GeoS4S Module Geospatial Analysis of Food Security and Sustainability

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Abstract
The teaching and learning system for this module is projected-based driven by hands-on experiments. The module includes context of food security, food security analysis using geospatial technologies, climate change issues and food security, and applications in food security. In completing this module, students will be able to understand the food security concept, to explore relationship between climate change and food production, and to use geospatial technologies in selected issues.

Key Words: Food security, Sustainability, Geospatial Analysis, Remote Sensing, Vulnerability

1. Introduction

Sustainability in the developing world context is poorly characterized, frequently challenged by both endemic food and resource scarcity, food safety, and political and social structures ill-suited for effective implementation. Many areas around the world are experiencing enormously growth in tourism industry and large population growth, with a focus on urban areas. This growth may be causing changes in the relationship of human and land suitable for agriculture. This leads to decreasing of available fertile land for agriculture and depleting of food production especially with current global climate change. Consequently, food security problems become immediate issues. In this module, a number of food security and geospatial analyses will be used to analyze country and household level vulnerability to food insecurity.

1.1 Module Description

Food security is a flexible concept and has evolved significantly over time. Food security as a concept originated only in the mid-1970s following world food crisis which primarily focus on food supply problems. However, the food crisis that plagued Africa in the 1980s indicated that an adequate supply of food at the national or international level does not in itself guarantee household level food security. Hence, in 1983, FAO expanded its concept to include securing access by vulnerable people to available supplies with the emphasis on "poverty and hunger" as well as the establishment of "malnutrition." The concept of food security is further elaborated by the Life Sciences Research Office in 1990 by introducing people's health status. It included the access of all people at all time. The food security concept is still evolving due to emerging problems and different views. It can be considered globally or locally. The concept might be varied due to spatial and time scales. For example in the case of Thailand, while Thailand was focusing on capital-intensive industrialization, in 1974, King Bhumibol Adulyadej introduced a new national development model, the philosophy of the 'Sufficiency Economy', which focused on investment in the rural agricultural sector where, traditionally, the vast majority of the Thai population was, and still is, employed (NSO, 2007). The Sufficiency Economy is explicitly sustainable based on the holistic concepts of moderation and contentment. The philosophy was introduced with the idea of production not just for profit maximization but also for advancement towards sustainability.

This module introduces the basic concepts of food security by firstly defining the concept of food security as well as other related concepts in terms of hunger, malnutrition, and poverty, following by addressing the linkages between food insecurity, hunger, malnutrition and poverty. This lesson also discusses on conceptual framework for analyzing food security as well as the key principles of sustainable food system.

This module defines sustainability as planning and policies aimed at preserving land suitable for agriculture. The rapid growth urban area of town in northeast, Thailand is the defined close system using as a study site; combining models and a rich case study, we introduce an example of spatially-explicit model-based simulations for land use land cover change scenarios within the rubric of sustainability science for this region.

1.2 Learning Outcomes

- To introduce multiple aspects of food security and sustainability
- To introduce knowledge and skills in geospatial analysis and climate change for food security analysis
- To be able to apply appropriate spatial analysis to food security and sustainability issues
- To develop necessary skills in practical geospatial analysis to solve selected research problem of food security and sustainability.

2. Module Structure

2.1 Module Overview

This module consists of 15 lessons in total which amounts to a minimum of 90 hours of effort required for studying the core material. Most of the lessons equal to about 4 to 5 hours, excluding exercises, assignments, reading material and mini-project. Students must complete 5 exercises, 5 assignments and a self-module project designed to provide practical experience with geospatial analysis of food security and sustainability.

2.2 Summary of Lesson Content

This section briefly presents the content and goals of each lesson.

- *Lesson 1: Introduction to food security* - This lesson explains food security concepts and frameworks in closed system and helps to better understand food supply and food demand.
- *Lesson 2: Introduction to GIS and RS data and food security* - This lesson introduces the usage of Geoinformation System and Remote Sensing in food security.
- *Lesson 3: Use of GIS and RS as tools in food security analysis* - This lesson explains steps of food security analysis and the way to communicate and report food security information using geospatial technologies.
- *Lesson 4: Food security indicator* - This lesson describes food security indicator and how to calculate indicators from collecting household data.
- *Lesson 5: Climate change data and food security* - This lesson introduces the concept of climate change. It also introduces usage of GIS, RS, and climate data on food availability issues.
- *Lesson 6: Use of GIS and RS in accessibility and sustainable agriculture systems* - This lesson explains principles of sustainable development for the improvement of agricultural production and a case study of sustainable agriculture for Thailand.
- *Lesson 7: Using GIS and RS in food utilization issue* - This lesson explains food utilization and how food safety will affect food security in selected population.
- *Lesson 8: Land use change model and food stability* – In this lesson, students will learn the effects of land use change and food stability, land use classification, and land use modeling.
- *Lesson 9: Case study 1: Data* - This lesson explains how to create questionnaire and field surveys of selected topic and plotting the based map for specific population.
- *Lesson 10: Case study 2: Access and risk* - This lesson concludes the basic concepts of food access and shows how to create risk model for Thailand by using GIS and RS data.
- *Lesson 11: Case study 3: Food availability* - This lesson concludes the basic concepts of food availability and relationship with climate change. It also introduces an analysis of climate change data and food availability using GIS and RS.
- *Lesson 12: Case study 4: Food safety* – This lesson concludes the basic concepts of food utilization and safety. It also shows how to create maps and layout of food-borne disease using spatial statistics.
- *Lesson 13: Case study 5: Land use change model and food stability* – This lesson concludes the basic concepts of food stability and land use change model. It also introduces an example of rice and Thai population.
- *Lesson 14: Mini project: selected task* - This lesson will give student a self- module project work. Student needs to explore the food security issue, characteristics, and factors for their selected area by integrating remote sensing and GIS techniques in project-based.
- *Lesson 15 Conclusion* – This lesson concludes and discusses food security in students' location context.

3. Hands-on Sessions

The module provides some exercises, assignments and various case studies to supplement the lecture content, deepen students' understanding, and develop their practical skills. Many of these activities are part of the module evaluation scheme. The list below is the list of exercises and assignment in the module;

Exercises list:

- Exercise 1: Creating map for food availability assessment
- Exercise 2: Calculate context-specific indicator of food security
- Exercise 3: Using climate data on food security issue
- Exercise 4: Spatial analysis of food safety, specifically on food-borne disease
- Exercise 5: Review the GIS web application and model of food security

Assignment list:

- Assignment 1: Field surveys and data collection by web or mobile application
- Assignment 2: Creating food security index and risk map by using GIS and RS
- Assignment 3: Applying climate change data in food security
- Assignment 4: Analysis of food safety application
- Assignment 5: Analysis of land use change and food stability issue

Mini-project: Design and implement GIS projects that integrate GIS and RS data and GPS based filed information

4. Teaching and Learning System

This module will provide students a project – based learning (PBL) with the mix of technical skills, practical experience and theoretical understanding on food security using remote sensing and geographic information system. To complete the module, students must complete 5 exercises, 5 assignments and a mini-project by design and implement geospatial analysis that integrate GIS and RS data and GPS based filed information on selected food security issues.

5. Evaluation System

Performance evaluation for this module involves two components: a mini-project (50%) and five assignments (50%).

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