GIS-BASED SOIL SAMPLING METHODS FOR PRECISION FARMING OF RICE

By

EBRAHIM JAHANSHIRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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September 2006

Chairman: Associate Professor Abdul Rashid Mohammed Shariff, PhD

Faculty: Engineering

Sampling is the first step in the process of precision farming that relies on spatial data. Soil sampling projects are costly and time consuming and selecting a representative sample that can estimate the statistical and spatial properties of soil is a challenge that can cause impasse in the precision farming projects and may dissuade the farmers to adopt precision farming. While the random sampling can ensure the unbiasedness of the results, it may not cover the whole study area. Systematic and stratified sampling designs have the potential to reduce the number that is needed for sampling the soil. A trial has been done with sampling on the interpolated map of 2003 data from soil survey of the Sawah Sempadan rice irrigation scheme at North of Selangor Malaysia in 2003 and the result were analyzed both statistically and spatially. For predicting the mean, systematic and stratified scheme produce good results, but stratified sampling could predict the mean with less standard error and narrower confidence interval of mean.

In terms of reproducing the spatial variation and mapping, stratified sampling showed weaknesses with minimum number of samples, while having results comparable to random scheme with three-fold less number of samples. Systematic

sampling showed intermediate precision for Nitrogen and Potassium, while higher precision with three-fold samples less than random scheme for Phosphorus. In general, systematic design with 70 samples proved to have good results for the macronutrients mapping.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KAEDAH PENCERAPAN TANAH UNTUK PERTANIAN JITU PADI BERASASKAN GIS

Oleh

EBRAHIM JAHANSHIRI

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Pengerusi: **Profesor Madya Abdul Rashid Mohammad Shariff, PhD**

Fakulti: **Kejuruteraan**

Pencerapan tanah adalah langkah pertama dalam proses pertanian jitu, yang bergantung pada maklumat spatial. Pencerapan tanah berkos tinggi dan memilih sampel representatif yang dapat menganggar ciri-ciri statistikal dan spatial tanah adalah suatu dugaan yang boleh memesongkan projek-projek pertanian jitu serta menghalang pesawah daripada mengamalkan pertanian jitu. Cerapan rawak mampu mengesahkan ketiadaan bias pada hasil cerapan, tetapi ia mungkin tidak meliputi seluruh kawasan ujian. Rekabentuk cerapan sistematik dan cerapan berstrata pula mempunyai potensi untuk mengurangkan bilangan cerapan sampel tanah. Ujian telah dijalankan dengan pencerapan tanah atas peta berinterpolasi data tahun 2003 hasil survey tanah rancangan pengairan Sawah Sempadan pada tahun 2003, dan hasilnya telah dianalisa secara statitistikal dan spatial. Bagi ramalan purata (mean), skema cerapan sistematik dan berstrata menghasilkan hasil yang baik, tetapi cerapan berstrata mampu meramalkan purata dengan ralat piawai yang kecil dan selang keyakinan yang lebih sempit bagi purata. Dari segi penghasilan semula variasi spatial dan pemetaan, walaupun cerapan berstrata menunjukkan kelemahan dengan angka cerapan yang minimum, namun ia mempunyai hasil yang setara dengan skema rawak

dengan satu pertiga bilangan cerapan. Cerapan sistematik menunjukkan kejituan sederhana bagi Nitrogen dan Potassium, dan kejituan tinggi bagi Fosforus dengan cerapan tiga kali kurang daripada skema rawak bagi Phosphorus. Amnya, kaedah, sistematik berdasarkan 70 sampel diusulkan bagi survey yang seterusnya ke atas kawasan kajian.

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I certify that an Examination Committee has met on 28th September 2006 to conduct the final examination of Ebrahim Jahanshiri on his Master of Science thesis entitled "GIS-Based Soil Sampling Methods for Precision Farming of Rice" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Desa Ahmed, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Jamarei Othman, PhD
Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Krishnan Vijayaraghavan, PhD
Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Taher Buyoung, PhD
Associate Professor
Faculty of Engineering
Universiti Islam Antarabangsa Malaysia
(External Examiner)

_____

HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
School of Graduate
Studies Universiti Putra
Malaysia

Date:

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Abdul Rashid Bin Mohammed Shariff, PhD
Associate Professor
Faculty Engineering
Universiti Putra Malaysia
(Chairman)

Ir. Mohammed Amin Mohammed Soom, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Anuar Abdul Rahim, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

_____
AINI IDERIS, PhD
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

EBRAHIM JAHANSHIRI

Date:

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