



SPATIAL ANALYSIS FOR FREE-RANGE DUCKS: A STUDY AREA OF PATHUM THANI PROVINCE, THAILAND

Anisara Pensuk Tibkaew¹ Nutpiputh Kongsompoj², Anchalee Suksri³, Sittipat Marayart⁴ and Kulapramote Prathumchai⁵

¹Department of Geography, Kasetsart University, 50 Ngam Wong Wan Rd, Lat Yao, Chatuchak, Bangkok, Thailand,

Email: anisara.pensuk@gmail.com

²Department of Public Works and Town & Country Planning, Bangkok, Thailand,

Email: bery.39@hotmail.com

³Khun Phithak Subdistrict Administrative Organization, Ratchaburi, Thailand,

Email: anchaleemild23113@gmail.com

⁴ Graduate School, Kasetsart University, 50 Ngam Wong Wan Rd, Lat Yao, Chatuchak, Bangkok, Thailand

Email: sittipat.marayart@gmail.com

⁵ Department of Geography, Kasetsart University, 50 Ngam Wong Wan Rd, Lat Yao, Chatuchak, Bangkok, Thailand,

Email: kulapramote.p@ku.th

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ABSTRACT: Free-range ducks is an agricultural activity which conduct mostly in paddy area. The left-over rice grains are important source of ducks' food. However, the declination of paddy area due to the expansion of urban has highly affected the free-range ducks farming. Pathum Thani province has high capability in rice producing for all year round due to the effective irrigation system and the suitable land quality. Therefore, free-range ducks farms are mostly found in Pathum Thani and other central regions provinces e.g. Ayuthaya, Supan Buri. The objectives of this research were 1) to the suitable paddy fields for free-range ducks farms in Pathum Thani and 2) to assess the risks which could threaten the free-range ducks activity. The Analytic Hierarchy Process (AHP) and GIS were used for assessing the suitable land for free-range ducks activity. Three main important factors namely 1) the size of the rice paddy area, 2) water source distance and 3) distance from the community. The research results showed the most suitable area for free-range ducks was found only 4% of the paddy area, moderately suitable paddy was 72.21%, and the less-suitable rice field was 23%. The risk factors and impacts on free-range ducks activity can be divided into 3 aspects, namely, human and social issues, consisting of (1) urban expansion problems affecting rice paddies and water sources, (2) insecurity from thieves. Environmental issues consisted of (1) the use of chemicals in rice farming; (2) the risk of epidemic outbreaks. Economic issue, prices and the marketing processes.

1. INTRODUCTION

Raising ducks is a long-standing agricultural occupation of Thai farmers. There are 4 methods in raising duck in Thailand (Thaweesak, et al), 1) Closed High-Biosecurity System: ducks are raised in closed sheds housing 5,000–6,000 birds in each house, mostly for meat ducks, Pekin ducks and white Cherry Valley ducks. 2) Open House System: ducks are raised for both meat and egg layers, the egg layer ducks are housed in flocks of 3,000 to 4,000 birds in this system. 3) Grazing System (Free-range Ducks): raised in the open on rice fields, most free-range ducks are egg-laying ducks. 4) Backyard Ducks: ducks are raised in the backyards of village homes together with other animals, including chickens, geese, and pigs.

The free-range ducks are mostly egg-laying ducks, ducks were also raised in the open space, for example, rice fields. They are free to roam outside in order to search for their food. Young female ducks are moved to the harvested rice fields after hatching and spending 3 weeks in a brooder. Their main food next 5 to 6 months are snails and residual rice. Ducks are moved to another paddy field when their food is exhausted. According to Department of Livestock (2014), approximately 6.5 million free-range ducks were being raised in Thailand. Throughout the year, most free-range ducks are raised in the central part where the paddy fields are locating. (Pasakorn Thammachot, Jetsada Rattanawut, and Areerat Thosadee, 2016).

There are advantages of having free-range ducks in paddy field, ducks can help reducing the rice pest such as shrimp, shellfish, snails and crabs in the rice field. In addition, the soil also has the benefits from duck droppings as organic fertilizer and their trampling help decompose the rice straw (Department of Livestock Development, 2012).

Raising free-range ducks currently become more difficult due to the shortage of suitable paddy rice for the ducks. The

intensive use of chemical, the sufficiency of water and the distance from cities are the risk factors of the suitable land area for free-range ducks (Chitchanok and Siriluck, 2013)

Therefore, the Aim of this study is to analyze of the suitable land for free-range ducks and investigate the risks of raising free-range ducks, the case study of Pathum Thani province

2. THE STUDY AREA

This research has been conducted at Pathum Thani province. Pathum Thani is one of the central provinces of Thailand and is part of the Bangkok metropolitan area. Most of the area of the province lies on the low alluvial flats of the Chao Phraya River that flows through the capital. Many canals cross the province and feed the rice paddies.

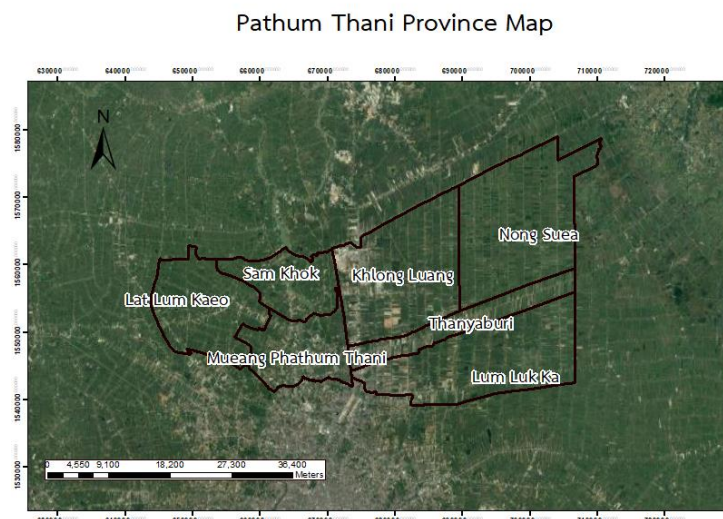


Figure 1 The study area: Pathum Thani Province

Pathum Thani is considered as peri urban area of Bangkok, it contains a wide variety of activities, including residences, factories, orchards and paddies fields. In the past few decades, the agricultural areas are degrading due to the encroachment of residences and some economic developments. The decreasing of agricultural areas especially paddy fields are threatening the free-range duck raising as it needs to rely on the paddy fields area.

There were totally 19 free-range duck farmers in the study area, 6 farmers in Lat Lum Kaeo, 2 farmers in Khlong Luang, 7 farmers in Nong Suea, and 3 farmers in Lam Luk Ka.

3. METHODOLOGY

3.1 Land suitability analysis

In this study, GIS and the field survey were conducted in order to analyze the suitable area for raising the free-range ducks in Pathum Thani Province, whereas the field survey with the household survey were conducted to investigate the risks and threats for the free-range ducks raising.

The GIS-based land suitability analysis using AHP approach as the multi-criteria was used in this research study. AHP is an effective procedure for land suitability analysis as it gives a systematic approach for making the proper site selection (Florentino and Walter, 2021). The AHP integrated with GIS can help analysis of the land suitability (Mendoza, 1997) for the free-range ducks.

3.2 Selecting of criteria

In this study criteria were selected using the literature reviews, experts' experiences and the availability of data. After conduct the experts meeting to discovered the important factors effective the free-range ducks raising, the factors including 1) water resource 2) land connectivity and 3) disturbance. Therefore, there are 3 the spatial criteria used for analyzing the suitable land area for raising free-range ducks, 1) distance from water resource 2) size of paddy area and 3) distance from communities.

3.3 Investigation the risks of free-range ducks

Questionnaire survey was conducted in order to retrieve the information about raising free-range ducks as well as the

risks of this agricultural activities. All of the free-range duck farmers in Pathum Thani (19 farmers) were observed and asked questions.

4. RESULTS AND DISCUSSION

4.1 Land use information of Pathum Thani Province

The land use change data of Pathum Thani Province was observed through satellite imagery of 2009 and 2019 (Figure 2-3). It was clearly shown the changes in Amphoe Khlong Luang, Muang, Thanyaburi and some part of Sam Khok. The major changes of the mentioned area were the increasing of build up area and the decreasing of the paddy area. Due to this reason, the suitable area for raising the free-range ducks was threatened and limited.

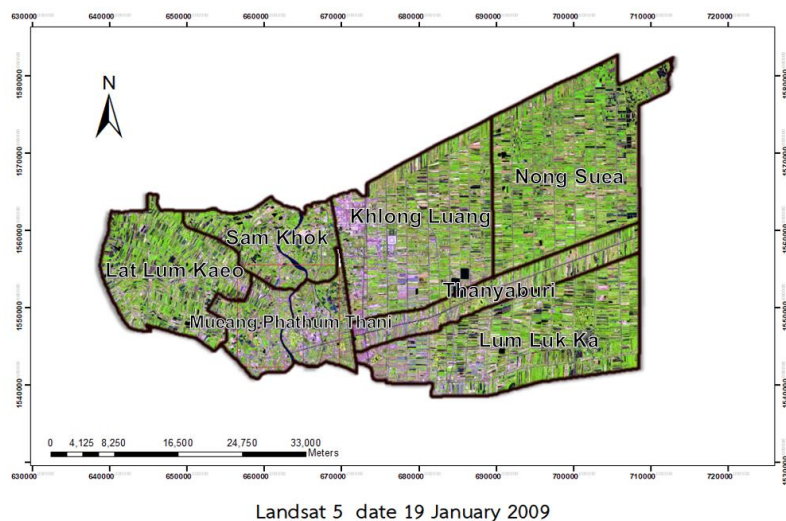


Figure 2 The satellite image of Pathum Thani Province in January 2009

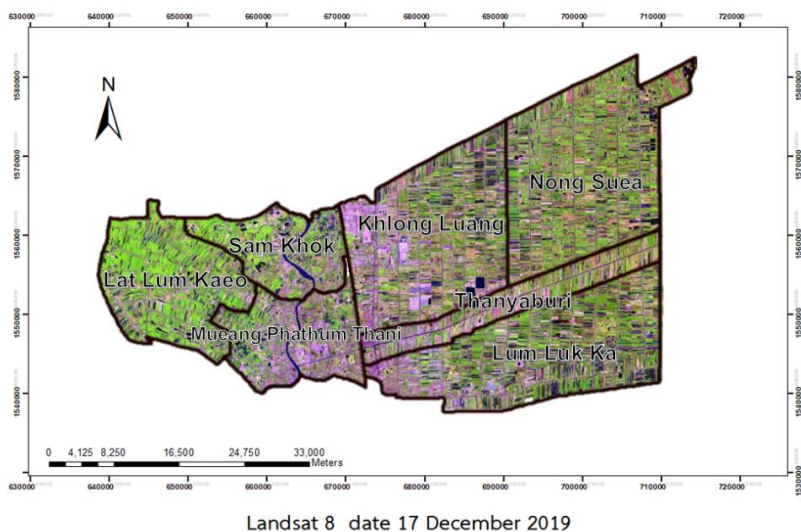


Figure 3 The satellite image of Pathum Thani Province in December 2019

4.2 Weighting and scoring of the criteria for land suitability analysis

All the criteria and sub criteria were weighted and scored using pairwise comparison method. Among three selected factors for free-range ducks, the most important factor used in this study was the water resource, therefore the distance from water resources was considered as the important criterion (weight = 0.75). The second important factor was the land connectivity, the size of paddy area was selected to use in this study (weight = 0.16), the most suitable land size for raising free-range ducks was about 1.6 hectares. The third factor used in this study was the disturbance, therefore the distance from communities was selected to use in this study (weight = 0.09), the most suitable area for free-range ducks was the area where far from the source of disturbance for example, communities, roads (Table 1).

Table 1 Weighting and scoring of criteria for free-range ducks raising

Factors	Criteria	Range of measurement	Score	Weight
Water resource	Distance from water resource	> 1000 meters	0.12	0.75
		200 – 1000 meters	0.26	
		< 200 meters	0.62	
Land connectivity	Size of paddy area	< 0.8 hectares (5 rai)	0.09	0.16
		0.8 – 1.6 hectares (5-10 rai)	0.24	
		> 1.6 hectares (10 rai)	0.67	
Disturbance	Distance from communities	< 500 meters	0.07	0.09
		500-5000 meters	0.28	
		> 5000 meters	0.64	

DISTANCE FROM WATER RESOURCE

Most of Pathum Thani Province are flood plain area which has Chao Phraya river runs through it. Pathum Thani typically has plenty of water throughout the year due to the several manmade canals. Figure 4 showed the area of water resource located whereas Figure 5 was the map generated according to the suitability level.

Water resource area in Pathum Thani Province

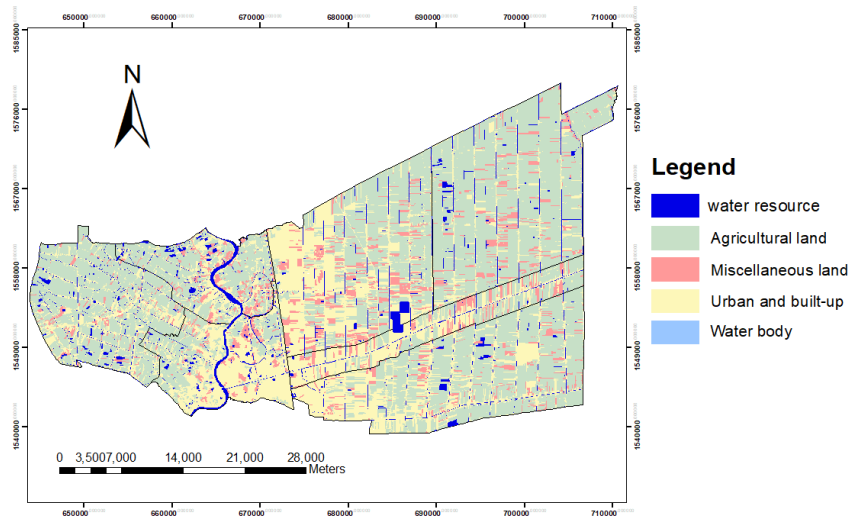


Figure 4 The water resource of Pathum Thani Province

Distance from Water resource Map

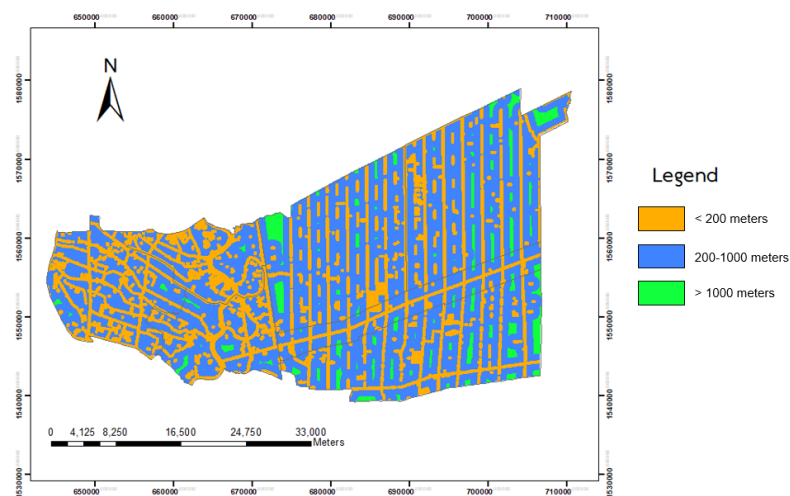


Figure 5 The sustainability level of area for water resource

Water resource was important factor for raising free-range ducks as the ducks need water for their living and their food source, therefore, Pathum Thani was one of the popular provinces for the free-range ducks farmers. However, due to the urbanization and the encroachment of cities, the suitability of the land would be decreasing. There were approximately 62% of the total land area has medium suitability level for free-range ducks, while 32% of total land area has high suitability. Most of the high suitability level area was found in Lat Lum Kaeo, Muang and Sam Khok.

Table 2 The area of each sustainability level for water resource

Distance from water resource	Suitability level	Area	
		Hectares	%
< 200 meters	High suitability	49,343	32.45
200 – 1000 meters	Medium suitability	95,547	62.83
> 1000 meters	Low suitability	7,190	4.73
Total		152,080	100.00

THE CONNECTIVITY OF PADDY AREA

Most of the free-range duck farmers are looking for the paddy area where newly harvested as there are plenty of left-over rice grain for their ducks. Due to the high number of ducks (about 20,000 ducks) in one farm, the free-range ducks activity needs large area of land for provide enough food for them.

Pathum Thani is one of the provinces where we often found the free-range ducks as three quarters of the agricultural area of Pathum Thani was the paddy field. However, the connectivity or the land size was important, therefore the paddy field area was considered as the important criteria for assessing the land suitability for free-range ducks.

According to the data, about 99% of paddy field area was larger than 1.6 hectares which was in high suitability level for free-range ducks activities (Table 2 and Figure 6).

Paddy field area in Pathum Thani Province

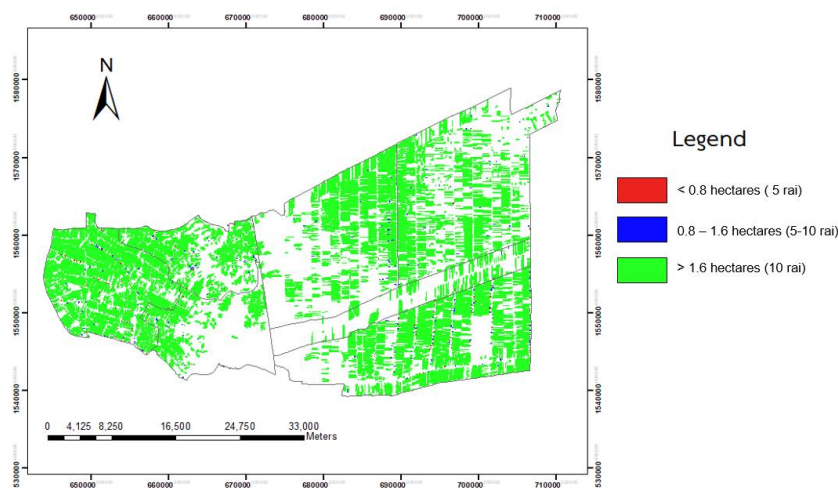


Figure 6 The connectivity of paddy area in Pathum Thani Province

Table 2 The size of paddy area in each sustainability level

Size of paddy area	Suitability level	Area	
		Hectares	%
< 0.8 hectares (5 rai)	Low suitability	114	0.19
0.8 – 1.6 hectares (5-10 rai)	Medium suitability	344	0.56
> 1.6 hectares (10 rai)	High suitability	60,589	99.25
Total		61,048	100.00

*Total paddy area of Pathum Thani = 61,048 hectares

DISTANCE FROM COMMUNITIES

Disturbance can create negative impacts for the health of the ducks, ducks would have less numbers of eggs. The main disturbance in Pathum Thani would be the encroachment of the residences, roads and other build up area. The distance from the communities was used as one of the criteria to find the suitable area for free-range ducks. Figure 7 showed the distribution of the communities and build up area. The distance from communities at 5,000 meters was considered as a good place for keep and raise the ducks (Figure 8).

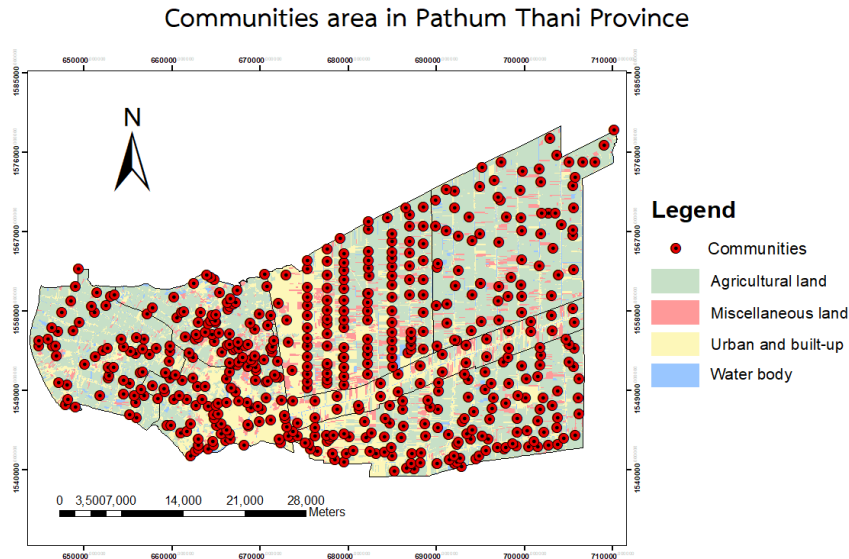


Figure 7 The distribution of communities in Pathum Thani Province

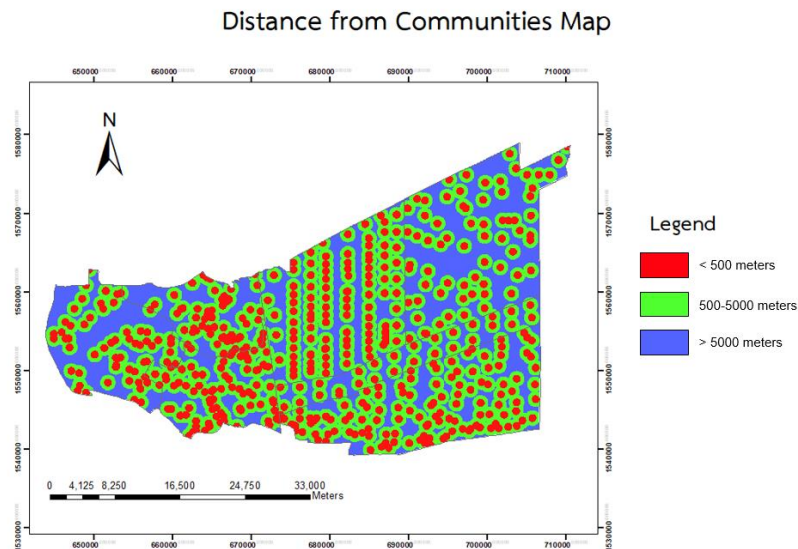


Figure 8 The sustainability level of area for distance from communities

The spatial analysis showed the different area has the different level of suitability. Almost half of the area (44%) had medium suitability for free-range ducks and only 32% of total land area has high suitability in terms of distance from communities (Table 3).

Table 3 The area of each sustainability level for distance from communities

Distance from communities	Suitability level	Area	
		Hectares	%
< 500 meters	High suitability	36,340	23.90
500-5000 meters	Medium suitability	67,034	44.08
> 5000 meters	Low suitability	48,707	32.03
Total		152,080	100.00

4.3 Land suitability for free range ducks

Three mentioned above criterions were used to analyze the suitability of land for free-range ducks. The different area had the different level of suitability. Figure 9 showed the map after analyzing the suitability of land according to three major criterions mentioned above. Most of the area of Pathum Thani Province had medium suitability for raising free-range ducks. The area with no color indicated non paddy type of land use which mostly found in Amphoe Muang, Khlong Luang and some part of Thanyaburi and Lum Luk Ka.

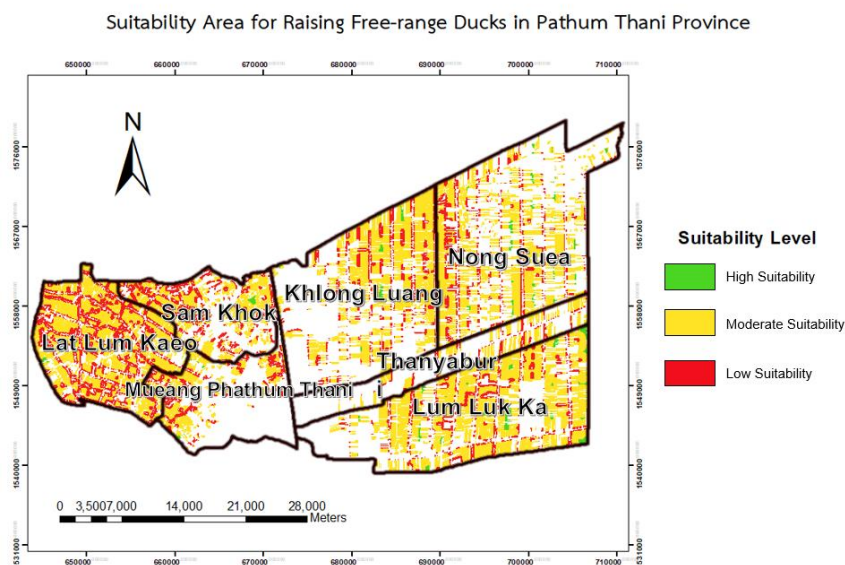


Figure 9 The sustainability map for raising the free-range ducks in Pathum Thani Province

The land suitability analysis for free-range ducks in this study was resulted from to 3 major criterions mentioned earlier. The results indicated 72.41% of total paddy area had medium suitability for free-range duck raising whilst 23% had low suitability and only 4% had high suitability.

Approximately 53% of high suitability area for free-range ducks raising was found in east part of Amphoe Lum Luk Ka where adjacent to Nakornnayok Province and 23% of the high suitability was found in Amphoe Nong Suea.

Table 4 The area of each sustainability level

Suitability level	Low suitability		Moderate suitability		High suitability	
	Hectares	%	Hectares	%	Hectares	%
Nong Suea	2,388	16.68	9,332	20.77	583	23.10
Khlong Luang	1,827	12.76	8,334	18.56	300	11.90
Lat Lum Kaeo	4,433	30.96	8,162	18.67	63	2.48
Sam Khok	2,044	14.28	3,469	7.89	43	1.71
Thanyaburi	448	3.13	1,558	3.52	102	4.03
Muang	1,039	7.25	2,106	4.79	76	3.02
Lum Luk Ka	2,141	14.95	11,243	25.80	1,357	53.76
Total	14,320	100.00	44,204	100.00	2,524	100.00

*Total paddy area of Pathum Thani = 61,048 hectares



4.4 Problem and risks in raising free-range ducks

In 2019, there were 19 free-range ducks farmers in Pathum Thani Province, all of them were interviewed about their problems and risks in raising free-range ducks. The problems were categorized into 2 dimensions; social dimensions and environment dimension. According to the information from the farmers, 14 farmers (73.7%) worried about the urbanization as the paddy area for raising their ducks would be decreased. Two farmers worried about their insecurity from thieves. For the environmental issues, 42% of farmers worried about the quality of paddy area and 10% worried about the usage of chemical which would be harmful for their ducks.

Table 5 Problem and risks in raising free-range ducks found in Pathum Thani Province

Dimension of the risks	Problems found	Number of farmers	%
Social	Urbanization	14	73.7
	Security	2	10.5
	No problem found	3	15.8
	Total	19	100.0
Environment	Land quality	8	42.1
	Chemical pollution	2	10.5
	No problem found	9	47.4
	Total	19	100.0

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