

unicef 
for every child



Application of an Innovative Floating Buoy for Turbidity Measurement in
Water Quality Assessment of the Phraya Kham Canal, Mueang District,
Chiang Mai Province

By

Miss Ami Yamamoto

Miss Pichaya Kunnatitada

Miss Chonchanok Gunboot

Miss Naprimphorn Pakham

Miss Siwaree Sujithara

Mr. Patinya Kanakupt

Advisors

Miss Rattanaporn Waenphet

Mr. Accadech Chaimoolthan

Mr. Kantapat Thapinta

2026 Virtual Science Symposium (VSS)

School: Varee Chiangmai School, Mueang District, Chiang Mai Province

Research Title: Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province

Research Team:

- Miss Ami Yamamoto
- Miss Pichaya Kunnatitada
- Miss Chonchanok Gunboot
- Miss Naprimphorn Pakham
- Miss Siwaree Sujithara
- Mr. Patinya Kanakupt

Level: Upper Elementary (Grade 4-6)

Advisors:

- Miss Rattanaporn Waenphet
- Mr. Accadech Chaimoolthan
- Mr. Kantapat Thapinta

School: Varee Chiangmai School, Mueang District, Chiang Mai Province

Abstract

The research titled "Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province" aimed to study water quality based on GLOBE Hydrosphere criteria, develop an innovative turbidity-monitoring buoy using a KidBright board and turbidity sensor, compare the turbidity values obtained from two different measurement methods, and evaluate the effectiveness of a tilt sensor in detecting potential flood risks. This study utilized both experimental and survey-based research methods. Data collection was performed four times (once per week) by testing the floating buoy on-site at the Phraya Kham Canal.

The results indicated that water quality, when measured according to GLOBE criteria, maintained a constant turbidity of 27 cm, representing a moderate level of clarity. Other parameters included a water temperature of 21–23°C, pH levels of 7.5–7.8, electrical conductivity of 223–231 $\mu\text{S}/\text{cm}$, and Dissolved Oxygen (DO) levels of 4.5–5.5 mg/L. Phosphate and nitrite levels remained stable throughout the study. These findings suggest that the water quality is at a moderate to good level and remained consistent during the assessment period. Regarding the floating buoy, the turbidity sensor recorded values in the range of 1000–1234, mirroring the trends observed in the GLOBE results—specifically, a slight increase in turbidity during the second week and a decrease in the fourth week. Furthermore, the tilt sensor successfully monitored the buoy's orientation within a normal range (5–10°),

with no abnormal tilting detected, demonstrating the stability of the buoy and its capacity for continuous water condition monitoring.

In conclusion, the developed innovative floating buoy can effectively measure turbidity and monitor water conditions, providing results consistent with the GLOBE Hydrosphere standard measurements. This innovation supports community water resource monitoring, advances students' learning in science and technology, and serves as a foundation for developing similar applications in other areas.

Keywords: Innovative Floating Buoy, Turbidity-Monitoring Buoy, Water Quality Study

Acknowledgements

The research project titled "Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province, and Student Participation in Water Quality Sampling" was successfully completed through the cooperation and support of many parties. The research team would like to express our deepest gratitude to the following:

We wish to thank the management of Varee Chiangmai School and Director Varee Patavanich for their continuous support in terms of policy, equipment, and for promoting the integration of science and innovation in student learning.

Our gratitude goes to the team of teachers involved in this project for their consultation, guidance, and coordination in ensuring that data collection and field experiments were conducted thoroughly and safely.

We are profoundly grateful to our research advisors, Miss Rattanaporn Waenphet, Mr. Kantapat Thapinta, and Mr. Accadech Chaimoolthan, for their invaluable advice, guidance, research review, and support at every stage of the process, which enabled this research to reach its successful conclusion.

We would like to thank the community leaders of the Phraya Kham Canal area and the local residents for granting us permission to use the site and for providing beneficial information regarding community water quality.

Finally, we thank everyone for their encouragement and support that allowed this research to be completed. Should there be any defects, the research team respectfully accepts them for further improvement in future studies.

The Research Team

Table of Contents

Content	Page
Abstract	
Acknowledgements	
Chapter 1: Introduction	8
- Background and Significance	
- Research Objectives	
- Research Questions	
- Research Hypotheses	
- Expected Benefits	
- Scope of Research	
Chapter 2: Literature Review	13
Chapter 3: Research Methodology	21
Chapter 4: Research Results	29
Chapter 5: Conclusion and Discussion	31
References	34

Chapter 1: Introduction

Background and Significance

Water is a vital natural resource essential for human life, ecosystems, and socio-economic development. The Phraya Kham Canal in Mueang District, Chiang Mai Province, is a water source that plays a crucial role in the community, supporting domestic consumption, agriculture, and drainage. However, community expansion, agricultural activities, and various human interventions may impact water quality, specifically leading to changes in turbidity. Turbidity is a key indicator reflecting the concentration of suspended solids and the potential risk of pollutant contamination in water sources.

Traditional water quality monitoring methods often require expensive equipment and lack the convenience needed for continuous surveillance. Consequently, this research focuses on developing the application of an innovative **Turbidity-Monitoring Buoy**. This device is designed to measure water turbidity conveniently and rapidly, making it suitable for the context of local community water sources.

Furthermore, this research integrates learning based on the **GLOBE Hydrosphere Protocols**. Students are actively involved in collecting water samples from the Phraya Kham Canal to measure parameters such as

turbidity, temperature, pH, and other related factors following international scientific guidelines. This process enhances students' research skills, analytical thinking, technological proficiency, and understanding of the importance of local water resource conservation.

Therefore, studying the water quality of the Phraya Kham Canal using the innovative turbidity-monitoring buoy alongside standard GLOBE criteria is significant for water quality surveillance, environmental innovation development, and the promotion of research-based learning for students. These efforts can be further expanded for the benefit of both the local community and international environmental monitoring networks.

Research Objectives

1. To study the water quality of the Phraya Kham Canal by collecting water samples according to GLOBE Hydrosphere criteria.
2. To develop an innovative Turbidity-Monitoring Buoy using the KidBright board and a turbidity sensor.
3. To compare the turbidity values obtained from manual GLOBE sampling with those measured by the innovative buoy.
4. To promote research-based learning in science and technology for students using real-world data from community water sources.

Research Questions

1. What are the turbidity levels and water quality variables of the Phraya Kham Canal when measured according to GLOBE Hydrosphere criteria?
2. Can the innovative buoy using the KidBright board measure water turbidity accurately and stably?
3. Are the turbidity values obtained from the buoy significantly different from those measured using the GLOBE protocol?
4. Can the tilt sensor effectively provide warnings regarding flood risks or flash flood conditions?

Research Hypotheses

1. The innovative buoy developed using KidBright can measure turbidity values close to those obtained through manual GLOBE Hydrosphere testing.
2. The water quality of the Phraya Kham Canal fluctuates over time, particularly in terms of turbidity.

Expected Benefits

1. To obtain accurate and reliable water quality data for the Phraya Kham Canal.
2. To produce a low-cost Turbidity-Monitoring Buoy suitable for community water resource surveillance.
3. To enable the community to use this data for water quality management planning and flood preparedness.

4. For students to acquire scientific, technological, and research skills following the GLOBE framework.
5. For the school to further develop this innovation for competitions and practical implementation in other areas.

Scope of Research

1. Content Scope

- Collect water samples from the Phraya Kham Canal 4 times (once per week) based on GLOBE Hydrosphere criteria.
- Measure the following variables:
 - **1.1 Variables from manual sampling (GLOBE):** Turbidity, Water Temperature, pH (Acidity/Alkalinity), Electrical Conductivity, Dissolved Oxygen (DO), Phosphate, and Nitrite.
 - **1.2 Variables from the innovative buoy:** Turbidity values from the analog turbidity sensor and buoy tilt/orientation (Tilt Sensor/Accelerometer) to detect abnormal water conditions. (Note: Ultrasonic sensor for water level was also considered for monitoring).
- Compare turbidity values from both methods and analyze sensor performance and overall innovation efficiency.

2. Geographic Scope This research was conducted at the Phraya Kham Canal, Mueang District, Chiang Mai Province. Specific monitoring points within

community zones were designated to reflect the impact of human activities on water quality in the study area.

3. Temporal Scope November 2025 – January 2026.

Chapter 2: Literature Review

In conducting the research titled "Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province," the research team studied relevant documents, concepts, and previous research. The findings are summarized into the following key topics:

2.1 Surface Water Quality Standards

"Surface water" refers to rivers, canals, swamps, marshes, lakes, reservoirs, and other public water sources within the land. This includes public water sources on islands but excludes groundwater. In cases where the water source is adjacent to the sea, it refers to the water within the estuary or lake mouth, as defined by the Marine Department.

2.1.1 Objectives of Water Quality Standards:

- To control and maintain water quality suitable for various uses and ensure public health safety.
- To conserve natural resources and the environment.

2.2 Criteria for Determining Water Quality Standards

- **Suitability for Use:** Consideration of various activities in cases of multi-purpose water sources, prioritizing primary uses without conflicting with other simultaneous activities.
- **Current Water Situation:** Analysis of the current water quality status of major water sources in the country and trends that may change due to future development.
- **Health and Safety:** Consideration of the health and safety of humans and most aquatic life.
- **Public Satisfaction:** Ensuring the accepted water quality level meets the satisfaction of the majority of residents in the watershed area.

2.3 Goals of Surface Water Quality Categorization

- To categorize water sources with appropriate standards consistent with their actual use.
- To establish standard water quality and inspection methods as a basis for planning projects involving water sources.
- To maintain natural water quality, especially at upstream sources, to remain free from contamination from any activities.

2.4 Categories of Surface Water Quality

Surface water quality is divided into 5 categories:

- **Category 1:** Water sources with natural conditions, free from wastewater from any activity. Useful for:
 - Consumption (after standard disinfection).
 - Natural reproduction of basic aquatic organisms.
 - Ecosystem conservation.
- **Category 2:** Water sources receiving wastewater from some activities. Useful for:
 - Consumption (after standard disinfection and general quality improvement).
 - Aquatic animal conservation and fisheries.
 - Swimming and water sports.
- **Category 3:** Water sources receiving wastewater from some activities. Useful for:
 - Consumption (after standard disinfection and general quality improvement).
 - Agriculture.
- **Category 4:** Water sources receiving wastewater from some activities. Useful for:
 - Consumption (after standard disinfection and special quality improvement).
 - Industry and other activities.

- **Category 5:** Water sources useful for navigation and other purposes not specified in categories 1–4.

2.5 Innovation

Innovation refers to new concepts, practices, or inventions used to improve and build upon existing things to make them better, more modern, and more valuable. This can be in the form of products, processes, services, or new business models to increase efficiency, save time/resources, and create positive change for the economy and society.

Key characteristics of innovation:

- **Novelty:** Something significantly different or new from the original.
- **Applicability:** The idea must be practical and usable in the real world.
- **Value Creation:** It must create benefits, add value, or solve problems.

2.6 History of the Phraya Kham Weir and Canal

Phaya Kham was an official who served in the Royal Court of Chiang Mai during the reign of Prince Inthawichayanon, the 7th Ruler of Chiang Mai. Prince Inthawichayanon was the father of Princess Dara Rasmi, a Royal Consort of King Chulalongkorn (Rama V). Phaya Kham served during the period of 1870 to 1897 (B.E. 2413–2440). During that era, titles such as Muen, Khun, Thao, and Phaya were bestowed upon individuals based on their merit and contributions to the nation. Phaya Kham was recognized for his

sacrifice, honesty, dedication, and perseverance in his duties, leading to his appointment as Phaya Kham by Prince Inthawichayanon.

Later, King Chulalongkorn (Rama V) reformed the traditional governance system into the Chatusadom system (The Four Pillars: Wiang, Wang, Khlang, Na—Town, Palace, Treasury, and Agriculture) to organize administrative responsibilities. Consequently, Prince Inthawichayanon established these four departments. Phaya Kham was appointed to the Department of Agriculture (Krom Na). His primary responsibility was to organize the local citizens to clear land for rice farming and to construct irrigation canals (Mueang) and weirs (Fai) to divert water for agriculture.

In Saraphi District, other notable officials appointed to the Department of Agriculture included Muen Kopkan Prachachob (Muen Rin) of Ban San Pa Sak, Thao Duang of Ban Nong Faek, and Pho Chao Luang Thammapanya of Ban Ku Daeng.

Phaya Kham led the local people in excavating a major irrigation canal starting from Chom Phu Subdistrict, extending through Chaiyasathan, the eastern part of Nong Phueng, Nong Hoi, and passing in front of the Provincial Electricity Authority at Ban Den. He also constructed a weir across the Ping River at Tha Sala to divert water for farming and gardening across the eastern Nong Phueng area, reaching as far as Chaiyasathan, parts of Pa Bong, and Chom Phu.

For the lower areas—including Nong Phueng, Yang Noeng, eastern Nong Faek, and Saraphi—the water eventually meets the Long Sam Pan waterway east of Ban San Pa Duea. Phaya Kham assigned Muen Kopkan Prachachuea (Muen Rin) to lead the citizens in digging a branch canal from the main Phaya Kham canal at Nong Phueng to supply these subdistricts. Therefore, the weir at Tha Sala is known as the Phaya Kham Weir (though some still refer to it as the Tha Sala Weir after its original location).



"Figure 1: Phaya Kham Canal, Nong Hoi Sub-district, Mueang District, Chiang Mai Province."

Whether it was the canal dug directly by Phaya Kham or the branch dug by Muen Rin, both are still known as the Phaya Kham Canal to this day.

As for the Long Sam Pan canal, where the western Saraphi branch of the Phaya Kham canal terminates, it was dug by Pho Thao Duang and Pho Chao Luang Thammpanya, who also served in the Department of Agriculture. This canal spans approximately 6 kilometers (3,000 wa),

stretching from the borders of Tha Wang Tan and Buak Khrok Tai down to Ban San Pa Duea in southern Nong Faek.

Today, if you travel along the Chiang Mai-Lamphun Road (the Old Road), you will see a bridge at the Saraphi intersection; this bridge crosses the branch of the Phaya Kham canal. Furthermore, if you head toward Chiang Mai city and pass the Ban Den Electricity Office, you will cross another bridge—this is the main Phaya Kham canal that receives water directly from the Phaya Kham Weir.

2.7 Related Research

2.7.1 University of Phayao: A study on "Application of Geoinformatics for Water Quality Monitoring in Kwan Phayao." This research used satellite imagery and water quality indices (BOD, Nitrate, Phosphorus) to create a water quality map. The results showed that most areas had excellent water quality, with some "fair" areas near urban centers due to organic waste influence.

2.7.2 Rajamangala University of Technology Thanyaburi: "Development of a Low-Power Water Quality Meter using a Floating Buoy." This research designed an Arduino-based buoy with sensors for pH, temperature, and Dissolved Oxygen (DO). It used 5G and wireless communication to send data to Google Sheets and provide real-time alerts via Line Notify.

2.7.3 Prachinburi River Water Quality Study: Research focused on health risks from toxic contamination. The study analyzed pH, DO, and turbidity

(27–67 NTU) across four districts. It also assessed heavy metal contamination (Arsenic and Cadmium) in aquatic animals like freshwater prawns and snails, providing a risk assessment for community consumption.

Chapter 3: Research Methodology

This study on the "Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province" utilizes both **Experimental and Survey Research** methodologies. The research process is divided into the following sections:

3.1 Equipment and Materials

3.1.1 GLOBE Hydrosphere Water Sampling Equipment:

- Turbidity Tube / Turbidity Kit
- Water Thermometer
- pH Meter
- Dissolved Oxygen (DO) Test Kit
- Phosphate Test Kit
- Nitrite Test Kit
- Clean water sampling bottles
- Latex gloves
- Water collection buckets or containers
- 250 ml Beakers
- Safety goggles
- Data recording forms

3.1.2 Innovative Turbidity-Monitoring Buoy Components:

- **Buoy Structure:** Upcycled gallon containers or foam floatation units.
- **Housing:** Waterproof box (IP65 standard).
- **Electronics:**
 - KidBright Board (System control unit)
 - Turbidity Sensor (Analog)
 - Tilt Sensor / Accelerometer (For buoy orientation monitoring)
 - Ultrasonic Sensor (For water level measurement)
 - 18650 Lithium-ion batteries
 - Small waterproof enclosure for circuitry
 - Solar panel for sustainable power supply

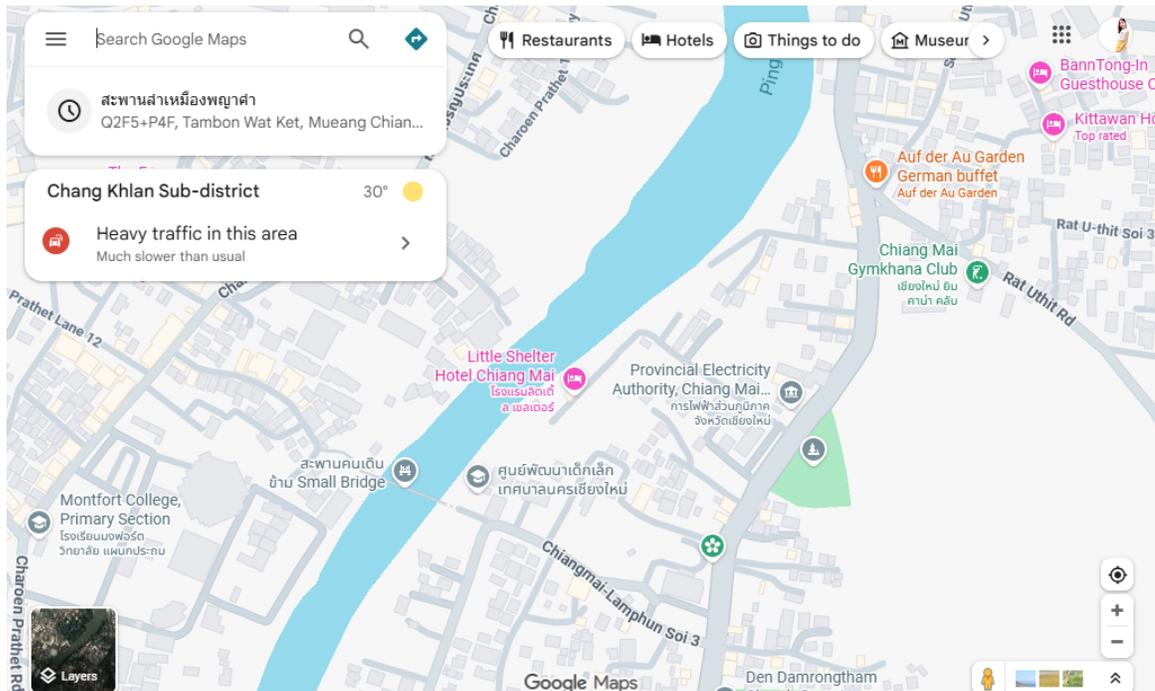
3.2 Research Procedures

The research was conducted through the following 8 steps:

Step 1: Site Preparation

- Surveyed the Phraya Kham Canal to identify 1–2 optimal sampling locations.
- Selected sites where the canal passes through community areas to reflect human impact.
- Identified secure installation points for the floating buoy.
- Conducted safety assessments regarding water depth and current velocity.

- **Study Site:** Phraya Kham Canal, Mueang District, Chiang Mai Province.



"Figure 2: Designated Study Sites along the Phaya Kham Canal, Mueang District, Chiang Mai Province."

Step 2: Water Sampling according to GLOBE Hydrosphere Protocols

- Conducted 4 sampling sessions (once per week).
- **Sampling Method:** Collected water at a depth of 20–30 cm using sterilized bottles, ensuring the cap was tightly sealed to prevent contamination.
- **Parameter Measurement:**
 1. **Turbidity:** Measured using a Turbidity Tube.
 2. **Water Temperature:** Measured with a thermometer.
 3. **pH:** Measured using a pH meter or reagent kit.
 4. **Electrical Conductivity**

5. Dissolved Oxygen (DO)

6. Phosphate and Nitrite levels

- Data were recorded on GLOBE Hydrosphere forms, including numerical values and environmental observations (color, odor, flow rate, etc.).



Figure 3: Water quality sampling at the designated study sites along the Phaya Kham Canal, Mueang District, Chiang Mai Province.

Step 3: Construction of the Innovative Floating Buoy

3.1 Assembly

- Assembled the floatation frame using foam or plastic buoys.
- Secured the waterproof box and installed the KidBright board inside.
- Turbidity Sensor: Mounted facing downward into the water.

- Tilt Sensor / Accelerometer: Placed inside the box to monitor stability.
- Ultrasonic Sensor: Mounted facing downward to measure the distance to the water surface.



Figure 4: Innovative floating buoy for turbidity measurement.

3.2 Programming the KidBright Board

The system was programmed to perform the following functions:

- Read data from the Turbidity Sensor.
- Monitor buoy tilt to detect abnormal water movement or levels.
- Measure water levels using the Ultrasonic Sensor.
- Log data to an SD card or transmit via Bluetooth/WiFi.
- Repeat the measurement cycle every 30 seconds to 5 minutes.



Figure 5: Programming and testing the KidBright board.

Step 4: Field Testing

- Deployed the buoy in the Phraya Kham Canal.
- Verified buoyancy and stability in the actual current.
- Recorded real-time sensor data and logged environmental conditions (e.g., weather, water clarity).



Figure 6: Field testing of the floating buoy in the study area.

Step 5: Data Comparison and Analysis

- Compared the turbidity values obtained from the GLOBE manual method with those from the electronic sensor.
- Analyzed correlations, stability of the buoy, and the impact of water currents on measurement accuracy.

Step 6: Sensor Performance Evaluation

- Verified the accuracy of the Tilt Sensor (detecting actual movement).
- Validated Ultrasonic Sensor data against observed water level fluctuations.
- Evaluated overall efficiency in terms of durability, accuracy, buoyancy, and suitability for community use.

Step 7: Data Entry and Conclusion

- Uploaded the collected data to the GLOBE Data Entry system.
- Formulated conclusions and prepared the research findings for presentation at national academic forums.

THE GLOBE PROGRAM การป้อนข้อมูลทางวิทยาศาสตร์ Thai (ภาษาไทย) บันทึกฉบับ Sangmanee Mingsrisuk

Try GLOBE's new Data Entry system for Atmosphere, Hydrosphere, Biosphere and Pedosphere protocols!

Short tutorial (pdf). More information is available->

ที่คั่นหน้าของฉัน

Varee Chiangmai school

Varee Chiang Mai School Soil Soil Moisture Via Sensor Varee Chiang Mai School Soil Soil Temperature Varee Chiang Mai School Soil Soil pH

รายชื่อสมาชิกในกลุ่มและจุดศึกษาของฉัน

Varee Chiangmai school ORIG_ID: 51004095

San Pa Liang

ละติจูด 18.75, ลองจิจูด (แนว) 99.01, ความสูง 825 เมตร, SITE_ID: 408745

THE GLOBE PROGRAM การป้อนข้อมูลทางวิทยาศาสตร์ บันทึกฉบับ Sangmanee Mingsrisuk

หน้าหลักของการป้อนข้อมูล Varee Chiangmai school San Pa Liang Freshwater Macroinvertebrates

Freshwater Macroinvertebrates การแก้ไข

Measured on date

2025-12-01

เลือกประเภทของที่อยู่

แหล่งที่อุดมสมบูรณ์

หรือ

บริเวณน้ำไหลเชี่ยว น้ำไหล สตมภ์

พื้นดินโคลน สิม่กึ่งที่ พื้นตายเป็นโคลน ทรายหรือทราย

Season *

Dry

ขึ้นกรจ่าแบกที่รวบรวมสำหรั **น้ำไหล**

จำนวนตัวอย่าง *

3

Figure 7: Submitting collected data via the GLOBE Data Entry platform.

Step 8: Data Processing, Analysis, Conclusion, and National Level Dissemination



Figure 8: Disseminating research findings at a national-level conference/forum.

Chapter 4: Research Results

The research on the "Application of an Innovative Floating Buoy for Turbidity Measurement in Water Quality Assessment of the Phraya Kham Canal, Mueang District, Chiang Mai Province" yielded the following results:

4.1 Water Quality Data based on GLOBE Hydrosphere Criteria

The manual sampling and testing conducted over four weeks provided the following parameters:

Table 1: Water Quality Data (GLOBE Hydrosphere Criteria)

Parameter	Week 1	Week 2	Week 3	Week 4
Turbidity (cm)	27	27	27	27
Water Temperature (°C)	22.5	22.0	23.0	21.0
pH Level	7.6	7.5	7.8	7.8
Conductivity (µS/cm)	223	225	231	225
Dissolved Oxygen (mg/L)	4.5	4.5	4.5	5.5
Phosphate (mg/L)	0.25	0.25	0.25	0.25
Nitrite (mg/L)	0.02	0.02	0.02	0.02

4.2 Innovative Floating Buoy Measurement Data

4.2.1 Sensor Reading Calibration (Analog Reading) The KidBright board processes voltage signals from the turbidity sensor via the Analog port, categorized as follows:

- **Value ≤ 1000 :** Clear water.
- **Value 1000–1800:** Low to moderate turbidity.
- **Value 1800–2000:** Moderately high turbidity.
- **Value > 2000 :** High turbidity.

4.2.2 Buoy Tilt Monitoring The tilt sensor monitors the buoy's orientation to assess water current risks or physical obstructions.

Table 2: Tilt Level Interpretation

Tilt Angle	Meaning	Risk Level
5–15°	Normal swaying with the current.	Safe
15–25°	Stronger current or minor debris impact.	Caution
25–30°	Potential flash flood or buoy destabilization.	Warning
> 45°	Buoy capsized; sensor readings may be invalid.	Immediate Action

Chapter 5: Conclusion and Discussion

The research titled "The Application of Innovative Turbidity-Measuring Buoys for Water Quality Assessment in the Phaya Kham Canal, Mueang District, Chiang Mai Province" aims to investigate water quality in accordance with GLOBE Hydrosphere protocols, develop innovative turbidity-measuring buoys, and compare the turbidity values obtained from two distinct methods. Furthermore, the study explores the efficacy of tilt sensors in detecting potential flash flood risks. The findings of this research can be summarized as follows:

5.1 Conclusion of Water Quality (GLOBE Criteria)

Table 3: Combined Turbidity and Tilt Data from the Innovative Buoy

Week	Trial	Turbidity (NTU/Analog)	Tilt Angle (°)
Week 1	1	1112	5
	2	1114	5
	3	1112	5
Week 2	1	1234	10
	2	1230	10
	3	1231	10
Week 3	1	1134	10
	2	1134	10
	3	1132	10
Week 4	1	1045	5
	2	1050	5
	3	1052	5

Over the four-week period, the turbidity measured with a Turbidity Tube remained constant at **27 cm**, indicating moderate and stable water clarity. The water temperature fluctuated slightly between **21–23°C**, which is within an optimal range for aquatic life. The pH levels (**7.5–7.8**) indicated neutral to slightly alkaline conditions, consistent with healthy natural water sources. Electrical conductivity (**223–231 $\mu\text{S}/\text{cm}$**) and Dissolved Oxygen (**4.5–5.5 mg/L**) were both at fair to good levels. Stable levels of Phosphate (**0.25 mg/L**) and Nitrite (**0.02 mg/L**) suggest no significant increase in nutrient pollution during the study.

5.2 Conclusion of Innovative Floating Buoy Performance

The turbidity values recorded by the buoy (1000–1234) consistently reflected the "clear to slightly turbid" range, matching the trends observed in the manual GLOBE measurements.

- **Week 2:** Observed a slight increase in turbidity, which correlated with the highest recorded conductivity (231 $\mu\text{S}/\text{cm}$).
- **Week 4:** Observed a decrease in turbidity, which correlated with lower temperatures and increased Dissolved Oxygen (5.5 mg/L). These results confirm that the buoy can accurately track real-time changes in water conditions.

5.3 Buoy Stability and Tilt Detection

Experimental data showed that the buoy remained in the safe zone (5–10°) throughout the study. The tilt sensor successfully provided real-time

feedback on the buoy's orientation, proving its utility as a monitoring tool for abnormal water flow or flood risks.

5.4 Comparison of Measurement Methods

While the GLOBE method (cm) and the electronic sensor (analog/NTU) use different units and methodologies, their **trends were identical**. Both methods detected a peak in turbidity during the second week and a decrease in the fourth week. Thus, the innovative floating buoy is a reliable alternative for long-term, continuous monitoring.

5.5 Final Summary

The innovative floating buoy using the KidBright board is an effective tool for measuring turbidity and monitoring the water conditions of the Phraya Kham Canal. It provides stable readings, reflects actual water quality changes, and enhances community water surveillance. Furthermore, this project serves as a practical foundation for students to develop more advanced environmental innovations in the future.

References

American Public Health Association. (2017). *Standard methods for the examination of water and wastewater* (23rd ed.). Washington, DC: APHA.

Chapman, D. (Ed.). (1996). *Water quality assessments: A guide to the use of biota, sediments and water in environmental monitoring* (2nd ed.). London: UNESCO/WHO/UNEP.

Chu-sri, S., et al. (2018). Water quality monitoring in community water sources. *Journal of Environmental Education*, 19(1), 1–12. (in Thai)

Department of Pollution Control. (2021). *Surface water quality standards of Thailand*. Bangkok: Ministry of Natural Resources and Environment. (in Thai)

Department of Water Resources. (2020). *Water resources management and water quality monitoring*. Bangkok: Ministry of Natural Resources and Environment. (in Thai)

Kumar, P., Singh, R., & Kumar, A. (2019). Development of low-cost water quality monitoring system using sensors and IoT. *International Journal of Engineering and Advanced Technology*, 8(5), 182–187.

Manojlovic, D., & Radenkovic, M. (2016). Floating sensor platforms for monitoring water quality parameters. *Environmental Monitoring and Assessment*, 188(3), 1–12.

Pongpattana, N. (2019). A study of surface water quality using turbidity as an indicator. *Journal of Environmental Science*, 23(2), 45–56. (in Thai)

United States Environmental Protection Agency. (2019). *Water quality standards handbook*. Washington, DC: U.S. EPA.