ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 07, Issue, 12, pp.17451-17460, December, 2017

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

ASSESSMENT OF SOIL NUTRIENT UTILIZATION FOR JASMINE RICE USING GEOGRAPHIC INFORMATION SYSTEMS IN TUNG KULA RONG HAI AREA

[1,*]Whadcharee Saetung and [2]Vidhaya Trelo-ges

[1]Land Resources and Environment Section, Department of Plant Science and Agricultural Resources, Faculty of Agriculture, Khon Kaen University
[2]Ph.D. Students, Soil Science and Environment Section, Faculty of Agriculture, Khon Kaen University

ARTICLE INFO

Article History:
Received 12th September, 2017
Received in revised form
08th October, 2017
Accepted 18th November, 2017
Published online 29th December, 2017

Key Words:
Soil Nutrient Utilization,
Jasmine Rice,
Tung Kula Rong Hai,
Potential.

ABSTRACT

Tung Kula Rong Hai is mostly sandy soil, lack of plant nutrients, flooding in some areas, water shortage of the growing season, flooding end of season and rainless in dry season, soil is spreading salinity, farmers lack motivation to improve the soil and the use of technology to increase crop yields. As a result, some areas of Tung Kula Rong Hai used to grow rice have reduced yield problems and low quality rice makes the aroma decrease. This problem is due to the fact that available of soil nutrients have decreased, especially nitrogen, phosphorus and potassium. This will affect the yield and quality of rice in terms of aroma, softness, toughness, etc. Therefore, the study on the usefulness of soil nutrients in Tung Kula Rong Hai area is important. The results of this study showed that the almost of area, total N content in the soil was found to be in the medium level of 0.02-0.04%, soil pH will have a moderate was >5.0-5.5, available phosphorus is low 10 mg/kg, potassium in soil is low 4-15 mg/kg, etc. The study suggests that to cultivate rice quality and high yield are need to have the quantity of nutrients in the soil, and soil pH that is appropriate such as nitrogen must be higher than 0.04%, available phosphorus must be greater than 25 mg/kg and available potassium higher than 50 mg/kg. It also requires soil pH suitable for rice planting is in the range of 5.0-6.5, etc. The results of this study suggest that almost of Tung Kula Rong Hai area will be available of soil nutrients are relatively low is 45.80% of total area, this may be due to the soil contain available phosphorus and potassium in low-threshold, mostly which may be caused by a runoff and leaching of various nutrients in the soil loss during the rainy season.

Citation: Whadcharee Saetung and Vidhaya Trelo-ges. 2017. "Assessment of soil nutrient utilization for jasmine rice using geographic information systems in tung kula rong hai area", *International Journal of Development Research*, 7, (12), 17451-17460.

INTRODUCTION

Tung Kula Rong Hai is the most famous jasmine rice in the Northeast of Thailand and aroma than growing in other areas. In order to produce good quality jasmine rice, it is necessary to consider aroma, taste and softness important for consumption and export to foreign countries. The present, Tung Kula Rong Hai area are plantation approximately 204,176.48 hectare, a total of yield 411,493 kg and average yield 2,012.50 kg / hectare. However, productivity has remained low because the soil of Tung Kula Rong Hai area is mostly sandy soils, deficient in plant nutrients and acid of soil properties.

Corresponding author: **Whadcharee Saetung,**
Land Resources and Environment Section, Department of Plant Science and Agricultural Resources, Faculty of Agriculture, Khon Kaen University.

In some areas flooding could not to be controlled, water shortage in growing season, flood at end of the growing, drought in dry season and soil salinity is spreading as well as the farmers lack incentives to improve the soil and use technology increase plant productivity. As a result, Tung Kula Rong Hai in some areas has a decreased productivity and low quality due to rice with the aroma decrease. This problem will make the benefits of soil nutrients have reduced quantity especially nitrogen, phosphorus and potassium that affect the productivity and quality of rice in the aroma, softness and toughness, etc. More from the research, found that the soil with high nitrogen is suitable for rice production because soil nitrogen content increased the amount of proline higher which proline is a precursor in the production of aromatic compounds 2AP (2-acetyl-1-pyrolline) in rice, etc. (Yang etal., 2012) It is also found that the cultivation of rice on high potassium soils

will produce rice with a high aroma, whiteness and high sequins as well. (Suwannarit *et al*., 2002) Therefore, the study on the usefulness of plant nutrients in Tung Kula Rong Hai area for rice cultivation is important.

MATERIALS AND METHODS

MATERIALS

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

METHODS

The Soil Sampling

The field survey was soil samples at 0-30 cm of soil depth for 67 samples. The number of soil samples can be calculated by using the scale on a survey 1: 100,000, which is semi-detail survey (Keawruenrom, 1999), so the point of survey is calculated by method of Forbes *et al*. (1984.) as follows. Number of survey = $(1/50) \times 10^{10} \times (\text{scale of the survey})^2$ 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 Lat 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)

Data Collection

Collected data related research and determine the criteria for levels of soil chemical properties to estimate the benefits of soil nutrients (Table1) with sampling point calculations in this location that main reference of soil series and then will mark point on the map, covering 5 provinces in Tung Kula Rong Hai area.

Soil Analysis

Soil samples were analyzed in laboratory to determine the soil chemical properties, total nitrogen, available phosphorus (P_2O_5), available potassium (K_2O) and soil pH. The evaluation of soil nutrient levels was done by scoring the results. Each soil property gives different values depending on the chemical properties analyzed. By assigning level a very low is 0.20 score, minimum level 0.50 score, medium level 0.80 score and high level 1.00 score. (Table1) Then bring up the scores of useful factor soil nutrients total 4 factors multiplied together. And take a multiplier that has come to define the range of score and then to assess the level of potential benefits of nutrients in the soil. If total score multiplier is value range ≥ 0.40960 that has huge potential, the score multiplier in range 0.17335 -0.40960 is moderate potential, the total score in range 0.06250 – 0.17355 that has the least potential and if the multiplier points in range ≤ 0.06250 that are non-potential (Table 2).

Index of Soil Nutrient

Import data index available of soil nutrients into geographic information system by determining the level of benefits of each factor is as follows:

- Given total nitrogen content in the soil, there is a high level in range >0.04%, as medium level in range 0.02-0.04% and low level in range < 0.02%.
- Determine the available phosphorus in high level range >25 mg/kg, as medium level in range 10-25 mg/kg and low level in range <10 mg/kg.
- Define the content of potassium in soil (exchangeable potassium), the value is High in range >50 mg/kg, as a medium in range >15-50 mg/kg, low level 4-15 mg/kg and very low in range <4 mg/kg.
- Soil pH have a high value in range >5.5-6.0, as medium level is soil pH >5.0-5.5, low level of soil pH 4.0-5.0 and very low of soil pH >6.0, <4.0
- Import data, information processing and data analysis in GIS to make the map show the benefits of soil nutrients.

Potential of Soil Nutrient

Import data potential benefits of soil nutrient into a geographic information system and define the potential benefits of soil nutrient as follows:

- Determining potential benefits of soil nutrients is high level in value range ≥0.40960, as a medium in range 0.17335 - 0.40960, low level is value 0.06250 -0.17355 and non-potential value range ≤0.06250.
- Imports the data processing and data analysis in geographic information system to produce a map showing potential benefits of nutrients in the soil along with written report on the results of the study.

RESULTS

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 Lat 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 (Figure1). 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. (Figure2)

Index of Soil Nutrient

Collecting soil samples at depth 0-30 cm of 67 samples for analyze index of soil nutrients 4 factors are include total N, available phosphorus, exchangeable potassium and soil pH. The result revealed that most areas will have total nitrogen content in the soil an average 0.02-0.03% (49 points),

Table 1. Available index of soil nutrient

Nutrient Level	Available Index of Soil Nutrient			
	Total N (%)	Available P (mg/kg)	Exchangeable K (mg/kg)	Soil pH
1. High	>0.04	>25.00	>50.00	>5.50-6.00
(The Score)	1.00	1.00	1.00	1.00
2. Medium	0.02-0.04	10.00-25.00	>15.00-50.00	>5.00-5.50
(The Score)	0.80	0.80	0.80	0.80
3. Low	<0.02	<10.00	4.00-15.00	4.00-5.00
(The Score)	0.50	0.50	0.50	0.50
4. Very Low	-	-	<4.00	>6.00, <4.00
(The Score)	-	-	0.20	0.20

Note: Modified from (Jongruk 2004)

Table 2. The potential available of soil nutrient

Potential Level	The Score
1) High	≥0.40960
2) Medium	0.17335 – 0.40960
3) Low	0.06250 – 0.17355
4) Non	≤0.06250

Note: Modified from Jongruk (2004)

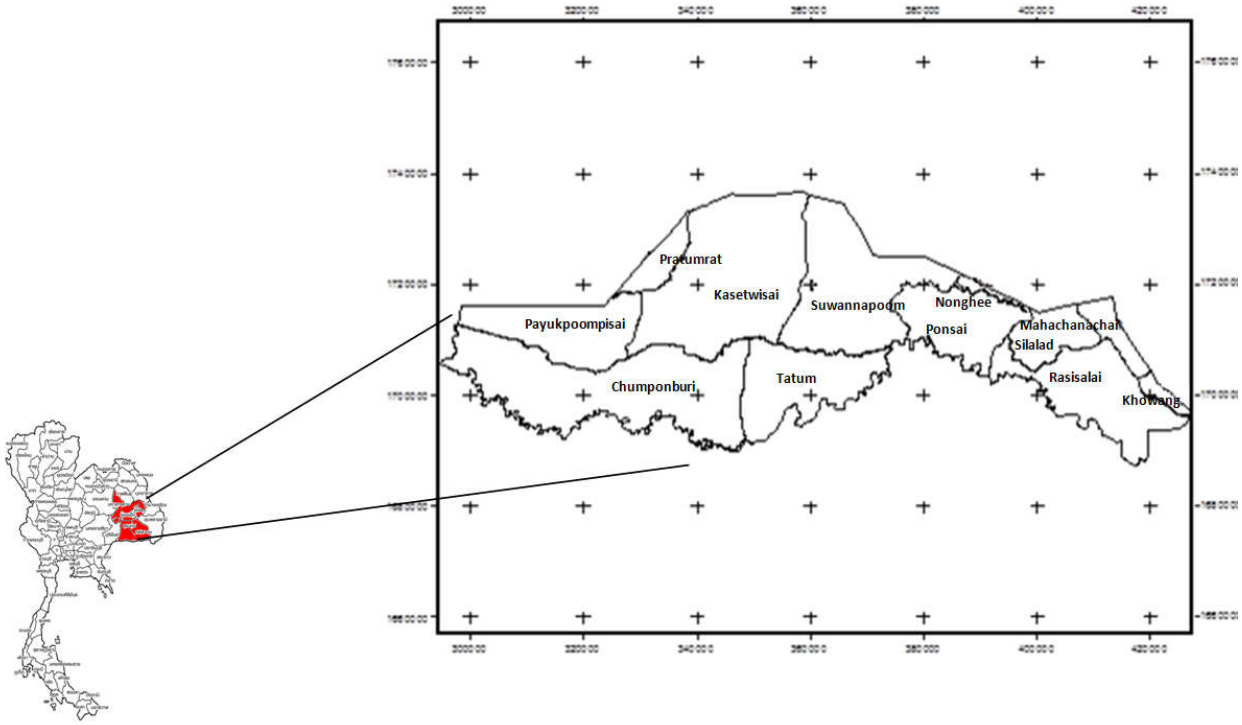

Figure 1. Study area (Tung Kula Ronghai)

phosphorus which benefits the average 3.00-6.00 mg/kg (42 points), potassium content is useful on average 3-15 mg / kg (43 points) and the soil pH was 5.0 - 6.0 (35 points) (Table 3). When the nutrient index was taken into consideration, the nutrient level in soil was to be at the moderate level 0.02-0.04%, representing area of 247,790.04 hectare, or about 79.03% of the total area, the next level of nitrogen content is low <0.02% in area 10,983.65 hectare or about 3.50% and nitrogen content was high at >0.04%, which was a little only 8,186.46 hectare or 2.62%.(Figure 3). In soil pH, it was found that the most area of soil pH is appropriate medium level in range >5.00-5.50 of 132,293.95 hectare, or about 42.19%, and the next is minimum level in range 4-0-5.0 equivalent to 125,374.90 hectare or 39.98% of total and soil pH are appropriate level is high with a pH in range >5.50-6.0 equivalent to 9,291.31 hectare or about 2.96%. (Figure 4) The available phosphorus in soil, it was found that most of area is a low nutrient level in the range <10.00 mg/kg which accounts for 264,381.20 hectare or 84.32% of total area and found that only a small percentage of medium in range 10.00-25.00 mg/kg, which is 2,578.97 hectare or 0.82%. (Figure 5) In the field of potassium, it is found that most of nutrient content in the soil is low about 4.00-15.00 mg/kg, which is 131,801.65 hectare or 42.03% of the total area, and the next potassium is beneficial moderate approximately >15.00-50.00 mg/kg, which is 104,887.90 hectare, or 33.45%, next is the potassium in soils is very low in range approximately < 4.00 mg/kg which is 18,982.98 hectare, or 6.05% and potassium is high in range > 50 mg/kg, representing only a small area of 11,287.62 hectare or 3.60% of the total area. (Figure 6)

Potential Available of Soil Nutrient

Analysis of soil nutrient beneficial, use soil properties to determine very low equal to 0.20 score, low level 0.50 score,

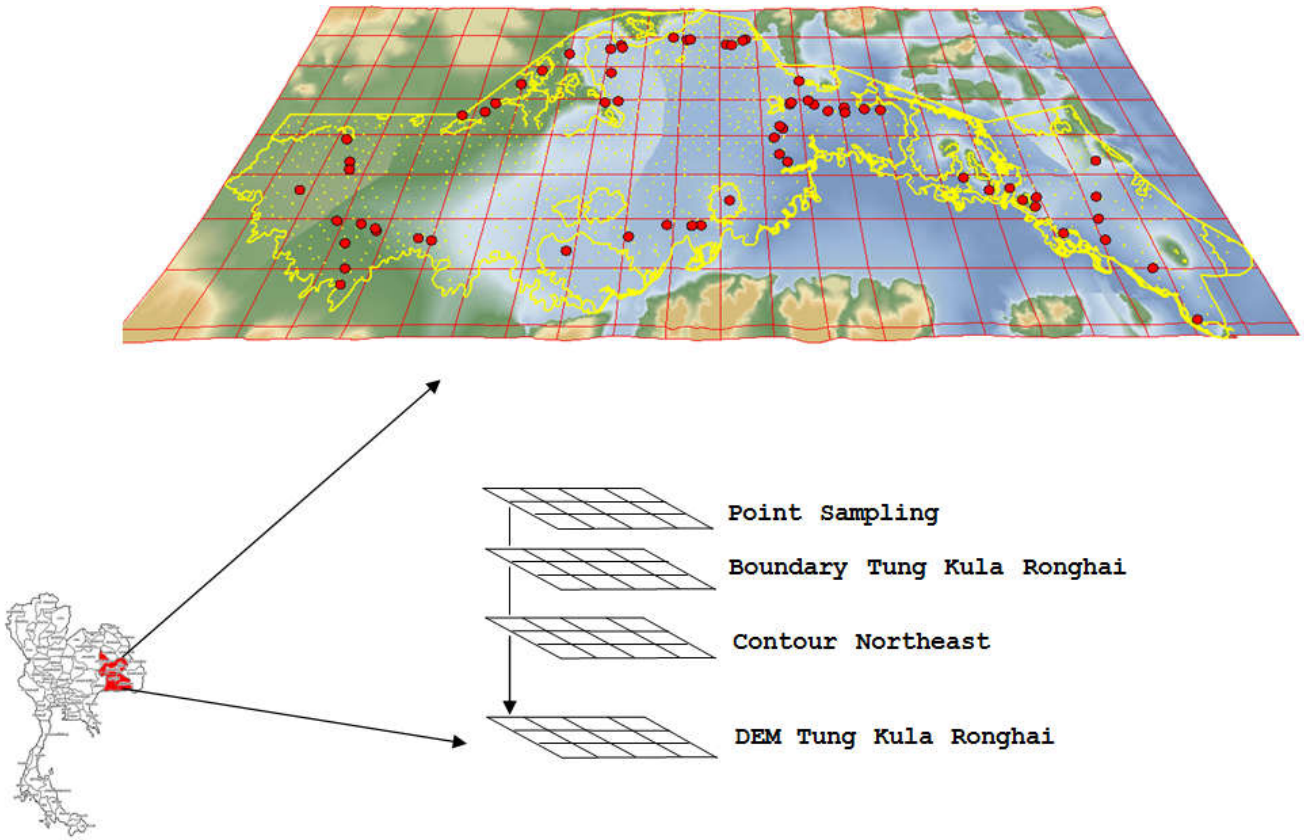

Figure 2. Soil sampling point in Tung Kula Ronghai

Table 3. Analysis of soil chemical properties at depth 0-30 cm in year 2017

Soil Sampling	Geographical Coordinates		Total N (%)	Soil pH	Available P (mg/kg)	Exchangeable K (mg/kg)
	x coordinate	y coordinate				
1	369685	1709820	0.03	5.50	9.00	9.00
2	342260	1696771	0.03	5.40	2.00	9.00
3	345261	1729193	0.02	6.00	3.00	11.00
4	379877	1717405	0.02	5.30	8.00	8.00
5	370706	1708697	0.06	4.90	5.00	37.00
6	330915	1721423	0.03	4.70	6.00	10.00
7	343605	1728375	0.02	5.00	4.00	13.00
8	371799	1717895	0.03	4.90	5.00	6.00
9	315705	1700075	0.04	5.20	6.00	22.00
10	355877	1730254	0.02	5.30	3.00	9.00
11	316095	1694775	0.09	4.60	3.00	440.00
12	354484	1699937	0.02	5.60	3.00	12.00
13	310542	1708632	0.07	4.80	6.00	13.00
14	365544	1730360	0.03	4.80	6.00	25.00
15	363230	1729239	0.02	5.60	20.00	45.00
16	346046	1718440	0.02	4.90	4.00	5.00
17	317710	1699545	0.01	5.20	2.00	4.00
18	316380	1692967	0.03	4.90	3.00	70.00
19	305805	1704588	0.08	5.10	2.00	6.00
20	317985	1699212	0.03	5.80	5.00	6.00
21	312417	1700493	0.03	5.50	2.00	18.00
22	323625	1715935	0.03	4.90	3.00	6.00
23	356477	1730378	0.02	5.00	4.00	4.00
24	333569	1723958	0.01	4.70	4.00	27.00
25	323589	1698329	0.03	5.10	9.00	17.00
26	353649	1730747	0.03	5.20	2.00	5.00
27	314743	1697705	0.02	4.90	3.00	90.00
28	357699	1699841	0.03	5.40	9.00	9.00
29	375412	1717879	0.01	5.10	3.00	9.00
30	311049	1707465	0.06	5.60	4.00	14.00
31	370455	1713835	0.02	5.10	4.00	5.00
32	325287	1698048	0.03	4.50	3.00	32.00
33	308512	1712058	0.01	5.30	2.00	6.00
34	362330	1729355	0.02	5.00	4.00	2.00

Note: Soil Analysis (2017)

Continue……

Soil Sampling	Geographical Coordinates		Total N (%)	Soil pH	Available P (mg/kg)	Exchangeable K (mg/kg)
	x coordinate	Y coordinate				
35	394506	1706310	0.03	4.60	2.00	11.00
36	374619	1718613	0.02	5.20	2.00	16.00
37	369055	1712390	0.03	5.30	7.00	3.00
38	377376	1716825	0.03	4.70	6.00	38.00
39	326805	1716545	0.02	5.00	15.00	14.00
40	362569	1703175	0.04	5.00	5.00	11.00
41	358921	1699895	0.04	5.00	4.00	24.00
42	379870	1716560	0.03	5.10	4.00	8.00
43	382895	1717165	0.03	4.80	4.00	31.00
44	327938	1717980	0.02	4.80	3.00	19.00
45	365089	1730098	0.02	4.50	2.00	26.00
46	345464	1728645	0.02	4.90	3.00	11.00
47	373580	1722090	0.08	4.90	2.00	12.00
48	357762	1699847	0.03	5.00	8.00	12.00
49	370016	1714255	0.04	4.80	5.00	8.00
50	385280	1716987	0.02	4.80	12.00	10.00
51	337193	1727254	0.03	4.30	7.00	16.00
52	349788	1698495	0.03	4.80	5.00	4.00
53	402278	1702340	0.02	5.60	3.00	18.00
54	344320	1723665	0.03	5.20	4.00	8.00
55	344125	1718196	0.02	5.00	4.00	6.00
56	413898	1694715	0.03	4.90	10.00	6.00
57	409866	1698088	0.03	4.60	4.00	3.00
58	410095	1700766	0.01	4.50	3.00	5.00
59	402998	1703595	0.01	5.00	3.00	14.00
60	397106	1704598	0.02	5.00	5.00	7.00
61	400189	1704846	0.03	4.50	2.00	36.00
62	411050	1703668	0.04	4.80	6.00	12.00
63	413218	1708789	0.03	4.50	6.00	12.00
64	400846	1703225	0.02	4.80	31.00	16.00
65	372008	1718260	0.03	4.90	4.00	5.00
66	404945	1698870	0.04	5.00	1.00	26.00
67	416343	1689090	0.02	4.60	2.00	20.00

Note: Soil Analysis (2017)

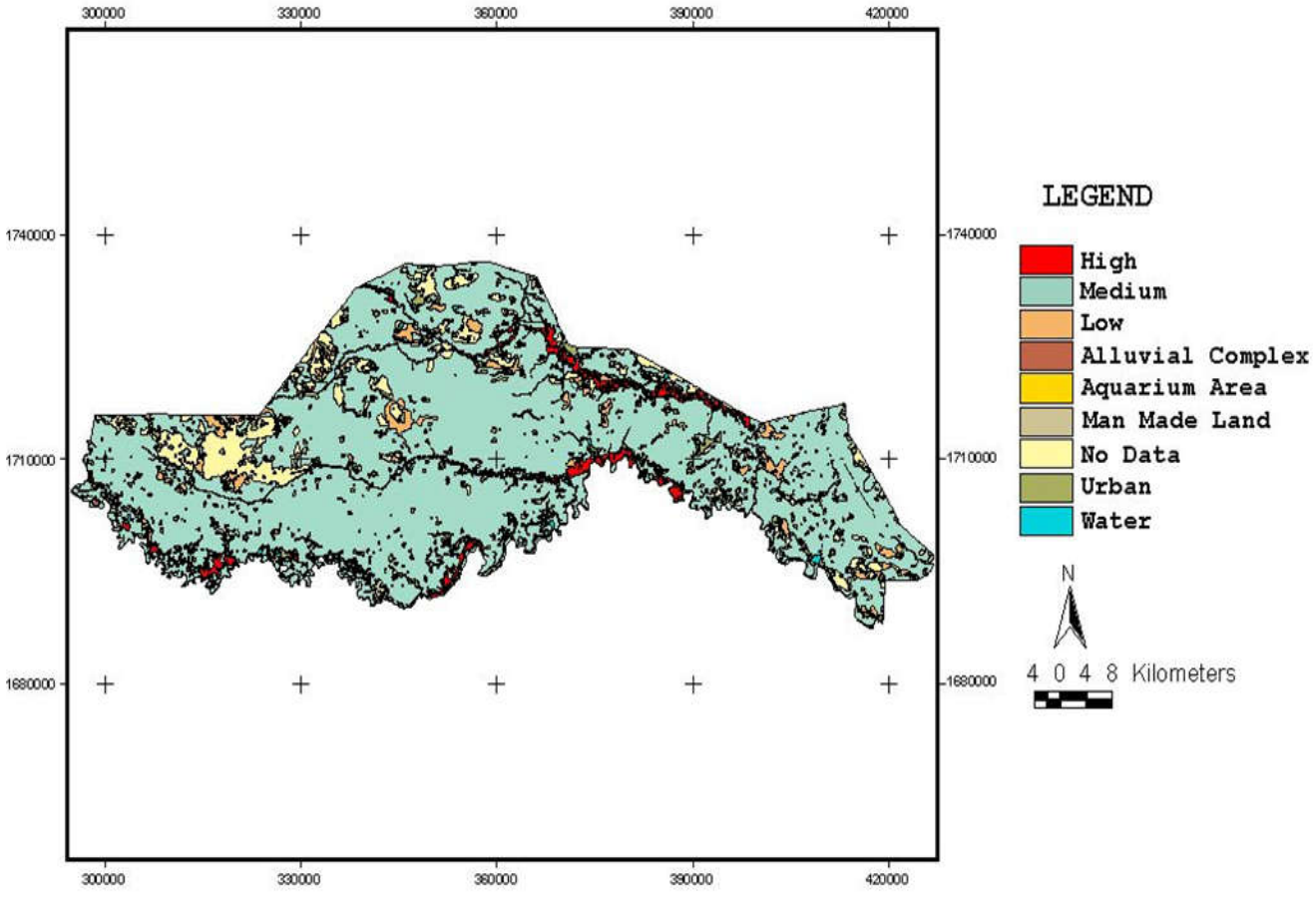

Figure 3. The usefulness of total nitrogen in the soil

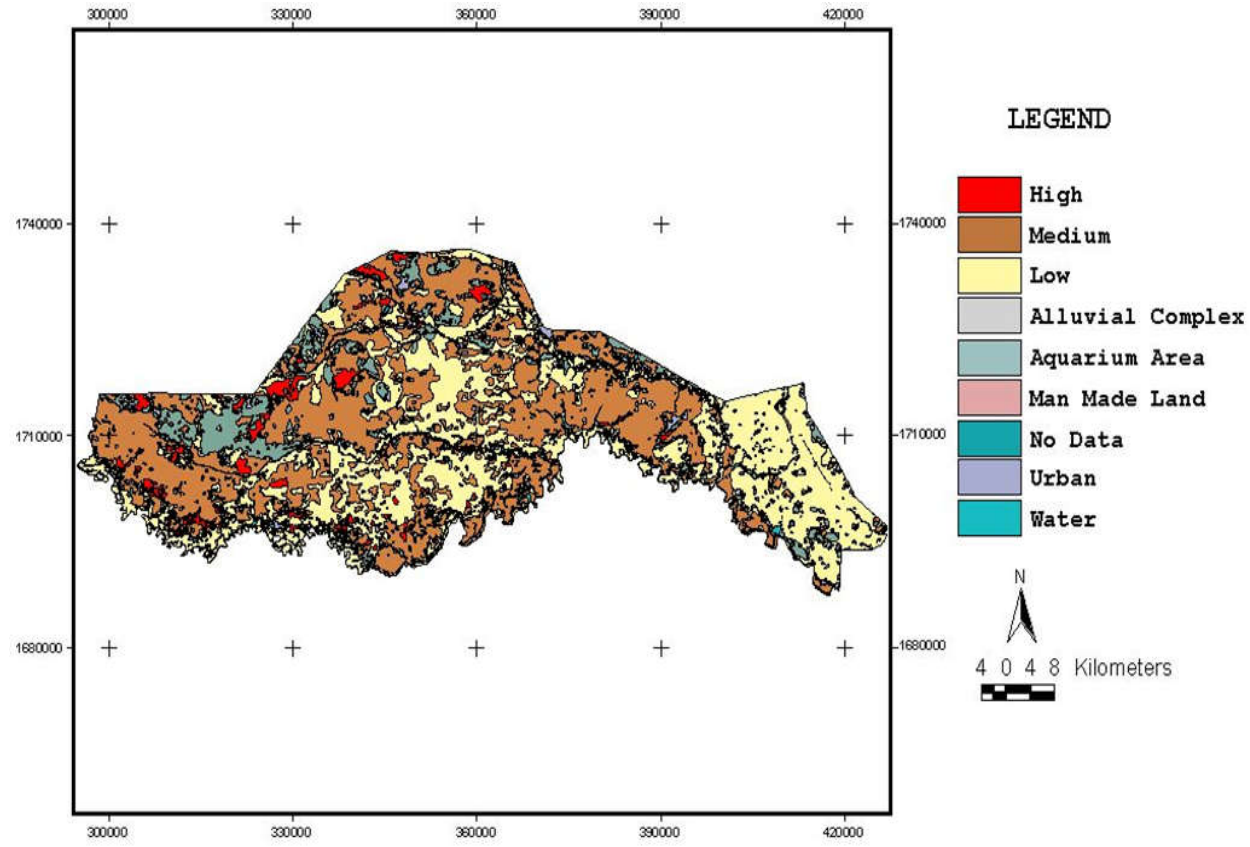

Figure 4. The usefulness of soil pH

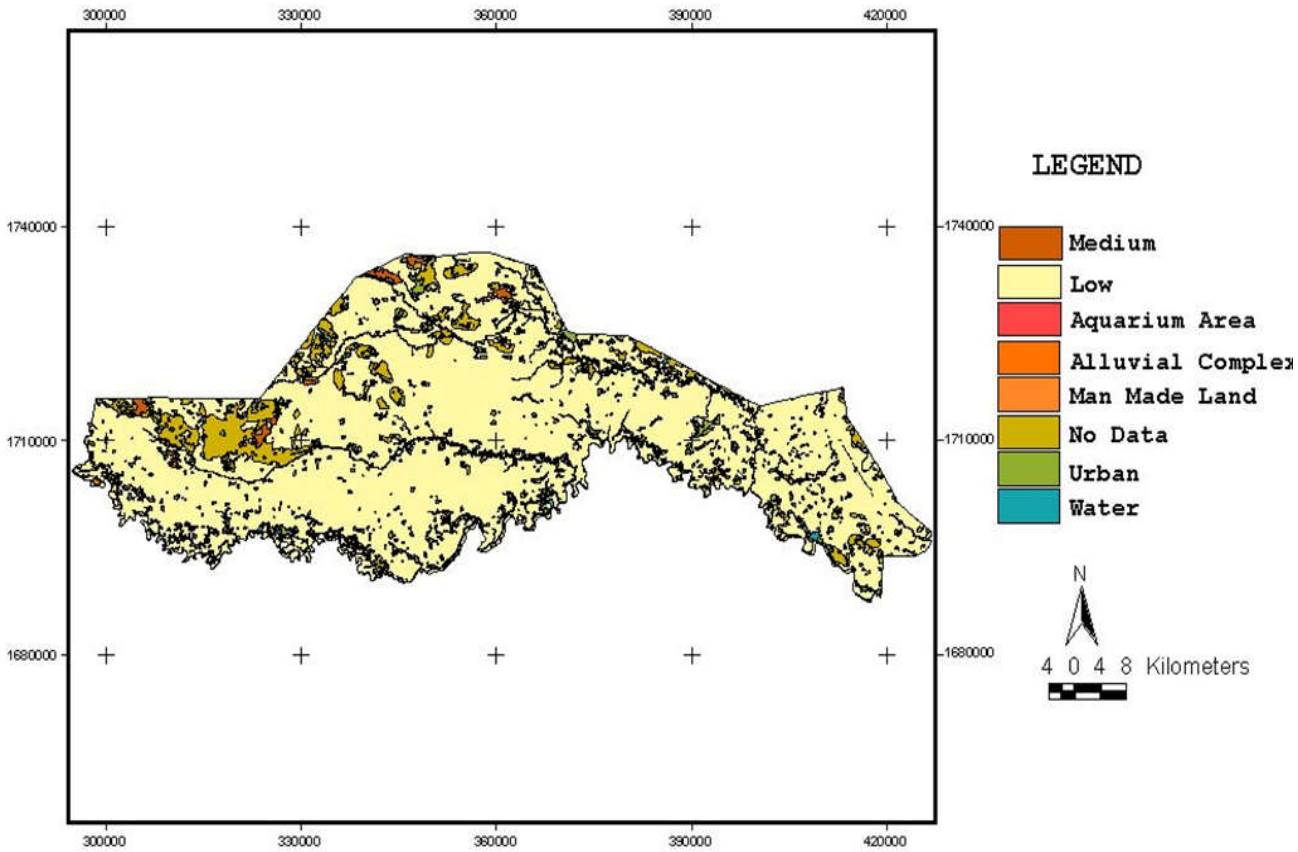

Figure 5. The available phosphorus in soil

Table 4 Potential available of soil nutrient

Soil Sampling	Total N (%)	Soil pH	Available P (mg/kg)	Exchangeable K (mg/kg)
1	0.03 (0.8)	5.50 (0.8)	9.00 (0.5)	9.00 (0.5)
2	0.03 (0.8)	5.40 (0.8)	2.00 (0.5)	9.00 (0.5)
3	0.02 (0.8)	6.00 (1.0)	3.00 (0.5)	11.00 (0.5)
4	0.02 (0.8)	5.30 (0.8)	8.00 (0.5)	8.00 (0.5)
5	0.06 (1.0)	4.90 (0.5)	5.00 (0.5)	37.00 (0.8)
6	0.03 (0.8)	4.70 (0.5)	6.00 (0.5)	10.00 (0.5)
7	0.02 (0.8)	5.00 (0.5)	4.00 (0.5)	13.00 (0.5)
8	0.03 (0.8)	4.90 (0.5)	5.00 (0.5)	6.00 (0.5)
9	0.04 (0.8)	5.20 (0.8)	6.00 (0.5)	22.00 (0.8)
10	0.02 (0.8)	5.30 (0.8)	3.00 (0.5)	9.00 (0.5)
11	0.09 (1.0)	4.60 (0.5)	3.00 (0.5)	440.00 (1.0)
12	0.02 (0.8)	5.60 (1.0)	3.00 (0.5)	12.00 (0.5)
13	0.07 (1.0)	4.80 (0.5)	6.00 (0.5)	13.00 (0.5)
14	0.03 (0.8)	4.80 (0.5)	6.00 (0.5)	25.00 (0.8)
15	0.02 (0.8)	5.60 (1.0)	20.00 (0.8)	45.00 (0.8)
16	0.02 (0.8)	4.90 (0.5)	4.00 (0.5)	5.00 (0.5)
17	0.01 (0.5)	5.20 (0.8)	2.00 (0.5)	4.00 (0.5)
18	0.03 (0.8)	4.90 (0.5)	3.00 (0.5)	70.00 (1.0)
19	0.08 (1.0)	5.10 (0.8)	2.00 (0.5)	6.00 (0.5)
20	0.03 (0.8)	5.80 (1.0)	5.00 (0.5)	6.00 (0.5)
21	0.03 (0.8)	5.50 (0.8)	2.00 (0.5)	18.00 (0.8)
22	0.03 (0.8)	4.90 (0.5)	3.00 (0.5)	6.00 (0.5)
23	0.02 (0.8)	5.00 (0.5)	4.00 (0.5)	4.00 (0.5)
24	0.01 (0.5)	4.70 (0.5)	4.00 (0.5)	27.00 (0.8)
25	0.03 (0.8)	5.10 (0.8)	9.00 (0.5)	17.00 (0.8)
26	0.03 (0.8)	5.20 (0.8)	2.00 (0.5)	5.00 (0.5)
27	0.02 (0.8)	4.90 (0.5)	3.00 (0.5)	90.00 (1.0)
28	0.03 (0.8)	5.40 (0.8)	9.00 (0.5)	9.00 (0.5)
29	0.01 (0.5)	5.10 (0.8)	3.00 (0.5)	9.00 (0.5)
30	0.06 (1.0)	5.60 (1.0)	4.00 (0.5)	14.00 (0.5)
31	0.02 (0.8)	5.10 (0.8)	4.00 (0.5)	5.00 (0.5)
32	0.03 (0.8)	4.50 (0.5)	3.00 (0.5)	32.00 (0.8)
33	0.01 (0.5)	5.30 (0.8)	2.00 (0.5)	6.00 (0.5)
34	0.02 (0.8)	5.00 (0.5)	4.00 (0.5)	2.00 (0.2)

Soil Sampling	Total N (%)	Soil pH	Available P (mg/kg)	Exchangeable K (mg/kg)	Total Score of Multiplication	Potential Level
35	0.03 (0.8)	4.60 (0.5)	2.00 (0.5)	11.00 (0.5)	0.10000	Low
36	0.02 (0.8)	5.20 (0.8)	2.00 (0.5)	16.00 (0.8)	0.25600	Medium
37	0.03 (0.8)	5.30 (0.8)	7.00 (0.5)	3.00 (0.2)	0.06400	Low
38	0.03 (0.8)	4.70 (0.5)	6.00 (0.5)	38.00 (0.8)	0.16000	Low
39	0.02 (0.8)	5.00 (0.5)	15.00 (0.8)	14.00 (0.5)	0.16000	Low
40	0.04 (0.8)	5.00 (0.5)	5.00 (0.5)	11.00 (0.5)	0.10000	Low
41	0.04 (0.8)	5.00 (0.5)	4.00 (0.5)	24.00 (0.8)	0.16000	Low
42	0.03 (0.8)	5.10 (0.8)	4.00 (0.5)	8.00 (0.5)	0.16000	Low
43	0.03 (0.8)	4.80 (0.5)	4.00 (0.5)	31.00 (0.8)	0.16000	Low
44	0.02 (0.8)	4.80 (0.5)	3.00 (0.5)	19.00 (0.8)	0.16000	Low
45	0.02 (0.8)	4.50 (0.5)	2.00 (0.5)	26.00 (0.8)	0.16000	Low
46	0.02 (0.8)	4.90 (0.5)	3.00 (0.5)	11.00 (0.5)	0.10000	Low
47	0.08 (1.0)	4.90 (0.5)	2.00 (0.5)	12.00 (0.5)	0.12500	Low
48	0.03 (0.8)	5.00 (0.5)	8.00 (0.5)	12.00 (0.5)	0.10000	Low
49	0.04 (0.8)	4.80 (0.5)	5.00 (0.5)	8.00 (0.5)	0.10000	Low
50	0.02 (0.8)	4.80 (0.5)	12.00 (0.8)	10.00 (0.5)	0.16000	Low
51	0.03 (0.8)	4.30 (0.5)	7.00 (0.5)	16.00 (0.8)	0.16000	Low
52	0.03 (0.8)	4.80 (0.5)	5.00 (0.5)	4.00 (0.5)	0.10000	Low
53	0.02 (0.8)	5.60 (1.0)	3.00 (0.5)	18.00 (0.8)	0.32000	Medium
54	0.03 (0.8)	5.20 (0.8)	4.00 (0.5)	8.00 (0.5)	0.16000	Low
55	0.02 (0.8)	5.00 (0.5)	4.00 (0.5)	6.00 (0.5)	0.10000	Low
56	0.03 (0.8)	4.90 (0.5)	10.00 (0.8)	6.00 (0.5)	0.16000	Low
57	0.03 (0.8)	4.60 (0.5)	4.00 (0.5)	3.00 (0.2)	0.04000	Non
58	0.01 (0.5)	4.50 (0.5)	3.00 (0.5)	5.00 (0.5)	0.0625	Low
59	0.01 (0.5)	5.00 (0.5)	3.00 (0.5)	14.00 (0.5)	0.0625	Low
60	0.02 (0.8)	5.00 (0.5)	5.00 (0.5)	7.00 (0.5)	0.10000	Low
61	0.03 (0.8)	4.50 (0.5)	2.00 (0.5)	36.00 (0.8)	0.16000	Low
62	0.04 (0.8)	4.80 (0.5)	6.00 (0.5)	12.00 (0.5)	0.10000	Low
63	0.03 (0.8)	4.50 (0.5)	6.00 (0.5)	12.00 (0.5)	0.10000	Low
64	0.02 (0.8)	4.80 (0.5)	31.00 (1.0)	16.00 (0.8)	0.32000	Medium
65	0.03 (0.8)	4.90 (0.5)	4.00 (0.5)	5.00 (0.5)	0.10000	Low
66	0.04 (0.8)	5.00 (0.5)	1.00 (0.5)	26.00 (0.8)	0.16000	Low
67	0.02 (0.8)	4.60 (0.5)	2.00 (0.5)	20.00 (0.8)	0.16000	Low

medium and high level equal to 0.80 and 1.00 score, respectively. Then bring up the scores of useful factor of soil nutrients in 4 factors multiplied together and evaluate the level of potential benefits of nutrients in the soil.

The results showed that most of the soil in Tung Kula Rong Hai area had low nutrient potential, which means that the nutrient potential value of the soil was 0.06250 - 0.17355. It covers an area of 143,618.21 hectare or 45.80% of the total,

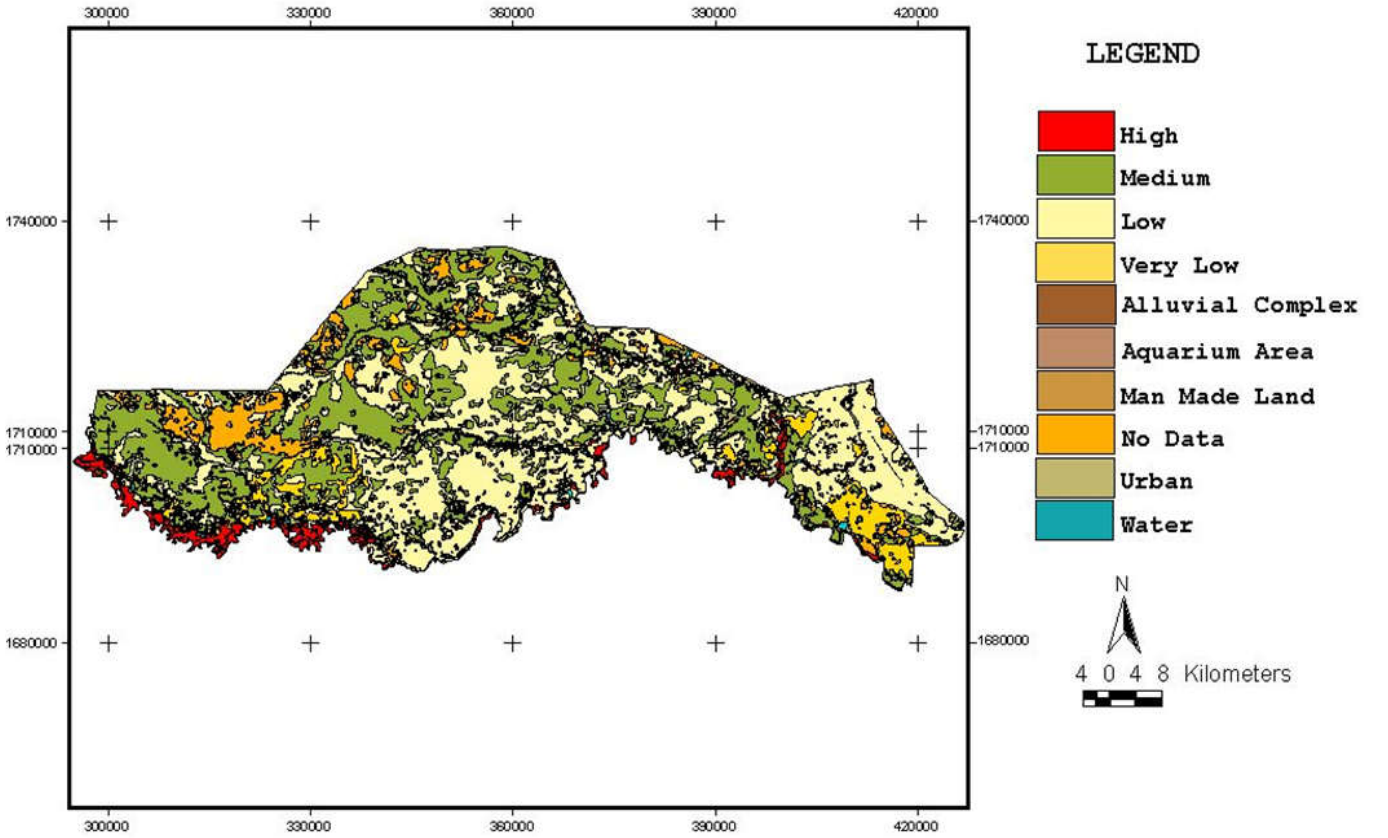

Figure 6. The available potassium in soil

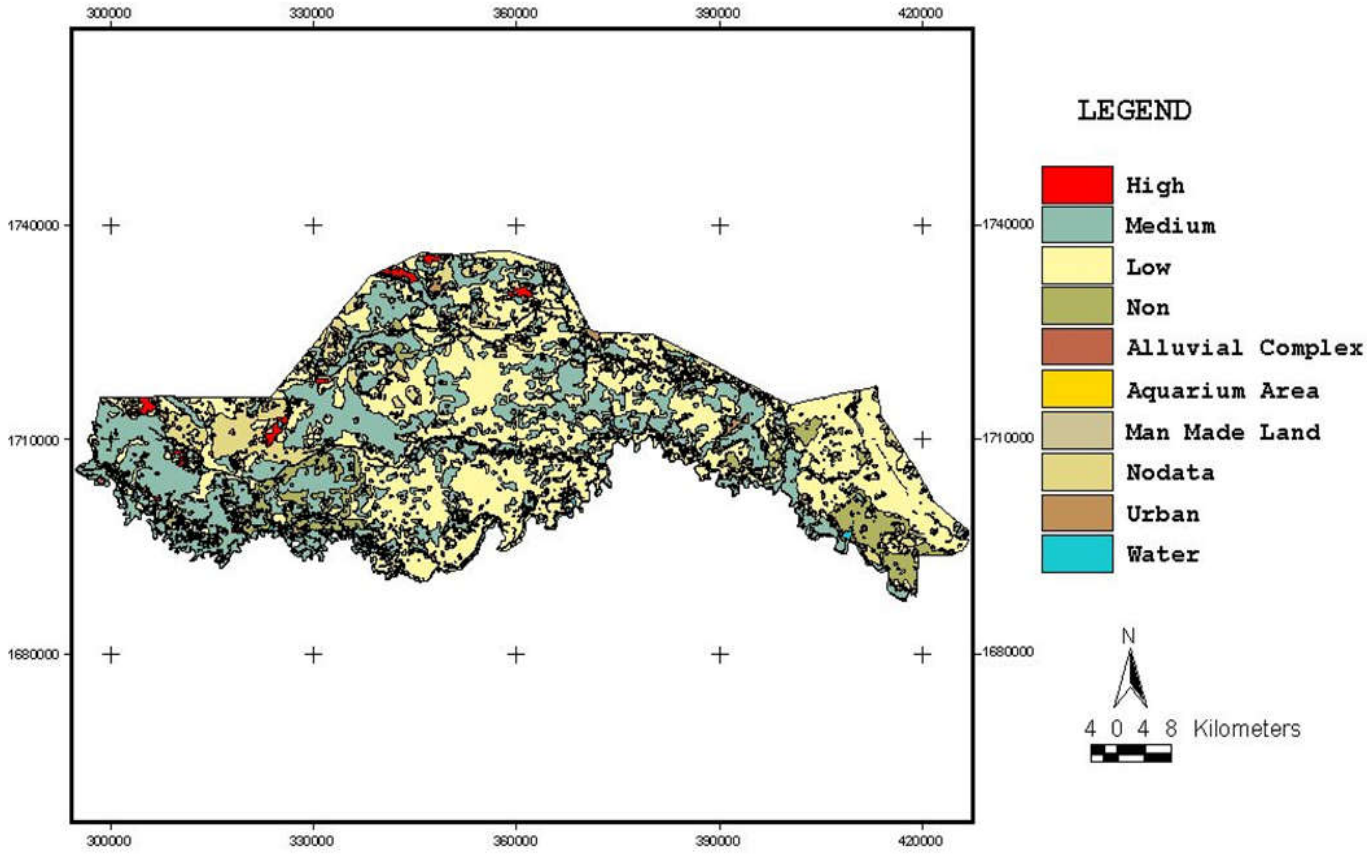

Figure 7. Potential benefits of soil nutrients

nutrient potential at a moderate level is mean that the nutrient potential value about 0.17335 - 0.40960, accounting for 101,779.98 hectare or 32.46%, non-potential area refer to the nutrient value is estimated to be ≤0.06250, which is 18,982.98 hectare or 6.05% of the total and area of high potential level is refer to the nutrient potential value about ≥ 0.40960, which is 2,578.97 hectare or 0.82%, etc. (Table 4 and Figure 7)

CONCLUSION AND DISCUSSION

From the results of the assessment are the benefits of soil nutrients in rice planting area, Tung Kula Ronghai in a geographic information system can be summarized as follows: The usefulness index of soil nutrients in almost area of Tung Kula Ronghai was found to be at the level 0.02-0.04% of total nitrogen, is mean that a moderately useful accounted for 79.03% of total area, soil pH in range >5.00-5.50 is refer to the medium level of 42.19%, available phosphorus in soil <10.00 mg/kg is mean to low level cover an area of 84.32%, and available potassium in soil will have the value in range of 4.00 - 15.00 mg/kg, which means a low benefit is 42.03% of total area, etc. From the results, it was found that the total N content in the soil and soil pH were found to be moderate. In parts of phosphorus and potassium in the soil is found to be useful in low levels. The study suggests that to grow jasmine rice has high productivity, the need to have a quantity of soil nutrient and soil pH is appropriate such as nitrogen, total nitrogen in soil must be higher than 0.04%, available phosphorus must be greater than 25 mg/kg and available potassium higher than 50 mg/kg. It also requires soil pH suitable for rice planting is in the range of 5.0-6.5, etc. which corresponds to the research of Sumrit etal. (2000) found that the productivity of jasmine rice will be correlated with organic matter and nitrogen content in the soil significantly. That is, in the soil with organic matter and high nitrogen content to make high-yield rice. In addition, nitrogen content in the soil also affected the aroma of jasmine rice which study from Yang etal. (2012) found that the increase nitrogen content in the soil resulted in higher l-proline content in rice. That is nitrogen in soil is a factor in the production of fragrant jasmine rice because proline is a precursor to the production of 2AP (2-acetyl-1-pyroloine) aromatic compounds in rice. It is also found that the cultivation of rice on high potassium will produce rice with a high aroma, whiteness and high sequin as well (Suwannarit etal., 2002). However, available phosphorus in soil is also positively correlated with yield of rice too, that is research of Zhang etal. (2012) found that increasing phosphorus fertilization increased rice yields in lowland and upland in dry conditions. (Dry Cultivation: DC)

Most of Tung Kula Rong Hai area has low potential for available soil nutrient at 45.80% of the total area with a moderate potential of 32.46%, non-potential of 6.05%, and the high potential area is 0.82%. The results show that most of the areas have low potential available soil nutrient because of their low phosphorus and potassium content. This may be due to nutrient in soil, loss of leaching or loss of runoff during the rainy season is possible. which corresponds to the research of Sumrit etal. (2000) This will be consistent with Jian *et al*. (2016), a study of phosphorus losses from runoff in rice-wheat cropping systems affected by rainfall and fertilizer application found that phosphorus fertilization at a balanced rate of 20-30 kg/ha, where rainfall is not heavy, irrigation management and drainage appropriately, will reduce the phosphorus losses from runoff in rice-wheat cropping systems.

Suggestion

- It can be store data, potential available of soil nutrient is the initial database in the GIS to monitor changes available of soil nutrients next time.
- Can take data, potential available of soil nutrient was applied to zoning the production of jasmine rice in Tung Kula Rong Hai area.

Suggestion

- This study found that the soil pH is relatively high of variance, is not suitable to be used as a factor in assessing the potential to produce aroma of rice, but the soil texture is important index that could be used to evaluate potential for production aromatic rice in Tung Kula Rong Hai better.
- The further studies should focus on soil moisture for aromatic rice production in order to obtain baseline data to assess the potential for production of aromatic rice quality in

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