

Eco-Friendly Cleansers Initiation for Eco-Campsite Development in Khao Yai National Park, Thailand

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Abstract—Environmental impact has occurred at Khao Yai National Park, especially the water pollution by tourist activities as a result of 800,000 tourists visiting annually. To develop an eco-campsite, eco-friendly cleansers were implemented in Lam Ta Khlong and Pha Kluay Mai Campsites for tourists and restaurants. The results indicated the positive effects of environmentally friendly cleansers on water quality in Lam Ta Khlong River and can be implemented in other protected areas to decrease chemical contamination in ecosystems.

Keywords—Sustainable Tourism Management, Eco-campsite, Khao Yai National Park.

I. INTRODUCTION

SINCE 1962, Khao Yai National Park (KYNP) was declared as the first national park in Thailand. KYNP is located in Northeastern Thailand, covering an area approximately 2,168 square kilometers. KYNP contains substantial tropical forest ecosystems, and creates the source of the Lam Ta Khlong River, which is situated in the central area of the national park and runs through campsites and other recreation areas. More than 2,500 species of flora, 605 species of fauna, 112 species of mammals, 392 species of birds, and 209 species of amphibians and reptiles have been recorded at KYNP [1]. In 2005, KYNP was designated as a part of Dongphrayayen - Khao Yai Forest Complex [2] and Thailand's most recent World Heritage Site. Therefore, KYNP became a popular destination for both domestic and international tourists.

The major activities for tourists are various such as trekking, bird watching, nature sightseeing, and camping. Consequently, some environmental impacts have appeared in term of natural resources management and carrying capacity which include tourist overcrowding during tourist high season, and inadequate facilities. The impact of tourist activities can especially lead to the degradation of natural resource, if there is a lack of consideration concerning the appropriate management.

At present, KYNP has 2 campsites, Lam Ta Khlong and Pha Kluay Mai. Both of these are located closed to Lam Ta Khlong River. Approximately more than 800,000 visitors visit KYNP each year [1]. From tourist statistics at Pha Kluay Mai Campsite, an average of 206 tourists visit on weekdays and 1,108 tourists visit during the weekends, among these 50 percent stay overnight. Based on the study of the carrying

capacity of KYNP, the number of tourists limited to 600 persons per night; whereas, Pha Kluay Mai Campsite can support a tourist carrying capacity of up to 800 persons per night.

The study of tourist water consumption at KYNP, shows tourist consume average of 227 liters/ person/ day for overnight visitors and 19 liters/ person/ day for day visitors [3]. Thus, amount of water consumed by tourists is 25,981 liters/day on weekdays and 128,809 liters/day during the weekends. Generally, 80 percent of the water consumption generated wastewater. Therefore, wastewater from Pha Kluay Mai campsite is estimated at 20,784.80 liters and 103,047.20 liters during weekday and weekend respectively. Therefore, it is necessary to find appropriate mitigation to prevent an impact from wastewater arising from tourists and restaurants at both campsites.

Many researchers have mentioned camping impacts on the ecosystem which include vegetation disturbance, composition change and loss of cover; loss of organic litter and exposure, compaction, and erosion of soil; damage and loss of shrubs and trees; pollution of water resources; and disturbance to wildlife [3]. Nowadays, most cleansing products contain of chemicals that are not biodegradable in a natural environment, such as LAS (Linear Alkyl Benzene Sulfonate) which is harmful to many species in water and remains in the ecosystem for a long time [4]. It can especially enhance destruction of biological processes and affects organism functions in the ecosystem. Thus, the implement of environmental friendly cleansers such as for dish washers, detergent, liquid soap for tourist and restaurants at campsite will be a viable method to decrease impact of chemical contamination to ecosystem especially in protected area.

The idea of an eco-campsite was developed in KYNP in order to reduce impact on the natural environment. Eco-campsites have been established in Europe since 1999 with the intention to develop an environmental management system, especially for campsites based on Environmental Management System (EMAS). The proposes of the eco-campsite concept are compose of increasing the satisfaction of guests through high service quality; minimizing and recycling waste; using energy and water efficiently; damaging neither soil nor water supplies with sewage; designing and maintaining campsites in a nature-oriented way; cleaning in an environmentally friendly way; avoiding the use of environmentally damaging materials; processing and selling regionally produced products; and considering nature and the environment with the choice of leisure activities.

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In this study, one of the prominent eco-campsite procedures was applied in Lam Ta Khlong and Pha Kluay Mai campsites of KYNP by enhancing eco-friendly cleansers for tourists, restaurants and staff accommodation along Lam Ta Khong River. Major parameters include Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Nitrates and Phosphates were monitoring monthly during the tourist high season. Tourists' attitudes and perceptions according to this mitigation have been evaluated. Tourists prepared their own cleansers when they traveled to the national park such as soap, shampoo, and dish washing detergent. In the tourist's opinion, soap and dish washing detergent created a high environmental impact on the natural environment. In case that the national park plan to sell or promote eco-friendly cleansers products, the suitable ones should be shampoo and dish washing detergent. 98 percent of tourists were happy to use eco-friendly cleansers prepared by the national park. If they have to pay some offset to save the environment; the optimum rate should between 10-20 baht [5].

The results of this research indicate the effect of environmental friendly cleansers on water quality in Lam Ta Khlong River which can be further managed, and reduce the negative environmental impacts on the fragile natural tourist destinations. Additionally, the eco campsite management can raise the awareness of tourists and park officers to participate in natural resources conservation in regards to initiating eco-friendly behavior in their daily life and leisure.

II. METHODOLOGY

Study area: Khao Yai National Park is located in the Phanom Dong Rak mountain range between latitude $14^{\circ} 5' - 14^{\circ} 15' N$ and longitude $101^{\circ} 5' - 101^{\circ} 50' E$. It is only 180 kilometers far from Bangkok and consists of complicated mountains and various types of ecosystem. The area has vast grassy fields alternating with different kinds of forest habitats and is the source of the following five rivers 1) Prachin Buri River 2) Nakhon Nayok River 3) Lam Ta Khlong River 4) Praplerng River and 5) Muag Lek Stream.

Presently, KYNP has two main campsites, Lam Ta Khong and Pha Kluay Mai situated in the middle of national parks along Lam Ta Khong River.

Proper standards of eco-friendly cleansers were implemented (which were ISO 14001 certified products) and are composed of dish washing detergent and liquid soap. Moreover, detergents and cleansers are also used for restaurants and staff accommodations along Lam Ta Khlong River. Some related parameters of water quality, including Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Nitrates, Phosphates, and Fat Oil and Grease (FOG) were monitored monthly before and during high tourist seasons. Other environmental factors and tourist statistics are also collected in order to identify the association and effect of eco-friendly cleanser on natural environment.

III. RESULTS

Eco-friendly cleansers such as dish washing detergent, liquid soap, laundry detergent, and cleansers were utilized in campsites for tourists and restaurants. The results of water qualities at both campsites compared before and after using eco-friendly cleansers are presented in Table I.

TABLE I
COMPARISON OF WATER QUALITY BEFORE AND AFTER USING ECO-FRIENDLY CLEANSERS IN KHAO YAI NATIONAL PARK

Parameter	Location	Average	
		Before	After
DO (mg/l)	LTK	7.87	8.07
¹ Std. ≥ 6.0	PKM	8.04	8.42
BOD (mg/l)	LTK	3.13	2.43
¹ Std. ≤ 1.5	PKM	3.03	1.70
Nitrate (mg/l)	LTK	5.78	6.20
¹ Std ≤ 5	PKM	5.68	5.68
Phosphate (mg/l)	LTK	1.15	0.84
	PKM	0.84	0.88
FOG (mg/l)	LTK ¹	0	7.06
	PKM	1.67	6.66

Remark ¹ Std: standard of Thailand surface water quality level 2

The results showed that, water quality at LTK and PKM campsites are improving when making the comparison between before and after using eco-friendly cleansers. BOD at both campsites and Phosphate at LTK were especially decreased; whereas, other parameters are still inconsistent. One significant issue for consideration during November-January is the tourist high season; therefore, water quality will vary dependent on the number of tourists.

When focusing on the comparison of water quality before and after implemented eco-friendly cleansers by using the t-test (sig. = 0.05), the results are revealed in Table II.

TABLE II
STATISTICAL COMPARISON OF WATER QUALITY BEFORE AND AFTER USING ECO-FRIENDLY CLEANSERS IN KHAO YAI NATIONAL PARK

PM	LCT	November		December		January	
		t	sig	t	sig	t	sig
BOD	LTK	15.63	0.000*	0.78	0.443	3.06	0.005*
	PKM	5.69	0.000*	6.61	0.000*	9.94	0.000*
DO	LTK	6.24	0.000*	-7.56	0.000*	0.55	0.585
	PKM	3.11	0.004*	-12.87	0.000*	3.44	0.002*
N	LTK	-7.29	0.000*	-7.29	0.000*	-7.29	0.000*
	PKM	-0.35	0.73	-0.35	0.73	-0.35	0.73
P	LTK	1.65	0.109	1.66	0.109	1.66	0.109
	PKM	-0.98	0.336	-0.98	0.336	-0.98	0.336
FOG	LTK	-2.11	0.043*	NA	NA	NA	NA
	PKM	0	1	1	0.326	-1.36	0.184

Remark: PM: Parameter, LCT: Location

The results revealed that at PKM campsites DO and BOD before and after implemented eco-friendly, cleansers are difference. As well as the value of Nitrate at LTK before and after using eco-friendly, the cleanser is different with a significant level of 95%.

According to the results, it was found that the effect of Eco-friendly cleansers can be related with BOD, Phosphates and Nitrates. Moreover, the tourist numbers are also very important for the variability of water quality and also includes others factors, such as behavior of tourists, physical and climate conditions.

IV. CONCLUSION

In order to reduce environmental impacts on fragile protected areas, usage of chemical detergents should be avoided especially when wastewater from campsites, canteens and toilets are discharged straight into the environment without wastewater treatment system mitigation, such as eco-friendly is the needful. Thus, the environmental friendly cleanser was provided to KYNP staff and tourist during high tourist season. Environmentally friendly cleansers were also well received attitudes from staff and tourists. Therefore, this implementation was able to reduce some severe environmental impacts to the national park and nearby ecosystem during high tourist season. Moreover, the mitigation can also be applied to other national parks in order to initiate tourist environmental awareness for eco-campsite development.

Based on the entire study, eco-camping mitigation by enhanced eco-friendly cleanser use in the park can solve some environmental impacts from tourist activities. Nevertheless, other issues should be considered, such as limitations on camp site and car park, water shortages, and waste management. Thus, the integration of environmental techniques by using the eco-camping concept should be applied and investigated in the study area. Baseline information on carrying capacity, solid waste management, water consumption, and eco-camping sites were also recommended for further study [6].

The recommendations for ecotourism and eco-campsite development in KYNP are:

- (1) Close the park and nature trails during the rainy season to tourist activities is highly recommended in order to keep the ecosystem recovery and for safety transportation.
- (2) Carrying capacity can be the first achievable mitigation to control extra tourists during the tourist high season.
- (3) Eco-friendly cleansers should be made available by the park officers instead of buying from outsource
- (4) Avoid the use of toxic chemicals and use biodegradable chemicals, encourage tourist and staff to use environmental cleansers where possible.
- (5) Try to protect waterways from pollution by chemicals, rubbish and other waste products, avoid the use of cleaning products, soaps, detergents, and toothpaste in or near freshwater.
- (6) In order to increase the number of tourists at camping sites, the proper wastewater treatment system should be implemented.
- (7) The research will be more completed if a link is created by monitoring the analysis of physical parameters and bio-indicators to find the correlation and actual status of water quality.

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