SPATIAL VARIATION OF SOIL NUTRIENTS IN PADDY LANDS; A CASE STUDY IN POLONNARUWA DISTRICT

BY

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M.Sc. 2014

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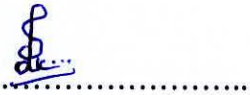
Thesis Submitted to the University of Sri Jayewardenepura
for the award of the Degree of Master of Science in
Geographic Information System and Remote Sensing

On

15.06.2014

DECLARATION OF THE CANDIDATE

The work described in this thesis was carried out by me under the supervision of Dr. Ranjith Premasiri and Mrs. H.M.B.S. Hearath, and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree / Diploma.



..... 15.06.2014 .....

M.S.L. Kulathunga Date

DECLARATION OF SUPERVISORS

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

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Spatial Variation of Soil Nutrients in Paddy Lands; A Case Study in Polonnaruwa District

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ABSTRACT

This study is attempted to identify soil nutrients variation and its impact on paddy growth and recommend site specific integrated plant nutrient management practices. Soil samples were collected, analyzed and mapped to determine these variations. The spatial analysis of soil nutrient content is reveal that the major nutrients (K, P, Mg and Ca) are not adequate and from micronutrients Zn and Cu are deficient and interestedly Fe is toxic for paddy cultivation. Micronutrient Mn is adequately present. The soil reaction if fairly proper range but there is an evidence of development of acidity and alkalinity. Hence, proper integrated nutrients management is necessary to break yield stagnation. The spatial variation map results are accordance with previously published experiments. Soil variation, GIS and visually analyzing spatial variability maps can be used as promising tools that provide guidance on best nutrient management practices for increase paddy yield. In this study, the point data was interpolated using the Kriging and Inverse Distance Weighting interpolating methods.

Keywords: spatial analysis, soil nutrient variation, GIS

ACKNOWLEDGEMENT

I am really grateful to my supervisors, Dr.Ranjith Premasiri, Senior Lecturer, Department of Earth Resources Engineering, University of Moratuwa and Mrs. H. M. B. S. Hearath, Senior Lecturer, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura; for their valuable guidance, advices, entire help to success my research. There is no doubt in my mind that without their continued support and counsel I could not have completed this.

I express my deep sense of gratitude with respect to Ven. Dr. Pinnawala Sangasumana, Head, Department of Geography, Faculty of Humanities & Social Sciences, University of Sri Jayewardenepura for valuable guidance and encouragements given to carry out my work throughout the whole period of post graduate course in GIS and Remote Sensing.

I am deeply indebted to Prof. Krishan Deheragoda, Department of Geography, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura who have given me a valuable opportunity of joining to this M.Sc. course at the last second and it has brought me closer to one of my academic goal and without him I would have not been able to achieve this.

I extend my heartfelt gratitude to all the lectures of Department of Geography, Faculty of Graduate Studies, University of Sri Jayewardenepura for their immense assistant and valuable support during the course period.

Special thanks with love and respect to my loving parents, brothers and friends who helped me in many ways to complete this study successfully.

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LIST OF ABBREVIATIONS

AT	Ambalanthota
BG	Batalagoda
BMP	Best Management Practices
CEC	Cations Exchange Capacity
DN	Digital Number
DOA	Department of Agriculture
GDB	Geodatabase
GIS	Geographic Information System
GND	Grama Niladhari Division
GPS	Geographic Position System
IDW	Inverse Distance Weighting
LD	Labuduwa
MOP	Muriate of Potash
MSL	Mean Sea Level
OFC	Other Field Crops
TSP	Triple Super Phosphate
USDA	US Department of Agriculture

Chapter One

INTRODUCTION

1.1. Rationale and Background

The best yields of any crop produces require adequate supply of plant nutrients. The amount of nutrients requirement highly deviate from plant species, its variety, soil type, management practices and environmental conditions. Plants require some elements in large amounts and others in only small amounts. The accurate plant nutrient requirement is determined by knowing the nutrient requirement of the plant and the nutrient supplying power of the soil.

The elements essential for plants are C, H, O, N, P, K, Ca, Mg, S, Fe, Cu, B, Mn, Mo, Zn, Cl. Out of these 16 elements, 9 essential elements have been classified as macronutrients as these are required in relatively large amount by the plants. These elements include C, H, O, N, P, K, Ca, Mg, and S. The remaining of the elements (B, Cu, Fe, Mn, Mo and Zn) is called micro nutrients; because they are required in small, but in critical concentrations by living organisms. Routine soil testing is carried out in fields to determine nutritional status of soils and fertilizer needs. Tests are available to evaluate nearly all elements essential for plant growth. These tests will be analyze the Soil texture, Soil pH (measures acidity / alkalinity), Electrical conductivity (measures salinity/ alkalinity), Exchangeable K content (C moles / kg soil) and Soil organic matter content (%).

Rice is grown in wide variety of soils found in Sri Lanka. It is the staple food of 18.6 million people and livelihood of more than1.8 million farmers in Sri Lanka. Among the many food crops cultivated, rice constitutes the main crop. Therefore, regular attention on paddy cultivation is important. It plays a vital role in the economy and livelihood of people. More than 30 % of the total labor force is directly or indirectly involved in the rice sector (Central Bank Report, 2009). The total land devoted for paddy is estimated to be about 708,000 Hectares at present.

There are two cultivation seasons namely; *Maha* and *Yala* which are synonymous with two monsoons. Maha Season falls during "north-east monsoon" from September to March in the following year. Yala season is effective during the period from May to end of August. If crops are sown and harvested during these periods, the particular season is defined. However, the whole area devoted for paddy is not being cultivated due to number of reasons such as shortage of water during the seasons, prevailing unsettle conditions on the ground, etc. (www.statistics.gov.lk)

Appropriate fertilizer recommendations provide plant nutrients needed to sustain maximum production and profitability while minimizing environmental impact of fertilizer use. Rice is a seasonal crop and it removes a considerable amount of nutrients proportional to the yield obtained. Higher quantities of potassium and silica are found in the straw and rice husk. Cultivation of high yielding wetland rice varieties requires conditions such as; water availability, ability of soil to retain water, nutrient availability, ability to retain added nutrients, adequate soil depth, Oxygen (O_2) availability, workability of land, temperature (>20^0 C), solar radiation (>300 Cal/cm^2), lack of noxious weeds and lack of pest and diseases for optimum crop growth (Wijewardena, 2001). These conditions vary with place to place.

1.2. Paddy Soil

Soil is a major natural resource in the rice growing ecosystems. Paddy lands; soil having optimum quality with its physical, chemical, biological properties in combination with other management practices to enhance the productivity are important. To perform the site specific soil management practices; requires the characterization of spatial variability of soil properties. Hence the estimating and mapping the spatial variability of soil properties is needed. Soil management is one of the reliable approaches to increase the productivity of existing paddy lands while minimizing the over utilization of natural resources.

Soil fertility plays a key role in increasing crop production in the soil. It comprises not only in supply of nutrients but also their efficient management. The fertility status of soil indicates their nutrient supplying capability. Moreover fertility of soil is subject to