



# Difficulties to be Overcome by the Peat Swamp Forest Fire Management in Nakhon Si Thammarat Province, Thailand

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## ARTICLE INFO

### Article history:

Received: 30 September 2021

Revised: 21 April 2023

Accepted: 16 September 2023

### Keywords:

Meteorological drought indices

Standardized precipitation index

Deciles index

Moisture available index

Palmer drought severity index

## ABSTRACT

This article presents the roles of the responsible organizations and the difficulties for the Kuan Kreng peat swamp forest fire management, Nakhon Si Thammarat Province, Thailand. Data were collected by using in-depth interviews from purposive and snowball samplings of policy makers (18 interviewees) and practitioners (18 interviewees) as well as a group discussion of 15 participants, observations, secondary data, digital camera and voice recordings, and note taking. Data were analyzed by using narrative analysis. There were a number of organizations responsible for the Kuan Kreng peat swamp forest fire management: local organizations under the Department of National Parks, Wildlife and Plant Conservation, Department of Forestry, Ministry of Natural Resources and Environment, local administrative organizations, Ministry of Interior, as well as a civic society called the Songkhla Lake Basin Committee. Several difficulties that the responsible organizations will have to be resolved for future solutions. These are the Policy Level (Internal) lack of a budget, and lack of personnel; (External) relationships between the Government and the local people, laws and regulations, and lack of participation; Practitioner level (Internal), lack of suppression tools, lack of highly experienced forest fire fighters; (External) the condition of the peat swamp forest, weather conditions, and lack of participation.

## 1. INTRODUCTION

Forest fire is an uncontrollable fire that free-flow burns natural resources in a forest, consuming soil, leaves, grasses, dry wood, weeds, and live plants [1]. Causes of forest fire include both natural and human made [2]. Natural causes of forest fire can be volcanic eruption, lightning strike, rock and/or wood clashing; and human-made causes of forest fire include food search or hunting, slash-burning, conflicts between people and government staff on land usage, carelessness, ranching, and ‘mad’ people [1, 3].

Small forest fires provide positive impacts on the environment, such as in natural reproduction, locking-in of nutrients, quick weed removal, soil nurturing and protection, water filtration, and killing diseases in the forest [1, 4]. Many authors [1-2, 4-7] have described how the negative impacts of severe forest fires can affect the water source conditions, soil destruction, burn small plants, terminate or slow down plant growth, decrease woodland conditions, burn an area open, damage the long-term ecological balance, create air pollution with health impacts, reduce visibility, damage local economic plants, cause climate change and global warming, and cause an imbalance in floods and droughts.

Thailand is among the many places with loss of forest

area from forest fires. Recent statistics in 2018 showed that there were 16 million hectares of forest in Thailand or about 31 percent of the whole country [8]. In 2019, there were 24 thousand hectares of forests burnt by forest fires [9]; however, this was mostly from human-made causes [3, 4]. Therefore, Thailand has delegated forest fire management to the Office of Forest Fire Protection, Suppression and Control; Department of National Parks, Wildlife and Plant Conservation; Department of Forestry, and Ministry of Natural Resources and Environment. After 1999, Thailand has also decentralized this function to local administrative organizations – Ministry of Interior – to look after forest fire management in their areas [10].

At present, the forest areas in southern Thailand are about 24 percent (or 1.7 million hectares) of the forest areas in the whole country [8]; and there were 2.2 thousand hectares (see Table 1) of forest fires in 2019 [9]. Two different ministries have been supervising peat swamp forests in the Nakhon Si Thammarat province as mentioned above; however, forest fires – in peat swamp forests – in the Nakhon Si Thammarat province have the highest statistics of burnt forests in 2019 for southern Thailand [9]. This may be because they have been working with different ministrie’s strategies, which might affect the ability to manage forest fires. Consequently,

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this article firstly assesses the roles of the responsible organizations, as well as secondly the hindrances in peat swamp forest fire management in the Nakhon Si Thammarat province, Thailand.

**Table 1. Statistics of forest fire in Nakhon Si Thammarat Province during 1998-20 August 2019**

Year	Number of Forest Fire Fighting (Times)	Areas of Forest Fires	
		Rai (Thai Measurement System)	Hectares 0.16 Hectare = 1 Rai
1998	4	48	7.68
1999	18	3,688	590.08
2000	10	265	42.40
2001	6	475	76.00
2002	49	7,675	1228.00
2003	11	318	50.88
2004	12	387	61.92
2005	89	4,887	781.92
2006	15	287	45.92
2007	49	1,086	173.76
2008	27	378	60.48
2009	116	2,424	387.84
2010	333	19,240	3,078.40
2011	1	3	0.48
2012	122	11,971	1,915.36
2013	17	348	55.68
2014	93	4,233	677.28
2015	23	857	137.12
2016	113	11,505	1,840.80
2017	16	211	33.76
2018	20	800	128.00
20 August 2019	62	13,948	2,231.68

Source: Data applied from [9].

## 2. LITERATURE REVIEW

### 2.1. Peat swamp forest, Nakhon Si Thammarat Province

A peat swamp forest is a type of deciduous forest in a low-lying area, where the area has a pan-shape and there are floods almost the whole year round. The evergreen forest is fully grown and there is organic matter heaped on the ground, called 'peat bog', that is soft and flexible, but with a high acidity that also makes water acidic [11].

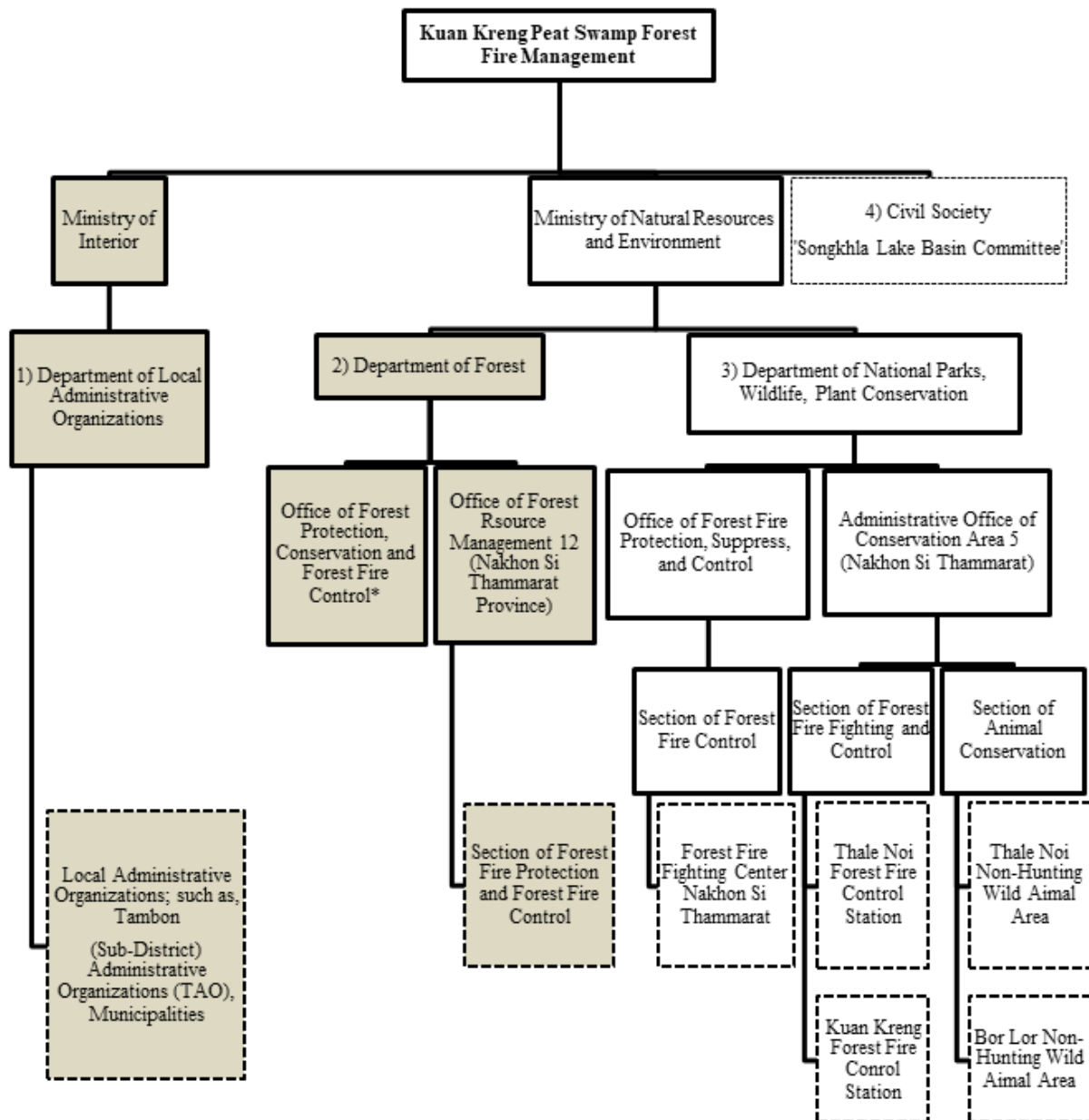
The Kuan Kreng Peat Swamp Forest in Nakhon Si Thammarat Province is locally well-known and a congregation of peat swamp forests that are situated in the Bor Lor and Thale Noi Non-Hunting Wild Animal Areas, in Nakhon Si Thammarat province of Thailand. Their announcement order is as follows: 1) Klongkong Conservation Forest, announced 13 February 1974 [12].

2) Thaachangkhaam Conservation Forest, announced 31 May 1974 [13]. 3) Thale Noi Non-Hunting Wild Animal Area, announced 18 February 1975 [3]. 4) Donsai and Klong Conservation Forest, announced 10 April 1978 [14]. 5) Baankumpae, Baannailum, and Kuan Krang Peat Swamp Conservation Forests, announced 22 October 1986 [15], and 6) Bor Lor Non-Hunting Wild Animal Area, announced 5 November 2012 [3].

Figures 1 and 2 show these peat swamp forests covering two of the non-hunting wild animal areas that overlap four conservation forests and are under the control of different organizations. Thus, the Department of Local Administrative Organizations (see No. 1; Figure 1) (and the Department of Forests (see No. 2; Figure 1) are responsible for forest fire management in the conservation forests. The Department of National Parks, Wildlife, and Wild Plants (see No. 3; Figure 1) is responsible for forest fire management in the non-hunting wild animal areas. In addition, the Songkhla Lake Basin Committee (see No. 4; Figure 1), a civil society group, serves on voluntary basis and works for the whole of the Kuan Krang forest fire management.

The Kuan Kreng Peat Swamp Forest, Nakhon Si Thammarat Province is about 5,600 hectares, and covers five Districts. There are 11 sub-districts – local administrative organizations – at the sub-district level that looks after the forest fire management. These are: 1) Chelermprakiet District; Suanluang Sub-District; 2) Cha-Uat District; Baantoon, Cha-Uat, Nanglhong, Khonhaad, and Kreng Sub-Districts; 3) Chienyai District; Maechaoyuhua, and Karaked Sub-Districts; 4) Huasai District; Lham, and Kuanchalik Sub-Districts; and 5) Ronpiboon District; Kuanpang Sub-Districts [16]. At present, there are 69,962 people, or 25,715 households, living in this area [17].

Kuan Kreng Peat Swamp Forest has long provided benefits for the local people. For example, it is a water source for the water basin, a place to filter sediments before release to the lower basin, a source of a variety of fish, wild food, and sedge for local handicraft [18]. However, after the announcement of the four conservation forests and non-hunting wild animal areas in the Kuan Kreng Peat Swamp Forest, Nakhon Si Thammarat province, there were conflicts due to unclear land ownership by the local people who claimed that they had lived here before the announcements of the conservation forests and non-hunting wild animal areas, and also there had been earlier forest fires in this area [3]. This is concordant with statistics of forest fires collected by the Section of Forest Fire Control [9] presented and shown in Table 1.



Note: \* means no office in local area; dashed box means representative interviewees selected in this study; this figure is specially produced for only this article.

Fig. 1. Responsible organizations for Kuan Krang peat swamp forest fire management. Source: Data applied from [10].

### 2.2. Forest fire management

Ketpraneed et al. [7] reported how to manage forest fires – used to present one of the results in this article – providing the following six methods.

1( The prevention method is a way of protection against forest fires by separating heat, fire and oxygen. Separating ‘heat’, such as preventing forest fires from fires lighted by a person, by law protection, providing education, information and campaigns to the people. Separating fires by lighting small forest fires before the forest fire season, making fire

tracks/roads to prevent forest fires from spreading. However, the last prevention method, by separating from ‘oxygen’, is quite difficult in practice, because oxygen is everywhere.

2( The pre-suppression method prepares forest fire fighters who pass training in forest fire skills and techniques, assigning clear jobs and descriptions to responsible organizations and people, preparing readily-available proper and effective forest firefighting equipment, and planning for safe forest fire fighting.

3( Detection is the method of determining as fast as possible the places and areas where a forest fire is, or could be, to control the forest fire and prevent expansion into a wider area.

4( Suppression is the method of fighting forest fires with safe, effective, and highly experience-proven techniques and personnel.

5( Use-of-fire is a method of using fire itself to ‘manage with care’, such as removing unwanted weeds, diseases, and bug infested destroyed or waste products.

have been local communities living in or around the areas – fire management was basically from continuing burning peat swamp forest fire for oil palm plantation; in addition, dry climate and accumulation of organic residues underneath on the ground caused escalation of peat swamp forest fires. The inappropriate irrigation system in Kuan Kreng Peat Swamp Forest, as well as the areal expansion of oil palm plantations from communities with unclear land ownership between community properties and Kuan Kreng Peat Swamp Forest government area, made Kuan Kreng Peat Swamp Forest fire management become tougher [3].

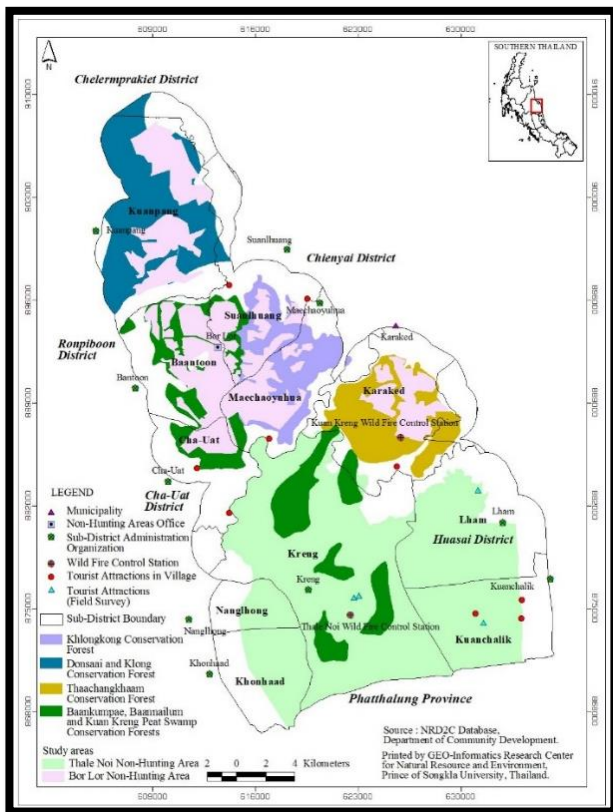
**3. MATERIALS AND METHODS**

This research study was conducted at the Kuan Kreng Peat Swamp Forest that covers five Districts and 11 Sub-Districts, and is situated in the Bor Lor and Thale Noi Non-Hunting Wild Animal Areas, Nakhon Si Thammarat province, Thailand. Data were collected by purposive and snowball samplings from representatives of policy makers )18 interviewees( and practitioners )18 interviewees( who were locally responsible for the Kuan Kreng Peat Swamp Forest Fire Management, Nakhon Si Thammarat province by using in-depth interviews )see Table 2( and focus group discussions )15 of available voluntary participants( together with observations, secondary data, digital camera recordings, voice recordings, and note-taking. Data were analyzed by using a narrative analysis.

**4. RESULTS AND DISCUSSION**

**4.1. Roles of responsible organizations in forest fire management**

This section presents the roles of the responsible organizations in the Kuan Kreng peat swamp forest fire management, where three departments from two major Ministries, and one civilian society look after the forest fire management. The local administrative organizations, under the Ministry of Interior and the Department of Forest, and the Ministry of Natural Resources and Environment are responsible for the conservation forests in the Nakhon Si Thammarat province. Furthermore, the Department of National Parks, Wildlife and Plant Conservation, the Ministry of Natural Resources and Environment are taking care of two of the non-hunting wild animal areas – Bor Lor and Thale Noi Non-Hunting Wild Animal Areas – in the Nakhon Si Thammarat province. Additionally, a civilian society, called the ‘Songkhla Lake Basin Committee’, is also concerned with forest fire issues in the Nakhon Si Thammarat province, which is a part of the Songkhla Lake Basin (see Figure 1 and Table 3).



Note: This map is specially produced for only this article.

**Fig. 2. Peat swamp forest, Nakhon Si Thammarat Province, Thailand. Source: [19].**

6) Evaluation is the last method. The evaluation of the impacts from forest fires in every method of forest fire management is essential to improve the efficiency and safety for the next forest fire.

**2.3. Situation of the Kuan Kreng Peat Swamp Forest fire management**

Prince of Songkla University [3] reported the most severe situation of Kuan Kreng Peat Swamp Forest – where there

**Table 2. Representation by in-depth interviewees in this study**

Represented stakeholder	Policy Maker Interviewed	Date of Interview	Practitioner	Date of Interview
Ministry of Interior Department of Local Administrative Organizations				
Chelermprakiet District				
Suanluang Sub-District	Head of TAO	22 May 2017	Forest Fire Fighting Volunteer	29 May 2017
Cha-uat District				
Baantoon Sub-District	Head of TAO	21 June 2017	Forest Fire Fighting Volunteer	13 September 2018
Cha-uat Sub-District	Head of TAO	22 June 2017	Forest Fire Fighting Volunteer	27 September 2017
Nanglhong Sub-District	Head of TAO	14 June 2017	Forest Fire Fighting Volunteer	17 January 2018
Khonhaad Sub-District	Head of TAO	14 June 2017	Forest Fire Fighting Volunteer	14 September 2017
Kreng Sub-District	Head of TAO	22 June 2017	Head of Forest Fire Fighting Volunteer	17 January 2018
Chienyai District				
Maechaoyuhua Sub-District	Head of TAO	22 May 2017	Forest Fire Staff	22 May 2017
Karaked Sub-District	Head of Municipality	15 June 2017	Forest Fire Fighting Volunteer	14 May 2017
Huasai District				
Lham Sub-District	Head of TAO	15 June 2017	Forest Fire Fighting Volunteer	16 June 2017
Kuanchalik Sub-District	Head of TAO	15 June 2017	Head of Forest Fire Fighting Volunteer	17 January 2018
Ronpiboon District				
Kuanpang Sub-District	Head of TAO	21 June 2017	Forest Fire Fighting Volunteer	13 September 2017
Ministry of Natural Resources and Environment Department of National Parks, Wildlife, and Plant Conservation				
Office of Forest Fire Protection, Suppress, and Control Section of Forest Fire Control	Head of Forest Fire Fighting Center, Nakhon Si Thammarat Province	30 June 2017	Special Forest Fire Fighter	30 June 2017
Administrative Office of Conservation Area 5 (Nakhon Si Thammarat) Section of Forest Fire Fighting and Control	Head of Kuan Kreng Forest Fire Control Station	28 June 2017	Kreng's Forest Fire Fighter	28 June 2017
	Head of Thale Noi Forest Fire Control Station	29 June 2017	Thale Noi's Forest Fire Fighter	29 June 2017
Section of Animal Conservation	Head of Bor Lor Non-Hunting Wild Aimal Area	27 September 2017	Forest Protection Staff	27 September 2017
	Head of Thale Noi Non-Hunting Wild Aimal Area	28 September 2017	Head of Kuan Kreng Protection, Thale Noi Non-Hunting Wild Animal Area	21 December 2017
Department of Forest	Head of Forest Fire Protection, Nakhon Si Thammarat Province	28 September 2017	Assistant of Forest Fire Protection, Nakhon Si Thammarat Province	12 February 2018
Civil Society	Songkhla Lake Basin Committee	14 September 2017	Member of Songkhla Lake Basin	14 September 2017
<b>Sum</b>	<b>18 Interviewees</b>		<b>18 Interviewees</b>	

Note: TAO means Tambon (Sub-District) Administrative Organization.

Table 3 presents the roles of the responsible organizations in forest fire management divided by legal functions and by real functions, and demonstrates that organizations from Department of National Parks, Wildlife and Plant Conservation (responsible for forest fire management in the non-hunting wild animal areas) and organizations from Department of Forest (responsible for forest fire management in the conservation forests), the Ministry of Natural Resources and Environment have had roles by legal functions and by real functions in all methods of forest fire management. They have planned for every month of the year what to do regarding forest fire management. Although they have had only few forest fire fighting personnel compared to the forest fire areas supervised, they also developed community networks to look after forest fires in these areas, with the limited budget allocated.

While the local administrative organizations, under Ministry of Interior, have had roles by legal functions and by real functions only at prevention and pre-suppression methods, it was not compulsory for them to manage detection, suppression, use of fire, or evaluation methods. Most of them have yearly plans regarding forest fire management. However, the forest fire management was only one of their many roles, so that their budgets also were distributed across other local development purposes.

Similar to the others, also Songkhla Lake Basin Committee has had roles by legal functions and by real

functions only at prevention, and the rest of its roles were alternatives to manage pre-suppression, detection, suppression, use of fire, and evaluation methods. This was because the Songkhla Lake Basin Committee has had a broad role in sustainable integrated local natural resources management, and forest fire management was one of the issues. So, the forest fire management in pre-suppression, detection, suppression, use of fire, and evaluation methods were only supported by organizations under the Ministry of Natural Resources and Environment, as well as the Ministry of Interior.

#### 4.2. Difficulties in forest fire management

Results on the roles of the responsible organizations in the Kuan Kreng peat swamp forest fire management appear to cover all the methods of forest fire management. However, the statistics in Table 1 on forest fires from the Section of Forest Fire Control [9] indicate that the Kuan Kreng peat swamp forest fires still remain annual and unchanged. This is because of the difficulties on the policy and practitioner levels that also can be divided into internal and external factors, as detailed next.

##### 4.2.1. Policy Level

###### 4.2.1.1 Internal Factors

###### 1) Lack of Budget

**Table 3. Roles of responsible organizations by law and in reality**

Name of Organizations	Roles of Forest Fire Management												
	Prevention		Pre-suppression		Detection		Suppression		Use of Fire		Evaluation		
	L	R	L	R	L	R	L	R	L	R	L	R	
Ministry of Natural Resources and Environment <u>Department of National Parks, Wildlife, and Plant Conservation</u> Non-Hunting Wild Animal Areas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kuan Kreng and Thale Noi Forest Fire Control Stations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Forest Fire Fighting Center, Nakhon Si Thammarat Province	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<u>Department of Forest</u> Section of Forest Fire Protection and Forest Fire Control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ministry of Interior <u>Department of Local Administrative Organizations</u> Local Administrative Organizations	✓	✓	✓	✓	-	✓	-	✓	-	✓	-	✓	✓
Songkhla Lake Basin Committee (Civil society)	✓	✓	-	✓	-	✓	-	✓	-	✓	-	✓	✓

Note: L means functions by law, R means functions by reality.

It is a red-tape process for the responsible organizations in the Kuan Kreng peat swamp forest fire management for the non-hunting wild animal areas to buy tools when there is an emergency forest fire. Many times, the staff had to use their own budgets to buy tools for protection against forest fires. In the meantime, local administrative organizations responsible for peat swamp forest fires in conservation areas had many functions to perform, not solely the forest fire management; in addition, the budgets received from tax allocations were very low for the local administrative organizations in rural areas, as in this particular case also. Therefore, there was never enough budget for the peat swamp forest fire management.

## 2) Lack of Personnel

This aspect was fine for the responsible organizations of the peat swamp forest fire for the non-hunting wild animal areas, because their main functions were forest fire management. They had highly-trained skilled personnel for this purpose. However, the local administrative organizations responsible for peat swamp forest fires in conservation areas were the sole supporting team for the responsible organizations of the peat swamp forest fires in the non-hunting wild animal areas, where the areas overlapped, as in this case. Consequently, they had very few personnel who knew or were skilled in forest fire management.

### 4.1.1.2 External Factors.

#### 1) Relationship between Government and Local People

The Kuan Kreng peat swamp forest was surrounded by a habitat of local people who lived within the Kuan Kreng peat swamp forest itself. All of the non-hunting wild animal areas and conservation forests in the Kuan Kreng peat swamp forest were announced after there were records that the local people had been living in these areas since 1955 (see Figure 2). The local people and the Government held different land ownership certificates, but there was no mutual agreement on this. The local people still kept carrying out their cultivation activities, such as slash and burn, that was illegal, especially when the fire spread from the local people's properties to the government land. These unclear boundaries made the local people have negative attitudes towards the Government. As a result, none of the Kuan Kreng peat swamp forest fires were from natural causes.

#### 2) Laws and Regulations

Many times, the responsible organizations planned to keep water for forest fire management in the highly inaccessible areas, stored in ditches in the Kuan Kreng peat swamp forest area. However, based on the laws and regulations in this area, "...*Non-Hunting Wild Animal Area is prohibited to occupy or process land or cut, clear, destroy trees or any other flora, dig for mineral, excavate soil, rock, gravel or sand or pasture animals, change a waterway, or cause the*

*water in a river, creek, swamp or marsh to overflow or dry up, close or obstruct a water course or way, or position or endanger any wild animal, unless written permission has been obtained from the Director-General or where the Director-General has been notified within a period of time"* (p.10) [20], even though the proposed project came from the responsible Government organization itself. Many times, the project of keeping water for forest fire protection was delayed or not approved, because the proposed project conflicted with the laws and regulations for the conservation of forest and non-hunting wild animal areas.

#### 3) Lack of Public Participation

This difficulty was triggered by a 'not good' relationship between the Government and the local people living around the Kuan Kreng peat swamp forest. The decision and announcement of the conservation forests and non-hunting wild animal areas had been made without any public participation. Even though the responsible organizations of the peat swamp forest fire management had educated the people, given out information, or executed campaigns on forest fire protection, the forest fires in this area were mainly human caused.

For example, the responsible organization might offer to help local people to light a fire before the forest fire season had begun (prevention method). However, because of the not-good relationship, the local people distrusted the Government and then did not participate in this offer. They preferred to light the fires themselves or without informing the fire fighters. Finally, they could not control the forest fires.

### 4.2.2. Practitioner Level

#### 4.2.2.1 Internal Factors.

##### 1) Lack of Sufficient Forest Fire Suppression Tools

The responsible organizations for the peat swamp forest fires in the non-hunting wild animal areas had more forest fire suppression tools than did the local administrative organizations responsible for peat swamp forest fire in the conservation areas. Many times, the local administrative organizations received donations from the responsible organizations of the peat swamp forest fire in the non-hunting wild animal areas. However, the suppression tools for a small forest fire were not sufficient, comprising water buckets, shovels and rakes. If the forest fire was very strong, the firefighter needed more heavy-duty tools to manage that fire, such as cars or trucks to carry the firefighters to the spot, binoculars, Global Positioning Systems (GPS), proper fire fighter uniforms, water pumps, water hoses, water trucks, and fire trucks. They had to keep asking for help from other organizations in other provinces, often far away.

##### 2) Lack of Sufficient Firefighter Experience in Peat Swamp Forest



Generally, a peat swamp forest fire is risky to the firefighters who need knowledge, understanding and skills, as well as strength and patience in fighting the fire. Firefighters who came from responsible organizations to the peat swamp forest fire and non-hunting wild animal areas were mostly trained in how to suppress the fire, but these were very few in number. However, firefighters from local administrative organizations responsible for the peat swamp forest fires in conservation areas were volunteers exposed only to very limited training. There was a difficulty when the forest fire took too long and voluntary people had to suppress the forest fire with simple tools. Firefighters with better training had to work harder all alone, because the volunteer firefighters lacked the skills to suppress the fire.

#### 4.2.2.2 External Factors

##### 1) Condition of Peat Swamp Forest

As mentioned earlier, the peat swamp forest is pan shaped with water flooding almost the whole year round; also, there is soft and flexible organic matter accumulated on the ground [11]. The forest firefighter carrying heavy suppression tools sometimes sank into the peat swamp. It was worse and very risky for a fire fighter when that peat swamp hole had a fire going on underneath. Besides, 'dug' water was very dry in the summer season. Under these conditions, it was also difficult to access the forest fire area with a vehicle. In addition, with the Kuan Kreng peat swamp forest being surrounded by a local community that had agriculture fields and ponds, the way to access the forest fire spot could only be by foot possibly extending a water hose.

##### 2) Weather Conditions

It becomes more difficult for the forest fire management when there is wind. Wind could strengthen the forest fire or blow it to a new spot, as well as risk the lives of the firefighters. Consequently, the firefighter must know the wind conditions when suppressing fires.

##### 3) Lack of Public Participation

It was found that the forest firefighting volunteers were local people who lived around the Kuan Kreng peat swamp forest. The responsible organizations formed a group of volunteers to help suppress forest fires in emergencies, even though the relationships between the local people and the Government were not that good. In addition, the firefighting volunteers perceived that the responsible organizations had their own firefighters and so, might not need them. In addition, the forest firefighting volunteers worked without pay, so that when there was a forest fire in the daytime and also with their agricultural work at their own farms, they were reluctant to help. However, if there was a forest fire after work, as in the late afternoon, they were willing to help. If the Government were to provide monetary support to these volunteers to leave their jobs and help suppress the forest

fire, such incentive could increase the numbers of local volunteers.

## 5. RECOMMENDATION AND CONCLUSIONS

This study assessed the roles of responsible organizations in the Kuan Kreng Peat Swamp Forest fire management, and found that there were multiple organizations looking after different types of forest for the authorities. However, in reality, they worked together and were responsible organizations under the Ministry of Natural Resources and Environment; Ministry of Interior; as well as civil society, with the two first ones having the major roles. While their duties covered all the categories of methods for forest fire management, this study found difficulties in forest fire management at the policy and the local practitioner levels. These can also be divided into internal and external factors that can be identified from the bottom-up to the policy makers at the central level. This research recorded feedback on peat swamp forest fire policy evaluation, especially in context of southern Thailand. The policy makers could use this information to revise their forest fire policies and prepare action plans matching the resources for peat swamp forest fire management; e.g. men, money, materials, and management.

Consequently, the difficulties identified in this study might be useful to know for both the policy makers and the practitioners in the responsible organizations, who should seek further solutions for the future peat swamp forest fire management.

Recommendations from this research study can be further given as follows:

Local staff of two ministries relating to forest fire fighting should keep close contact with, listen to, and discuss with local communities to appreciate their real needs.

1) Local community participation in forest fire fighting networks should be strengthened, and the responsibilities distributed, in order to raise community awareness and participation.

2) For local administrative organizations that are associated with forest fire issues, but not yet fully responsible for forest fire management, they should facilitate yearly action plans and budgeting of their forest fire management.

3) Reorganize structure of the local administrative organizations that have no clear duty in forest fire management.

4) Increase the numbers of forest fire fighters regularly trained, especially those with the local administrative organizations lacking properly trained manpower.

5) Accommodate effective, sufficient, and safe forest fire fighting tools.

6) Peat swamp forest fire management may not reach a total absence of forest fires, because these relate to



traditional life as practiced in the local communities; hence, promoting alternative practices or careers, irrelevant to natural resources in peat swamp forest, in the local communities, may reduce the number of future peat swamp forest fires.

### ACKNOWLEDGEMENTS

The authors are grateful for the proofreading service performed by Assoc. Prof. Seppo Karrila on behalf of the Publication Clinic, Research and Development Office, Prince of Songkla University.

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