SOIL DEGRADATION ASSESMENT USING FAO GUIDELINE IN KASET WISAI DISTRICT OF ROI ET PROVINCE IN THAILAND

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ABSTRACT

The study has focused on the determination of the appropriate methodology for the assessment of land degradation following international journals, which study about land degradation. We found FAO (1979) guide line more suitable for the assessment of soil degradation and used this guide line for comparison of soil data obtained from the study area. Secondly, the study has focused on the assessment of Geographic Information System (GIS) to quantify soil degradation risk by comparing with FAO (1979) guideline and show map of soil degradation area in Kaset Wisai district of Roi Et province, Thailand. Soil samples were collected from Kaset Wisai district of Roi Et province, Thailand from land development department and at various depths within each collecting site. Of these, samples from 2 years in 2004 and 2011 were analyzed in the laboratory. The results from the study showed the improvement of soil quality in 2011 as compared to the soil quality in 2004. To be more precise, the amount of available phosphorous was considerably increased in the year 2011 than that of 2004 with slightly improvement of other soil indicators (Organic Matter and Potassium).

Keywords: land/soil degradation, GIS, FAO guideline, soil degradation indicator

1. INTRODUCTION

Land and soil degradation assessment has recently become more fashionable responding to environmental concerns particularly in industrial countries, following the lead in developing countries that have claimed significant effects of land degradation on their agricultural production and food security. Problems of degradation are increasing worldwide, so an evaluation system is required to improve knowledge and to identify the extent of already degraded and threatened areas. There are several approaches to the assessment of soil conditions. Some are based on visual assessment of features previously linked to soil properties and evaluated using a scorecard system (McGarry, 2005). Another approach is the evaluation of the concept of soil quality (Doran and Parkin, 1994). Overall, despite the significant development in the evaluation of soil conditions using integrated quality indexes, sometimes the scope and definition of those indices are still vague (Sojka et al., 2003). In recent year evaluation of the soil degradation has been done on the global scale as GLASOD project, which is based on a qualitative assessment of soil degradation and are approved in many countries to assess soil degradation.

In Thailand, study regarding land degradation assessment has not been conducted for the entire region of Thailand. The land degradation assessment conducted so far has not followed the proper internationally accepted guideline like FAO or GLASOD. This study focus on conducting the land degradation assessment using the international guideline which can be implemented on parts of Thailand.

2. METHODOLOGY

2.1 Description of the Study Area

The study area is located at Thung Kula Rong Hai which is in the southern part of the Korat Basin in the Northeast of Thailand. For this study, Roi Et province has been chosen and the biggest district in Roi Et province i.e. Kaset Wisai district. The total area of this district is about 580.1 square kilometer. The study area lies between 330000E to 360000E latitude and 1707000N to 1747000N longitude.

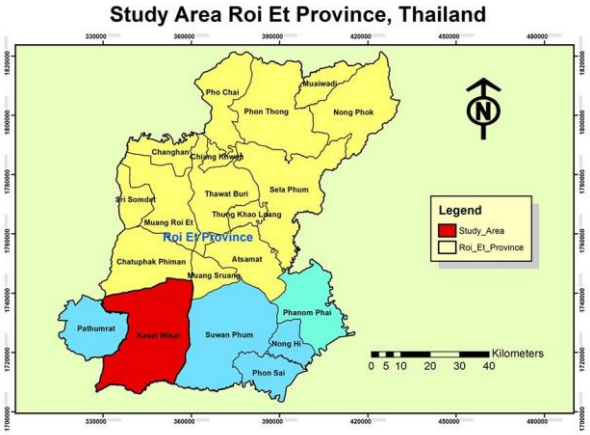

Figure 1: Roi Et Province, Thailand

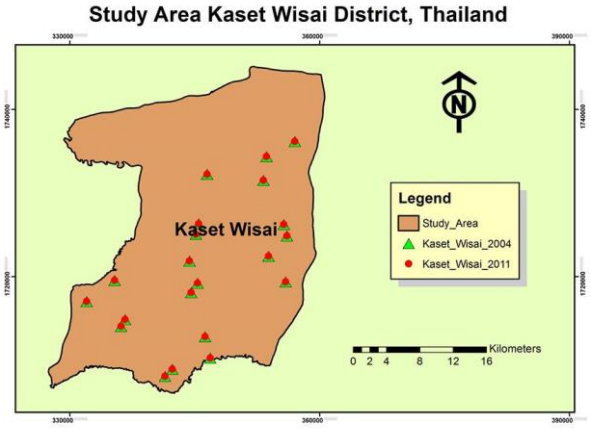

Figure 2: StudyArea with Soil Sample Site , Kaset Wisai, Roi Et Province

2.2 Soil data collection

The data was collected for the month of February in years 2004 and 2011. The samples were taken from the soil depth of 0 to 15 cm. The total of 21 samples were taken from this district based on the geographical area i.e. paddy field or flat area etc. The location of the area from where samples were taken was recorded during process.

Table 1: Soil properties in 21 sites of study area in 2004 and 2011

Location		2004				2011			
Latitude	Longitude	OM (%)	P (mg kg-1)	K (mg kg-1)	K (cmolkg-1)	OM (%)	P (mg kg-1)	K (mg kg-1)	K (cmolkg-1)
355679	1726216	0.13	1.70	9.00	0.02	0.66	12.00	13.00	0.03
356055	1724852	0.96	0.50	31.00	0.08	1.56	13.00	14.00	0.04
355913	1719341	0.26	1.00	13.00	0.03	0.76	19.00	25.00	0.06
353852	1722426	0.55	1.80	45.00	0.12	1.03	40.00	31.00	0.08
353227	1731511	0.16	2.00	56.00	0.14	0.88	3.00	14.00	0.04
353602	1734363	0.37	0.40	10.00	0.03	0.71	10.00	8.00	0.02
357006	1736177	0.14	2.10	2.00	0.01	0.55	18.00	5.00	0.01
346476	1732225	0.51	2.20	27.00	0.07	0.70	43.00	19.00	0.05
345450	1726311	0.08	3.20	5.00	0.01	0.71	30.00	44.00	0.11
345131	1725047	0.30	0.90	12.00	0.03	0.66	21.00	9.00	0.02

344344	1721845	0.16	1.90	6.00	0.02	0.78	6.00	7.00	0.02
345317	1719198	0.23	1.80	3.00	0.01	0.65	17.00	7.00	0.02
344553	1718064	0.00	1.20	3.00	0.01	0.50	15.00	8.00	0.02
346227	1712780	0.67	2.90	3.00	0.01	0.75	10.00	15.00	0.04
346857	1710229	0.91	4.60	27.00	0.07	1.09	19.00	18.00	0.05
342302	1708899	0.16	1.70	7.00	0.02	0.71	8.00	18.00	0.05
341405	1708043	0.44	0.80	21.00	0.05	0.70	10.00	27.00	0.07
336613	1714846	0.44	1.60	10.00	0.03	0.96	9.00	14.00	0.04
336125	1714035	0.13	1.00	6.00	0.02	0.77	10.00	21.00	0.05
335359	1719537	0.44	0.70	6.00	0.02	1.04	36.00	8.00	0.02
331993	1717014	0.30	0.80	24.00	0.06	0.50	20.00	31.00	0.08

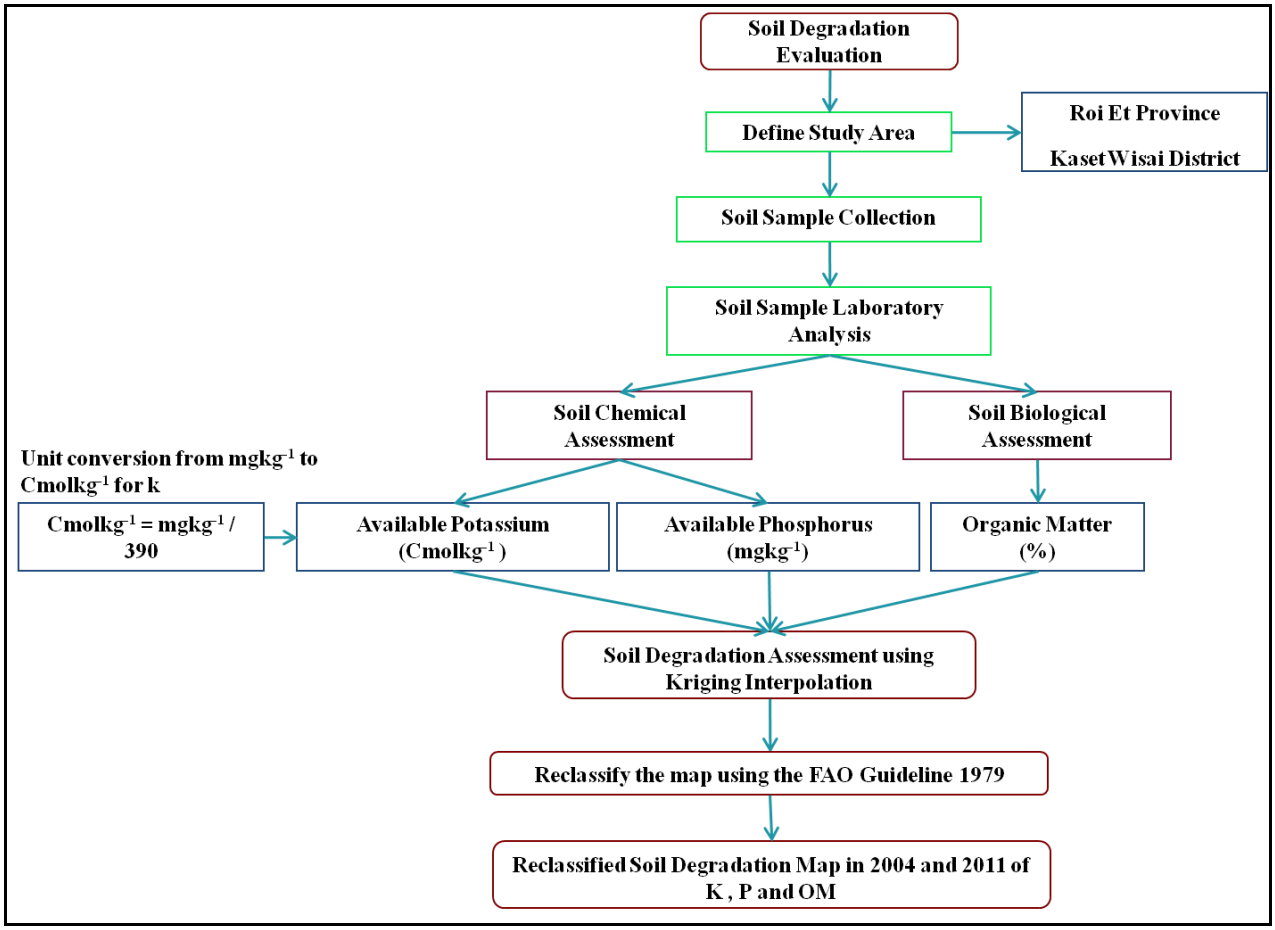

Figure 3: Flow chart of soil degradation assessment

Following the comparison of the indicator parameter with FAO (1979) guidelines, we estimated the soil degradation level in the study area for different indices namely 1. None to slightly degraded soils, 2.Moderately degraded soils, 3.Highly degraded soils and 4.Very highly degraded soils.

2.3 Soil analysis and degradation assessment

Each sample collected from the study area was analyzed in the laboratory for Soil pH, Electrical Conductivity, Organic Matter Content, Available Phosphorus, Available Potassium and Extractable Calcium. For the soil degradation assessment, soil chemical assessment and soil biological assessment is conducted. For chemical assessment two chemical Potassium and Phosphorus is used as for biological assessment Organic Matter content is used. The laboratory data is then interpolated using the kriging interpolation method for soil degradation assessment. This process is done for both the data from the 2004 and 2011. Following the kriging interpolation the soil degradation Map is generate for Potassium, Phosphorus and Organic Matter. The Map generated in then reclassified following the comparison of the indicator parameter with FAO (1979) guidelines. Finally the three map from each year of 2004 and 2011 is combined together using raster calculator to generate the overall soil degradation Map.

3. RESULT AND DISCUSSION

The parameters of soil properties are compared with the FAO (1979) guideline for monitoring and evaluation of the soil degradation. Selected indicators are evaluated on the basis of FAO guideline as organic matter (OM), phosphorus (P) and potassium (K), where degradation indices are described as 1 for none to slight degraded soils, 2 for moderately degraded soils, 3 for highly degraded soils and 4 for very highly degraded soils as showed in table 2.

Table 2: Indicators and criteria of some chemical soil degradation

Indicator	Degradation index			
	1	**2**	**3**	**4**
Organic matter (%)	> 2.5	2 – 2.5	1.0 – 2	< 1.0
Phosphorus (mg kg^{-1})	> 8	7 – 8	6 – 7	<6
Potassium (cmol kg^{-1})	> 0.16	0.14 – 0.16	0.12 – 0.14	< 0.12
Base Saturation (Decrease more than 50%)	< 2.5%	2.5 – 5%	5 – 10%	> 10%
Excess Salts (Increase in conductivity) (mmho/cm/yr)	< 2	2 – 3	3 – 5	> 5

Source: FAO (1979), Snaking et al. (1996).
*Where
1= None to slight degraded soils
2= Moderately degraded soils
3= Highly degraded soils
4= Very highly degraded soils.

The soil chemical properties data of all 21 sites in year 2004 and 2011, which emphasize on soil organic matter, available phosphorus and available potassium content, was processed as The soil chemical properties data of all 21 sites in year 2004 and 2011, which emphasize on soil organic matter, available phosphorus and available potassium content, was processed as to compare with FAO (1979) guideline. Assessment of soil degradation in study area (21 sites of soil sampled) by using FAO guideline in term of soil organic matter were

identified as degradation index = 4 and assigned as very highly degraded soil in 2004. However, in 2011 soil organic matter are identified as the same as in 2004, except for few areas where the degradation were identified as degradation index = 3 and assigned as highly degraded soil as showed in figure 4. This shows there is some improvement in the degraded soil in terms of soil organic matter content in the year 2004 and 2011.

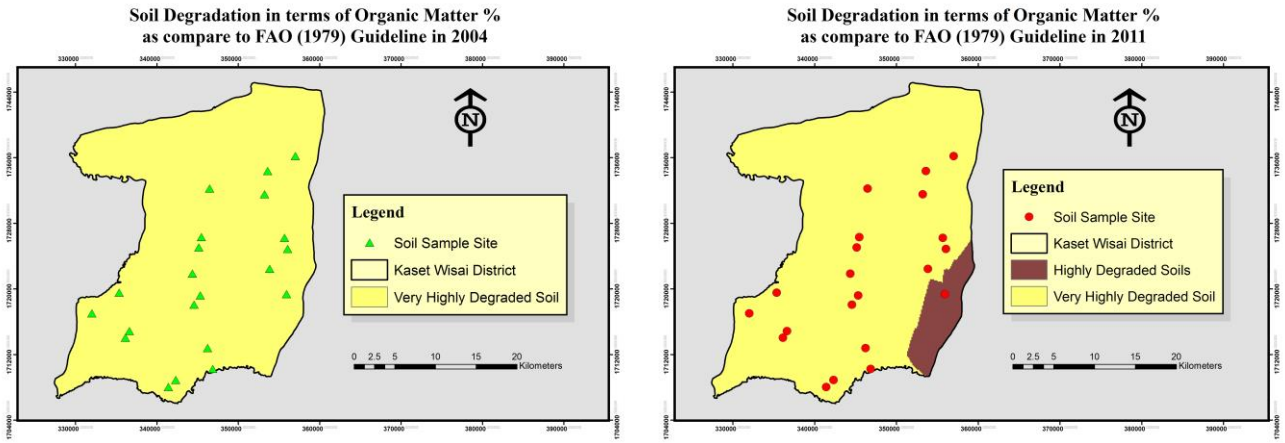

Figure 4: Soil degradation in terms of organic matter content (%)
(a) In year 2004 and (b) In year 2011

Assessment of soil degradation, in terms of available phosphorus content, all are identified as degradation index = 4 and assigned as very highly degraded soil in 2004 (as showed in figure 5 a). The assessment of soil degradation in phosphorus content in 2011 for the same site was identified as degradation index = 1 as none to slightly degraded soil in almost the entire region except for the small area which has degradation index = 4. This shows there is some improvement in the degraded soil in terms of soil organic matter content in the year 2004 and 2011 as showed in figure 5 (b).

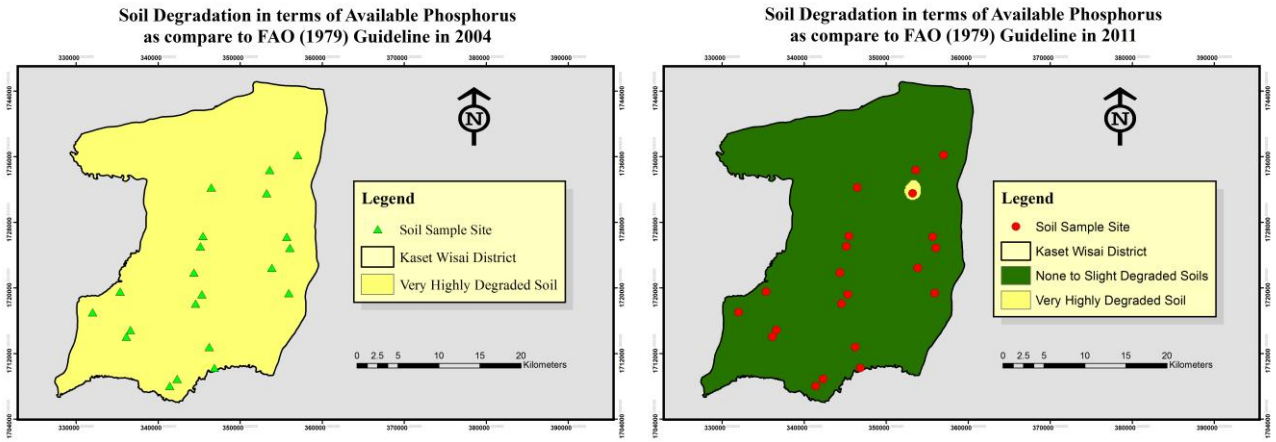

Figure 5: Soil degradation in terms of phosphorus content (%)
(a) In year 2004 and (b) In year 2011

Assessment of soil degradation, on the basis of available potassium content by using FAO guideline were identified as degradation index = 4 and assigned as very highly degraded soil in 2004 except for the small area which has the degradation index = 3 and assigned as

highly degraded soils as showed in figure 6.(a). However, in 2011 soil available potassium content were identified as degradation index = 4 for the entire region as showed in figure 6.(b). This shows that there is no improvement in the degraded soil in term of soil available potassium content in the year 2004 and 2011.

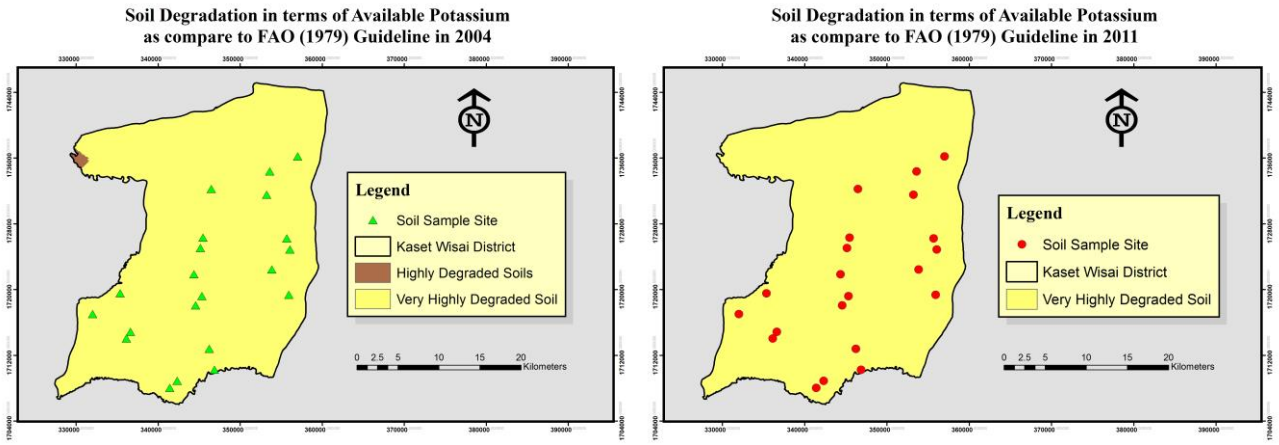

Figure 6: Soil degradation in terms of available potassium content (mg kg^{-1}) (a) In year 2004 and (b) In year 2011

4. CONCLUSION

The study shows the degree to soil degradation in the Kaset Wisai district of Roi Et province Thailand. From the study we were able to determine the soil degradation assessment in the Kaset Wisai district of Roi Et Province, Thailand. The study done for the soil sample taken from the year 2004 shows that the soil is very highly degraded in terms of the indicator of Available Phosphorous, Available Potassium and Organic Matter Percentage. On the other hand the soil sample taken from the year 2011 showed considerable improvement in the soil in term of Available Phosphorous. But for the other two indicators i.e. Available Potassium and Organic Matter percentage there was little to no change in terms of soil degradation. Using FAO (1979) guideline we were able to do precise comparison of the various soil degradation indicator and parameters.

This study focus on finding the suitable method for assessment of soil degradation. The FAO guideline was utilized for this purpose. One of the challenge that faced during the study was the lack of available data. As suggested in the FAO guideline for soil degradation assessment, we need to analysis physical indicator which included soil bulk density and permeability, chemical indicator which included nitrogen, phosphorus, potassium, soluble salt, ESP, Base saturation and excess salt, and biological indicator which included the organic matter content. But the available data only included phosphorus, potassium and organic matter content. In order to conduct comprehensive soil degradation assessment, we need to include all the indicators as mentioned in the FAO guideline.

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