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**Water Quality Assessment of Ayeyarwaddy River Basin in
Mandalay: Environmental Implications**

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Water Quality Assessment of Ayeyarwaddy River Basin in Mandalay: Environmental Implications

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Abstract

Ayeyarwaddy River, the largest river of Myanmar, has not only become degraded in water quality but is now, shallower and its fish population has decreased. Mandalay District is located at the bank of Ayeyarwaddy River and its Taungthaman Lake experienced mass death of fish in 2015 due to eutrophication affected by wastewater entering nearby. Besides, part of city water supply depends on the Ayeyarwaddy River and 2.26% of district's population relied on the river, stream, and lake for drinking purpose. In order to address the water quality degradation problem in Ayeyarwaddy River basin this study conducted water quality assessment in Mandalay district as case study. The main purpose of the water quality monitoring was to identify wastewater sources of each township from upstream to downstream, and to find out the possible solutions for controlling them. The study used secondary data especially on-site water quality measurement results, pollutant sources data and water-related regulations list. The results of temperature, dissolved oxygen (DO), pH, turbidity and total dissolved solids (TDS) were selected for a period of eleven months measured in twelve monitoring points on four water bodies and evaluated comparing with Thailand Water Quality Criteria for Aquatic Living and drafted Myanmar National Drinking Water Quality Standards considering water usage, respectively. This study analyzed the quality of the water of Ayeyarwaddy River Basin in Mandalay by analyzing the data of five parameters (Temperature, DO, pH, Turbidity and TDS) for a period of eleven months. The study identified the wastewater sources of each township as domestic, manufacturing, industrial enterprises, infrastructure and service industries, agriculture, livestock, forestry, and mining. Finally, the study assessed the current water related regulation and enforcement activities.

Key words: Regulation, Townships, Wastewater, Water Quality Assessment

မန္တလေးရှိ ဧရာဝတီမြစ်ဝကျွန်းပတ်တွင် ရေအရည်အသွေး ဆန်းစစ်ခြင်း - ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှုများ

ခင်မျိုးဆက်အေး၊ ဦးစီးအရာရှိ
ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန

စာတမ်းအကျဉ်း

မြန်မာနိုင်ငံ၏ အကြီးဆုံးမြစ် ဖြစ်သည့် ဧရာဝတီမြစ်၏ ရေအရည်အသွေးသည် ကျဆင်းလာရုံ သာမက မြစ်ကြောင်း တိမ်လာခြင်းနှင့် ငါးအရေအတွက် ကျဆင်းလာခြင်းတို့ ဖြစ်ပေါ်လျက်ရှိ ပါသည်။ မန္တလေး ခရိုင်သည် ဧရာဝတီမြစ်ကမ်းပေါ်တွင် တည်ရှိပြီး ၎င်းခရိုင်ရှိ တောင်သမန်အင်း တွင် အင်းအနီးအနားရှိ ရေဆိုးများ ဝင်ရောက်ပြီး eutrophication ဖြစ်ပွားမှုကြောင့် ၂၀၁၅ ခုနှစ်က ငါးအမြောက်အမြား သေဆုံးခဲ့ပါသည်။ ထို့အပြင် မန္တလေးမြို့ ရေပေးဝေရေး၏ တစ်စိတ်တစ်ပိုင်း အတွက် ဧရာဝတီမြစ်ပေါ်တွင် လည်းကောင်း၊ ခရိုင်လူဦးရေ ၂.၂၆ ရာခိုင်နှုန်း၏ သောက်သုံးရေ အတွက် မြစ်၊ ချောင်း၊ အင်းအိုင်များ အပေါ်တွင်လည်းကောင်း မှီခိုနေရပါသည်။ ဧရာဝတီမြစ်ရေ အရည်အသွေး ကျဆင်းခြင်း ပြဿနာရပ်ကို ညွှန်ပြနိုင်ရန် ဤလေ့လာမှုကို မန္တလေးခရိုင်တွင် Case Study အနေဖြင့် ဆောင်ရွက်ခဲ့ပါသည်။ ရေအရည်အသွေး စောင့်ကြပ်ကြည့်ရှုခြင်း၏ အဓိက ရည်ရွယ်ချက်မှာ ခရိုင်ရှိ မြစ်အထက်ပိုင်းမှ မြစ်အောက်ပိုင်းအထိ မြို့နယ်များရှိ စွန့်ပစ်ရေ အရင်း အမြစ်များကို ခွဲခြမ်းစိတ်ဖြာရန်နှင့် ၎င်းတို့အား ထိန်းချုပ်နိုင်မည့် နည်းလမ်းများကို ရှာဖွေရန် ဖြစ်ပါ သည်။ အထူးသဖြင့် နေရာတွင်-တိုင်းတာထား သည့် ရေအရည်အသွေး ရလဒ်များ၊ ညစ်ညမ်းမှု ဖြစ်စေသည့် ဇာစ်မြစ်များနှင့် ရေနှင့်ဆက်စပ်သော စည်းမျဉ်း စည်းကမ်းများစသည့် Secondary Data များကို ဤလေ့လာမှုတွင် အသုံးပြုခဲ့ပါ သည်။ ရေထု (၄)ခု၌ တိုင်းတာမှတ် (၁၂) မှတ်တွင် (၁၁) လစာ တိုင်းတာ ထားသည့် Temperature, dissolved oxygen, pH, turbidity နှင့် total dissolved solids ရလဒ်များကို အသုံးပြု၍ ထိုင်းနိုင်ငံ၏ ရေနေ သတ္တဝါအတွက် ရေအရည်အသွေး စံသတ်မှတ်ချက်များနှင့် မြန်မာနိုင်ငံ၏ သောက်သုံးရေအရည်အသွေး စံချိန်စံညွှန်းများဖြင့် ရေ အသုံးချမှုအပေါ်မူ တည်၍ အသီးသီး နှိုင်းယှဉ် စိစစ်ခဲ့ပါသည်။ ဤလေ့လာမှုတွင် (၁၁) လစာ Parameter (၅) မျိုး (Temperature, DO, pH, Turbidity နှင့် TDS) ၏ရလဒ်များကို စိစစ်၍ မန္တလေးရှိ ဧရာဝတီမြစ်ရေအရည်အသွေး စိစစ်ခဲ့ပါသည်။ မြို့နယ် တစ်ခုချင်းစီရှိ စွန့်ပစ်ရေဇာစ်မြစ် များဖြစ်သည့် လူနေအိမ်၊ စက်ရုံအလုပ်ရုံ၊ ဝန်ဆောင်မှုပေးသည့် လုပ်ငန်းများ၊ စိုက်ပျိုးရေး၊

မွေးမြူရေး၊ သစ်တောလုပ်ငန်းများနှင့် သတ္တုတွင်းလုပ်ငန်းများကို ခွဲခြမ်းစိတ်ဖြာစိစစ်ခဲ့ပါသည်။ ရေနံဆက်စပ် သောစည်းမျဉ်းစည်းကမ်းများနှင့် အကောင်အထည်ဖော် ဆောင်ရွက်မှုများကို နောက်ဆုံးပိုင်းတွင် ဆန်းစစ်ခဲ့ပါသည်။

Water Quality Assessment of Ayeyarwaddy River Basin in Mandalay: Environmental Implications

1. Introduction

Ayeyarwaddy River is the largest river of Myanmar crossing the country from north to south. Its river basin was a home for around two-third of country's population and around 1,400 mammal, bird and reptile species (World Wide Fund for Nature 2018). However the quality of the water of the river has not only degraded but it now, shallower and its fish population has decreased. Rapid urbanization and increasing industrialization have significantly affected the water resources (Ghosh, 50 FAQs on Water Pollution, 2014). Mandalay is the uppermost largest city of five biggest cities along the river. In addition, mass fish deaths occurred in 2015 in Taungthaman Lake of Mandalay due to eutrophication as a result of wastewater entering nearby. Study area was Mandalay District located in the central part of country. Part of city water supply depended on the Ayeyarwaddy River and 2.26% of district's population relied on the river, stream and lake for drinking water. In order to address this serious problem, this study conducts water quality assessment on the catchment area of Ayeyarwaddy River in Mandalay, to identify the wastewater sources of each township from upstream to downstream, and to find out the possible solutions for controlling wastewater sources.

2. Materials and methods

Water quality assessment defined as the investigation and evaluation of water quality, biological life, particulate matter and physical characteristic of water body (Ballance, 1996). This study used secondary data especially on-site water quality measurement results, pollutant sources data and water-related regulations list. Five parameters (Temperature, Dissolved Oxygen (DO), pH, Turbidity and Total Dissolved Solids (TDS)) were selected for a period of eleven months measured in twelve sampling points on Ayeyarwaddy River, Dokehtawaddy River, Thingazar Creek and Taungthaman Lake in Mandalay District. Fish health is mainly related to the levels of water temperature, DO, pH and turbidity parameters (Svobodova, Lloyd, & Machova, 1993). It is important to consider the level of water pH for water treatment and water distribution, as well as TDS for palatability of water and scaling of water pipe. Turbidity indicates the possibility of microorganisms breeding and high concentration of Turbidity can cause the gastrointestinal infection (WHO, 2011). Therefore, water quality results were evaluated for aquatic life and drinking purpose comparing with Thailand Water Quality Criteria for Aquatic Living and drafted Myanmar National Drinking Water Quality Standards considering the water usage, respectively. Urban wastewater drainage, Thingazar Creek, was considered for aquatic life only.

3. Results

The water quality results were influenced by both temporal and special changes. Almost all of the results did not meet the standards during dry season. All the results of pH and DO met the standards for aquatic living but temperature results were slightly lower than lower standard limit in most points. Water pH and TDS values were under limits for drinking

purpose except Taungthaman Lake. Turbidity results of all water bodies were extremely high (see Figure 1) but the results met the limit at the upstream Dokehtawaddy River.

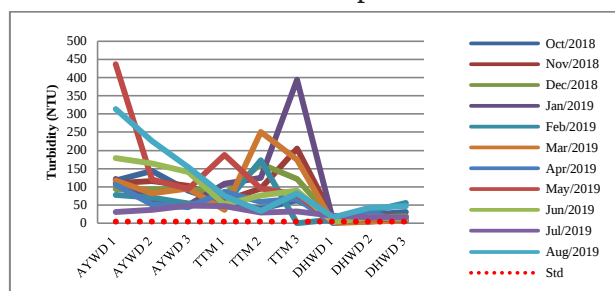


Figure 1 Comparing Turbidity Results and Standard Limit for Drinking Purpose

Thingazar Creek was generally acceptable for aquatic life but its upstream turbidity results were higher than downstream. Besides, upstream water color was black and it changed as moss green in the downstream. Taungthaman Lake was not suitable for drinking purpose because its results of pH, turbidity and TDS did not meet the standards for drinking purpose and high values of these parameters were found. Dokehtawaddy River water results were quite good compared to others according to the results of turbidity. Water pH and TDS results of the river water were higher than Ayeyarwaddy River. Upstream turbidity results of Ayeyarwaddy River water were higher than downstream.

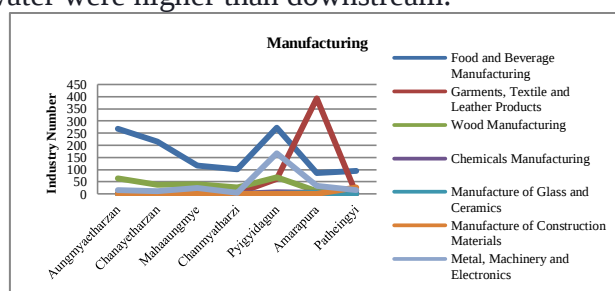


Figure 2 Manufacturing Industries Number of each Township

Mandalay District occupies several wastewater sources including domestics, manufacturing industrial enterprises, infrastructure and service industries, agricultural lands, livestock, forestry and mining. Townships of Mandalay settle along the Ayeyarwaddy River from upstream to downstream. Upstream townships have higher population density and more large, medium and small industrial enterprises than downstream (see Figure 2). Three of upstream townships have ports along the river. Mandalay Industrial Zone is located in Pyigyidagun Township which also has many livestock farms. The downstream township, Amarapura, has a large number of small-scale industries. Amarapura and Patheingyi Townships are rural areas so they also have agricultural areas and livestock farms. Forestry areas and a gold mine are found in Patheingyi Township.

4. Discussion

Thingazar Creek, wastewater channel, passed three upstream townships so its water quality was influenced by domestic and industrial activities. There were three aerators installed in the creek so the water color changed in the downstream. Taungthaman Lake is bounded with Amarapura and Pyigyidagun Township so its water quality was affected by the domestic, industrial, livestock and agricultural activities. Upstream Dokehtawaddy River water is pretty good as there is no significant pollutant source but a number of households, industrial enterprises and the wastewater discharge point of Industrial Zone are found near middle stream. However, the river water could dilute the wastewater until now but it would be definitely difficult for long-run. Dokehtawaddy River originates from the plateau limestone so its TDS results are higher than Ayeyarwaddy River due to the mineral deposit of

the sedimentary rock. Ayeyarwaddy River water has higher turbidity content so it could be the effect of upstream mining and agriculture area contributing with urban wastewater at Mandalay. In addition, high total coliform and E.coli values were detected along the river according to the past study. It could be the results of ships, boats and urban wastewater. There were no specific law for water pollution control, water quality standards and sufficient monitoring activities in Myanmar. And, direct wastewater discharge practices should be controlled by regulations. Water quality standards and enforcement activities are required to enhance the Ayeyarwaddy River water quality.

5. Conclusions

This study analyzed the quality of the water of Ayeyarwaddy River Basin in Mandalay by analyzing the data of five parameters (Temperature, DO, pH, Turbidity and TDS) for a period of eleven months. The study identified the wastewater sources of each township as domestic, manufacturing, industrial enterprises, infrastructure and service industries, agriculture, livestock, forestry and mining. Finally the study assessed the current water related regulation and enforcement activities.

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