Wastewater management skills of municipal human resources in Songkhla Lake Basin, Thailand

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Abstract

In recent years, Songkhla Lake has been increasingly polluted by urban and industrial wastewater draining into the lake through various canals. This study aims to investigate the limitations of wastewater management skills of municipal human resources operating in Songkhla Lake Basin and to explore how to build them up. The survey study was conducted by using a questionnaire and focus group meeting with 21 municipalities located in Songkhla Lake Basin. It was found that most of the representatives (93%) from municipalities working on water pollution in the Basin were faced with domestic wastewater problems. It was also found that 77% and 71% of them had limited knowledge and skills of domestic wastewater management systems and wastewater treatment system designs, respectively. The results also illustrated that 86% and 79% of them wished to learn more about the specific competency of wastewater treatment system management and how to access the data source of wastewater control and its design criteria, respectively. This information will help the concerned academic organizations in Songkhla Lake Basin to further strengthen the knowledge, skills and competency of the municipal human resources who work on water pollution, and guide them in the right direction.

Keywords: Songkhla Lake, wastewater management, municipality, human resources, water pollution, competency

บทคัดย่อ

ในช่วงที่ผ่านมา ทะเลสาบสงขลาได้ประสบปัญหามลพิษน้ำมากขึ้น อันเนื่องมาจากน้ำเสียที่ระบายจากแหล่งชุมชนและอุตสาหกรรม รอบทะเลสาบ รายงานวิจัยนี้ มีวัตถุประสงค์เพื่อสำรวจถึงข้อจำกัดของทักษะด้านการจัดการน้ำเสียของบุคลากรของเทศบาลในลุ่มน้ำทะเลสาบสงขลา เพื่อหาแนวทางในการเสริมสร้างทักษะที่เหมาะสมและตรงกับข้อจำกัดต่อไป ได้ดำเนินการ การศึกษาโดยการใช้แบบสอบถามและการประชุมกลุ่มแบบเจาะจงของ 21 เทศบาลที่ตั้งอยู่ในลุ่มน้ำทะเลสาบ ผลการศึกษาพบว่า ตัวแทนของบุคลากรจากเทศบาลเกือบทั้งหมดที่ศึกษา (ร้อยละ 93) ซึ่งทำงานด้านมลพิษน้ำในลุ่มน้ำทะเลสาบสงขลาระบุว่า กำลังประสบปัญหาด้านมลพิษน้ำจากชุมชน โดย ร้อยละ 77 และ ร้อยละ 71 ของกลุ่มเทศบาลที่ศึกษามีข้อจำกัดด้านความรู้และทักษะในระบบการจัดการน้ำเสียชุมชน และการออกแบบระบบบำบัดน้ำเสียชุมชนตามลำดับ นอกจากนี้ผลการศึกษา พบว่าร้อยละ 86 และ ร้อยละ 79 ของเทศบาลที่ศึกษามีความต้องการที่จะเรียนรู้และพัฒนาตนให้มากขึ้นในด้านสมรรถนะด้านการจัดการระบบบำบัดน้ำเสียและวิธีการเข้าถึงแหล่งข้อมูลของการควบคุมน้ำเสียและเกณฑ์การออกแบบระบบบำบัดน้ำเสียตามลำดับ ผลการศึกษาที่ได้จะช่วยให้หน่วยงานทางวิชาการในลุ่มน้ำทะเลสาบสงขลา สามารถช่วยเสริมสร้างความเข้มแข็งของความรู้ ทักษะ และสมรรถนะของทรัพยากรบุคคลของเทศบาลในลุ่มน้ำทะเลสาบสงขลาที่ต้องรับผิดชอบภารกิจด้านมลพิษน้ำได้ถูกทิศทางตามความต้องการ

คำสำคัญ: ทะเลสาบสงขลา, การจัดการน้ำเสีย, เทศบาล, ทรัพยากรมนุษย์, มลพิษน้ำ, สมรรถนะ

1. Introduction

Songkhla Lake is the largest natural coastal lagoon lake in Thailand, located on the Malay Peninsula in the Southern part of the country. Songkhla Lake Basin, with a catchment area of about 8,765 km^2 consists largely of agricultural land. Rubber, oil palm and paddy are the main crops in the area. It is also becoming rapidly industrialized and urbanized. There are 29 municipalities in Songkhla Lake Basin, classified

by size to be 2 city municipalities, 4 municipalities and 23 district municipalities. The present trend of population growth and industrial development in Songkhla Lake Basin may create greater problems in terms of water quantity and quality. In general, the main sources of water pollution in Songkhla Lake could be summarized as follows: 1) untreated and or improperly treated domestic and municipal wastewater from municipalities, 2) untreated and or improperly treated industrial wastewater, and 3) wastewater from animal farms, and runoff from agricultural areas, into the lake. The most critical problem at present is due to domestic and industrial wastewater. Domestic wastewater was found to be the main polluting material of the total wastewater disposed into the lake. Pollutants entering the water bodies are mainly degradable organic matter causing localized problems. The critical areas include large cities/municipalities located along the major rivers and near Songkhla Lake (Danteravanich, Proukaew, & Puetpaiboon, 2003; Chevakidagarn, 2006; Environmental Office Region 16, 2007).

At present, there are many governmental agencies in Songkhla Lake Basin dealing with water resources planning, development, administration and management, but regarding domestic wastewater pollution problems, the local authorities are the main agencies who have to respond, in particular to the areas of control and prevention. Environmental Office Region 16 (2012) reported that there are 2 central domestic wastewater treatment plants and 3 small community wastewater treatment plants in 5 municipalities in Songkhla Lake Basin, whereas the other 24 municipalities are under planning for wastewater treatment plant design and construction. Municipal wastewater treatment plants and related facilities have evolved along with other components of the urban environment to meet the need to protect water sources. Municipal wastewater treatment plants provide an important buffer between the natural environment and wastewater from urban areas (Water Environment Federation, WEF, 1996, p 6). In fact, the implementation and management of municipal wastewater treatment plants consist of several steps, such as policy setting, planning, design, construction, operation and monitoring, etc. In addition, each process must be dealt with effectively, in consultation with a variety of people, including municipal policy makers, regulators, design engineers, suppliers, plant employees, public interest groups, and other concerned citizens. Therefore, effective municipal wastewater management is as the art of making good things happen through people. However, the successful key of this management is personnel development and subsequent deployment.

Not much information on human resources with wastewater management skills, particularly in municipalities in Thailand including Songkhla Lake Basin, is available. There have been some reports on the subject, but they have focused only on the operators of municipal wastewater management plants. For example, by 2004 it was reported that Thailand had constructed 68 municipal wastewater treatment plants, but 80% of them did not function well. One of the main problems causing this unsatisfactory result was a lack of skilled operators. Although there were a few local technicians operating the plants, they could not solve scientific and engineering problems adequately (Pollution Control Department, 2004). It is evident that the information on wastewater management skills of the municipal human resources is limited. To upgrade the water environment in Songkhla Lake Basin, one of initiatives has focused on boosting the local authority agencies' ability to respond to water pollution problems. Although many trainings and workshops to strengthen them have been conducted over the years, but no needs analysis was undertaken thereafter on wastewater management skills/knowledge of municipal human resources. If skills needs and limitations of the municipal human resources could be determined, then developing skills necessary to fill future needs could be better focused on and would further contribute to improved work on wastewater management in the Basin. Therefore, this study aimed to investigate and analyze the limitations of knowledge and skills of municipal human resources on wastewater management in Songkhla Lake Basin and to explore how to overcome them.

2. Methodology

This study focused on the municipalities in Songkhla Lake Basin. The investigation was conducted in January 2012 by utilizating focus group meeting and questionnaires to collect data from the municipalities. Moreover, the secondary data, especially the background of wastewater in the Basin obtained from various research reports were reviewed.

It was planned that the 29 municipalities in Songkhla Lake Basin would be involved in this investigation. However, after the authors officially invited and requested representative personnel from each municipality, whose responsibility was working on water pollution management in the municipal area, to have a focus group meeting and answer the questionnaire, only 21 municipality representatives accepted and participated in this study. Therefore, the target sample used to collect data for this study was 21 municipality representatives who also participated in the focus group meeting (72.4% of the municipalities).

The process of data collection was carried out one time within 3 days. It started with the focus group meeting. During the meeting, discussions and interviews to share and learn from each other regarding experiences about water pollution and water quality management in Songkhla Lake Basin were carried out, and limitations about the programmes/projects on municipal wastewater management reaching actual implementation were consulted on. These sessions were an introduction to water pollution and water quality management, providing the participants with the necessary contents to deal with the implementation process when municipal wastewater treatment plants project is planning to construct. The "need to know" principle was followed in determining the contents for discussion and interviews; the main objectives of the discussion were to evaluate the abilities and skills of the target personnel on wastewater management. Observation by the researchers during meetings was conducted. The final evaluation was an integral part of the meeting with questionnaires furnished to all participants involved in the focus group meeting. The data collection process was designed to gather real information that investigated municipal human resources, and could indicate to the researchers whether they had experience and were involved in water pollution and water quality management in the area, and what issues would need greater emphasis on such skills/knowledge developmement as well as its limitations.

The questionnaires were developed by the researchers and used for the purpose of qualitative data collection to collect basic information of the demographic characteristics of the respondents, including gender, age, education level, work experiences on wastewater treatment, as well as work description on wastewater management. The information dealing with the knowledge, ability and skills of the respondents on wastewater management and its limitation were also collected together with what the requirements were for educating personnel in knowledge and skills of water pollution management. In addition, recommendations with open-ended answers were also asked for.

The 21 questionnaires were directly given to the target group and 21 (100 %) responded. Before the questionnaires were analyzed, data editing was undertaken. Data were cross-checked with the background of the participants obtained during discussions/interviews when the meeting was carried out. The data were analyzed using the following descriptive statistics: percentage and frequency. Concurrent with all information obtained from the focus group meeting and questionnaires were analyzed and used for results report. Resulting from a series of such data collection, it was mutually agreed by the researchers to further give informative recommendations for a joint effort of key elements for the success of skill development for the municipal human resources in Songkhla Lake Basin.

3. Results and discussion
3.1 The background of wastewater in Songkhla Lake Basin

Songkhla Lake Basin is located at 6° 27′ N to 8° N latitude and 99° 44′ E to 100° 41′ E longitude (Suwanidcharoen & Liengcharernsit, 2012). The Basin lies within the 3 provinces of Nakhon Si Thammarat, Phattalung, and Songkhla. It covers approximately 8,765 km^2 consisting of approximately 1,080 km^2 of lake area. It is noted that Songkhla Lake Basin is a very special watershed due to the inclusion of 4 ecosystems: Thale Noi, Upper Songkhla Lake (Thale Luang), Middle Songkhla Lake (Thale Sap), and Lower Songkhla Lake (Thale Sap Songkhla). It is characterized by two narrow mountain ranges to the West and the South. It is a shallow lake. The average depth across the Lake is approximately 2 meters (Danteravanich, Proukaew, & Puetpaiboon, 2003; Department of Fisheries, Ministry of Agriculture and Cooperatives, 2010).

The Lake is a necessity for the livelihood of the Southern people. More than a million people rely on it. The Lake, once famous for its fertile, complex and unique ecosystem, is

becoming a huge basin for wastewater discharged into it. At present, Songhkla Lake is being slowly killed by water pollution. Degradation of the Lake is like a chronic disease, which past governments have failed to remedy. In Songkhla Lake Basin, the estimation of domestic wastewater volume and waste load measured in terms of biological oxygen demand (BOD) from 29 municipalities has been assumed to be 105,000 m³/day and 17,500 kg BOD/day, respectively. The central wastewater treatment plants belonging to municipalities in Songkhla Lake Basin were observed to be only 5 plants located in Hat Yai city municipality, Songkhla city municipality, Phatthalung and Sadao municipalities and Pakpayun district municipality. The details of these domestic wastewater treatment plants are shown in Table 1. On the other hand, on-site domestic wastewater treatment

systems in the municipal areas of Songkhla Lake Basin are mainly septic tanks and cesspools. These systems could treat only excreta wastewater, but not other domestic wastewater. This implies that the major reason for water pollution problems in the Lake was insufficient wastewater treatment facilities. In addition, available data on industrial wastewater volume generated into Songkhla Lake Basin was reported to be 71,000 m³/day with a BOD load of 3,000-4,000 kg/day. These wastewaters were discharged from 60 factories. Most of them were food processing factories and rubber factories, thus contributing to the discharge of organic loads into the Lake (Environmental Office Region 16, 2007; Environmental Office Region 16, 2012; Ratanachai & Sutthivipakorn, 2005).

Table 1 Central and small community wastewater treatment in Songkhla Lake Basin

Provinces	Municipality	Year of project start	Service area (km²)	Capacity of received wastewater (m³)	Current received wastewater flow (m³/day)	Type of wastewater treatment plant
Songkhla	Songkhla City Municipality	2002	6.7	25,000	4,700	Aerated lagoon and pond system
	Hat Yai City Municipality	2002	21	138,000	40,000	Stabilization pond system
	Sadao Municipality*	2006	2.1	50	50	Contact aerated filter system
Phattalung	Muang Phattalung Municipality*	2006	5.6	80	80	Contact aerated filter system
	Pakpayun District Municipality*	2006	ND	50	50	Integrated pond system

Source: Environmental Office Region 16 (2012); Environmental Office Region 16 (2007)
    ND : data not available, * : small community wastewater treatment plants

Although governments have tried to resuscitate the Lake, however, wastewater treatment projects have not been able to achieve their objectives. Chevakidagarn (2006) pointed out that municipal wastewater treatment plants in Songkhla Lake Basin usually had a low operating performance. The main reasons for plant failure were 1) inadequate influent loading fed to treatment plants, 2) an inadequate budget for operation and maintenance, and 3) low manpower capacity building. Wastewater treatment plants in the industrial sector also lacked control systems. Each municipality with a wastewater treatment plant and industrial plant needed to prepare the

plans for controlling their wastewater treatment operational problems. However, the Need to Know principle on wastewater management should be a joint development for municipal human resources in Songkhla Lake Basin. This will provide them with the necessary background knowledge to go on to further, more specific job-oriented work in wastewater management locally. It should also develop the ability to recognize and understand the basic functions and processes in the development of wastewater treatment and management projects, including planning, designing, constructing as well as operating in an effective and proper way.

3.2 Demographic characteristics of respondents

This investigation was obtained from 21 municipalities out of 29 in Songkhla Lake Basin. This investigated target sample is equal to 72.4% of the total municipalities in the study area. The demographic characteristics of respondents obtained from 21 municipalities located in Songkhla Lake Basin were analyzed individually into frequency and percentage. They were gender, age, education level, work experience on wastewater treatment, as well as work description on wastewater management. The demographic characteristics of respondents can be described as follows. The majority of respondents, 81% were male and 19% were female. Most of them were aged over 40 (57%). Other age groups were 25-30 years old, 31-35 years old, and 36-40 years old which were 14 %, 19 %, and 9 %, respectively. It was found that 48% of them had a Master's degree, the highest level of education, whereas 43% had Bachelor's degrees. Most respondents had jobs relating to wastewater management. The majority, 57% worked on wastewater project planning. The rest, 44%, 25% and 19%, worked on wastewater treatment control, advising on wastewater treatment system designs, and approving wastewater treatment documents, respectively. These results illustrated that the target group investigated were incorporated working on water pollution and water quality management in Songkhla Lake Basin, and the following results obtained from them will really reflect on the determination of wastewater management skill needs and their limitations with regards to personel in the area.

3.3 Wastewater management, skills, needs and its limitation

Most investigated municipalities, namely 81% of them, informed that they had onsite wastewater treatment systems. All of them used septic tanks and cesspools. Twenty-nine per cent of them mentioned that they used an anaerobic system, and only 14% had a central wastewater treatment system. This is quite consistent with the secondary data obtained. As mentioned in Table 1, municipal wastewater treatment plants have been used in 5 municipalities in Songkhla Lake Basin, as approved by the central government. Two treatment plants were planned on a large scale as central wastewater treatment plants for a whole city, whereas the other three were pilot treatment plants used only for small community wastewater treatment in municipalities. In 5 municipalities, the physical units for pretreatment and biological units for the main wastewater treatment process were combined as wastewater treatment systems. The biological wastewater treatment technology used in 5 municipalities is presented in Table 1. For stabilization ponds or pond systems used in the municipalities, the treatment system included either the anaerobic, facultative and/or aerobic ponds/units.

It was observed that 90% of the municipalities discharged treated wastewater into the watercourses nearby. Looking at the pressing issues on working in wastewater management, the municipalities noted that 43% of them lack land for wastewater treatment plant construction. Another group, consisting of 33%, said that the pressure on them was from lack of professional operators and a lack of budget for wastewater treatment construction. Meanwhile 29% and 14% of them pointed out that there was a lack of information on the effective management of wastewater and no academic consultants for wastewater treatment, respectively.

Figure 1 presents the problem of the municipal human resources who work with municipal wastewater treatment. It was found that 93% of them mentioned having problems. All of them said that they had problems of inadequate man-power. It was observed that 77% and 69% were faced with the problem of managing wastewater treatment systems and of choosing the appropriate treatment technology, respectively. Seventy-seven per cent and 71% of them had limited knowledge and skills about domestic wastewater management systems and wastewater treatment system designs, respectively. Figure 2 illustrates several problems on the design of domestic wastewater treatment that the municipalities have been facing. It was noted that 70% of them were faced with the problem of inadequate knowledge in design criteria and also not achieving treatment functions after using the recommended design criteria. The results also illustrated that 86% and 79% of them wished to learn more on the specific competency of wastewater treatment system management and how to access the data sources of wastewater control and their design criteria (Table 2). In addition, all

of them needed to learn more on the principal of wastewater treatment technology.

In consonance with the size of municipalities, the skills and knowledge of environmental personnel working on wastewater management systems there should be awareness regarding matching the properly qualified persons to the right jobs. Needless to say, priority requirements on more skilled personnel would have to be given to the large municipalities, such as Hat Yai city and Songkhla city due to the greater complexity of working on wastewater management system implementation than in smaller sized municipalities. For example, the large municipalities, such as Hat Yai and Songkhla have to plan for and operate large size municipal wastewater treatment plants. These implementations need to meet capital-intensive and high technical approach utilization and investments. If using more skilled and experienced personnel then more success on wastewater management will be achieved.
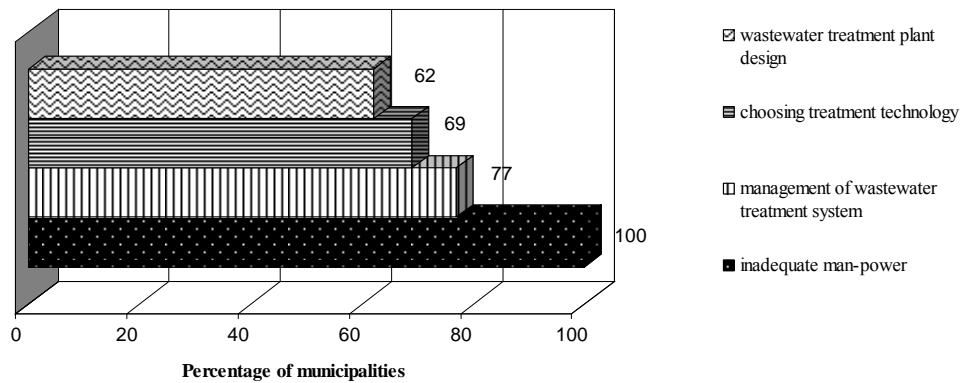

Figure 1 Types of problem relating to domestic wastewater treatment systems that municipalities are faced with.
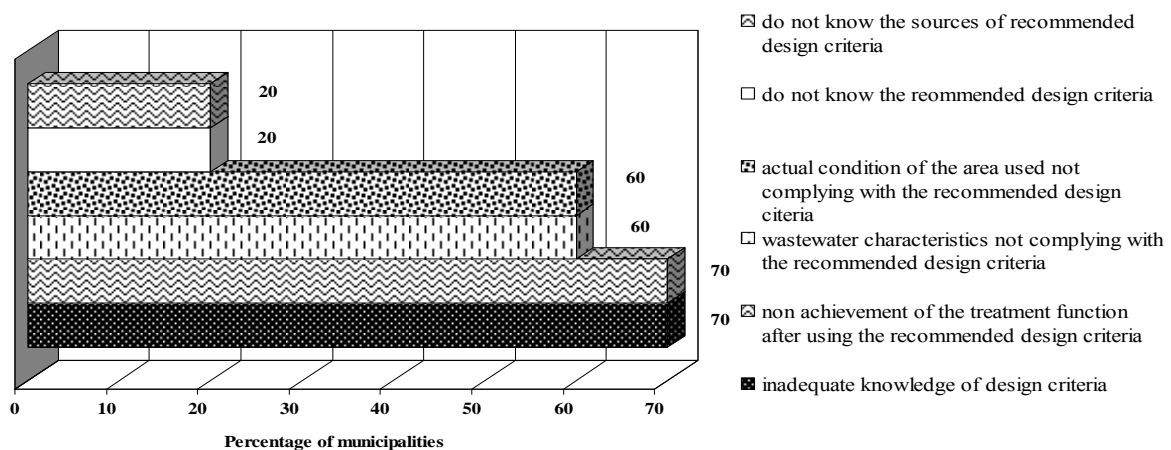

Figure 2 Several problems on domestic wastewater treatment design that the municipalities have been facing**.**

Table 2 Specific knowledge or skills on wastewater that municipality personnel needed to learn more about

Items	% of respondents
Principles of wastewater treatment technology	100
Management of wastewater treatment systems	86
Ways to reach the sources of information on design and control of wastewater treatment	79
Control of wastewater treatment systems	64
How to read and understand the wastewater treatment design map	57
Improvement of wastewater treatment system	57
Ways to select suitable design criteria of wastewater treatment plants	57
Assessment of wastewater generation rate	50
Wastewater characteristics	43
Parameters used for designing wastewater treatment	43

In 1993, there was a study to predict the personnel requirements for water quality management in Thailand. It was reported that four levels of environmental personnel were required for the country's water quality management namely, engineers, scientists, senior technicians and junior technicians. The study reflected that junior technicians were highly in demand, but senior technicians were the least sought after. However, scientists and engineers played major roles (Panswad & Polprasert, 1993). Taken in perspective from our viewpoint, the human resources should immediately and properly be developed to solve the wastewater management problems in the municipal areas of Songkhla Lake Basin. However, it is not only the quantities that should be considered, but also their quality. It must also be stated that municipal human resources development is a critical tool for achieving sustainable wastewater management in the municipal areas, and the more skilled personnel, i.e. technicians, professionals, and related categories need to meet the requirements of wastewater management works that have been increased in the near future. Therefore, municipal human resources capacity in the field of wastewater management in Songkhla Lake Basin must be strengthened. Towards this, the results obtained from this study in particular, show that municipalities should be concerned with further strengthening, the specific knowledge or skills on wastewater management that they required (Table 2).

4. Recommendation and conclusions

According to the discussion obtained from the group meeting, it can be concluded that Local Authorities, in particular municipalities in Songkhla Lake Basin had both authority and responsibility to look after their water environment, but they were expected to be more active. Active participations should be applied in the areas which have serious water and environmental problems. Water pollution prevention in Songkhla Lake Basin is best viewed as a continuing process, but success will depend on stakeholders' willingness to support each other in the work. Strong stakeholder involvement can lead to a strong sense of ownership towards Songkhla Lake Basin.

The problem of wastewater and water pollution is increasing, especially in rapidly expanding urban areas. One of the pressing issues is the capacity for water pollution control and water quality management by the local authorities. The municipalities' administration have recognized the need to address the water environment management issues to avoid further negative impacts on the area. In line with this, capacity building of manpower working on wastewater management should continue to be planned and implemented. The municipal pesonnel are knowledgeable and information-rich due to direct contact with the problems and have been trained in several water pollution and water quality management trainning programs organized by the academic support agency, in particular the Environmental Office Region 16. They must be responsible to deal with the weak point of ineffective wastewater management for their area, and should be ready to update and adjust their competency when required. Their knowledge seems to be sufficient for routine working purposes, but more specific competency is needed for fine-tuning. It depends on the facility size and organizational structure, however, and clear vision and practical objectives are needed by involved individuals or groups who are responsible for

actual program development and deployment for water pollution and water quality management.

Although there have been several training programs on water pollution and water quality management for the municipal human resources in Songkhla Lake Basin in the past, the demand is still increasing. Not all trained persons have always worked and will continue to do so in Songkhla Lake Basin. Some of them, after training, have moved to work outside the area due to the governmental policy of human resources rotation. Therefore, continued education is necessary. Besides this, independent academic organizations, such as universities in the area, are trusted and respected by the public and the municipalities, and aim to be involved in the training of municipal human resources working on water pollution in Songkhla Lake Basin. It is also recommended a roadmap be adopted on increasing competency for effective water pollution control and water quality management.

5. Acknowledgements

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