

# Sustainable Water Management for Tourist Accommodations in Amphawa, Samut Songkram, Thailand

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**Abstract**—This study aims to initiate sustainable water management for tourist accommodations in Amphawa, Samut Songkram Province, Thailand. Wastewater generated by tourist accommodation was conducted in 10 homestays and resorts in Amphawa during August – October, 2011. The prominent parameters which are of pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Fat Oil and Grease (FOG), Nitrate ( $\text{NO}_3^-$ ), and Phosphate ( $\text{PO}_4^{3-}$ ) were conducted monthly. The results revealed that some parameters were over national water quality standard (Class II). Especially, 90% of tourist accommodations have been recorded that FOG was over the standard of wastewater quality from accommodation (group I: total room of accommodation less than 200 rooms). Therefore, grease trap and natural treatment should be utilized in tourist accommodations in order to reduce the discharged of fat, oil, and grease from tourism activities. In addition, number of tourists also relate statistically with BOD and Nitrate at 0.05 level of significance.

**Keywords**—Sustainable Water Management, Tourist Accommodations, Environmental Protection, Samut Songkram.

## I. INTRODUCTION

THAILAND has been promoted tourism since 1970s with the great assets for tourism development which are including 148 national parks, 89 wildlife sanctuaries, 5 UNESCO world heritage sites and historical parks [1], as well as highly diverse traditions. This can be led mass tourism to many popular destinations. Mass tourism provides little contribution to the local economy where as if not adequately controlled, can also generated environment damage which can be visible in natural environment [2]. Especially, in major tourist destinations in high tourist season, tourism also affected local people lifestyles, distribution of native species, and also caused environmental damage in various aspects. Firstly, mass tourism can be caused the depletion of water resources and contamination of rivers and beaches. In addition, it can also generate tons of waste in popular destinations, as well as in Amphawa.

Currently, Amphawa is the most popular weekend destination for both domestic and international tourists in Thailand. Amphawa is located in Samut Songkram Province, Thailand, covering an area approximately 170 square kilometers, at a distance of 70 kilometers from Bangkok (Fig. 1) Amphawa is covering with various kinds of attractive natural and cultural destinations.

The major tourism activities in Amphawa are including

agro tourism, natural tourism, and religion and cultural tourism. Especially, in the core area of Amphawa is the critical area for firefly watching, appreciation way of life, floating markets and sightseeing along canals. Therefore, the development of tourism in Amphawa is increasing rapidly while several environmental impacts have appeared. More than 112 homestays and resorts have been developed in Amphawa (Fig. 2) [3], especially along the riverside. The mass tourists at Amphawa floating market can generate income to local people however tons of waste and wastewater have been generated by tourists, respectively. Light from the expansion of the municipal area, resorts, and tourism activities also affect mating behavior of fireflies. In addition, water consumption of tourists during weekend also creates water shortage in Amphawa as well as wastewater from tourist accommodations can also discharged through natural environment if with or without wastewater treatment system.



Fig. 1 Location of Amphawa, Samut Songkram

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Fig. 2 Tourist Accommodations in Amphawa

Moreover, the location of tourist's accommodation is situating nearby the riverside, where is very sensitive to discharge wastewater, waste, chemical pollutants to natural water resources may occur if there is a lack of appropriate environmental management system. Therefore, this study aimed to initiate sustainable water management for tourist accommodations in Amphawa, Samut Songkram Province by evaluated wastewater characteristics from 10 tourist accommodations. Implementation of this study can be applied the mitigations to reduce contamination of water resources and protection natural resources which are the great assets for local

people and future generations.

## II. METHODOLOGY

This research was conducted wastewater characteristics of 10 tourist accommodations in Amphawa District, Samut Songkram Province, Thailand from August – October 2011. Six parameters which are pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Fat Oil and Grease (FOG), Nitrate ( $\text{NO}_3^-$ ), and Phosphate ( $\text{PO}_4^{3-}$ ) were analyzed monthly (Table I and Fig. 3).

TABLE I  
SAMPLING SITES

Site	Position (UTM)	
	X	Y
1. Ban Ruen Pen	47 P 602830	1482932
2. Ban Suan Ra Beang Nam	47 P 603568	1482045
3. Ban Tor Sang	47 P 602847	1483544
4. Nate Natee Resort	47 P 601865	1480741
5. Ruen Loi Nam	47 P 602586	1484852
6. Ban Kam Ma Thep	47 P 602584	1484845
7. Ban Mae Nam Homestay	47 P 602583	1484489
8. Ban Mai Chai Klomg	47 P 602855	1483069
9. Rim Nam Suan Ka Set	47 P 602737	1482566
10. Ban Suan Pak Jai	47 P 601744	1482932

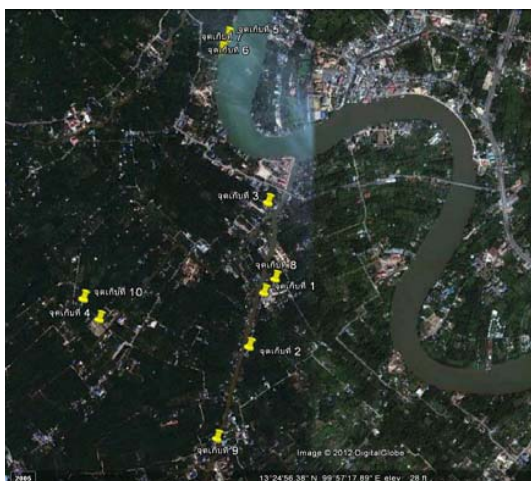


Fig. 3 Tourist Accommodation's Sampling Sites

In addition, numbers of tourists at each tourist accommodations are also collected in order to identify correlation between number of tourists and wastewater qualities at the statistical significance level of 0.05.

### III. RESULTS

Results of wastewater qualities from 10 tourist accommodations in Amphawa are presented in Table II.

TABLE II  
WASTEWATER QUALITIES OF TOURIST ACCOMMODATION IN AMPHAWA,  
SAMUT SONGKRAM

Sampling Sites	Parameters				
	DO (mg/L)	BOD (mg/L)	FOG (mg/L)	PO <sub>4</sub> <sup>3-</sup> (mg/L)	NO <sub>3</sub> <sup>-</sup> (mg/L)
1	4.52	0.060	22.80	2.419	0.350
2	4.20	0.058	18.20	2.380	0.317
3	4.42	0.067	27.00	2.520	0.360
4	3.98	0.061	32.00	2.286	0.319
5	4.70	0.039	40.60	2.622	0.274
6	4.68	0.059	40.08	2.481	0.276
7	4.52	0.041	33.44	2.676	0.346
8	3.76	0.062	27.36	2.603	0.376
9	3.64	0.062	39.20	2.631	0.334
10	0.94	0.061	32.44	2.751	0.283
Standard*	> 4 mg/L	< 40 mg/L	< 20 mg/L	-	< 5 mg/L

\*Water Quality Standard [5]

This study was collected wastewater from 10 tourists accommodations and the results are summarized in Table I. Average Dissolved Oxygen was between 0.94 – 4.70 mg/L. 60 percent of Dissolved Oxygen of tourist accommodations was higher than water quality standards whereas 40 percent less than water quality standard (4 mg/L).

Biochemical Oxygen Demand from tourist accommodations was less than the standards. However, 90 percent of Fat, Oil and Grease of tourist accommodations was exceed the water quality; only 10 percent meet the standard (< 20 mg/L). Average Phosphate in this study was between 2.286 – 2.751 mg/L. In addition, nitrate of all tourist accommodations was lower water quality standard (< 5 mg/L).

In order to identify the impact of tourism on wastewater characteristics, number of tourists at tourist accommodations was evaluated during the same duration. The results from correlation analysis revealed that number of tourists also relate statistically with BOD and Nitrate at 0.05 level of significance.

### IV. CONCLUSION

Sustainable water management for tourist accommodation in Amphawa has been investigated into several parameters. The critical parameters that exceed standard were Dissolved Oxygen and Fat, Oil and Grease. From the previous study of environmental management system of tourist accommodations was found that grease traps has been settled 49.1 percent in order to decrease the contamination of water resources by grease and oil from canteen and restaurants. However, the results revealed that at least 21.3 percent discharged wastewater directly to the water bodies [4]. In addition, Fat Oil and Grease also affected from floating market. Activities of the floating market on Friday Saturday and Sunday caused the suspended solids (SS), fat oil and grease (FOG) and dissolved oxygen (DO) were higher than the days of inactivity. Boat caused high suspended solid (SS). Cooking, clearing of container and oil boat redounded contamination of FOG [6].

The most fascinating mitigation is to initiate environmental friendly cleansers for tourist's accommodation along the riverside in Amphawa in order to decrease chemical discharge to the water resources.

Regarding to water management, water supply is the major problem as during the high tourist season, many resorts are facing a water supply shortage. Therefore, a sanitary community tap water supply should be developed in prominent sub districts [4] or pursued reuse purified gray water as well as collected and use rainwater [7].

Moreover, initiation of sustainable tourism in Samut Songkram can be developed by encourage participation of the owner of tourist accommodations with the support from governments and Tourism Authority of Thailand (TAT) to promote sustainable tourism local and international tourists.

However, impacts of tourism activities in Amphawa, Samut Songkram are not only generated from tourist

accommodations, but also created by other activities such as floating market, firefly watching motor-boat, and riverside temple tours. Therefore, holistic approaches should be implemented with the collaboration from local stakeholders before beyond carrying capacity of natural environment.

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