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Monitoring in Soil Fertility Change in Tung Kula Rong Hai Using Geographic Information Systems

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***Abstract*—** *Tung Kula Rong Hai is a major source of jasmine rice in the northeastern region and is a major source of the country, but its yields are still very low at an average of 2,187-2,500 kg/hectare, compared to rice grown in other regions. The limitations such as drought and floods, because most of the area is located in rainfed area, the soil is low fertility, resulting in lower rice yield. So, in this study, we have monitored changes in soil fertility in rice fields in Tung Kula Rong Hai area to obtain basic information on improving the productivity of jasmine rice, the area has the potential to increase rice yield in Tung Kula Rong Hai area.*

The soil fertility evaluation was used to assess the Soil Survey Division Method (1980). The five soil chemical properties were determined, organic matter, cation exchange capacity, base saturation, available phosphorus and available potassium. The result of soil fertility evaluation showed that in 2004, most of the area had moderate abundance of 51.23% and low abundance of 37.95%. For the year 2017, Soil fertility in most areas was low at 84.86%, and moderate abundance was 0.50%. The results indicate that fertility of the soils in Tung Kula Rong Hai area is decreasing. This may be due to inadequate soil management methods for example the use of chemical fertilizers may increase. Some chemical fertilizers contain some trace elements in the soil, causing the soil to be more acid. This will reduce the availability of nutrients in the soil or the lack of soil improvement with organic matter, such as the use of manure, compost, or fresh manure. As a result, the soil lacked abundance..

***Keywords*—** *Jasmine Rice, Soil Fertility Change, Tung Kula Rong Hai, Soil Improvement*.

I. INTRODUCTION

Tung Kula Rong Hai is a major source of good quality jasmine rice in Thailand because smells like Pandanus, a long grain, whiteness, it's rice cook sequins and soft, two cultivars in Thailand are KDML 105 and KDML 15. The most cultivated varieties are KDML 105 (Department of Rice, 2009). At present, yields in this region are very low, with average yields of 2,187-2,500 kg / hectare, such as Mahasarakham province yielding 2,843 kg / hectare in year 2009 production (Saosama, 2011) and average yield of 2,593 kg / hectare in Srisaket province (Kumla, 2012) compared to rice grown in other regions because the most of area is located in rainfed and low fertility, resulting in lower rice yield. Therefore, improving the productivity of jasmine rice at the farmer level is important and it is found that soil fertility is very important for increasing yield because it's will change over time depending on different soil fertility management, as well as for cropping the other in after season. These reasons have affect to change of soil fertility in Tung Kula Rong Hai area, so in this study we have monitored changes in soil fertility in rice fields to obtain basic information on improving the productivity of jasmine rice in Thailand.

II. MATERIALS AND METHODS

2.1) Materials

- Topographic Map Scale 1: 50,000
- Detection of the Position is GPS
- Soil Map in Tung Kula Rong Hai Scale 1:100,000
- Soil Sampling Kits, Computers and GIS Software

2.2) Methods

1) Point calculation

The number of soil samples in Tung Kula Rong Hai can be calculated by using the scale on a survey 1: 100,000, which is semi-detail survey (Keawruenrom, 1999) the sampling point of soil survey is calculated by method of Forbes et al. (1984.) as follows.

Number of survey = $(1/50) \times 10^{10} \times (\text{scale of the survey})^2$
$= (1/50) \times 10^{10} \times (1/100{,}000)^2$
= 1 point per 50 square kilometers.
= 62.70 points per Tung Kula Rong Hai all areas (3,135.41 square kilometers)

The result, we found that should be at least about 63 points, and this study was conducted on 67 samples for soil sampling is cover 12 districts with 5 provinces, namely Kaset Wisai, Pathum Rat, Suwannapoom, Phon Sai, Nong Hee District in Roi-Et Province, and Rasi Salai, Sila Lad District in Srisaket Province, for Maha Chana Chai, Kho Wang District in Yasothon Province, and Tha Tum, Chumphon Buri District in Surin Province, and Phayakkhaphum Phisai District in Mahasarakham Province with geographical location coordinates, etc. (Figure 1)

2) Data collection

Collected data related research and determine the criteria for levels of the chemical properties to assess soil fertility of soil survey method (1980), along with soil sampling point calculations in the study area. In this soil sampling that main reference of soil series and then will mark point on the map, covering 5 provinces in Tung Kula Rong Hai area. After that, soil samples collected in the field, at depth 0-30 cm of 67 samples with the recorded values of the coordinates, geographic position, etc.

3) Data analysis

Soil samples were analyzed in the laboratory for the analysis of soil chemical properties for example organic matter, cation exchange capacity, base saturation, available

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phosphorus (P_2O_5) and exchangeable potassium (K_2O) and then to assess the level of soil fertility on the soil survey method (1980) after it imports the data processing and data analysis in GIS to make the map show level of soil fertility, and maps showing the changing fertility of soil, along with written report on the results of the study.

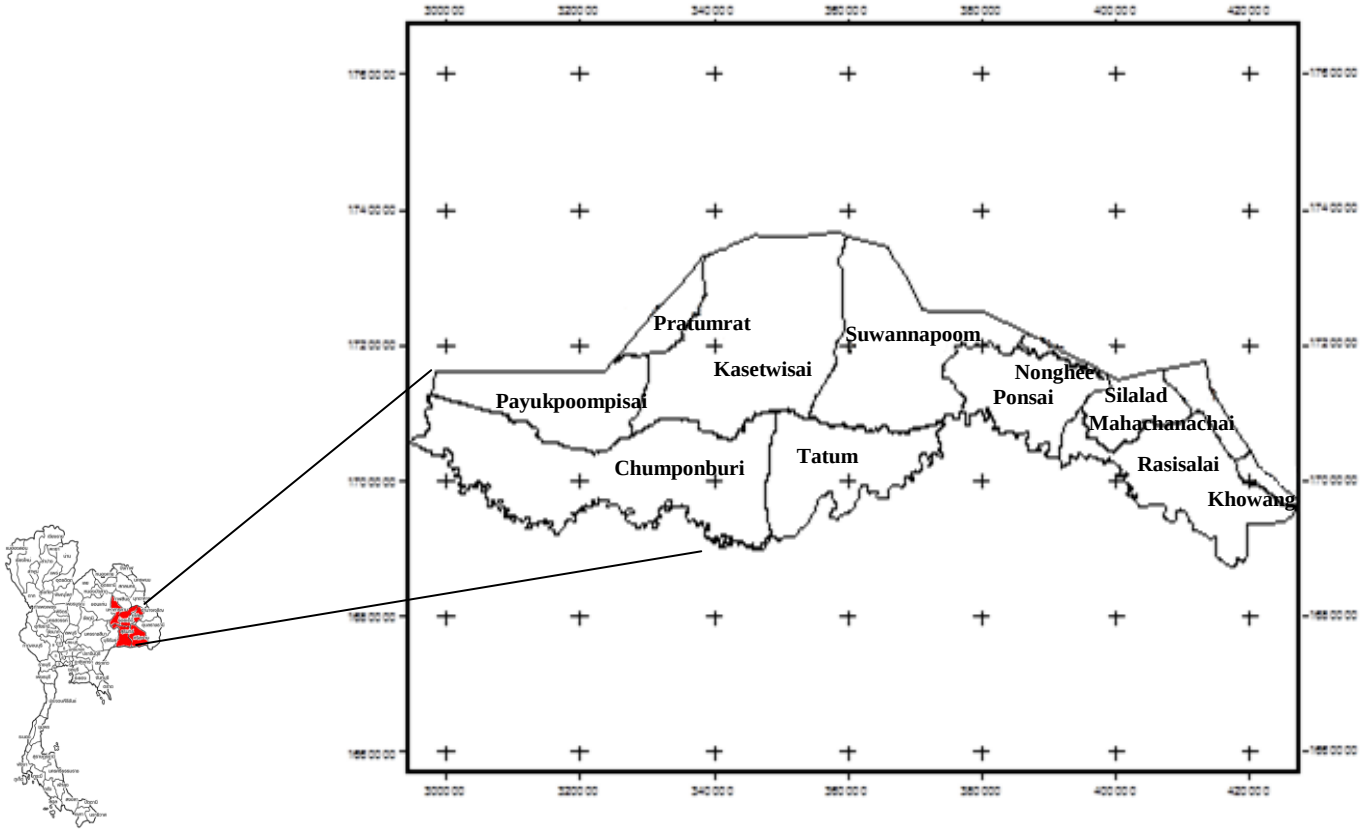


Fig. 1. Study area (Tung Kula Rong Hai).

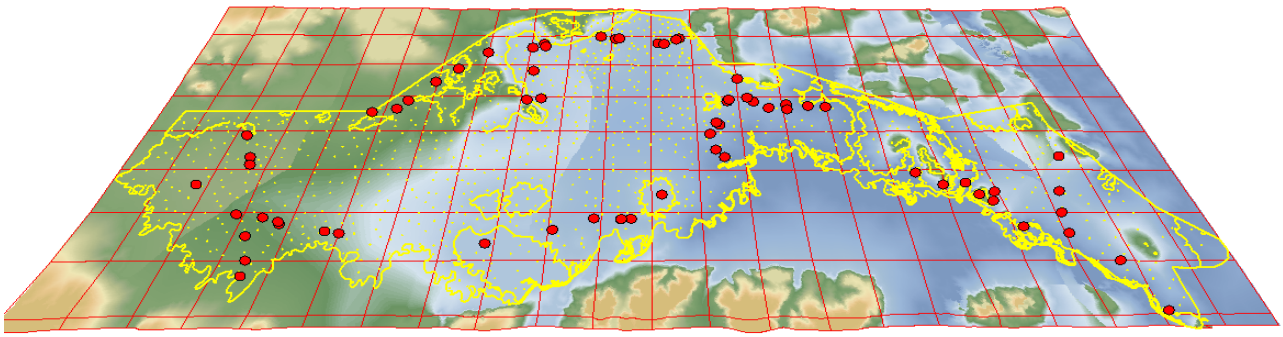
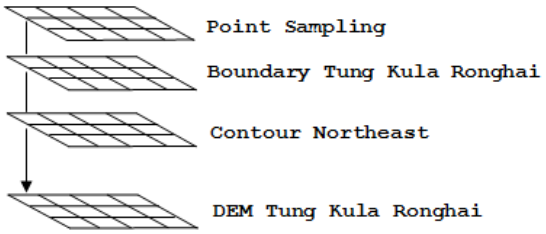


Fig. 2. Soil sampling point in Tung Kula Rong Hai.



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III. THE RESULT

3.1) General Data

Tung Kula Rong Hai, is located in the Northeast of Thailand and total area approximately 336,000 hectare. The territory covers 12 districts of 5 provinces including: Kaset Wisai, Pathum Rat, Suwannapoom, Phon Sai, and Nong Hee of Roi Et Province, Rasi Salai, and Sila Lad of Srisaket Province, Maha Chana Chai, and Kho Wang of Yasothon Province, Tha Tum and Chumphon Buri of Surin Province and Phayakkhaphum Phisai of Mahasarakham Province which 45.13% in Roi-Et, 29.93% in Surin, 13.74% in Srisaket, 8.42% in Mahasarakham and 2.71% in Yasothon, respectively (Fig.1) Topography is a wide pan around will be gradual high terrace to middle terrace (broad depression) almost area is flat, soil slope 0-2%, shaped length from west to east 50 kilometers and wide from north to south 50 kilometers located to the southeast of the Korat Plateau, Northeast of Thailand at the latitude 15° 14′ N to 15° 44′ N and longitude 103° 4′ E to 104° 20′ E. (Fig.2) The most of area is located in the soil group 20, which is the Kula Rong Hai series (Ki) is about 50,489.70 hectare or 16.10% of the total area. The next is Thawat Buri and Tha Tum series (Th -Tt) of soil complexes unit, which belong to soil group 7 are 43,987.46 hectare or about 14.03%, etc. Characteristics of soil group 20 is a soil salinity cause by sedimentary river, salt strains on surface or hardpan with salt accumulation within the depth of 100 cm from surface. The soil reaction is slightly acid to alkaline, poorly drainage, low fertility, loamy sand, shortage of water resources in the area of saline soils and flooding in the rainy season which will damage the plant does not like water, etc. For soil group 7 found that is very deep clay soil group cause by sedimentary river, soil pH is neutral to alkaline, poorly drainage, moderate fertility, solid structure, hard plowing and flooding in rainy season. The land use of almost areas is used to rice planting and slope area is 0-1%.

At present, the yield of jasmine rice in Tung Kula Rong Hai area is very low in the range of 2,187-2,500 kg / hectare, compared with rice grown in the other regions due to some limitations such as drought, flood, rainfed area and low fertility. So as a result, rice production decrease. However, jasmine rice in Tung Kula Rong Hai area has a moderate aroma of 68.80%, with a very aroma and soft aroma of only 19.96% and 3.55%, respectively. (Saetung and Trelo-ges, 2017)

3.2) Result of Soil Analysis

Soil sampling depth 0-30 cm the number 67sample to analyze the soil chemistry including: organic matter, cation exchange capacity, base saturation, available phosphorus and potassium in the soil, in order to evaluate the soil fertility. The result in year 2003, show that most of area have low organic matter was <1.50%, low cation exchange capacity was <10 cmol / kg, moderately base saturation was 35-75%, low available phosphorus <10 mg / kg and low exchangeable potassium <60 mg / kg. The soil chemical properties in year 2017, reveal that the organic matter content is low in the soil was <1.5%, low cation exchange capacity was <10 cmol / kg, low base saturation <35%, low available phosphorus <10 mg / kg and low exchangeable potassium <60 mg / kg, etc.

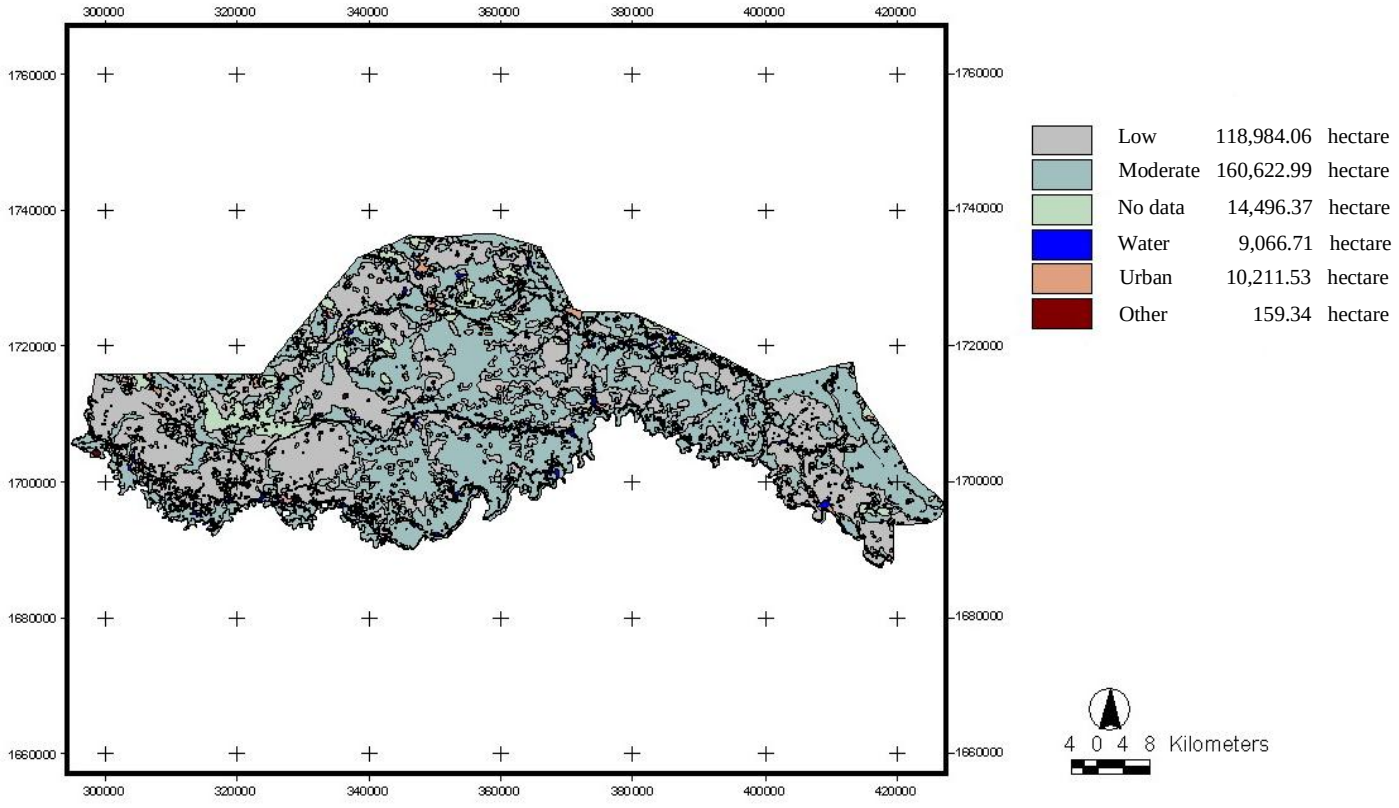

Fig. 3. Soil fertility in Tung Kula Rong Hai in year 2004.

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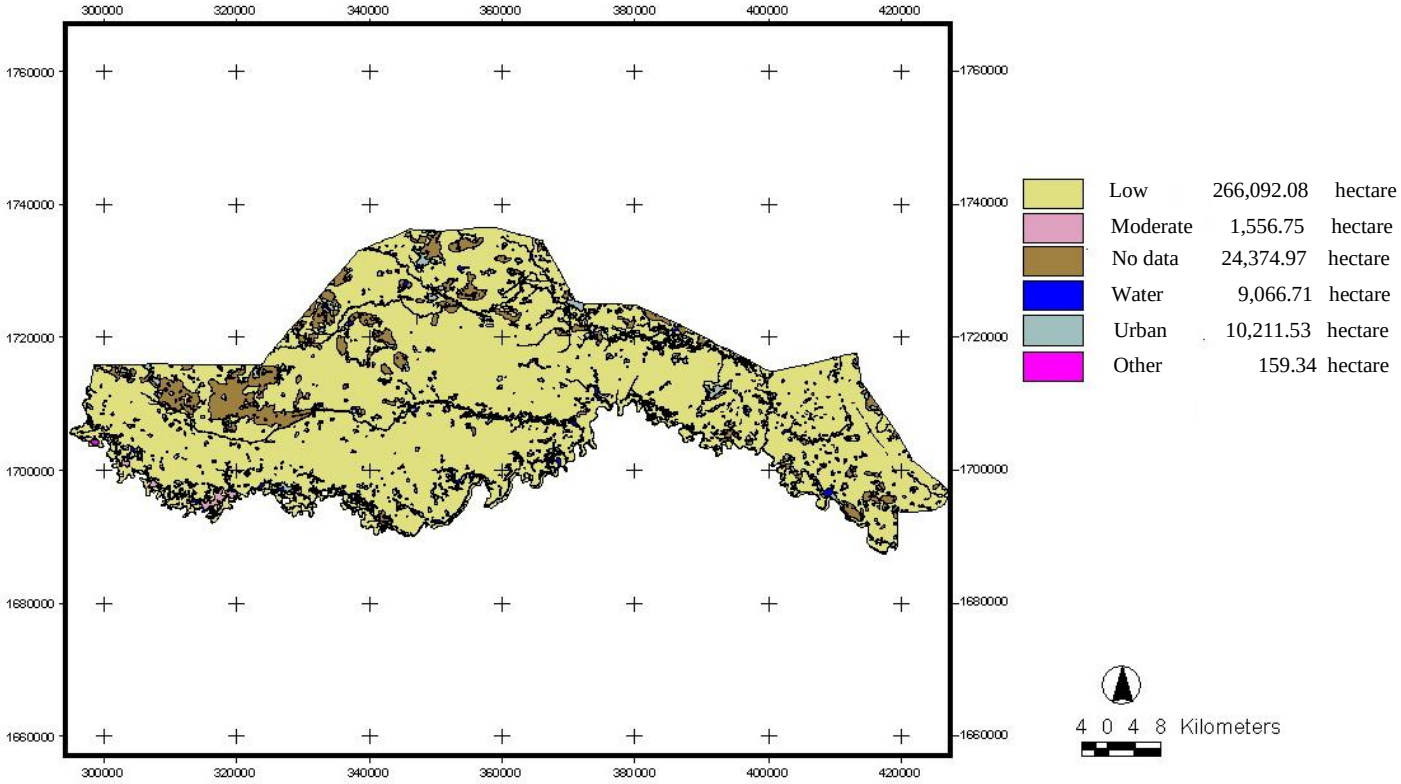

Fig. 4. Soil fertility in Tung Kula Rong Hai in year 2017.

3.3) Soil Fertility Change

In the soil fertility evaluation, using soil survey method (1980) with 5 factors of soil chemical properties including: organic matter, cation exchange capacity, base saturation, available phosphorus and exchangeable potassium. The estimation method is based on the values of the soil properties. The minimum criteria is 1 score, the medium criterion is 2 score and the high criterion is 3 score. If the total score is ≤ 7 the soil has a low fertility level, the total score in range of 8-12 is considered to be moderate fertility and the total score is ≥ 13 the soil has high fertility. The results showed that in year 2003, the most of area was moderate fertility of 160,623 hectare or 51.23%, low fertility of 118,984 hectare or 37.95%. (Fig.3) In year 2017, the soil fertility in area was mostly low at 266,092 hectare or 84.86%, medium level was 1,556 hectare or 0.50%. (Fig.4)

The results of this study found that the average soil fertility in Tung Kula Rong Hai area are moderate in abundance decreased about 159,066 hectare or 50.73%, low fertility increased approximately 147,108 hectare, or 46.92%. It is evident that the changing area will be mostly low fertility. It can be said that the medium fertility area has changed to a low fertility area. The results show that soil fertility in Tung Kula Rong Hai area is decreasing, this may be due to invalid management of soils, such as may have to use chemical fertilizers increased which some trace element will increase the acidity of the soil, lack of soil improvement with organic matter continuously, such as may be the use of manure, compost or green manure, the content is little, therefore, as a result making the soil lacks fertility, etc. It also found that medium-fertility areas has changed to a low fertility areas increase. It will find the district, Chumphon Buri, Prathumrat, Tha Tum, Nong Hee, Kasetwisai, Suwannapoom, Phon Sai, Kho Wang, Mahachana Chai, Silalad and etc.

IV. Conclusion and Discussion

4.1) The average soil fertility in Tung Kula Rong Hai area are moderate in abundance decreased about 50.73%, low fertility increased approximately 46.92%. It is evident that the changing area will be mostly low fertility. It can be said that the medium fertility area has changed to a low fertility area.

4.2) Soil fertility in Tung Kula Rong Hai area is decreasing, this may be due to invalid management of soils, such as may have to use chemical fertilizers increased which some trace element will increase the acidity of the soil, lack of soil improvement with organic matter continuously, such as may be the use of manure, compost or green manure, the content is little, therefore, as a result making the soil lacks fertility, etc.

4.3) The moderate fertility areas has changed to low fertility areas increase. It will be find the district, Chumphon Buri, Prathumrat, Tha Tum, Nong Hee, Kasetwisai, Suwannapoom, Phon Sai, Kho Wang, Mahachana Chai, Silalad and etc.

V. Suggestion

1) Soil fertility can be stored as an initial database in the GIS to monitor soil fertility changes next time.

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2) The soil fertility data can be applied to zoning the production of jasmine rice in Tung Kula Rong Hai area.

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