CHAPTER 3

Water monitoring with modern information technology at Chiang Mai Moat as a study area

3.1 Background information

Chiang Mai moat is an important historical canal of Chiang Mai, with more than 750 years old [81]. It is a square with sides of length 1.5 km. Today, Chiang Mai moat is surrounded with communities, emporiums, hospitals, schools and temples etc. It has been served for various proposes, such as recreation, plant watering and sewage canal of the surrounding community. Also, it has been the avenue for some special activities for cultural festivals, such as Songkran (Thai New Year) and Loy Kratong. Thus, it is important for water quality monitoring in the Chiang Mai moat.

3.2 Aim of the studies

To demonstrate the water quality monitoring system employing modern information technology at Chiang Mai Moat.

3.3 Application of purpose

Chiang Mai moat has been polluted by wastewaters from human activities in Chiang Mai city area. The developed water quality monitoring system using modern IT was applied to Chiang Mai moat by following 5 steps of the procedure as described in Chapter 2. The operation planning was done using Google Earth to measure the length of the area of interest and then using Google Street View to survey and assign a sampling point. In Fig. 3.1, it shows the length of each side is approximately 1.5 km, so 8 sampling points were assigned located at 4 corners and in the middle of 4 sides, thus, each sampling points is 700 – 800 m away from another. A mapping for water quality sampling points was created on Google Maps as shown in Figure 3.2; https://www.google.co.th/maps/@18.7895195,98.9831341,15.38z/data=!4m2!5m1!1b1?hl=en.

In addition, the working team was divided to 6 teams; team 1-4 to monitor water parameters by test kits (2 points per team), team 5 to monitor water parameters by digital probe meter for all points and team 6 is at the center lab in Chiang Mai University. The center lab was responsible for evaluation process (see section 2.2.3, Chapter 2) and displaying the water quality results on the website as shown in Figure 3.2: https://sites.google.com/site/chiangmaimoatwaterquality/. During the operation period, a communication between all the teams was made via mobile application. According to the plan, water quality monitoring of Chiang Mai moat was performed twice on March 29, 2013 and April 5, 2013.

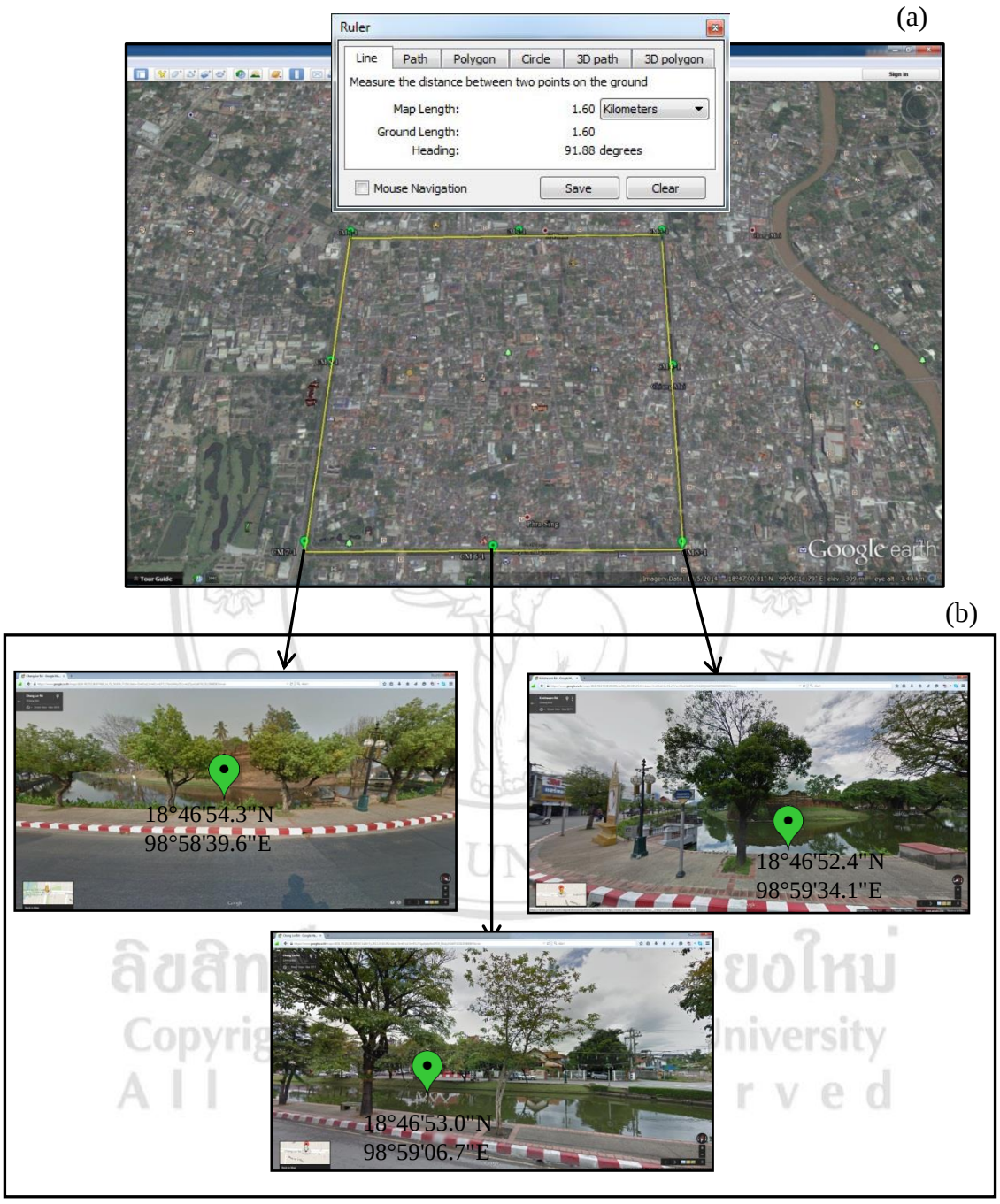

Figure 3.1 Uses Google Earth (a) and Google Street View (b) to survey and assign a sampling site in Chiang Mai Moat

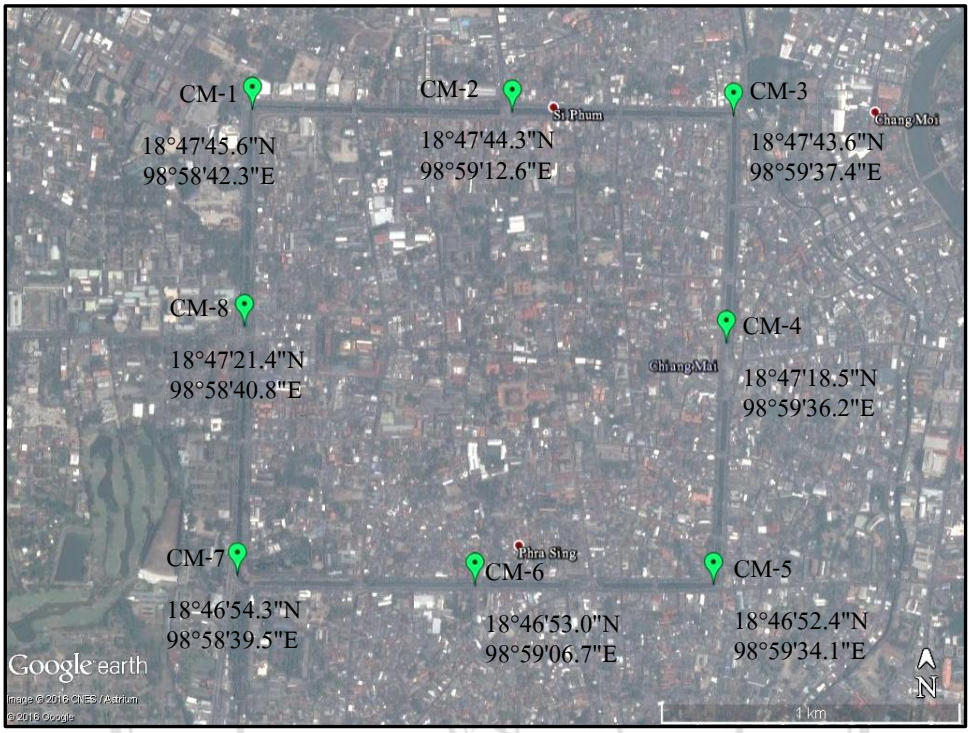

Figure 3.2 Placemarks of the sampling sites on Google Maps

(a)

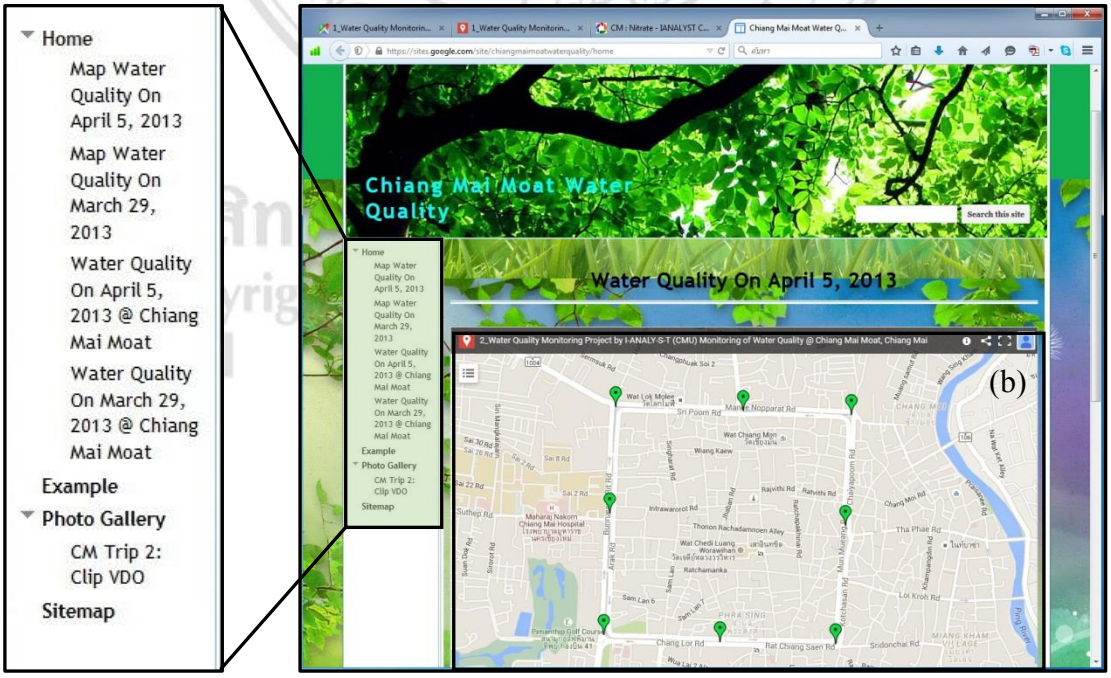

Figure 3.3 Website displaying the menu (a) and data information (b)

According to the mapping of water quality monitoring, all the on-site team were navigated to each designated sampling site using Google Maps application on a smart phone. The water quality monitoring at each sampling point was performed at the same time and the teams communicated with each other via a mobile application. After monitoring was done, all data were uploaded to the cloud system as described in Section 2.2 (Picasa Web Album and Google Drive). The on-site team and the center lab could communicate with each other using a mobile application. Then, the data were evaluated and displayed on the website by the center lab team. If any outlier or abnormal result was found, the center lab would report to the on-site team to redo the test at that sampling site immediately.

3.4 Results of water quality monitoring and discussion of Chiang Mai Moat

The results of water quality monitoring performed at 8 sampling points in Chiang Mai moat on 29 March and April 5, 2013 were shown in Table 3.1.

For the water quality result on March 29, 2013, it shows nitrate was high at CM7-1 and CM8-1. It could be due to wastewater drained from nearby community into stagnant water. Also, it was found that there are some fountains to help adding oxygen into the water, resulting in increasing DO.

For the water quality result on April 5, 2013, it was found that, at CM1-2, % DO sat (DO) was relatively low while COD, conductivity, TDS and ammonium were high compared to those of others.

It also found a drainage to the moat at CM1-2 as shown on website (VDO clip; https://sites.google.com/site/chiangmaimoatwaterquality/photo-gallery/cm-trip-2-clip-vdo). It was similar to household wastewater contaminated with organic matter, surfactant and sewage. Thus, a BOD parameter was examined additionally for this area. In addition, the observed results were found to be in agreement with the official water quality report of Chiang Mai moat prior Song Kran festival 2013 (see Table B1, Appendix B [79]).

Table 3.1 Results of water quality monitoring of Chiang Mai Moat

Sampling Site -Trip	Temp. (°C)	pH	Conduct. (µS.cm^{-1})	TDS (mg/L)	DO (mg/L)	
					Measure	%DO Sat
Field trip on March 29, 2013						
CM 1-1	28	8	260	174	6	77
CM 2-1	28	8	281	178	8	102
CM 3-1	29	8	259	171	7	91
CM 4-1	28	7	264	171	7	89
CM 5-1	29	9	256	180	13	169
CM 6-1	28	9	271	181	12	153
CM 7-1	28	8	292	195	7	89
CM 8-1	29	8	271	182	4	52
Field trip on April 5, 2013						
CM 1-2	29	8	371	252	1	13
CM 2-2	30	8	290	193	6	79
CM 3-2	31	8	303	202	5	67
CM 4-2	29	8	282	188	5	65
CM 5-2	30	7	299	199	7	93
CM 6-2	31	8	287	192	4	54
CM 7-2	31	9	265	178	8	108
CM 8-2	29	9	292	195	7	91

Table 3.1 Data of water quality monitoring of Chiang Mai Moat (continued)

Sampling Site -Trip	COD (mg/L)	Turbidity (mg/L)	Nitrate (mg/L)	Ammonium (mg/L)	Phosphate (mg/L)	BOD* (mg/L)
Field trip on March 29, 2013						
CM 1-1	2	8	1	0.2	0.5	4
CM 2-1	5	13	1	0.2	0.2	6
CM 3-1	5	12	1	0.2	0.2	7
CM 4-1	10	13	3	1	0.2	3
CM 5-1	7	18	3	1	0.2	4
CM 6-1	8	13	3	0.2	0.2	7
CM 7-1	4	13	7	1	0.05	5
CM 8-1	8	13	5	0.6	0.2	2
Field trip on April 5, 2013						
CM 1-2	20	24	< 1	5	0.5	8
CM 2-2	6	18	2	0.2	0.1	4
CM 3-2	7	10	1	0.2	0.1	5
CM 4-2	10	12	1	0.2	0.2	5
CM 5-2	10	10	2	0.7	0.05	6
CM 6-2	15	9	3	1.5	0.05	4
CM 7-2	4.5	9	< 1	0.2	1.0	4
CM 8-2	12	15	3	0.5	0.2	9

Remark: * = Parameter was added in this studies

3.5 Results of applied the water quality monitoring system employing modern information technology to Chiang Mai Moat

The water quality monitoring system using modern IT was first applied to Chiang Mai moat as a study area. Many free software and mobile applications were made use of. The teams were able to work together from different places via internet. In planning process, Google Earth, Google Maps and Google Street View were employed for remote survey, measurement, selection and assignment of a sampling point, before going to the real site. Also, a map created on Google Map was used on a smart device for navigation.

10 parameters of water quality were chosen to be monitored using digital probe meters and test kits (Packtest). This allowed the measurement to be done in short time, the water quality of all 8 sampling points was analyzed within 3 hours.

The cloud system can be used for free and can be connected to from anywhere anytime. The cloud computing system can calculate the data and plot a graph. A photo stored on the cloud system can display the traceable detail on Picasa web album automatically including the location coordinates which can be plotted on Google Maps later.

The system based on Google service served as an easy, user-friendly platform. It can be used to design and create a webpage displaying all water quality monitoring results, including water quality maps on Google Map, Numerical data on Google Docs, VDOs on Google Drive, Photos on Picasa Web Album. All of these Google services can be used by all OS and platforms. It also provides good security service by notifying a IP administrator number every time it was logged in. A user can control the data access as well.

The data storage on the cloud and data displaying could be designed and set up once prior monitoring process. The data management system could be used throughout a trip and the data could be public displayed in real-time. Any outlier or abnormal data could be reported and examined immediately. It helped the monitoring system became time-saving and cost-effective.