



## Canal Water Level as a Canal Water Management System: Case Study of Klong Rangsit, Phatumthani, Thailand

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**Abstract** This research paper deals with the management of the canal water level (CWL) of *Klong Rangsit Canal* (KRC) as a canal water management system (CWMS) by relevant local government units and the CWL impacts on the livelihood of local residents. The relevant local agencies responsible for the CWMS in the area under study are the Royal Irrigation Department (RID) Area 11, the *Bungyeetho* municipality (BYM) and the *Phachatiphat Sub-District* municipality (PSM). The officials and personnel tasked with the CWMS responsibility were interviewed. In addition, the collection of field data was carried out. The findings indicate that attempts have been made by both municipalities to improve the living conditions and livelihood of the local residents. However, the local administrations lack the proper knowledge and skills to operate the floodgates. The municipalities operate the floodgates according to the demands of local residents. It is thus possible to draw a conclusion that most local-level state agencies give their own remit the first priority while the overall efficiency or cooperative efforts with other stakeholders are given a second priority.

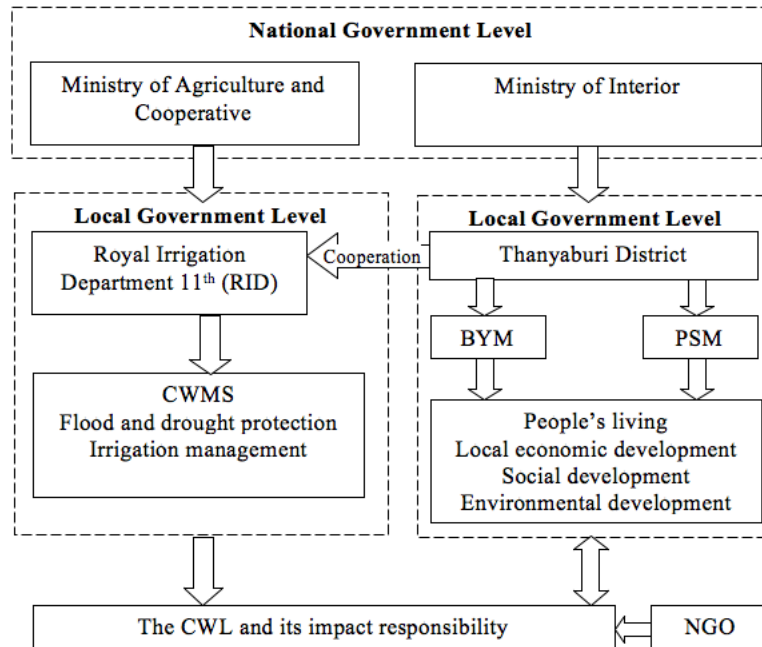
**Keywords** canal water, management, government, responses

### INTRODUCTION

Many CWL problems arise from ineffective management or a lack of participation and cooperation among stakeholder groups in the CWMS (Hearne and Torpen, 2010). Some canals are long, complex and connected to main rivers, the characteristics which influence the water flow in the canals. In addition, misuse and overuse of canal water resources occurs, especially when there is a water shortage. Construction projects and canal gates slow canal water flow. In addition, floods could be influenced by rising sea levels, land subsidence and variation in the levels of rainfall (Chyan-Deng et al., 2007). Variation in canals and soil loss during land clearing affects low-lying areas and those with poor drainage (Casadio et al., 2010). The relevant government agencies in Thailand that are responsible for management of natural resources, including the CWMS, have been classified into two levels: the National Government (NG) and the Local Government (LG) levels, as shown in Figure 1.

At the NG level, this research paper is concerned with two key state agencies, i.e. the Ministry of Agriculture and Agricultural Cooperatives of Thailand and the Ministry of Interior of Thailand. The agriculture ministry is tasked with the duties and powers with respect to agriculture, water sourcing and irrigation development, agriculturist promotion and development, cooperative system promotion and development. In addition, under the Ministry of Agriculture and Agricultural Cooperatives, the Royal Irrigation Department (RID) of Thailand is a national-level state body mainly responsible for the irrigation management in Thailand (Ministry of Agriculture and Agricultural Cooperatives, 2011). On the other hand, the interior ministry is responsible for the livelihood of citizens and the social, economic and environmental developments through district and *tambon* (sub-district) administrations. At the level of LG, the focus is on the Royal Irrigation Department's Area 11, which is a local government agency directly responsible for Klong Rangsit Canal (KRC), the canal under study. The RID's Area 11 is tasked with surveillance of water levels in KRC and prevention of flooding to the agricultural lands and communities near and along the

canal. The LG-level units are structured to enable a close collaboration with local residents to build a correct understanding of the area characteristics and thereby allow for timely response. This is the goal impossible to achieve with the NG-level state agencies. KRC is located in Thanyaburi district of Phatumthani province north of Bangkok. The district covers the municipalities of BYM and PSM, both of which are responsible for the areas along Klong (canals) 1-5.



**Fig. 1 The NG-level and LG-level state agencies**

**OBJECTIVE**

The objective of this research is to study the CWMS of the relevant local government units and the environmental impacts and effects on local residents of the CWMS implementation.

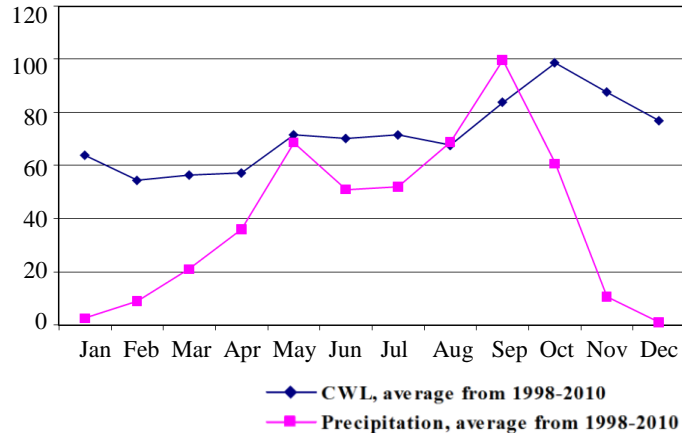
**RESEARCH METHODOLOGY**

This research work relies on two sources of data: the primary and secondary sources. The primary data sources include interviews with the local residents along the canal and with relevant authorities as well as questionnaires. The secondary sources are reviews of books and journals, official records of the relevant government agencies, and from other stakeholders. The government agencies from which the official records were obtained are Bungyeetho Municipality (BYM), Phachatiphat Sub-District Municipality (PSM) and the Royal Irrigation Department (RID) Area 11. The officials and personnel responsible for the CWMS of the area under study were interviewed. In addition, field data were gathered from interviews with local residents and observations. The interview sessions enable a correct understanding of the present conditions, the CWMS implementation and its impacts on the livelihood of the local residents.

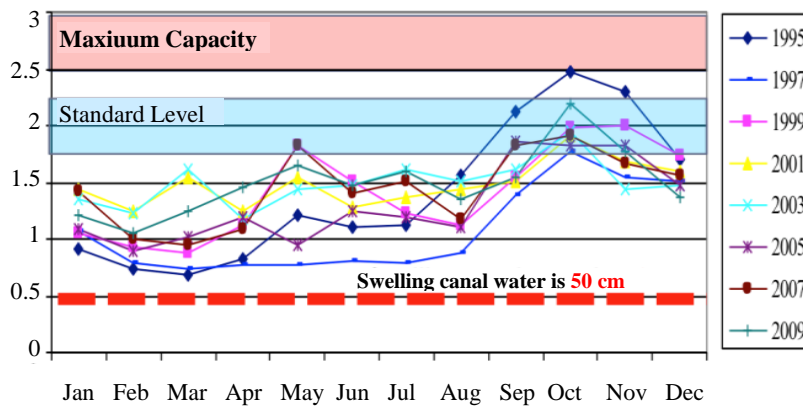
**RESULTS AND DISCUSSION**

The data from the RID Area 11 shows the impacts of changing precipitation on the CWL. Figure 2 depicts the relationship between the CWL in KRC and the average monthly rainfall from four irrigation stations located in the lower North region from 1998 through 2010. A maximum average rainfall was observed in September, one month before the CWL in KRC reached its annual peak in

October. This is because following heavy precipitation water from the North region slowly flows south and thus increases the CWL in Bangkok and its nearby areas. December had the lowest precipitation level and subsequently a lower CWL in the following months.



**Fig. 2 Precipitation and CWL from 1998 to 2010 by percent of peak value**

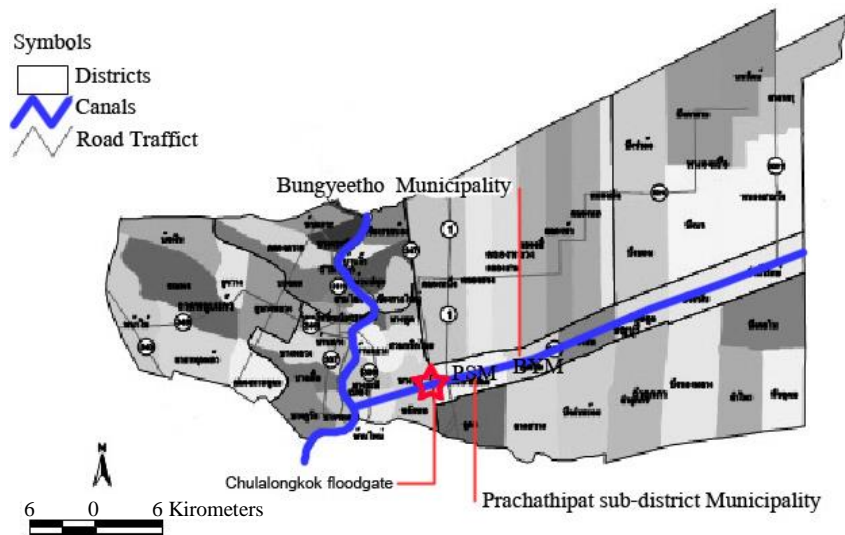


**Fig. 3 Levels of canal water of 1995-2009**

As seen in Fig. 3, the CWL could drop below 1.50 meters for up to 8 months of a year during the period of 1995 to 2009. Ideally, the CWL should be in the range of 2.00-2.50 meters. Especially from April to July, the canal water quality failed to meet the Biological Oxygen Demand (BOD) standard and the CWL was the lowest during the period (Doungdearn, J. et al, 2002). In addition, it is possible to conclude that the levels of canal water downstream are directly influenced by the variability of precipitation in the North region of Thailand. The CWL in KRC was relatively stable at approximately 0.5-0.9 m. Annual variable precipitation results in changes in the CWL (Thai Meteorological Department, 2010). This fact is confirmed by Fig. 3, which illustrates the differences in the CWLs from 1995 to 2009. From 1995 to 1998, there were greater differences between the highest and lowest CWLs, compared to from 2003 to 2009. The same figure also shows that the CWL was below 1.50 meters for up to 8 months of a year during the dry season. An ideal CWL should be in the range of 2.00 to 2.50 meters. In addition, the canal water quality failed to meet the BOD standard and the CWL was at its lowest during the period of April through July. A low and stable CWL of 0.5-0.9 meter was observed for most of the year. As indicated in Fig. 3, the RID maintains a minimum CWL at no less than 0.50 meter or 50 cm in order to control the pollution level and maintain the water aeration in KRC. A lower CWL could affect the water aeration in the canal since water inflow is insufficient to replenish oxygen in the water. Furthermore, the lower CWL makes it impossible to flush waste water in KRC into the main river.

## CWMS Evaluation

The KRC canal flows and discharges into the Chao Phraya River. The water level of KRC is subject to the water levels of the Chao Phraya River and the water from the northern region. In a high CWL in KRC, the Chulalongkorn main floodgate would be opened to discharge the canal water into the Chao Phraya River to prevent flooding. In the dry season in March and April, when the CWL is low, the main floodgate would be opened to drain the water from the river into the KRC canal. However, in case that the water level in the Chao Phraya River is lower than that in KRC in any dry season, the river water would be pumped into KRC to maintain the canal water quality and appropriate CWL. The minimum and maximum of CWL of KRC are 50 cm and 2.50-3.00 meters, respectively. According to the RID Area 11, there are many floodgates along KRC to regulate the CWL. When a demand for water arises, the RID 11<sup>th</sup> would be notified either by local residents or by the BYM or PSM local administration to operate the floodgates. To efficiently manage the CWL of KRC, the local RID launched the Operation and Maintenance South Rangsit Irrigation Canal Project. The aims of the project are flood prevention and better water management for agriculture. In addition, during the rainy season, the local RID closely monitors the CWL situation of KRC and updates other relevant agencies for a timely decision and effective operation of the floodgates.



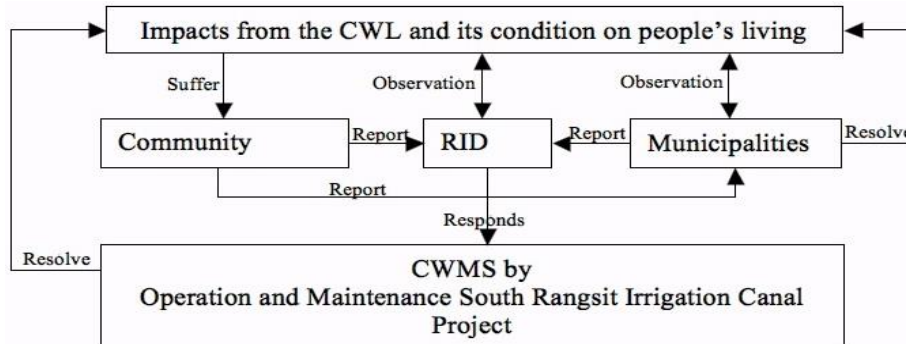
**Fig. 4 Location of the Chulalongkorn main floodgate**

## Government Responses

According to an interview with Mr. Nithaklon Yentakoun, head of the Canal Water Management Division of KRC, the canal water flows both upstream and downstream depending on the water level of two rivers on either side of KRC in different seasons. The rivers are the Chao Phraya River and the Bang Phrakok River. The BYM municipality is responsible for the canal cleanliness and quality and the provision of assistance to the local residents affected by floods. In addition, the municipality collaborates with local leaders and community members to improve the condition and sustainability of the canal, e.g. the clean canal campaigns, landscape improvement projects and the programs to address environmental impacts from the industrial development in or around the area.

Figure 5 illustrates the cooperation between the relevant local government agencies and local residents to address the problems and impacts arising from the CWL. When a CWL problem arises, the RID Area 11 and the relevant municipalities would be alerted. The local RID would operate the canal water floodgates according to the requirements, while the municipalities provide the local residents with food, sanitation and basic accommodations. Occasionally, community leaders alert the local RID to operate the floodgates or request assistance from a community closer to the local

RID to alert the local state body to operate the floodgates. According to Thawee Wong Sriburi, a vice president of the Thailand Environment Institute (TEI) (2003), Thailand has at least 30 state agencies under eight different ministries, other than two independent committees, responsible for or tasked with canal water-related projects or duties. This unnecessarily complicates the efficient and successful national-level implementation of the CWMS policies and practices in the country. In addition, the inputs from local residents are usually excluded from the formulation of the national-level CWMS policies and practices. This leads to ineffective implementation of the CWMS policies in the local level. The issues must be addressed urgently by which the local inputs are included and more cooperation of various relevant agencies is encouraged in the policy setting.



**Fig. 5 Schematic of the operation and maintenance South Rangsit Irrigation Canal Project**

### Implementation of CWMS

**(A) Alleviation measures in case of floods and droughts:** According to an interview with the mayor of BYM, the municipality would take necessary measures to alleviate the suffering of the residents affected by floods or droughts. For instance, local residents whose houses are flooded would be provided with safe temporary shelters and evacuated if required. In addition, they would be provided with foods and medicines. However, some flood victims fail to receive the aids as their residences were illegally built on the state land and thereby are not shown in the local demographic census.

**(B) Preventive measures to wastewater:** The illegal settlers were found to fail to care for the environment and thus dump household wastewater into KRC (Sajor, E.E. and Ongsakul, R., 2007). In addition, our survey found that household wastewater from these illegal settlements is untreated since the area is outside the municipalities' jurisdiction. Nevertheless, the educational campaigns have failed to instill in these settlers a sense of responsibility and cooperation. Thus, both municipalities of BYM and PSM have taken other necessary steps to improve the condition of the canal and its CWL with such a project as the canal cleaning and dredging project which is held once or twice annually. The project is supported by non-governmental organizations (NGOs) and local schools that send volunteers to help with the project.

**(C) Assessment and treatment of canal water:** When the CWL of KRC is low, the PSM municipality would replenish the oxygen level in the canal water, especially in the area where many restaurants and floating markets are located, i.e. Klong (canals) 1 and 2. The oxygen replenishing machines are scheduled to run every day during 2.30 p.m. - 5 p.m. Although the municipality has four machines under its care, only one is functional.

**(D) Recovery of environmental degradation:** Both BYM and PSM municipalities constructed a canal embankment along one side of the KRC canal and converted the other side into a small avenue for walking and bicycles. In addition, improvements have been made to the landscape along the canal. The developments are intended to prevent new illegal settlement along the canal and to evict the illegal settlers in a most ingenious and diplomatic manner.

## **Ineffective CWMS of Relevant Local Government Units**

The study results reveal a lack of cooperation between the local government units in charge of KRC in tackling the CWL and pollution problems in an efficient and sustainable fashion. An interview with the mayor of BYM indicated that three main agencies are tasked with the CWMS responsibility of KRC, i.e. the engineering division of the municipality, the environment division of BYM and the RID 11<sup>th</sup>. For example, construction of a bridge is the responsibility of the municipality's engineering division or the local RID or other local state units since the activity affects land use and the canal characteristics. In addition, an interview with Mr. Nithaklon Yentakoun, an official stationed at the RID Area 11, revealed that no standard operating procedure of the floodgates exists. Another interview with community leaders of the Klong Rangsit 3 market showed that the local residents require the canal water for both agriculture and drainage to flush water contaminants. The municipality sometimes involuntarily operated the floodgates to flush waste water following the local community leaders' requests.

The local municipalities operate the floodgates and manage the CWL of KRC in accordance with the demands of local residents since the local administrations lack the proper knowledge and skills to operate the floodgates. The municipalities would tackle the problem only when it arises. It is also found that most local-level state agencies give their own remit the first priority while the overall efficiency or cooperative efforts with other stakeholders are given a second priority. According to Chitradon (2009), the key to a successful CWMS is the adaptive capability and the collaboration and participation of all concerned parties, i.e. local governmental agencies, cities, and communities.

## **CONCLUSION**

The findings indicate a lack of regular and systematic monitoring of the quantity and quality of water in KRC. This contributes to a severe water shortage in dry seasons and to high pollution and low oxygen in the water. Since the dredging of KRC a hundred years ago, the RID has been a key government unit responsible for the CWMS of the canal. However, the agency has focused its tasks on the prevention of flooding and maintaining of adequate water in the canal (i.e. a minimum of 50 cm); but has never assessed the quality of the water in KRC. The local RID operates the water floodgates according to the needs of local residents who are affected by contamination or pollution in the canal water. In addition, it is found that the ineffective implementation of CWMS could possibly be attributed to an ambiguous division of CWMS responsibility between various local government units.

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