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Capacity Development in Basic Water Environment Management in Myanmar

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Contents

Capacity Development in Basic Water Environment Management in Myanmar

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Abstract

This project was implemented to strengthen capacities of environmental authorities in Myanmar for water environmental management and Environmental Impact Assessment (EIA) review works. The activities were implemented based on the Record of Discussions (R/D) signed between Ministry of Environmental Conservation and Forestry (MOECAF) and Japan International Cooperation Agency (JICA) in December 2014. The project had two components: namely water environment management component and EIA component. The water environment management component covers Outputs 1 through 4, and the activities were implemented jointly by Environmental Conservation Department (ECD) of Ministry of Natural Resources and Environmental Conservation (MONREC) which succeeded MOECAF in 2016), Yangon City Development Committee (YCDC), Mandalay City Development Committee (MCDC), and JICA Expert Team (JET). Many of the project activities were implemented in the two pilot study areas: namely Hlaing River basin in Yangon and Doke Hta Waddy River basin in Mandalay. They were selected to study impacts of industrial activities on river water qualities.

Keywords: Basic water environment management, JICA, JET, MONREC, EIA, ECD, CDC, Outputs

Capacity Development in Basic Water Environment Management in Myanmar

1. Introduction

Myanmar has faced considerable challenges in environmental management, ever since the country's transition to civilian rule in 2011 fuelled investments and industrial growth. To address the challenges the Environmental Conservation Law (ECL) was enacted in 2012, followed by the development of Environmental Conservation Rules (ECR) in 2014 to implement the Environmental Conservation Law. The two regulations were the first and only Law existent in the Country that served as guidance documents for the government, until other regulations are issued in 2015.

Capacity development in basic water environment management in Myanmar as the project is a bilateral technical cooperation implemented by the Government of the Republic of the Union of Myanmar with support from the Japan International Cooperation Agency (JICA). This project was implemented to strengthen capacities of Environmental Authorities in Myanmar for water environmental management and Environmental Impact assessment (EIA) review works. Overall goal is that impact of industrial effluents from industrial zones on river water quality is alleviated, and advanced EIA approach for complicated issues are taken into account.

2. Objectives

The Objectives of the project are to (1) enhance the capacity of the city development committees in Yangon and Mandalay to develop basic water pollution control measures, based on obtained and interpreted information, and to (2) strengthen the Institutional framework for Ministry of Natural Resources and Environmental Conservation (MONREC) to review the Environmental Impact Assessment (EIA).

Project Purpose is that 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 of the Project are that inspection procedure is standardized, capacity for implementing water quality survey to obtain reliable information is enhanced, database of water pollution sources and river water quality is developed and capacity of interpreting the information for water pollution control measures is enhanced.

Table 1. Overall Goal, Project Purpose and Outputs of the Project

Item	Content	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 environmental management
	Output 2	Capacity for implementing water quality survey to obtain reliable information is enhanced.	Water environmental management
	Output 3	Database of water pollution sources and river water quality is developed.	Water environmental management
	Output 4	Capacity of interpreting the information for water pollution control measures is enhanced.	Water environmental 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
Duration	June 2015 – May 2018 (3 years)		

3. Outputs

3.1 Output – 1 (Inspection)

Output 1 was implemented to standardize the procedure of environmental inspection of factories by ECD, YCDC and MCDC. In order to standardize the inspection procedure, an inspection manual was developed. It was designed to support officers to understand important steps of the procedure and to minimize mistakes that arise from lack of knowledge and experience.

3.2 Output – 2 (Water Quality Survey)

The water qualities in Hlaing River and Pan Hlaing River in the rainy season (September 2017) were acceptable for conservation of aquatic life, irrigation and water transportation, except for total suspended solid (TSS) and total coliform. In the dry season (February 2018), the water quality deteriorated as shown by high COD detected at some points and slight oil and grease detected at all points. The upstream area of Hlaing River (upstream of Shwe Pyi Thar Bridge) maintained adequate water quality for irrigation and water transportation even in the dry season, except for TSS, total coliform and oil and grease. The water quality of the creek in the Shwe Pyi Tar IZ improved in September 2017 following the suspension of distilleries in the area, although it deteriorated again in February 2017 after the operation of the factories resumed.

The Doke Hta Waddy River seems to have adequate water quality for domestic water supply after conventional treatment. The level of organic pollution does not appear to be very high. None of the results in this project showed elevated levels of toxic substances. The water quality did not dramatically vary in seasons or from point to point. The water quality in Taung Tha Man Lake was eutrophic, which was manifested by higher phosphorus and

nitrogen concentrations, relatively low DO as well as high COD and pH. The water quality in the lake deteriorated significantly during the dry season compared with the rainy season.

3.3 Output – 3 (Database)

Output 3 aimed to develop databases of pollution sources and river water quality. Based on the data collected through the pollution source surveys in 2016 and 2017, a pollution source database was developed. The database contained data and information of 202 factories in Yangon and Mandalay, and is linked to a GIS software.

3.4 Output – 4 (Information Interpreting Capacity)

Output 4 focused on developing capacities to interpret environmental information in order to develop strategies to control water pollution. The pollution load analyses in Yangon (Case Study 1) and Mandalay (Case Study 2) were implemented to examine contributions of different sources of pollution, including not only industrial sources, but also domestic wastewater (sewage) and non-point sources, on the overall pollution loads to the Hlaing River and the Doke Hta Waddy River. The results showed that contributions of these sources vary significantly from location to location, and it is essential to elucidate pollution mechanisms to control water pollution.

4. Recommendations

Based on the experiences gained through the activities of Outputs 1 to 3, and the findings from the five case studies in Output 4 mentioned above, a series of strategies and action plans were developed jointly to improve water environment management in the future.

The suggestions for improvement of water environment management identified through the activities of Outputs 1 to 3 are summarized in the table below.

Table 2. Suggestions from Activities of Outputs 1 to 3

Output	Suggestions	Summary
Output 1 (Inspection)	Clarification of Environmental Requirement	Implement sectorial studies, and set requirements considering the best practices in each sector.
	Clarification of Inspection Procedure for Each Environ-mental Requirement	Once environmental requirements for factories are set, clarify the detailed inspection procedure for each environmental requirement. Revise the manual accordingly.
	Support to Factories on Pollution Control	Organize workshops and consultation events to educate regulated communities focusing on both procedural and technical issues. Workshops for specific sector or area should

		be considered.
Output 2 (Water Quality Survey)	Improvement of monitoring data quality in Myanmar	Standardize analytical methodologies and establish QA/QC, including proficiency testing and accreditation system. Also obtain more reliable data as the basis for comparison with monitoring data.
	Development of proper water environmental standard	Develop the surface water quality standard that has proper criteria and is also implementable with the capacity of monitoring organizations.
	Regular Surface Water Monitoring	Plan and implement regular surface water monitoring programs by responsible authorities. Ensure reporting of results from regional ECDs to ECD Headquarters. For important cases, implement special investigations to elucidate detailed, site-specific pollution mechanisms.
Output 3 (Database Development)	Gathering Information from Factories	Collect relevant information from factories through EMP and as part of reporting requirements of ECC. Or implement a questionnaire survey similar to the one implemented in this project.
	Development of Database of Pollution Sources	For managing ECC, expansion of the EIA database may be appropriate. Limit the information to be digitized if digitizing work is overwhelming.
	Improving Reliability of Measurement of Water Usage and Wastewater Qualities	Include installation of water meters and measurement of water usage as part of ECC requirements. Standardize analytical methodologies and introduce a system of QA/QC.
	Improving Environmental Measures by Factories	Enforce realistic environmental regulations and implement support measures. Regulate groundwater abstraction. Request regulated communities to take their own initiatives for pollution control and efficient production, possibly spearheaded by MOI and/or industrial associations.

Recommended series of strategies for water environment management developed in Output 4 activities are summarized in the Figure below. The suggestions from Outputs 1 to 3 and the results of case studies in Output 4 were taken into consideration. The strategies were developed for Yangon, Mandalay and at the national level, and the actions were divided into three terms: short-term (within 3 years), middle-term (within 5 years), and long-term (within 10 years). Counterpart organizations are urged to discuss these strategies further, develop official documents, get approval, and implement the actions.

To support implementation of these strategies and action plans, further recommendations for top decision makers are also provided in the report. They cover (i) clear demarcation of responsibilities among environmental authorities, (ii) development of realistic environmental requirements, (iii) inducing behavior change in regulated communities, (iv) involvement of stakeholders, such as local residents, NGOs and industrial associations, and (v) promotion of regional coordination for activities that are beyond the capacity of environmental authorities.

4.1 Hlaing River Basin

The collected information is summarized in Table 2.4-2. The Hlaing River runs through the western part of Yangon City, joins with the Pan Hlaing River, becomes the Yangon River, and drains to Andaman Sea. Overall, readily available information on the Hlaing River and its basin was quite scarce. The spatial and temporal fluctuations of the flow of Hlaing River, which is significantly affected by the tide, have not been investigated in detail in the past. The main pollution sources along the Hlaing River in the urban area seemed to be domestic wastewater and industrial wastewater. Several industrial zones are located on both sides of the Hlaing River, and the water quality of drainage channels receiving discharges from factories seemed deteriorated. However, the impact of pollution sources on the water quality of Hlaing River had not been studied prior to the project.

4.2 Doke Hta Waddy River Basin

Collected information is summarized in Table 2.4-3 below. The Doke Hta Waddy River flows from east to west in the south of Mandalay City and joins the Ayeyarwaddy River. There is a large industrial zone (three zones) in Pyi Gyi Tagon Township discharging wastewater to the south toward Doke Hta Waddy River and to the west toward Taung Tha Man Lake. As for the south-bound flow from Pyi Gyi Tagon IZ, it is discharged directly to the Doke Hta Waddy River through a 10 - inch-diameter pipeline. In the upstream of discharging point, WSD-MCDC plans to abstract water for domestic water supply in the future. The pollution load from the factories and sewage in the area was also affecting Taung Tha Man Lake through the west-bound flow from the industrial zone. The lake is famous as a tourist destination in Amarapura (former capital of Myanmar), and is rich in fishery resources. Because there were major fish kill incidents in the lake in April – May and September – October 2015 presumably due to the pollution load from factories as well as other sources, WSD-MCDC started to check the water quality in the lake and surrounding channels periodically.

5. Water quality survey result in Hlaing River basin

5.1 Pollution levels in Hlaing River and Pan Hlaing River

– Except TSS (Total Suspended Solid) and total coliform, the water quality in Hlaing River and Pan Hlaing River in the rainy season (September 2017) was acceptable for conservation of aquatic lives, irrigation and water transportation based on the Vietnamese surface water quality guideline values. During the dry season (February 2018), the water quality deteriorated as shown by high COD detected at some points and slight oil and grease detected at all points. Only the upstream area of Hlaing River (upstream of Shwe Pyi Thar Bridge) still kept the good water quality desirable for irrigation and water transportation except above-mentioned TSS, total coliform and oil and grease. In the middle-stream of Pan Hlaing River (upstream of Hlaing Bridge), the river water was extremely muddy in February 2018 resulting in very low dissolved oxygen (DO) and high BOD and COD, presumably due to the effect of sediment in the water stirred by a surging tide flow or other reasons.

Table 3: Classification of BOD and COD Levels in the Hlaing River Basin

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

5.2 Spatial distribution of pollution in Hlaing River: difference in water quality from upstream to downstream

– The results in Hlaing River did not show clear deterioration of the surface water quality in the flow direction during the rainy season.
– During the dry season, the COD level increased from the up-stream to downstream. While there was no significant difference in BOD level among the locations. It implies that the high COD in the dry season in the downstream area was largely due to organic matter associated with suspended solid in the water and not soluble organic substance.

5.3. Seasonal changes of water quality

– The concentration of pollutants in the dry season was higher than one in the rainy season for most sampling points and for most parameters as represented by BOD and COD. It indicated that in the rainy season the storm water diluted such pollutants and alleviated the pollution impact in the river. The result revealed that the pollution impact of industrial wastewater and domestic wastewater from the basin gets larger during the dry season, making it difficult to fully maintain the desired water quality in the Hlaing River during the dry season.

5.4. Pollution impact from IZs

- In the creek that flows through the Shwe Pyi Thar Industrial Zone (IZ) to Hlaing River, the water quality in the past surveys until February 2017 was significantly worse due to the inflow of wastewater, which was indicated by low DO as well as high concentrations of COD, BOD, oil and grease, nutrients, phenol and others.
- The water quality of this creek improved in September 2017 probably because the operation of distilleries along the creek was suspended. This order was given by the Yangon Region Government to six distilleries in the IZ in July or August 2017. However, after the new pipeline from distilleries was constructed in the creek, the water quality deteriorated again.
- The water quality in the creek hinges on the impact of wastewater from these factories. It is important to continue to monitor the wastewater from these pollution sources, which could improve or deteriorate depending on the factories' operation and performance of wastewater treatment.
- Overall, Hlaing River has a significant capacity to dilute water from the creek, and the pollution impact to Hlaing River does not appear to be so high, though the impact of localized pollution would be a concern.

5.5. Water quality for domestic water supply at Kokkowa River and Wataya

- The sampling points of Kokkowa and Wataya were investigated as possible future intake point(s) of domestic water supply to Yangon City. The water treatment plant is planned to be constructed on the bank of the Kokkowa River, upstream of Hlaing River. WSD-YCDC is also seeking the possibility to withdraw water from Hlaing River to Hlawga Lake to prevent a drawdown of Hlawga Lake in the dry season.
- There are some potential pollution sources along Hlaing River in the surrounding of Wataya. The water samples in these surveys were taken during the spring tide time and when the water was flowing downward after high-tide. However, the pollution level might change in a farming season, or when the water flows upward after low-tide.

Table 4: Comparison with Draft Drinking Water Quality Standard for Possible Domestic Water Supply (Hlaing River Basin)

Parameter	Unit	Kokkowa		Wataya		MOH Draft National Drinking Water Quality Std(2014)
		Sep 2017	Feb 2018	Sep 2017	Feb 2018	
pH	-	7.89	8.35	7.61	8.21	6.5 - 8.5
Turbidity	NTU	545	169	618	>1000	5
TDS	mg/L	66	140	81	156	1000
Cyanide(total)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	0.07
Zinc (Zn)	mg/L	0.029	0.014	0.054	0.13	3
Total chromium (T-Cr)	mg/L	0.019	0.010	0.048	0.11	0.05
Arsenic (As)	mg/L	0.0016	0.0015	0.0026	0.011	0.05
Copper (Cu)	mg/L	0.010	0.0054	0.017	0.045	2
Total Mercury (Hg)	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001
Cadmium (Cd)	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	0.003
Lead (Pb)	mg/L	< 0.005	< 0.005	0.0097	0.024	0.01
Pesticides (total 17 paramete	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	Specified for some parameters respectively

: Satisfied with reference standard
: Not satisfied with reference standard

6. Water quality survey result in Doke Hta Waddy River Basin

6.1 Pollution impact of the industrial wastewater to Doke Hta Waddy River

- The Doke Hta Waddy River seems to have adequate water quality for domestic water supply with water treatment facility using filters and other ordinary means. The level of organic pollution does not appear to be very high. The water quality did not dramatically vary in seasons or from point to point.
- Until the 3rd water quality survey in February 2017, the wastewater discharged from 10-inch pipeline had contained high concentrations of pollutants that included oil and grease, phenols and hexavalent chromium in addition to organic materials and nutrients. The concentrations of these pollutants were higher than the guideline values applied to general wastewater (general application, National Environmental Quality (Emission) Guidelines, 2015). It was noted that the pollution impact of this 10-inch pipe wastewater on water quality of Doke Hta Waddy River was limited because of the large dilution capacity of the river, though localized pollution and adverse impact, such as an awful odor to residents in the vicinity of the discharging point, were undeniable.
- After several distilleries in Pyi Gyi Tagon IZ were shut down their operation temporarily from June – August 2017 by instructions of Mandalay Region Government and MCDC, the pollution load from the 10-pipe line seemed to decrease. However, the discharging wastewater still contained oil and grease, phenols, and other pollutants.
- The concentrations of pollutants in the dry season was higher than those in the rainy season for most sampling points and for most parameters. On the other hand, the pollution loads of organic substances, i.e., BOD and COD, in Doke Hta Waddy River in October 2017 seemed larger than those in February 2018. It indicated that the storm water in the rainy season flushed more organic substances with soils from the upper basin to the river, though the concentrations of organic substances is not higher because of the dilution effect.

Table 5. Classification of BOD and COD Levels in Doke Hta Waddy River Basin

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

6.2. Pollution level of Taung Tha Man Lake

- The water quality in Taung Tha Man Lake was characterized as eutrophic. The lake, manifested traits like higher phosphorus and nitrogen concentrations compared to general indicators for eutrophication.
- As a whole the water quality in the lake was significantly deteriorated in the dry season compared with the rainy season. Especially in February 2018, the nutrient level was very high in the northern lake. At that period, the lake's water level was quite low and the water area was enclosed without enough water exchanges between the lake and other water bodies in the dry season. In such condition, the influent nutrients are further accumulated in the lake. It will increase algae and phytoplankton and result in internal organic production, which accelerates eutrophication. There is no doubt that the lake is eutrophic, even hypereutrophic. However the eutrophication mechanism in the lake is not clear and complicated. Since the water quality in the lake has changed or fluctuated dramatically over time or with seasons, more monitoring data will be necessary to examine the mechanism of water pollution in the lake.
- The creek flowing through U Shwe Taung Bridge, which is a confluence of Pa Yan Taw creek, Let Khot Pin stream and Columbo creek, is one of the major pollution paths to Taung Tha Man Lake. Among these creeks, the pollution loads of organic material and nutrients were the highest in Pa Yan Taw creek except the total nitrogen in the dry season. This implies that the Pa Yan Taw creek basin would have the highest priority for pollution control measures among these three basins in order to reduce the load to Taung Tha Man Lake.

Table 6. Comparison with Draft Drinking Water Quality Standard for Existing/Possible Domestic Water Supply (Doke Hta Waddy River Basin)

Location Name	Unit	DHWD1		Intake AYWD		MOH Draft National Drinking Water Quality Std(2014)
		Sep 2017	Feb 2018	Sep 2017	Feb 2018	
pH	-	8.40	8.15	7.88	8.06	6.5 - 8.5
Turbidity	NTU	39.5	9.5	74.1	80	5
TDS	mg/L	160	0.245	133	0.101	1000
Cyanide(total)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	0.07
Zinc (Zn)	mg/L	0.0081	< 0.005	0.0087	0.0078	3
Total chromium (T-Cr)	mg/L	0.0058	< 0.005	0.0056	< 0.005	0.05
Arsenic (As)	mg/L	0.0016	0.0023	0.0017	0.0013	0.05
Copper (Cu)	mg/L	< 0.005	< 0.005	< 0.005	0.014	2
Total Mercury (Hg)	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001
Cadmium (Cd)	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	0.003
Lead (Pb)	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	0.01
Pesticides	mg/L		-	< 0.0005	< 0.0005	Specified for some parameters respectively

: Satisfied with reference standard
: Not satisfied with reference standard

7. Development of Water Quality Survey Reports

A series of seminars on the development of water quality survey reports were organized for the technical staff of ECD (HQ office, Yangon Regional Office and Mandalay Regional Office), YCDC (PCCD and WSD) and MCDC (WSD and CD) and was conducted from November 2017 to February 2018 in order to provide an opportunity to evaluate the survey results based on their own survey objectives and to develop technical reporting skills in the area of water environmental management. The C/P staff involved in Output 2 activities were divided into five groups (ECD group, PCCD-YCDC group and WSD-YCDC group for Hlaing River basin and ECD group and MCDC group for Doke Hta Waddy River basin), and they developed their own water quality survey reports in line with their duty of water environmental management and interest of each C/P organization. Another water quality report was developed by JET in order to present the comprehensive survey results.

7.1. Improvement of Monitoring Data Quality in Myanmar

Issues: The quality control of survey data was a big challenge in the first half of the project as described in Section 2.4.8. A series of validation processes of analytical data revealed that the accuracy and precision of the results from local laboratories were not always good enough to evaluate water environmental quality. The suspected errors were likely caused by improper analytical methodologies and/or performance at laboratories. For example, some laboratories apply a simple and quick analysis method, but it was sometimes insufficient considering the monitoring purpose and the nature of the water sample. Even if the laboratory applies a reasonable analysis method, there are other difficulties in conforming to each step of the procedure and requirement specified in the original analysis method due to lack of understanding of the method, as well as insufficient skill and unavailability of a reagent, apparatus and equipment. Furthermore, there is no national accreditation system to judge the performance of laboratories. The capacity improvement of laboratory in Myanmar is one of key challenges to acquire reliable data.

Suggestions: The technical guideline and guidance to environmental analysis laboratories should be provided by ECD. The required measures include the standardization of environmental analytical methodologies of laboratories and establishment of a wide range of QA/QC (Quality Assurance/Quality Control) system that will ensure appropriate data management in a laboratory. The monitoring method should be specified for each environmental parameter once the national surface water quality standard is stipulated. The QA/QC activities include an implementation of proficiency test and cross-check, as well as establishment of a quality management system required by an accreditation system of laboratories, such as ISO17025. In addition, it is also crucial to obtain more reliable environmental surface water quality data in wider areas in Myanmar so that the obtained data at specific site can be compared with the data of different area or time, which will help validate the monitoring data.

7.2. Development of Proper Water Environmental Standard

Issues: Since a surface water quality standard has not been set in Myanmar, it is difficult for relevant parties including environmental authorities to have a common understanding of desirable water quality in the target water body. The environmental standard is important to assess water quality based on the surface water quality standard, and then to implement environmental management measures necessary to achieve the standard.

Suggestions: National Environmental Quality Standards including surface water quality standard is under development by ECD/MONREC according to Article 10 of the Environmental Conservation Law (Law No.9, 2012). The surface water quality standard should have proper criteria to characterize water quality under different water usage, and also financially and technically enforceable with the capacity of monitoring organization.

7.3. Regular Surface Water Monitoring

Issues: The water quality data might have been affected by a specific event, such as soil erosion, wastewater discharged temporarily, sand excavation activities, etc. In addition, the water quality would have not only seasonal variation, but also other variations at monthly or daily frequency. Only two-times-per-year sampling survey cannot reveal the mechanisms and reasons of such variations. More sampling frequency to acquire at least monthly data for representative points and parameters will be required in terms of environmental water quality monitoring

Suggestions: It is suggested that the regular water quality monitoring be planned, conducted and reported by responsible authorities. According to Article 13 of the Environmental Conservation Law (2012), ECD is developing a nation-wide environmental monitoring program. Under such national program and instruction, regional ECDs will be expected to develop a detailed monitoring plan for the region, conduct the survey, and report the results to ECD Headquarters and other relevant parties.

7.3.1 Output 3 – Database Development

This output aims to develop a databases for pollution sources and river water qualities.

Table 7. Activities and Indicators of Output 3

Output 3	Database of water pollution sources and river water quality is developed.
Activities	3-1 To collect and sort out the information on water pollution sources which was collected by the Activityv1-1, inspection results and the water quality survey results
	3-2 To develop a system concept
	3-3 To design the database based on the system concept
	3-4 To collect additional information required to develop the database

	3-5 To develop the database
	3-6 To conduct training on operation and utilization of the database
	3-7 To develop an operation and maintenance manual of the database
Indicator	At least 150 factories' information is accessible on the database. Results of water quality survey is accessible on the database

8. Conclusion

The project for Capacity Development in Basic Water Environmental Management and EIA System in Myanmar has been implemented between Ministry of Natural Resources and Environmental Conservation and JICA. There have the four outputs; Water Quality Survey, database development and the interpretation of information. This project is very effective due to fulfilling not only the environmental conservation activities of our department but also the best practices and experiences of Japan. Capacity building of relevant departments is supported by this project. Our citizen can have very good opportunity to protect their health by the environmental pollution. And so this project is very supportive and effective in time for solving the current difficulties for water environment management and EIA component. The outputs of this project in line with work plan have been conducted successfully during 3 years not only by cooperation of the relevant ministries but also the efficient technical assistance of JICA.

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