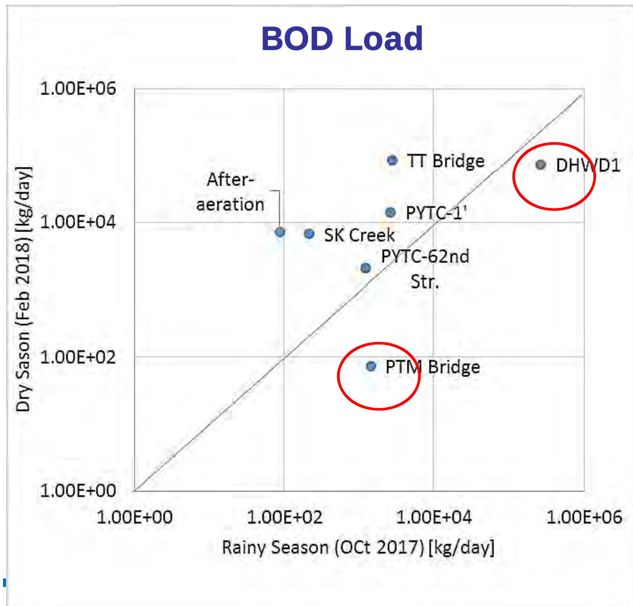
Concentrations of pollutants : rainy season < dry season
(Due to dilution by storm water in the rainy season)

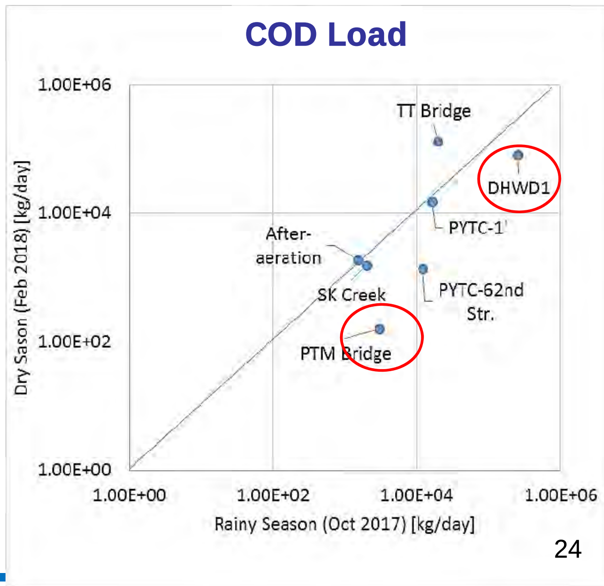




(1) Seasonal Changes

Pollution loads of organic matters in DHW River: rainy season > dry season
(Due to flushed organic substances from the upper basin to river)





(1) Pollution Impact from IZ to Doke Hta Waddy River

Wastewater discharged from Pyi Gyi Tagon IZ through 10-inch pipeline

- High concentrations of pollutants (organic matters, nutrients, oil and grease, phenols and hexavalent chromium etc.) discharged by 2016.
- Limited pollution impact to DHW River because of the large dilution capacity of the river
- After several distilleries in IZ shut down their operation temporarily from June – August 2017, the pollution load from the 10-pipe line seemed decreased, although the discharging wastewater still contained oil and grease, phenols, and other pollutants.

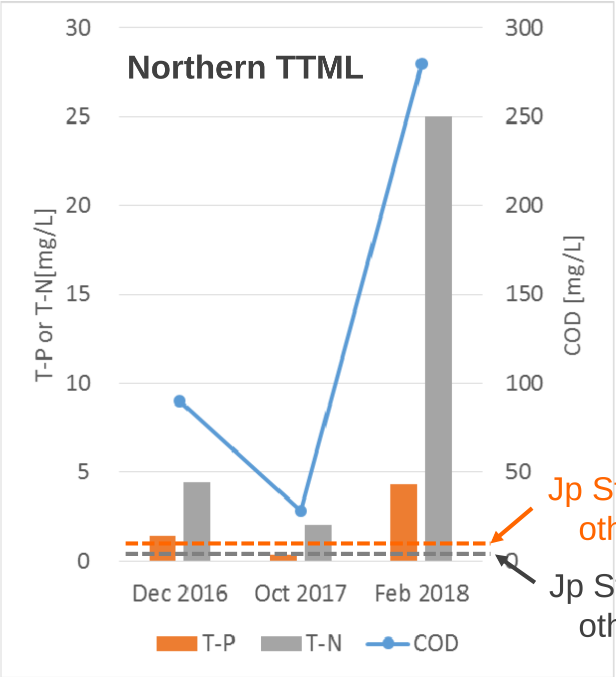
(2) Pollution Level of Taung Tha Man Lake

- Eutrophication manifested by high phosphorus and nitrogen especially in the northern lake
- Increasing algae and phytoplankton and resulting in internal organic production, which accelerates eutrophication

mg/L

Location Name		Total Phosphorus		Total Nitrogen	
		Oct 2017	Feb 2018	Oct 2017	Feb 2018
N-TTML		0.38	4.3	2.0	25
S-TTML		0.36	1.7	1.7	9.2
Comparison with Japanese Environmental Standard (lake) for reference					
I	Conservation of natural environment	0.005 mg/L or less		0.1 mg/L or less	
II	Water supply for purify water using filters and other simple means, fishery for salmon/troun, sweetfish, bathing etc.	0.01 mg/L or less		0.2 mg/L or less	
III	Water supply for purify water using pre-treatment and other advanced methods	0.03 mg/L or less		0.4 mg/L or less	
IV	Fishery for smelt etc.	0.05 mg/L or less		0.6 mg/L or less	
V	Fishery for smelt etc., industrial water, agricultural water, and conservation of the environment	0.1 mg/L or less		1 mg/L or less	
Remarks	1 Standard values are based on daily average values. 2 Standard values for total phosphorous are not applicable to water for agricultural use.				

(2) Eutrophication in the Lake



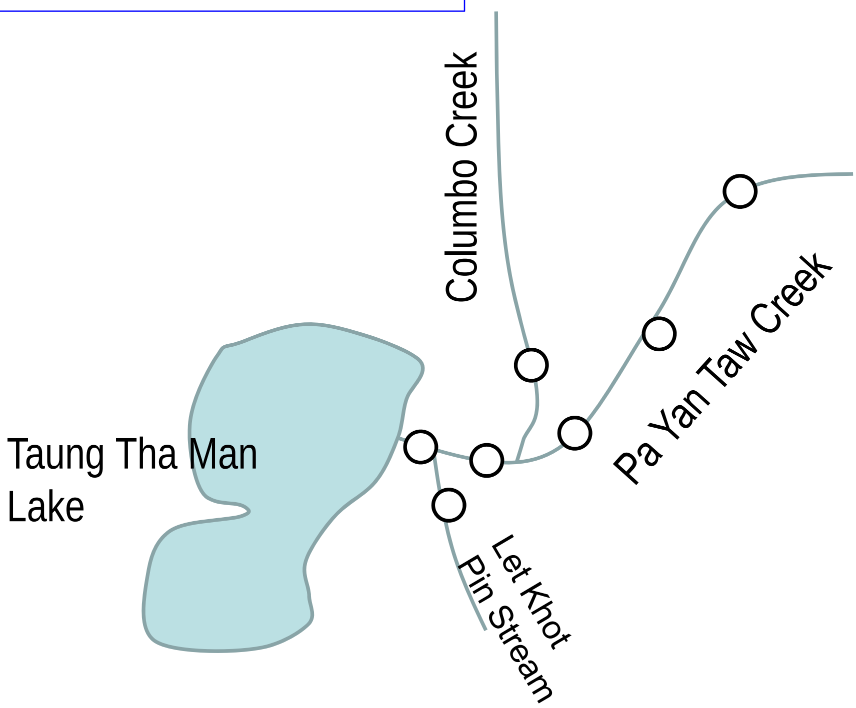
- Water quality changes dramatically with seasons or time
- Hypereutrophic due to enclosed water conditions in the dry season when the water level is quite low

Jp Std of T-N for fishery and other purpose: 1.0 mg/L

Jp Std of T-P for fishery and other purpose: 0.1 mg/L

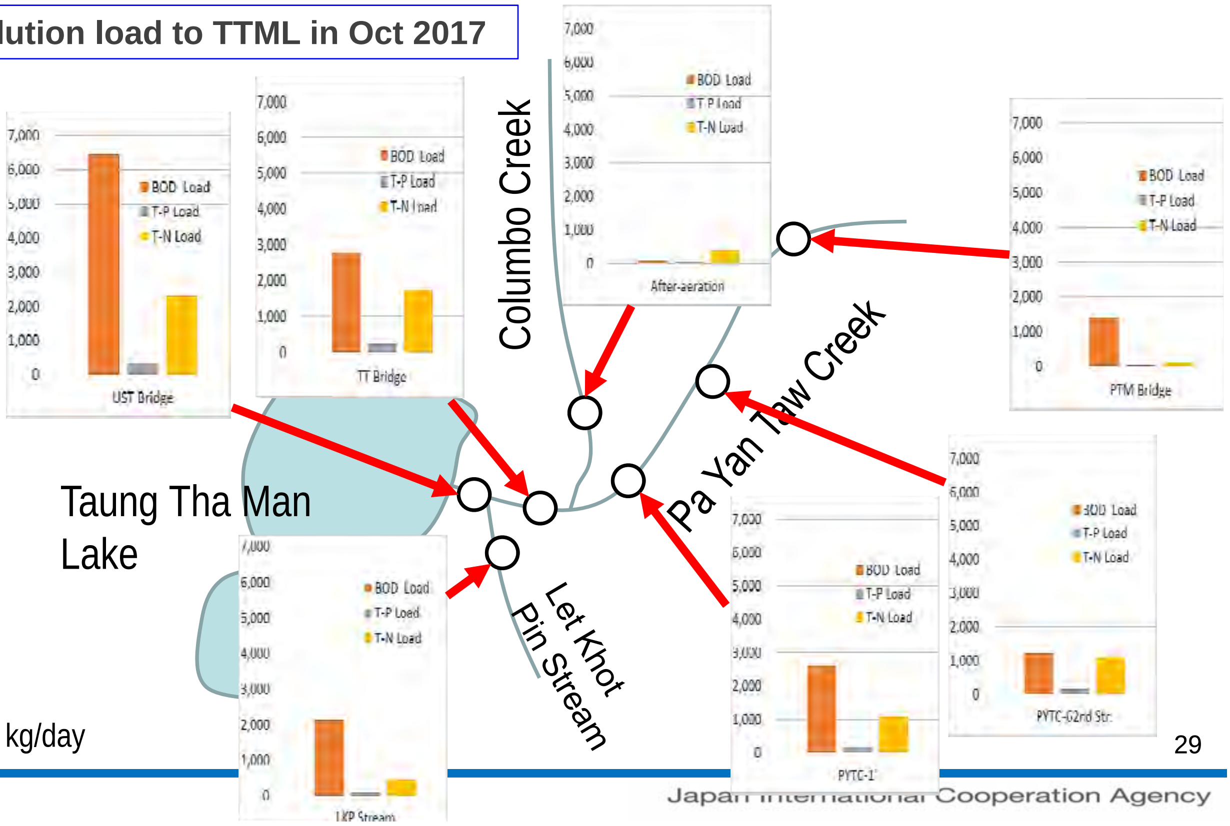
(3) Pollution Path to Taung Tha Man Lake

Pollution load to TTML in Oct 2017



(3) Pollution Path to Taung Tha Man Lake

Pollution load to TTML in Oct 2017



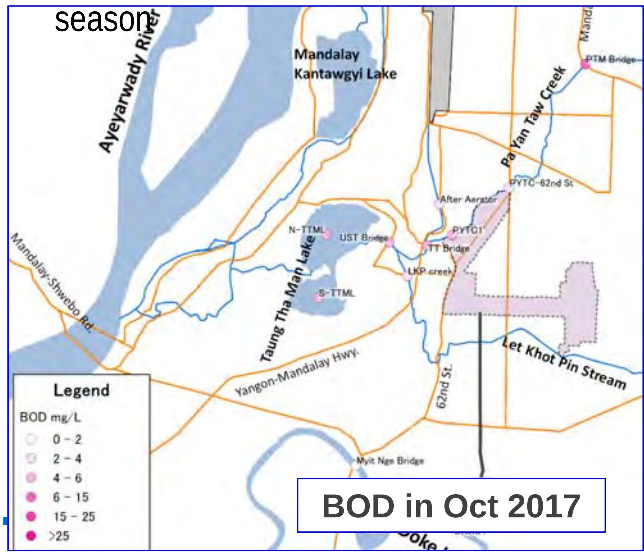
Unit: kg/day

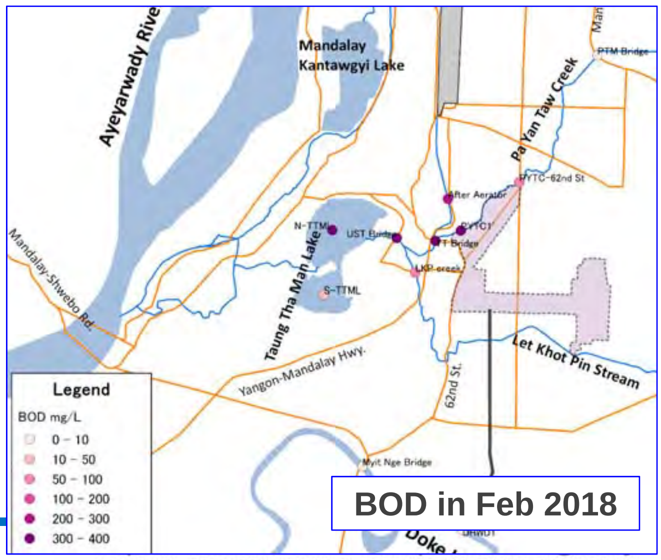
Doke Hta Waddy River Basin

(3) Pollution Path to Taung Tha Man Lake

Japan International Cooperation Agency

- The main pollution path to TTML would be Pa Yan Taw creek, followed by Columbo Creek and Let Khot Pin Stream
- Deterioration of water quality in these creeks in the dry season. In addition to organic matter and nutrients, moderate levels of oil and grease (max. 10 mg/L) and phenols (max. 0.06 mg/L) were detected.
- Pollution load from faming land seems limited, but need to be investigated in other farming season





Key Conclusions

1. Pollution Impact from IZ to Doke Hta Waddy River
   - Adequate water quality in DHW River for domestic water supply with simple treatment facility
   - Pollution impact from 10-inch pipeline is limited and reduced apparently due to tentative shut-down of distilleries and other measures, but wastewater still contains oil and grease and phenols etc.
2. Pollution level of Taung Tha Man Lake
   - Eutrophication manifested by high phosphorus and nitrogen
   - Water quality changes dramatically with seasons or time
   - Hypereutrophic in the dry season
3. Pollution path to the TTML
   - Highest pollution loads of organic material and nutrients in Pa Yan Taw creek among three creeks reaching U Shwe Taung Bridge except T-N in the dry season.
   - Deterioration of water quality in creeks in the dry season
   - Pollution load from faming land is limited, but need to be investigated in other farming season

4th Survey Result (1) : Oct 2017 : Basic parameters

No.	Location Name	pH	DO	BOD	Total Coliform	TSS	COD Cr	Total Cyanide	Oil and grease	Phenols
		-	mg/L	mg/L	MPN/100ml	mg/L	mg/L	mg/L	mg/L	mg/L
1	DHWD1	8.40	7.73	5.4	92,000	14	5.3	< 0.1	< 1	< 0.005
2	DHWD2	8.30	6.21	4.5	-	16	6.0	-	-	-
3	Myint Nge Bridge	7.96	7.78	1.1	160,000	22	4.2	< 0.1	< 1	< 0.005
4	DP*	7.59	4.82	11.0	> 160,000	86	150	< 0.1	9.1	0.012
5	LKP Stream	8.03	6.57	2.7	35,000	7.8	17	< 0.1	< 1	< 0.005
6	UST Bridge	7.77	6.70	5.6	> 160,000	22	31	< 0.1	< 1	< 0.005
7	TT Bridge	7.46	5.11	4.8	-	28	34	< 0.1	< 1	< 0.005
8	PYTC-62nd Str.	7.86	6.31	2.3	-	68	23	< 0.1	< 1	< 0.005
9	PYTC-1'	7.82	8.89	5.1	> 160,000	36	32	< 0.1	< 1	< 0.005
10	After-aeration	7.93	5.36	3.9	160,000	28	70	< 0.1	< 1	0.0086
11	N-TTML	8.18	5.12	6.0	17,000	15	28	< 0.1	< 1	< 0.005
12	S-TTML	8.56	6.43	5.4	24,000	14	28	< 0.1	< 1	< 0.005
13	PTM Bridge	7.56	7.38	6.6	-	44	14	-	-	-
14	SK Creek	8.02	8.52	1.6	-	62	15	-	-	-
15	Intake AYWD	7.88	7.68	5.4	92,000	45	11	< 0.1	< 1	< 0.005
Comparison with Vietnamese Environmental Standard for reference										
A1	For domestic water supply	6 - 8.5	≥6	4	2500	20	10	0.05	0.3	0.005
A2	For domestic water supply with treatment and conservation of aquatic lives	6 - 8.5	≥5	6	5000	30	15	0.05	0.5	0.005
B1	For irrigation	5.5 - 9	≥4	15	7500	50	30	0.05	1	0.01
B2	For water transportation and other purposes with demand for low-quality water	5.5 - 9	≥2	25	10000	100	50	0.05	1	0.02
Less than B2		<5.5, >9	<2	>25	>10000	>100	>50	>0.05	>1	>0.02

4th Survey Result (2) : Oct 2017 : Heavy metals

No.	Location Name	T-P	T-N	Zn	T-Cr	Cr 6+	As	Cu	T-Hg	Cd	Pb	PCBs
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	DHWD1	< 0.06	0.30	0.0081	0.0058	< 0.005	0.0016	< 0.005	< 0.0005	< 0.001	< 0.005	-
2	DHWD2	-	-	-	-	-	-	-	-	-	-	-
3	Myint Nge Bridge	< 0.06	0.34	0.0098	< 0.005	< 0.005	0.0019	< 0.005	< 0.0005	< 0.001	< 0.005	-
4	DP*	0.32	2.8	0.014	0.0050	< 0.005	0.0033	0.016	< 0.0005	< 0.001	0.0056	-
5	LKP Stream	0.10	0.60	0.010	< 0.005	< 0.005	0.0040	< 0.005	< 0.0005	< 0.001	< 0.005	-
6	UST Bridge	0.31	2.0	0.016	0.011	< 0.005	0.0041	0.0097	< 0.0005	< 0.001	0.0051	-
7	TT Bridge	0.39	3.0	0.0096	< 0.005	< 0.005	0.0034	< 0.005	< 0.0005	< 0.001	< 0.005	-
8	PYTC-62nd Str.	0.28	2.1	0.014	0.0054	< 0.005	0.0032	< 0.005	< 0.0005	< 0.001	< 0.005	-
9	PYTC-1'	0.31	2.1	0.011	0.0054	< 0.005	0.0035	< 0.005	< 0.0005	< 0.001	< 0.005	-
10	After-aeration	2.7	18	0.018	0.0050	< 0.005	0.0041	< 0.005	< 0.0005	< 0.001	< 0.005	-
11	N-TTML	0.38	2.0	0.0074	< 0.005	< 0.005	0.0037	< 0.005	< 0.0005	< 0.001	< 0.005	-
12	S-TTML	0.36	1.7	0.0050	< 0.005	< 0.005	0.0042	< 0.005	< 0.0005	< 0.001	< 0.005	-
13	PTM Bridge	0.063	0.63	-	-	-	-	-	-	-	-	-
14	SK Creek	0.20	1.2	-	-	-	-	-	-	-	-	-
15	Intake AYWD	0.077	0.51	0.0087	0.0056	< 0.005	0.0017	< 0.005	< 0.0005	< 0.001	< 0.005	< 0.0005
A1	For domestic water supply	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	0.5	0.05	0.01	0.01	0.1	0.001	0.005	0.02	-
A2	For domestic water supply with treatment and conservation of aquatic lives	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.0	0.1	0.02	0.02	0.2	0.001	0.005	0.02	-
B1	For irrigation	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.5	0.5	0.04	0.05	0.5	0.001	0.01	0.05	-
B2	For water transportation and other purposes with demand for low-quality water	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	2	1	0.05	0.1	1	0.002	0.01	0.05	-
Less than B2		-	-	>2	>1	>0.05	>0.1	>1	>0.002	>0.01	>0.05	-

5th Survey Result (1) : Feb 2017 : Basic parameters

Jap

No.	Location Name	pH	DO	BOD	Total Coliform	TSS	COD Cr	Total Cyanide	Oil and grease	Phenols
		-	mg/L	mg/L	MPN/100ml	mg/L	mg/L	mg/L	mg/L	mg/L
1	DHWD1	8.15	6.6	4.74	610	4	5.2	< 0.1	< 1	< 0.005
2	DHWD2	7.02	5.0	5.65	-	< 4	2.8	-	-	-
3	Myint Nge Bridge	8.07	6.9	4.72	1,400	5.8	2.9	< 0.1	< 1	< 0.005
4	DP*	6.89	5.5	175.9	>160,000	79	660	< 0.1	2.4	0.021
5	LKP Stream	8.03	6.8	80.7	>160,000	38	63	< 0.1	1.2	0.0053
6	UST Bridge	6.80	2.5	348.38	>160,000	91	370	< 0.1	6.3	0.14
7	TT Bridge	6.71	5.5	354.14	-	260	540	< 0.1	9.6	0.057
8	PYTC-62nd Str.	7.65	4.7	63.58	>160,000	15	42	< 0.1	< 1	< 0.005
9	PYTC-1'	7.13	4.8	347.1	>160,000	82	370	< 0.1	7.9	0.025
10	After-aeration	7.55	3.9	239.58	>160,000	13	60	< 0.1	2.5	0.0091
11	N-TTML	7.47	2.9	356.7	>160,000	51	280	< 0.1	< 1	0.050
12	S-TTML	8.74	4.7	22.62	24,000	130	130	< 0.1	< 1	< 0.005
13	PTM Bridge	7.70	5.0	9.76	-	89	21	-	-	-
14	SK Creek	7.57	6.1	86.78	-	58	20	-	-	-
15	Intake AYWD	8.06	9.2	4.74	35,000	50	4.4	< 0.1	< 1	< 0.005
Comparison with Vietnamese Environmental Standard for reference(QCVN08:2015)										
A1	For domestic water supply	6 - 8.5	≥6	4	2500	20	10	0.05	0.3	0.005
A2	For domestic water supply with treatment and conservation of aquatic lives	6 - 8.5	≥5	6	5000	30	15	0.05	0.5	0.005
B1	For irrigation	5.5 - 9	≥4	15	7500	50	30	0.05	1	0.01
B2	For water transportation and other purposes with demand for low-quality water	5.5 - 9	≥2	25	10,000	100	50	0.05	1	0.02
Less than B2		<5.5, >9	<2	>25	>10,000	>100	>50	>0.05	>1	>0.02

5th Survey Result (2) : Feb 2017: Nutrients and heavy metals

No.	Location Name	T-P	T-N	Zn	T-Cr	Cr 6+	As	Cu	T-Hg	Cd	Pb	PCBs
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	DHWD1	< 0.06	0.3	< 0.005	< 0.005	< 0.005	0.0023	< 0.005	< 0.0005	< 0.001	< 0.005	-
2	DHWD2	-	-	-	-	-	-	-	-	-	-	-
3	Myint Nge Bridge	< 0.06	< 0.25	< 0.005	< 0.005	< 0.005	0.0022	< 0.005	< 0.0005	< 0.001	< 0.005	-
4	DP*	1.3	20	0.048	< 0.005	< 0.005	0.0032	0.0098	< 0.0005	< 0.001	0.005	-
5	LKP Stream	1.3	5.1	0.017	< 0.005	< 0.005	0.0091	< 0.005	< 0.0005	< 0.001	< 0.005	-
6	UST Bridge	3.1	24	0.065	0.0052	< 0.005	0.0056	0.012	< 0.0005	< 0.001	0.0064	-
7	TT Bridge	4.0	37	0.12	0.018	< 0.005	0.0074	0.032	< 0.0005	< 0.001	0.013	-
8	PYTC-62nd Str.	2.1	14	0.0098	< 0.005	< 0.005	0.0039	< 0.005	< 0.0005	< 0.001	< 0.005	-
9	PYTC-1'	2.5	17	0.047	0.0056	< 0.005	0.0064	0.025	< 0.0005	< 0.001	0.0058	-
10	After-aeration	3.1	30	0.011	< 0.005	< 0.005	0.0043	< 0.005	< 0.0005	< 0.001	< 0.005	-
11	N-TTML	4.3	25	0.0072	< 0.005	< 0.005	0.0048	< 0.005	< 0.0005	< 0.001	< 0.005	-
12	S-TTML	1.7	9.2	0.014	< 0.005	< 0.005	0.01	< 0.005	< 0.0005	< 0.001	0.012	-
13	PTM Bridge	0.15	1.4	-	-	-	-	-	-	-	-	-
14	SK Creek	0.37	2.0	-	-	-	-	-	-	-	-	-
15	Intake AYWD	0.12	1.3	0.0078	< 0.005	< 0.005	0.0013	0.014	< 0.0005	< 0.001	< 0.005	< 0.0005
Comparison with Vietnamese Environmental Standard for reference(QCVN08:2015)												
A1	For domestic water supply	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	0.5	0.05	0.01	0.01	0.1	0.001	0.005	0.02	-
A2	For domestic water supply with treatment and conservation of aquatic lives	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.0	0.1	0.02	0.02	0.2	0.001	0.005	0.02	-
B1	For irrigation	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	1.5	0.5	0.04	0.05	0.5	0.001	0.01	0.05	-
B2	For water transportation and other purposes with demand for low-quality water	Specified as PO_4^{3-}	Specified as NO2- and NO3- respectively	2	1	0.05	0.1	1	0.002	0.01	0.05	-
Less than B2		-	-	>2	>1	>0.05	>0.1	>1	>0.002	>0.01	>0.05	-

5th Survey Result : Pesticides

mg/L

No.	Parameter	Sep 2017		Feb 2018	
		DHWD1	Intake AYWD	DHWD1	Intake AYWD
1	Aldrin	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2	Atrazine	< 0.0005	< 0.0005	< 0.0005	< 0.0005
3	4,4'-DDD	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4	4,4'-DDE	< 0.0005	< 0.0005	< 0.0005	< 0.0005
5	4,4'-DDT	< 0.0005	< 0.0005	< 0.0005	< 0.0005
6	Endosulfan	< 0.0005	< 0.0005	< 0.0005	< 0.0005
7	Endosulfan sulfate	< 0.0005	< 0.0005	< 0.0005	< 0.0005
8	Endrin	< 0.0005	< 0.0005	< 0.0005	< 0.0005
9	HCH-alpha (benzene hexachloride-alpha)(alpha-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
10	HCH-beta(beta-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
11	HCH-delta(delta-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
12	HCH-gamma(Lindane)(ganma-BHC)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
13	Alachlor	< 0.0005	< 0.0005	< 0.0005	< 0.0005
14	Diazinon	< 0.0005	< 0.0005	< 0.0005	< 0.0005
15	Chlorpyrifos	< 0.0005	< 0.0005	< 0.0005	< 0.0005
16	Dimethoate	< 0.0005	< 0.0005	< 0.0005	< 0.0005
17	Imidacloprid	< 0.0005	< 0.0005	< 0.0005	< 0.0005

Recommendations from Output 2

1) Standardize an environmental analytical method

- An environmental analytical method of laboratories in Myanmar should be standardized, as a first step to secure the good quality control of monitoring data in order to obtain reliable results.

2) Develop an proper water environmental Std/GL

- It is recommended to utilize these monitoring data in Output 2 for establishment of an environmental quality standard/guideline in Myanmar, in order to develop a proper criteria that is adequate for characterization and water usage etc. of each water body.

3) Regular surface water quality monitoring

- Especially, the water status in tidal area of Hlaing River and eutrophication mechanism in the TTM lake are complicated and not clear. More monitoring data is required to examine the mechanism of water pollution in the river and lake.
- It is crucial to carry out the regular/freaquent water quality monitoring in the target water body.

Japan International Cooperation Agency

The Project for Capacity Development in Basic Water Environment Management and EIA System in the Republic of the Union of Myanmar

(Water Environment Management Component)

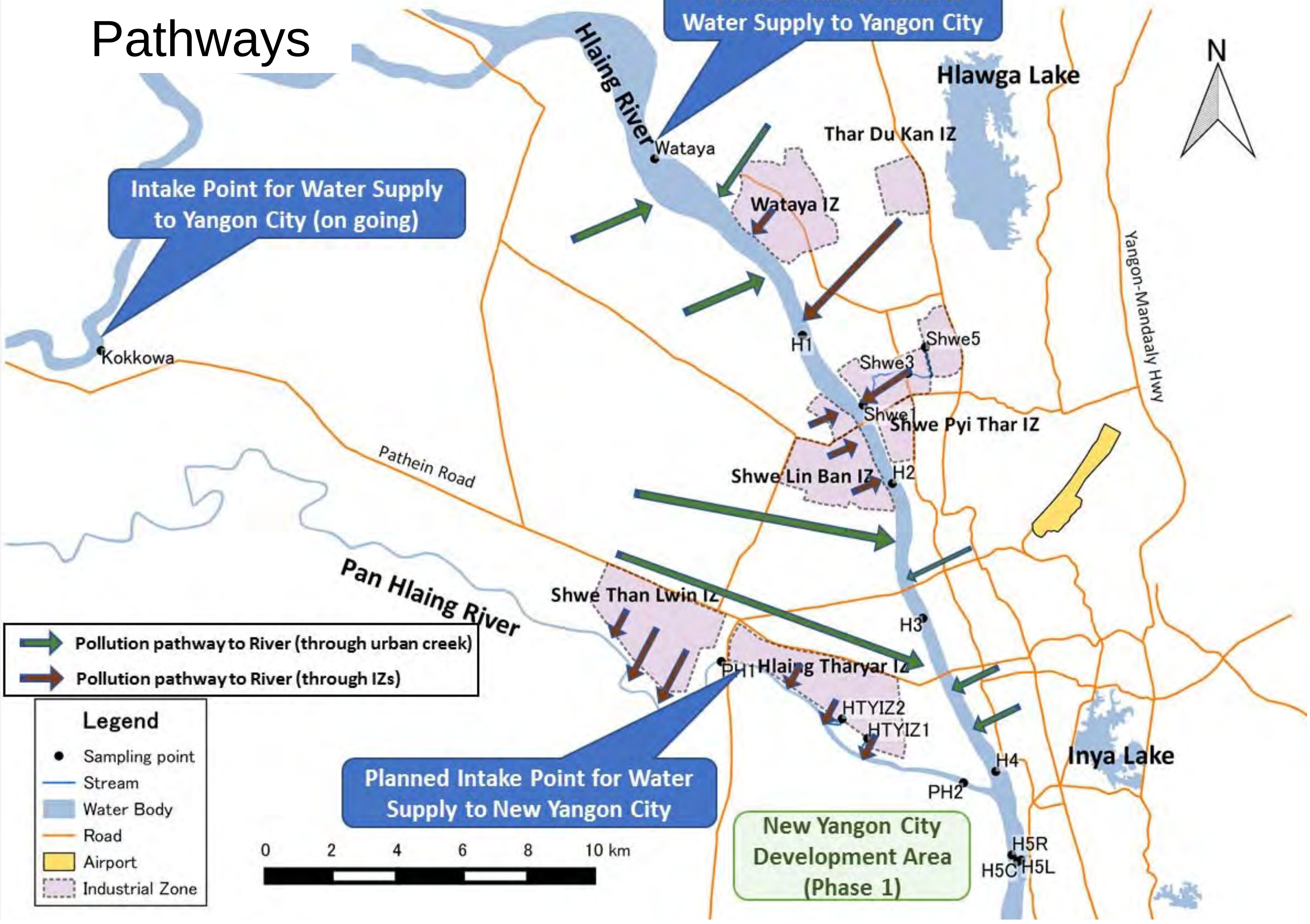
17 May 2018
Shunsuke HIEDA
JICA Expert Team

Water Quality Status of Hlaing River Basin in Yangon

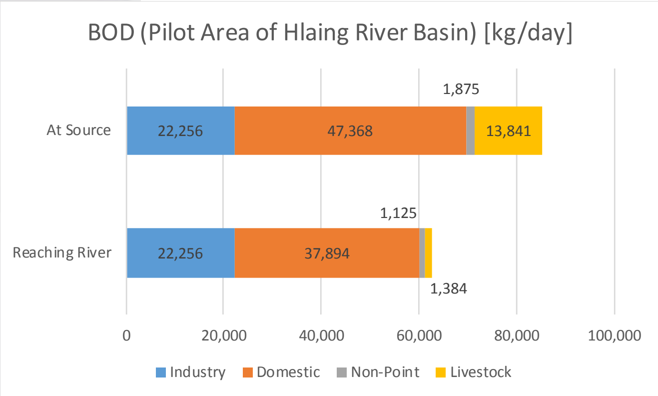
1. Pollution Load Analysis in the Pilot Area in Yangon

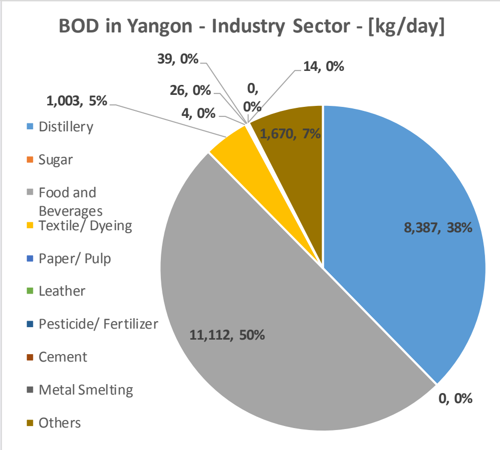
Japan International Cooperation Agency

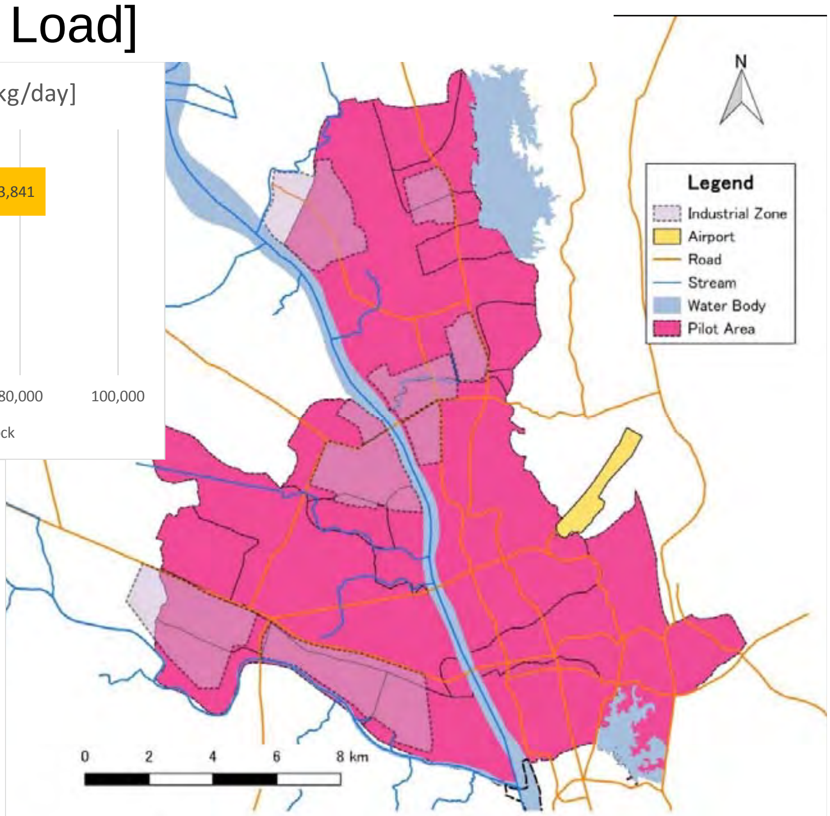
Pollution Pathways



Townships in Yangon along Hlaing River [BOD Pollution Load]



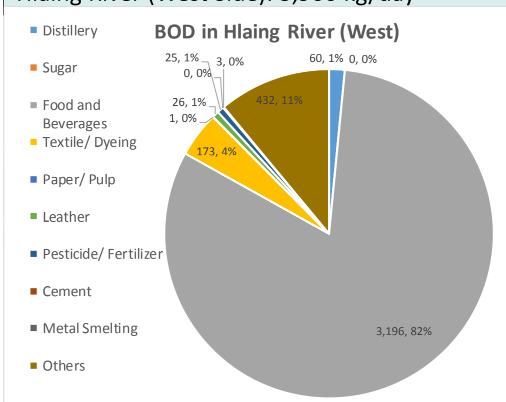




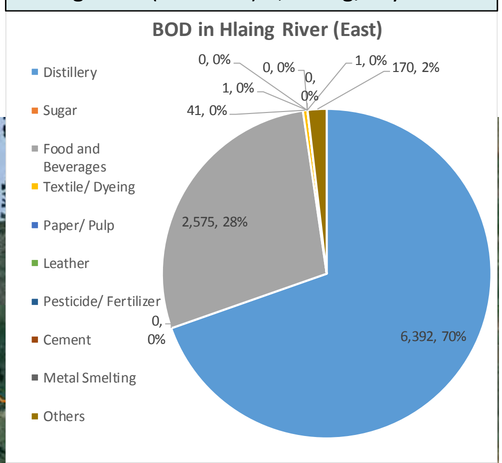
- Watershed: JET by Satellite Image & DEM (SRTM)
- Pilot Area: Tsp. in Hlaing River Basin (Hlaingtharya, Mayangone, Insein, Hlaing" & "Shwepyithar)

[Industry] - BOD Pollution Load (kg/day) -

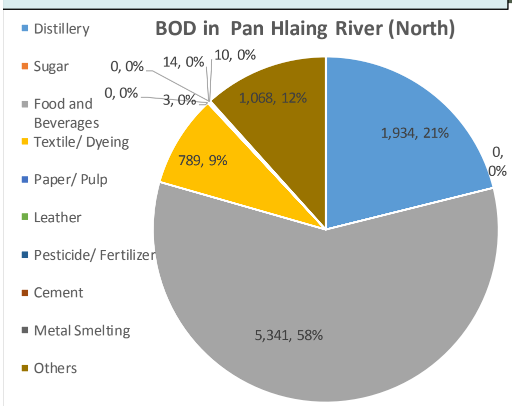
Hlaing River (West Side): 3,900 kg/day



Hlaing River (East Side):9,200 kg/day



Pan Hlaing River (North Side): 9,200 kg/day



2. Strategies and Action Plans for Water Pollution Control from Industrial Zones and Other Pollution Sources in Yangon

Existing Water Quality Status in Yangon

River Water Quality

[Upstream of Hlaing River (out of Yangon City)]

- Limited impact from factories and good enough for domestic water supply at Kokkoa

[Downstream of Hlaing River (in Yangon City)]

- Limited impact from factories and good enough for aquatic life, irrigation, transportation (rainy season)
- Some parameters (e.g. CODcr, lead, chromium) in dry season were worse than rainy season but need to check impact from industry based on accumulated water quality monitoring data
- Stream in Shwe Pyi Htar is polluted BOD, oil and grease, nutrients, phenol etc.

[Pan Hlaing River]

- Limited impact from industries and good enough for aquatic life, irrigation, transportation in rainy season
- Polluted by industry and less water volume from upstream due to temporary dam at the location between Hlain Tharyar IZ and Shwe Than Lwin in dry season

Existing Water Quality Status in Yangon

Pollution Source and Control Status

1) Domestic and factories are main pollution sources of organic pollution
2) Distillery, food and beverage, textile and dyeing are main organic pollution sources in industrial sectors
3) Some factories (leather, battery, dyeing etc.) discharge toxic substances above NEQG
4) Number of factories which installed secondary treatment is increasing year by year, but these factories are mainly large scaled. So, it may take time to treat wastewater from all of the factories in IZs.
5) Centralized WWTP will be desired for wastewater treatment in the IZs but it should be clarified which organization is going to lead installation of Centralized WWTP.
6) Sewerage is planned to be expanded in downtown area and south-western part of Yangon city, but sewerage connection in the pilot area will be expected after 2040.

Strategies for Water Pollution Control from Industrial Zones and Action Plans

Key Strategies

- Key Strategy 1: Installation of centralized wastewater treatment plants in industrial zones to prevent pollution to surrounding area
- Key Strategy 2: Development of a mechanism for promoting water environment management by factories
- Key Strategy 3: Development of water environment management plans and its implementation in priority areas

Target Period

- Short term: within there years (aiming FY2020-21)
- Middle term: within five years (aiming FY2022-23)
- Long term: within ten years (aiming FYI 2027-28)

Organizations to implement action plans

- Yangon Region Industrial Supervision Committee
- YCDC
- ECD Yangon Region

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (1)

Strategy 1: Installation of centralized wastewater treatment plants in industrial zones to prevent pollution to surrounding area

- Further prompt actions by Yangon Region Industrial Zone Supervision Committee
- Utilization of an opportunity to install a pilot wastewater treatment project under UNIDO project
- Establishment of practical and realistic PPP scheme to reduce cost burden of wastewater treatment fee by factories

Action Plans (by Yangon Region Government)

- **AY1-1:** Setting policy for installation of C-WWTP in IZs (short-term)
- **AY1-2:** Construction and operation of a pilot CWWTP in a IZ (short-term to middle-term)

AY1-3: Formulation of PPP scheme for C-WWTP in priority IZs (short-term)

AY1-4: Construction and operation of C-WWTP in priority IZs (middle-term to long-term)

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (2)

Strategy 2: Development of a mechanism for promoting water environment management by factories

- Improvement of inspection activities (efficiency, legal bases)
- Follow-up activities on Notification No. 03/2018 (EMP for existing factories of 9 sectors)
- Development of supporting tools for pollution control by factories (e.g. sharing good practice on pollution control, setting consultation desks at district/ township levels, awarding system, incentives, financial support)

Action Plans (by YCDC)

AY2-1:: Improvement of inspection activities with the revised YCDC law (short-term)

AY2-2: Strengthening on-site monitoring (short-term)

AY2-3: Examining the possibility to introduce wastewater discharge fee system (middle-term)

Action Plans (by Yangon Region ECD)

AY2-4 & AY2-5: Follow-up Notification No.03/2018 for EMP preparation (short-term)

AY2-6: Seminars for introduction of good practice on pollution control (short-term)

AY2-7: Setting consultation desks in district/township ECD offices (middle-term)

AY2-8: Examining the possibility to promote water environment management (middle-term)

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (3)

Strategy 3: Development of water environment management plans and its implementation in priority areas

- To conserve water quality at planned intake points for Yangon City (Kokkowa and Wataya in Hlaing River)
- To conserve water quality at planned intake point for Yangon New Development City (in Pan Hlaing River)
- To develop water environmental management plan and its implementation in the priority areas

Action Plans (by YCDC)

AY3-1:: Improvement of wastewater from domestic & commercial facilities (short to middle-term)

AY3-2: Expansion of sewerage area (middle to long -term)

AY3-3: Development and implementation of water environmental management plans (short to middle-term)

Action Plans (by Yangon Region ECD)

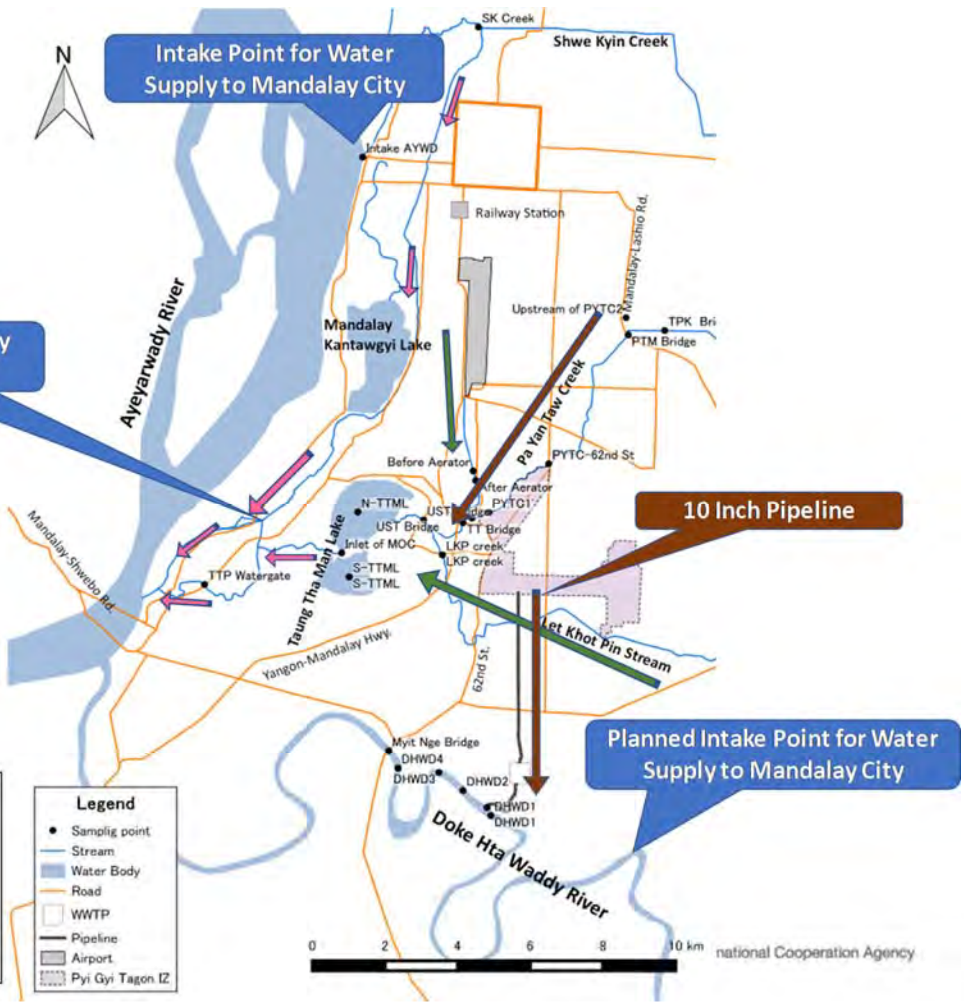
AY3-4: Development of water quality testing laboratories (short-term to long-term)

AY3-5: Surface water quality monitoring in regional level rivers (middle to long-term)

Water Quality Status of Doke Doke Hta Waddy River in Mandalay

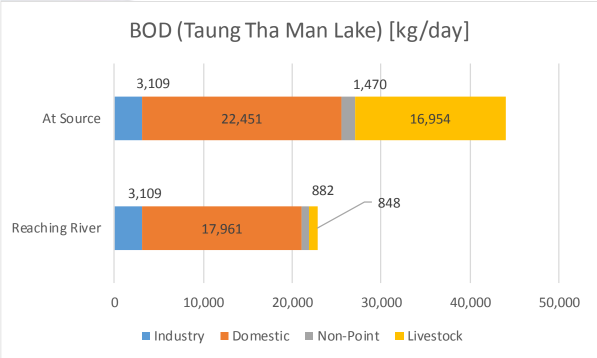
1. Pollution Load Analysis in the Pilot Area in Mandalay

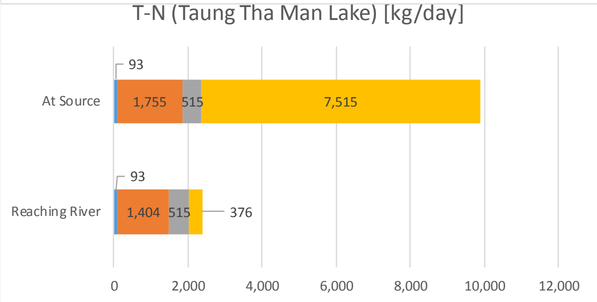
Pollution Pathways

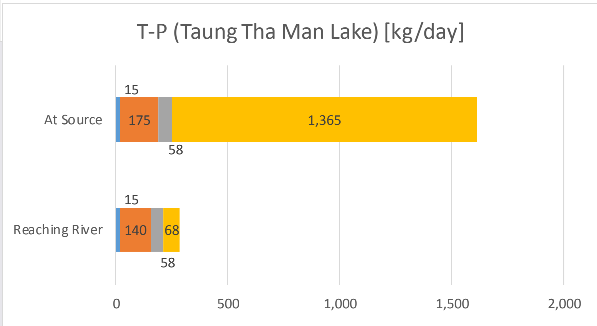


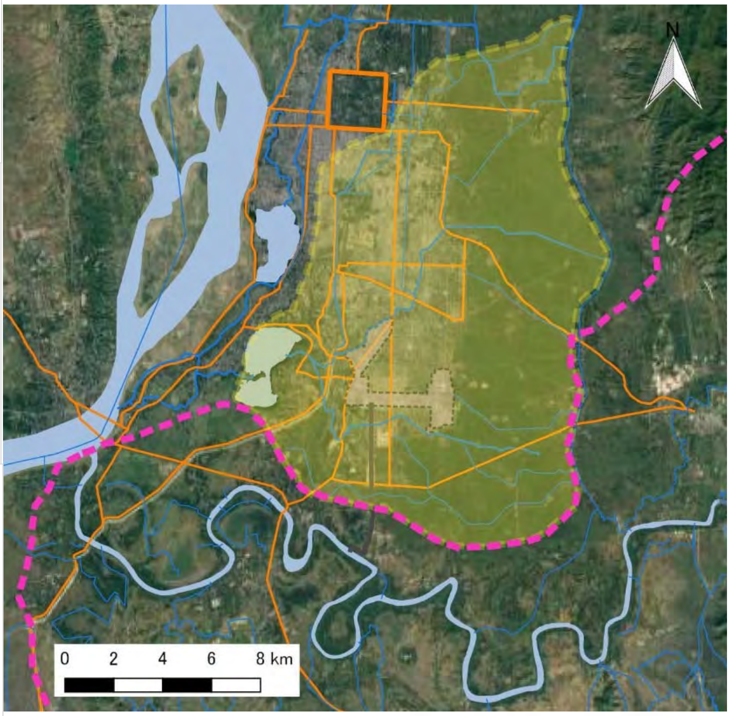
- Pollution pathway to Taung Tha Man Lake and Doke Hta Waddy River (through IZs)
- Pollution pathway to Taung Tha Man Lake (through urban creek)
- Pollution pathway to Ayeyarwady River

BOD, T-N, T-P Pollution Load in Taung Tha Man Lake Basin



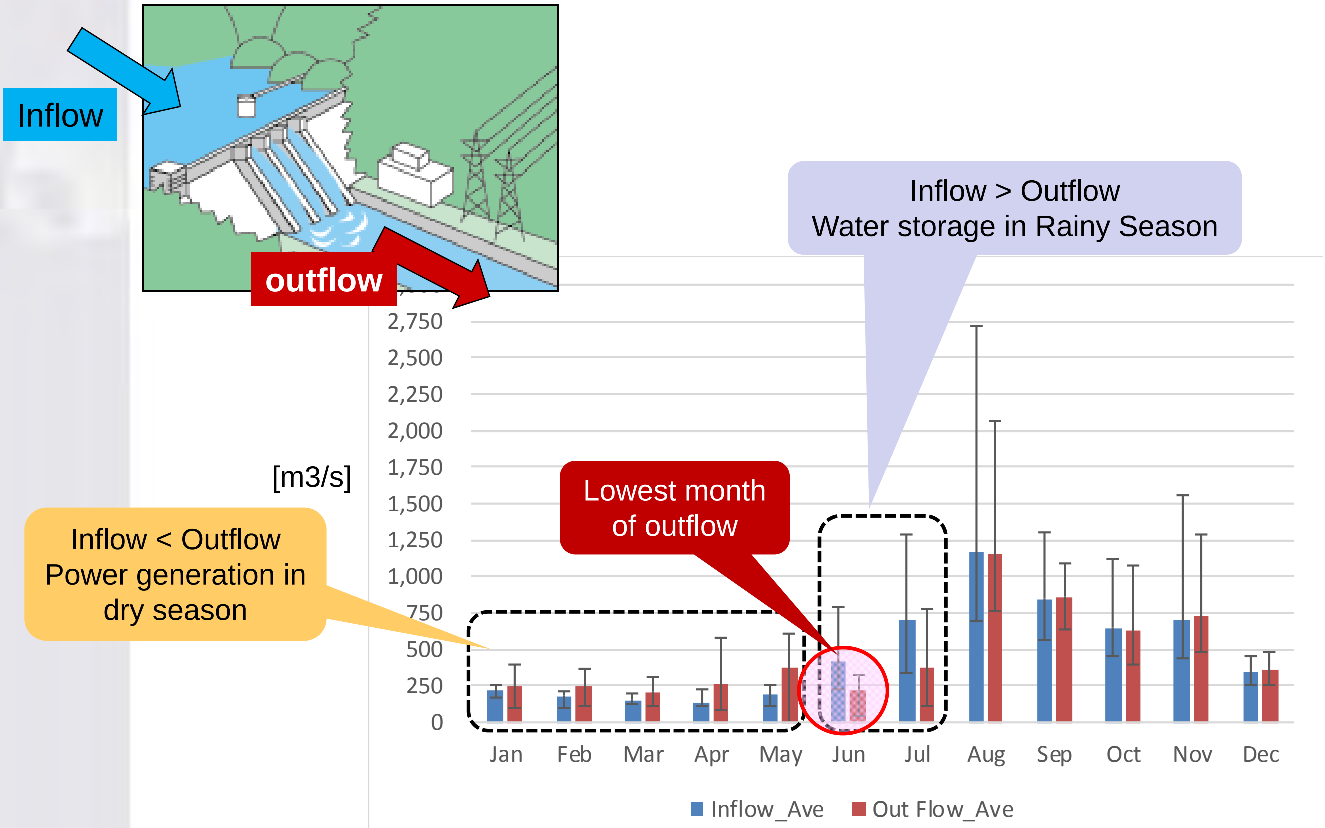






2. Preliminary Estimation of Dilution Capacity of Water Quality in Doke Hta Waddy River

2. Monthly Inflow and Outflow (Average) from Yeywa Dam in 2016

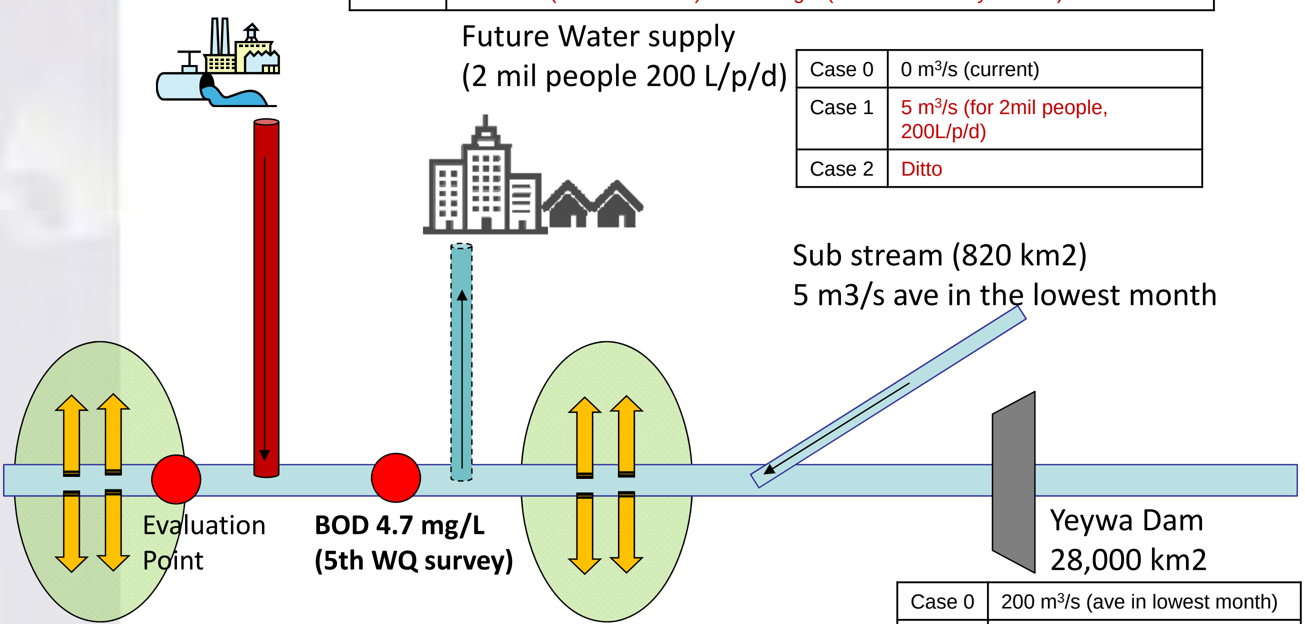


10 inch pipeline and Future WWTP

Case 0	0.03 m³/s (capacity of WWTP) with 6,500 mg/L (without treatment, inlet BOD of WWTP)
Case 1	0.05 m³/s (twice of Case 0) with 6,500 mg/L (same as Case 0)
Case 2	0.05 m³/s (twice of Case 0) with 50 mg/L (with treatment by WWTP)

Future Water supply (2 mil people 200 L/p/d)

Case 0	0 m³/s (current)
Case 1	5 m³/s (for 2mil people, 200L/p/d)
Case 2	Ditto



Case 0	200 m³/s (ave in lowest month)
Case 1	100 m³/s (half of Case 0)
Case 2	Ditto

Case 0	**BOD 4.7 mg/L**
Case 1	**BOD 8.8 mg/L**
Case 2	**BOD 4.7 mg/L**

Intakes for Irrigation

Case 0	10 m³/s (maximum)
Case 1	20 m³/s (twice of Case 0)
Case 2	Ditto

3. Strategies and Action Plans for Water Pollution Control from Industrial Zones and Other Pollution Sources in Mandalay

Existing Water Quality Status in Mandalay

River and Lake Water Quality

1) Good enough for domestic water supply at Doke Hta Waddy River
2) Stream reaching TTML is polluted by organic materials, nutrients, moderate level of oil & grease, phenols are found in dry season.
3) No heavy metals, pesticide are found
4) Eutrophication was found in TTML

Pollution Source and Control Status

1) Domestic is main pollution source on organic pollution
2) Industry is second largest pollution source on organic pollution
3) In TTML, agriculture is also main pollution source on TN and TP
4) Distillery, food and beverage, textile and dyeing, paper and pulp are main organic pollution source in industrial sector
5) Some factory (leather, battery, dyeing etc.) discharge toxic substance against NEQG
6) Sewerage in catchment of TTML will be expected after 2020
7) WWTP will be functionable facility for Doke Hta Waddy River Water Quality

Strategies for Water Pollution Control from Industrial Zones and Action Plans

Key Strategies

- Key Strategy 1: Water environment conservation for future water use of Doke Hta Waddy River
- Key Strategy 2: Improvement of water quality of Taung Tha Man Lake to increase value of the lake for tourism, recreation, fisheries, etc.

Target Period

- Short term: within there years (aiming FY2020-21)
- Middle term: within five years (aiming FY2022-23)
- Long term: within ten years (aiming FYI 2027-28)

Organizations to implement action plans

- MCDC
- ECD Mandalay Region

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (1)

Strategy 1: Water environment conservation for future water use of Doke Hta Waddy River

- Increasing the capacity to treat industrial wastewater from Pyi Gyi Tagon IZ for future
- Setting regulations or rules for investment in large-volume water intake and/or discharging of wastewater from/to Doke Hta Waddy River for future

Action Plans (by MCDC)

AM1-1: Setting a coordination committee among stakeholders for water use right and setting the maintenance flow of Doke Hta Waddy River (short-term)

AM1-2: Completion of construction and starting operation of C-WWTP (on-going, short-term to middle-term)

AM1-3: Installation of the water supply system from Doke Hta Waddy River (middle-term)

Action Plans (by Mandalay ECD)

AM1-4 & AY1-5: Follow-up Notification No.03/2018 for EMP preparation (short-term)

AY1-6: Starting-up and implementation of surface water quality monitoring in rivers in the Region out of Mandalay City (middle-term to long-term)

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (2)

Strategy 2: Improvement of water quality of Taung Tha Man Lake to increase value of the lake for tourism, recreation, fisheries, etc.

- Domestic wastewater is critical pollution source
- Improvement of lake water will be benefit for water user
- Some activities for pollution control have been already implemented
- Water pollution reduction plan will be developed based on further water quality and hydrological data

Action Plans (by MCDC)

AM2-1: Monitoring of connection status of the 10-inch-pipeline (started, short-term)

AM2-2: Issuing a notification of installation of WWT system to new large scaled facilities, (drafting, short-term)

AM2-3: Participation in awareness raising activities for farmers by DOA (short-term)

AM2-4: Monitoring of eutrophication status in TTML (short-term)

AM2-5: Expansion of the sewerage area in Mandalay City (middle-term to long-term)

Action Plans (by Mandalay ECD)

AM2-5 & AM2-6: Follow-up Notification No.03/2018 for EMP preparation (short-term)

Strategies for Water Pollution Control from Industrial Zones and Other Pollution Sources (3)

Other Supportive Activities

Action Plans (by Mandalay ECD)

AM3-1: Organizing seminars for introduction of good practice on pollution control in Myanmar (short-term)

AM3-2: Setting consultation desks in district/township ECD offices to provide advices/information to factories on pollution control (middle-term)

AM3-3: Examining the possibility to promote water environment management (e.g. awarding system with some incentives, establishment of low interest fund, consultation on cleaner production) in Yangon Region, through research for similar systems in ASEAN countries (middle-term)

AM3-4: Arrangement of ad hoc coordination meetings to exchange information on pollution sources and results of inspections among DISI, MCDC, ECD Mandalay Region (short-term)

Strategies and Action Plans for Water Pollution Control from Industrial Zones and Other Pollution Sources at National Level

Functions of Regional and National Water Environment Management Strategies

Regional Water Environment Management Strategies

- To understand regional issues and take actions (e.g. wastewater from IZs, priority sector to be controlled)
- To conserve water environment for water use (e.g. water supply for Mandalay City, Yangon City/ Region)
- To improve current water quality in important area in Regional Level (e.g. TTML)

National Water Environment Management Strategies

- To understand nation wide/ cross border issues and take actions (e.g. Ayeyawaddy river, import/ export of waste)
- To identify priorities areas to be controlled among state and regions
- To provide environment management tools to support env management at regional level by unified policies/ regulations/ systems
- To strengthening organization in ECD HQ and Regional ECD

Existing Regulations and Actions for Industrial Wastewater Control

Law and Regulations

- - Environmental Conservation Law (2012)
- - Environmental Conservation Rules (2014)
- - EIA Procedures (2015)
- - National Environment Quality (Emission) Guidelines (2015)
- - Notification (No. 3/ 2018) of preparation of EMP for existing 9 sectors factories (2018)

Industrial Pollution Control Tools

- - Environmental Inspection/ Monitoring in accordance EIA procedures
- - Environmental Inspection by YCDC law/ other registration
- - Examination of installation of central wastewater treatment system
- - Following-up Notification (No. 3/ 2018) of preparation of EMP for existing 9 sectors factories (2018)
- - National Environmental Quality (Emission) Guidelines
- - Improvement of septic tank/ treatment facilities

Approach and Goals for Water Pollution Control from Industrial Zones at National Level

Approach

- To utilize function of regional ECDs as much as possible in line with the strategy of localization by ECD Headquarters, such as expanding ECD office at the district and township levels;
- To develop actions for "pollution control" and "environment management other than pollution control" separately because restructuring PCD since April 2018;
- To utilize current regulation tools and activities on pollution control, such as EIA procedures, NEQG, notification on preparation of EMPs, and inspection.

Goals

Short term goal:	Important industrial pollution sources are identified and surface water quality in key rivers at national level are started to be monitored (within 3 years)
Middle term goal:	All of the industrial pollution sources in the country are identified and some pollution control tools are introduced (within 5 years)
Long term goal:	Industrial pollution control and environmental management system by government organizations are in the level of ASEAN top five (within 10 years)

Strategies for Water Pollution Control from Industrial Zones at National Level

Industrial Pollution Control

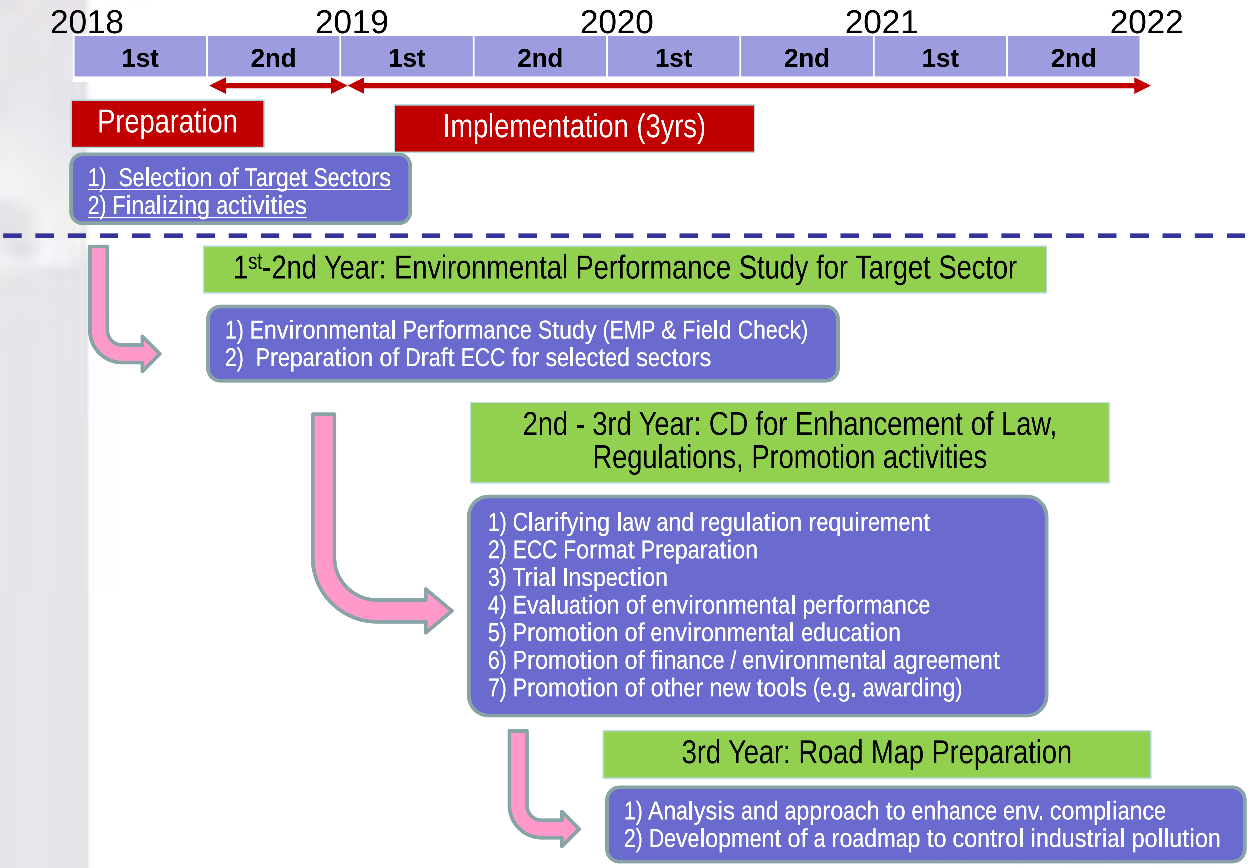
[Strategy 1: Development of National Pollution Source Inventory]

- **KA1-1:** Follow-up notification on preparation of EMP by existing factories in 9 sectors (Short to Middle Term)
- **KA1-2:** Strengthening monitoring system after issuing ECCs (or completion of EIA/ IEE/ EMP Study) (Short to Middle Term)
- **KA1-3:** Development of pollution source inventory system (upgrading pollution source database) (Short to Middle Term)
- **KA1-4:** Development of National Pollution Source Inventory (Middle Term)

[Strategy 2: Strengthening Pollution Control System]

- **KA2-1:** Formulating National Environmental Quality (Emission) Standards (Short Term)
- **KA2-2:** Promotion of centralized wastewater treatment plants (Short to Long Term)
- **KA2-3:** Strengthening inspection activities (Short to Middle Term)
- **KA2-4:** Development of pollution control tools (Short to Long Term)

Concept for Project on CD in Enforcement and Promotion of Environmental Compliance



Strategies for Water Pollution Control from Industrial Zones at National Level

Water Environmental Management

[Strategy 3: Development of Surface Water Quality Standards and National Water Quality Monitoring Network]

KA3-1: Formulating Surface Water Quality Standards (Short Term)

KA3-2: Development of national surface water quality monitoring network (Short to Long term)

KA3-3: Establishment of Water Quality Testing Laboratory (Short to Long Term)

Strategy 4: Promoting Actions for Water Environment Management

KA4-1: Preparation of environmental statistics (Short Term)

KA4-2: Promoting environmental awareness (Short to Long term)

KA4-3: Preparation of the state of pollution report (Middle to Long term)

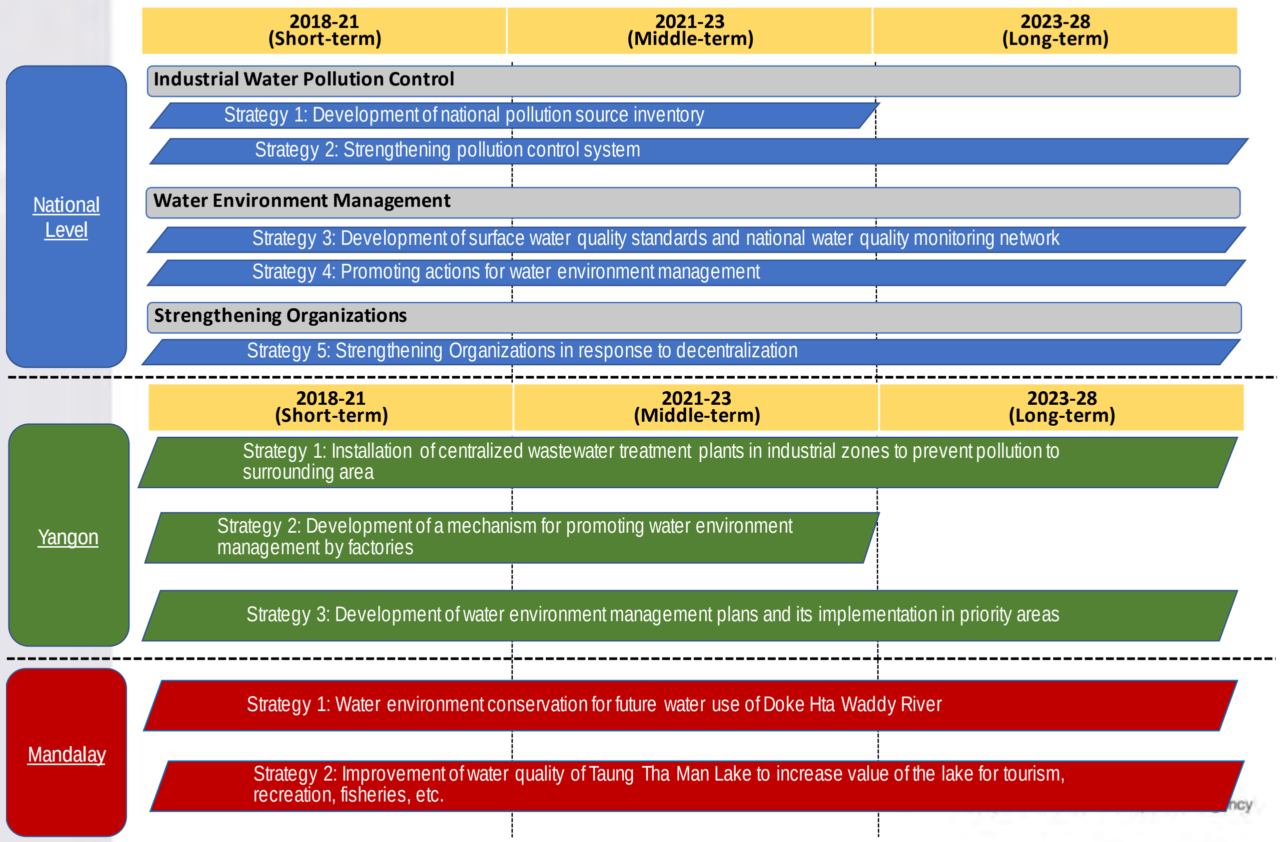
Strengthening Organizations

[Strategy 5: Strengthening organizations for decentralization]

KA5-1: Training for industrial pollution control (Short to Middle term)

KA5-2: Training for Water environment management (Middle to long term)

Strategies for Water Pollution Control from Industrial Zones at Regional and National Levels



Water Environmental Management Tools and Application

Regulatory approach	EIA, Water pollution control act, effluent standard, inspection, penalty, monitoring, pollution control agreement
Economic approach	Tax, environmental fund, wastewater discharge fee, trading, subsidy
Technical renovation approach	Cleaner production, reducing water use, information sharing platform
Awareness raising approach	Environmental performance rating and awarding system, awareness raising
Information approach	Information disclosure, publish, database development, self monitoring and disclosure by factory side
Infrastructure development	Promoting centralized wastewater treatment system
Legislation	Pollution control manager system, ISO 14001
Officer Training/ localization	Unified training system, decentralization

Thank for your attention!
(Let's create good water environment in Myanmar!)

Appendix 15:

Publicity Documents

Appendix 15-1:Project Newsletter

အခြေခံရေနှင့်ဆိုင်သော ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုနှင့် ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်း
စနစ်အတွက် စွမ်းဆောင်ရည် ဖွံ့ဖြိုးမှုဆိုင်ရာလုပ်ငန်းစီမံကိန်း

The Project for Capacity Development in Basic Water Environmental Management and EIA System

သတင်းစာစောင်

ဆောင်းဦး ၂၀၁၇၊ စာစဉ် အမှတ်စဉ်
နံပါတ် ၁
မြန်မာစာမျက်နှာ : စာ.၁-၅

Newsletter

Fall 2017, Issue No.1

English Pages : p.6-10

သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်
ထိန်းသိမ်းရေးဝန်ကြီးဌာန
Ministry of Natural Resources and
Environmental Conservation

ဂျပန်အပြည်ပြည်ဆိုင်ရာ
ပူးပေါင်းဆောင်ရွက်ရေး
အေဂျင်စီ
Japan International Cooperation
Agency

စီမံကိန်းဒါရိုက်တာ၏ အမှာစကား

ဦးလှမောင်သိန်း၊ ညွှန်ကြားရေးမှူးချုပ်၊ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန

'Project for Capacity Development in Basic Water Management and EIA System in Myanmar' အား ဂျပန်အပြည်ပြည်ဆိုင်ရာပူးပေါင်း ဆောက်ရွက်ရေးအေဂျင်စီနှင့် ပူးပေါင်း၍အကောင်အထည်ဖော် ဆောင်ရွက်ခဲ့သည်မှာ ခရီးတစ်ဝက်သို့ရောက်ရှိခဲ့ပြီးဖြစ်သည့်အားလျော်စွာ ယခုအချိန်အထိရရှိခဲ့သည့် တိုးတက်မှုများသည် မိမိတို့အတွက်အားတစ်ခုဖြစ်စေခဲ့ပါသည်။ မြန်မာနိုင်ငံ၏ ရေရှည်စီးပွားဖွံ့ဖြိုးတိုးတက်ရေးကို မျှော်မှန်းဆောင်ရွက်ရာတွင် သက်ဆိုင်ရာအဖွဲ့အစည်းများနှင့်ပူးပေါင်း၍ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးနှင့် ပတ်ဝန်းကျင်ညစ်ညမ်းမှု ကာကွယ်ရေးလုပ်ငန်းများကိုပေါင်းစပ်ဆောင်ရွက်နိုင်ရေးသည် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန၏ အဓိကတာဝန်တစ်ရပ်ဖြစ်ပါသည်။ အဆိုပါရည်မှန်းချက်ကိုအောင်မြင်စေရန် စက်ရုံအလုပ်ရုံများမှထွက်ရှိသော စွန့်ပစ်ရေများကြောင့် ပတ်ဝန်းကျင်ညစ်ညမ်းစေမှုကိုကြိုတင်ကာကွယ်နိုင်ရေးအတွက် ရင်းနှီးမြှုပ်နှံမှုလုပ်ငန်းများတွင် ပတ်ဝန်းကျင် စီမံခန့်ခွဲရေးကိုထည့်သွင်းအကောင်အထည်ဖော်ဆောက်ရွက်နိုင်ရန် ကြိုးပမ်းဆောင်ရွက်လျက်ရှိပါသည်။ အဆိုပါစီမံကိန်းအား ဂျပန်အပြည်ပြည်ဆိုင်ရာပူးပေါင်းဆောက်ရွက်ရေးအေဂျင်စီနှင့်အတူ ပူးပေါင်းဆောင်ရွက်ခွင့်ရရှိသည့်အခွင့်အရေးသည် မြန်မာနိုင်ငံရှိစက်မှုစွန့်ပစ်ရေသန့်စင်မှုလုပ်ငန်းများကို တိုးတက်စေမည့်စီမံကိန်းရလဒ်များရရှိနိုင်လိမ့်မည်ဟုမျှော်လင့်ပါသည်။ ဂျပန်အပြည်ပြည်ဆိုင်ရာ ပူးပေါင်းဆောင်ရွက်ရေးအေဂျင်စီကိုပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဦးစီးဌာနရဲ့ ကိုယ်စားကျေးဇူးအထူးတင်ရှိပါသည်။

JICA Expert Team ခေါင်းဆောင်၏ အမှာစကား

ဒေါက်တာ အီတာရှု အိုကူတာ

စီမံကိန်းမှကြိုဆိုပါတယ်ခင်ဗျာ။ ယခုစီမံကိန်းမှာ အတော်အတန်ပြီးဆုံးနေပြီ ဖြစ်သော်လည်းစီမံကိန်းတွင်ပူပေါင်းပါဝင်ဆောင်ရွက်ကြသည့် ပုဂ္ဂိုလ်များနှင့် အဖွဲ့အစည်းများအပေါ် လှိုက်လှဲစွာကျေးဇူးတင်ရှိကြောင်းဖော်ပြလိုပါသည်။ ပြီးခဲ့သည့်နှစ်နှစ်တာကာလအတွင်း သိသာထင်ရှားသောတိုးတက်မှုများကိုဆောင်ရွက်ခဲ့ပြီးဖြစ်သော်လည်း ရေသယံဇာတပတ်ဝန်းကျင်ကို ကောင်းမွန်စွာစီမံခန့်ခွဲနိုင်ရန်နှင့် ထိရောက်သောပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ချက်စနစ်ကို စတင်နိုင်ရန်အတွက်ကျွန်တော်တို့တွင်စိန်ခေါ် မှုများစွာကို ရင်ဆိုင်နေရဆဲဖြစ်ပါသည်။ ရန်ကုန်မြို့ နှင့် မန္တလေးမြို့ရှိစက်ရုံများ၏စက်မှုစွန့်ပစ်ရေစီမံခန့်ခွဲမှုများကိုလည်း အတော်အတန်သိရှိထားပြီးဖြစ်ပါသည်။ ထို့အပြင် ခိုင်မာသည့်မြစ်ရေအရည်အသွေးစစ်တမ်းကောက်ယူမှုများကို အကောင်အထည်ဖော်ဆောင်ရွက်သည့် ထင်ရှားသောအတွေ့အကြုံများလည်းရရှိခဲ့ပြီးဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းနှင့်ပတ်သက်၍ ဥပဒေရေးဆွဲခြင်း၊ သင်တန်းများပေးခြင်းဖြင့် စွမ်းဆောင်ရည်ရည်မြှင့်တင်ခြင်းနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာအထောက်အပံ့ပစ္စည်းများ ပြုစုခြင်းကဲ့သို့သော ရလဒ်များကိုလည်းဆောင်ရွက်ပြီးစီးပြီးဖြစ်ပါသည်။ အဆိုပါအားထုတ်ကြိုးပမ်းမှုများသည်မြန်မာနိုင်ငံ၏ ပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲမှုအတွက် အခြေခံအုတ်မြစ်များဖြစ်လာပါသည်။ နောင်တွင်ဆက်လက်ထွက်ရှိမည့်သတင်းစာစောင်တွင်လည်းအဓိကကျသည့်ရလဒ်များမှအချို့ကိုအသေးစိတ်ဆက်လက်တင်ပြပါဦးမည်။

စီမံကိန်းအကြောင်း

(၁) စီမံကိန်း မျှော်မှန်းချက်၊ စီမံကိန်း၏ ရည်ရွယ်ချက်နှင့် ရလဒ်များ

စီမံကိန်း မျှော်မှန်းရလဒ်များ၊ စီမံကိန်းရည်ရွယ်ချက် နှင့် ရလဒ်များကို အောက်ပါဇယားတွင်ဖော်ပြထားပါသည်။ ယခုစီမံကိန်းတွင် ရေသယံဇာတ ပတ်ဝန်းကျင်စီမံခန့်ခွဲခြင်းနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဟူ၍ အပိုင်း(၂)ပိုင်းပါဝင်ပါသည်။ စီမံကိန်း၏ ရေသယံဇာတပတ်ဝန်း ကျင်စီမံခန့်ခွဲမှုအပိုင်းတွင် ကွင်းဆင်းစစ်ဆေးခြင်း (ရလဒ်၁)၊ ရေအရည်အသွေးစစ်တမ်းကောက်ယူခြင်း (ရလဒ်၂)၊ Database တည်ဆောက်ခြင်း (ရလဒ်၃)နှင့် ရေထုညစ်ညမ်းမှုထိန်းချုပ်ခြင်းဆိုင်ရာ စီမံချက်များနှင့်ပတ်သက်သည့်သတင်းအချက်အလက်များ အဓိပ္ပာယ်ဖွင့်ဆိုခြင်း (ရလဒ်၄)စသည့်ရလဒ်လေးမျိုးရရှိမည်ဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းအပိုင်းတွင် နည်းပညာဆိုင်ရာလက်စွဲစာအုပ်/သတ်မှတ်ပုံစံများပြုစုခြင်း (ရလဒ်၅) နှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလုပ်ငန်းများကို ပြန်လည်ဆန်းစစ်ခြင်းဆိုင်ရာစွမ်းဆောင်ရည်မြှင့်တင်ခြင်း (ရလဒ်၆) စသည့်ရလဒ်နှစ်မျိုးရရှိမည်ဖြစ်ပါသည်။ အဆိုပါလုပ်ငန်းဆောက်ရွက်မှုများဖြင့် စီမံကိန်းမျှော်မှန်းချက်နှင့် အညီစီမံကိန်းရည်ရွယ်ချက်များကို စီမံကိန်းလုပ်ငန်းစဉ်အတွင်း ကြိုးပမ်းရရှိရန်နှင့် စက်မှုစွန့်ပစ်ရေဆိုင်ရာပြဿနာများ လျော့ပါးစေရေး၊ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းလုပ်ငန်းအပေါ်ပြန်လည်ဆန်းစစ်မှုများလုပ်ငန်းများ တိုးတက်စေရေးတို့ကို မြန်မာနိုင်ငံအား ထောက်ပံ့ပေးနိုင်ရန် မျှော်လင့်ထားပါသည်။

အကြောင်းအရာ	မာတိကာ	
စီမံကိန်း မျှော်မှန်းချက်	စက်မှုဇုန်များမှ စွန့်ပစ်ရေများကြောင့် မြစ်ရေအရည်အသွေး ထိခိုက်မှုကိုလျော့ကျစေရန်နှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာ ခေတ်မီနည်းလမ်းများကို ထည့်သွင်းစဉ်းစားဆုံးဖြတ်ရန်။	
စီမံကိန်း ရည်ရွယ်ချက်	စုစည်းရရှိသည့် သတင်းအချက်အလက်များကို အဓိပ္ပာယ်ဖွင့်ဆိုခြင်းအပေါ် မူတည်၍ ရေထုညစ်ညမ်းမှုထိန်းချုပ်ခြင်းနည်းလမ်းများ ဖွံ့ဖြိုးမှုဆိုင်ရာ စွမ်းဆောင်ရည်တိုးမြှင့်စေခြင်းနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလုပ်ငန်းများ၏ အဖွဲ့အစည်းဆိုင်ရာ မူဘောင်ကိုစတင်ထူထောင်နိုင်ရန်။	
ရလဒ်များ	ရလဒ်(၁)	ကွင်းဆင်းစစ်ဆေးရေး လုပ်ထုံးလုပ်နည်းများ ကိုစံပြုသတ်မှတ်ခြင်း။
	ရလဒ်(၂)	တိကျသောအချက်အလက်များရရှိနိုင်ရန်အတွက် ရေထုအရည်အသွေး စစ်တမ်းကောက်ယူခြင်းဆိုင်ရာ စွမ်းဆောင်ရည်မြှင့်တင်ခြင်း။
	ရလဒ်(၃)	ရေထုညစ်ညမ်းမှု ဖြစ်စေသော ဇာစ်မြစ်များနှင့် မြစ်ရေအရည်အသွေး တို့၏အချက်အလက်များပြုစုခြင်း။
	ရလဒ်(၄)	ရေထုညစ်ညမ်းမှု ထိန်းချုပ်ခြင်း နည်းလမ်းများအတွက် သတင်းအချက်အလက် အဓိပ္ပါယ်ဖွင့်ဆိုခြင်းဆိုင်ရာ စွမ်းဆောင်ရည်မြှင့်တင်ခြင်း။
	ရလဒ်(၅)	ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအတွက် လိုအပ်သောနည်းပညာလက်စွဲ စာအုပ်များ နှင့် သတ်မှတ်ပုံစံများပြုစုခြင်း။
	ရလဒ်(၆)	ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းနှင့်ပတ်သက်၍ သယံဇာတနှင့်သဘာဝ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာနနှင့် အခြားသက်ဆိုင်ရာအဖွဲ့အစည်းများ၏စွမ်းဆောင်ရည်မြှင့်တင်ခြင်း။

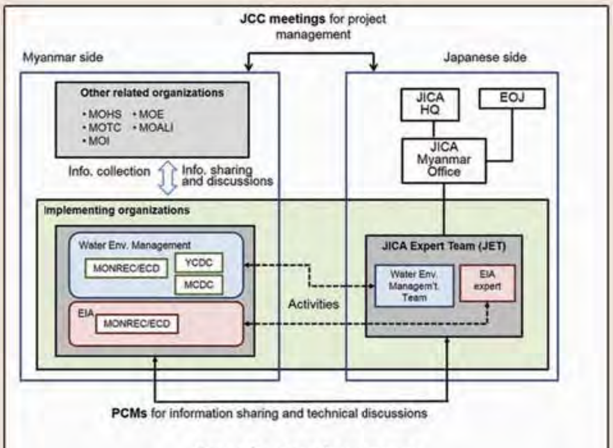
(၂) စီမံကိန်းကာလ

စီမံကိန်းကာလ - ၂၀၁၅ မှ ဇွန်လ ၂၀၁၈ခုနှစ်၊ မေလ အထိ

(၃) ဖွဲ့စည်းတည်ဆောက်ပုံ

မြန်မာနိုင်ငံဘက်မှစီမံကိန်းကိုအကောင်အထည်ဖော်ဆောင်ရွက်သည့် အဖွဲ့အစည်းများမှာ ပတ်ဝန်းကျင်ထိမ်းသိမ်းရေးဦးစီးဌာန၊ ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီနှင့် မန္တလေးမြို့တော်စည်ပင်သာယာရေးကော်မတီတို့ ဖြစ်ပါသည်။ ဂျပန်နိုင်ငံဘက်မှအဖွဲ့အနေဖြင့် ဂျပန်အပြည်ပြည်ဆိုင်ရာပူးပေါင်းဆောင်ရွက်ရေးအေဂျင်စီမှ ပတ်ဝန်းကျင်ဆိုင်ရာကျွမ်းကျင်ပညာရှင်အဖွဲ့ကို မြန်မာနိုင်ငံသို့စေလွှတ်ခဲ့ပါသည်။ လက်ရှိပတ်ဝန်းကျင်ဆိုင်ရာကျွမ်းကျင်ပညာရှင်အဖွဲ့တွင်အဖွဲ့ဝင်(၆)ဦးရှိပါသည်။ အထက်ဖော်ပြပါအဖွဲ့အစည်းများအပြင်စိုက်ပျိုးရေး၊ မွေးမြူရေးနှင့်ဆည်မြောင်းဝန်ကြီးဌာန၊

ပို့ဆောင်ရေး နှင့် ဆက်သွယ်ရေးဝန်ကြီးဌာန၊ စက်မှုဝန်ကြီးဌာန၊ ပညာရေးဝန်ကြီးဌာန နှင့် ကျန်းမာရေးနှင့်အားကစားဝန်ကြီးဌာန တို့သည်လည်း စီမံကိန်းဆိုင်ရာညှိနှိုင်းပူးပေါင်းဆောက်ရွက်ရေးကော်မတီပူးပေါင်းဆောင်ရွက်ရေးကော်မတီအဖွဲ့ဝင်များအနေဖြင့် ပူးပေါင်းပါဝင်ဆောက်ရွက်လျက်ရှိပြီးအဆိုပါကော်မတီအစည်းအဝေးကို တစ်နှစ်လျှင်တစ်ကြိမ်ကျင်းပခဲ့ပါသည်။ စီမံကိန်းရလဒ်များအားမျှဝေရန်နှင့် နည်းပညာဆိုင်ရာ ကိစ္စရပ်များကိုဆွေးနွေးရန်အတွက်စီမံကိန်း ပူးပေါင်းဆောင်ရွက်ရေး အစည်းအဝေးကိုလည်းတစ်နှစ်လျှင်နှစ်ကြိမ်ကျင်းပခဲ့ပါသည်။

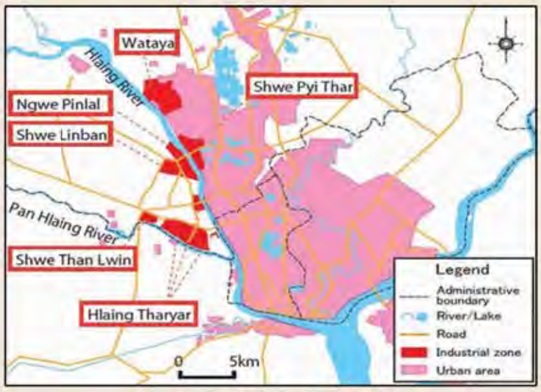


Organizational structure

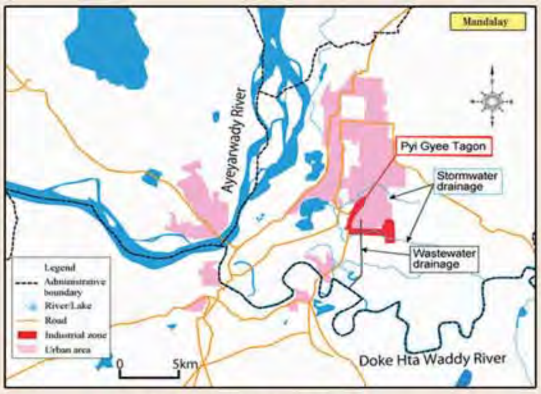
ရေသယံဇာတပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအပိုင်း၏ လုပ်ငန်းဆောင်ရွက်မှုများ

(၄) အဓိကထား ဆောင်ရွက်မည့် နယ်ပယ်များ

မြန်မာနိုင်ငံတွင် ခိုင်မာသည့် ပတ်ဝန်းကျင်ဆိုင်ရာ သတင်းအချက်အလက်များ နည်းပါးနေဆဲဖြစ်ပြီး ထိုသို့နည်းပါးခြင်းသည် ပတ်ဝန်းကျင်ဆိုင်ရာ ဆုံးဖြတ်ချက်များ ချမှတ်ရာတွင် အဓိကအခက်အခဲတစ်ခုဖြစ်ပါသည်။ သတင်းအချက်အလက် စုစည်းခြင်း၊ စိစစ်ခြင်းနှင့်အဓိပ္ပါယ်ဖွင့်ဆိုခြင်း တို့ကိုလက်တွေ့ဆောင်ရွက်ရန်အတွက် ရန်ကုန်မြို့ရှိ လှိုင်မြစ်ဝှမ်းနှင့် မန္တလေးမြို့ရှိဒုဋ္ဌဝတီမြစ်ဝှမ်းတို့ကို အဓိကထားဆောင်ရွက်မည့်နယ်ပယ် နှစ်ခုအဖြစ်သတ်မှတ်ထားပါသည်။ အဆိုပါအဓိကထားဆောင်ရွက်မည့်နယ်ပယ်များအတွင်း စက်မှုဇုန်များများစွာတည်ရှိနေပြီး ၎င်းနယ်ပယ်များသည်စက်မှုစွန့်ပစ်ရေများမှမြစ်များ၏မြစ်ရေအရည်အသွေးအပေါ် အကျိုးသက်ရောက်စေမှုကို ဖော်ထုတ်နိုင်ရန်အတွက် အကောင်းဆုံး နေရာများ ဖြစ်ပါသည်။



ရန်ကုန်မြို့ရှိ လှိုင်မြစ်ဝှမ်း



မန္တလေးမြို့ရှိ ဒုဋ္ဌဝတီမြစ်ဝှမ်း

(၅) ရေသယံဇာတပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအပိုင်း၏ ရလဒ်များ

ရလဒ် – ၁း ကွင်းဆင်းစစ်ဆေးခြင်း

ရလဒ်-၁ သည်ကွင်းဆင်းစစ်ဆေးရေးလုပ်ထုံးလုပ်နည်းများကို စံပြုသတ်မှတ်ရန် ရည်ရွယ်ပါသည်။ ကွင်းဆင်းစစ်ဆေးရေးလက်စွဲစာအုပ်ကိုပြုစုထားပြီး စွန့်ပစ်ရေနမူနာကောက်ယူခြင်း နှင့် စွန့်ပစ်ရေသန့်စင်မှု နည်းပညာများဆိုင်ရာသင်တန်းပေးခြင်းကဲ့သို့သော ကွင်းဆင်းစစ်ဆေးရေးနှင့် ၎င်းဆက်စပ်သည့် စွမ်းဆောင်ရည် မြှင့်တင်ခြင်းလုပ်ငန်းဆောင်ရွက်ချက်များကို အကောင်အထည်ဖော်ဆောင်ရွက်လျက်ရှိပါသည်။

ရလဒ် – ၂။ ရေအရည်အသွေးစစ်တမ်းကောက်ယူခြင်း

ရလဒ် ၂တွင် လှိုင်မြစ်ဝှမ်းနှင့် ဒုဋ္ဌဝတီမြစ်ဝှမ်းတို့၌ အဆိုပါမြစ်တို့၏မြစ်ရေ အရည်အသွေးအပေါ် စက်မှုဇုန်များမှ စွန့်ပစ်ရေများကြောင့် ထိခိုက်မှုကိုဖော်ထုတ်ရန် ရေအရည်အသွေးစစ်တမ်းကောက်ယူခြင်းကို(၅)ကြိမ် (ခြောက်သွေ့ရာသီတွင် (၃)ကြိမ် နှင့်မိုးရာသီတွင်(၂)ကြိမ်) ဆောင်ရွက်မည်ဖြစ်ပါသည်။ ၂၀၁၇ခုနှစ်၊ စက်တင်ဘာလနှင့် အောက်တိုဘာလတို့တွင် စတုတ္ထအကြိမ် ရေနမူနာကောက်ယူ ခြင်းကိုဆောင်ရွက်ခဲ့ပါသည်။

ရလဒ် – ၃။ Database တည်ဆောက်ခြင်း

ရလဒ်-၃၏ ရည်ရွယ်ချက်သည် မြစ်ရေအရည်အသွေးနှင့် ညစ်ညမ်းမှုဖြစ်စေသည့် ဇာစ်မြစ်များဆိုင်ရာ အချက်အလက်များပြုစုရန်ဖြစ်ပါသည်။ စက်မှုလုပ်ငန်းဆိုင်ရာ အချက်အလက်များနည်းပါးသောကြောင့် ၂၀၁၇ခုနှစ်နှင့် ၂၀၁၆ခုနှစ်တို့ တွင် ရန်ကုန်မြို့နှင့် မန္တလေးမြို့တို့၌ ညစ်ညမ်းမှုဖြစ်စေသည့် ဇာစ်မြစ်များ စစ်တမ်းကောက်ယူခြင်းကို ဆောင်ရွက်ခဲ့ပါသည်။ရေအရည်အသွေးစစ်တမ်း ကောက်ယူခြင်း (ရလဒ်၂) ၏ရလဒ်များကို မြစ်ရေအရည်အသွေးအချက်အလက်များတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

ရလဒ် – ၄။ သတင်းအချက်အလက်များ အမိပ္ပါယ်ဖွင့်ဆိုခြင်း

စာရင်းကောက်ယူထားသည့် လှိုင်မြစ်ဝှမ်းနှင့် ဒုဋ္ဌဝတီမြစ်ဝှမ်းတို့၏ သတင်းအချက်အလက်များကို စိစစ်ပြီး ညစ်ညမ်းမှုဖြစ်စဉ်များကို ရှင်းလင်းချက်ထုတ်မည်ဖြစ်ပါသည်။ ထို့နောက်၎င်းမှ ရရှိသည့်ရလဒ်များအား အသုံးပြုပြီးရေထုညစ်ညမ်းမှု ထိန်းချုပ်ခြင်းဆိုင်ရာ ကွဲပြားသောနည်းလမ်းများကို ဖော်ထုတ်မည်ဖြစ်ပါသည်။

(၆) လက်ရှိ လှုပ်ရှားဆောင်ရွက်မှုများ

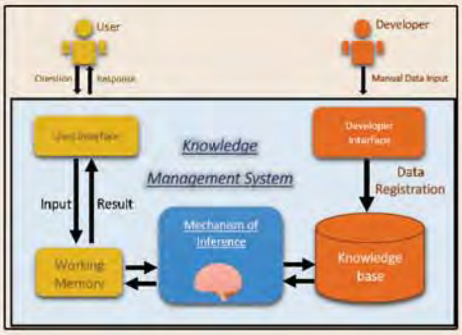
ရန်ကုန်မြို့တွင် ဆောင်ရွက်ခဲ့သည့်စက်မှုစွန့်ပစ်ရေသန့်စင်ခြင်းဆိုင်ရာ အလုပ်ရုံဆွေးနွေးပွဲ

စက်မှုဇုန်များမှ စွန့်ပစ်ရေများကို ထိန်းချုပ်ရန်အတွက် ဗဟိုရေဆိုးသန့်စင်စက်ရုံ တည်ဆောက်ခြင်းသည်ကောင်းမွန်သော နည်းလမ်းတစ်ခုဖြစ်သော်လည်း မြန်မာနိုင်ငံရှိစက်မှုဇုန်အများစုတွင် ထိုကဲ့သို့သောစက်ရုံများမရှိသေးပါ။ ဗဟိုရေဆိုးသန့်စင်စက်ရုံတစ်ရုံတည်ဆောက်ရန်အတွက် နည်းပညာရွေးချယ်မှုများ၊ ကုန်ကျစရိတ်၊ ငွေကြေးကိစ္စရပ်များ၊ မြေအနေအထားရရှိနိုင်မှု၊ စက်မှုလုပ်ငန်းများအကြားသဘောတူညီမှု၊ အဆိုပါစက်ရုံအားစီမံခန့်ခွဲမည့်လုပ်ငန်း၊ ကုန်ကျစရိတ်နှင့် တာဝန်ယူခြင်းတို့အတွက်ပေါင်းစပ်ဆောင်ရွက်မည့်အစိုးရ စသည့်ကိစ္စရပ်များစွာကိုထည့်သွင်းစဉ်းစားရမည်ဖြစ်ပါသည်။ အဆိုပါကိစ္စရပ်များကိုရှင်းလင်းချက်ထုတ်နိုင် ရန်အလို့ငှာ ရန်ကုန်မြို့ရှိ စက်မှုဇုန်တစ်ခုတွင်အသေးစားရှေ့ပြေးလေ့လာမှုတစ်ခုကို စီမံကိန်းမှဆောင်ရွက်ခဲ့ပြီးရလဒ်များကို ၂၀၁၇ခုနှစ်၊ အောက်တိုဘာလ ၃၀ရက်နေ့တွင်ရန်ကုန်တိုင်းဒေသကြီးအစိုးရဆက်သွယ်ရေးဝန်ကြီးဌာန၊ အဖွဲ့ရုံး၌ကျင်းပခဲ့သည့် စက်မှုစွန့်ပစ်ရေသန့်စင်ခြင်းဆိုင်ရာ အလုပ်ရုံဆွေးနွေးပွဲတွင်တင်ပြခဲ့ပါသည်။ အဆိုပါအလုပ်ရုံဆွေးနွေးပွဲတွင်ဗီယက်နမ်နိုင်ငံရှိစက်မှုဇုန်၊ ရန်ကုန်မြို့ရှိသီလဝါအထူးစီးပွားရေးဇုန်၊ မန္တလေးမြို့ရှိဗဟိုရေဆိုးသန့်စင်မှုစသည့်တင်ပြချက်များကို အဓိကထားတင်ပြခဲ့ပါသည်။ အဆိုပါအလုပ်ရုံဆွေးနွေးပွဲအား ရန်ကုန်တိုင်းဒေသကြီးအစိုးရအဖွဲ့၊ ဝန်ကြီးချုပ်ဦးဖြိုးမင်းသိန်းမှဦးဆောင်ခဲ့ပြီး စီမံကိန်း၏ကြိုးပမ်းအားထုတ်မှုများကိုအသိအမှတ်ပြုလျက် ရန်ကုန်မြို့ရှိစက်မှုဇုန်များတွင် ဗဟိုရေဆိုးသန့်စင်ခြင်းကိုလက်တွေ့အကောင်အထည်ဖော်နိုင်ရန် အလုပ်ရုံဆွေးနွေးပွဲ၌ ပါဝင်ဆွေးနွေးအဖြေရှာကြပါရန်တိုက်တွန်းခဲ့ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ချက်အပိုင်း၏ လုပ်ငန်းဆောင်ရွက်ချက်များ

(၇) ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ချက်အပိုင်း၏ ရလဒ်များ

ရလဒ် – ၅။ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာ လက်စွဲစာအုပ်များနှင့် ဥပဒေပြဌာန်းချက်များ



ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း အစီရင်ခံစာများကိုစိစစ်ရာတွင် ပိုမိုလွယ်ကူ အထောက်အကူဖြစ်စေရန် 'e-Manual' ကွန်ပျူတာဖြင့် ထိန်းချုပ်ဆောင်ရွက်သည့်စနစ်ကိုဆောင်ရွက်လျက်ရှိပါသည်။ EIA အစီရင်ခံစာများ စိစစ်ပြီးစီးမှုကို သိရှိနိုင်ရန် 'Tracking System' 'ခြေရာခံခြင်းစနစ်' ကို ပြုစုခဲ့ပြီးဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာဥပဒေပြဌာန်းချက်များအရ 'အကြံပေးပုဂ္ဂိုလ်အတွက် လိုင်စင်ထုတ်ပေးခြင်းစနစ်' ကို မူကြမ်းပြုစုပြီးဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာလေ့လာမှုများအတွက် အရည်အသွေးပြည့်မီသည့် အကြံပေးပုဂ္ဂိုလ်များကိုသတ်မှတ်နိုင်ရန်အလို့ငှာ မှတ်ပုံတင်လုပ်ထုံးလုပ်နည်းတစ်ခုကိုရေးဆွဲထားခြင်းဖြစ်ပါသည်။

ရလဒ် – ၆။ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလုပ်ငန်းများကို ပြန်လည်ဆန်းစစ်ခြင်းဆိုင်ရာစွမ်းဆောင်ရည်မြှင့်တင်ခြင်း

ဤလုပ်ငန်းတွင်အခြေခံနှင့် အဆင့်မြင့်သင်တန်းများ၊ လူမှုဆောင်ရွက်ချက်များ (ဥပမာ-အလုပ်ရုံဆွေးနွေးပွဲ၊ EIA Portal site နှင့် လက်ကမ်းစာစောင်ဖြန့်ဝေခြင်း)နှင့် နိုင်ငံတကာအဖွဲ့အစည်းများနှင့် ဆက်ဆံရေးတည်ဆောက်ခြင်း (ဥပမာ-နိုင်ငံတကာညီလာခံ/ဆွေးနွေးပွဲများသို့ဖိတ်ကြားခြင်း) စသည့်လုပ်ငန်းဆောင်ရွက်ချက် (၃)ခု ပါဝင်ပါသည်။

(၈) လက်ရှိ လှုပ်ရှားဆောင်ရွက်မှုများ

နေပြည်တော်တွင် ဆောင်ရွက်ခဲ့သည့် မြန်မာနိုင်ငံ နှင့် ကမ္ဘောဒီးယားနိုင်ငံနှစ်နိုင်ငံကြားနည်းပညာဖလှယ်ခြင်းဆိုင်ရာ ဆွေးနွေးပွဲ

သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန၊ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနနှင့် ဆောင်လုပ်ရေးဝန်ကြီးဌာနအပါအဝင် အကောင်အထည်ဖော်ဆောင်ရွက်သည့် အဖွဲ့အစည်းများအတွက် နည်းပညာပူးပေါင်းဆောင်ရွက်သည့်စီမံကိန်းများမှ တစ်ဆင့်မြန်မာနိုင်ငံ၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာထည့်သွင်းစဉ်းစားရမည့်အချက်များအပေါ် JICAမှ ပံ့ပိုးပေးလျက်ရှိပါသည်။ ကမ္ဘောဒီးယားနိုင်ငံ၊ ပြည်သူ့အလုပ်အမှုဆောင်နှင့် ပို့ဆောင်ရေးဝန်ကြီးဌာန၊ စီမံကိန်းဌာနမှညွှန်ကြားရေးမှူး၊ ကမ္ဘောဒီးယား JICAကျွမ်းကျင်ပညာရှင်အဖွဲ့မှ မစ္စတာပရော့ဒ်နိုဗီဒါ တို့သည်နှစ်နိုင်ငံအတွေ့အကြုံများကိုဖလှယ်နိုင်ရန် နေပြည်တော်နှင့် ရန်ကုန်မြို့သို့လာရောက်ခဲ့ပါသည်။ မြန်မာနိုင်ငံ၏ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း နှင့် ပတ်ဝန်းကျင်ဆိုင်ရာလုပ်ငန်းဆောင်ရွက်မှုများကို ကမ္ဘောဒီးယားနိုင်ငံနှင့် နှိုင်းယှဉ်ပါကအလွန်နီးစပ်ပါသည်။ ပုဂ္ဂလိကကဏ္ဍများအပါအဝင်Stakeholder များ၏လေးစားလိုက်နာမှု၊ နိုင်ငံစံချိန်စံညွှန်းများအကြား ကွာဟချက်၊ ပတ်ဝန်းကျင်နှင့် သဟဇာတရှိသည့် အင်ဂျင်နီယာဘာသာရပ်ဆိုင်ရာနည်းပညာအကန့်အသတ်များကဲ့သို့သောစိန်ခေါ်မှုများစွာကို ကမ္ဘောဒီးယားနိုင်ငံတွင်ရင်ဆိုင်နေရပါသည်။ JICAနှင့် အတူမြန်မာနိုင်ငံပါဝင်ဆောင်ရွက်သည့် အဖွဲ့အစည်းများ၏ ပတ်ဝန်းကျင်နှင့် လူမှုအကျိုးပြုစီမံကိန်းများအား အကောင်အထည်ဖော်ဆောင်ရွက်နေမှုအခြေအနေများကို သိရှိနိုင်ရန်အတွက် အဆိုပါအဖွဲ့သည် JICAမှ ပါဝင်ဆောင်ရွက်လျက်ရှိသော စီမံကိန်းများသို့သွားရောက်လေ့လာခဲ့ပါသည်။

Message from Project Director:

Mr. Hla Maung Thein, Director General, Environmental Conservation Department

As we approach the halfway mark of our work with JICA on the "Project for Capacity Development in Basic Water Environment Management and EIA System in Myanmar", I am encouraged by the progress which has been made so far. With the aim of sustainable economic development in Myanmar, the integration of enviornmental conservation and protection measures are one of the main tasks of the Environmental Conservation Department through coordination with relevant agencies. In order to achieve this objective, we are endeavoring to mainstream environmental management into investment to reduce the environmental impacts due to waste water produced by the industry. Due to this, the opportunity to work with JICA on this project, I look forward to the outcomes of the project improving the treatment of industrial waste water in Myanmar. I would like to express my deepest gratitude on behalf of Enviromental Conservation Department to Japan International Cooperation Agency.

Message from Leader of JICA Expert Team:

Dr. Itaru Okuda

Welcome to our project! Although we are only half way through the project, we would like to express our sincere gratitude towards those who have been participating in the project. We still have immense challenges ahead to properly manage water environment and to introduce effecitve EIA systems, but we already made significant progresses in the last two years. We now know a lot about how industrial effluent is managed by factories in Yangon and Mandalay. Also, we gained significant exprerience in implementing reliable river water quality surveys. With respect to EIA, several outputs have been already accomplished such as a legal formulation, capacity building through trainings, and developing EIA tools. These efforts are becoming the cornerstones of environmental management in Myanmar. In the next issue of our newsletter, we will explain some of key achievements in more detail.

About the Project

(1) Overall Goal, Project Purpose and Outputs of the Project

The table below lists the overall goal, project purpose and outputs of the project. This poject has two components, namely water enviroment managemnet component and EIA component. The water enviornment management component of the project has four outputs to achieve, namely, inspection (Output 1), water quality survey (Output 2), development of database (Output 3) and interpretation of information on water pollution control measures (Output 4). EIA component has two outputs to achieve, i.e., development of technical manuals/forms (Output 5) and capacity development on EIA review (Output 6).Through these activities, we are hoping to attain the project objectives during the course of the project, and support Myanmar alleviate problems of industrial effluent and improve EIA review, as envisioned in the overall goal.

Item	Contents	
Overall Goal	Impact of industrial effluents from industrial zones on river water quality is alleviated, and advanced EIA approach for complicated issues are taken into account.	
Project Purpose	Capacity for developing basic water pollution control measures based on obtained and interpreted information is enhanced and the institutional framework of the EIA review works is established.	
Outputs	Output 1	Inspection procedure is standardized.
	Output 2	Capacity for implementing water quality survey to obtain reliable information is enhanced.
	Output 3	Database of water pollution sources and river water quality is developed.
	Output 4	Capacity of interpreting the information for water pollution control measures is enhanced.
	Output 5	Necessary technical manuals and legislation for the EIA operation are developed.
	Output 6	Capacity of MONREC and the EIA Report Review Body on the EIA review is enhanced.

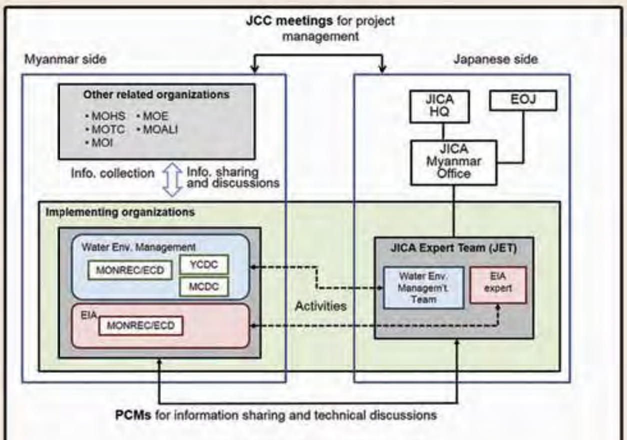
(2) Project Period

The Project Period in Myanmar is June 2015 - May 2018.

(3) Organization Structure

The implementing organizations from the Myanmar side are ECD, YCDC and MCDC. From the Japanese side, JICA dispatched a team of evironmental expert, JICA Expert Team (JET), to Myanmar.

Currently, there are six members in JET. In addition to above mentioned organizations, MOHS, MOTC, MOI, MOE and MOALI are participating in the project as members of the Joint Coordinating Committtee (JCC), which is organized once a year. We also plan to organize Project Coordination Meetings (PCMs) two times per year to share achievements and to discuss technical issues.

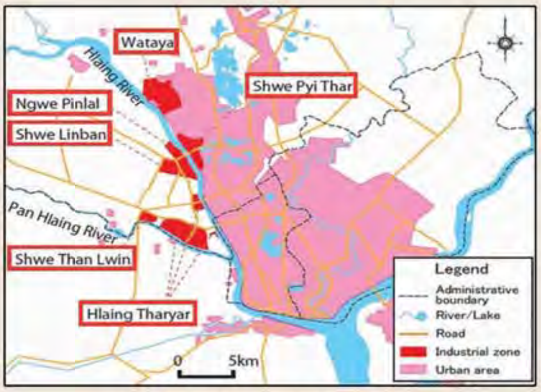


Organizational structure

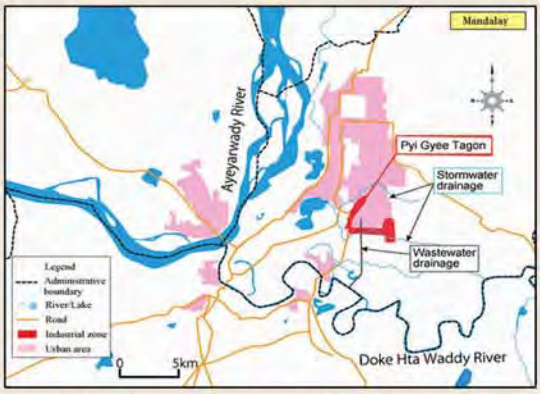
Activities of Water Environment Management Component

(4) Target Areas

In Myanmar, reliable environmental information is still very scarce and this is a major obstacle to make environmental decisions. To demonstrate how to collect, analyze and interpret information, the project focuses on two target areas: namely the Hlaing River basin in Yangon and Doke Hta Waddy River basin in Mandalay. There are many industrial zones in these areas, and they are ideal areas to examine how industrial wasterwater is affecting water qualities of the rivers.



Hlaing River Basin in Yangon



Doke Hta Waddy River Basin in Mandaly

(5) Outputs of Water Environment Managemnet Component

Output 1: Inspection

Output 1 aims to standardize inspection procedures. We have developed an inspection manual, and are implementing capacity development activities related to inspection, such as joint wastwater sampling and training on wastewater treatment technologies.

Output 2: Water Quality Survey

Under Ouput 2, Water quality surveys in Hlaing River basin and Doke Hta Waddy River basin are implemented five times (three times in dry season and twice in rainy season) to examine impacts of wastewater from industrial zones on water quality of these rivers. We implemented the fourth sampling in Sept and Oct 2017.

Output 3: Database Development

The target of Output 3 is to develop databases of pollution sources and river water quality. Because data on factories was scarce, we implemented pollution source surveys in Yangon and Mandalay in 2016 and 2017. The results of the water quality surveys (Output 2) are input to the river water quality database.

Output 4: Information Interpretation

The collected data and information in Hlaing River basin and Doke Hta Waddy River basin are analyzed and pollution mechanisms are clarified. Then different approaches to water pollution control are explored using the results.

(6) From Recent Activities

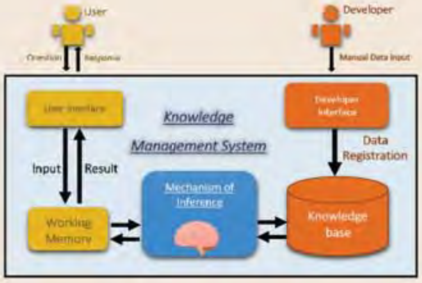
Workshop on Industrial Wastewater Treatment in Yangon

Constructing a centralized wastewater treatment facility is a good way to control wastewater in industrial zones, but most industrial zones in Myanmar do not have such facilities yet. To construct a centralized wastewater treatment facility, one has to consider many issues, such as technical options, cost, financing, available land, as well as agreement among factories, firm that operates the facility and the government to share costs and responsibilities. In order to clarify such issues, the project carried out a small pilot study in an industrial zone in Yangon, and presented the results at the workshop on industiral wastewater treatment on 30 October 2017 at Yangon Regional Government. The workshop also featured presentations on centralized wastewater treatment in Mandalay, Thilawa SEZ in Yangon, and an IZ in Vietnam. Chief Minister of Yangon Regional Government, Mr. Phyo Min Thein, who was presiding over the workshop, appreciated the efforts of the project, and requested everyone to resolve issues discussed in the workshop to realize centralized wastewater treatment in IZs in Yangon.

Activities of EIA Component

(7) Outputs of EIA Component

Output 5: EIA Manuals and legislation



'e-Manual' - a computerized system for providing useful information of EIA to users - is under development, and - Tracking System - has also been developed for recording EIA review track. In terms of EIA legislation, - Consultant Licensing Scheme - has finally been drafted. It stipulates a registration procedure in order to secure qualified consultants for any EIA related studies.

Output 6: Enhancement of EIA Review

This work includes three activies, namely: Basic and Advanced Trainings, Socialization (e.g. Workshop, EIA Protal Site and flyers- distribution), and relationship-building with international society (e.g. invitation to international conference/seminar).

(8) From Recent Activities

Technical Exchange Seminar between Myanmar and Cambodia in NayPyiTaw

JICA is supporting Myanmar-s Environment and Social Consideration through Technical Cooperation Projects for ECD-MONREC as well as implementing agencies including Ministry of Construction (MOC). Cambodian JICA Expert team headed by Mr. Prok Novida, Director of Planning Department, Ministry of Public Works and Transportation (MPWT) visited Napyitaw and Yangon to exchange the experience of each country. It is too soon to implement EIA and other Environmental measures in Myanmar compared to Cambodia. Cambodia faces various challenges such as compliance of many stakeholders including private sector, differences between international standards, and technical limitations of enviroment-friendly engineering. The team also visited JICA-s infrastructure projects in order to witness how Myanmar counterparts implement environment and social friendly projects with JICA.

ပို၍ပြည့်စုံသည့်အချက်အလက်များရရှိနိုင်ရန် Website တွင်ဝင်ရောက်လေ့လာနိုင်ပါသည်။

အခြေခံရေနှင့်ဆိုင်သောပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုနှင့်ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ချက်စနစ်အတွက် စွမ်းဆောင်ရည်ဖွံ့ဖြိုးမှုဆိုင်ရာလုပ်ငန်းစီမံကိန်း
http://myanmar-waterenvironment.com

For more information, please visit our website

The Project for Capacity Development in Basic Water Environmental Management adn EIA System
http://myanmar-waternvironment.com

Project for Capacity Development in Basic Water Environment Management and EIA System

The Republic of the Union of Myanmar

Terminal Evaluation of the Project and 4th JCC Meeting

Posted on 06/03/2018

As the project will come to an end in five months, in May 2018, the Terminal Evaluation of the project was implemented during 2 – 23 February 2018. Both the Water Environment Management component and the EIA component were the target of the evaluation, and Dr. Ito, Ms. Hosokai and Ms. Yoshinaga came from JICA Tokyo for the evaluation. On 22 February 2018, the 4th JCC meeting was organized in Nay Pyi Taw, and the participants discussed the results of the Terminal Evaluation.

Overall, the project was considered successful. The evaluation team found that most of the project activities had already achieved the targets (indicators) of outputs set in the Project Design Matrix (PDM), though some activities are still remaining and to be implemented by the end of the project. The team also evaluated the project with respect to the five evaluation criteria (relevance, effectiveness, efficiency, impact and sustainability) as summarized in the following table.

Criteria	Concept	Result	Reasons
Relevancy	Whether Project's design and approach are appropriate to key policies and beneficiary's needs	High	The project was consistent with policies and needs, and the project design was appropriate.
Effectiveness	Whether six outputs all together have achieved Project's primary objective	High	Given the context and achievements, the project was successful.
Efficiency	Whether inputs and activities are managed efficiently	Relatively High	Although the project lacked some inputs

			and coordination in the first year, the members were highly committed, and the project was managed well.
Impact	Impact over time and across sectors	Relatively High	Because the Overall Goals are likely to be achieved, and knowledge-sharing has been observed.
Sustainability	Whether activities and outcomes of this Project will last	Moderate	For some CPs, the mandate and the staff assignment still need to be clarified, and capacity development should continue.

The sustainability is considered “moderate” largely because we are still going to face significant challenges in the future, such as, clarifying responsibilities of different organizations; making individual-level experiences and knowledge gained through the project into those at the level of organization; making sure tools developed in the project are used and improved; and convincing the decision makers about the need to continue activities and ensure allocation of budget and other resources.

Let’s start discussing how to overcome these challenges!

— Signing of Minutes of Meeting by (from left to right) Mr. Iwai, Mr. Thein and Dr. Ito)

Posted in Uncategorized | Leave a Reply

Seminar on Development of W ater Quality Survey Report

Posted on 01/12/2017

In the second half of November 2017, seminar on development of water quality survey report was held in Yangon and Mandalay, each for two days. Its objectives, schedule and program are described as follows.

Objectives

- To provide an opportunity to develop a water quality survey report on trial basis.
- To deliver and improve a technical reporting skill for water environmental survey

Schedule

- [Yangon] 17th & 20th Nov. 2017 at YCDC (9am to 4pm)
- [Mandalay] 22nd & 23rd Nov. 2017 at MCDC (9am to 4pm)

Program

- 1st Day: Practice on writing a water quality survey report (e.g. how to set the objective of the report & evaluate the water quality data, basic ethic of scientific writing, report structure, etc.)
- 2nd Day: Database development by using Excel & Map Preparatiion by QGIS

Around 10 participants (from ECD, YCDC & MCDC) joined each seminar and learned the basic technical reporting skill including the basic practice of Word/Excel/QGIS. Next seminar will be held in December 2017 and/or January 2018.

— Discussion (to set the objectives)

— Evaluation of Water Quality Data

— Presentation (discussion result)

Posted in Uncategorized | Leave a Reply

Workshop on Industrial Wastewater Treatment in Yangon on 30th Oct 2017

Posted on 08/11/2017

On 30th Oct. 2017, the workshop on industrial wastewater treatment was held at the meeting hall in Yangon Regional Government (YRG). Around 60 participants including the Chief Minister of YRG joined from various kinds of organizations (e.g. Industrial Zone Steering Committee in YRG, MONREC-ECD, MOI-DISI, MOHA-GAD, YCDC, MCDC, Industrial Zone Management Committee, UMFCCI, Embassy of Japan, JICA Myanmar Office, etc.). The main objectives are as follows.

1. To learn how industrial wastewater is managed in industrial zones (IZs)

2. To examine options for industrial wastewater management in Hlaing Tar Yar IZ
3. To discuss effective & realistic industrial wastewater treatment in IZs in Myanmar

At the meeting, activities by MONREC-ECD and treatment systems in Mandalay, Thilawa IZ & Vietnam were introduced in conjunction with the options of wastewater treatment in Hlaing Thar Yar IZ. It was a good opportunities for different organizations to share the current situation of water environment in Myanmar and options in the future.

— Opening Remarks by Chief Minister of YRG

— Options in Hlaing Thar Yar IZ by Mr. Nishio, KOBELCO ECO-SOLUTIONS

— Introduction of Wastewater Treatment System in Thilawa

— Introduction of WWTP in Vietnam

Posted in Uncategorized | Leave a Reply

UMFCCI Industrial W astewater Management Forum

Posted on 22/10/2017

On 12th and 13th October, JET participated in the Industrial Wastewater Management Forum organized by UMFCCI. This was one of the first dialogues between representatives of industries, environmental authorities and civil society on the issue of industrial wastewater management, and our counterpart organizations, i.e., ECD and YCDC, also took part in the forum. JET made a short presentation on the current situation of pollution control by factories in Yangon and Mandalay based on the results of the pollution source survey implemented in 2016. Our survey revealed that many factories are lagging very much behind in their effort to control environmental pollution and also are facing different obstacles to improve environmental performance. We are currently implementing the 2nd pollution source survey in order to confirm and verify the results of our survey in 2016. We believe such information is very important to advance discussions between environmental authorities and industries.

— UMFCCI Wastewater Forum on 12th and 13th October 2017

Japan faced serious pollution problems in the 1960s and 1970s, and it took a lot of time and efforts of environmental authorities, industries and civil societies to find ways to control pollution. Even today, we are exploring ways to control pollution in more efficient and effective manner.

Posted in Uncategorized | Leave a Reply

The 4th Water Quality Survey in Yangon and Mandalay

Posted on 11/10/2017

The Water Environment Management component of the Project for Capacity Development in Basic Water Environment Management and EIA System has planned to carry out (4) Outputs. Among these 4 outputs, as output (2), the water quality surveys are conducted in the pilot area of Yangon and Mandalay. Total three surveys were already conducted from 2015 and remaining two surveys, namely 4^{th} and 5^{th} surveys are planned from middle 2017 to early 2018.

The 4^{th} Water Quality Survey in Yangon was implemented in Hlaing River basin on 18^{th}, 19^{th} and 20^{th} September 2017. Under the supervision of counterparts from ECD-YGN, PCCD-YCDC and WSD-YCDC, JET and sub-contractor conducted the water sampling. Total 10 water samples were taken from Hlaing River, Pan-Hlaing River, Kokkowa River and creeks from Shwe Pyi Thar Industrial Zone.

The survey in Mandalay was implemented for total 15 sampling points with the participation of counterparts from ECD-MDL and WSD-MCDC in the Doke Hta Waddy River basin on 2^{nd} and 3^{rd} October 2017. The sampling points included not only Doke Hta Waddy River but also Shwe Kyin Creek, Pa Yan Taw Creek and Taung Ta Man Lake etc.

This time the water samples are analyzed in Japanese laboratory for securing good data quality and wider range of measurement parameter in addition to the on-site water quality measurement as well as chemical and biological analysis in Myanmar laboratory. YCDC and MCDC laboratories also cooperated to analyze some parameters.

The results will be reported in November.

— Sampling in Hlaing River

— Samples to be sent to Japanese laboratory

— On-site measurement with Counterparts

— Adjusting pH value for sample preservation

Posted in Uncategorized | Leave a Reply

The 2nd pollution source survey in Yangon and Mandalay

Posted on 15/09/2017

From August- September 2017, the 2nd pollution source survey for database development were conducted in industrial zones in Yangon (Hlaing River basin) and Mandalay (Doke Hta Waddy River basin). Sub-contractor and JICA Expert Team (JET) visited total 40 factories with CPs (ECD, YCDC and MCDC) and collected wastewater samples after treatment in and around target industrial zones. Wastewater sampling for remaining 10 factories in Mandalay were implemented on September 21st and 22nd.

— 2nd Pollution Source Survey in Mandalay

Based on the discharge time/way of each target factory, the sampling method was selected (grab or composite). Also, the information of questionnaire survey and wastewater management system were confirmed again to compare with the previous survey results, and the wastewater flow rate of target factories were measured by using the water flow meter. Target parameters were selected for each sector based on the National Environmental

Quality Emission Guidelines (NEQEG, 2015) and they will be analyzed not only at the laboratory in Myanmar or Thailand but also in Japan to improve the database results of pollution source survey.

— 2nd Pollution Source Survey in Yangon

The 2nd pollution source survey were implemented both in Yangon and Mandalay successfully with the kind support of ECD, YCDC and MCDC.The result of the survey will be reported at the end of October 2017.

Posted in Uncategorized | Leave a Reply

Start of Pollution Source Survey in 2017

Posted on 19/08/2017

From August 2016 to January 2017, the first pollution source survey was implemented in Hlaing River basin (Yangon) and Doke Hta Waddy River basin (Mandalay). The trend of industries of both area and the water quality of wastewater got obvious, however, further survey is needed to see the current situation of pollution source deeply and to find the better steps for water environment management in Myanmar. Therefore, the following-up survey (Aug-Oct 2017) was planned and started in the both aera again (see the following outline).

- Activity: To collect additional information required to develop database
- Objective: To confirm (i) wastewater management, (ii) pollution levels for some paarmeters and (iii) wastewater flow rate, and to develop database
- Scope: (i) On-site investigation, (ii) wastewater sampling & analsis and (iii) estimation of flow rate
- Period: Aug.-Oct. 2017
- Explanation Meeting: 10th Aug. in Yangon and 15th Aug. in Mandalay

— Meeting in Hlaing Tharyar IZ (1), Yangon on 10th Aug. 2017

— Meeting in Pyi Gyee Tagon IZ, Mandalay on 15th Aug. 2017

The meetings for target factories were held both in Yangon and Mandalay successfully with the kind support of ECD, YCDC and MCDC. The result of the survey will be reported in November 2017.

Posted in Uncategorized | Leave a Reply

4th PCM (Project Coordination Meeting)

Posted on 01/07/2017

The activities in Period 2 (June 2017 – May 2018) have just started. The first event, 4th PCM (Project Coordination Meeting) was held in Nay Pyi Taw on 21st June 2017, chaired by U Hla Maung Thein, Director General of ECD/MONREC. The past achievement of the Project was presented by each CP and JICA Expert Team. They also discussed the plan of activities in Period 2, which is summarized as below.

- Technical discussions on wastewater treatment in industrial zones
- 4th and 5th Water Quality Survey in Hlaing River basin in Yangon and Doke Hta Waddy River basin in Mandalay
- Training on GIS and database
- Workshops/seminars to interpret the collected information for water pollution control measure
- Study program on planning and implementation of water quality monitoring and pollution source control in Japan
- Update and finalization of technical documents

We will have several discussions with each target C/P to elaborate the details of plans until early July.

— 4th PCM held in Nay Pyi Taw on 21st June 2017

— Chaired by U Hla Maung Thein, Director General of ECD/MONREC

Posted in Uncategorized | Leave a Reply

Meeting on W ork Plan in Period 2

Posted on 17/06/2017

It's been a while since the last post. Because of the water festival and the end of project's fiscal year, most of the Japanese members had been out of Myanmar, but now we are back to resume activities. A meeting was held on 16th June 2017 at YCDC to discuss achievements in Period 1 (June 2015 – April 2017) and proposed new activities in Period 2 (June 2017 – May 2018).

In Myanmar, reliable environmental information is very scarce. Nevertheless, after two years of project implementation with a lot of effort to gather site-level data and information, we now know, for example,

- Only half of factories have wastewater treatment facilities, and most of them are rudimentary primary treatment facilities.
- Many factories are not meeting NEQEG (2015) requirements (not obligatory). Those meeting the requirements are largely because their wastewater is weak, and not because they are treating their wastewater adequately.
- Only a few factories are responsible for the significant part of organic pollution load (e.g., BOD).
- Concentrations of heavy metals appear to be low, but further investigation is needed. Some data (e.g., effluent volume, concentrations of some pollutants, information on wastewater treatment facilities) are not very accurate.

We have a long way to go, but with data and information at hand, we have started discussing practical solutions to improve the situation.

— Hlaing River basin

Posted in Uncategorized | Leave a Reply

Workshop on Industrial WWTP (17th – 19th Jan. 2017)

Posted on 25/01/2017

Workshop on Industrial Wastewater Treatment Plant were held in three cities from 17th to 19th January 2017 as follows.

- 17th Jan.: Workshop in Yangon
- 18th Jan.: Workshop in Nay Pyi Taw
- 19th Jan.: Workshop in Mandalay
- Participants: ECD (MONREC), YCDC, MCDC, relevant ministries, Industrial Zone Management Committees (IZMC) and representatives of various factories (around 50 participants for each)

The purposes of the workshops are 1) introduction of water environment management by Governments, 2) introduction to industrial wastewater treatment in Myanmar, Japan, and Vietnam, and 3) discussion on effective and realistic industrial wastewater treatment in Industrial Zones. Detailed information and knowledge on industrial WWTP in Myanmar, Japan and Vietnam, and the future of water environment management were discussed. The next workshop will be held in this summer.

— Dr. Okuda's Speech on Japanese Experience in YGN on 17th Jan.

— Ms. Van's Presentation on Vietnamese Experience in NPT on 18th Jan.

— Mr. Nishio's Presentation on Case Studies in MDL on 19th Jan.

Posted in Uncategorized | Leave a Reply

← Older posts Newer posts →

Meeting and GIS Training in Mandalay on 12th Jan. 2017

Posted on 15/01/2017

A Happy New Year !!

The meeting on Inspection & WWTP and Database Training by using GIS were held in Mandalay on 12th January 2017 as follows:

- Discussion on Inspection Manual (Dr. Okuda)
- Lecture on WWTP (Mr. Nishio)
- Database Training (Mr. Nakagawara)

Many officers and staff from WSD & CD of MCDC and ECD Mandalay joined and made a discussion. Also, one flow meter were handed over directly to the Mayor of MCDC and Head of WSD from Dr. Okuda. On 19th Jan., the workshop on WWTP will be held inviting IZMC, factories and other related organizations.

— Hand Over of Flow Meter with Mayor

— Discussion with Head of WSD

— GIS Training

— Lecture on WWTP

Posted in Uncategorized | Leave a Reply

Project Coordination Meeting (PCM) No.3 on 8th Dec. 2016

Posted on 10/12/2016

The project Coordination Meeting No. 3 was held in December 8, 2016 in Nay Pyi Taw with ECD, YCDC, MCDC and related Ministries. The main issues are as follows.

- Training in Japan (by Ms. Khin Myo Sat Aye from ECD – MONREC)
- Results of 2nd Water Quality Survey and Schedule of 3rd survey (Output 2)
- Tentative Results of Pollution Source Survey and Schedule (Output 3)
- Discussion on Inspection Manual (Output 1)
- Discussion on Clarification of objectives of Water Quality Status Report (Output 4)

There are many comments on each issues to improve the activities (e.g. accuracy of water quality survey, database development, collaboration with each organization of inspection, etc.). Director General, Mr. Hla Maung Thein, also mentioned the future of the activities after June 2018 and good management of Thilawa IZ.

Workshop on wastewater treatment, 3rd water quality sampling and Training for Database are scheduled in January 2017.

— Opening Remarks (Mr. Sein Htun Lin)

— Introduction of Training in Japan (Ms. Khin Myo Sat Aye)

— Explanation of Output 1, 2 and 4 (Mr. Hieda)

— Discussion with Director General (Mr. Hla Maung Thein)

Posted in Uncategorized | Leave a Reply

Introduction of Industrial Wastewater T reatment Plant in Yangon

Posted on 03/12/2016

On 2nd December 2016 in Yangon, Mr. Nishio, industrial wastewater expert, had a lecture on “Introduction of Industrial Wastewater Treatment Plant (WWTP)” at YCDC’s office as in Mandalay. Staffs from PCCD and WSD of YCDC, and ECD Yangon are participated in this meeting and there are questions regarding some methods of WWTP. Also, the preliminary results of pollution source survey was explained.

The schedule of activities in Yangon are described as follows.

- December 2016 (3rd week): Next Meeting (and sampling) for Water Quality Survey
- January 2017: Lecture regarding industrial WWTP
- January 2017: Database Training by using Excel and QGIS

— Participants (from PCCD & WSD of YCDC and ECD Yangon)

— Lecture on Industrial WWTP by Mr. Nishio

Posted in Uncategorized | Leave a Reply

Introduction of Industrial Wastewater T reatment Plant in Mandalay

Posted on 01/12/2016

On 30th November 2016 in Mandalay, Mr. Nishio, a new expert for industrial wastewater from JICA Expert Team, had a lecture on "Introduction of Industrial Wastewater Treatment Plant" at MCDC's office. The outline and basic information of wastewater treatment plant (WWTP) were introduced and general matrix of treatment for each sector was explained. Also, one example of central WWTP was introduced with its concept and process flow. It would be appreciated if the participants could review the handouts and utilize their knowledge effectively.

In addition, there were two other presentations for water quality survey and pollution source survey. Results and schedule of the activities were explained.

The schedule of these activities in Mandalay are described as follows.

- December 2016 (3rd week): Next Meeting (and sampling) for Water Quality Survey
- January 2017: Lecture regarding industrial WWTP
- January 2017: Database Training by using Excel and QGIS

— Lecture on Industrial WWTP

— Participants from WSD & CD of MCDC and ECD Mandalay

Posted in Uncategorized | Leave a Reply

The 3rd JCC Meeting on Results of Mid-term Review

Posted on 25/11/2016

The 3rd Joint Coordinating Committee meeting of the project was held in Naypyidaw on 9th November 2016 (Wednesday). The participants were representatives of MONREC, YCDC, MCDC and other relevant organizations in Myanmar, representatives of JICA, JICA Expert Team, and the Mid-term Review Team specially organized for the mid-term review of the project.

In the meeting, Mr. Min Maw, Project Manager, ECD, MONREC, made a presentation regarding the progress, findings and challenges of the project activities of PCD and Regional ECDs related to water environment management.

Following the presentation by Mr. Min Maw, Mr. Bawi Kyone from PCCD, YCDC and Mr. Khin Maung Thinn from WSD, MCDC also made presentations to explain the progress and impact of water environment management component.

For EIA component, Mr. Htin Aung Kyaw from ECD MONREC presented the progress. Then, Dr. Kanji Usuii of JICA Expert Team introduced the newly developed decision-support system for EIA review.

After these presentations, the Mid-term Review Team presented their findings about the progress of the project, and the participants discussed project management issues raised by the Mid-term Review Team, such as amendment of the project design matrix, donor coordination, etc. At the end, Mr. Kotaro Nishigaki from JICA Myanmar Office, Dr. Minpei Ito from JICA Headquarters and Mr. Sein Htoon Linn, Deputy Director General, ECD, MONREC, signed the minutes of meetings and the Joint Mid-term Review Report. In December, a Project Coordination Meeting (PCM) will be held to share the latest result of the project activities.

— Participants from JICA side

— Participants from Myanmar side

— Signing of minutes of meeting (Mr. Kotaro Nishigaki from JICA Myanmar Office; Mr. Sein Htoon Linn from ECD, MONREC (center), and Dr. Minpei ITO from JICA Headquarters (right))

Posted in Uncategorized | Leave a Reply

JICA Mid-Term Review: Courtesy Calls on MCDC (2nd Nov.) and YCDC (4th Nov.)

Posted on 17/11/2016

On 2nd Nov. 2016, JICA Review Team and JICA Expert Team (JET) paid a courtesy call on the Mayor of MCDC. Current situation and necessary action for water environment in Mandalay were discussed between the Mayor and the team. After the courtesy call, the team made a site visit in the basin of Doke Hta Waddy River and held a meeting with Water Sanitation Department (WSD) of MCDC and ECD Mandalay Region to check/share the progress of the Project and issues in project implementation.

On 4th Nov. 2016, the team also paid a courtesy call on the Committee Member of YCDC, Daw May May Thwal. It was a good opportunity to introduce the outline and progress of the Project. After the courtesy call, a meeting with Pollution Control and Cleansing Department (PCCD) and WSD of YCDC, and ECD Yangon Region was held for the same purpose as in Mandalay.

— Courtesy Call on Mayor, MCDC

— Courtesy Call on Committee Member, YCDC

Posted in Uncategorized | Leave a Reply

JICA Mid-Term Review: Courtesy Call on Minister of MONREC

Posted on 16/11/2016

On 31st October 2016, JICA Mid-Term Review Team arrived at Myanmar from Japan to evaluate the progress of the Project and improve the project design if necessary. On the next day, 1st November, JICA Review Team and JICA Expert Team (JET) paid a courtesy call on Minister of Ministry of Natural Resources and Environmental Conservation (MONREC), U Ohn Winn. It was a great opportunity for the Minister and the Team to share the details/current situation of the Project and agree with the importance of capacity development regarding water environment management in Myanmar.

— Courtesy Call on Minister of MONREC

Posted in Uncategorized | Leave a Reply

Pollution source survey . Part II: Wastewater Sampling and Analysis

Posted on 15/10/2016

Following the questionnaire survey, we have started the second component of the pollution source survey – wastewater sampling and analysis. In this component, wastewaters from all together 50 factories representing different sectors, such as distillery, food, leather, textile, etc, are to be collected and analyzed. Analytical parameters were set in accordance with the new Environmental Quality (Emission) Guideline issued in 2015. We started the sampling on 10 Oct. 2016.

— Wastewater sampling in Mandalay 01

— Wastewater sampling in Mandalay 02

Posted in Uncategorized | Leave a Reply

Pollution source survey . Part I: Questionnaire Survey

Posted on 15/10/2016

Industrial factories are widely believed as major sources of pollution in Myanmar, but information on factories is highly limited. Without understanding what is going on in factories, it is impossible to develop effective policies to control pollution. Thus, we have started a survey of factories. The survey has two components, namely (i) questionnaire survey, and (ii) wastewater sampling and analysis, and the target areas of the survey are the Hlaing River basin in Yangon and the Doke Hta Waddy River basin in Mandalay.

In the questionnaire survey, we requested over 200 factories in these areas to answer to a questionnaire covering different aspects of operations, such as raw materials, production processes, pollution control measures, and difficulties factories are facing in controlling pollution. The survey is being implemented by a team of local environmental consultants, officers from YCDC/MCDC and ECD, and JICA Expert Team, with support from Industrial Zone Management Committees. We visited each of these factories to support factories to provide accurate data and to confirm the situation. The questionnaire survey will last until late October 2016.

— Pollution source survey : Part 1 – questionnaire survey

Posted in Uncategorized | Leave a Reply

Second water quality monitoring in Yangon and Mandalay

Posted on 14/10/2016

Our apology for not posting this post sooner. We carried out the second water quality monitoring in Hlaing River basin in Yangon (June 27-28) and Doke Hta Waddy River basin in Mandalay (June 20-21). Based on the results of the first monitoring, this time we revised the monitoring program slightly, placing more focus on investigating conditions of channels in industrial zones.

— Second water quality monitoring in Hlaing River

— Second water quality monitoring in Doke Hta Waddy basin

Posted in Uncategorized | Leave a Reply

Project for Capacity Development in Basic Water Environment Management and EIA System

The Republic of the Union of Myanmar

Newer posts →

Reconnaissance in Yangon

Posted on 22/08/2016

On 9th June, YCDC (PCCD) and JET made a reconnaissance survey of industrial areas in Yangon in order to design the second water quality survey to be implemented in June.

— Reconnaissance survey in Yangon

— Industrial wastewater in Yangon

Posted in Uncategorized | Leave a Reply

President of Myanmar gives advice to the Project!

Posted on 09/06/2016

On 5th June 2016, MONREC organized many events to celebrate the World Environment Day all over the country. We participated in the one in Nay Pyi Taw, where the President of the Union of Myanmar, Mr. Htin Kyaw, gave an opening speech. For this event, we had prepared a poster to explain our activities. We were so thrilled that the President and the Minister of MONREC, Mr. Ohn Win, actually came to our booth to talk to us.

— President of Myanmar and Minister of MONREC came to our poster

After hearing our explanation about the project, he pointed out the importance of monitoring for informed environmental decision making, and he was even aware of the importance of monitoring in dry season when the water level is low and the impact of industrial wastewater becomes pronounced.

Congratulations to MONREC for successfully organizing the event, and we look forward to the event next year. Let's come up with an even better poster showing our new achievements so that we can impress our leaders!

Posted in Uncategorized | Leave a Reply

Mandalay workshop on results of 1st water quality survey and

information interpretation

Posted on 05/06/2016

— Meeting on Output 2 and Output 4 on 2nd June 2016

On 2nd June 2016, MCDC, ECD Mandalay and JET met to confirm the results of the first water quality survey in the Doke Hta Waddy River basin, including Thang Ta Man Lake. The members also discussed current issues of water environmental management in Mandalay and possible approaches to improve water environment. The next water quality survey will be implemented in late June 2016.

Posted in Uncategorized | Leave a Reply

Yangon workshop on results of 1st water quality survey and information interpretation

Posted on 04/06/2016

— Meeting at YCDC on 1/June/2016

YCDC, ECD Yangon, DISI and JET met in Yangon on 1st June 2016 to discuss the results of the 1st water quality survey in Hlaing River basin in February 2016 (Output 2) and the current status of water environment management (Output 4). We will carry out next water quality survey in June 2016.

Posted in Uncategorized | Leave a Reply

Project website launched!

Posted on 27/05/2016

Dear all, the project website has been launched! We will try to add contents as soon as possible.

Posted in Uncategorized | 1 Reply

Welcome!!

Posted on 21/05/2016

Welcome to our project website.

Posted in Uncategorized | 1 Reply

Project for Capacity Development in Basic Water Environment Management and EIA System

The Republic of the Union of Myanmar

About Project

Overall Framework of the Project

This project is a bilateral technical cooperation project between Myanmar and Japan with the aim to support and enhance capacities of Ministry of Natural Resources and Environmental Conservation (MONREC) and other organizations concerned to manage water environment (water environmental management component) and to implement EIA reviews (EIA component). It is being implemented based on the Record of Discussions (R/D) signed on 23rd December, 2014 between then MOECAF and Japan International Cooperation Agency (JICA). The project activities in Myanmar started in June 2015, and will last until May 2018.

— JCC Meeting on 8th July 2015

Table below summarizes the overall framework of the project in accordance with the Project Design Matrix (PDM) and the Plan of Operation (PO) contained in the original R/D agreed in December, 2014.

Item	Contents	Component
Overall Goal	Impact of industrial effluents from industrial zones on river water quality is alleviated, and advanced EIA approach for complicated issues are taken into account.	

Project Purpose	Capacity for developing basic water pollution control measures based on obtained and interpreted information is enhanced and the institutional framework of the EIA review works is established.		
Outputs	Output 1	Inspection procedure is standardized.	Water environment management
	Output 2	Capacity for implementing water quality survey to obtain reliable information is enhanced.	Water environment management
	Output 3	Database of water pollution sources and river water quality is developed.	Water environment management
	Output 4	Capacity of interpreting the information for water pollution control measures is enhanced.	Water environment management
	Output 5	Necessary technical manuals and forms for the EIA review are developed.	EIA
	Output 6	Capacity of MONREC and the EIA Report Review Body on the EIA review is enhanced.	EIA

Source: JET

Project Activities of Water Environment Management Component

The project activities are divided into two components: namely (i) the water environment management component and (ii) the EIA component. Among the six outputs of the project, the water environment management component covers standardization of environmental inspection (Output 1), water quality survey (Output 2), development of databases of pollution sources and river water quality (Output 3), and interpretation of information for water pollution control measures (Output 4).

For specific contents and the schedule of each output, please visit the following pages.

Output 1 – Inspection

Output 2 – Water Quality Survey

Output 3 – Database Development

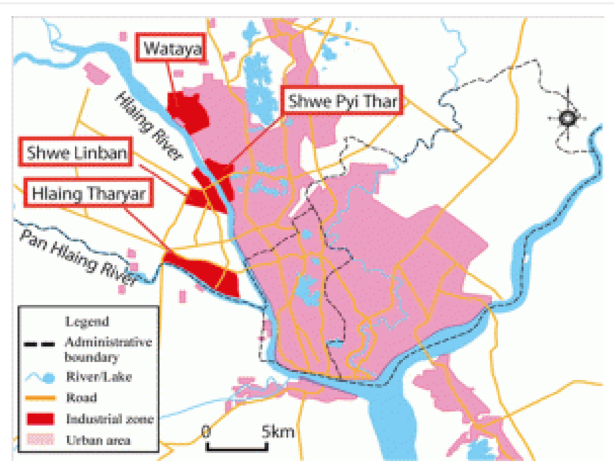
Output 4 – Information Interpretation

Target Areas of Water Environment Management Component

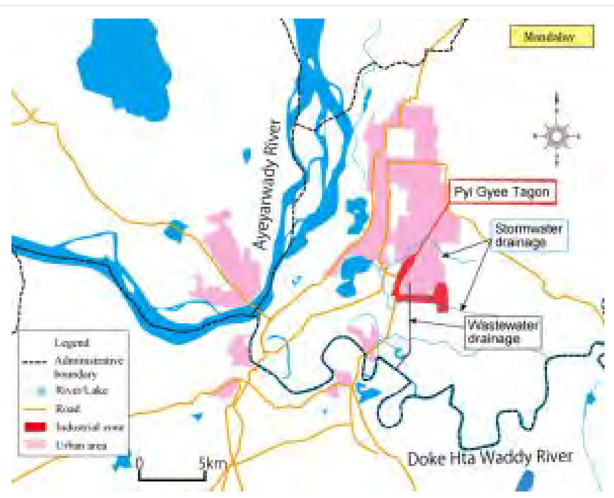
Activities of the water environment management component of the project are being implemented in three cities in Myanmar, namely Yangon, Mandalay and Nay Pyi Taw.

— Map of Myanmar

The water quality component has two target areas, Hlaing River basin in Yangon and Doke Hta Waddy River basin in Mandalay. These areas were selected to investigate the impact of industrial effluent from industrial zones on water quality of rivers.



— Hlaing River basin



- Doke Hta Waddy River basin

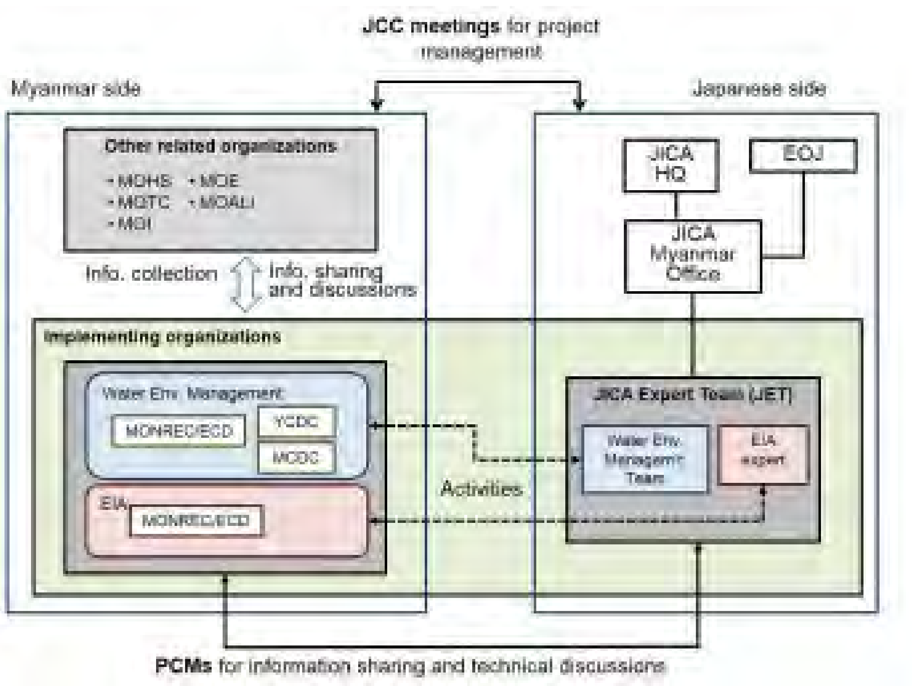
Project for Capacity Development in Basic Water Environment Management and EIA System

The Republic of the Union of Myanmar

About Us

Organizational Structure of the Project

The implementing organizations for the water environment management component are MONREC (Ministry of Natural Resources and Environmental Conservation), YCDC (Yangon City Development Committee) and MCDC (Mandalay City Development Committee). In addition, MOHS (Ministry of Health and Sports), MOTC (Ministry of Transport and Communications), MOI (Ministry of Industry), MOE (Ministry of Education) and MOALI (Ministry of Agriculture, Livestock and Irrigation) are participating in the project. Figure below schematically shows the organizational chart of the project.



Organizational structure

Joint Coordinating Committee and JICA Expert Team

In order to manage the project, Joint Coordinating Committee (JCC) has been organized. See the following link about the tasks and members of the JCC.

Joint Coordinating Committee

To support relevant organizations implement the project activities, JICA has dispatched a team of environmental expert, JICA Expert Team (JET). Although they are based in Japan, they spend considerable time in Myanmar, and all project activities are being implemented jointly by the counterpart personnel from implementing organizations and JET members.

JICA Expert Team