ESTIMATION OF PADDY CULTIVATION USING REMOTE SENSING AND GIS: BASED ON IMBULPE DIVISIONAL SECRETARIAT DIVISION

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Abstract

A preliminary data collection method called "Sample Surveys" is still used to estimate paddy cultivation areas in Sri Lanka. Also, the representation of such data is done only at the district level. But Remote Sensing technology and Geographic Information Systems can be used as an easy and viable alternative to traditional methods of compiling agricultural statistics in response to emerging data needs and overall opportunities for a sector in high demand, such as rice, in modern agriculture. Through this research, a new methodology has been introduced using Remote Sensing technology and Geographic Information Systems to generate statistical data on paddy cultivation areas. Imbulpe Divisional Secretariat division has been used for data collection. According to the technical method, it was found that the paddy cultivation area of Pallewela village is 188.573 acres. The results showed a classification accuracy of 83.33% and a Kappa coefficient of 0.7807. Accordingly, this research will encourage and support the Department of Census and Statistics to adopt satellite pilot-based technology as an alternative to the existing data collection and representation methods, and to present the feasibility of representing such data at the rural level. It aims to educate other researchers and readers that adopting this methodology can improve the quality and timeliness of agricultural statistics, as well as encourage this methodology.

Keywords: *Paddy Cultivation Estimation, Traditional Sample Surveys, Image Classification, Geographic Information System, Remote Sensing Technology.*

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Introduction

The Department of Census and Statistics estimates the average yield of paddy at the district level through a sample survey. This method may involve problems with regard to the accuracy of the crop area. The errors also directly affect the yield estimation, where the issue of paddy excess or deficit can also be affected. As a result, the method introduced for estimating paddy cultivation areas using GIS and RS, will essentially be a new method that can meet the Department of Census and Statistics' needs for ease of data collection and data accuracy.

Material and Methods

This research is completely based on secondary data. The satellite images used here are: WorldView 2 and QuickBird 2 (1.5 m) – Imbulpe [256 sq. km] [2011/12]. In order to compare the results of this analysis, the data of paddy cultivation areas obtained under the current estimation methods were available through the Imbulpe District Secretariat. Also, the data on production and surplus/deficit estimated by the Department of Census and Statistics 2011–12 by season and district, as well as the 2011–12 Ratnapura paddy area in acres, bushels, and hectares, in kilograms, were obtained separately for the two seasons.

In order to accurately identify paddy fields, the method called image classification was understood to be more appropriate in the study area. There, a more accurate image classification could be done through ERDAS IMAGINE compared to the image classification done through Arc GIS. But when classifying images through this method, it is important to open the relevant satellite image through Arc GIS and confirm the accuracy at eye level.

Results and Discussion

Here, the data required for this analysis from the data obtained using traditional methods are:

- Areas of paddy fields related to the year 2011–12 in the Pallewela Grama Niladhari domain
- Paddy harvest related to the year 2011-2012 in Pallewela village officer domain
- Surplus/deficit in the Pallewela Grama Niladhari domain for the years 2011–12

This data was obtained by the Population and Statistics Department and through the resource profile of the Imbulpe Divisional Secretariat, and since

the Population and Statistics Department data is at the district level, the data should be converted according to the area of Pallewela.

- Areas of paddy fields related to 2011/12 in Pallewela Grama Niladari division 181 acres
- Paddy harvest related to the year 2011/12 in Pallewela Grama Niladari division 416561.05119840003 kg
- Surplus/Deficit in Pallewela Grama Niladari division for the year 2011/12 63953.83884 kg

Analysis of the data obtained from the study methodology

Image classification results

Figure 2 below shows the final result of image classification using ERDAS IMAGINE and Arc GIS.

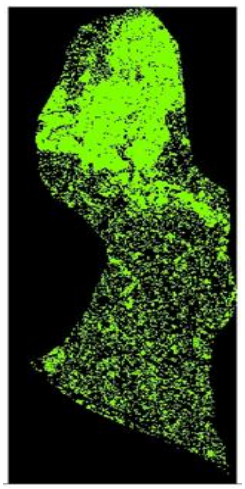
Figure 1:

Before image classification

Source: Author. *WorldView 2 and QuickBird 2 (1.5 m) – Imbulpe [256 sq. km] [2011/12]* [Satellite Image].

Figure 2:

After image classification



Source: Author. *WorldView 2 and QuickBird 2 (1.5 m) – Imbulpe [256 sq. km] [2011/12]* [Satellite Image].

Classification Accuracy Assessment Report

Image File: c:/users/user/pallewela_fin_11.img

Username: user

Date: Thu Dec 16 13:08:56 2021

Accuracy Totals

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Paddy	6	6	5	83.33%	83.33%

Kappa statistical analysis

Since this study focuses only on paddy fields, the accuracy of Kappa coefficient value for paddy fields is considered here. Accordingly, the Kappa coefficient of paddy fields has a high accuracy of 0.7807.

KAPPA (K^) STATISTICS

Overall, Kappa Statistics = 0.2363

Conditional Kappa for each Category.

Class Name	Kappa
Unclassified	1.0000
Other	0.0196
Paddy	0.7807

According to the technical method, it was found that the paddy cultivation area of Pallewela village is 188.573 acres. Based on that data, paddy surplus can be calculated.

Table 1:

According to the study results, paddy area, paddy production and paddy excess

Area	Paddy area in acres	Paddy production in kg	Paddy excess kg
Pallewela	188.573	433987.2669725298	66628.56

Comparison of the study results with the results of the traditional method

In a situation where it is not possible to provide a standard assessment of the correctness of the cultivation area through the traditional data collection method, without spending a lot of time, effort and money, under the new method it is possible to collect data about the paddy cultivation area very efficiently without any physical connection with the study area. For this, the information obtained from the farmers by the village officials and primary reporters is not necessary, and here only an officer with satellite photos and GIS knowledge for the relevant year is required.

Table 2:

Conventional estimation data and study results

Data type	Conventional data collection methodology	Technical Data Collection Methodology
Acres of paddy land	Acres 181	Acres 188
Rice production	416561.05119840003 kg	433987.2669725298 kg
Paddy excess	63953.83884 kg	66628.56 kg

Source: Using Conventional and Technical data created by the Author

Studying the gap between the two methods

As far as the gap between the two methods is concerned, it is also seen that it is more appropriate to obtain data under the new method, which is easy and efficient since relatively large differences cannot be identified.

Variation in the paddy area

188 acres - 181 acres = 7 acres

Variations in rice production

433987.2669725298 kg - 416561.05119840003 kg = 17426.2149 kg

Paddy surplus

66628.56 kg - 63953.83884 kg = 2674.72116 kg

Conclusion and Recommendations

At present, the collected data is represented only in terms of districts. But the study area selected in this research is the village officer domain. Here, the paddy cultivation areas were calculated using satellite images without any difficulty. There are various problems related to time, labor, and wealth in collecting data through the traditional method such as a sample survey without accurate ground level, but according to the findings of the study, the satellite images obtained through this method can confirm 83.33% accuracy. This means that there is a very high possibility of obtaining reliable data.

Policies can be made to use the new method as an alternative to the traditional method.

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