The Application of Geographic Information System (GIS) to Assess the Risk Area of Rice Bug (Leptocorisa oratorius (Fabricius)) Outbreak in Amphoe Paphayom and Amphoe Khuankanun, Phatthalung Province

Tharnsawat Pimsen, Anisara Pensuk Tibkaew and Wigunda Rattahapan

Abstract— *Rice is the main economic and household consumption crop of the people in Phatthalung Province and all over Thailand. Phatthalung province, especially Amphoe Phapayorm and Amphur Khuankanun are the important area of rice production in southern region of Thailand. However, rice farming has been decreasing overtime as influenced by several factors such as flood, rice price recession, diseases, insect and pests. Insects and pest always make difficulties and damages to the farmers due to the outbreaks and they destroy crop rapidly and make damage to crop product significantly. The important rice insect pest in Amphoe Phapayorm and Amphur Khuankanun is rice bug (Leptocorisa oratorius (Fabricius)). The outbreak of the bug is in the early rainy season. This study aimed to apply of Geographic Information Systems (GIS) to assess the spread of rice bug in Amphoe Phapayorm and Amphoe Khuankanun in order to identify areas that are vulnerable to the spread and outbreak of rice bug to prevent yield loss and find out the prevention and the method to get rid of rice bug properly and correctly. From the study, the ideal conditions for the outbreak are weed-full area as that area can be the suitable habitat of the bug, therefore, the rubber plantation area adjacent to the rice field can be the best habitat of the rice bug. The level of rice bug out break has decresing over the distance from the rubber plantation, the severity showed the most severe in 50 m. radious, and the most light of the rice bug outbreak was found in 350 m. radious around the rubber plantation. After evaluating the area prone to be damaaged by the rice bug of the sample area – Makoknua sub-district, Khuankanun distrtct, the result showed that only 6% of rubber plantation can cause the rice bug outbreak more than half of total area, the most severe and the severe was about 16% and 25% of total area, respectively.*

Keywords— **Geographic Information System (GIS), Phatthalung Province**, **rice bug, rice farming.**

1. INTRODUCTION

Rice is the main source of carbohydrate for the world's population and the grown area mostly found in Asia, as it had the suitable environment for rice production. Rice is the main crop and rice farmers are also considered as the main occupation of Phatthalung Province from the past to the present. The rice field of Amphoe Paphayom and Khuankanun occupied the area about 14,265.12 Hectare or almost 1/3 of overall rice field area of Phattalung province [1]. However, rice farming has been decreasing overtime by several factors, for example, flood, rice price recession and diseases and insect pests. Rice insect pest that make a difficult to estimate of damage to farmer. Due to the outbreaks and they destroy crop rapidly and make damage to crop product significantly. The important pest in Amphoe Phapayorm and Amphur Khuankanun is the rice bug (*Leptocorisa oratorius* (Fabricius)). The Larvae and mature rice bug use their mouth stabbed and suck nutrient from rice grain in milk grain stage. Moreover, they can stab to dough grain and mature grain which can make wither or poor rice grain and damage effect to decrease rice yield. The outbreak of rice bug is in the early rainy season [2].

Rice bug or Stink bug (*Leptocorisa acuta* (Thunberg) and *Leptocorisa oratorius* (Fabricius) (Hemiptera: Alydidae) (Figure 1), its mature is about 15 mm. in length, long thin shape with tentacles retracted. Its upper side of the body is brown and lower side is in green color. The bug fly when they were disturbed they fly and spray the stench from odor gland from the bottom. The mature rice bugs start looking for their food in the afternoon and evening. They do not like hot and sunny, so they rest on grass during sunny days. The females lay hundreds of eggs in a life span of about 2-3 months with 10-12 eggs laid in a row on the rice leaf surface parallel to the center line. Dark red brown egg is oval dish shaped. They stay in egg period for 7 days. The larvae are light brown green stay together in a group. The larvae suck nutrient from rice leaf first then the mature rice bugs stabbed and suck nutrient from rice grain in milk grain stage until mature grain.

The spread out of the rice bugs were usually found in early rainy season. They grown and breeding for 1-2 generation on grass weeds before migrate to rice field in flowering period. Rice bugs were found in any environment but found many in rainfed and upland rice field. The ideal conditions for the outbreak are the field that near the forest, there's a lot of weeds near rice field

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and grow rice in overlap period. Larvae and mature rice bug use their mouth stabbed and suck nutrient from rice grain (figure 2) in milk grain stage. However, they can also stab to dough grain and mature grain which make wither or poor rice grain and effecting to decreasing of rice yield. Suck feeding of rice bugs don't make a pore on the rice husk like the other bug, the damage caused by the destruction of the rice bugs is reduced quality of the rice rather than the reduced seed weight. The damaged rice grains were broke when milling. However, we can notice the outbreak of the rice bug by its stink smell.

Fig.1. Lavae and mature rice bug [3].

Fig.2. Structure of damages

This study is the application of geographic information systems (GIS) to identify the area where prone to be damaged by the breakout of rice bugs in Amphoe Phapayorm and Amphoe Khuankanun in order to prevent yield loss and find the appropriate methods to protect the rice from the bug.

2. THE STUDY AREA

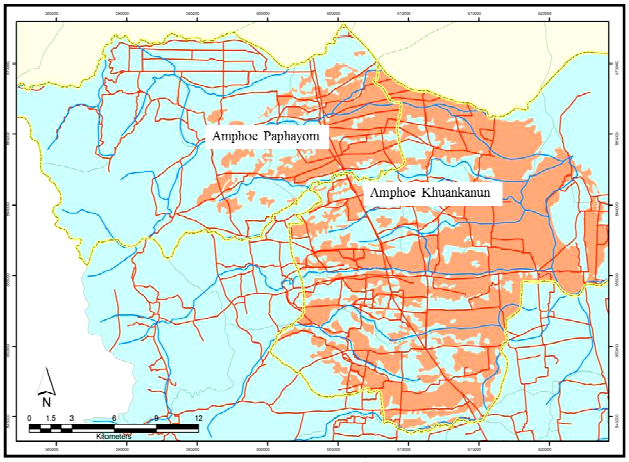
This study was conducted at Amphoe (District) Paphayom and Amphoe Khuankanun, Phatthalung province, southern Thailand. The areas of these two districts are known as the hughest rice production area of the southern region of Thailand. However, the rubber plantation is currently encroached in this area due to the high price of rubber products. The rubber plantation, therefore considered as the important habitat of the rice bug.

3. METHODOLOGY

Land use detection

The open source data of satellite images (Google Earth) of the study area was used to identify the land use characteristic of the study area. Three main land use types were identified, i.e. rubber plantation, paddy field and shrub area.

The GPS device was used to locate the coordinate of those three land use types in the ground and identified them in the Google Map in order to produce the land use map in KMZ format. The KMZ format files of land use types were finally converted into GIS file format (Shape file).



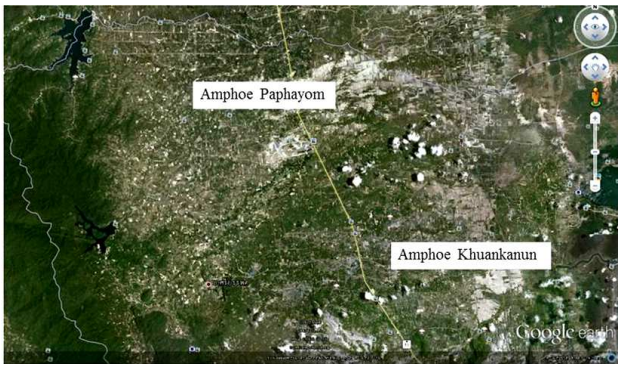


Fig.3. The study area

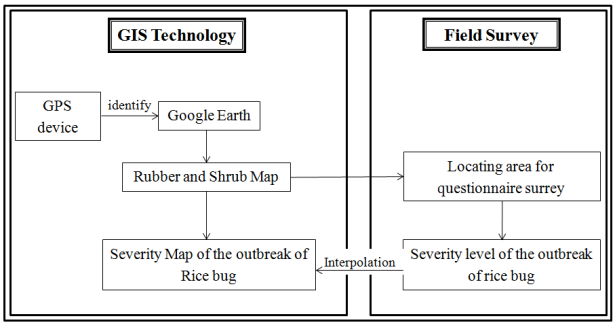


Fig.4. Research framework

Rice bug severity level evaluation

The questionnaire was use to query the farmers whose

their rice fields located adjacent to rubber plantation. In order to identify the severity of the outbreak of the rice bugs, the distance from the rubber plantation or the shrub area were taken into consideration.

4. RESULTS

Land use characteristics of the study area

The sub-district name Makoknua, Khuankanun District was selected to investigate the land use characteristic in detailed, as two major land use types appeared in this area, i.e. paddy field and rubber plantation.

The total area of Makoknua sub-district, Khunkanun district is 3,091.46 hectare, it could be recognized that in the past, the area of Makoknua was fully covered by paddy field (Fig.5) but it was recently changed into rubber plantation. Land use area of the study area was identified in the year 2012 by the mentioned method. Most of the area (about 2,897.47 hectare or 93.72%) was covered by paddy field and rubber plantation covered 193.99 hectare (6.28%) of the total area (Table 1). The pattern distribution of rubber plantation was random as the changing of land use is totally depending on the land owner (Fig.6). The major reason of changing in land use in the study area is the economic return [4]

Table 1. Land use of Makoknua sub-district, Khunkanun District

Land use type	Area	
	Hectare	%
Paddy field	2,900.61	93.72
Rubber plantation	193.99	6.28
Total	3,094.60	100.00

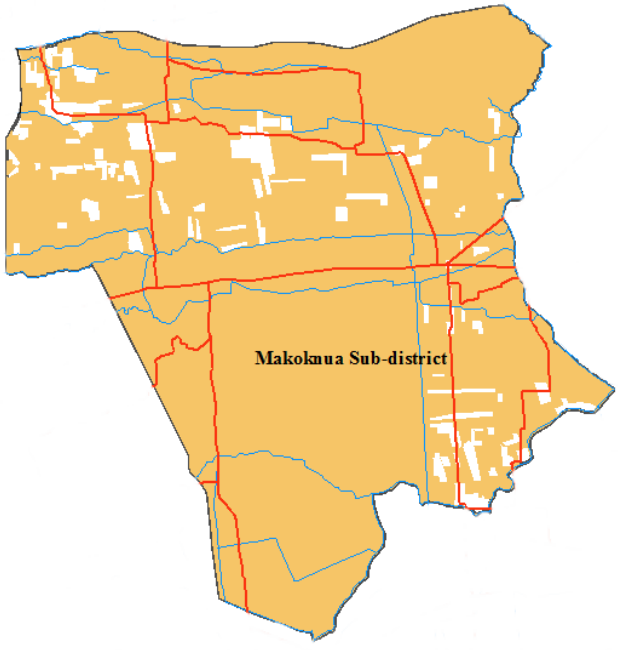


Fig.5. Paddy field area of Makoknua sub-district, Khunkanun District

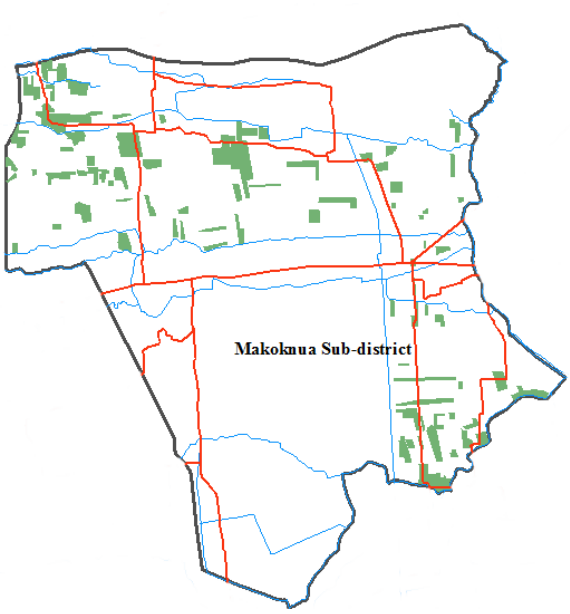


Fig.6. Rubber plantation area of Makoknua sub-district, Khunkanun District

The outbreak of rice bug in of the study area

The outbreak of rice bug was also investigated by using in dept interview to the farm owner. The results showed that the outbreak of rice bug was decreasing over the distance from the rubber plantation area (Fig.7).

The severity of rice bug outbreak during the rice seeding season was investigated via the field survey by using indepth interview to the rice farmers. Rice farmers responded the scale of severity from 1-10, it was found that the area paddy field where located near the rubber plantation area has higher sever of rice bug outbreak than the farer paddy field area. In the average, the level of severity reduced in every 100 meter of distance from rubber plantation (Fig.7).

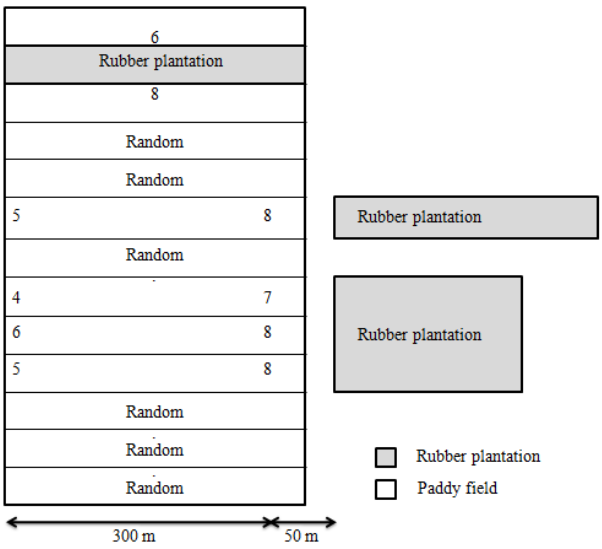


Fig.7. The level of severity of the outbreak of rice bug and distance to rubber plantation area

The risk area of rice bug outbreak of the study area

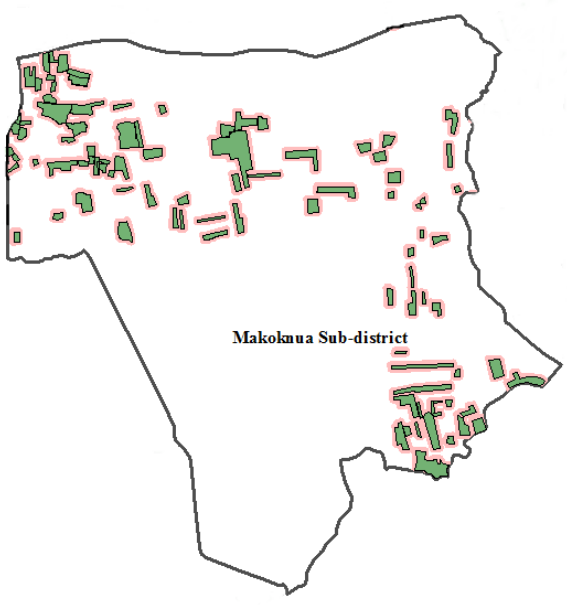
The area of rice bug outbreak according to severity level. The extremely severe of rice bug outbreak is the paddy that close to rubber plantation when the paddy has more distance from rubber plantation the severity level been decreases.

Table 2. The area of rice bug outbreak according to severity level

Severity level	Distance from rubber plantation area (m.)	Accumulated area of rice bug spread out (Hectares)	% of total area
Extremely severe	50	494.77	15.99
Very severe	100	784.91	25.36
Severe	150	1,034.75	33.44
Intermediate	250	1,439.70	46.52
Light	350	1,728.86	55.87

The extremely sever of the outbreak was found in 50 m. radius from the rubber plantation, the area of the highly risk to the outbreak was about 494 hectares or about 16% of the total area. The very sever and severe level was found with 100 and 150 m. radius from the rubber plantation and the accumulated area of very severe and severe level was about 784 and 1,034 hectares, or 25% and 33% respectively. Whereas the intermediate and light severe level was at 250 m and 350 m. radius from rubber plantation and 1,439 and 1,728 hectare (46% and 56%), respectively.

The severity level recognized from the field survey was encoded into GIS format in order to identify the radius from the rubber plantation according to relationship of the severity level and the distance from rubber plantation (Fig.8).



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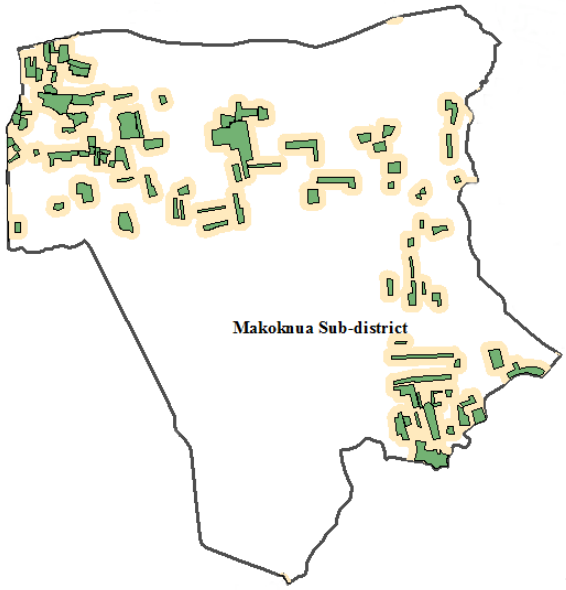

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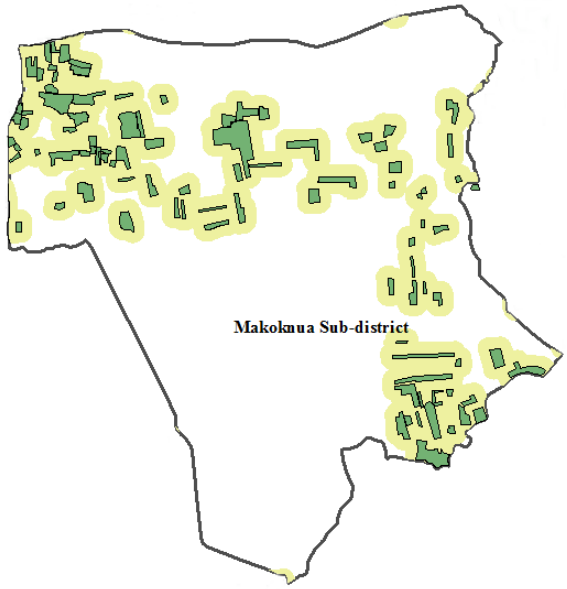

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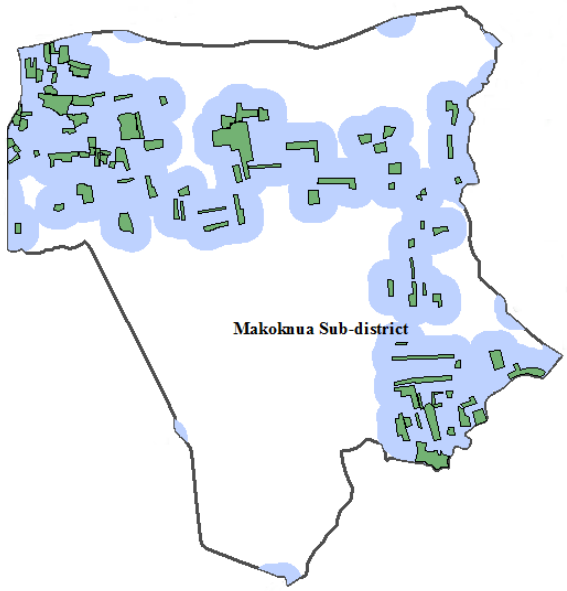

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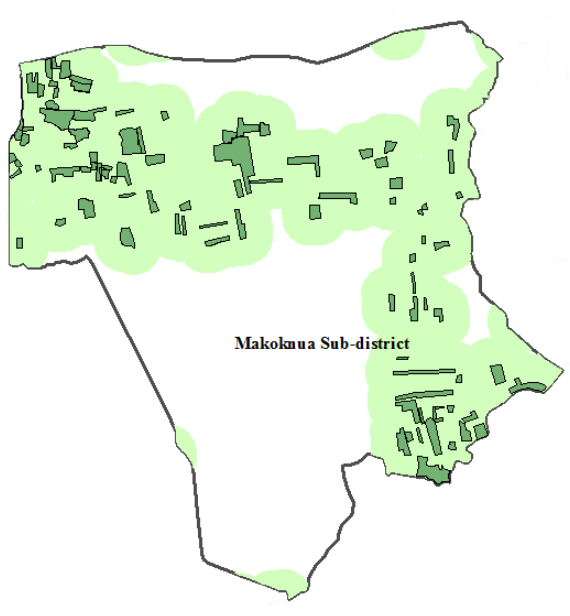

e.

Fig. 8. Map of severity level of rice bug outbreak (a=extremely severe, b= very severe, c=severe, d=intermediate, e=light)

5. DISCUSSION AND RECOMMENDATIONS

One ot the major factor causing abandoned paddy field is the cost of damages from rice insect pest, as the outbreaks and they destroy crop rapidly and make damage to crop product significantly. By knowing in earlier of the factors supporting the outbreak of the pest can help protecting the damaged caused by them.

Due to the sample area of this study, the area of rubber plantation was only 6% but it consequences the outbreak of rice bug up to about 56% with the most severe and sever of totally about 25% of the total area.

In case of the outbreak of the rice bug in Phatthalung province, rubber plantation where locating near the paddy field is the major cause. However, it is impossible to stop the land owner to plant the rubber tree in their own area. Therefore, the means of protecting rice from the bug is still needed in order to prevent the loss.

The weed-full rubber plantation can be the best habitat during the rice harvested area. The suitable means to eliminate the negative effects of the rice bug is to establish the weed and pest control during the rice harvested months in order to reduce the numbers of the bug during their resting period.

6. CONCLUSION

The damages from the rice bug are very high and resulting to abandoned field. The rice bug has very particular habitat and habit as they like resting in the weed-full area and they can wait until rice start seeding. The weed-full area such as rubber plantation can be their best habitat, therefore, the conversion of rice field to rubber plantation due to higher economic return not only cause food insecurity issue in the national level but also cause the unexpected outbreak of the rice bug in the local level.

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REFERENCES

[1] Phatthalung Agricultural Office. 2010. Phatthalung Province Website.
[2] Wantana Sriratanasak. 2007. Insect – rice pest and Protection Elimination: The Agricultural Co-operative of Thailand. Ltd.
[3] Bureau of Rice Research and Development (BRRD). 2009:29. Knowledge of rice pests: a guide for Thai farmers.
[4] Anisara, P. and R. Shrestha. 2007. Effect of Land Use Change on Rural Livelihoods: A Case Study of Phatthalung Watershed, Southern Thailand. In Proceeding of GMSARN International Conference. 12-14 December 2007. Pattaya, Chonburi, Thailand