Agriculture with Satellite remote sensing & sensors

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Rice crop working groups accomplishment in 2011

- Develop mock-up system to estimate rice crop production for rain-fed region at Khon Kaen province by using SAR data (ALOS and RADARSAT-2), crop growth model (KKU model) and ground observation data.
Estimation Process

- Satellite data
- SAR data analysis
- Rice Crop Acreage
- Acreage

- Satellite data
- Statistic information
- Crop model
- Rice Crop Yield
- Yield

Production = Acreage * Yield

Rice crop acreage estimation using SAR image

- Flooding or Planting
- Growing

- 27-Jun-07
- 17-Jul-07
- 06-Aug-07
- 26-Aug-07
- 15-Sep-07
- 05-Oct-07
- 25-Oct-07

- σ₀[dB]
- Field 1
- Field 2
- Field 3
- Field 4
- Field 5
Rice crop acreage estimation using SAR image

1. Image input (1)
   (Transplanting season)
2. Image input (2)
   (Well growing season)
3. Initial detection of paddy field
4. Post processing
Rice crop acreage estimation using SAR image

1. Image input (1)
   (Transplanting season)
2. Image input (2)
   (Well growing season)
3. Initial detection of paddy field
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Rice crop acreage estimation using SAR image

Rice crop yield estimation using KKU model

Interpolate to the mesh

Get the data every day

Calculate the yield per unit each mesh
Rice crop production estimation

Acreage

Yield

Production

696,258 [ton]

Validation

Study Site
### Validation

<table>
<thead>
<tr>
<th>Result of estimation</th>
<th>Acreage [m²]</th>
<th>Yield [g/m²]</th>
<th>Production [ton]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>164,405.99</td>
<td>203.96</td>
<td>33.53</td>
</tr>
<tr>
<td>Validation data by field survey</td>
<td>166,766.39</td>
<td>2.47 - 750.08</td>
<td>40.96</td>
</tr>
<tr>
<td>Accuracy</td>
<td>98.58%</td>
<td>-</td>
<td>81.87%</td>
</tr>
</tbody>
</table>

*Statistic information: Average of the past five years.*

- Estimating acreage is good.
- Estimating production depends on yield by statistic information.
NECTEC field server

The field server at a rice crop field in Suphanburi province, Thailand

Rain gauge tipping-bucket

Digital Cameras; RGB and NIR sensors

Pyranometer

Anemometer

Temperature and Humidity sensors

Photo at a rice crop field in Suphanburi province, Thailand on date of July 1, 2012
The flowchart of rice crop height measurement

Vegetation Index

To measure the levels of live green plants, vegetation indices will be considered.

**Excessive green (ExG)**

\[
ExG = 2 \cdot g - r - b
\]

**Normalized Green-Red Difference Index (NGRDI)**

\[
NGRDI = \frac{g - r}{g + r}
\]

ExGR is a difference of ExG and ExR.

\[
ExGR = ExG - ExR
\]

When \( ExR = 1.4 \cdot r - g \)

When \( rgb \) is normalised of RGB component.

\[
\begin{align*}
    r &= \frac{R}{R + G + B} \\
    g &= \frac{G}{R + G + B} \\
    b &= \frac{B}{R + G + B}
\end{align*}
\]

Similar in RGB normalized.

A. Rice field segmentation

RGB image (Suphan Buri)

**Excessive Green**

\( ExG = 2 \cdot g - r - b \)

\( ExG \) is varied between \([-2, 2]\).

Initial rice field mask

\[
Mask_{rice\_field}(i, j) = \begin{cases} 
1, & \text{if } ExG(i, j) \geq 0.2 \\
0, & \text{otherwise}
\end{cases}
\]
Experiments

Comparative results of vegetation indices (ExG, NGRDI, ExGR)

Suphanburi

Roi Et
Rice growing stages, Suphanburi

Rice growing stages, Roi Et
Phenology monitoring using Time-series MODIS imagery
MODIS is a device that is installed on the Terra and Aqua satellites, used to measure the spectrum to track and monitor natural resources. The characteristic of sensor has 705 km. of altitude, 36 bands of product between 0.4 – 14 um., resolution of data is between 250 – 1000 meter, and repeat in every 16 days.

**Data Used**

**MODIS**

Moderate Resolution Imaging Spectroradiometer

The white is area of agriculture activity where is plants spectrum reflection is more than other area, so white in picture is area where have active agricultural.

**Time-series NDVI**

- The white is area of agriculture activity where is plants spectrum reflection is more than other area, so white in picture is area where have active agricultural.
Rice Crop calendar

Single crop
Double crop
2.5 crop

Single Crop

Geo-Informatics and Space Technology Development Agency (Public Organization)
2.5 Crop
Using Time Series Segmentation for Deriving Vegetation Phenology Indices from MODIS NDVI Data

Ref:
Ideal NDVI Data

HMM for NDVI Data
The Viterbi Algorithm
Applied with NDVI Time-series Data

0 = Nothing, 1 = Increasing, 2 = Maximum, 3 = Decreasing

= NDVI data

Result
Result
GISAGRO project
for Agriculture Effectiveness and Efficiency Management in Thailand

THE OVERALL GISAGRO SYSTEM

Vector Data
1. Administrative Boundary
2. Transportation
3. Landuse/Landcover

Satellite Data

GeoDatabase

Meteorological Data

Irrigation Data/ Irrigated Zone

Soil Suitability

Cash Crop Cultivated Calendar

WMS: GISAGRO

Crop Monitoring System

Agricultural Technology Transfer System

Weather Forecast System

Productivity Estimation System

Other Data

Agricultural

 Provincial/Subdistrict Agricultural Department

Irrigation

 Department of Irrigation

Land Development

 Department of Land Development

Royal Forestry

 Department of Royal Forestry

Department of Export Promotion

Rice Department

Department of Trade
Main Agricultural Products in Thailand

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning

Main Factors
Quality
Agricultural Products

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning

Weather + Fertile soil → High Quality Agricultural Products
Longan Quality Control

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning

Longan GIS Productivity

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning
Initial Meeting with Farmers

Overview

Main Factors

Longan Precision Farming

QC Management

Cultivated Planning
Farm Assistant Training

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning

Surveying & Assisting

Overview
Main Factors
Longan Precision Farming
QC Management
Cultivated Planning
Ambassador of India and Counselor in Chiangrai

Agriculture and flood
Geospatial Database - Satellite data - FGDS - In situ

RADARSAT
THEOS
TERRA MODIS
AQUA MODIS

within 4 hours daily basis

GISTDA

http://flood.gistda.or.th
WMS

GISTDA team at FROC

FROC

FROC: Flood Relief Operation Center

Geospatial Database
- Satellite data
- FGDS
- In situ

EOS Application for Flood

Observation / Preparing
- 2 times of acquisition;
  - Terra (morning)
  - Aqua (afternoon)

Monitoring / Response
- Every 1-2 day acquisition;
  - RADARSAT 1&2

Assessment / Recovery
  - Pre and post flood (once)
  - During flood (hot spot)

High resolution data

High spatial resolution
High Temporal resolution
Small Coverage

Low Spatial resolution
High Temporal resolution
Large Coverage

High resolution data

Low Spatial resolution
High Temporal resolution
Large Coverage
Large amount of water flooding into the roads and agriculture fields.

Flood extent

Water volumes in Chao Phraya river basin

Affected houses localization by HRS Data

Upper left: Residence area location in flooded area
Upper right: Thaichote acquired on October 23, 2010
Lower left: Thaichote

Information for flood victims compensation verification
ตารางสรุปพื้นที่ได้รับผลกระทบแบ่งตามการใช้ประโยชน์ที่ดินและช่วงระยะเวลาเกิดอุทกภัย

<table>
<thead>
<tr>
<th>Land use</th>
<th>Flood extent (Unit: Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-7 Day</td>
</tr>
<tr>
<td>Rice</td>
<td>1,261,875</td>
</tr>
<tr>
<td>Farm</td>
<td>40,639</td>
</tr>
<tr>
<td>orchard</td>
<td>85,131</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>73,617</td>
</tr>
<tr>
<td>อื่นๆ</td>
<td>400,750</td>
</tr>
<tr>
<td>Total area</td>
<td>1,862,013</td>
</tr>
</tbody>
</table>