INTEGRATION OF REMOTE SENSING AND GIS FOR POPULATION ESTIMATION, MAGWAY DISTRICT, MAGWAY REGION, MYANMAR

Naing Phyo Kyaw

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การบูรณาการการรับรู้จากระยะไกลและระบบสารสนเทศภูมิศาสตร์สำหรับการประมาณจำนวนประชากร เมืองมักเวย์ มณฑลมักเวย์ ประเทศเมียนมาร์

นายนายพโย จอ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรวิทยาศาสตรมหาบัณฑิต

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การประมาณประชากรเป็นสิ่งจำเป็นสำหรับการตัดสินใจเชิงนโยบาย การวางผังเมืองและการบริหารจัดการในประเทศเมียนมาร์ กระบวนการของการประมาณประชากรจะใช้ข้อมูลสำมะโนประชากรครั้งล่าสุดหรือการสำรวจประชากรพร้อมกับสารสนเทศประกอบ ดังนั้นการค้นหาวิธีการการประมาณประชากรที่ทันสมัยจึงมีความจำเป็นเพื่อลดข้อจำกัดของการสำรวจประชากรในประเทศเมียนมาร์ วัตถุประสงค์ของการวิจัยคือ (1) เพื่อประมาณประชากรด้วยวิธีการสร้างแบบจำลองทางสถิติ (statistical modeling method) (2) เพื่อประมาณประชากรด้วยวิธีการประมาณค่าในช่วงเชิงพื้นที่ (areal interpolation method) (3) เพื่อประเมินความถูกต้องและระบุวิธีการที่เหมาะสมสำหรับการประมาณประชากร และ (4) เพื่อประยุกต์ใช้วิธีการที่เหมาะสมในการประมาณประชากรในพื้นที่อื่น ในการศึกษาครั้งนี้ เริ่มต้นจากการประมาณประชากรด้วยวิธีการสร้างแบบจำลองทางสถิติและวิธีการประมาณค่าในช่วงเชิงพื้นที่เพื่อระบุวิธีการที่เหมาะสมสำหรับการประมาณประชากรในเมืองมักเวย์ (Magway district) มณฑลมักเวย์ (Magway region) ประเทศเมียนมาร์ (Myanmar) และนำวิธีการที่เหมาะสมสำหรับการประมาณประชากไปทดสอบความสมเหตุสมผลกับเมืองมินบู (Minbu district) ในมณฑลมักเวย์

จากผลการศึกษาที่ได้รับ พบว่า แบบจำลองทางสถิติที่เหมาะสมที่สุดสำหรับการประมาณประชากรจากการวิเคราะห์การถดถอยเชิงเส้นตรงแบบหลายตัวแปรภายใต้วิธีการสร้างแบบจำลองทางสถิติ ได้แก่ สมการที่สร้างจากลอการิทึมธรรมชาติของความหนาแน่นประชากรที่ได้จากการสุ่มตัวอย่างตามชั้นภูมิ (stratified random sampling) ของความหนาแน่นประชากรระดับชั้นปานกลางและสูง แบบจำลองสามารถให้ค่าสัมประสิทธิ์สหสัมพันธ์ (R) ค่าสัมประสิทธิ์การตัดสินใจ (R^2) และค่าสัมประสิทธิ์การตัดสินใจที่ปรับแก้แล้ว (adjusted R^2) เท่ากับ 0.860, 0.739 และ 0.723 ตามลำดับ มีจำนวนประชากรจากการประมาณค่าเท่ากับ 1,255,788 คน ขณะที่ข้อมูลอ้างอิงของเมืองมักเวย์ในปี ค.ศ. 2014 เท่ากับ 1,235,030 คน วิธีการสร้างแบบจำลองทางสถิติให้ค่าความผิดพลาดส่วนตกค้าง (residual error) เท่ากับ -20,758 คน ที่ให้ผลการประมาณค่าสูงไป (overestimation) ความผิดพลาดสัมพัทธ์เท่ากับ -1.68% ความผิดพลาดสัมพัทธ์โดยรวม (overall relative error) เท่ากับ 56.44% และความผิดพลาดสัมบูรณ์โดยรวม (overall absolute error) เท่ากับ

1,256.32 คน ในขณะเดียวกันวิธีการดาซีเมตริกแบบไบนารี (binary dasymetric method) ที่ต้องใช้พื้นที่ที่มีประชากรและไม่มีประชากรจากแผนที่การใช้ประโยชน์ที่ดินและสิ่งปกคลุมดินในการประมาณประชากร แผนที่การใช้ประโยชน์ที่ดินและสิ่งปกคลุมดินจำแนกจากข้อมูลภาพแพนชาร์ปเพนนิงของขั้นตอนวิธี High Pass Filtering โดยใช้ตัวจำแนก Nearest neighbor ภายใต้การวิเคราะห์ข้อมูลภาพเชิงวัตถุ (object-based image analysis) ค่าความถูกต้องโดยรวม (overall accuracy) และค่าสัม ประสิทธิ์แคปปาแฮท (Kappa hat coefficient) ของแผนที่การใช้ประโยชน์และสิ่งปกคลุมดิน เท่ากับ 92.86% และ 90.85% จำนวนประชากรจากการประมาณค่าเท่ากับ 1,231,934 คน วิธีการดาซีเมตริกแบบไบนารีให้ค่าความผิดพลาดส่วนตกค้าง (residual error) เท่ากับ 3,096 คน ที่ให้ผลการประมาณค่าต่ำไป (underestimation) ความผิดพลาดสัมพัทธ์เท่ากับ 0.25% ความผิดพลาดสัมพัทธ์โดยรวม (overall relative error) เท่ากับ 21.14% และความผิดพลาดสัมบูรณ์โดยรวม (overall absolute error) เท่ากับ 577.57 คน ขณะที่ วิธีการถ่วงน้ำหนักเชิงพื้นที่ (areal weighting method) ที่ต้องใช้พื้นที่บล็อกและไม่ใช่บล็อกสำมะโนประชากร มีจำนวนประชากรจากการ ประมาณค่าเท่ากับ 1,109,846 คน วิธีการถ่วงน้ำหนักเชิงพื้นที่ให้ค่าความผิดพลาดส่วนตกค้าง (residual error) เท่ากับ 125,184 คน ที่ให้ผลการประมาณค่าต่ำไป และความผิดพลาดสัม พัทธ์เท่ากับ 10.14% จากผลลัพธ์ดังกล่าว วิธีการดาซีเมตริกแบบไบนารีจึงเป็นวิธีการที่เหมาะสมสำหรับก ารประ มาณประชากรในเมืองมักเวย์ และวิธีการดังกล่าวถูกนำไปใช้ประมาณประชากร ของเมืองมินบูสำหรับการตรวจสอบความสมเหตุสมผลแบบจำลอง ซึ่งให้ผลลัพธ์ที่ยอมรับได้

สาขาวิชาภูมิสารสนเทศ ลายมือชื่อนักศึกษา_____

ปีการศึกษา 2563 ลายมือชื่ออาจารย์ที่ปรึกษา_____

NAING PHYO KYAW : INTEGRATION OF REMOTE SENSING AND GIS FOR POPULATION ESTIMATION, MAGWAY DISTRICT, MAGWAY REGION, MYANMAR. THESIS ADVISOR : ASSOC. PROF. SUWIT ONGSOMWANG, Dr. Rer. Nat. 220 PP.

Population estimation is essential for policy-making, urban planning, and administration. In Myanmar, the population estimation process is based on the recent census or demographic surveys with ancillary information. Therefore, a new suitable method for population estimation is investigated to minimize demographic surveys' limitations in Myanmar. The research objectives were (1) to estimate population using the statistical modeling method; (2) to estimate population using the areal interpolation method; (3) to access accuracy and to identify an optimum method for population estimation; and (4) to validate an optimum method for population estimation in the test area. In this study, the statistical modeling and areal interpolation (binary dasymetric and areal weighting) methods were first examined to identify an optimum population estimation method in Magway District, Magway Region, Myanmar. The identified optimum method for population estimation was then applied to validate in the Minbu District of the Magway Region.

The most suitable statistical model for population estimation using multiple linear regression analysis under the statistical modeling method was an equation derived from the natural logarithm of population density from the stratified random samplings by moderate and high population density. The model could provide the R, R^2 and adjusted R^2 values of 0.860, 0.739 and 0.723. The estimated population was 1,255,788 persons, while the 2014 reference data of Magway District is 1,235,030

persons. The statistical modeling method contributed the residual error of -20,758 persons with an overestimation, the relative error of -1.68%, the RE of 56.44%, and the AE of 1,256.32 persons. Meanwhile, the binary dasymetric method required populated and unpopulated areas from land use and land cover (LULC) map for population estimation. The LULC map in 2014 was classified from a pan-sharpened image of the High Pass Filtering algorithm using the nearest neighbor classifier under the object-based image analysis. The overall accuracy and Kappa hat coefficient of the LULC map were 92.86% and 90.85%. The estimated population was about 1,231,934 persons. The binary dasymetric method contributed the residual error of 3,096 persons with an underestimation, the relative error of 0.25%, the RE of 21.14%, and the AE of 577.57 persons. In the meantime, the areal weighting method required only blocked and unblocked areas for population estimation. The estimated population was 1,109,846 persons. The areal weighting method contributed the residual error of 125,184 persons with an underestimation and the relative error of 10.14%. As a result, the binary dasymetric method was chosen as an optimum method for population estimation in the Magway district, and it was applied to estimate the population of the Minbu district for model validation with acceptable results.

School of Geoinformatics Student's Signature_____

Academic Year 2020 Advisor's Signature_____

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Naing Phyo Kyaw

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LIST OF ABBREVIATIONS

NDVI	=	Normalized Different Vegetation Index
OBIA	=	Object Based Image Analysis
UIQI	=	Universal Image Quality Index
RE	=	Relative Error
AE	=	Absolute Error
PD	=	Population Density
LPD	=	Natural Logarithm of Population Density
SPD	=	Square root of Population Density
ESRI	=	Environmental Systems Research Institute
GIS	=	Geographic Information System
LULC	=	Land Use and Land Cover
NDWI	=	Normalized Different Water Index
UN	=	United Nations
SAVI	=	Soil Adjusted Vegetation Index
RDVI	=	Renormalized Different Vegetation Index
TNDVI	=	Transformed Normalized Different Vegetation Index
SRB	=	Spectral Reflectance of Band
BT	=	Brightness Temperature
BUI	=	Built Up Index
SWIR	=	Short-Wavelength Infrared
NIR	=	Near Infrared

LIST OF ABBREVIATIONS (Continued)

VIF	=	Variance Inflation Factor
TOL	=	Tolerance
SR	=	Simple Ratio

CHAPTER I

INTRODUCTION

1.1 Background problems and significance of the study

Population projection deals with computations of future projection size and characteristics based on assumptions about future trends in fertility, mortality, and migration. Obtaining reliable population numbers estimates is essential for policy-making, urban planning, and administration, both at the regional and local scale. It is also fundamental for risk assessment related to natural and human-induced hazards. However, it is impossible to predict the future trends in fertility, mortality, and migration with percent certainty; it is also impossible to accurately predict the population's prospective size and characteristics (United Nations, 2015).

In the meantime, town planning requires a fair idea of the future for which planning needs to be done. For this purpose, planners use various methods and tools for predicting the future, which generally involves population data and population projection as people are the ones who need to be kept in mind. Many important factors of the future situation facing the community on which the planner must advise are derived directly from the population projection. It forms a framework for a great deal of the subsequent work in devising, testing, evaluating, and implementing the plan. Most of the critical decisions about significant land uses and services are derived from population estimates: the demand for water, power, and waste disposal facilities; housing, open spaces, and schools; the supply of labor; spending power available for

the retail trade, the numbers of private cars to be, etc. The accuracy of population projections is generally considered directly proportional to the size of the existing population and the historical growth rate and inversely proportional to the time projection (Graves, 2012).

In practice, the number of populations can be conducted using census and demographic surveys. Typically, the census is conducted in ten years' periods. The United Nations (2015) recommends a census enumeration at least once every ten years and once every 5 for even better data, rather than merely relying on estimates and projections alone. Estimating and mapping the population is not an easy research project due to human activities and the natural environment. Also, the demographic survey could not be made every year because its estimation with various methods requires time.

Besides, the result of the population estimation should be nearly closed to the current situation. The overestimation and underestimation of the population can affect the quality of the current project. For example, in residential housing planning for disaster-affected communities, the overestimation can waste the financial budget. Also, the underestimation can need residential people (Guha-Sapir, Hoyois, and Below, 2015).

Myanmar's last population census was conducted in 2014. Before the 2014 census, the previous census was held in 1983. The gap between the two statistics was over three decades. The number of populations is essential information, which many agencies in Myanmar frequently require for driving government policy and short- and long-term development projects. The Myanmar Government relies on the calculation of population on demographic surveys. Up to the present, the population estimation in

Myanmar is conducted based on the recent census or demographic survey using a statistical method with ancillary information (Department of Population, 2015).

Overestimation or underestimation generally affects government policy and short- and long-term development projects in Myanmar. For instance, the demographic surveys assumed the total population of Myanmar in 2010-2011 was about 60 million, but the actual population after the census survey in 2014 was only 51.4 million (Central Statistical Organization, 2012).

Besides, it is impossible to visit all parts of the country and conduct enumeration in 100 percent of its territory under the last three population censuses (1973, 1983 and 2014) in Myanmar. The problem's reasons include inter-communal tensions, disagreements between government and community leaders on conducting the census, and security-related concerns. For example, in the 2014 Census, some areas of ethics communities in Kachin and Kayin States were not counted; some communities in the northern part of Rakhine state were not counted because they could not self-identify using a name that the Government does not recognize. According to the 2014 Myanmar population and housing census, 70% of Myanmar's population lives in a rural area. The left 30% live in the urban area (Department of Population Myanmar, 2015). The summary of the existing problem regards to population estimation in Myanmar is reported in Table 1.1.

In general, there are many methods in population estimation. Most of them use ancillary information from recent census and surveys. Many methods take time, and others requirement financial and labor force. The population estimation by combining remote sensing and GIS is an efficient and effective method because it can reduce

time, money, and labor compare with other estimation methods (Wu, Qiu, and Wang, 2005).

The existing population estimation methods with GIS and remote sensing were two categories: areal interpolation methods and statistical modeling methods. Areal interpolation methods can be further separated into two categories depending on whether ancillary information is used. Statistical modeling methods can be further grouped into five categories based on the relationship between populations and urban areas, land uses, dwelling units, image pixel characteristics, or other physical or socioeconomic characteristics (Wu et al., 2005).

Li and Weng (2005) estimated the population density in Indianapolis, Indiana, USA by combining Landsat Enhanced Thematic Mapping Plus data with US Census data using a statistical modeling method. Likewise, Kim and Choi (2011) estimated the population density of Georgia State, USA, based on the US Census Bureau TIGER98 Census tracts, national land cover data and 30-meter Landsat Thematic Mapper (TM) using hybrid dasymetric mapping.

Therefore, the population estimation with remote sensing and GIS approaches, which include population estimation using statistical modeling method and areal interpolation method (binary dasymetric and area weighting methods), will be investigated and justified as an appropriate method to Myanmar situation for reducing time, budget, human resources and accessibility.

Table 1.1 The existing problem regards population estimation.

1. Government requires to estimate population approximately every ten years
2. Many places in remote areas in Myanmar are challenging to conduct a survey, such as Shan, Kachin and Rakhine states.
3. Myanmar had not applied remote sensing and GIS integration for population estimation.

Source: Department of Population (2015).

1.2 Research objectives

This research aims to produce an optimum model for population estimation. Specific research objectives are set as follows:

(1) To estimate population using the statistical modeling method;

(2) To estimate population using the areal interpolation method;

(3) To assess accuracy and to identify an optimum method for population estimation; and

(4) To apply an optimum method for population estimation in another area.

1.3 Scope of the study

(1) For population estimation using the statistical modeling method, multiple linear regression analysis is applied to identify the correlation between the population density and spectral reflectance and index values of image pixels. The dependent variable is population density and its transformation (square root of population density and the natural logarithm of population density), while independent variables include the spectral reflectance, vegetation indices, principal components, texture

indicators, brightness temperature, built-up index, and water index are extracted from the Landsat image.

(2) For population estimation using a binary dasymetric method, the classified LULC data using standard nearest classifier under object-based image analysis are reclassified into two groups, “populated” and “unpopulated” areas, for assignment all residential areas pixels within a source zone (census block) with an equal share of the total population.

(3) For population estimation using the area-weighting method, a constant population density is calculated from the source zone (census block). Then the size of each overlapping area between the source zone and target zone (study area) is used as a weight to estimate the target zone’s population with the average population from the source zone.

(4) Accuracy of statistical modeling and the areal interpolation methods for population estimation is assessed using absolute error (AE) and relative error (RE).

(5) Magway district, Magway region, is chosen as a study area for identifying the optimal method for population estimation. Meanwhile, Minbu District, Magway region, is selected to validate an optimal method for population estimation.

1.4 Limitation of the study

(1**)** The census blocks are not only the habited area and mixed with other land use types**.** The census blocks are the same as the wards and village tract boundary areas**.** The 2014 Myanmar population and housing census was conducted only in the residential area.

(2**)** As the traditional living practice of the people who live in Myanmar**'**s middle parts, including the Magway and Minbu districts, some people are not live in villages and towns**.** They are separately live in the forest area and agriculture area**.** It may cause population estimation, and their living area is apart from the residential area**.**

(3**)** Due to cloud cover, only two satellite images in the summer period in 2014 can be downloaded and applied in this study. However, the acquisition date of two Landsat 8 OLI images, Path 134 Row 46 and Path 133 Row 46, on 19 April 2014 is close to the conducted Census project during 1-10 April 2014.

1.5 Study area

The study area is Magway, and the testing area is Minbu district. The Magway district is one of the districts from the Magway Region in central Myanmar located between 19° 23'09.8" N and 20° 56'20.7" N, 94° 46'19.6" E and 95° 50'25.9" E (Figure 1.1). It is bounded to the south by Thayet district, to the east by Meiktila district and Yamethin district of Mandalay region, Oketaya district and Detkhina district of Nay Pyi Taw union territory, to the north by Pakokku district of Magway region and Nyaung-U district of Mandalay region, to the west by Minbu and Thayet district of the same region. Magway district constitutes six townships and 400 wards and village tracts (census block) (Department of General Administration, 2013). The Magway district area is 9,630 km^2, the total population is 1,235,030 persons, the population density is 128 persons per $km^{2,}$ and an annual growth rate is 0.86. Eighty-five percent of the population lives in rural areas, and only the left 15% live in urban areas**.** Most of the areas are agricultural areas**.** The main cultivation crops are sesame, peanut, paddy, cotton, and various types of beans**.** Magway district has no problematic

area to travel to, but the agricultural areas are enormous, and the residential areas are small. The population densities of some areas in the Magway district are less than 50 persons per km^2 (Department of Population, 2017**)**.

The climate of the Magway district belongs to short, sweltering, humid and moderately cloudy; the winters are short, warm, and mostly clear; and it is dry the whole year. Its landform is characterized by flat or almost flat about 35%, slightly undulating is about 47%, undulating is 15%, and the rolling, hilling and steep are not more than 3%. The distribution of elevation and landform classification by slope for Magway District is shown in Figure 1.2. The area and percentage of slope classification and landform in the study area are shown in Table 1.2.

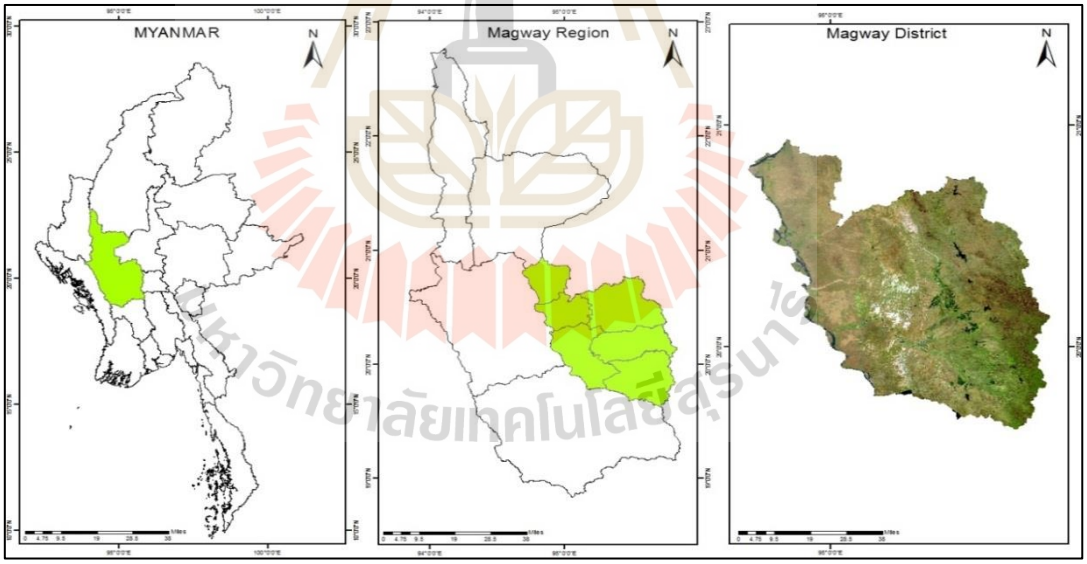
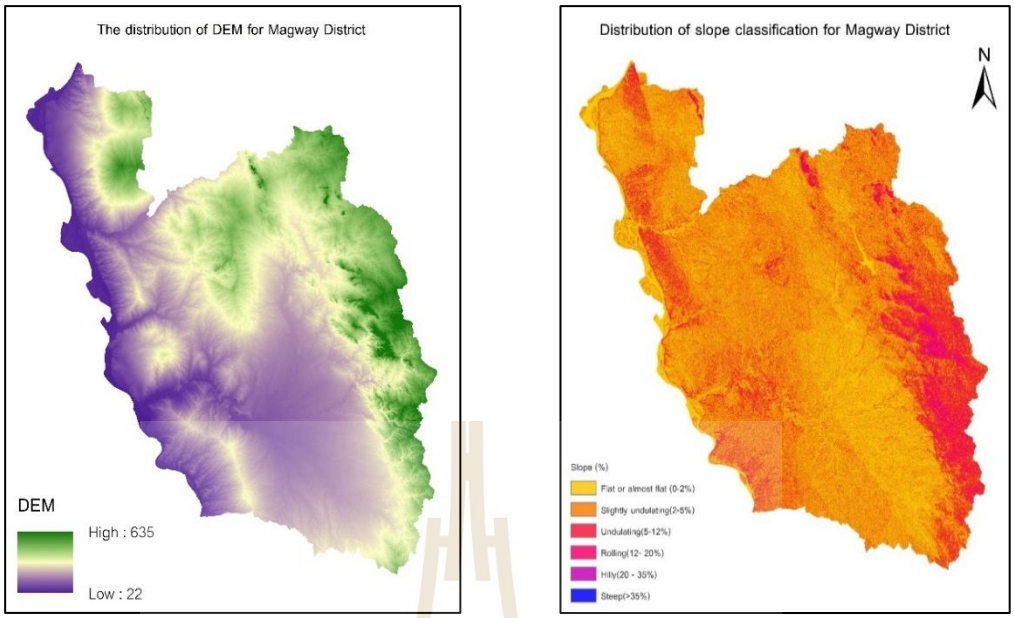


Figure 1.1 Location of Magway District, Magway Region, Myanmar.



(a) (b)

Figure 1.2 Distribution of elevation (a) and slope classification and landform by slope in Magway District (b).

Table 1.2 Area and percentage of slope classification and landform in Magway District.

No	Slope (%)	Landform	Area (sq. km)	Percentage
1	0-2	Flat or almost flat	3,382.69	35.090
2	2-5	Slightly undulating	4,526.87	46.959
3	5-12	Undulating	1,499.26	15.552
4	12-20	Rolling	196.49	2.038
5	20-35	Hilly	34.28	0.356
6	>35	Steep	0.46	0.010
		Total	**9,640.07**	**100.00**

Meanwhile, Minbu district is a district of the Magway region located in the middle part of Myanmar. It is bounded to the south by Thayet District, to the east by Magway district, to the north by Pakokku district and Gangaw district, to the northwest by Mindat district of Chin State, and the west by Sittwe district of Rakhine

State and Kyaukpyu district of Rakhine State (Figure 1.3). Minbu district constitutes five townships and 310 wards and village tracts. The Minbu district area is 9,314 km^2, the total population is 687,575 persons, the population density is 74 persons per $km^{2,}$ and an annual growth rate is 0.78. Eighty-five percent of the population lives in rural areas, and only the left 15% live in the urban area. The main cultivation crops are sesame, peanut, paddy, cotton, and various types of beans. Minbu district has no problematic area to travel to, but the agricultural areas rather significant, and the residential areas are small. The population densities of some areas in the Minbu district are less than 50 persons per km2 (Department of Population, 2017).

Also, the climate of Minbu district belongs to short, sweltering, torrid spring and moderately cloudy; the winters are short, warm, and mostly clear; and it is dry around the year. The landform of the Minbu district was quite different from the Magway district. The flat or almost flat area is about 23%, slightly undulating is about 27%, undulating is 17%, the rolling area is about 12%, hilling area is about 1.6%, and the steep area is only 1.6%. The distribution of elevation and slope classification and landform for Minbu District is shown in Figure 1.4. The area and percentage of slope classification and landform in Minbu District are shown in Table 1.3.

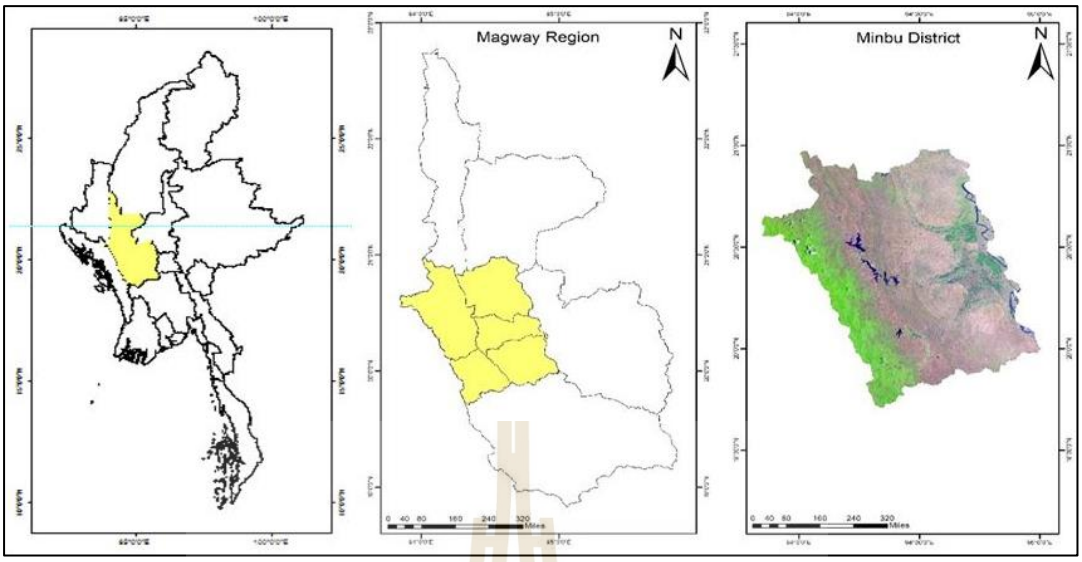
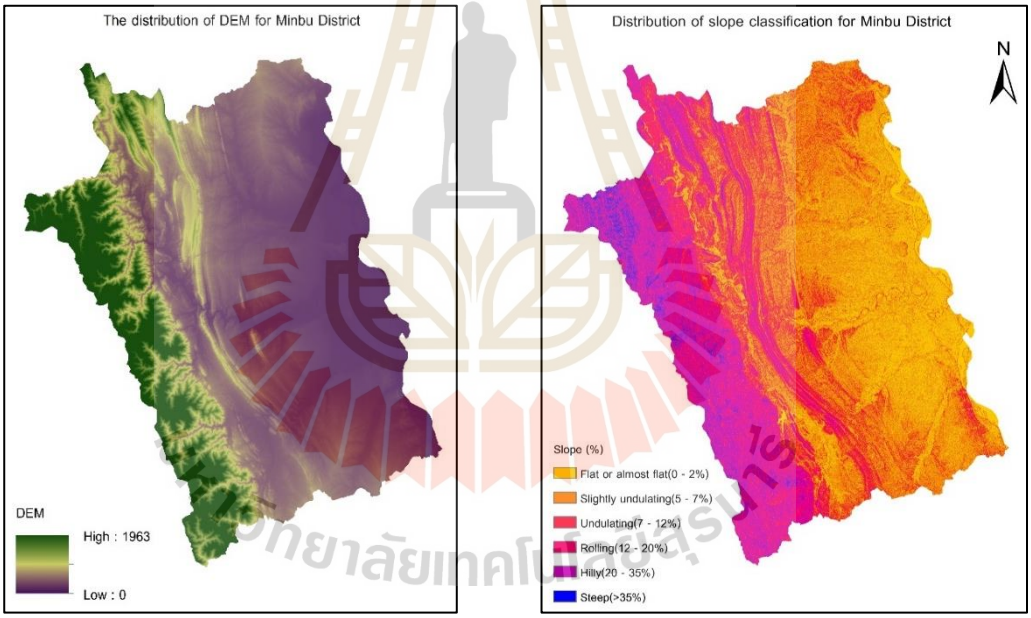


Figure 1.3 Location of Minbu District, Magway Region, Myanmar.



(a) (b)

Figure 1.4 Distribution of elevation (a) and slope classification and landform by slope in Minbu District (b).

Table 1.3 Area and percentage of slope classification and landform in Minbu District.

No	Slope (%)	Landform	Area (sq. km)	Percentage
1	0-2	Flat or almost flat	2200.27	23.692
2	2-5	Slightly undulating	2659.057	28.632
3	5-12	Undulating	1648.213	17.748
4	12-20	Rolling	1118.42	12.043
5	20-35	Hilly	1510.593	16.266
6	>35	Steep	150.3819	1.619
		Total	**9,286.935**	**100.00**

1.6 Benefit of the study

The benefits of the study are covered with all research objectives, including:

(1) The research framework from this study can support the population estimation for Myanmar's future population estimation projects and surveys, particularly regions or districts with similar landscape features.

(2) All the census projects cannot conduct the total investigated area. For example, in northern Rakhine, Kachin and Kayin States were either partially enumerated or not covered during the enumeration. The statistical modeling method with stepwise regression analysis can be applied to estimate populations because the spectral reflectance and indices, as independent variables, can be quickly extracted from remotely sensed data and population data, as the dependent variable can be retrieved from available census data.

(3). The binary dasymetric method, as the optimum method for population estimation in this study, can be applied for inter-census projects because it can reduce cost and time. The inter-census projects estimate the population between two official census dates for the concentration of population estimation. In Myanmar, the 2019 inter census survey was based on the 2014 population and housing census. The

sample EAs were first allocated to the districts according to the square root of the number of households in each district from the 2014 Myanmar Census. The resulting allocation was then adjusted to have a minimum of 32 samples EAs in most of the smallest districts and a maximum of 120 samples EAs in the largest districts. Within each stratum, the sample EAs were selected systematically with probability proportional to size (PPS) based on the number of private households in each EA from the 2014 Census frame (Department of Population, 2020).

(4) Details of LULC classification with high accurate data from OBIA can be further support local government agencies for resources management, planning and conservation and so on.

CHAPTER II

RELATED CONCEPTS AND LITERATURE REVIEWS

Basic concepts, including population estimation using statistical modeling and areal interpolation methods, and literature reviews are summarized.

2.1 Population estimation using the statistical modeling method

Statistical modeling approaches in remote sensing started in the mid-1950s, mainly to search for an alternative to a population census. Researchers have conducted various statistical modeling methods for population estimation on different scales with different remotely sensed imagery types. In general, there are five categories of approaches, based on the relationship between population and (1) urban areas, (2) land use, (3) dwelling units, (4) image pixel characteristics, and (5) other physical or socio-economic characteristics (Lo, 1986; Liu, 2003). This research uses correlation with image pixel characteristics to estimate population with a statistical regression model.

The population method's relevant statistical modeling methods are briefly summarized based on Wu et al. (2005) below.

2.1.1 Correlation with urban areas

This approach concern with the relationship between the urban area and population size, and the use of the built-up area (A) of a settlement is proportional to its population (P) raised to some power (Nordbeck, 1965):

$$A = a * P_b. \quad (2.1)$$

Tobler (1969) applied satellite imagery from the Gemini manned space flight program to study the relationship between population and urban areas and further used images to study many cities' populations globally. Assuming that the study area can be considered as a circular shape, and if shape varies insignificantly with time.

The correlation coefficients between radii and populations of 0.87 or higher in the following function:

$$r = a * P^{b}. \quad (2.2)$$

where a is the coefficients, and b is the exponential for the urban area. This model is used for comparing the many study areas from the United States and other world cities.

Lo and Welch (1977) found correlation coefficients of 0.82 or higher between populations and classified urban areas in a modified model of Nordbeck (1965) as follows:

$$P = a * Ab. \quad (2.3)$$

This function can be referred to as the allometric growth model (Lee, 1989; Lo, 2003), which describes that the population's relative growth rate is proportional to the residential land area's relative growth rate.

2.1.2 Correlation with land use

The statistical modeling approach does not directly use census data as the input. Instead, it uses socio-economic variables and applies theories in urban geography for population estimation; census population data only participate in the model training process. This approach is designed initially to estimate the inter-census population or population of an area challenging to enumerate. However, it can also be

incorporated into the process of interpolating the census population. The total population for an area can be calculated according to the following function (Wu et al., 2005):

$$P = \sum_j A_j * \mathrm{D_j} \quad (2.4)$$

Where P is the total estimated population; A_j is the area of land use j; and D_j is the population density for land use j, which is to be determined through regression analysis. This essential function is similar to that used in the dasymetric method. Areas for different land use types could be extracted from remote sensing images, and land use types classification can make by using several classification methods.

2.1.3 Correlation with dwelling units

The total population of an area can be calculated by multiplying the number of dwelling units and population per dwelling unit. Each dwelling unit has a different population, and the average population by dwelling units can get from population census and surveys. The total number of dwelling units can estimate from Landsat images.

2.1.4 Correlation with image pixel characteristics

The physical characteristics on the land can be extracted from remotely sensed imagery, and the population density also directly correlated to the spectral reflectance value of image pixels. Hsu (1973) was probably the first to suggest the idea of using imagery pixel values to develop a multiple regression model for population estimation (Lo, 1986). The mean spectral value of Landsat variables is strongly correlated with population density. Harvey (2002a; 2002b) incorporated a variety of spectral transformation measures, such as the band-to-band ratio and

difference-to-sum ratio, in addition to textural measures, in a series of stepwise regression models for population estimation.

2.1.5 Correlation with other physical or socio-economic characteristics

Several types of physical and socio-economic variables can be correlated with population density. For a simple example, people want to live in the best residential areas with social, health, education, transportation, and economic services. So, the best service areas may be a highly-populated areas.

Many physical and socio-economic variables can help estimate population; the attributes that can be directly or indirectly observed and extracted from remotely sensed imagery are applicable in the remote sensing context. Residential areas constitute a significant component of such an analysis. The data are usually of two types:

(1) The structural conditions of individual residential units; and

(2) Attributes reflecting the residential or neighborhood environment.

Green (1957) and Green and Monier (1959) pioneered research using aerial photographs to study socio-economic and demographic variables. They cited extensive literature to demonstrate that social values are attached to the housing and residential communities. By extension, observable physical data have meaningful sociological correlations, regardless of whether socio-economic or pixel characteristics are used in statistical modeling for population estimation.

2.2 Application of statistical modeling method

Many literature reviews showed that many researchers apply the statistical modeling method in population estimation. For example, Lwin and Murayama (2009)

estimated the building population in Japan for Micro-spatial Analysis with the GIS approach by using building footprints and height with the Digital Height Model (DHM) and building volume with the Digital Volume Model (DVM) of LiDAR remote sensing images. The ancillary data are census tract files (Shape polygon) to estimate the residential building population with area metric method, volumetric method and linear regression analysis. Population mapping at the residential level estimated building population with weighted area metric model and population estimation error with volumetric metric model micro spatial analysis, are produced with the r^2 value of 0.8004 in the area metric method and at 0.9488 volumetric methods.

Also, Abutaleb, Yones, El-Shirbeny, Ma' mon, and Al-Ashal (2019) made modeling and monitoring house fly *M. domestica* using remote sensing data in Mansheitt Al-Gammal, a village of Markaz Tamiya, Fayoum governorate, which is located in the western desert of Egypt, by Landsat 8 imagery. The data used two field visits were carried out for house fly counting and land surface temperature recording. Three replicates were taken for the fly count and surface temperature as well. Data processing and constructing model are reflectance sub-model, Tasseled Cap indices sub-model, NDVI, and NDWI calculation of study area and stepwise regression analysis for selection of optimum estimation model. A strong correlation was found between the estimated house density of fly (HDF) by the model and the measured HDF at the field with r = 0.84. The derived model can produce the future in overcoming the disease infection as a problem in Egypt. It may achieve more understanding and illustrate how these findings could control these flies and perform a database to predict the distribution.

Likewise, Harvey (2002a) provided the population estimation models based on individual TM pixel at 110 km west of Melbourne, Victoria, Australia, with the Landsat thematic mapper (TM) scene, Path 93 and Row 86. Ancillary data used are the collection of census district boundaries and estimated annual population counts. The data processing and regression analysis was done using Aggregate-based methods, Pixel-based methods and Ordinary Least-Squares (OLS) models. The population estimation model produced a mathematically complex census district-based model, which utilized spatial aggregations of a variety of spectral and spatial transformations of six TM bands and a mathematically simple pixel-based model, which utilized the six untransformed TM bands for supervised classification and iterated regression modeling, followed by a contextual reclassification and a non-linear transformation of the regression estimates.

2.3 Population estimation using the areal interpolation method

Areal interpolation is primarily designed for zone transformation, and it is applied to transform source zone data to finer scale raster data by a specific interpolation method. By definition, areal interpolation is the process of changing the spatial data from one set of the unit to another (Bloom, Pedler, and Wragg, 1996; Fisher and Langford, 1996) and is often used to compare multiple datasets, each collected using different enumeration units, and it used to transfer all data to a standard set of enumeration units (e.g., census enumeration area) to access efficient comparison and analysis (Wu et al., 2005).

There are two main methods for areal interpolation for population estimation that consists of (1) areal interpolation without ancillary information and (2) areal interpolation with ancillary information (Wu et al., 2005).

2.3.1 Areal interpolation without ancillary information

Areal interpolation without ancillary information is further classified into two methods: point-based methods and areal-based methods (Lam, 1983). In point-based interpolation, the control point represents every source zone, and a grid map is generated with grid point value generated from grid points values. Areal-based interpolation is concerned with volume preservation. It summarizes population data to the original set of areal units to transform a new set of areal units.

(1) Point-Based Methods.

Many point-based interpolation methods developed in the past and separated into two groups, global and local, depending on whether they consider all of the data values at once or the values within a pre-defined neighborhood of each point. Lam's (1983) approach to group point-based methods into exact methods and approximate methods depends on whether they are concerned with preserving the original sample point values or determining an overall surface function f(x, y). The reason for this categorization is that whether interpolation methods preserve original data values on the inferred surface is fundamental in analyzing their accuracy. The exact methods include interpolating polynomials, most distance-weighting methods, kriging, spline functions, and finite difference methods. In contrast, the approximate methods include power-series trend models, Fourier series models, distance weighted least squares, and least-squares fitting with splines. Each of these methods has its

advantages and disadvantages, and none of them is superior to all others for all applications (Lam, 1983).

The main problem of point-based methods is that they mostly do not conserve each source zone's total value. Volume preservation is essential because it gives reliability to the approximation of grid values for the source zone. Thus, the subsequent estimation for the target zone is less subject to error. Besides, in the context of population interpolation, people should not be "destroyed" or "manufactured" during the redistribution process (Langford and Unwin, 1994). To correct the problem, Martin (1996) modified the original kernel-based interpolation algorithm (which is a point-based method) to ensure that the populations reported for target zones are constrained to match the source's overall sum units.

(2) Area-Based Methods.

Area-based methods are the overlay operation based on the geometric properties of the source and target zones. To obtain each source zone's proportion in each target zone, superimposing the source zone on the target zone is required. The proportion then serves as a weight, and the values of target zones become a weighted linear function of source zones. Assuming the homogeneity within each source zone is the major problem with the overlay method. For these reasons, the reliability of target zone estimates is controlled mainly by the nature and degree of the source zone's homogeneity and by the size of the target zone with the source zone (Lam, 1983). The overlay methods will give more accurate estimates if the surface is discontinuous.

2.3.2 Areal interpolation with ancillary information

Many areal interpolation methods can be incorporated into dasymetric mapping methods to improve the choropleth map's detail below the enumeration units (Fisher and Langford 1996). The dasymetric method was initially developed by Wright (1936) because choropleth maps do not represent population distribution within enumeration units. With the development of digital data supporting and GIS technology, the dasymetric method can preserve the GIS overlay process's easy and efficient use.

Wright's dasymetric method relies on knowledge of the local areas to determine subzone population densities. Flowerdew and Green (1989) proposed using statistical regression analysis to estimate subzone population densities; Langford, Maguire, and Unwin (1991) first applied multivariable regression techniques to estimate dasymetric subzone population densities. Their approach is based on the following function:

$$P_i = \sum P_{ij} = \sum A_{ij} * D_j \tag{2.5}$$

where P_i is the total population of source zone i; P_{ij} is the total population of land use j within source zone i (subzone ij); A_{ij} is the total area of land use j within source zone i, and D_j is the average population density of land use j. A_{ij} can be obtained by a GIS overlay operation of a land use map and a source zone map. Since there are multiple source zones, multivariable regression can be applied to estimate D_j of multiple land use types. Volume preservation is further maintained by scaling up or down derived density measures to fit each source unit's original total population.

The most straightforward dasymetric mapping approach with remote sensing–derived land use data is a binary division approach in which land use is classified into two groups "populated" and "unpopulated," and census populations are redistributed to those populated areas; some example studies included Holt, Lo, and Hodler (2004); Fisher and Langford (1996); Langford and Unwin (1994). Langford et al. (1991) modified the developed method by Harvey (2002a; 2000b) with the homogeneity assumption within subzones by estimating population density in pixels' spatial units. This method assigns all residential areas pixels within a source zone with an equal share of the total population with the following equation

$$P_{ij} = {}^{P_i}/_{n}, \text{ i} = 1, 2, \ldots, n \quad (2.6)$$

Where P_{ij} is the population initially assigned to the j^{th} pixel in source zone i, whose total population is Pi, and n is the number of pre-classified residential pixels in source zone i. Since there were many source zones, each of which had some residential pixels with different digital values, an ordinary least-squares regression could be conducted between the population and the pixels' digital value. With the regression coefficients obtained, the population of each pixel was adjusted by the following equation:

$$\text{P}_{\text{ij}} \text{ (adj)} = \hat{P}_{ij} + \hat{r} \quad (2.7)$$

where $\hat{P}_{ij}$ is the regression estimate, and

$$\hat{r} = \frac{\sum_{i=1}^{n}(P_{ij} - \hat{P}_{ij})}{n} \quad (2.8)$$

The result was that the adjusted reference population lay closer to the regression line than the initially assigned population. If the iteration were rerun with the adjusted value, the R^2 would be improved. The process was repeated iteratively,

and R^2 continued to increase monotonically with decreasing increments and stopped when a pre-defined threshold was reached. Harvey (2000b) proved that this iterated regression procedure is a least-square approximation to the Expectation Maximization (EM) algorithm that was initially presented by Dempster, Laird, and Rubin (1977) and applied by Flowerdew and Green (1989, 1991) for combining data from two incompatible sets of spatial zones.

The areal interpolations methods can be classified into two categories depending on the utilization of ancillary information. Using ancillary information with the dasymetric method can take more precise results than areal interpolations without ancillary information.

2.4 Application of areal interpolation method

The combination of remote sensing and GIS techniques has been used to estimate the population with areal interpolation using the dasymetric method. For instance, Ural, Hussain, and Shan (2011) studied building population mapping with aerial imagery and GIS data in Indiana, USA. The binary dasymetric method applied residential and non-residential areas with area metric and volume models, object-based image classification, and land cover classification. The overall accuracy of 98% achieved with the combination of high spatial resolution imagery and elevation data. The outputs were population mapping at a residential level, estimated building population with weighted area metric model, and population estimation error with weighted area metric model.

Also, Kim and Choi (2011) estimated the population density of dasymetric maps in the State of Georgia, USA using Hybrid Dasymetric Mapping (dasymetric

and pycnophylactic methods) with 30-meter Landsat TM data, US Census Bureau TIGER98 Census tracts, and National land cover data. The data processing methods are a dasymetric method, pycnophylactic area interpolation, and combined method. The outputs produce a population grid map generated with mean absolute percent error (MAPE), 21.57% for the dasymetric method, 37.94% for pycnophylactic interpolation, and 19.92% combined method.

Yang et al. (2019) applied the township-level spatially disaggregates the census population data into each pixel for producing a population distribution map with an acceptable spatial resolution in Zhejiang, southeastern coast of China with the data set of census population data, administrative boundary, points of interest, DMSP/OLS data (1 km resolution), MODIS EVI data (250 m resolution) and GDEM data (30 m resolution). The data processing methods were zonal statistics, binary linear regression models, and kernel density estimation. A pixel-based elevation-adjusted human settlement (EAHSI) method, point of interest EAHSI (POI-EAHSI) method, and world population (WorldPop) method were used to produce a relationship between the predicted gridded estimated and census population total. The POI-EAHSI method showed the highest correlation with R^2 of 0.88 compared WorldPop R^2 of 0.79 and EAHSI with R^2 of 0.71.

The dasymetric mapping method uses census blocks population data (source zones) as input and land cover data (ancillary zones). It readjusts the population data to a set of target zones formed from the intersection of the source. Bielecka (2005) used the ancillary zones to produce Poland's population density map with the dasymetric method. The binary and aerial-weighting dasymetric methods and regression models were applied for population density maps with land cover data

classification. As a result, two dasymetric methods exposed the inter-regional variation in population density more reasonable, in particular, among urban and rural areas.

Furthermore, Eicher and Brewer (2001) implemented the dasymetric mapping and areal interpolation in Maryland, Virginia, with three types of dasymetric methods: grid and polygon binary methods polygon and grid three-class method and limiting variable method. The experimentation was made with six socio-economic variables reflecting the different appearance of population distribution map data obtained from the 1990 US Census and the two population variables total population and black population. The dasymetric approach produced a correlation between the density of the total population. The black population density was 0.70. The correlation between the total population and four housing variables ranged from 0.60 to 0.79 when the correlations between the black population and housing variables were 0.27 to 0.47. The correlation between housing variables was from 0.81 to 0.99. The dasymetric methods can provide population density maps, percent error in population estimation, and count error in the number of persons for each study area's census block.

CHAPTER III

RESEARCH METHODOLOGY

The overview research methodology is schematically illustrated in Figure 3.1. It consists of data collection and preparation and five components that include (1) population estimation using statistical modeling method, (2) population estimation using areal interpolation method, (3) accuracy assessment, (4) optimum method for population estimation, and (5) validation of an optimum method for population estimation. Brief information on data collection and preparation and components is summarized in the following section.

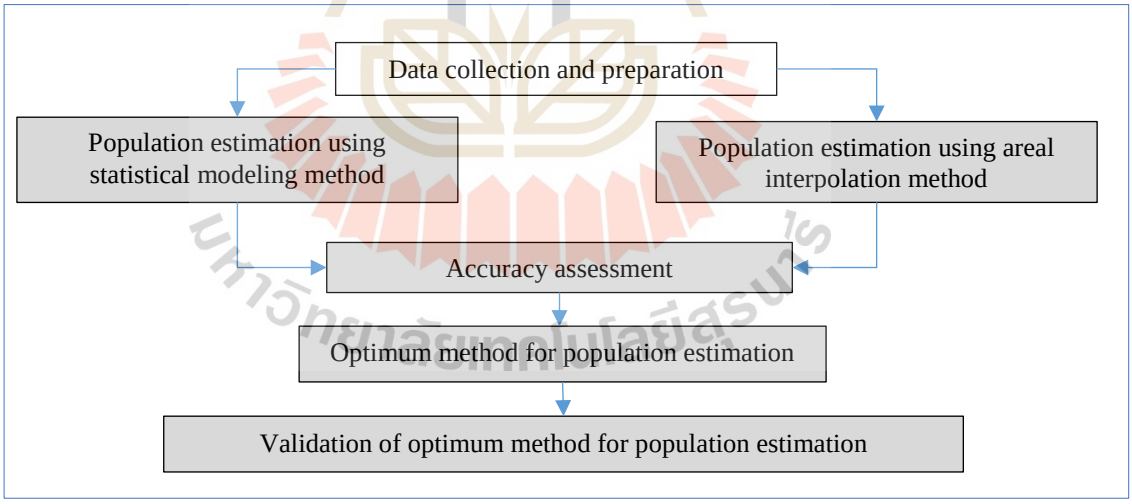


Figure 3.1 Overview of the research framework.

3.1 Data collection and preparation

Collection and preparation data were included ancillary data, remotely sensed data, and GIS data as a summary Table 3.1. The ancillary data was the census block population data from the 2014 Myanmar Population and Housing Census. Figure 3.2

displays an example of three villages: Yone Kone, Kun Ohn (N) and Kun Ohn (S) in one census block, and Figure 3.3 displays an enumeration area map of Kun Ohn (N) village in the Magway district. This map shows the location of housing, school, and pagoda. Meanwhile, Landsat 8 OLI data (Path/Row: 133/46 and 134/46, dated 19 April 2014) were downloaded from the USGS website (www.earthexplore.usgs.org) for population estimation using statistical modeling, and areal interpolation methods are displayed in Figure 3.4. Besides, administrative data (district and region) in GIS format were collected from the Survey Department, Ministry of Natural Resources and Environmental Conservation Myanmar.

Table 3.1 List of data collection and preparation for population estimation in the study.

Data	Data collection	Data Preparation	Source	Component
Ancillary data	Number of populations of census blocks in Magway and Minbu districts	Simple random and stratified random sampling for the dependent variable	2014 Myanmar Census	1, 2, 3, 4,5
Remote Sensing data	Landsat 8 OLI image (Path/Row: 133/46 and 134/46), Dated 26 April 2014.	Independent variable extraction and LULC Classification	USGS website (www.earthexplore.usgs.org)	1, 2,5
GIS data	Administrative boundary and Census blocks		Survey Department, Ministry of Natural Resources and Environmental Conservation, Myanmar	1, 2,5

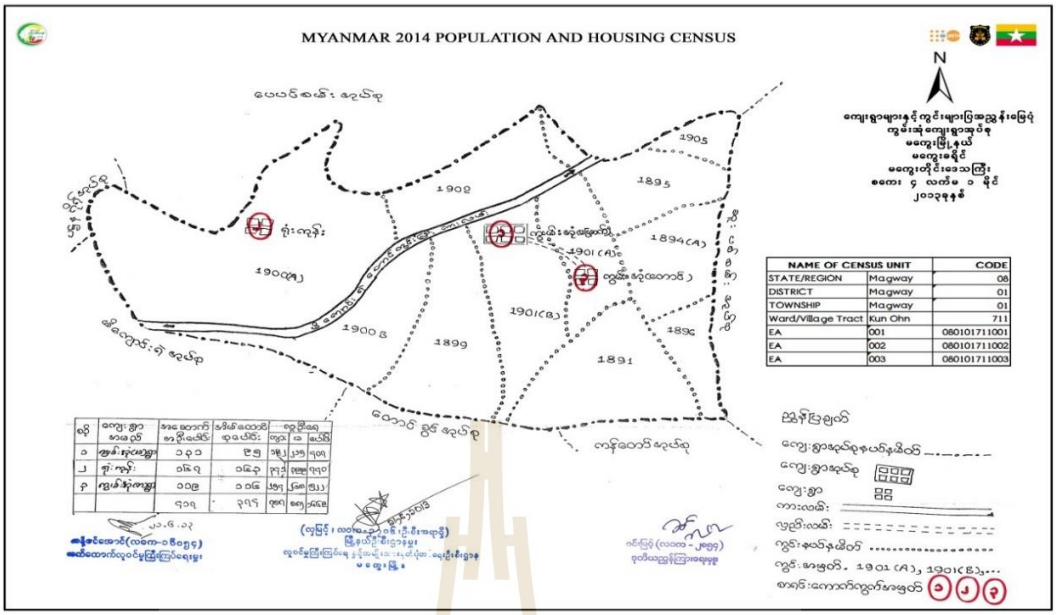


Figure 3.2 Sketch map of three villages in one census block in 2014 of Magway District.

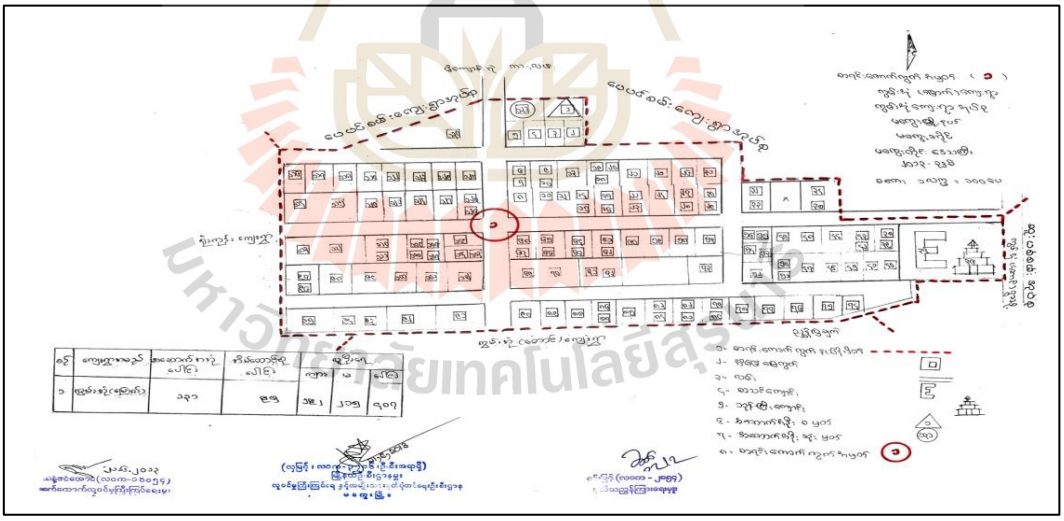
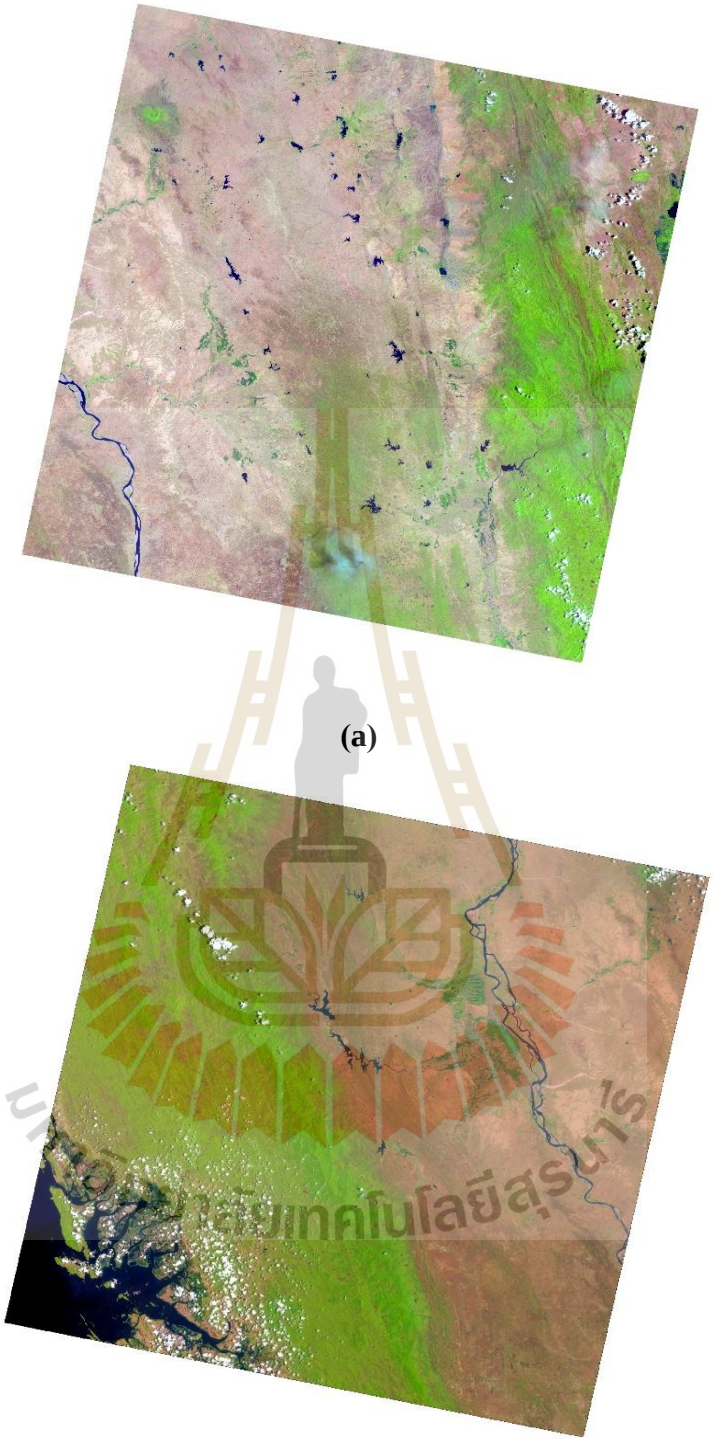


Figure 3.3 Enumeration area map of Kun Ohn (N) village in Magway District.



(a)

(b)

Figure 3.4 False-color composite imagery of Landsat 8 OLI image with band combination of 5, 4, and 3 (RGB) for Path/Row: (a) 133/46 and (b) 134/46.

3.2 Population estimation using the statistical modeling method

Overall, the population estimation under the statistical modeling method was conducted using multiple linear regression analysis. In practice, each census block's population density and its transformation as a dependent variable and the spectral reflectance and indices from the Landsat data as independent variables were first extracted for multiple regression analysis. The estimated population was then calculated from the best regression model based on the correlation coefficient (R), coefficient of determination (R^2) and adjusted R^2 values. Finally, an accuracy assessment of the derived models was performed using overall relative error (RE) and overall absolute error (AE) statistics. The workflow of population estimation using the statistical modeling method is displayed in Figure 3.5.

To estimate population using statistical modeling method, population density (PD) and its transformation (natural logarithm population density, LPD and the square root of population density, SPD) as the dependent variable was first extracted from GIS data and then selected sample cases with simple random sampling and stratified random sampling (moderate and high population density). In practice, the geographic coordinates of census blocks were first converted to the UTM to match the Landsat images. Each census block has a total population and area with km^2. Then the sample blocks were selected by simple and stratified random sampling methods with the SPSS software. In this study, 60% of census blocks from Magway district from both simple and stratified random sampling methods were selected for multiple regression analysis. For a stratified random sampling method, the population density was classified into two classes: (1) low population density and (2) moderate and high

population density using the geometric interval classification method for census block sample selection.

Meanwhile, non-selected census block samples (40%) were further applied for accuracy assessment. Since the number of census blocks in the study area is small, the ratio of selected and non-selected census blocks is 60% and 40% was applied in this study. So, 60 percent of the Magway district's census blocks were randomly selected using simple random and stratified random samplings for multiple linear regression analysis. In the meantime, non-selected sample blocks, which account for 40 percent of census blocks, were kept for accuracy assessment.

Meanwhile, independent variables, including spectral reflectance data, vegetation indices, three principal components, texture by variance with different window sizes, brightness temperature, built-up index and water index, were extracted from Landsat 8 OLI data in 2014.

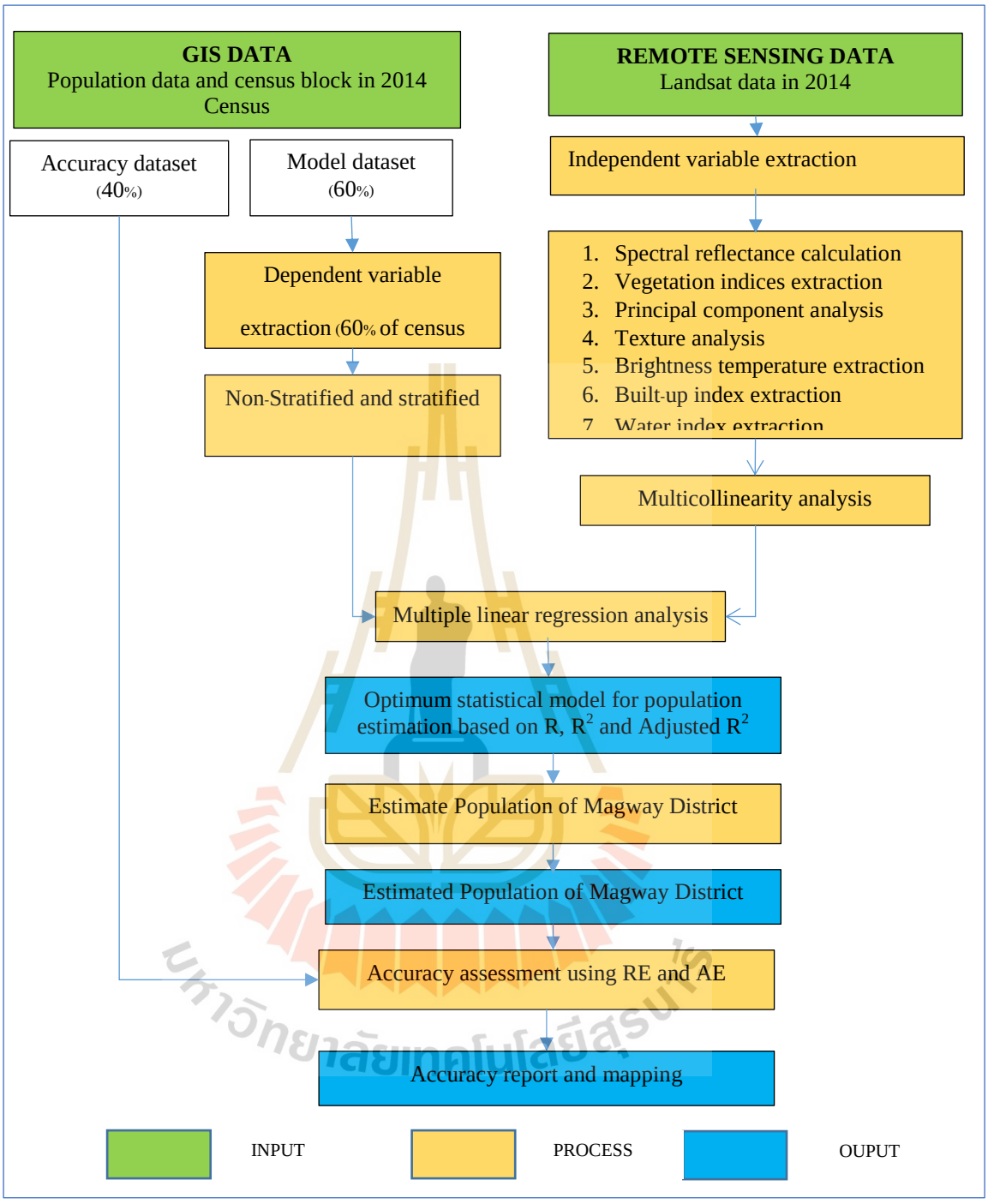


Figure 3.5 Workflow of population estimation using statistical modeling method.

The list of independent variables by grouping is presented in Table 3.2. Brief information for independent variable extraction from Landsat 8 OLI data under the ERDAS Imagine environment was separately described in the following sections.

Table 3.2 List of the extracted independent variables from the Landsat OLI image.

	Independent group	Independent variables	Abbreviation
1	Spectral reflectance	Band 2 (Blue)	SRB2
		Band 3 (Green)	SRB3
		Band 4 (Red)	SRB4
		Band 5 (NIR)	SRB5
		Band 6 (SWIR-1)	SRB6
		Band 7 (SWIR-2)	SRB7
2	Vegetation indices	NDVI	NDVI
		SAVI	SAVI
		RDVI	RDVI
		TNDVI	TNDVI
		SVI	SVI
		SR	SR
3	Principle component analysis	PC-1	PC1
		PC-2	PC2
		PC-3	PC3
4	Texture by variance with different window sizes	3x3	NIR3x3 or SWIR3x3
		5x5	NIR5x5 or SWIR5x5
		7x7	NIR3x3 or SWIR7x7
5	Brightness temperature	BT	BT
6	Built-up index (BUI)	BUI	BUI
7	Water index	NDWI	NDWI

(1) Spectral reflectance. Spectral reflectance values for Band 2 to Band 7 of Landsat OLI image of the study area were extracted using the standard method suggested by USGS's handbook (USGS, 2019). Herein, the 16-bit integer values at the level 1 product were converted to top of atmosphere (TOA) reflectance using Eq. 3.1.

$$\rho\lambda' = M_\rho * Q_{cal} + A_\rho \quad (3.1)$$

where $\rho\lambda'$ is TOA planetary spectral reflectance, without correction for solar angle (Unitless), M_ρ is reflectance multiplicative scaling factor for the band from the

metadata, A_ρ is reflectance additive scaling factor for the band from the metadata, and Q_{cal} is the L1 pixel value in DN.

(2) Vegetation indices. Vegetation indices, which represent green areas of agriculture and forest areas for population estimation, were selected as applied by many researchers for population estimation such as Lo and Welch, 1977. In this study, five vegetation indices, namely, normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI), renormalized difference vegetation index (RDVI), transformed NDVI (TNDVI), and simple ratio (SR), were selected to extract green area for population estimation, as a summary in Table 3.3.

Table 3.3 Equations for vegetation index calculation.

Vegetation Index	Formula	Reference	Equation
Normalized Different Vegetation Index (NDVI)	$\frac{NIR - RED}{NIR + RED}$	Rouse et al. (1974)	(3.2)
Soil adjusted vegetation index (SAVI)	$\frac{(1+L)(NIR - RED)}{NIR + RED + L}$ L=0.5	Huete (1988)	(3.3)
Renormalized Different Vegetation Index (RDVI)	$\frac{\text{NIR} - \text{RED}}{\sqrt{\text{NIR} + \text{RED}}}$	Roujean and Breon (1995)	(3.4)
Transformed NDVI (TNDVI)	$\sqrt{(NDVI + 0.5)}$	Deering et al. (1975)	(3.5)
Simple Ratio (SR)	NIR/RED	Birth and McVey (1968)	(3.6)

(3) Principal component analysis. Principal components were derived from the original data using principal component analysis (PCA) under the spectral enhancement function of ERDAS imagine software. In principle, the first component accounts for the maximum proportion of the original dataset variance, and subsequent

orthogonal components account for the maximum portion of the remaining variance (Holden and Ledrew, 1998; Zhao and Maclean, 2000). After performing PCA, the original correlated bands are transformed into independent principal components (PCs), and the first PC contains the most considerable data variance. The second PC contains the second-largest data variance, and so on. The higher-numbered PCs often appear noises because they contain minimal variance of information (Richards, 1994). In this study, the first three PCs extracted from Band 2 to 7 of Landsat 8 data, which account for more than 95 percent of the total variance, were used in population estimation analysis.

(4) Texture by variance. Texture often refers to the pattern of the intensity of variations in an image. Many texture measures have been developed, and these are used for land cover classification (Haralick, Shanmugam, and Dinstein, 1973; He and Wang, 1990). A standard texture measure, variance, is useful in improving land cover classification (Shaban and Dikshit, 2001). This study extracted a variance from Band 4 (NIR) and Band 7 (SWIR-2) with three different window sizes: 3x3, 5x5, and 7x7 were used to examine its relationship with the population.

(5) Brightness temperature. The brightness temperature (BT) data, which represents temperature in the study area, are extracted from the OLI thermal infrared band (band 10) for population estimation. The procedure to extract the BT involves two-steps:

In the first step, the 16-bit integer values of the Level-1 product were converted to spectral radiance using the radiance scaling factors provided in the metadata file:

$$L_\lambda = M_L * Q_{cal} + A_L \quad (3.7)$$

where L_λ is spectral radiance (W/ (m^2·sr·μm)), M_L is radiance multiplicative scaling factor for the band from the metadata, A_L is radiance additive scaling factor for the band from the metadata, and Q_{cal} is the L1 pixel value in DN.

The second step was TIRs data to be converted from spectral radiance to BT, the satellite's sufficient temperature under an assumption of unity emissivity. The conversion formula is as follows:

$$BT = K2/\ln(\frac{K1}{L_\lambda} + 1) \quad (3.8)$$

where BT is TOA BT, in Kelvin, L_λ is spectral radiance (Watts/ (m^2·sr·μm)), K1, and K2 are thermal conversion constant for the band from the metadata.

(6) Built-up index. The build-up areas and bare soil reflect more SWIR than NIR. The water body doesn't reflect on the infrared spectrum. In the case of the green surface, a reflection of NIR is higher than the SWIR spectrum. For better results, many researchers apply the built-up index (BUI). The BUI is an index for the analysis of urban patterns using NDBI and NDVI as:

$$BUI = NDBI - NDVI \quad (3.9)$$

Where NDBI is derived by the following equation:

$$NDBI = (SWIR - NIR) / (SWIR + NIR) \quad (3.10)$$

The BUI is the binary image with only a higher positive value indicating built-up and barren, allowing BUI to map the built-up area automatically.

(7) Water index. The normalized difference water index (NDWI) is used for the water bodies analysis. The index uses green and near-infrared bands of remote sensing data. The NDWI can enhance water information efficiently in most cases. It is sensitive to build-up land and results in overestimated water bodies. The NDWI

products can be used in conjunction with NDVI change products to assess the context of apparent change areas. Water bodies having low reflectance, and it only reflects within the visible portion of the electromagnetic spectrum. Water bodies in their liquid state are generally high reflectance on the Blue (0.4 - 0.5 μm) spectrum than Green (0.5 -0.6 μm) and Red (0.6 – 0.7 μm) spectrum. Clearwater can get the most significant reflectance in the blue portion of the visible spectrum. So, the water appears blue. Turbid water has higher reflectance in the visible spectrum. There is no reflection in the near infrared (NIR) and beyond. NDWI was developed by Gao (1996) to enhance the water-related features of the landscapes. The formula of NDWI was then modified by Xu (2005). It uses Green and SWIR band as:

$$\text{NDWI} = \frac{Green - SWIR}{Green + SWIR} \tag{3.11}$$

In this study, census blocks data and remotely sensed data have different formats and spatial resolutions; they need to be integrated. With ERDAS Imagine software, remotely sensed data were aggregated to block group level using zonal statistics. The mean value of selected remote sensing variables at the block group level, which is the most commonly used measure of central tendency (Jensen, 2015), was computed for population estimation with the statistical modeling method. The mean value of independent variables is assumed to be homogeneous land use and land cover in each census block for population estimation.

Two main steps, including multicollinearity analysis and multiple linear regression analysis, were conducted for population estimation under the SPSS software after dependent and independent preparation.

3.2.1 Multicollinearity analysis

Multicollinearity analysis is a phenomenon when two or more predictors are correlated. If this happens, the coefficients' standard error will increase (Clendon and Kee, 2002). Increased standard errors mean that the coefficients for some or all independent variables may be found to be significantly different from 0. Multicollinearity represents a high degree of linear inter-correlation between explanatory variables in a multiple regression model and leads to incorrect regression analyses.

In general, multicollinearity is detected by examining the tolerance (TOL) for each independent variable and variance inflation factor (VIF) (Kim, 2005). The coefficient of determination (R^2) from a multiple linear regression model can also be used to measure the extent of multicollinearity between explanatory variables. The tolerance is the amount of variability in one independent variable that is no explained by the other independent variables, and it can be calculated using the following equation:

$$\text{Tolerance (TOL)} = 1\text{-}R^2 \tag{3.12}$$

Daoud (2009) suggested that tolerance values less than 0.10 indicate collinearity.

For variance inflation factors (VIF), when a correlation exists between predictors, the standard error of predictors coefficients will grow, and the variance of predictor's coefficients is inflated. The VIF is a tool to measure and quantify how much the variance is inflated. VIFs are usually calculated by the software as part of regression analysis and appear in the VIF column as part of the output (Daoud, 2017). Table 3.4 presents the interpretation of the VIF.

Table 3.4 VIF interpretation.

VIF value	Interpretation
VIF =1	Not correlated
1 <*VIF* <=5	Moderately correlated
VIF >5	Highly correlated

Source: Daoud (2017).

The meaning of VIF itself in showing whether the predictors are correlated, the square roof of VIF indicates how much larger the standard error (Daoud, 2017). The VIF can be calculated using the following equation.

$$\mathrm{VIF} = \frac{1}{1-\mathrm{R}_\mathrm{i}^2} \tag{3.13}$$

If the VIF is greater than 5 to 10 and the TOL lower than 0.1 to 0.2 (R^2 = 0.8 to 0.9), multicollinearity exists. Although the variance inflation factor helps determine multicollinearity, it cannot detect the multicollinearity's explanatory variables (Kim, 2019).

3.2.2 Multiple linear regression analysis

To perform multiple linear regression analysis, the mean values of selected independent variables at the block group level, which include spectral reflectance, vegetation indices, three principal components, texture by variance with three different window size, BT, BUI and water index, were firstly computed using zonal analysis function of ERDAS Imagine software. Then, dependent and independent variables were then exported into the SPSS software to analyze multiple linear regression with the stepwise method. After that, the correlation coefficient (R), coefficient of determination (R^2), and adjusted R^2 values applied to quantify the

variable's relationship in a regression model were examined to justify the suitable model for population estimation under the statistical modeling approach.

Furthermore, the estimated population data are used to assess accuracy based on non-selected samples in terms of residual error using the RE and AE measurement.

3.3 Population estimation using the areal interpolation method

Two methods of the areal interpolation approach include the binary dasymetric method and the area-weighting method, were applied to estimate the population in this study. Details of each approach are separately described in the following section.

3.3.1 Population estimation with a binary dasymetric method

Qiu, Zhang, and Zhou (2012) stated that the binary dasymetric method is based on ancillary data (such as land use) that provides a binary divide between populated and unpopulated units. As control units, the ancillary data allows the population to be redistributed only to populated units and therefore does not assume an evenly distributed population in a source zone.

The binary dasymetric procedure, described by Langford and Unwin (1994) and Eicher and Brewer (2001), was applied to inhabited areas by selecting urban and built-up classes out of total LULC classes in the study area. The population density in the binary dasymetric method was calculated by dividing the number of inhabitants into the census blocks by the area of the inhabited part. The raster and vector implementation of the binary dasymetric method can be used to estimate the population.

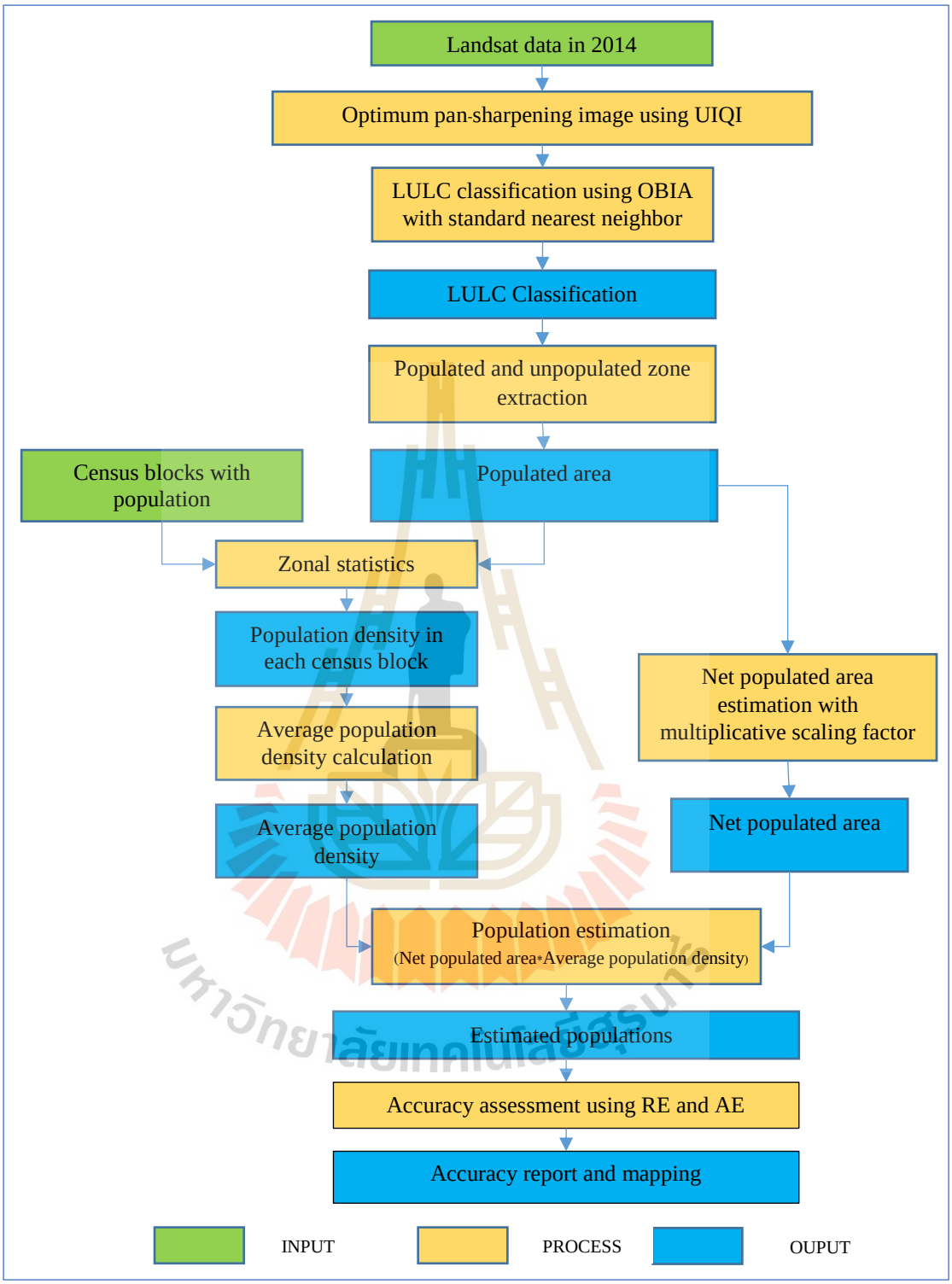


Figure 3.6 Workflow of population estimation using areal interpolation with a binary dasymetric method.

In this study, population estimation with a binary dasymetric method was implemented in raster format. The workflow of population estimation using areal interpolation with the binary dasymetric method is displayed in Figure 3.6. Significant steps of population estimation using areal interpolation with the binary dasymetric method are summarized in the following sections.

(1) LULC classification using a standard nearest neighbor classifier

Two downloaded Landsat images of the study area were firstly applied to prepare pan-sharpening images using the selected algorithms, including (1) Ehlers fusion, (2) Gram-Schmidt pan-sharpening, (3) High Pass Filtering, (4) Modified IHS, (5) Principal Components Analysis (PCA) transformation and (6) Wavelet transform. Then, an optimum pan-sharpening image was identified for LULC classification based on the Universal Image Quality Index (UIQI) of Wang and Bovik (2002) as:

$$UIQI = \frac{\sigma_{xy}}{\sigma_x \sigma_y} * \frac{2\bar{x}\bar{y}}{(\bar{x})^2+(\bar{y})^2} * \frac{2\sigma_x \sigma_x}{\sigma_x^2 \sigma_y^2} \quad (3.14)$$

Where

σ_x is a standard deviation of MS band

σ_y is a standard deviation of PS band

σ_{xy} is a covariance between MS and PS bands

$\bar{x}$ is a mean value of MS band

$\bar{y}$ is a mean value of PS band

σ_x^2 is a variance of MS band

σ_y^2 is a variance of PS band

The pan-sharpened images with an optimum pan-sharpening algorithm were further applied to classify LULC using the standard nearest neighbor classifier under OBIA of the eCognition software. In this study, nine LULC types were classified, including (1) settlement, (2) built-up areas, (3) paddy field, (4) oil crops, (5) forest land, (6) shrubland, (7) waterbody, (8) bare land, and (9) sand bar. Additionally, the classified LULC map was further assessed accuracy (overall accuracy, producer's accuracy, user's accuracy and Kappa hat coefficient) using very high spatial resolution from Google Earth.

Lastly, the classified LULC data were regrouped into two zones: populated and unpopulated zone for population estimation using the binary dasymetric method. The area of the populated zone is directly extracted from the settlement class. However, the inherent LULC objects in settlement class, such as school, pagoda, and market, should be detached by reducing the area of settlement with a multiplicative scaling factor of 0.005 (Personnel communication with Kyaw Naing Win, 2020). This scaling factor will reduce the area of settlement in each census block by about 5%.

(2) Population estimation

For population estimation with the binary dasymetric method, two significantly required steps, including net populated area extraction and average population density calculation, were first conducted as a summary below.

The net populated area was extracted by subtraction of populated areas (settlement class) with the summation of multiplication of settlement area in each census block from *n* blocks with a multiplicative scaling factor (0.005), as shown in the following equation

$$Net\ populated\ area = Total\ Settlement\ area - \sum_{i=1}^{n} Settlement\ area\ in\ block_i * 0.005 \quad (3.15)$$

Meanwhile, the average population density was estimated based on the population density of each census block and the total number of census blocks using the following equation:

$$Average\ Population\ density = \frac{Total\ population\ density\ from\ eac\square\ census\ block}{Total\ number\ of\ census\ block} \quad (3.16)$$

The number of populations was finally estimated by multiplication between the net populated area with average population density in the study area, as shown in the following equation.

$$Estimated\ population = Net\ populated\ area * Average\ population\ density \quad (3.17)$$

Furthermore, the estimated population data were used to assess accuracy based on census population using the RE and AE measurement.

3.3.2 Population estimation with area-weighting method

The area-weighting method is a straightforward algorithm for performing areal interpolation and the most general choice when ancillary information (LULC data) is not available (Goodchild and Lam, 1980). Under the area-weighting method, the study area's population density was calculated by dividing the block population by the total study area as a constant population density of the study area. Meanwhile, the ratio between the census block area and the study area was calculated as a weight. Finally, the total population in the study area was estimated using the following equation.

$$Estimated\ Population = Blocked\ area * Weig\square t * Constant\ population\ density \quad (3.18)$$

Furthermore, the estimated population data were used to assess accuracy based on census population in 2014 using the RE and AE measurements. The

Workflow of population estimation using areal interpolation with the area-weighting method is displayed in Figure 3.7.

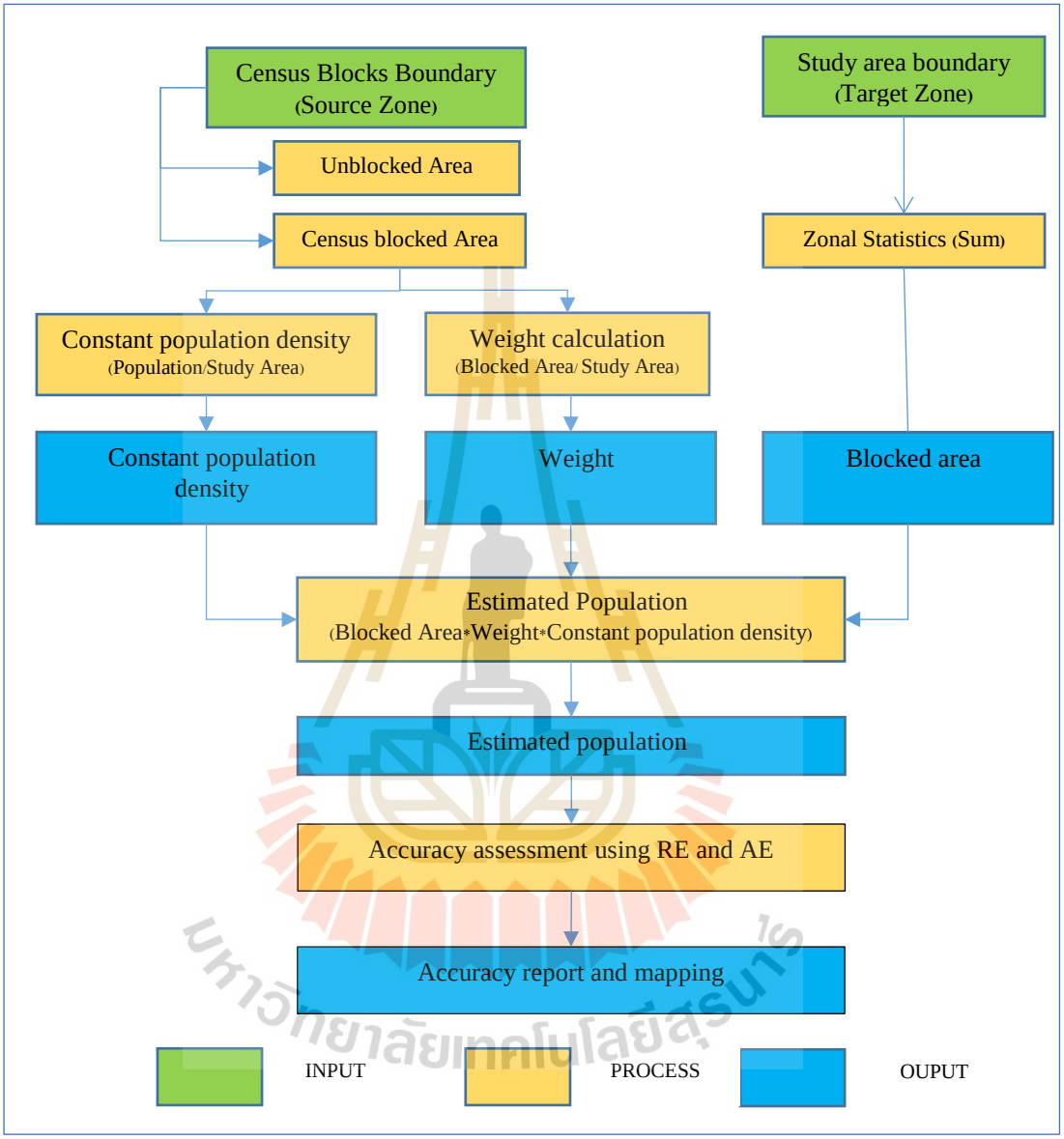


Figure 3.7 Workflow of population estimation using areal interpolation with an area-weighting method.

3.4 Accuracy assessment

When a model is applied for population estimation, there are always differences between reference and estimated population, and this different value is called residuals. The smaller the residuals, the accuracy of the population estimation is better than the higher residuals (Harvey, 2002b).

For an individual case, the relative error can be expressed as:

$$\text{Relative error} = \left(\frac{P_g - P_e}{P_g}\right) \times 100 \tag{3.19}$$

Where Pg and Pe are the reference and estimated values, respectively. The residual (*Pg - Pe*) for individual cases may be negative or positive, so absolute values of the residuals were used to assess the overall performance of a developed model, i.e.:

$$\text{Overall relative error (RE)} = \frac{\sum_{k=1}^{n} |Relative\ error_n|}{n} \tag{3.20}$$

$$\text{Overall absolute error (AE)} = \frac{\sum_{k=1}^{n} |Pg - Pe|}{n} \tag{3.21}$$

Where n is the number of block groups used for accuracy assessment.

For accuracy assessment, 40 percent of non-selected census blocks were applied to calculate RE and AE under the statistical modeling method. Meanwhile, the census block population and estimated population were applied to calculate RE and AR under the binary dasymetric and area-weighting methods.

3.5 Optimum method for population estimation

The optimum method for population estimation between the statistical modeling and the areal interpolation methods was based on four criteria: residual value, relative error, RE value and AE value.

3.6 Validation of the optimum method for population estimation

The optimum method for population estimation was further applied in Minbu district, Magway Region, for model validation. As a result, the data validation process can get the data consistency check for the population estimation process.

CHAPTER IV

POPULATION ESTIMATION USING STATISTICAL MODELING METHOD

This chapter presents the study's first objective results for population estimation using the statistical modeling method. Overall, each census block's population density and its transformation (square root and the natural logarithm of population density) as dependent variables were extracted from the 2014 Myanmar Population and Housing Census, while the spectral reflectance and indices from Landsat data as independent variables are extracted from Landsat 8 OLI data, date 26 April 2014, for population estimation using multiple linear regression analysis. The population was then estimated using the best regression model based on the R, R^2 and adjusted R^2 values. Detailed population estimation results using the statistical modeling method are separately described and discussed in the following sections.

4.1 GIS data collection and preparation for dependent variable extraction

GIS data of the population as the dependent variable were first collected and extracted the population density and then selected sample cases with random and stratified random sampling methods. In this study, the population density of the Magway district was retrieved from the 2014 Myanmar Population and Housing Census Blocks.

The spatial distribution of population density classification is displayed in Figure 4.1. As a result, a population with low density is less than or equal to 136 persons/km^2, moderate density is between 136.01 and 1,683.68 persons/km^{2,} and high density is more than 1,683.68 persons/km^2.

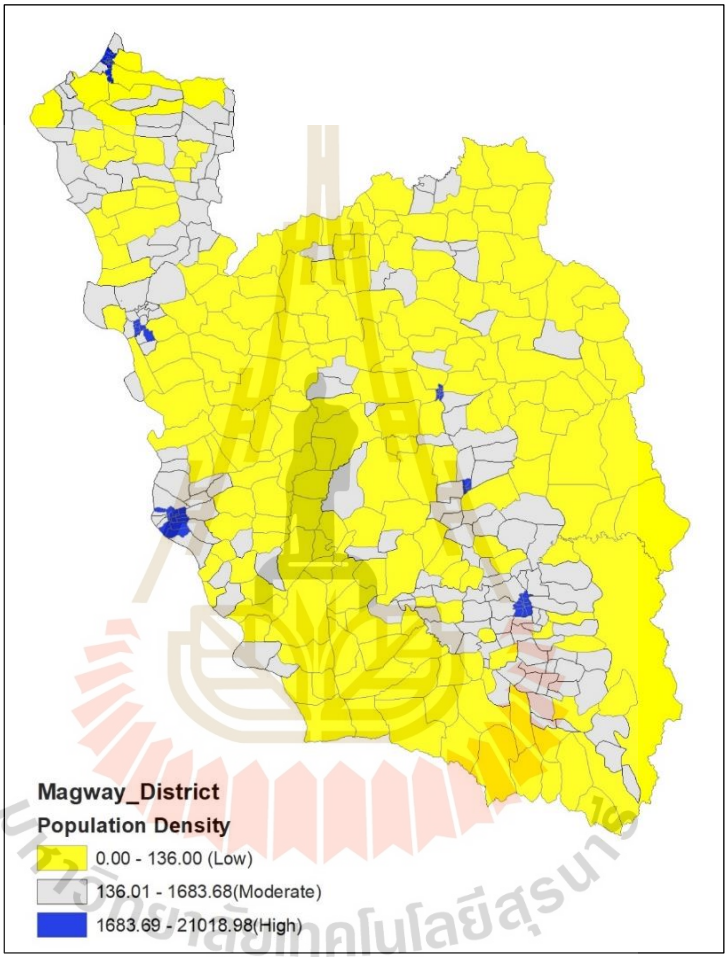


Figure 4.1 Classification of population density of Magway District, Magway Region.

Meanwhile, the spatial distribution of the selected and non-selected random census block samples by 60% and 40% using the SPSS software is displayed in Figure 4.2. The selected census block samples (60%) are accounted for 240 blocks, while the non-selected census block samples (40%) are 160 blocks.

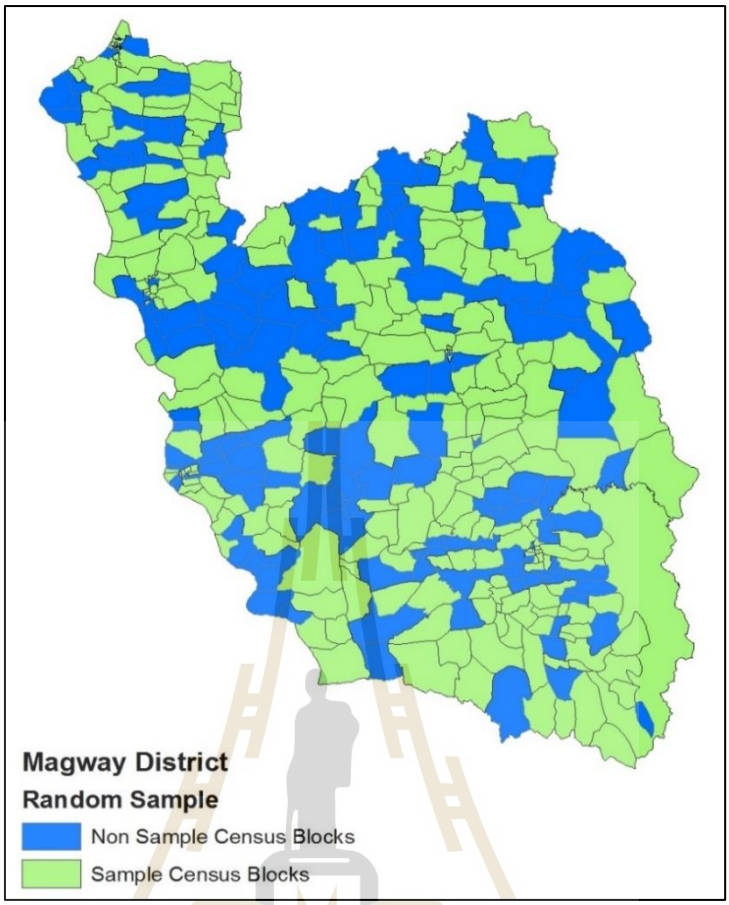


Figure 4.2 Spatial distribution of the selected and non-selected random census blocks samples.

In the meantime, the spatial distribution of the selected and non-selected stratified random samples for low population density by 60% and 40% is displayed in Figure 4.3. They are accounted for 118 and 77 census blocks, respectively. Likewise, the spatial distribution of the selected and non-selected stratified random samples for moderate and high population density by 60% and 40% is displayed in Figure 4.4. They are accounted for 126 and 79 census blocks, respectively.

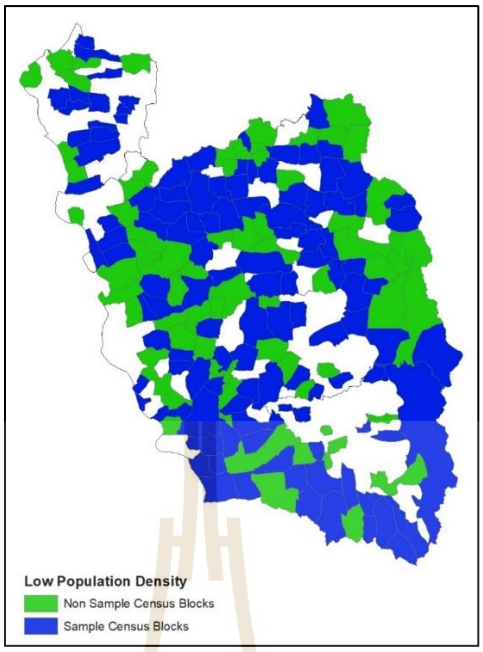


Figure 4.3 Spatial distribution of the selected and non-selected stratified random census block samples for low population density.

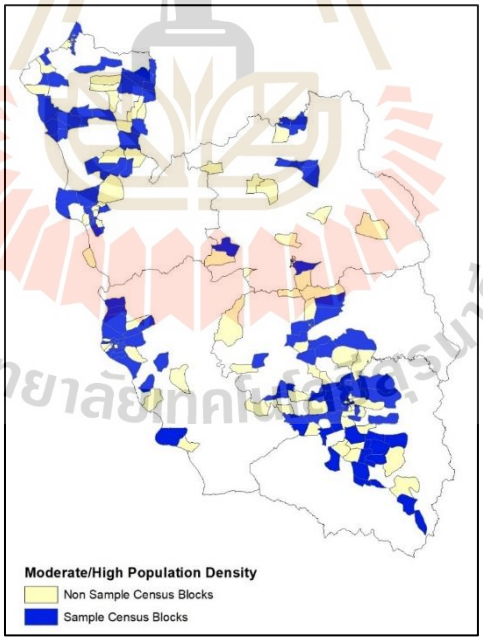


Figure 4.4 Spatial distributions of the selected and non-selected stratified random census block samples for moderate and high population density.

4.2 Remote sensing data collection and preparation for independent variable extraction

4.2.1 Spectral reflectance data

Spectral reflectance values for Band 2 to Band 7 of Landsat 8 OLI image of the study area, date 26 April 2014, are extracted using Equation 3.1, as standard method suggested by USGS's handbook (USGS, 2019). The spatial distribution of spectral reflectance data of Landsat OLI in 2014 is displayed in Figure 4.5.

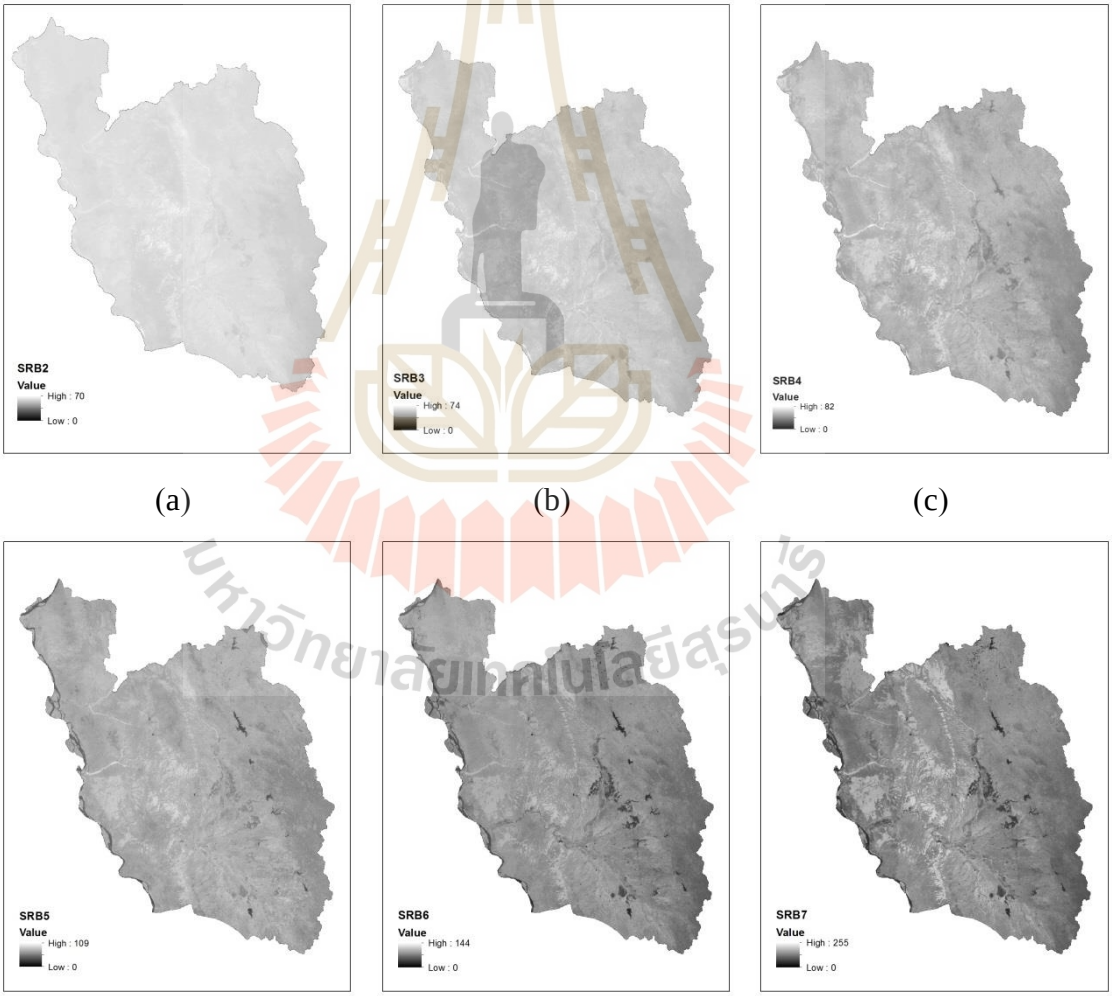


Figure 4.5 Spatial distribution of spectral reflectance data of Landsat OLI in 2014: (a) Band 2, (b) Band 3, (c) Band 4, (d) Band 5, (e) Band 6, and (f) Band 7.

4.2.2 Vegetation indices

Five vegetation indices, namely, NDVI, SAVI, RDVI, TNDVI, and SR, were extracted for population estimation based on corresponding equations (3.2 to 3.6) in Table 3.3, as shown in Figure 4.6.

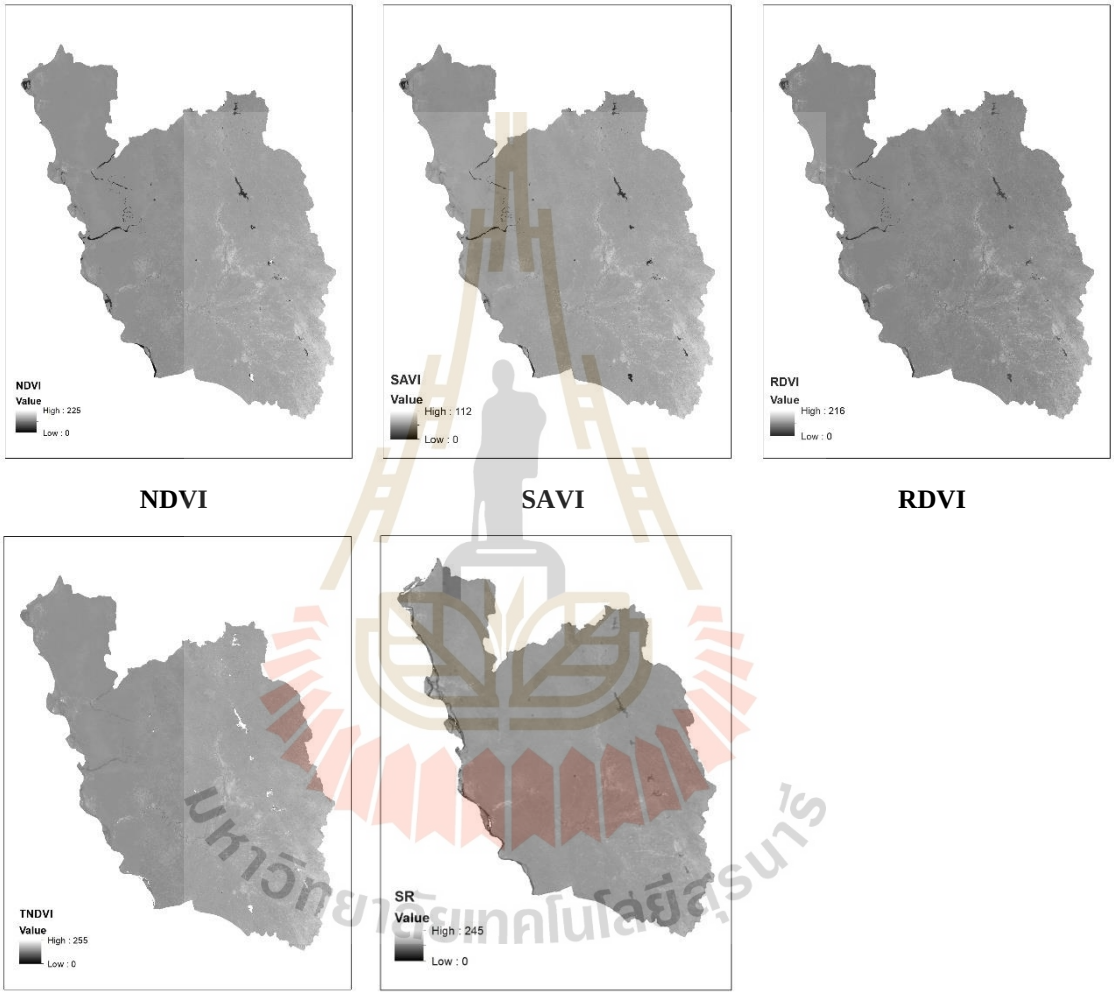
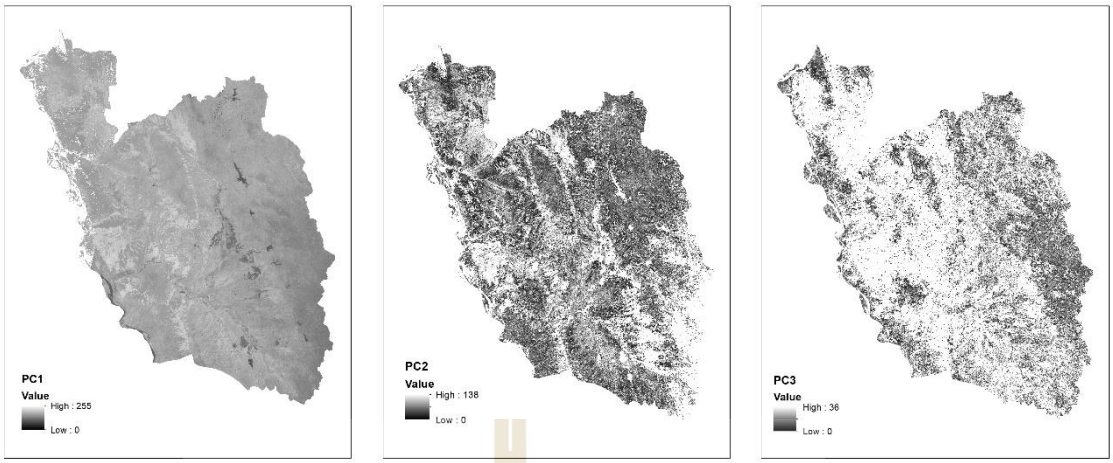


Figure 4.6 Spatial distribution of vegetation indices.

4.2.3 Principal Component

Three principal components (PCs) based on principal component analysis from Landsat 8 data are displayed in Figure 4.7.



PC-1 PC-2 PC-3

Figure 4.7 Spatial distributions of three principal components.

4.2.4 Texture (Variance)

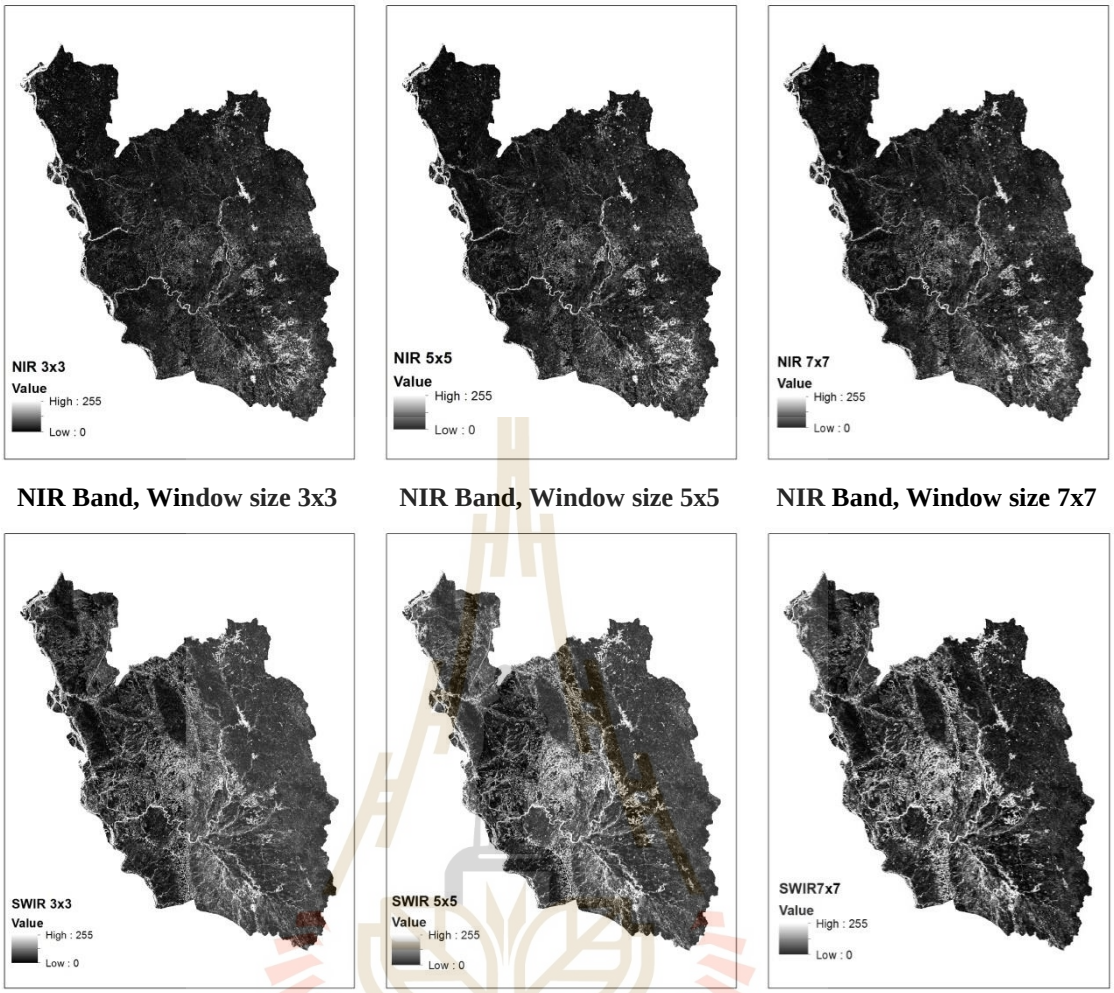
A standard variance texture data with window sizes of 3x3, 5x5, and 7x7 from NIR and SWIR bands, strongly correlated with urban features, are displayed in Figure 4.8.

4.2.5 Brightness temperature

The spatial distribution of brightness temperature, which was extracted using Equations 3.7 and 3.8, is displayed in Figure 4.9(a).

4.2.6 Built-up index

The spatial distribution of the built-up index, which was extracted using Equations 3.9 and 3.10, is displayed in Figure 4.9(b).



NIR Band, Window size 3x3 **NIR Band, Window size 5x5** **NIR Band, Window size 7x7**

SWIR Band, Window size 3x3 **SWIR Band, Window size 5x5** **SWIR Band, Window size 7x7**

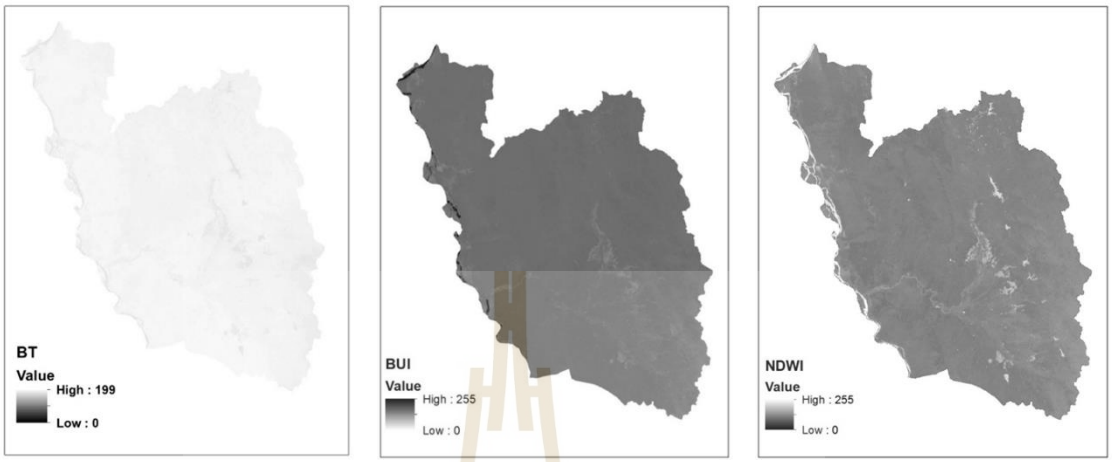
Figure 4.8 Spatial distribution of variance texture with different window sizes.

4.2.7 Water index

The spatial distribution of the water index, which was extracted using Equation 3.11, is displayed in Figure 4.9(c).

Furthermore, the primary statistical data of spectral reflectance and indices for multiple linear regression analysis are summarized in Table 4.1. As a result, it can be observed that the mean value of SAVI is quite different from other vegetation indices because the L value, which accounts for differential red and near-

infrared extinction through the canopy, is applied by a default value (0.5) without adjustment.



(a) (b) (c)

Figure 4.9 Spatial distribution of brightness temperature (a), built-up index (b) and water index (c).

Table 4.1 Basic statistic data of spectral reflectance and indices for multiple linear regression analysis.

No	Index	Min	Max	Mean	Median	Std Dev
1	SRB2	0	70	32.72	55	29.4
2	SRB3	0	74	31.15	51	28.06
3	SRB4	0	81	31.75	50	28.8
4	SRB5	0	109	40.06	63	36.52
5	SRB6	0	143	44.74	65	41.41
6	SRB7	0	255	41.39	57	38.77
7	NDVI	0	255	73.69	126	66.83
8	SAVI	0	112	36.56	62	33.16
9	RDVI	0	216	66.64	113	60.29
10	TNDVI	0	255	85.48	146	77.22
11	SR	0	245	70.52	120	63.88
12	PC 1	0	255	89.52	138	84.1
13	PC 2	0	138	3.15	0	5.43
14	PC 3	0	36	0.826	0	3.302
15	NIR 3x3	0	255	4.62	1	13.77
16	NIR 5x5	0	255	6.85	2	18.11
17	NIR 7x7	0	255	8.45	3	20.93
18	SWIR 3x3	0	255	12.13	2	27.93

Table 4.1 (Continued)

No	Index	Min	Max	Mean	Median	Std Dev
19	SWIR 5x5	0	255	18.24	5	36.64
20	SWIR 7x7	0	255	19.76	6	37.63
21	BT	0	199	105.97	189	95.05
22	Built UP	0	255	68.42	118	61.57
23	NDWI	0	255	58.63	98	53.4

4.2 Multicollinearity analysis

The TOL value of 0.1 and a VIF index of 10 were set as standard to diagnose the multicollinearity problem among predictor variables. If the TOL value is less than 0.1, and the VIF value is greater than 10, the variables are considered to have high correlation/multicollinearity (See detail in Section 3.2.1).

The multicollinearity analysis results, which are performed in statistical SPSS software, are reported in Tables 4.2 and 4.3. As a result, over the 23 dependent variables, the diagnoses choose 11 reliable variables and reject 12 variables, which VIF value are more than 19 and TOL also less than 0.1.

4.4 Multiple linear regression analysis

In this study, the population density, square root of population density, and natural logarithm of population density as dependent variables were regressed with seven groups of remote sensing data as independent variables. Since regression analysis was applied according to population data of census block samples using simple random sampling and stratified random sampling techniques, so the result is separately described and discussed by sampling technique.

Table 4.2 List of the selected independent variables after multicollinearity analysis.

No	Spectral Indices Factors	Collinearity Statistics	
		TOL	VIF
1	SRB2	0.229	4.364
2	SRB5	0.113	8.875
3	NDVI	0.161	6.208
4	TNDVI	0.114	8.739
5	PC1	0.241	4.145
6	PC2	0.231	4.336
7	NIR5x5	0.282	3.55
8	NIR7x7	0.434	2.306
9	SWIR7x7	0.449	2.228
10	BT	0.317	3.158
11	BUI	0.163	6.122

Table 4.3 List of the excluded independent variables after multicollinearity analysis.

No	Spectral Indices Factors	Collinearity Statistics	
		TOL	VIF
1	NDWI	0.083	12.062
2	SRB3	0.038	26.000
3	NIR3x3	0.020	48.823
4	PC3	0.020	50.432
5	SR	0.015	66.032
6	SWIR5x5	0.008	119.054
7	SWIR3x3	0.009	110.875
8	RDVI	0.007	140.451
9	SRB7	0.006	156.765
10	SAVI	0.004	259.483
11	SRB4	0.003	391.611
12	SRB6	0.003	397.479

4.4.1 Regression model of simple random sampling technique.

A simple random sampling technique for population estimation produces seven regression equations with population density (Table 4.4), six regression equations with the square root of population density (Table 4.5), and five regression equations with the natural logarithm of population density (Table 4.6).

Table 4.4 Equations for population estimation of simple random sampling with population density.

No	Regression Equation	R	R^2	Adj-R^2
1	5337.473-30.323*PC1	0.649	0.421	0.419
2	24705.582-25.294*PC1-164.708*BUI	0.721	0.519	0.515
3	29449.057-24.236*PC1-195.956*BUI-10.311*NIR7x7	0.739	0.545	0.54
4	21733.351-27.220*PC1-154.128*BUI-16.342*NIR7x7+16.405 * NIR5x5	0.749	0.562	0.554
5	22659.151-31.122*PC1-166.056*BUI-15.556*NIR7x7+19.259* NIR5x5+80.340*PC2	0.756	0.571	0.562
6	6142.804-33.143*PC1-116.509*BUI-18.903*NIR7x7+20.057 * NIR5x5+137.424*PC2+68.917*TNDVI	0.766	0.587	0.576
7	-15840.328-31.887*PC1-97.587*BUI-20.081*NIR7x7+24.330* NIR5x5+129.881*PC2+107.628* TNDVI+163.178*SRB2	0.773	0.598	0.585

Table 4.5 Equations for population estimation of simple random sampling with the square root of population density

No	Regression Equation	R	R^2	Adj-R^2
1	68.989-0.331*PC1	0.688	0.473	0.471
2	286.142-0.275*PC1-1.847 *BUI	0.768	0.590	0.586
3	327.122-0.265*PC1-2.117 *BUI-0.089*NIR7x7	0.780	0.608	0.603
4	194.686-0.261*PC1-1.660 *BUI-0.122*NIR7x7+0.514*TNDVI	0.787	0.619	0.612
5	-65.371-0.239*PC1-1.545 *BUI-0.117*NIR7x7+1.044*TNDVI + 2.059*SRB2	0.798	0.637	0.629
6	-229.747-0.267*PC1-1.064*BUI-0.182*NIR7x7+1.175*TNDVI +2.751*SRB2+0.190*NIR5x5	0.810	0.655	0.647

Table 4.6 Equations for population estimation of simple random sampling with the natural logarithm of population density

No	Regression Equation	R	R^2	Adj-R^2
1	8.499-0.021*PC1	0.663	0.439	0.437
2	23.806-0.017*PC1-0.130 *BUI	0.754	0.569	0.565
3	19.459-0.016*PC1-0.148 *BUI+0.083*SRB2	0.762	0.580	0.575
4	-10.920-0.015*PC1-0.091 *BUI+0.218*SRB2+0.082*TNDV	0.789	0.622	0.616
5	-12.629-0.014*PC1-0.090 *BUI+0.211*SRB2+0.100*TNDVI-0.006*NIR7x7	0.799	0.639	0.631

According to the population estimation models from simple random sampling (Tables 4.4 to 4.6), the most suitable statistical model, which provides the highest value of R, R^2 and adjusted R^2 with the value of 0.810, 0.655 and 0.647, respectively. It is derived from the simple random sampling independent variables with the square root of population density. The regression model for population estimation is as follows:

$$SPD = -229.747 - 0.267 * PC1 - 1.064 * BUI - 0.182 * NIR7x7 + 1.175 * TNDVI + 2.751 * SRB2 + 0.190 * NIR5x5 \quad (4.1)$$

Where SPD is square of population density, PC1 is principal component 1, BUI is build-up index, NIR7x7 is variance texture of NIR with 7x7 window size, TNDVI is Transformed Normalized Different Vegetation Index, SRB2 is spectral reflectance value of Band 2 (Green), and NIR5x5 is variance texture of NIR with 5x5 window size.

In stepwise regression, the size of R^2 is generally taken to indicate how well the regression model fits the data; that is, how close the estimated value of the dependent variable comes to the observed ones. The R's value also indicates how

accurately predicting the regression model correlates with model variables (Moksony,1999). The interpretation of the R-value is presented in Table 4.7.

The result of multiple linear equations revealed that the number of populations shows a positive correlation with TNDVI, SRB2, and NIR5x5 variables. In contrast, PC1, BUI, and NIR7x7 variables negatively correlate with the number of populations. The top three significant variables are SRB2, TNDVI, and BUI. The case of SRB2 indicates that when available water resources (SRB2) increase, the population increases. Likewise, when the vegetation index (TNDVI) increases, the population increases, it infers scattered housing patterns over agricultural fields. However, the negative linear relationship of BUI with population indicates that as built-up area increases, population decreases. This finding is an unexpected result because of areas of built-up related to people activity. Additionally, the significant factors of the model can explain the linear relationship with the square of population density about 65%.

Table 4.7 Interpretation of R-values

Value of r	**Meaning of r**
-1	A perfect negative linear relationship
-1< r < -0.5	A strong negative linear relationship
-0.5< r < -0.3	A moderate negative relationship
-0.3< r < -0.1	A weak negative linear relationship
0	No linear relationship
0.1< r < 0.3	A weak positive linear relationship
0.3 < r < 0.5	A moderate positive relationship
0.5 < 1	A strong positive linear relationship
1	A perfect positive linear relationship

Source: Cohen (1988)

4.4.2 Regression model of stratified random sampling technique

The stratified random sampling technique with low population density for population estimation produces two regression equations with population density (Table 4.8), two regression equations with the square root of population density (Table 4.9), and two regression equations with the natural logarithm of population density (Table 4.10).

Table 4.8 Equations for population estimation of a stratified random sampling of low population density with population density.

No	Regression Equation	R	R^2	Adj-R^2
1	-4.709+0.664*SRB5	0.310	0.096	0.089
2	59.581+0.607*SRB5-0.258*NIR5x5	0.369	0.136	0.121

Table 4.9 Equations for population estimation of a stratified random sampling of low population density with the square root of population density

No	Regression Equation	R	R^2	Adj-R^2
1	3.631+0.040*SRB5	0.319	0.102	0.094
2	7.200+0.037*SRB5-0.014 *NIR5x5	0.371	0.137	0.122

Table 4.10 Equations for population estimation of a stratified random sampling of low population density with the natural logarithm of population density

No	Regression Equation	R	R^2	Adj-R^2
1	2.982+0.010*SRB5	0.328	0.107	0.100
2	3.803+0.010*SRB5-0.003*NIR5x5	0.371	0.138	0.123

As results of population estimation from stratified random sampling with low population density in Tables 4.8 to 4.10, the most suitable statistical model, which provides the highest value of R, R^2 and adjusted R^2 with the value of 0.371, 0.138, and 0.123, respectively, is derived from the stratified random sampling by low population density with the natural logarithm of population density. The regression model for population estimation is as follows:

$$LPD = 3.803 + 0.010 * SRB5 - 0.003 * NIR5x5 \quad (4.2)$$

Where LPD is the natural logarithm of population density, SRB5 is the spectral reflectance value of Band5 (NIR), and NIR5x5 is the variance texture of NIR with 5x5 window size.

As a result, the number of populations positively correlates with the SRB5 variable, while it negatively correlates with the NIR5x5 variable. The significant derived factors of the model can explain the linear relationship with the natural logarithm population density of only 12%.

Meanwhile, the stratified random sampling technique with moderate/high population density for population estimation produces six regression equations with population density (Table 4.11), nine regression equations with the square root of population density (Table 4.12), and seven regression equations with the natural logarithm of population density (Table 4.13).

Table 4.11 Equations for population estimation of a stratified random sampling of moderate/high population density with a population density.

No	Regression Equation	R	R^2	Adj-R^2
1	5434.113-29.289*PC1	0.573	0.329	0.323
2	23771.559-26.990*PC1-154.208*BUI	0.662	0.438	0.429
3	29831.979-26.150*PC1-188.656*BUI-18.885*NIR7x7	0.703	0.494	0.481
4	11616.507-30.364*PC1-92.110*BUI-29.944*NIR7x7 +36.640*NIR5x5	0.732	0.535	0.519
5	18067.210-21.495*PC1-116.805*BUI-38.388*NIR7x7+42.107* NIR5x5-40.862*SRB5	0.756	0.571	0.552
6	20551.367-23.634*PC1-136.658*BUI-40.19*NIR7x7+53.759 * NIR5x5-64.294*SRB5+177.208*PC2	0.768	0.590	0.568

Table 4.12 Equations for population estimation of a stratified random sampling of moderate/high population density with the square root of population density.

No	Regression Equation	R	R^2	Adj-R^2
1	71.299-0.311*PC1	0.655	0.430	0.425
2	254.346-0.288*PC1-1.539*BUI	0.746	0.557	0.549
3	299.350-0.281*PC1-1.795*BUI-0.140*NIR7x7	0.770	0.593	0.582
4	71.526-0.273*PC1-1.025*BUI-0.232*NIR7x7+0.912*TNDVI	0.795	0.632	0.619
5	-103.838-0.307*PC1-0.142*BUI-0.333*NIR7x7+1.008*TNDVI +0.304*NIR5x5	0.815	0.664	0.650
6	-131.888-0.309*PC1-0.342*NIR7x7+1.057 *TNDVI+0.324* NIR5x5	0.815	0.664	0.652
7	-477.393-0.283*PC1-0.341*NIR7x7+1.679 *TNDVI+0.332* NIR5x5+ 3.115*SRB2	0.826	0.682	0.669
8	-525.264-0.228*PC1-0.387*NIR7x7+1.666 *TNDVI+0.422* NIR5x5 +3.884*SRB2-0.267*SRB5	0.835	0.698	0.682
9	-538.730-0.256*PC1-0.414*NIR7x7+1.812 *TNDVI+0.524* NIR5x5 +3.740*SRB2-0.433*SRB5+1.576*PC2	0.845	0.714	0.696

Table 4.13 Equations for population estimation of a stratified random sampling of moderate/high population density with the natural logarithm of population density.

No	Regression Equation	R	R^2	Adj-R^2
1	8.592-0.017* PC1	0.687	0.472	0.468
2	-0.090-0.016* PC1+0.054* TNDVI	0.774	0.598	0.592
3	-3.054-0.016*PC1+0.080 *TNDVI-0.011*NIR7x7	0.810	0.656	0.648
4	-3.100-0.017*PC1+0.067 *TNDVI-0.014*NIR7x7+0.012* NIR5x5	0.828	0.685	0.674
5	-26.208-0.015* PC1+0.108*TNDVI-0.014 *NIR7x7+0.012* NIR5x5+0.208*SRB2	0.845	0.714	0.702
6	-28.708-0.012*PC1+0.107*TNDVI-0.017*NIR7x7+ 0017* NIR5x5+0.248*SRB2-0.014*SRB5	0.854	0.729	0.715
7	-29.212-0.010*PC1+0.112*TNDVI-0.019*NIR7x7+0.022* NIR5x5+0.232*SRB2-0.018*SRB5+0.011*SWIR7x7	0.860	0.739	0.723

According to the estimation models from stratified random sampling for moderate/high population density (Tables 4.11 to 4.13), the most suitable statistical model, which provides the highest value of R, R^2 and adjusted R^2 with the value of 0.860, 0.739, and 0.723, respectively, is derived from the regression analysis with the natural logarithm of population density. The regression model for population estimation is as follows:

$$LPD = -29.212 - 0.010 * PC1 + 0.112 * TNDVI - 0.019 * NIR7x7 + 0.022 * NIR5x5 + 0.232 * SBR2 - 0.018 * SBR5 + 0.011 * SWIR7x7 \quad (4.3)$$

Where LPD is the natural logarithm of population density, PC1 is principal component 1, TNDVI is Transformed Normalized Different Vegetation Index, NIR7x7 is variance texture with 7x7 window size, NIR5x5 is variance texture of NIR with 5x5 window size, SRB2 is spectral reflectance value of Band 2 (Green), SRB5 is spectral reflectance value of Band 5 (NIR) and SWIR7x7 is variance texture of SWIR-2 with 7x7 window size.

As a result, the number of populations shows a positive correlation with TNDVI, NIR5x5, SRB2, and SWIR7x7 variables, while PC1, NIR7x7 and SRB5 show a negative correlation. The top three significant variables are SRB2, TNDVI, and NIR5x5. In the case of SRB2, when available water resources (SRB2) increase, the population increases**.** Likewise, when vegetation index (TNDVI) or spectral reflectance of NIR band (SBR5) increases, the population increases because TNDVI or SBR5 is positively correlated with agriculture activities**.** These findings of the top three variables show an expected result**.** Additionally, the significant derived factors of the model can explain the linear relationship with the square of population density of about 72%.

4.4.3 Suitable statistical model for population estimation

The most suitable statistical model for population estimation in the Magway district based on the R, $R^{2,}$ and adjusted R^2 values from three different sampling techniques is the natural logarithm of population density derived from the stratified random samplings by moderate and high population density. The suitable statistical model can provide the least errors with the R value of 0.860, the R^2 value of 0.739 and the adjusted R^2 values of 0.723.

As a result, the R value shows a strong linear relationship between population density and influential factors. Meanwhile, the significant derived factors of the model can explain the linear relationship with a population density higher than 70%. The R^2 and adjusted R^2 indicate good to very good performance for population estimation. So, the suitable model for population estimation can be acceptable.

This finding is similar to Li and Weng (2005) previous study, which applied Landsat ETM+ imagery to measure population density in Indianapolis, Indiana, USA. They reported that the best performance models for medium and high populations varied from 0.83 to 0.86.

4.4.4 Population estimation with a suitable statistical model

According to the suitable statistical model from a stratified random sampling of moderate and high population density, as shown in Eq. 4.3, the average population density of Magway District from 122 sample census blocks with the statistical modelling method was first estimated from census block samples. It then multiplied with the average population distribution of Magway District for population estimation.

The average population density of Magway District from 122 sample census blocks with moderate/high population density is 880.53, while the average population distribution of Magway District as constant value is 1,426.18. Thus, the estimated population of Magway District with the statistical modelling method is 1,255,788 (880.53*1426.18) persons. The result indicates an overestimation when it only compares with reference 2014 census data of 1,235,030 persons. The derived result will be further applied to access accuracy using AE and RE.

Details of the reference and estimated population data of each census block using the suitable statistical model are reported in Table 1 in Appendix A. The distribution of actual residuals from each census block with the suitable statistical model is displayed in Figure 4.10. As a result, the suitable statistical model is biased in data space because the scatters plot of residuals shows a more clustered distribution when the number of populations is low. The actual residuals map of the suitable statistical model is displayed in Figure 4.11.

Additionally, a scatter plot between reference and estimated natural logarithm population density (LPD) of the suitable statistical model is shown in Figure 4.12. It reveals a linear relationship between reference and estimated population density (LPD) with an R^2 value of 0.9714.

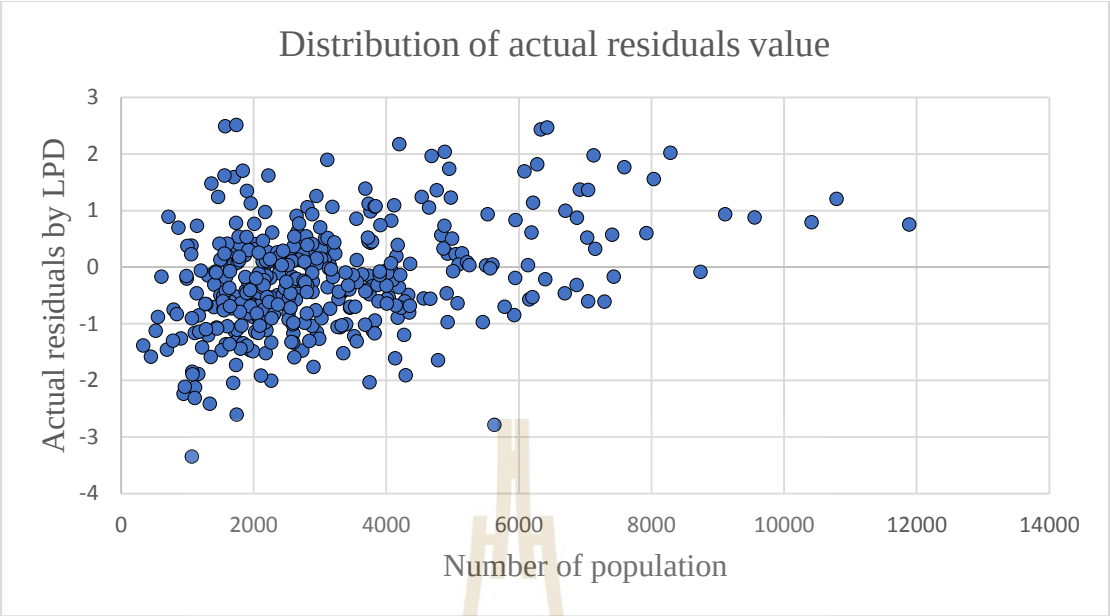


Figure 4.10 Distribution of actual residual values by the number of population based on a suitable statistical model.

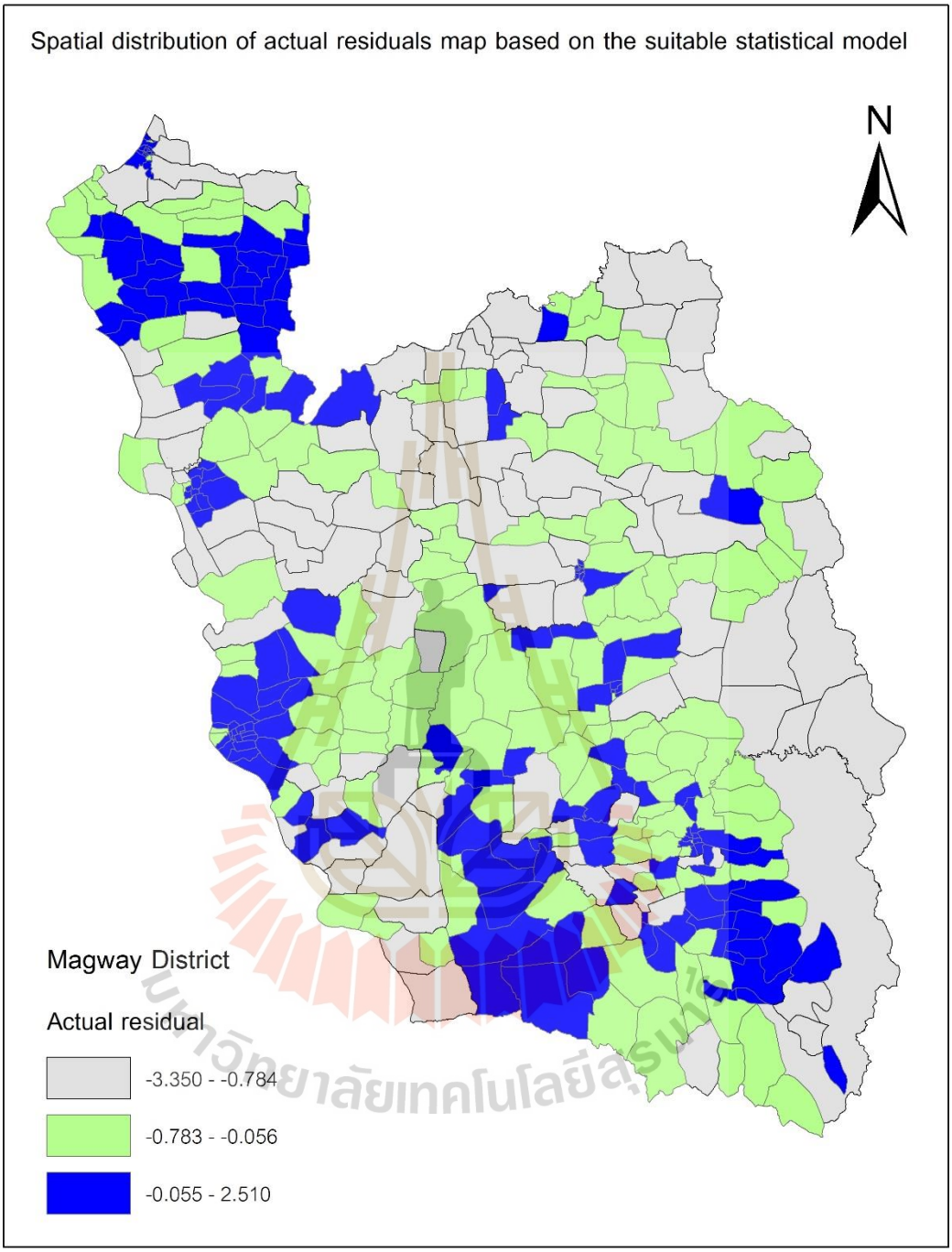


Figure 4.11 Spatial distribution of actual residuals map based on the suitable statistical model.

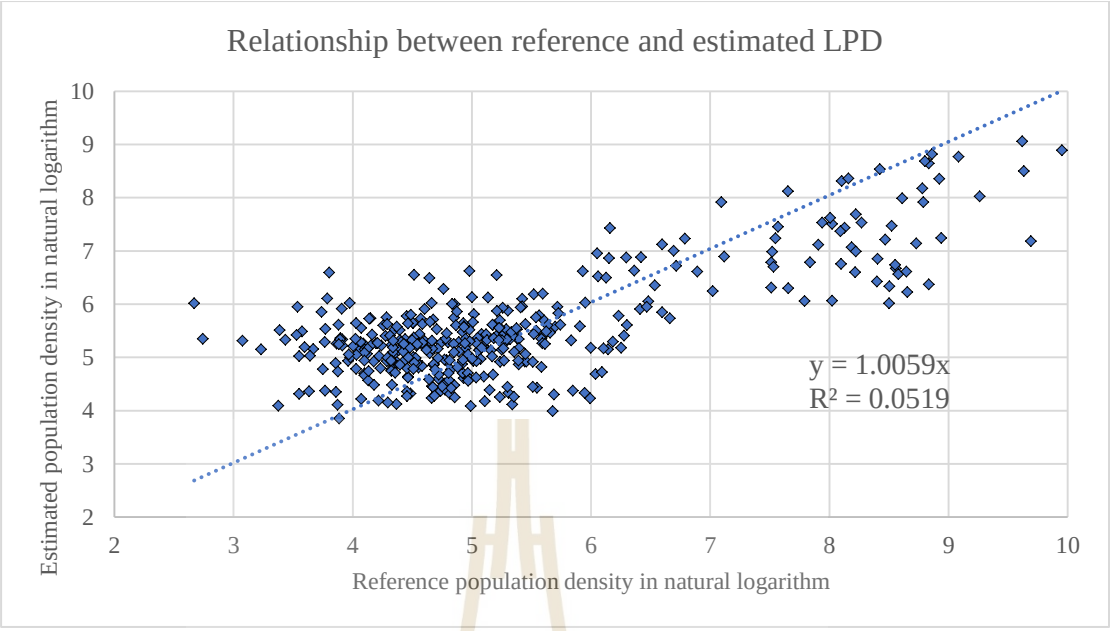
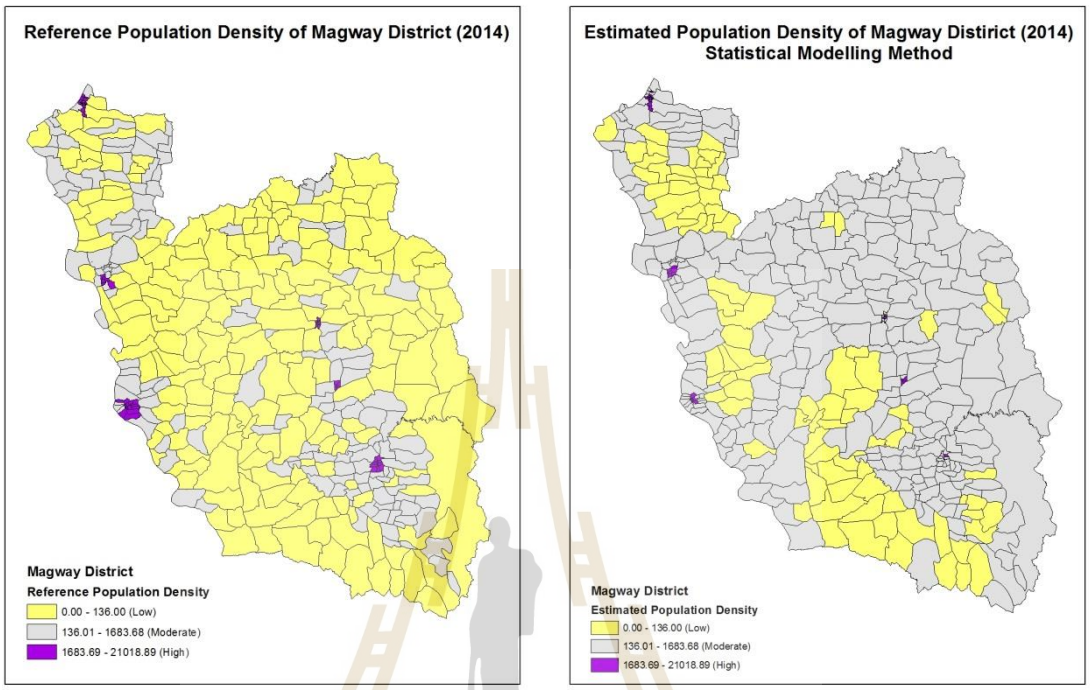


Figure 4.12 Scatter plot between reference and estimated natural logarithm population density.

Furthermore, the classification of the estimated population density of the Magway district using the statistical modeling method is spatially compared with the classification of 2014 reference data, as shown in Figure 4.12. As a result, it can be observed that spatial patterns of population density are different. Some reference census blocks with low population density become moderate population density classes based on a suitable statistical model. The transitional change matrix of reference and estimated population density classification is reported in Table 4.14. It reveals that population density classification based on reference and estimated data is upgraded to higher 134 census blocks. In contrast, population density classification based on reference and estimated data is downgraded to lower 58 census blocks. This finding can be confirmed as overestimation. In the meantime, population density classification based on reference and estimated data is unchanged, with 207 census

blocks. This finding indicates a moderately consistent result between reference and estimated data, about 51.88%, as overall accuracy.



(a) (b)

Figure 4.12 Spatial distribution of population density classification of Magway district in 2014: (a) Reference population density from 2014 Census data and (b) Estimated population density from the suitable statistical model.

Table 4.14 Transitional change matrix of population density classification between reference (2014 Census data) and estimated data of the suitable statistical model.

Population density classification		**Estimated data**			
		Low	**Moderate**	**High**	**Total**
Reference data	**Low**	61	133		194
	Moderate	29	122	1	152
	High		29	24	53
	Total	90	284	25	399
Overall accuracy (%)		**51.88**			

Summary

By comparison the model performance of three different suitable statistical models from three different sampling approaches (Table 4.15), the first suitable statistical model for population estimation in the Magway district was the natural logarithm of population density derived from the stratified random sampling by moderate and high population density. The first suitable statistical model can provide the high performance with the R value of 0.860, the R^2 value of 0.739 and the adjusted R^2 values of 0.723. Meanwhile, the second suitable statistical model was derived from the simple random sampling with the square root of population density. It could provide the R value of 0.810, R^2 value of 0.655 and adjusted R^2 value of 0.647. On the contrary, the statistical model from the stratified random samplings by low population density with the natural logarithm of population density showed poor performance with the R, R^2 and adjusted R^2 values of 0.371, 0.138, and 0.123, respectively. The common significant independent variables from the first and second suitable statistical models are spectral reflectance Band 2 (SRB2), TNDVI, Principal Component 1 (PC1), and variance texture of NIR band with 5x5 and 7x7 window sizes. Additionally, the NIR band with 5x5 window sizes was a significant independent variable in three suitable models.

To apply the most suitable statistics for population estimation in Myanmar, the derived suitable statistical model should be examined the effect of the spatio-temporal change of remote sensing data because an only single date with a limitation of data was applied in this study. Besides, additional independent variables which are related to settlement, such as terrain, river, and road network, should be considered for population estimation because the significant derived factors of the

most suitable statistical model can explain the linear relationship with the square of population density of about 72%.

Table 4.14 Model performance of three different suitable models from different samplings.

Indicators	Simple random	Stratified random	
		Low population density	Moderate/high population density
Model dataset	240	118	126
Accuracy dataset	160	77	79
Dependent variable	SPD	LPD	LPD
Number of independent variables	6	2	7
Independent variable	SRB2, TNDVI, PC1, NIR7x7, NIR5x5, BUI,	SRB5, NIR5x5	SRB2, SRB5, TNDVI, PC1, NIR7x7, NIR5x5, SWIR7x7
R value	0.810	0.371	0.860
R^2 value	0.655	0.138	0.739
Adjusted R^2 value	0.647	0.123	0.723

CHAPTER V

POPULATION ESTIMATION USING AREAL INTERPOLATION METHOD

This chapter presents the second objective related to the population estimation with the areal interpolation method. Two approaches resulting from the areal interpolation methods, including population estimation with binary dasymetric and areal weighting methods are separately described and discussed in the following sections.

5.1 Population estimation with a binary dasymetric method

Overall, the primary purpose of the binary dasymetric method for population estimation is to classify the study area into two groups, populated area and unpopulated area. When the populated area achieves, it estimates the average population density and the total population in the study area. To get the populated area of the study area, the OBIA was firstly conducted to classify LULC type with the optimum pan-sharpened image using the UIQI. Then, the population density of the census block was calculated, and it was further applied to calculate an average population density. Finally, the number of populations was estimated by multiplication between the net populated area with average population density in the study area. Detailed population estimation results using the binary dasymetric method are described and discussed in the following sections.

5.1.1 Optimum pan-sharpening image using UIQI

Multispectral and panchromatic bands of two mosaiced Landsat 8 OLI images: Path/Row: 133/46 and 134/46, date 26 April 2014, which were downloaded from EarthExplorer website of the USGS, were firstly extracted for the study for pan-sharpening operation by selected algorithms, including (1) Ehlers fusion, (2) Gram-Schmidt pan-sharpening, (3) High Pass Filtering, (4) Modified IHS, (5) Principal Components Analysis (PCA) Transformation and (6) Wavelet Transform. The optimum pan-sharpening algorithm was later identified to produce the most suitable image for classifying the LULC map under the OBIA using the universal quality image index (UIQI) using Equation 3.14 under Model Builder Module of ERDAS Imagine environment (Figure 5.1). In principle, the pan-sharpening algorithm is to combine the higher spatial details from a high spatial resolution-low spectral resolution (PAN) image with the low spatial resolution-high spectral resolution (MS) image to create a high spatial and high spectral resolution image (Stathaki, 2008).

Figure 5.2 displays the original panchromatic band and multispectral bands of Landsat data in 2015 for the pan-sharpening operation. The pan-sharpened image from six selected pan-sharpening methods of Landsat 8 OLI data in 2014 for the Magway district is displayed in Figure 5.3.

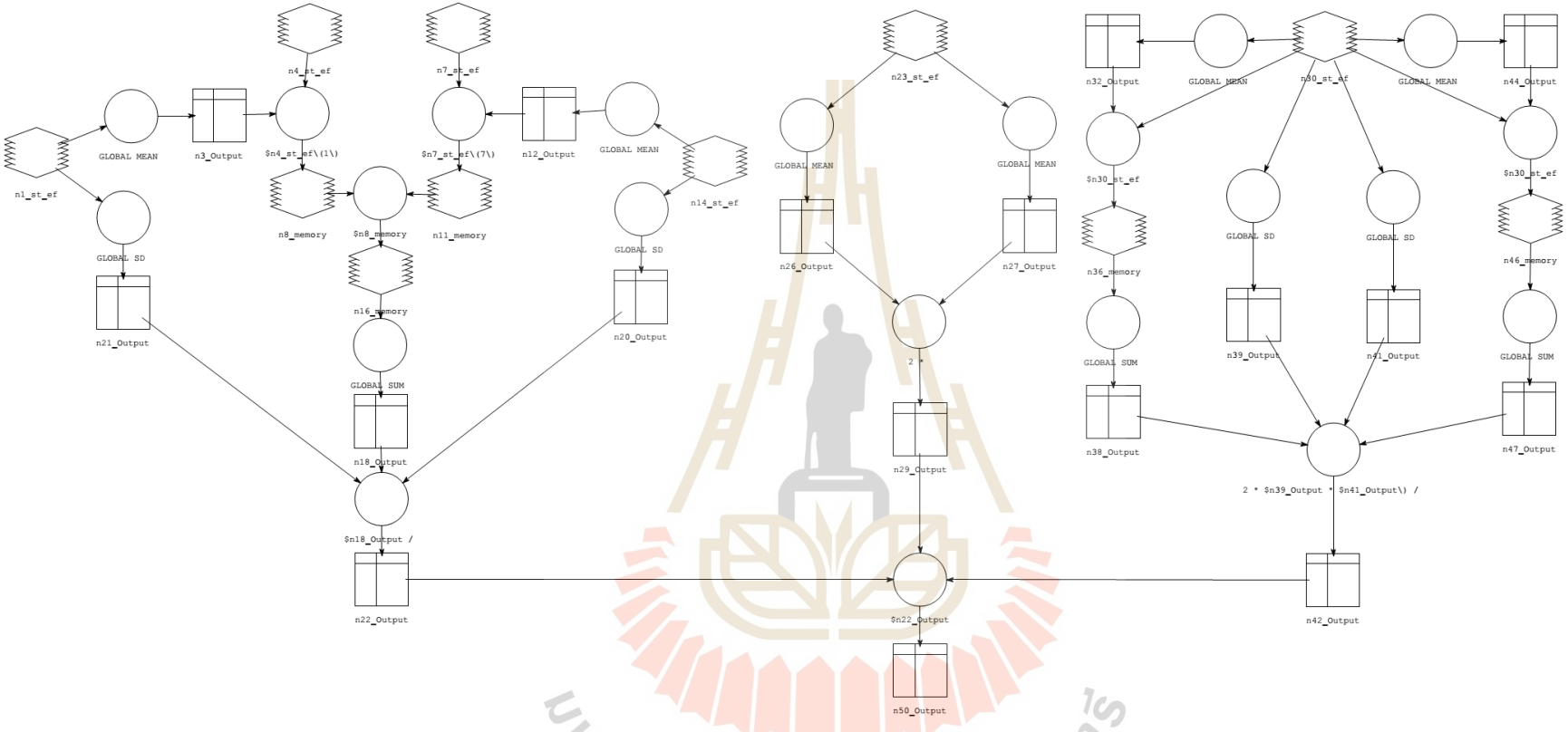
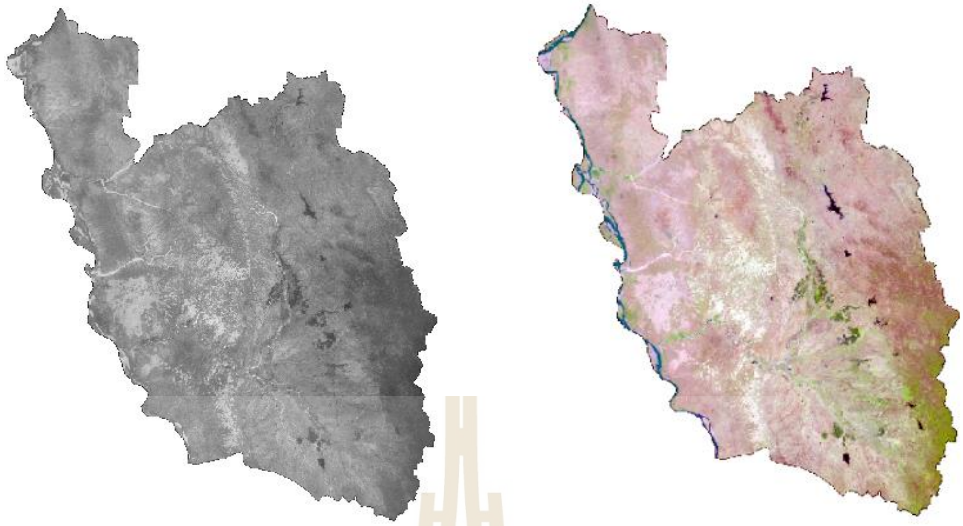
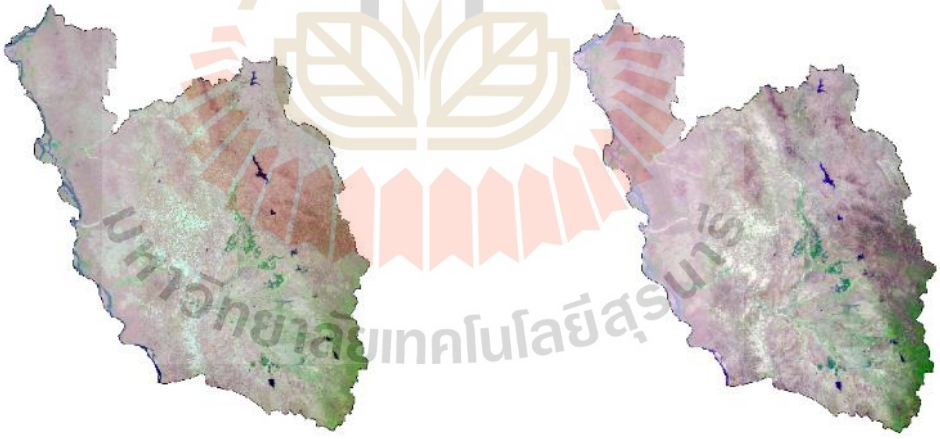


Figure 5.1 Universal Image Quality Index Model.



Panchromatic (2014) Multispectral image (2014)

Figure 5.2 Original panchromatic and multispectral images of Landsat data in 2014 for pan-sharpening operation.



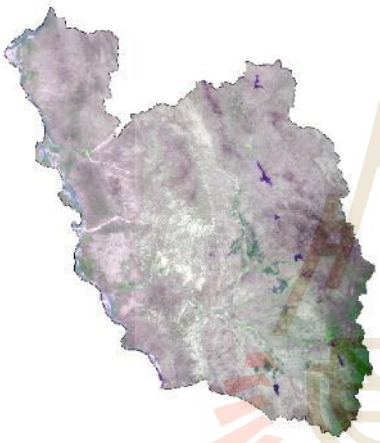
(a) False color image of Ehlers fusion, Band 5, 4 and 3 (RGB)

(b) False color image of Gram-Schmidt pan-sharpening, Band 5, 4 and 3 (RGB)

Figure 5.3 Pan-sharpened images from various selected algorithms.

(c) False color image of HPF, Band 5, 4 and 3 (RGB)

(d) False color image of Modified HIS, Band 5, 4 and 3 (RGB)



(e) False color image of PCA Band 5, 4 and 3 (RGB)

(f) False color image of Wavelet Transform, Band 5, 4 and 3 (RGB)

Figure 5.3 (Continuted) Pan-sharpened images from various selected algorithms.

Meanwhile, the average UIQI value from 6 bands (Band 2, 3, 4, 5, 6, and 7) of six different pan-sharpening algorithms of Landsat data in 2014 is reported in Table 5.1. According to the average ranking of the UIQI, the high pass filtering (HPF) image provides the highest average value, and it yields the least image distortion for supporting LULC classification using OBIA. This finding is similar to the previous

work of Ongsomwang and Saraisamrong (2017). They found that the most suitable image algorithm for producing the pan-sharpened image from Landsat 8 data was high pass filtering

Table 5.1 Average UIQI value of six different pan-sharpening algorithms for Landsat 8 OLI images in Magway district.

UIQI	EHLER	GS	HPF	MIHS	PCA	WT
Band 1	0.283213	0.930509	0.956642	0.963679	0.769231	0.970574
Band 2	0.181541	0.915569	0.959613	0.952251	0.721258	0.940586
Band 3	0.260494	0.902394	0.962204	0.970185	0.655439	0.966664
Band 4	0.394491	0.885637	0.956578	0.857365	0.657526	0.974364
Band 5	0.876443	0.876767	0.961568	0.964780	0.532690	0.941170
Band 6	0.900269	0.879026	0.961386	0.975660	0.519903	0.961465
Average	**0.482742**	**0.898317**	**0.959670**	**0.947320**	**0.642674**	**0.959137**
Ranking	**6**	**4**	**1**	**3**	**5**	**2**

5.1.2 LULC classification using OBIA with standard nearest neighbor

Two essential steps for LULC classification under OBIA are image segmentation and classification. In this study, the multiresolution segmentation with a scale parameter of 15, color's weight of 0.9, shape's weight of 0.1 and compactness's weight of 0.5 and smoothness's weight of 0.5 was first applied to segment image objects. The segmentation process yields 176,668 image objects over the study area in the subset image. Then, training sample areas of each LULC type were collected from image objects for LULC classification using the standard nearest neighbor classifier. Herein, the selected object features, including mean, standard deviation, maximum difference, ratio layers, brightness value, NDVI and NDBI, were applied to classify the LULC types.

In this study, nine LULC types were classified, including (1) settlement, (2) built-up area, (3) paddy field, (4) oil crops, (5) forest land, (6) shrubland, (7) waterbody, (8) bare land, and (9) sand bar. The description of the LULC class is summarized in Table 5.2. Meanwhile, the example of training areas from segmented images and reference high spatial resolution images from Google Earth are presented in Figures 5.4 to 5.12. The spatial distribution of the LULC map in 2014 of Magway district is displayed in Figure 5.13. Meanwhile, the area and percentage of LULC classification in 2014 of Magway district are summarized in Table 5.3.

Table 5.2 Description of land use and land covers classes.

No	LULC type	Description
1	Settlement	Habitat area or populated area in urban or rural
2	Built-up areas	Road, street, airport, garden, sports complex and other public areas do not have any population.
3	Paddy field	Rice agriculture cultivation area determines by the inundation of fields.
4	Oil crop	Peanut, bean, sesame and dry farmland
5	Forest land	Forest land spans more than 0.5 hectares, with trees higher than 5 meters and a canopy cover of more than 40 percent, or trees can reach this threshold in situ.
6	Shrubland	Scrubland is a plant community characterized by vegetation dominated by shrubs and bushes, including grasses, herbs, and geophytes.
7	Waterbody	Rivers, lakes and reservoirs
8	Bare land	Bare land is an area with no dominant vegetation cover on at least 90 % of the area
9	Sand bar	Sandy land, sandy creeks that have no water

Source: Toe, M. T., Kanzaki, M., and Cheng, K.-S. (2016) and Myint, A. A., and Min, M. M. (2019)

LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Settlement	1		
	2		
	3		
	4		
	5		

Figure 5.4 Training areas of settlement.

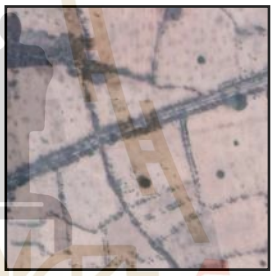
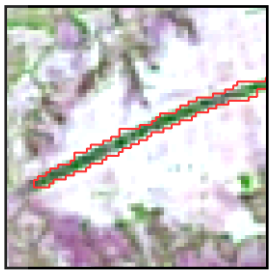
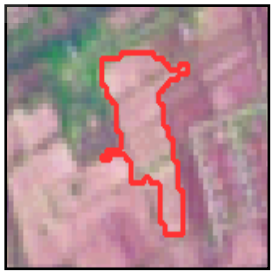
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Built-up area	1		
	2		
	3		
	4		
	5		

Figure 5.5 Training areas of built-up area.

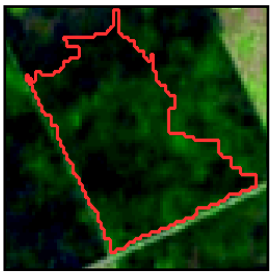
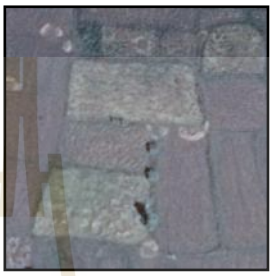
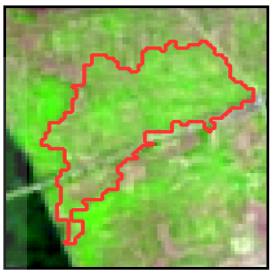
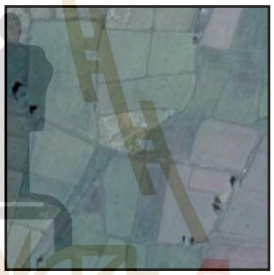
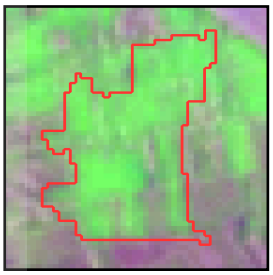
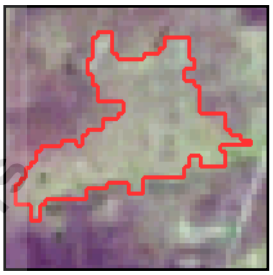
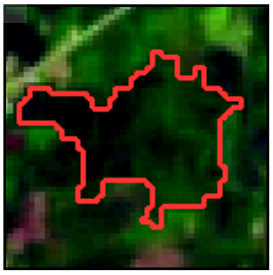
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Paddy field	1		
	2		
	3		
	4		
	5		

Figure 5.6 Training areas of paddy field.

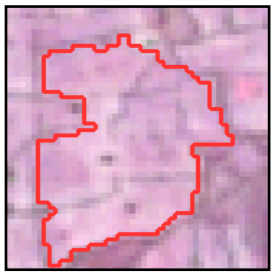
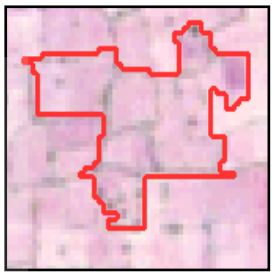
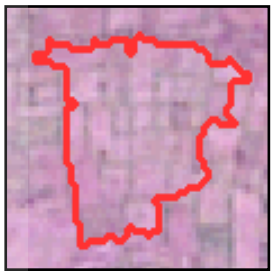
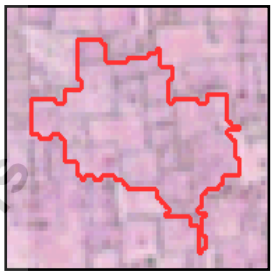
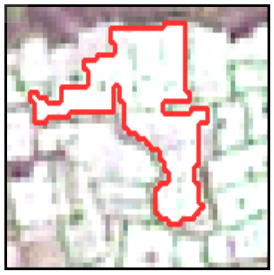
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Oil crops	1		
	2		
	3		
	4		
	5		

Figure 5.7 Training area of oil crops.

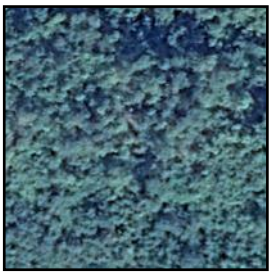
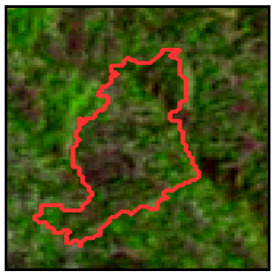
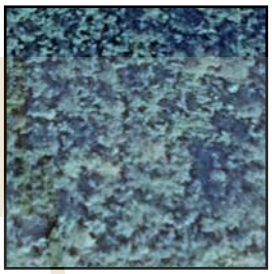
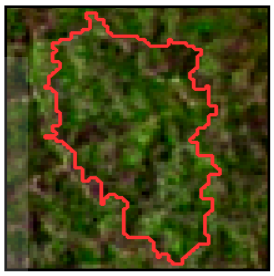
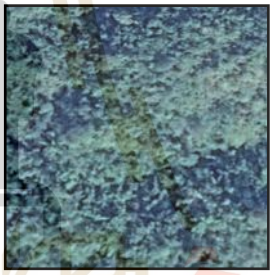
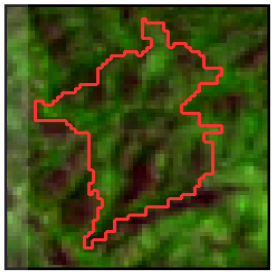
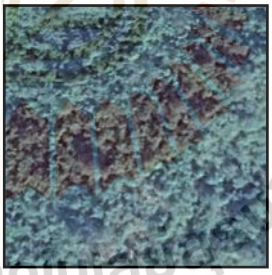
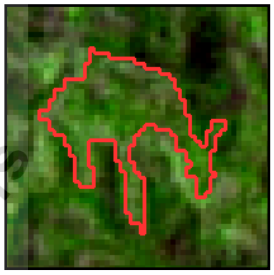
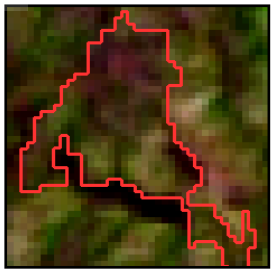
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Forest land	1		
	2		
	3		
	4		
	5		

Figure 5.8 Training area of forest land.

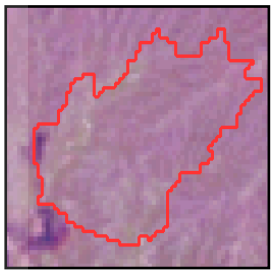
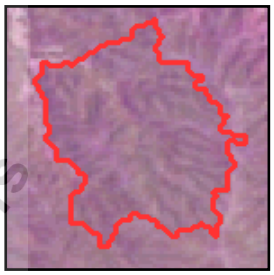
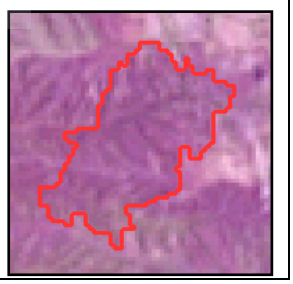
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Shrubland	1		
	2		
	3		
	4		
	5		

Figure 5.9 Training area of shrubland.

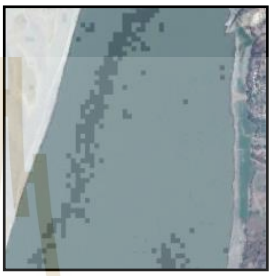
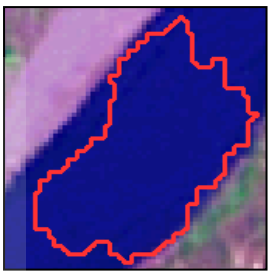
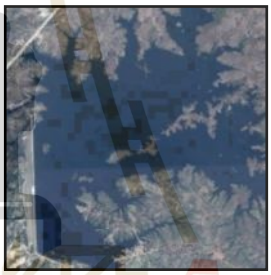
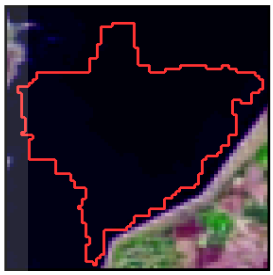
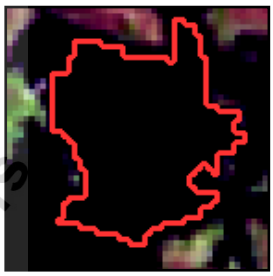
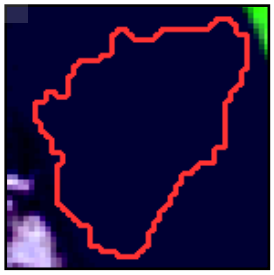
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Waterbody	1		
	2		
	3		
	4		
	5		

Figure 5.10 Training area of a waterbody.

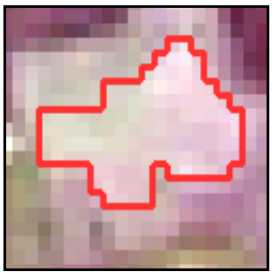
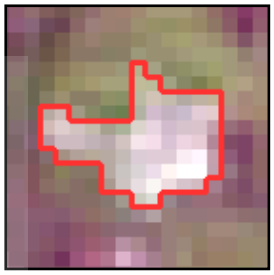
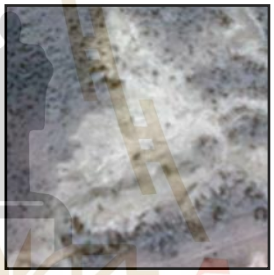
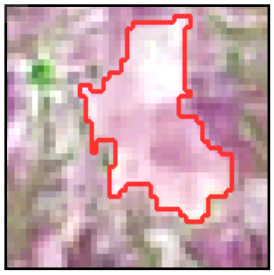
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Bare land	1		
	2		
	3		
	4		
	5		

Figure 5.11 Training area of bare land.

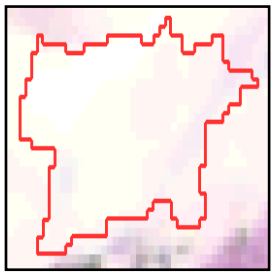
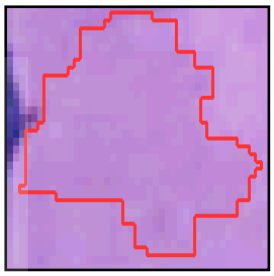
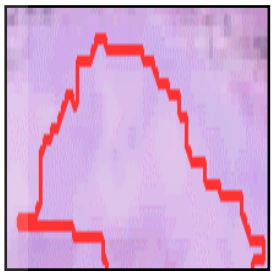
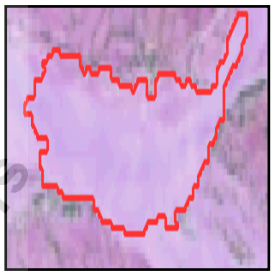
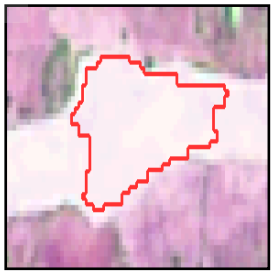
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Sand bar	1		
	2		
	3		
	4		
	5		

Figure 5.12 Training area of a sand bar.

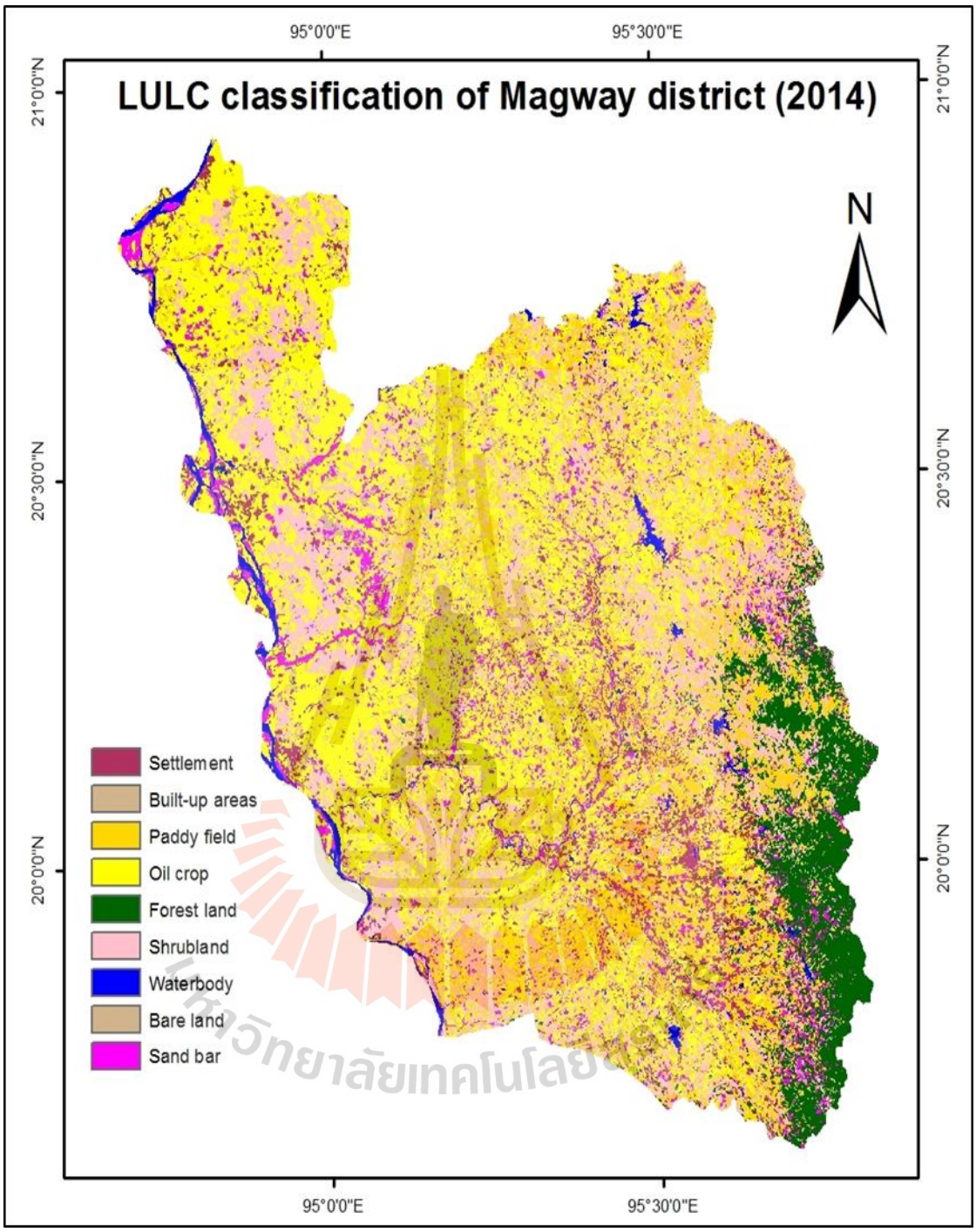


Figure 5.13 LULC map for Magway District in 2014.

Table 5.3 Area and percentage of land use and land cover area for Magway district in 2014.

No.	LULC Class	Sq. km^2	Percent
1	Settlement	263.08	2.72
2	Built-up area	266.09	2.75
3	Paddy field	1,704.02	17.63
4	Oil crop	3,920.17	40.57
5	Forest land	822.62	8.51
6	Shrub land	1,815.99	18.79
7	Waterbody	187.49	1.94
8	Bare land	131.99	1.37
9	Sand bar	552.33	5.72
	Total	**9,663.77**	**100.00**

As a result, the top three dominant LULC types are oil crop, shrubland and paddy field and cover area of 3,920.17, 1,815.99 and 1,704.02 or about 40.57%, 18.79% and 17.63% of the study area, respectively. In the meantime, the settlement area classified using standard nearest neighbor classifies under OBIA is 263 sq. km^2 or 2.72% of the study area. Most settlement areas are situated along the major and minor rivers in the study area (Figure 5.14). Simultaneously, the existing forest land is located on the hill and mountain range in the eastern part of the Magway district.

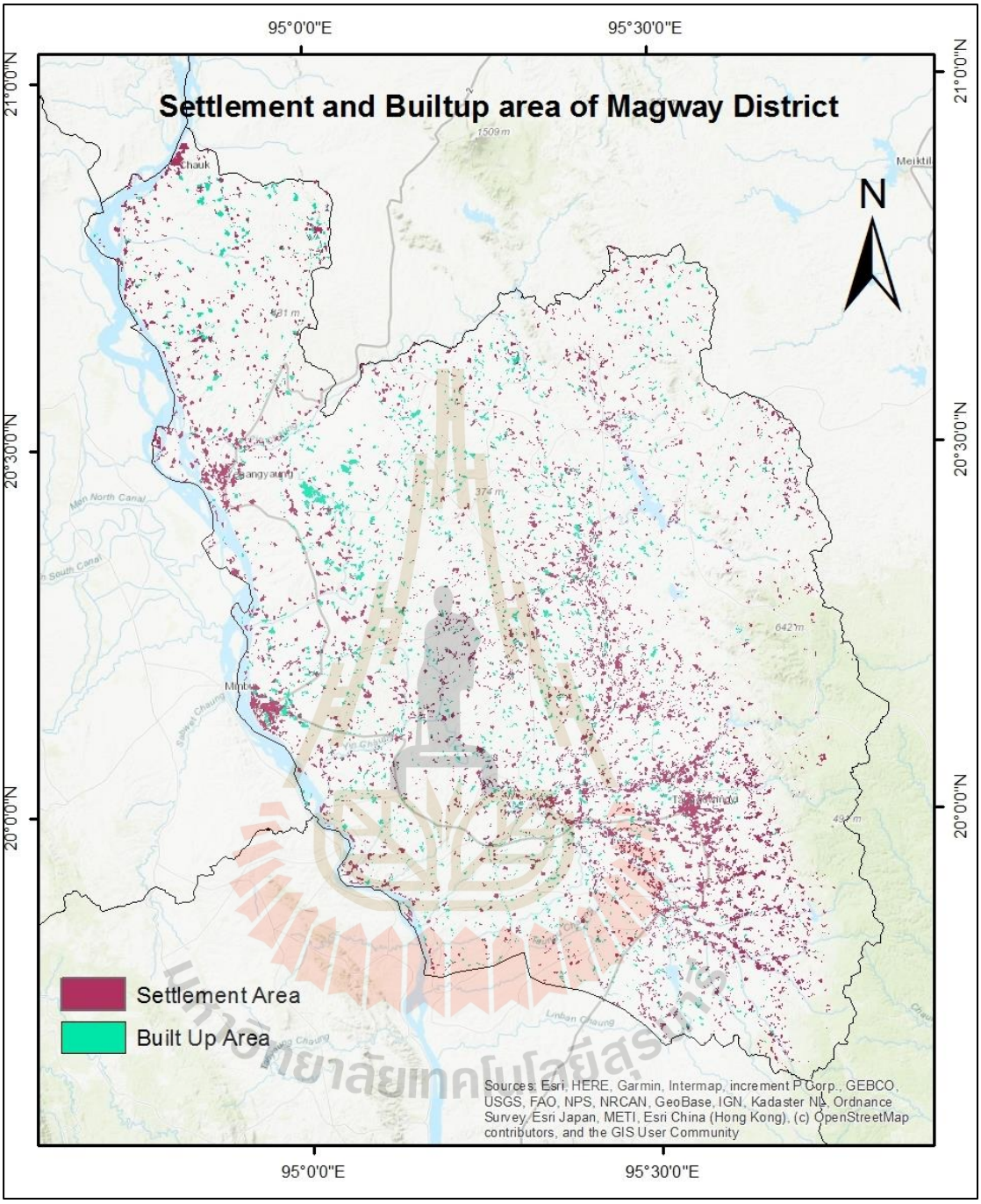


Figure 5.14 Spatial distribution of settlement and built-up area.

5.1.3 Accuracy assessment of LULC classification

In this study, the sample size for accuracy assessment was estimated based on the multinomial distribution theory, and they were allocated using the stratified random sampling method**.** Sample size (N) derived from a multinomial distribution is based on the following equation (Tortora, 1978; Congalton and Green, 1999):

$$N = \frac{B \prod_i (1 - \prod_i)}{b_i^2} \quad (5.1)$$

Where $\prod_i$ is the portion of a population in the ith class out of classes with the proportion closest to 50%.

b_i is the desired precision (e.g., 5%) for the class.

B is the upper (α/k) X 100 percentile of the chi-square distribution with 1 degree of freedom.

k is the number of classes.

As the sample size calculation with multinomial distribution, 742 points were required for thematic accuracy assessment. The spatial distribution of sampling points for accuracy assessment is displayed in Figure 5.15. The accuracy assessment result, which includes an error matrix and its accuracy, is presented in Table 5.4.

As a result, the overall accuracy and Kappa hat coefficient of the thematic LULC map of Magway district in 2014 are 92.86% and 90.85%. Meanwhile, producer's accuracy, which represents omission error, varies between 75.00% for built-up areas and 100% for oil crops, whereas user's accuracy, which represents commission error, varies between 72.73% for bare land and 100% for the waterbody.

Based on Fitzpatrick-Lins (1981), the Kappa hat coefficient of more than 80 percent represents strong agreement or accuracy between the classified map and the reference map. Likewise, the overall accuracy of the LULC map in 2014, more than 85%, can provide an acceptable result (Anderson, Hardy, Roach, and Witmer, 1976). Besides, the overall accuracy and Kappa hat coefficient in the current study are similar to the previous study of Kete, Suprihatin, Tarigan, and Effendi (2019). They applied the nearest neighbor classifier to classify LULC from Landsat OLI data with a spatial resolution of 30m, acquired 26 July 2016 at Kendari City, Southeast Sulawesi Province, Indonesia. Their results provided an overall accuracy at 81.38% and Kappa hat coefficient at 78.77%. Thus, the classified LULC in 2014 in this current study can be accepted and further applied for population estimation with the binary dasymetric method.

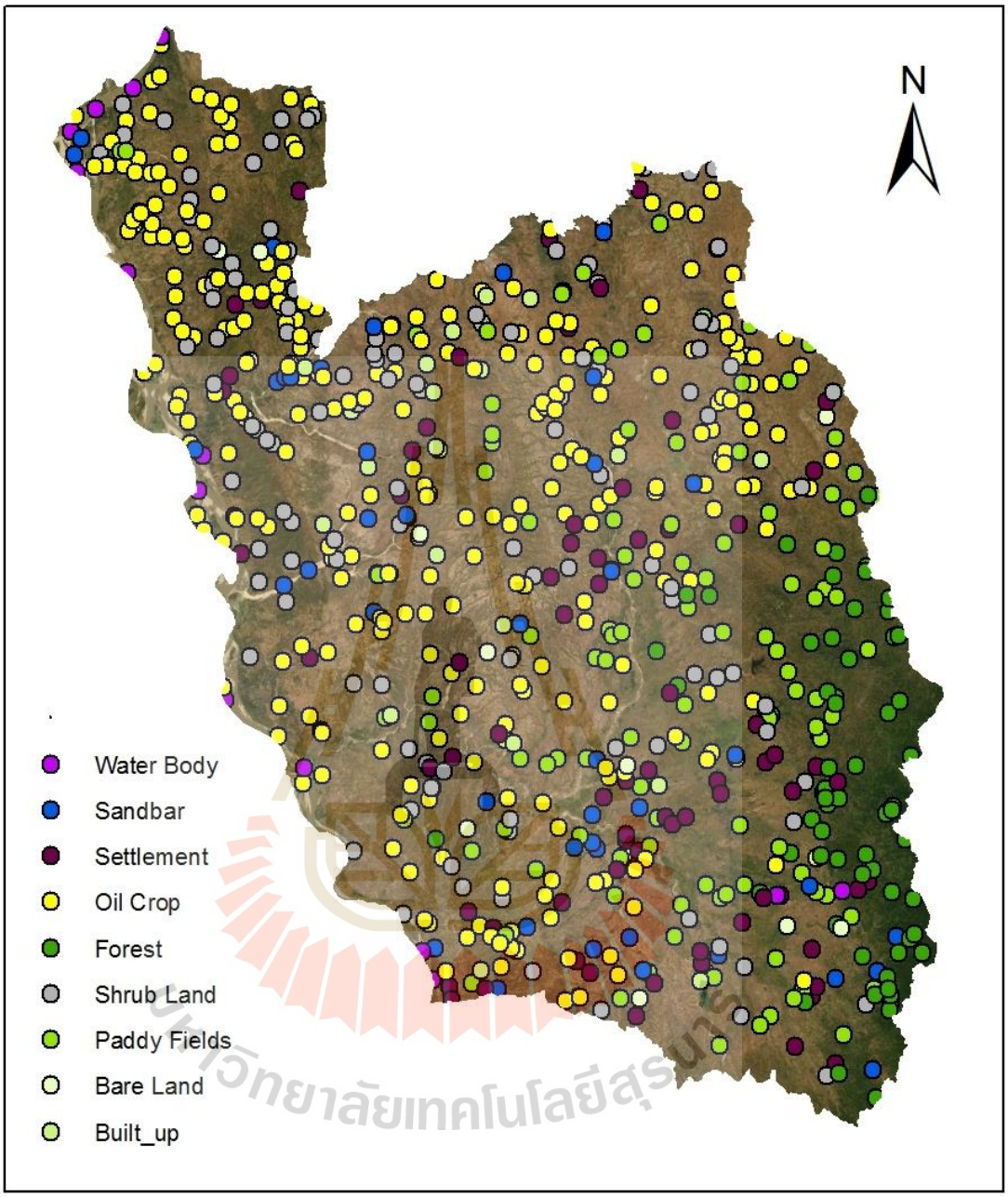


Figure 5.15 Spatial distribution of sampling points for accuracy assessment of LULC map in 2014.

Table 5.4 Error matrix and accuracy assessment of LULC in 2014.

Classified LULC data in 2014		Ground reference data from Google Earth in 2014									
	LULC type	SE	BU	PF	OC	FL	SL	WB	BL	SL	Total
	Settlement (SE)	**36**	1	4	2	1	4				48
	Built-up areas (BU)	2	**12**	1	1						16
	Paddy field (PF)			**116**	2		2				120
	Oil crop (OC)	3	1	2	**255**		2			2	265
	Forest land (FL)	1		1	2	**49**	2				55
	Shrubland (SL)	1	1	1	3	1	**156**			1	164
	Waterbody (WB)							**13**			13
	Bare land (BL)				1		1		**8**	1	11
	Sand bar (SB)	1	1			1	1	1	1	**44**	50
Total		44	16	125	266	52	168	14	9	48	**742**
Producer's accuracy		81.82	75.00	92.80	95.86	94.23	92.86	92.86	88.89	91.67	
User's accuracy		75.00	75.00	96.67	96.23	89.09	95.12	100.00	72.73	88.00	
Overall accuracy		92.86									
Kappa hat coefficient		0.9085									

5.1.4 Populated and unpopulated zone extraction

For population estimation with the binary dasymetric method, each census block's populated areas were extracted by overlay analysis between census block boundary and sediment areas. As a result, the total area of Magway district is 9,656.50 km^2, and the populated area is 263.08 km^2. Details of the populated area in each census block in Magway District are presented in Table 2 in Appendix A. The classification of the populated and unpopulated areas is exhibited in Figure 5.16.

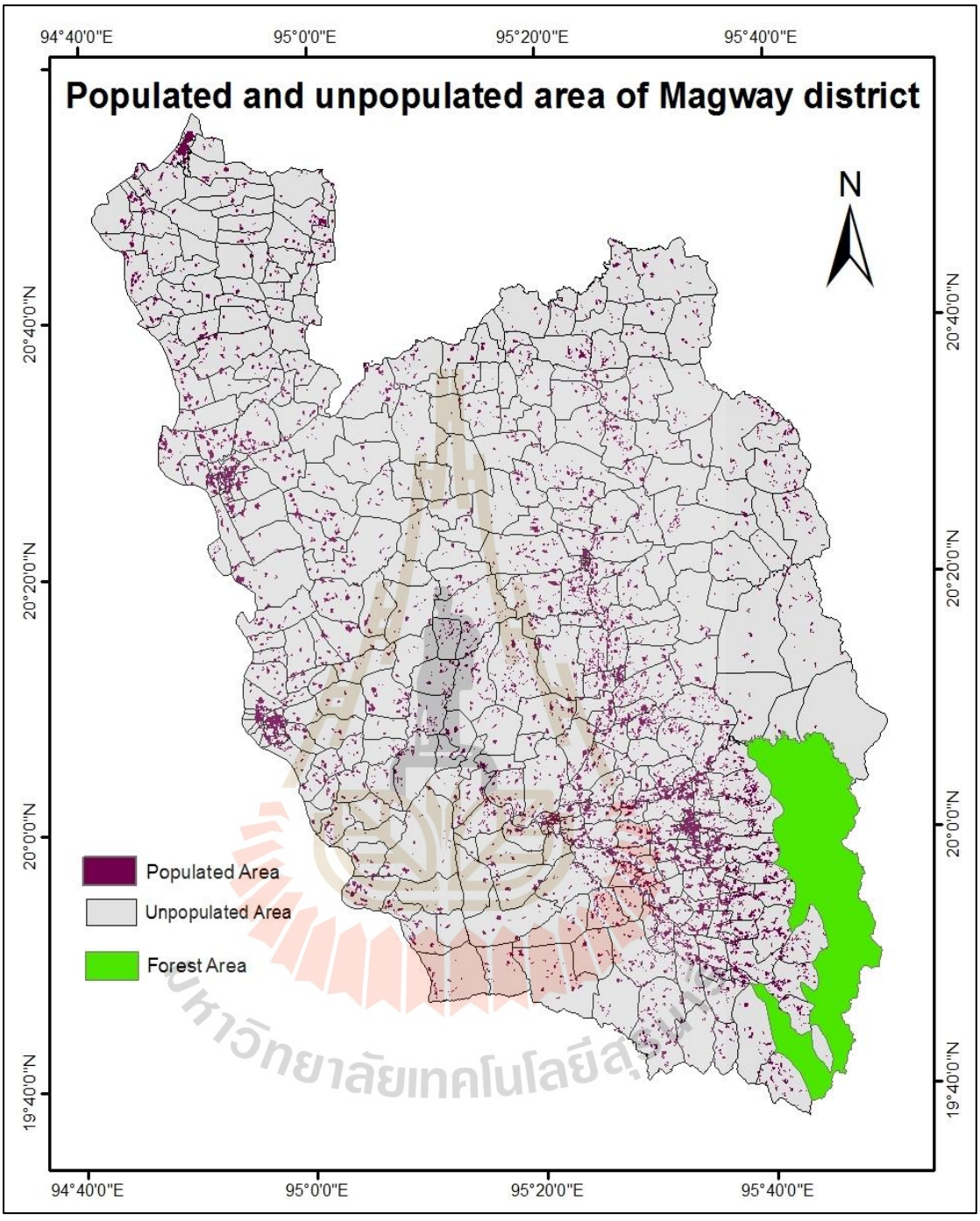


Figure 5.16 Populated area and unpopulated area of Magway District.

5.1.5 Estimation of the population with the binary dasymetric method

For population estimation with the binary dasymetric method, the net populated area was first estimated using Equation 3.15, and the average population density was calculated using Equation 3.16. Then, the number of populations was estimated using Equation 3.17.

The detailed population estimation steps and the result are reported below.

Populated area of Magway District (km^2)	263.08
Sum product between settlement area in each census with 0.005	44.32
Net populated area (263.08 - 44.32)	218.77
Average population density (400 Census Blocks)	5,631.31
Estimated population (218.77 * 5,631.31)	1,231,933.71
The total population of Magway District (2014 Census)	1,235,030

As a result, the estimated population of the Magway district in 2014 using the binary dasymetric method is about 1,231,934 persons, while the reference population of the 2014 Census data in Magway district is 1,235,030 persons**.** The result indicates an underestimation of 3,096 persons**.** The derived result will be further applied to access accuracy using AE and RE**.** The reference and an estimated population in each census block of Magway district using the binary dasymetric method in detail are reported in Table 3 in Appendix A.

A scatter plot between reference and estimated population density in natural logarithm form with the binary dasymetric method is shown in Figure 5.17. As a result, it discloses a linear relationship between reference and estimated natural logarithm population density (LPD) with the R^2 value of 0.9505.

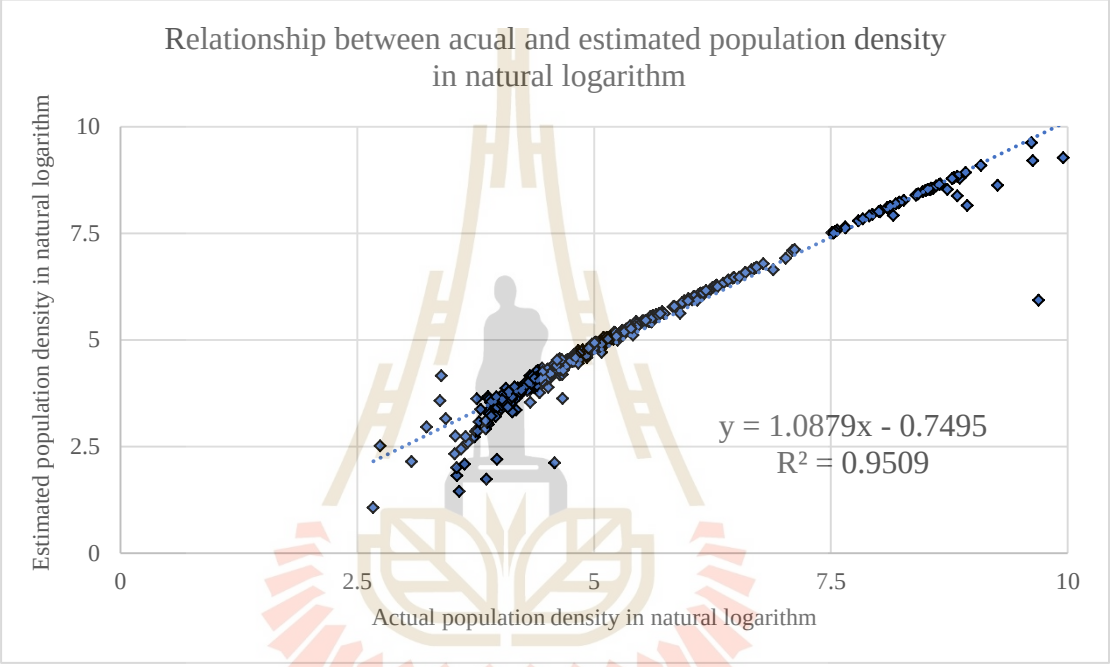
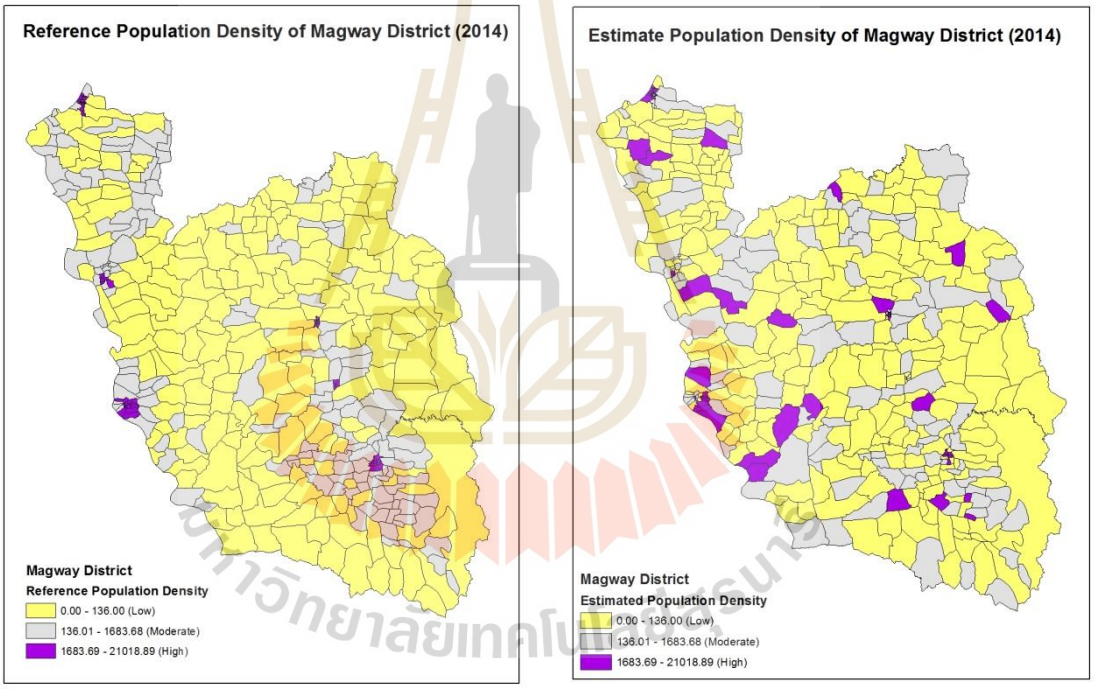


Figure 5.17 Scatter plot between reference and estimated natural logarithm population density of binary dasymetric method.

Furthermore, the classification of the estimated population density of the Magway district using the binary dasymetric method is compared with the classification of 2014 Census data, as shown in Figure 5.18. As a result, it can be observed that spatial patterns of population density are quite similar. The transitional change matrix of reference and estimated population density classification is informed

in Table 5.5. It reveals that population density classification based on reference and estimated data is upgraded to higher only two blocks. In contrast, population density classification based on reference and estimated data is downgraded to lower 36 blocks. This finding can be confirmed as underestimation. In the meantime, population density classification based on reference and estimated data is unchanged, with 361 blocks. This finding indicates a high consistent result between reference and observed population density classification, about 90.48%, as overall accuracy.



(a) (b)

Figure 5.18 Spatial distribution of population density classification of Magway district in 2014: (a) Reference population density from 2014 Census data and (b) Estimated population density from the binary dasymetric method.

Table 5.5 Transitional change matrix of population density classification between reference and estimated data from the binary dasymetric method.

Population density classification		Estimated data			
		Low	Moderate	High	Total
Reference data	Low	192	2		194
	Moderate	35	117		152
	High		1	52	53
	Total	227	120	52	**399**
Overall accuracy (%)		90.48%			

5.2 Population estimation with areal weighting methods

The areal weighting method is a simple method and easy to estimate the population**.** But it cannot estimate the population by every census block as statistical modeling and binary dasymetric method**.** This method classified the census blocks into two groups**:** blocked and unblocked areas**.** Magway district had only one unblocked area and 399 blocked areas with the population**.** The classification of the blocked and unblocked area of the Magway district is displayed in Figure 5**.**19**.** The detailed calculation steps and results are described in the following section**.**

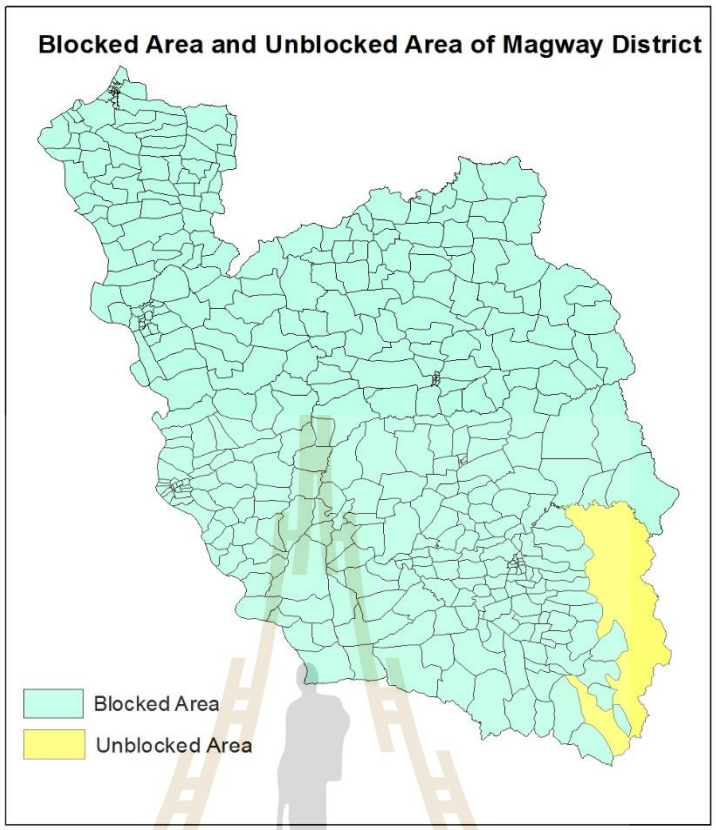


Figure 5.19 Classification of the blocked and unblocked area in Magway District.

5.2.1 Estimation of the population with an areal weighting method

The population was estimated by multiplicating three key factors: average population density, area weight, and the total area of Magway district, using Equation 3.18 as a result shown below.

The estimated population of Magway District is 9154.03 *0.94*134.92 or 1,109,846.23 or about 1,109,846 persons, while the reference population of the 2014 Census data in Magway district is 1,235,030 persons. The result indicates an underestimation of 125,184 persons. The derived result will be further applied to access accuracy using AE and RE.

CHAPTER VI

ACCURACY ASSESSMENT FOR POPULATION ESTIMATION

This chapter presents the third objective results cover accuracy assessment for the population estimation among three methods (statistical modeling, binary dasymetric, and areal weighting methods) and optimum method identification for population estimation.

6.1 Population estimation using the statistical modeling method

The statistical modeling method's optimum estimation model was derived from the stratified random sampling of moderate and high population density, and the dependent variable was the natural logarithm of population density.

The estimated population using the optimum statistical modeling method of Magway District in 2014 is 1,255,788 persons. Meanwhile, the reference population from the 2014 Census data of Magway District is 1,235,030 persons. The difference between the reference and estimated Magway District population in 2014 is (-) 20,758 persons. This finding shows an overestimate result. The relative error of population estimation using the statistical modeling method, which was calculated using Equation 3.19, is -1.68%.

6.1.1 Accuracy assessment for the statistical modeling method

The statistical modeling method's accuracy was assessed based on 40% of the non-selected sample census blocks using the overall relative errors (RE) and absolute errors (AE). The RE and AE were calculated using Equations 3.20 and 3.21, respectively.

It revealed that the RE is 56.44%, and the AE is 1,256.32 persons. As a result, the AE is relatively high. Since the mean value of independent variables, which are assumed to be homogeneous, is applied to estimate population, even though some census blocks might be heterogeneous with various land use.

6.2 Population Estimation using a binary dasymetric method

For population estimation with the binary dasymetric method, net populated area and average population density were calculated using Equations 3.15 and 3.16, respectively. The total population was finally estimated by multiplication between the net populated area with average population density in the study area using Equation 3.17.

The estimated population using the binary dasymetric method of Magway District in 2014 is about 1,231,934 persons. Meanwhile, the reference population from the 2014 Census data of Magway District is 1,235,030 persons. The difference between the reference and estimated Magway District population in 2014 is (+) 3,096 persons. This finding shows an underestimate result. The relative error of population estimation using the binary dasymetric method is 0.25%.

6.2.1 Accuracy Assessment for binary dasymetric method

The accuracy assessment of the binary dasymetric method was done using the overall relative errors (RE) and overall absolute errors (AE) from each

census block's population density**.** It revealed that the RE is 21.14%, and the AE is 577.57 persons**.** Both AE and RE in the binary dasymetric method are better than the statistical modeling method.

6.3 Population estimation using the areal weighting method

For population estimation with the areal weighting method, the total population was estimated by multiplicating three key factors (blocked area, area weight and constant population density) using Equation 3.18.

The estimated population using the areal weighting method of Magway District in 2014 is about 1,109,846 persons. On the contrary, the reference population from the 2014 Census data of Magway District is 1,235,030 persons. The difference between the reference and estimated Magway District population in 2014 is (+) 125,184 persons. This finding shows an underestimate result. The relative error of population estimation using the areal weighting method is 10.14%.

6.3.1 Accuracy Assessment for areal weighting method

The accuracy assessment of the areal weighting method was conducted using the overall relative errors (RE) and overall absolute errors (AE) for the whole study area. It was discovered that the RE is 10.14%, and the AE is 125,184 persons. Both AE and RE of the areal weighting method are calculated for the whole study area.

6.4 Optimum method for population estimation

The optimum method for population estimation was justified based on the primary four criteria, including residual value, relative error, RE value and AE value.

The comparison of the four criteria values of three different methods is summarized in Table 6.1.

As a result, the binary dasymetric method is an optimum method for population estimation because it can provide the lowest residual, relative error, RE and AE values than the statistical modeling method. Additionally, the binary dasymetric method can be applied to estimate the population density and population number in each census block, like the statistical modeling method.

However, when LULC data are difficult to classify in the remote area, the statistical modeling method can be applied to estimate the population density because dependent and independent variables can be easily collected and prepared for multiple linear regression analysis.

Table 6.1 Comparison of estimation results for population estimation methods

Criteria	**Method**		
	Statistical Modeling	**Binary Dasymetric**	**Areal Weighting**
Residual value (Persons)	(-) 20,758	(+) 3,096	(+) 125,184
Relative error (%)	-1.68	0.25	10.14
RE (%)	56.44	21.14	Not apply
AE (Persons)	1,256.32	577.57	Not apply
Estimation at a census block level	Yes	Yes	No

CHAPTER VII

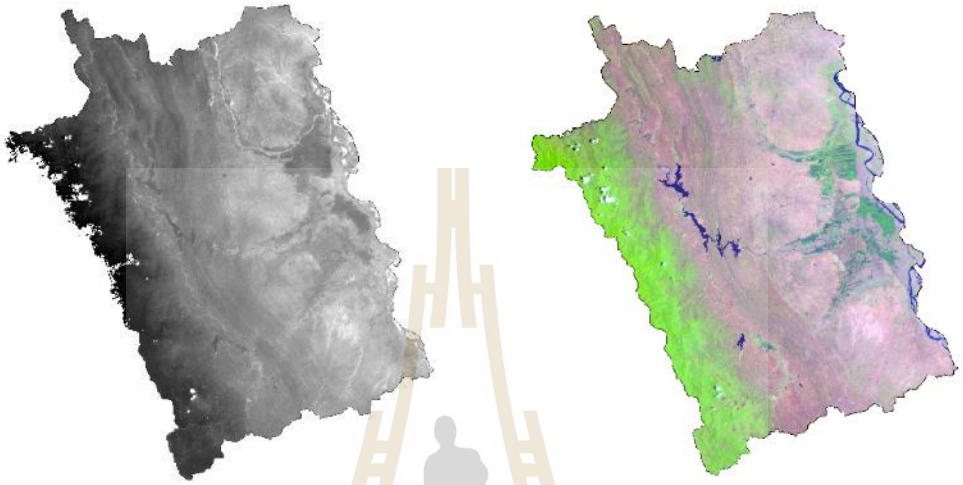
VALIDATION OF OPTIMUM METHOD FOR POPULATION ESTIMATION

This chapter presents the fourth objective results. The identified optimum method for population estimation in the Magway district, namely the binary dasymetric method, is reapplied to estimate the Minbu district population for model validation. Significant results for population estimation using the binary dasymetric method in Minbu district, as a testing area, are described and discussed in the following sections.

7.1 Optimum pan-sharpening image using UIQI

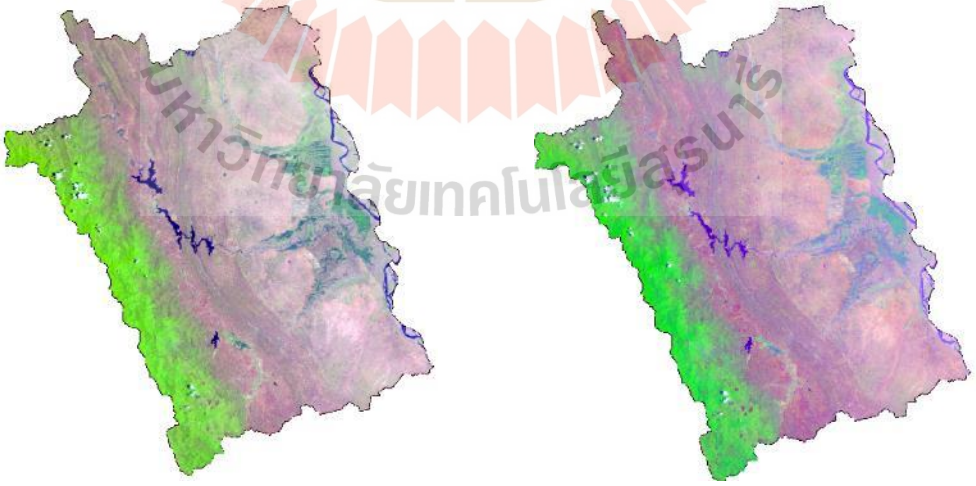
Multispectral and panchromatic bands of two mosaiced Landsat 8 OLI images: Path/Row: 134/46, dated 26 April 2014, which were downloaded from EarthExplorer website of the USGS, were firstly extracted for pan-sharpening operation using six selected algorithms, including (1) Ehlers fusion, (2) Gram-Schmidt pan-sharpening, (3) High Pass Filtering, (4) Modified IHS, (5) Principal Components Analysis (PCA) Transformation and (6) Wavelet Transform. The optimum pan-sharpening algorithm was later identified using universal quality image indices (UIQI) using Equation 3.14. Then, the optimum pan-sharpening algorithm was applied to produce the pan-sharpened image of the Minbu district for LULC classification under the OBIA.

Figure 7.1 displays the original panchromatic band and multispectral bands of Landsat 8 OLI data in 2014 for the pan-sharpening operation. The pan-sharpened image from six selected pan-sharpening methods is displayed in Figure 7.2.



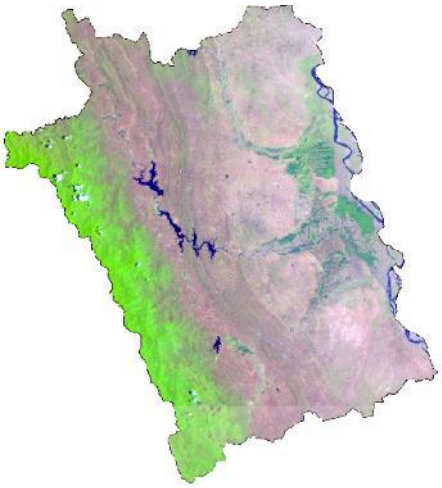
Panchromatic (2014) Multispectral image (2014)

Figure 7.1 Original panchromatic and multispectral images of Landsat data in 2014 for pan-sharpening operation.

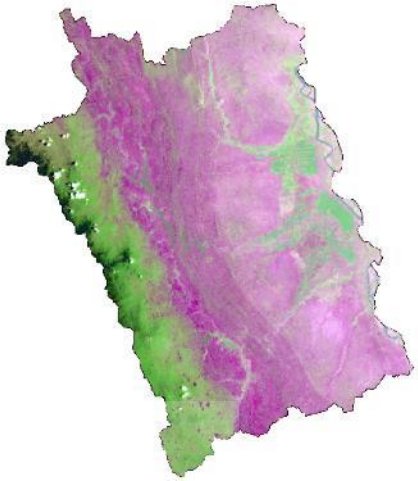


(a) False color image of Ehlers fusion, Band 5, 4 and 3 (RGB) **(b)** False color image of Gram-Schmidt pan-sharpening, Band 5, 4 and 3 (RGB)

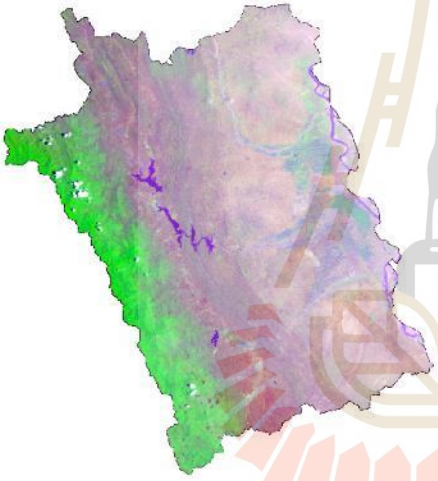
Figure 7.2 Pan-sharpened images from six selected algorithms.



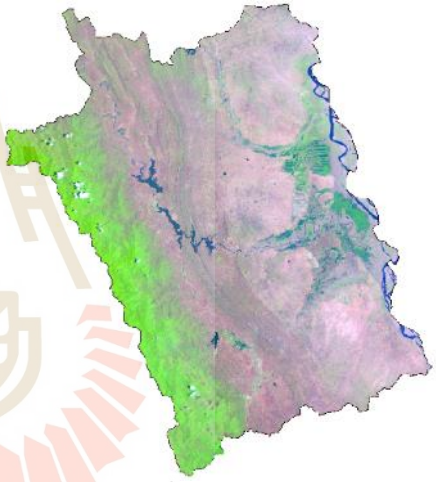
(c) False color image of HPF, Band 5, 4 and 3 (RGB)



(d) False color image of Modified HIS, Band 5, 4 and 3 (RGB)



(e) False color image of PCA Band 5, 4 and 3 (RGB)



(f) False color image of Wavelet Transform, Band 5, 4 and 3 (RGB)

Figure 7.2 (Continued) Pan-sharpened images from six selected algorithms.

Meanwhile, the average UIQI value from 6 bands (Band 2, 3, 4, 5, 6, and 7) of six different pan-sharpening algorithms of Landsat data in 2014 are informed in Table 7.1. According to the average ranking of the UIQI, the high pass filtering (HPF) image provides the highest average value with the least color distortion. It produces the least distortion image to support the LULC classification in the Minbu district under OBIA.

As a result, the most suitable algorithm for the best pan-sharpened production, namely high pass filtering (HPF), is the same as an identified algorithm in the Magway district. Still, the ranking of all six algorithms in the Minbu district is different from the Magway district, as reported in Chapter V.

Table 7.1 Average UIQI value of six different pan-sharpening algorithms for Landsat 8 OLI images in Minbu district.

UIQI	EHLER	GS	HPF	MIHS	PCA	WT
Band 1	0.930572	0.949664	0.967894	0.966111	0.891060	0.930829
Band 2	0.945756	0.943814	0.968498	0.967974	0.879252	0.973831
Band 3	0.972426	0.936398	0.969477	0.981165	0.854927	0.978746
Band 4	0.900877	0.976889	0.962412	0.729061	0.952500	0.954374
Band 5	0.977126	0.928705	0.965320	0.898249	0.823577	0.950316
Band 6	0.941920	0.935671	0.965946	0.924594	0.813078	0.972521
Average	**0.944779**	**0.945190**	**0.966591**	**0.911192**	**0.869066**	**0.960103**
Ranking	**4**	**3**	**1**	**5**	**6**	**2**

7.2 LULC classification using OBIA with standard nearest neighbor

Two steps for LULC classification under OBIA, image segmentation and classification, were applied in Minbu district, same as Magway district. The multiresolution segmentation with a scale parameter of 15, color's weight of 0.9, shape's weight of 0.1, compactness's weight of 0.5 and smoothness's weight of 0.5 were also applied to segment image objects. The segmentation process creates 193,687 image objects. Then, training sample areas of each LULC type were collected from image objects for LULC classification with the standard nearest neighbor classifier under the eCognition software. The selected object features,

including mean, standard deviation, maximum difference, ratio layers, brightness value, NDVI and NDBI, were applied to classify nine LULC types (settlement, built-up area, paddy field, oil crops, forest land, shrubland, waterbody, bare land, and sand bar) again. The example of training areas from segmented images and reference high spatial resolution images from Google Earth are presented in Figures 7.3 to 7.11. The spatial distribution of the LULC map in 2014 of the Minbu district is displayed in Figure 7.12. Meanwhile, the area and percentage of LULC classification in 2014 of Minbu district are summarized in Table 7.2.

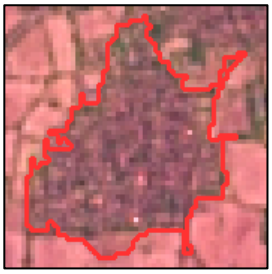
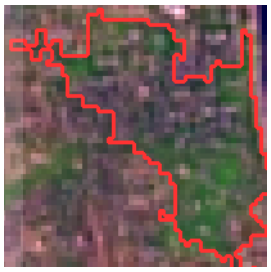
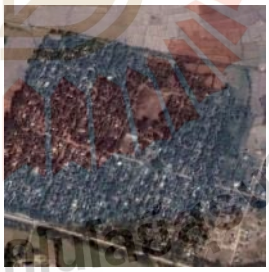
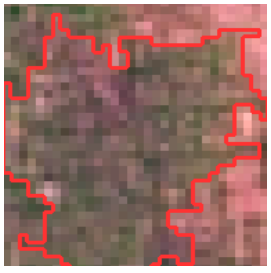
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Settlement	1		
	2		
	3		
	4		
	5		

Figure 7.3 Training areas of settlement.

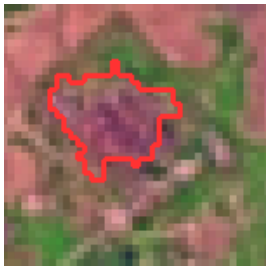
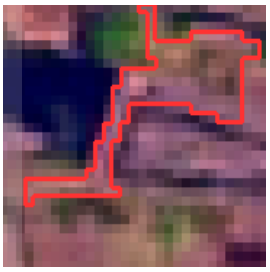
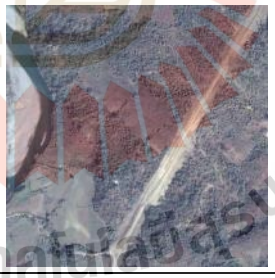
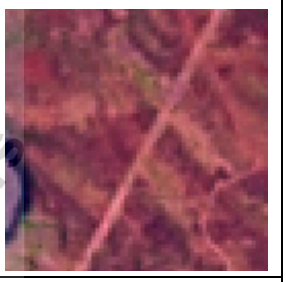
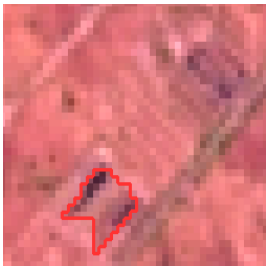
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Built-up area	1		
	2		
	3		
	4		
	5		

Figure 7.4 Training areas of built-up area.

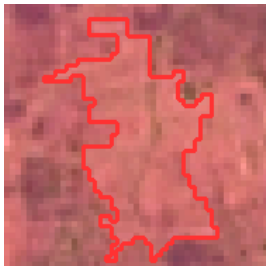
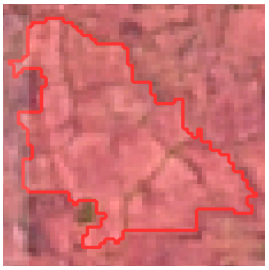
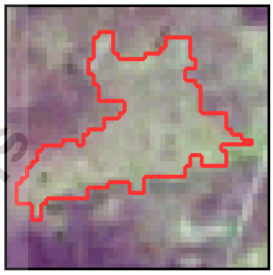
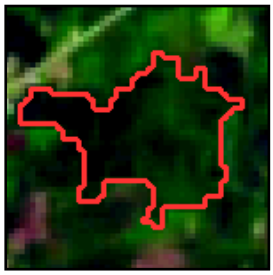
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Paddy field	1		
	2		
	3		
	4		
	5		

Figure 7.5 Training areas of paddy field.

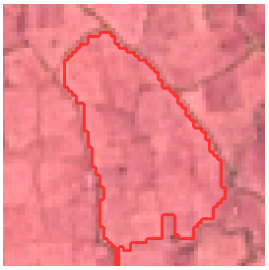
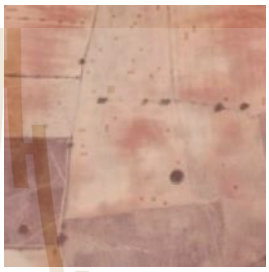
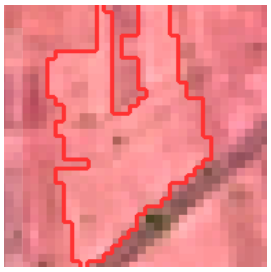
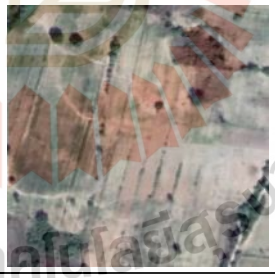
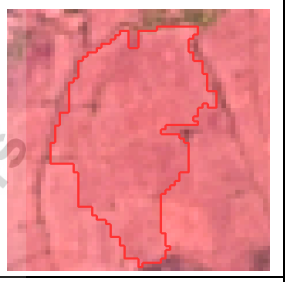
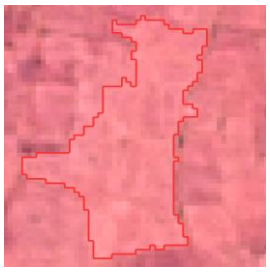
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Oil crops	1		
	2		
	3		
	4		
	5		

Figure 7.6 Training area of oil crop.

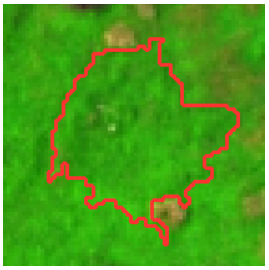
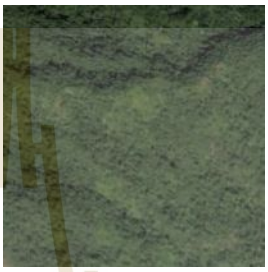
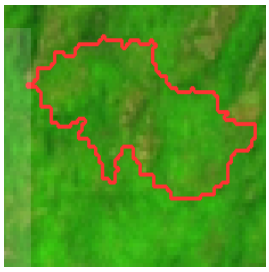
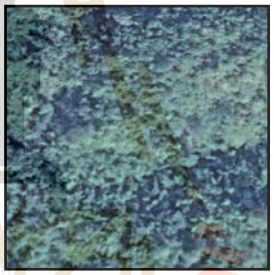
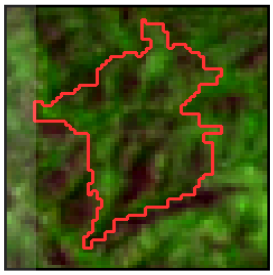
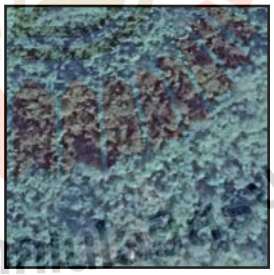
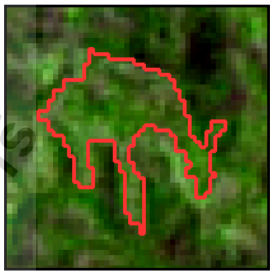
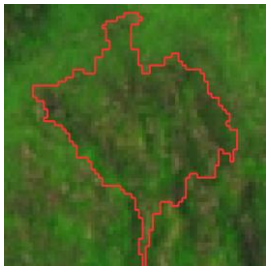
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Forest land	1		
	2		
	3		
	4		
	5		

Figure 7.7 Training area of forest.

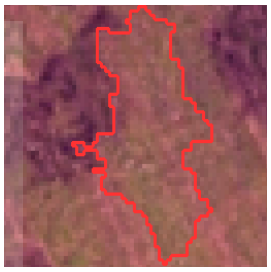
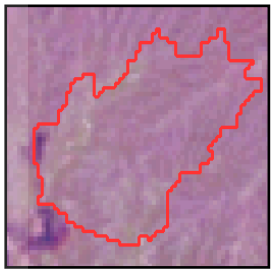
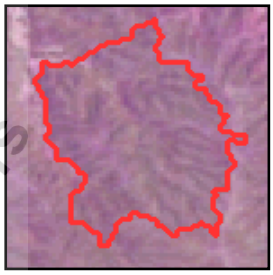
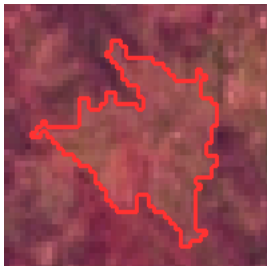
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Shrubland	1		
	2		
	3		
	4		
	5		

Figure 7.8 Training area of shrubland.

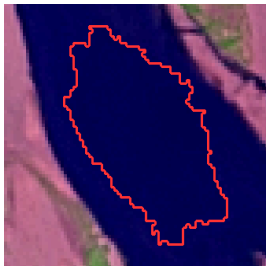
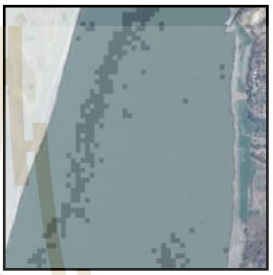
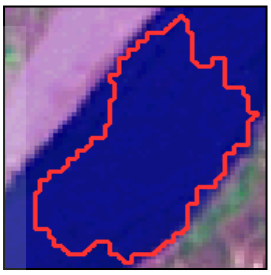
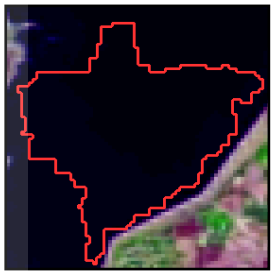
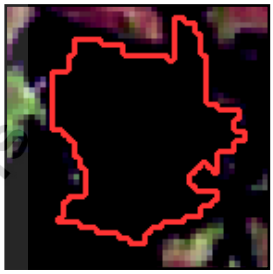
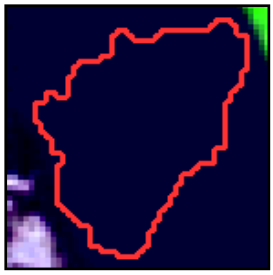
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Waterbody	1		
	2		
	3		
	4		
	5		

Figure 7.9 Training area of a waterbody.

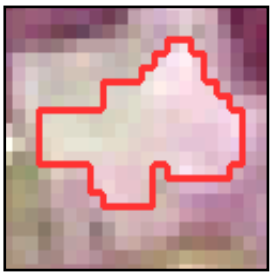
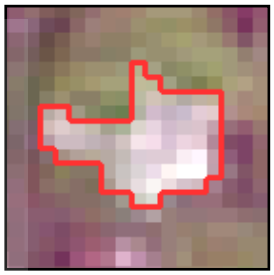
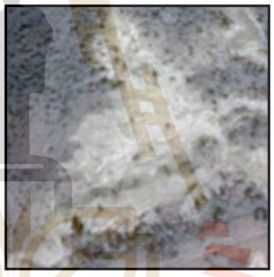
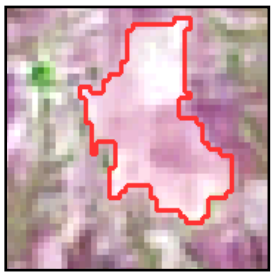
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Bare land	1		
	2		
	3		
	4		
	5		

Figure 7.10 Training area of bare land.

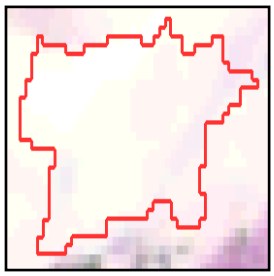
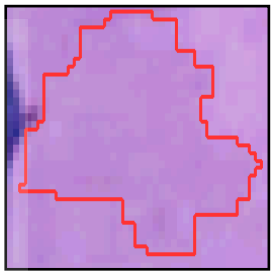
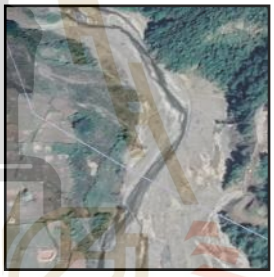
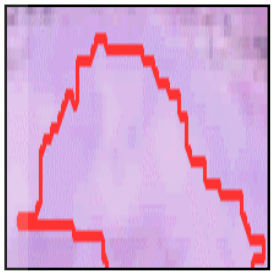
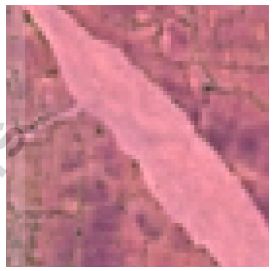
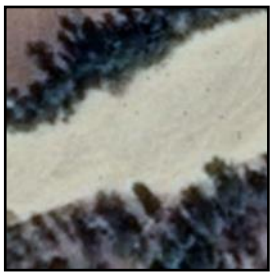
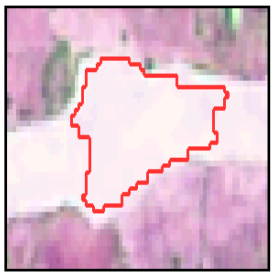
LULC type	Training area	Google image in 2014	Pan-sharpened image in 2014 by HPF
Sand bar	1		
	2		
	3		
	4		
	5		

Figure7.11 Training area of a sand bar.

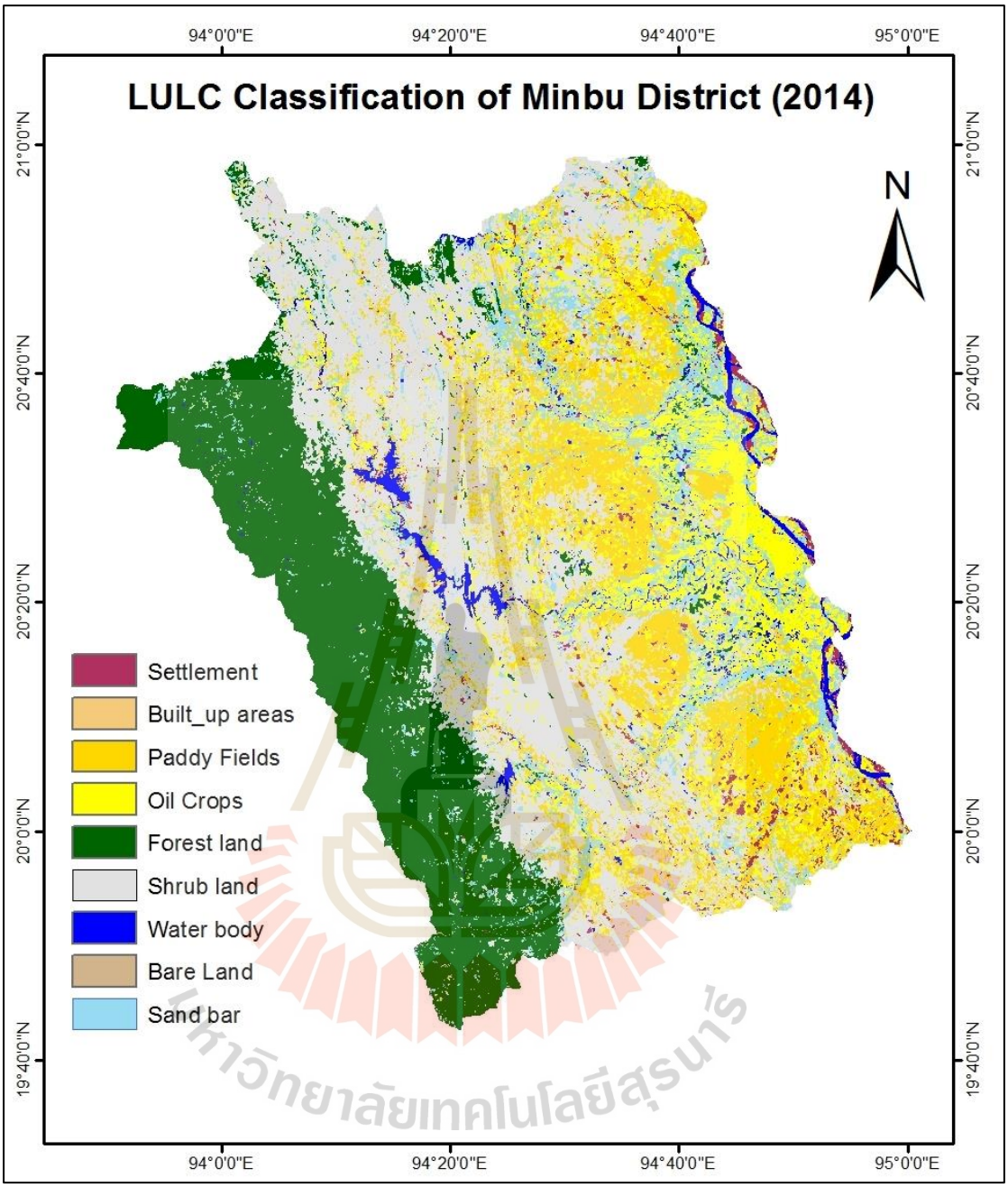


Figure 7.12 LULC map for Minbu district in 2014.

Table 7.2 Area and percentage of land use and land cover area for Minbu district in 2014.

No.	LULC Class	Sq Km^2	Percent
1	Settlement	189.13	2.03
2	Built-up area	99.89	1.07
3	Paddy field	1,457.28	15.65
4	Oil crop	1,284.52	13.79
5	Forest land	2,051.40	22.02
6	Shrubland	3,025.68	32.48
7	Waterbody	206.46	2.22
8	Bare land	45.98	0.49
9	Sand bar	954.13	10.24
	Total	**9,314.46**	**100.00**

As a result, the top three dominant LULC types are shrubland, forest land, and paddy field and cover area of 3,025.68 (32.48%), 2,051.40 (22.02%) and 1,457.28 (15.65%), respectively. In the meantime, the settlement area is 189.13 sq. km^2 or 2.03% of the study area. The settlement areas of Minbu district are relatively low, and they randomly scatter as small villages in the area.

7.3 Accuracy assessment of LULC classification

The sample size for accuracy assessment was also estimated based on the multinomial distribution theory using Equation 5.1, and they were allocated using the stratified random sampling method. In the case of the Minbu district, 672 points were required for the thematic accuracy assessment. The spatial distribution of sampling points for accuracy assessment is displayed in Figure 7.13**.** The error matrix and accuracy assessment are reported in Table 7.3.

As a result, the overall accuracy and Kappa hat coefficient of the thematic LULC map of Minbu district in 2014 are 85.98% and 83.21%, respectively.

Meanwhile, the producer's accuracy varies between 72.22% for settlement areas and 100% for bare land, whereas the user's accuracy varies between 80.00% for bare land and 97.26% for the forest land.

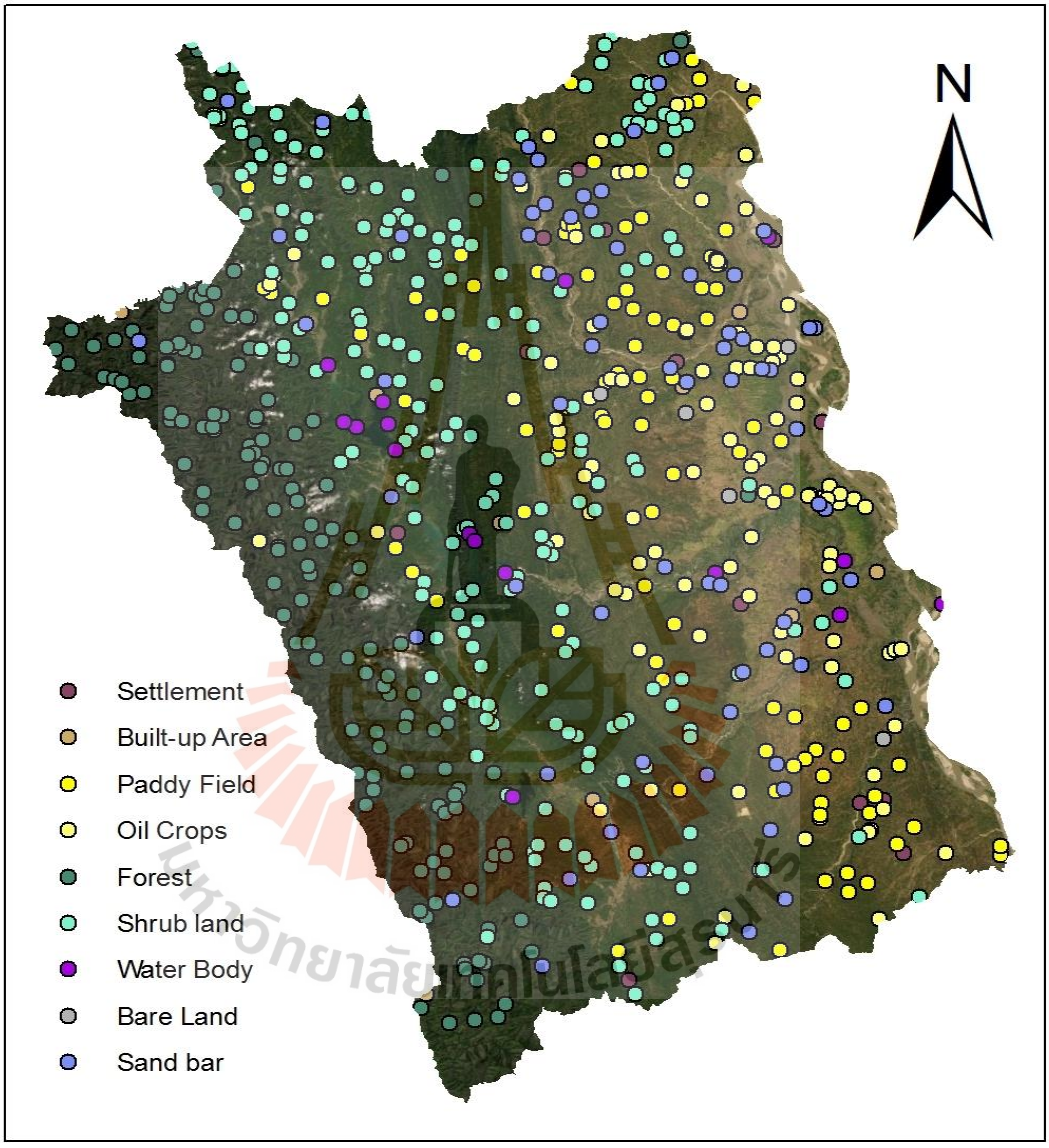


Figure 7.13 Spatial distribution of sampling points for accuracy assessment of Minbu LULC map in 2014

Table7.3 Error matrix and accuracy assessment of LULC in 2014.

Classified LULC data in 2014		Ground reference data from Google Earth in 2014									Total
	LULC type	SE	BU	PF	OC	FL	SL	WB	BL	SL	
	Settlement (SE)	**13**		1	1						**15**
	Built-up areas (BU)	1	**8**								**9**
	Paddy field (PF)			**101**	1	1	1			1	**105**
	Oil crop (OC)		1	1	**88**	1	1				**92**
	Forest land (FL)	1		1	1	**142**				1	**146**
	Shrubland (SL)	2	2	1	1	4	**203**	1		1	**215**
	Waterbody (WB)				1			**14**		1	**16**
	Bare land (BL)						1		**4**		**5**
	Sand bar (SB)	1		1	1			1		**65**	**69**
Total		**18**	**11**	**106**	**94**	**148**	**206**	**16**	**4**	**69**	**672**
Producer's accuracy		**72.22**	**72.73**	**95.28**	**93.62**	**95.95**	**98.54**	**87.50**	**100.00**	**94.20**	
User's accuracy		**86.67**	**88.89**	**96.19**	**95.65**	**97.26**	**94.42**	**87.50**	**80.00**	**94.20**	
Overall accuracy		**85.98**									
Kappa hat coefficient		**83.21**									

As a result, the overall accuracy of the LULC map in 2014 of Minbu district more than 85% can provide an acceptable result, as suggested by Anderson et al. (1976). Based on Fitzpatrick-Lins (1981), the Kappa hat coefficient of more than 80 percent represents strong agreement or accuracy between the classified map and the reference map. However, the derived values for thematic accuracy of Minbu district are lower than Magway district with an overall accuracy of 92.86% and Kappa hat coefficient of 90.85%.

7.4 Populated and unpopulated zone extraction

For population estimation with the binary dasymetric method, each census block's populated areas were extracted by overlay analysis between census block boundary and sediment areas. As a result, the populated area in Minbu district is 189.15 km2 or 2.03% of the total area (9,314.46 km^2). Details of the populated area in each census block are presented in Table 4 in Appendix A. The classification of the populated and unpopulated areas in the Minbu district is displayed in Figure 7.14.

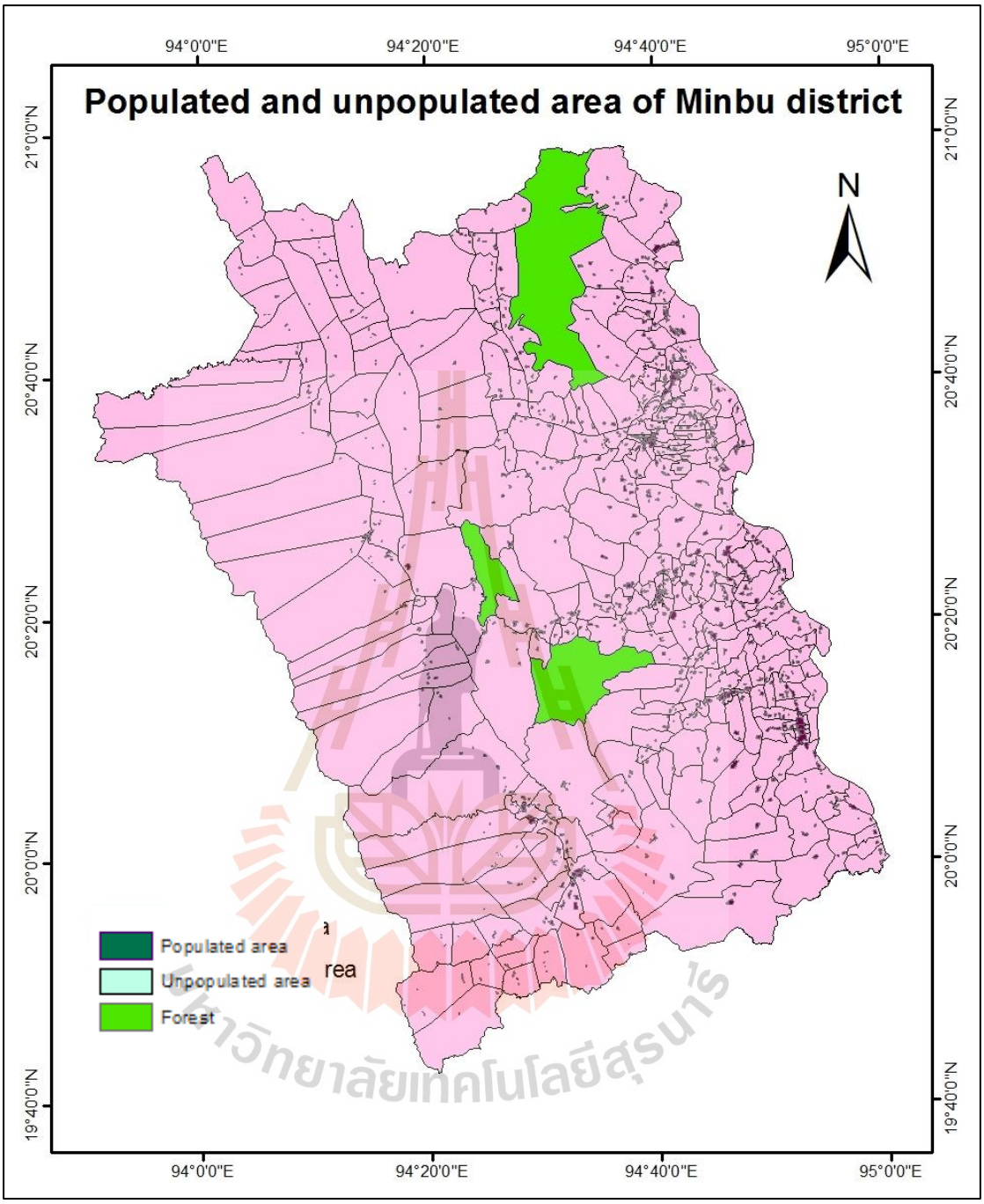


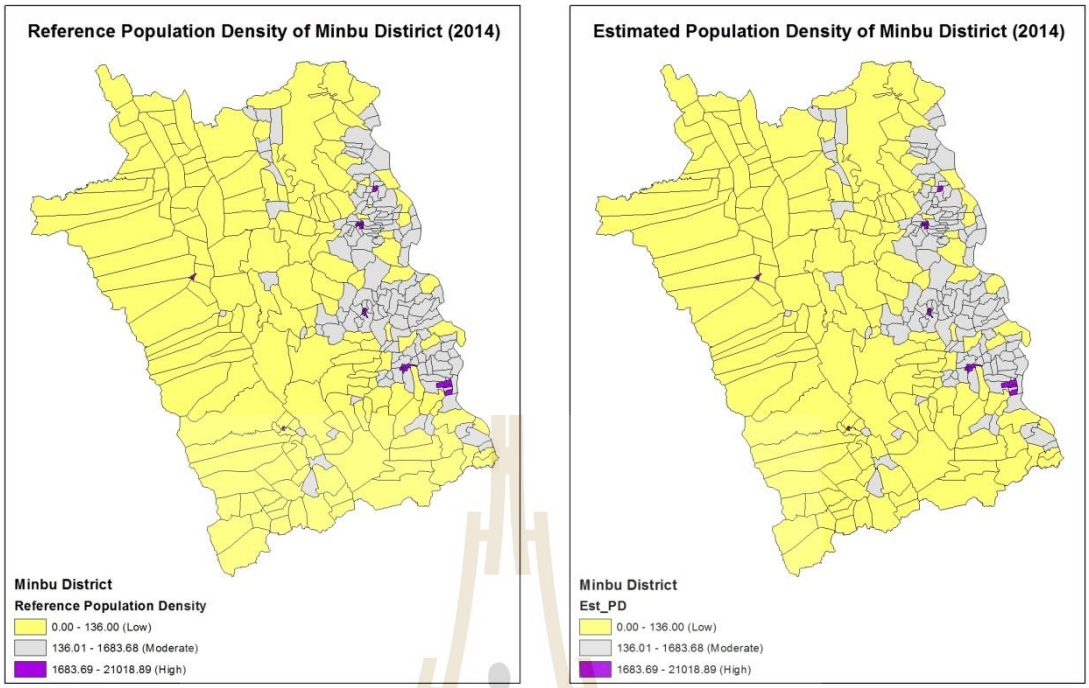
Figure 7.14 Populated area and unpopulated area in 2014 of Minbu District.

7.5 Estimation of the population with the binary dasymetric method

For population estimation with the binary dasymetric method, the net populated area was first estimated using Equation 3.15, and the average population density was calculated using Equation 3.16. Then, the number of populations was estimated using Equation 3.17. The detailed population estimation steps and the result are reported below.

Populated area of Minbu District (km^2)	189.13
Sum product between settlement area in each census with 0.005	0.94563
Net populated area (189.13 - 0.94563)	188.18
Average population density (322 Census Blocks)	3,603.02
Estimated Population (188.18 * 3,603.02)	678,016.30
The total population of Minbu District (2014 Census)	688,098

As a result, the estimated population of the Minbu district in 2014 using the binary dasymetric method is about 678,016 persons, while the reference population of the 2014 Census data in Minbu district is 688,098 persons. The result indicates an underestimation of 10,082 persons. The reference and an estimated population in each census block of Minbu district using the binary dasymetric method in detail are reported in Table 5 in Appendix A. The estimated population density classification of the Minbu district in 2014 using the binary dasymetric method is compared with a population density of 2014 Census data in Figure 7.15.



(a) (b)

Figure 7.15 Spatial distribution of population density classification of Minbu district in 2014: (a) Reference population density from 2014 Census data and (b) Estimated population density from the binary dasymetric method.

7.6 Accuracy Assessment

The estimated population using the binary dasymetric method of Minbu district in 2014 was about 678,016 persons. Meanwhile, the actual population from the 2014 Census data of Minbu district was 688,098 persons. The difference between the actual and estimated Minbu district population in 2014 is 10,082 persons. This finding shows an underestimate result. The relative error is 1.46%.

Besides, the accuracy assessment of model validation for the Minbu district was conducted by the overall relative errors (RE) and overall absolute errors (AE) from each census block's population density. It was discovered that the RE is 46.01% and the AE is 714.86 persons**.** It can be observed that both AE and RE in the

Minbu district are higher than the Magway district because the characteristics of LULC in the two districts are different**.** Area about 55% of Minbu district cover by forest land and shrubland in the Rakhine hill range, while only about 27% of Magway district cover by forest land and shrubland**.** Additionally, the settlement with about 189 km^2 is dispersedly scattered as a small village over Minbu district while clustered settlements are found in Magway district.

Comparison of accuracy assessment for population estimation in 2014 using a binary dasymetric method in Magway district as study area and Minbu district as the testing area is presented in Table 7.4. The result revealed that estimating the population in both districts is underestimated, relative errors are low, and the RE and AE are slightly different. As all processing and results, the binary dasymetric method as an optimum method for population estimation in the Magway district can be validated to estimate the Minbu district population for model validation.

Table 7.4 Comparison of accuracy assessment for population estimation in 2014 using a binary dasymetric method in Magway and Minbu districts.

Accuracy Assessment	**Magway district**	**Minbu district**
1. Residual value	(+) 3,096	(+)10,082
2. Relative error (%)	0.25	1.46
3. RE (%)	21.14	46.01
4. AE (Persons)	577.57	714.86

CHAPTER VIII

CONCLUSION AND RECOMMENDATION

Population projection deals with computations of future projection size and characteristics based on assumptions about future trends in fertility, mortality, and migration. Obtaining reliable population numbers estimates is essential for policy-making, urban planning, and administration, both at the regional and local scale. This research aims to produce an optimum model for population estimation. Specific research objectives are (1) to estimate population using the statistical modeling method, (2) to estimate population using the areal interpolation method, (3) to access accuracy and to identify an optimum method for population estimation; and (4) to validate an optimum method for population estimation in the test area. To achieve goals and objectives, the statistical modeling and areal interpolation (binary dasymetric and areal weighting) methods were first examined to identify an optimum method for population estimation in Magway District, Magway Region, Myanmar. The identified optimum method for population estimation was then applied to validate the model in the Minbu district of the Magway Region. The conclusions and recommendations of the study are presented in this chapter.

8.1 Conclusions

8.1.1 Population estimation using statistical modeling

The statistical modeling for population estimation is the important one for the population estimation process. In this study, 60% of census blocks from simple and stratified random sampling methods were selected for multiple linear regression analysis and non-selected census block samples (40%) were applied for accuracy assessment. In practice, population density and its transformation of 2014 Magway District from Myanmar Population and Housing Census data by two sampling methods, as the dependent variable, and the significant spectral reflectance and indices from Landsat 8 OLI data in 2014, as independent variables were separately examined using stepwise regression analysis under SPSS software. Finally, the optimum statistical model was identified based on the derived correlation coefficient (R), coefficient of determination (R^2) and adjusted R^2 values.

The optimum statistical model for population estimation under the statistical modeling method was the natural logarithm of population density derived from the stratified random samplings by moderate and high population density. The model could provide the R, R^2 and the adjusted R^2 values of 0.860, 0.739 and 0.723, respectively. The optimum statistical model could explain the linear relationship between the natural logarithm of population density and significant predictors higher than 70%. The estimated population of Magway District in 2014 was 1,255,788 persons. The estimated result showed overestimation when it was compared with the 2014 Census data of 1,235,030 persons.

8.1.2 Population estimation with binary dasymetric method

The binary dasymetric method is the famous one for population estimation. The main objective of the binary dasymetric method is to classify the study area into two zones, populated and unpopulated zones**.** To achieve the populated area of the study area, the object-based image analysis was firstly conducted to classify LULC types from the optimum pan-sharpened image derived from the High Pass Filtering algorithm**.** After that, net populated area and average population density were calculated for population estimation.

As a result, the populated area of Magway district by standard nearest neighbor classification under the object-based image analysis was 263**.**08 km^2**.** The overall accuracy and Kappa hat coefficient of the thematic LULC map of Magway district in 2014 were 92.86% and 90.85%. Meanwhile, the estimated population of Magway District in 2014 was about 1,231,934 persons. The estimated result showed underestimation when it was compared with the 2014 Census data of 1,235,030 persons.

8.1.3 Population estimation with areal weighting method

The areal weighting method is a simple method and easy to estimate the population. Still, it cannot estimate each census block's population as statistical modeling and binary dasymetric method. Under the areal weighting method, the census blocks were classified into two types**:** blocked and unblocked areas**.** The population was estimated by multiplicating three key factors: average population density, area weight, and the total area of the study area.

As a result, the estimated population of Magway District in 2014 was 1,109,846 persons. The estimated result showed underestimation when it was compared with the 2014 Census data of 1,235,030 persons.

8.1.4 Accuracy assessment and the optimum method for population estimation

When the population of the study was estimated, the accuracy assessment was conducted for data consistency. The residual value, relative error, overall relative error and overall absolute error were calculated for three different estimation methods. They were then applied to identify an optimum method for population estimation.

As a result, the statistical modeling method with the optimum statistical model contributed the residual value (persons) of -20,758, relative error (%) of -1.68, overall relative error (%) of 56.44, and overall absolute error (persons) of 1,256.32. In the meantime, the binary dasymetric method contributed the residual value (persons) of 3,096, the relative error (%) of 0.25, the overall relative error (%) of 21.14, and overall absolute error (persons) of 577.57. Meanwhile, the areal weighting method contributed the residual value (persons) of 125,184 and the relative error (%) of 10.14.

According to the accuracy assessment of three different applied methods for Magway District, the optimum method for population estimation was the binary dasymetric method. It could provide the lowest residual, relative error, overall relative error and overall absolute error values than the statistical modeling method. Additionally, the binary dasymetric method can be applied to estimate the population density and population number in each census block, like the statistical modeling method.

8.1.6 Validation of an optimum method for population estimation

The optimum method for population estimation, the binary dasymetric method, was further applied for model validation in Minbu district, Magway Region. As a result, the populated area of Minbu District by standard nearest neighbor classification was 189.13 km^2. Meanwhile, the estimated population of Minbu District in 2014 was about 678,016 persons. The estimated result showed underestimation compared with the 2014 Census data of Minbu District with 1,235,030 persons. Additionally, the applied binary dasymetric method contributed the residual value (persons) of 10,082, the relative error (%) of 1.4, the overall relative error (%) of 46.01, and overall absolute error (persons) of 714.86. Results of population estimation in both districts were underestimated, relative errors were low, and values of overall relative error and overall absolute error were slightly different.

As a result, the binary dasymetric method as an optimum method for population estimation in the Magway district can be validated to estimate the Minbu district population for model validation.

8.2 Recommendations

Population estimation was examined in Magway District using statistical modeling and areal interpolation methods. The optimum method for population estimation, a binary dasymetric method, was applied in Minbu District for model validation. The possible expected recommendations and implications could be made for further studies below.

1. Free downloaded high spatial resolution images, such as Sentinel-2 data with 10 m spatial resolution (red, green, blue and NIR bands), can be directly applied

to classify LULC type without pan-sharpening operation for population estimation by binary dasymetric method. This recommendation can reduce the time for population estimation because the spatial resolution of Sentinel-2 data is better than Landsat pan-sharpening images.

2. Statistical modeling method with stepwise regression analysis can be applied to estimate populations when supporting data is unavailable for LULC classification. Because independent variables can be quickly extracted from remotely sensed data and the number of census blocks sample as the dependent variable are adjustable as recommended by Wu, Qiu, and Wang (2005).

3. To apply the most suitable statistics for population estimation in Myanmar, the derived suitable statistical model should be examined the effect of the spatio-temporal change of remote sensing data because only a single date with a limitation of data was applied in this study.

4. Additional independent variables, which are related to settlement, such as terrain, river, and road network, should be considered for population estimation because the significant derived factors of the most suitable statistical model can explain the linear relationship with the square of population density of about 72% as suggested by Wu, Qiu, and Wang (2005).

5. Under the binary dasymetric method, the net populated area was extracted by subtracting populated areas (settlement class) with the summation of multiplication of settlement area in each census block from n blocks with multiplicative scaling factors. In this study, a multiplicative scaling factor with the value of 0.005 was applied in Magway and Minbu districts. If the binary dasymetric method, as the optimum method for population estimation, will be applied in another district or

region, the suitable multiplicative scaling factors should be consulted with local experts.

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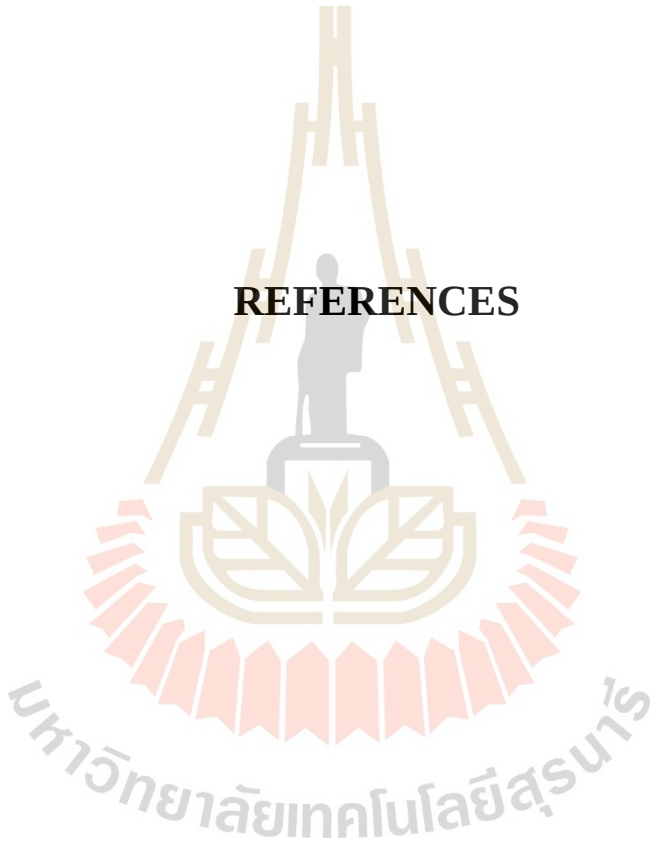

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APPENDIX

Table 1 Details of the references and estimated population data of each census blocks using the optimum statistical model

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
1	Sar Lel	32.67	4176	127.84	4.85	79.32	116.07	150.71	120.99	196.78	85.62	24.61	5.744	0.89
2	Kyauk Ye	26.81	1945	72.55	4.28	79.73	110.08	149.48	123.89	184.51	77.30	32.19	5.752	1.47
3	Myay Sun	23.02	3195	138.77	4.93	77.68	134.60	149.26	168.18	184.20	56.72	19.29	4.608	0.32
4	Kyaung Yar Taw	17.99	2649	147.24	4.99	77.46	143.43	149.94	169.03	162.27	55.03	25.67	4.086	0.91
5	Than Bo	20.83	6089	292.29	5.68	77.75	147.58	149.18	172.86	159.04	46.51	20.60	3.989	1.69
6	Poke Pa Kan	56.09	4336	77.31	4.35	77.03	132.89	150.31	160.05	198.20	66.65	22.16	4.840	0.49
7	Taung Ba Lu	18.97	1719	90.63	4.51	80.33	117.14	148.71	127.79	182.88	77.72	36.29	5.641	1.13
8	Gway Pin Ywar Thit	23.84	4978	208.80	5.34	77.46	148.30	148.04	187.80	179.04	46.63	24.47	4.114	1.23
9	Swei Pauk Kan	15.52	2756	177.61	5.18	78.17	145.71	148.66	176.05	193.83	57.48	28.61	4.677	0.50
10	Wa Thea San	11.67	2012	172.37	5.15	76.57	138.80	149.09	182.04	198.37	67.77	34.34	4.385	0.76
11	Nyaung Zin	24.35	1175	48.26	3.88	76.49	130.42	151.19	159.27	190.82	65.37	22.70	4.733	0.86
12	Nyaung Chaung	10.43	2840	272.23	5.61	81.06	132.87	149.07	141.80	182.59	78.23	37.19	5.420	0.19
13	Sa Lin Taung	18.51	4930	266.35	5.58	81.39	132.83	148.03	147.05	185.79	76.86	29.96	5.345	0.24
14	Lay Pin Kone	23.99	2585	107.78	4.68	79.86	139.19	148.10	162.40	188.19	69.19	23.27	4.856	0.18
15	Su Yit Kan	20.86	2876	137.88	4.93	81.19	151.72	147.45	185.48	176.13	51.20	22.22	4.700	0.23
16	Ywar Ma	12.61	1585	125.68	4.83	78.25	137.66	149.48	171.69	179.14	64.26	26.71	4.504	0.33
17	Pa Khan Nge	30.69	6161	200.73	5.30	79.87	122.11	152.33	105.23	191.11	102.74	44.84	5.874	0.57
18	Taung Thar	18.76	2213	117.98	4.77	80.33	142.16	147.48	179.32	163.19	44.06	14.92	4.508	0.26
19	Myay Pa Don	19.92	2741	137.57	4.92	79.85	138.61	147.51	180.78	194.42	71.07	22.44	4.705	0.22
20	Na Ywe Taw	16.45	2362	143.57	4.97	78.07	131.97	149.02	170.32	202.65	80.69	24.55	4.707	0.26
21	Se Kan	8.30	1064	128.23	4.85	77.03	136.80	149.33	176.85	207.33	87.44	38.35	4.475	0.38
22	Gway Pin Gyi	13.84	2017	145.73	4.98	78.71	142.11	147.69	180.97	195.55	63.48	24.68	4.589	0.39
23	Lin Ta Kaing	8.79	1005	114.32	4.74	77.63	140.46	148.55	178.23	197.44	76.63	32.32	4.368	0.37

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
24	Zee Pwar	8.97	2683	299.00	5.70	79.22	137.99	149.49	150.53	215.70	75.77	31.58	5.574	0.13
25	Ma Gyi Kan	8.09	1876	231.86	5.45	79.34	148.36	147.92	180.09	198.76	58.89	34.51	4.924	0.52
26	Aw Zar Taw	14.12	2031	143.86	4.97	78.08	139.77	148.88	175.45	186.37	59.09	25.37	4.564	0.41
27	Sar Taung	11.15	2169	194.52	5.27	79.92	142.41	148.41	163.39	202.79	78.64	48.70	5.257	0.01
28	Kywe Tat	14.36	1706	118.76	4.78	78.48	141.80	147.99	180.55	193.30	75.94	33.93	4.394	0.38
29	Thit To Kan	23.00	3145	136.71	4.92	78.61	133.40	148.81	172.22	202.92	74.93	23.74	4.871	0.05
30	Htein San	25.91	2358	91.01	4.51	79.19	130.89	147.99	172.66	202.36	68.12	18.13	5.008	0.50
31	Tha Lone Thway	13.70	2389	174.34	5.16	79.83	137.65	147.91	171.75	200.49	63.74	23.03	5.133	0.03
32	Gway Cho	26.04	4196	161.14	5.08	78.79	130.19	150.40	146.60	199.99	68.77	22.32	5.440	0.36
33	Pan Be	6.84	1313	191.90	5.26	79.13	131.85	148.83	163.08	204.32	60.04	21.75	5.403	0.15
34	Kyauk Tan	35.87	1738	48.46	3.88	79.38	121.71	149.28	152.62	202.81	64.35	15.26	5.612	1.73
35	U Yin	15.15	2679	176.80	5.18	81.41	112.54	148.98	114.48	176.92	103.78	44.84	5.605	0.43
36	Let Pan Kyun	29.17	2771	95.01	4.55	82.47	109.89	145.23	106.43	142.02	100.38	40.29	4.805	0.25
37	Nyee Su	6.22	1671	268.76	5.59	79.64	138.45	151.08	141.90	175.15	63.29	30.78	5.263	0.33
38	Ya Thit	16.78	3159	188.21	5.24	80.05	144.63	150.46	151.53	168.95	63.48	28.53	4.917	0.32
39	Zaung Taw Kan	26.43	3236	122.44	4.81	80.32	145.21	149.31	161.32	162.73	61.51	22.15	4.572	0.24
40	Ma Gyi Kone	17.59	1870	106.32	4.67	79.71	136.16	147.44	176.42	175.39	59.64	13.88	4.458	0.21
41	Chaung Tet	29.60	2894	97.76	4.58	79.68	132.90	148.11	170.48	177.54	52.02	14.01	4.836	0.25
42	Sa Lay	10.91	6695	613.92	6.42	78.86	115.10	156.27	62.10	207.79	110.73	47.43	6.883	0.46
43	Yae Twin	33.53	2603	77.63	4.35	80.61	108.73	149.75	119.50	147.15	60.51	29.51	5.522	1.17
44	Twin Lat	18.65	2624	140.70	4.95	79.48	131.89	148.54	163.75	196.83	64.15	18.63	5.168	0.22
45	Kyoet Pin	17.81	2144	120.38	4.79	79.40	130.14	148.41	167.30	189.59	65.38	16.54	4.926	0.14
46	Htein Kan	25.81	4094	158.63	5.07	79.79	128.01	148.49	163.81	188.03	60.31	15.67	5.152	0.08

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
47	Thway Net	30.56	2959	96.84	4.57	80.35	125.50	149.13	122.34	181.76	56.88	14.45	5.727	1.15
48	Byi Pin	20.29	1742	85.86	4.45	80.17	125.70	148.94	146.74	192.29	50.25	14.38	5.773	1.32
49	Ohn Hmyar Gyi	14.96	1584	105.88	4.66	81.33	128.90	149.25	110.46	168.00	39.69	12.17	6.024	1.36
50	Pa Day Thar	2.36	1733	733.92	6.60	79.84	118.89	154.86	42.34	246.51	161.66	61.61	7.121	0.52
51	Dat Myay Aww Zwar	4.87	2642	542.14	6.30	79.58	79.78	153.58	37.13	178.75	118.88	50.26	6.872	0.58
52	No (3) Ward	0.30	992	3310.17	8.10	78.84	111.84	162.42	0.00	251.66	142.90	21.18	8.312	0.21
53	No (2) Ward	0.63	1149	1833.56	7.51	80.59	35.27	151.25	0.42	101.78	75.95	18.38	6.784	0.73
54	No (1) Ward	6.32	2990	473.31	6.16	80.79	94.83	152.08	32.62	193.08	90.20	32.82	7.427	1.27
55	No (4) Ward	1.59	3023	1897.79	7.55	79.73	80.04	154.96	6.09	166.72	90.44	13.68	7.238	0.31
56	No (7) Ward	0.60	3111	5217.03	8.56	79.89	52.57	153.79	7.30	166.62	162.30	50.63	6.668	1.89
57	No (9) Ward	0.23	1611	6871.55	8.84	78.92	102.04	159.19	1.41	225.48	85.35	20.61	8.642	0.19
58	No (6) Ward	0.15	3189	21018.98	9.95	78.92	103.97	158.91	0.00	246.84	86.54	7.32	8.890	1.06
59	No (8) Ward	0.48	2665	5498.60	8.61	79.09	61.53	155.17	0.87	210.29	122.23	25.97	7.988	0.62
60	No (10) Ward	0.32	4830	15069.50	9.62	79.43	109.34	157.66	5.55	238.25	64.73	17.69	9.057	0.56
61	No (11) Ward	0.14	1467	10524.98	9.26	78.88	101.80	157.81	0.00	169.30	38.41	8.92	8.022	1.24
62	No (12) Ward	0.23	2026	8826.30	9.09	78.23	107.02	159.68	0.00	220.02	56.54	9.63	8.768	0.32
63	No (13) Ward	0.52	2384	4550.56	8.42	79.84	114.87	157.05	13.32	231.07	74.70	15.27	8.532	0.11
64	No (14) Ward	4.09	5049	1233.74	7.12	79.38	75.40	154.16	30.85	143.60	67.31	18.76	6.890	0.23
65	No (15) Ward	2.30	7035	3055.52	8.02	80.25	120.30	153.50	59.84	213.32	62.65	15.51	7.507	0.52
66	No (5) Ward	0.53	3555	6652.32	8.80	79.40	107.98	156.73	4.23	221.45	57.25	11.01	8.681	0.12
67	Thet Yin Taw	24.48	1226	50.08	3.91	79.37	133.93	150.41	176.29	226.16	95.52	27.38	5.334	1.42
68	Lint Myint	52.76	3797	71.97	4.28	80.10	138.86	150.64	176.32	229.79	102.61	28.97	5.405	1.13
69	Kyar Kan	70.57	7295	103.37	4.64	81.83	154.78	151.67	187.46	231.06	134.41	56.39	5.248	0.61

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
70	Gyoe Gyar Kan	20.78	1989	95.72	4.56	80.94	146.92	151.64	181.81	237.21	122.62	42.14	5.440	0.88
71	Hpoe Lay lone	31.09	3742	120.38	4.79	79.68	141.57	151.43	179.41	225.29	117.08	28.93	4.943	0.15
72	Nyaung Kan	35.31	4041	114.46	4.74	79.39	138.52	151.22	176.77	232.10	107.19	29.10	5.272	0.53
73	Kyit Son Pway	41.38	4279	103.41	4.64	78.24	142.21	155.64	170.30	203.44	90.76	35.01	5.245	0.61
74	Aing Gyi Kone	32.09	3342	104.16	4.65	80.39	152.21	153.40	185.39	223.45	115.72	30.69	5.079	0.43
75	Let Pu To	14.11	794	56.27	4.03	77.99	122.98	148.62	170.34	228.03	113.23	28.17	4.785	0.75
76	Ohn Twe	49.82	3308	66.39	4.20	76.87	113.95	151.58	163.15	203.36	69.74	17.98	5.261	1.07
77	Yin Nar Gwe Chaung	18.59	1112	59.81	4.09	76.51	114.19	150.08	162.86	227.69	81.46	12.26	5.259	1.17
78	Lel Yar	27.41	3075	112.17	4.72	76.54	127.74	150.14	173.44	235.49	113.18	21.80	4.597	0.12
79	Pay Pin San	103.95	5458	52.51	3.96	75.98	124.43	151.07	170.06	228.38	91.96	23.91	4.934	0.97
80	Myin Saing	28.73	2549	88.72	4.49	77.96	141.08	152.38	178.04	234.93	133.84	6.68	4.320	0.17
81	Yin Thar Si	20.04	3764	187.87	5.24	78.44	142.65	150.40	180.51	234.14	123.91	0.00	4.254	0.98
82	Thit Yar Kauk	40.45	4994	123.47	4.82	77.71	143.33	151.59	179.47	226.32	109.84	0.00	4.312	0.50
83	Lat Pa Taw	14.31	1787	124.87	4.83	78.31	136.91	151.22	176.49	247.54	141.32	0.00	4.423	0.40
84	Ywar Thar	41.88	1985	47.40	3.86	78.63	136.63	151.11	178.14	251.63	152.76	0.00	4.348	0.49
85	Ngar Saung	35.50	3765	106.06	4.66	77.78	139.36	149.28	177.84	226.32	105.68	0.00	4.236	0.43
86	Ah Lel Bo	65.26	5146	78.85	4.37	77.18	133.58	149.79	174.97	231.26	119.99	0.00	4.122	0.25
87	San Ma Gyi	41.19	3023	73.40	4.30	76.19	128.39	154.52	168.65	237.89	150.22	0.00	4.151	0.14
88	Min	62.26	3834	61.58	4.12	75.77	111.52	152.79	161.59	238.92	112.81	8.69	5.063	0.94
89	Taung Khwin	29.45	2886	98.00	4.58	78.29	111.52	153.34	162.73	223.30	111.63	31.32	5.627	1.04
90	Kan Taw	20.86	2254	108.03	4.68	76.69	120.01	147.70	166.84	244.08	101.95	13.35	4.874	0.19
91	Mi Kyaung Ye	13.48	4103	304.36	5.72	77.33	102.60	156.22	156.48	220.75	102.52	20.47	5.947	0.23
92	Su Pyit San	38.09	1648	43.26	3.77	76.46	134.09	153.22	173.45	227.52	117.19	5.24	4.377	0.61

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
93	Kun Ohn	43.54	1518	34.87	3.55	75.94	118.69	149.13	165.87	237.96	91.61	19.44	5.021	1.47
94	Pa Hta Na Go	33.25	4568	137.39	4.92	76.69	105.65	152.16	162.28	226.12	99.32	26.57	5.476	0.55
95	Hpa Yar Kone	22.42	2027	90.41	4.50	78.56	110.23	149.36	165.87	229.18	93.09	24.76	5.646	1.14
96	Myit Thar Si	30.31	1753	57.83	4.06	78.77	125.41	149.42	172.80	222.29	95.57	25.71	5.169	1.11
97	Shar Saung Kan	25.12	2827	112.53	4.72	80.16	143.16	148.34	186.08	214.35	107.91	40.60	4.673	0.05
98	Myay Nu	9.29	845	90.92	4.51	81.84	92.49	147.42	145.09	166.54	104.73	45.53	5.344	0.83
99	Pu Htoe	13.42	1582	117.85	4.77	81.44	110.12	145.17	156.41	188.67	104.98	36.87	4.955	0.19
100	Kyun Pyat	12.47	2378	190.71	5.25	80.55	104.82	148.55	151.53	194.22	122.03	43.64	5.144	0.11
101	Tat Kone	22.64	2062	91.09	4.51	79.94	135.63	150.64	172.89	210.28	93.24	43.69	5.371	0.86
102	Tha Yet Lay Pin	24.98	3454	138.27	4.93	80.05	131.78	149.71	174.18	206.67	67.42	33.38	5.645	0.72
103	Zee Kyun	12.63	1070	84.70	4.44	79.16	138.47	152.40	169.54	221.69	104.42	37.95	5.343	0.90
104	Hpoke Kone	14.95	2080	139.15	4.94	79.27	145.40	154.43	169.97	230.22	118.73	55.91	5.580	0.64
105	Shar Pin Hla	19.68	2113	107.34	4.68	79.06	134.92	152.90	169.91	222.55	93.15	41.51	5.710	1.03
106	Su Kauk san	20.38	1882	92.36	4.53	78.50	135.84	151.87	174.47	207.11	90.50	26.26	4.945	0.42
107	Tha Pyay San	29.23	2016	68.96	4.23	81.11	162.22	148.12	192.25	211.68	86.52	38.85	4.792	0.56
108	Hpa Yar Pyo	33.33	3120	93.60	4.54	81.02	161.40	148.14	189.05	215.38	85.83	37.05	4.895	0.36
109	Nyaung Pin	28.90	2196	75.98	4.33	79.43	152.33	148.21	181.71	220.97	110.41	42.08	4.482	0.15
110	Kan Pyar	11.36	4763	419.20	6.04	80.72	162.31	147.56	191.44	229.89	112.51	50.67	4.684	1.35
111	Nat Kan	10.79	2177	201.81	5.31	79.82	156.90	147.46	192.90	227.59	114.35	39.34	4.335	0.97
112	Ta Pauk Taw	25.36	5508	217.23	5.38	79.28	130.10	149.46	156.29	215.55	93.38	33.45	5.352	0.03
113	Tha Man Taw	10.29	1980	192.39	5.26	78.16	136.26	154.39	109.28	232.80	135.90	65.81	5.932	0.67
114	Kayin	12.69	2080	163.95	5.10	80.95	143.92	148.17	133.60	202.83	102.17	41.33	5.213	0.11
115	Ma Gyi Chay Htauk	40.00	3027	75.67	4.33	80.11	120.75	147.71	141.14	193.47	90.34	32.76	5.232	0.91

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
116	Ywar Haung Kan	30.00	2582	86.06	4.46	79.13	148.22	147.80	185.79	210.66	94.57	31.25	4.356	0.10
117	Kan Thar Gyi	17.74	2281	128.61	4.86	79.03	152.56	148.66	184.64	210.65	104.68	38.51	4.248	0.61
118	Tei Pin Kan Pauk	37.08	2238	60.36	4.10	78.63	145.75	149.45	175.45	201.77	76.56	29.25	4.696	0.60
119	In Taing Gyi	42.03	4361	103.76	4.64	79.31	144.64	147.65	174.47	214.12	98.14	32.96	4.584	0.06
120	Gyoke Kone	35.64	3305	92.75	4.53	79.92	141.99	148.85	174.89	227.99	108.81	30.99	4.986	0.46
121	Da Hat Kan	7.58	1777	234.44	5.46	80.05	155.30	148.34	187.41	233.75	111.50	53.63	4.918	0.54
122	Sar Taing Kan	15.65	6921	442.10	6.09	80.02	154.32	148.32	187.30	215.54	91.26	36.28	4.721	1.37
123	Ma Gyi Kan	14.41	6706	465.53	6.14	78.41	132.75	150.20	170.45	230.84	105.32	33.27	5.151	0.99
124	May Hla Taung	19.95	5093	255.33	5.54	80.07	113.00	149.77	156.49	215.43	120.47	46.34	5.498	0.04
125	Nan Kat Kyun	16.20	11889	734.00	6.60	79.00	114.64	151.69	101.18	197.37	101.21	36.03	5.844	0.75
126	Bon	1.74	1408	806.97	6.69	77.71	110.02	157.69	40.19	216.14	127.10	51.73	7.004	0.31
127	Myo Haung	1.54	4688	3049.13	8.02	80.07	101.80	152.20	71.50	160.64	100.38	52.01	6.062	1.96
128	Oe Bo Myo Ma	2.99	1406	469.86	6.15	77.63	76.38	156.12	10.17	190.30	136.59	42.18	6.862	0.71
129	Zel Lel Zoe	1.99	1643	825.60	6.72	78.35	55.63	152.38	21.67	169.61	127.54	54.16	6.717	0.00
130	Sar Shwe Kin	3.19	5953	1864.90	7.53	79.98	69.06	151.25	47.83	177.31	135.66	74.10	6.701	0.83
131	Min Kan Gyi	3.83	10419	2717.33	7.91	76.06	126.98	163.03	105.38	243.25	109.02	43.72	7.116	0.79
132	Aung Myit Thar	5.89	10793	1833.97	7.51	78.08	109.63	153.41	114.36	217.19	106.32	53.06	6.309	1.21
133	Aung Min Galar	1.56	8290	5327.32	8.58	76.51	124.47	158.43	134.27	242.03	93.83	29.26	6.563	2.02
134	Thein Gar Gi Ri	1.46	9560	6565.44	8.79	76.35	126.85	161.65	39.69	248.86	101.37	39.98	7.914	0.88
135	Pyi Taw Tar	0.79	5602	7058.96	8.86	75.38	119.71	173.41	7.34	247.11	124.23	24.59	8.816	0.05
136	Kan Thar	0.99	7409	7506.20	8.92	76.64	115.36	162.11	4.38	247.12	100.61	20.60	8.355	0.57
137	Aung Chan Thar	1.21	6280	5179.66	8.55	77.58	122.33	156.37	106.45	244.79	105.37	29.35	6.739	1.81
138	Aung Ya Danar	1.80	8036	4474.25	8.41	77.98	128.19	156.26	104.29	249.06	108.64	36.86	6.851	1.55

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
139	Myin Thar	1.10	6332	5745.60	8.66	76.45	127.20	157.89	89.01	247.05	149.82	55.30	6.226	2.43
140	Nyaung Kyat San	7.02	610	86.89	4.46	76.24	139.45	156.01	175.15	228.51	121.05	20.23	4.637	0.17
141	Ywar Thit Pwe Kyo	0.41	6219	15280.66	9.63	75.47	113.34	167.73	1.84	244.83	113.69	22.54	8.499	1.13
142	Myin Kun	20.93	5224	249.56	5.52	80.07	117.11	149.29	166.07	215.76	111.03	44.11	5.438	0.08
143	Ma Nawt Kone	11.37	987	86.81	4.46	79.23	141.57	148.70	181.00	220.89	113.54	41.08	4.621	0.16
144	Nwar Hla	23.73	2954	124.48	4.82	79.94	143.48	150.48	181.20	223.71	121.14	32.35	4.768	0.06
145	Sit Ta Lin	29.52	3640	123.32	4.81	77.47	129.70	153.91	171.51	228.43	106.79	0.00	4.946	0.13
146	War Gyi Aing	14.58	3736	256.24	5.55	79.25	145.23	150.01	184.67	212.54	96.27	6.06	4.429	1.12
147	Lay Taing Sin	60.71	8740	143.96	4.97	81.16	151.48	150.72	185.80	239.74	143.78	54.52	5.055	0.09
148	Yone Taw	39.74	1911	48.09	3.87	80.93	155.13	148.13	190.50	231.64	136.04	12.85	4.109	0.24
149	Se Lel	63.81	4348	68.14	4.22	78.78	133.18	151.37	176.82	236.06	106.54	0.00	5.023	0.80
150	Gway Cho	13.03	2142	164.35	5.10	79.59	140.05	148.95	181.25	228.83	105.16	0.00	4.637	0.47
151	Htauk Shar Tan	44.05	3792	86.09	4.46	79.53	135.96	148.56	179.53	240.86	112.69	0.00	4.794	0.34
152	Yae Pyayt	77.33	4666	60.34	4.10	79.98	141.96	151.74	179.05	242.35	146.74	11.32	4.662	0.56
153	Tei Pin San	16.60	1923	115.81	4.75	80.66	144.98	151.36	181.17	238.48	148.84	0.00	4.451	0.30
154	Tha Hpan Kone	10.43	1608	154.13	5.04	79.10	133.80	152.77	171.58	245.84	153.13	0.00	4.623	0.41
155	Pay Kone	17.51	2138	122.10	4.80	79.43	142.21	152.77	178.70	237.29	131.40	0.00	4.703	0.10
156	Nin Kyan	30.85	3752	121.62	4.80	79.44	130.81	151.70	173.38	232.54	102.87	0.00	5.283	0.48
157	Gway Kone	9.40	2128	226.36	5.42	76.41	128.80	162.62	162.13	214.02	73.63	0.00	6.099	0.68
158	Na Be Kone	7.73	1703	220.28	5.39	77.20	124.12	153.16	165.36	222.56	79.91	0.00	5.343	0.05
159	Lin Lei	25.91	2893	111.65	4.72	79.10	134.03	152.89	173.17	239.73	117.46	0.00	5.159	0.44
160	Chauk Kyar	8.61	1894	219.89	5.39	77.94	126.60	149.21	171.05	244.05	110.34	0.00	4.864	0.53
161	Htan Ta Pin	15.48	3828	247.35	5.51	76.76	111.00	151.02	158.26	250.48	157.66	0.00	4.444	1.07

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
162	Hpa Lan Taing	7.34	3734	508.90	6.23	75.07	118.41	166.35	150.41	242.84	145.43	0.00	5.780	0.45
163	Kan Swie	17.94	1499	83.56	4.43	75.75	105.16	156.39	145.96	248.54	161.65	0.00	4.923	0.50
164	Nyaung Kaing	19.36	1620	83.68	4.43	77.19	124.87	151.83	168.15	237.60	97.41	0.00	5.147	0.72
165	Bawt	74.05	1069	14.44	2.67	72.91	94.44	163.71	146.68	239.94	112.32	0.00	6.015	3.35
166	Su Tat Gyi	32.62	5946	182.29	5.21	75.67	115.62	161.11	154.48	242.17	141.51	0.00	5.400	0.19
167	Dan Dalun Pin	27.41	6206	226.40	5.42	75.93	126.91	163.76	161.52	228.57	101.11	0.00	5.953	0.53
168	Myay Pin Thar	44.03	6872	156.08	5.05	75.16	118.27	160.61	158.03	239.61	126.62	0.00	5.369	0.32
169	Myo Lu Lin	18.94	3980	210.18	5.35	75.22	116.10	164.02	151.31	250.32	162.55	0.00	5.425	0.08
170	Pu TeeKone	13.32	3481	261.35	5.57	75.82	121.79	163.33	156.39	246.22	133.95	0.00	5.788	0.22
171	Nyaung Zin	9.77	2188	223.90	5.41	76.70	123.33	162.62	160.07	245.37	128.34	0.00	5.934	0.52
172	Sin Phyu Chi	15.53	2261	145.55	4.98	78.56	125.56	154.72	166.93	226.96	99.37	0.00	5.519	0.54
173	Pa Lin Gyi	44.06	3826	86.83	4.46	75.21	113.11	161.47	154.57	244.04	130.14	0.00	5.637	1.17
174	Si Thar	43.57	943	21.64	3.07	74.76	108.71	154.84	158.29	242.68	103.10	0.00	5.314	2.24
175	Aing Ma	120.23	4297	35.74	3.58	71.41	94.15	162.39	143.44	249.57	127.13	0.00	5.488	1.91
176	Kwin Gyi	112.48	1746	15.52	2.74	71.82	91.09	159.10	144.72	247.90	120.29	0.00	5.350	2.61
177	Aing Me	22.91	2443	106.64	4.67	73.32	100.39	153.78	154.68	247.08	102.35	0.00	5.159	0.49
178	Inn Ywar Gyi	25.01	4867	194.60	5.27	76.28	117.68	152.99	162.26	248.82	126.85	0.00	4.941	0.33
179	Pa Lin Pyar	60.25	3518	58.39	4.07	74.55	102.59	154.95	156.00	243.86	110.90	0.00	5.289	1.22
180	Ta LOke Pin	16.79	2954	175.93	5.17	75.62	106.74	160.57	147.17	248.12	177.12	0.00	5.016	0.15
181	Ma Gyin Kone Gyi	31.75	5009	157.75	5.06	76.39	117.74	154.57	159.60	250.40	130.58	0.00	5.134	0.07
182	Ma Gyi Htu	27.88	3709	133.01	4.89	77.73	125.02	158.51	163.23	244.66	146.54	0.00	5.290	0.40
183	Kaing	11.73	1762	150.22	5.01	79.67	137.15	150.33	177.55	246.47	123.82	0.00	4.933	0.08
184	Le Lu	59.21	3689	62.31	4.13	78.77	129.69	150.83	172.86	249.11	147.85	0.00	4.564	0.43

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
162	Hpa Lan Taing	7.34	3734	508.90	6.23	75.07	118.41	166.35	150.41	242.84	145.43	0.00	5.780	0.45
163	Kan Swie	17.94	1499	83.56	4.43	75.75	105.16	156.39	145.96	248.54	161.65	0.00	4.923	0.50
164	Nyaung Kaing	19.36	1620	83.68	4.43	77.19	124.87	151.83	168.15	237.60	97.41	0.00	5.147	0.72
165	Bawt	74.05	1069	14.44	2.67	72.91	94.44	163.71	146.68	239.94	112.32	0.00	6.015	3.35
166	Su Tat Gyi	32.62	5946	182.29	5.21	75.67	115.62	161.11	154.48	242.17	141.51	0.00	5.400	0.19
167	Dan Dalun Pin	27.41	6206	226.40	5.42	75.93	126.91	163.76	161.52	228.57	101.11	0.00	5.953	0.53
168	Myay Pin Thar	44.03	6872	156.08	5.05	75.16	118.27	160.61	158.03	239.61	126.62	0.00	5.369	0.32
169	Myo Lu Lin	18.94	3980	210.18	5.35	75.22	116.10	164.02	151.31	250.32	162.55	0.00	5.425	0.08
170	Pu TeeKone	13.32	3481	261.35	5.57	75.82	121.79	163.33	156.39	246.22	133.95	0.00	5.788	0.22
171	Nyaung Zin	9.77	2188	223.90	5.41	76.70	123.33	162.62	160.07	245.37	128.34	0.00	5.934	0.52
172	Sin Phyu Chi	15.53	2261	145.55	4.98	78.56	125.56	154.72	166.93	226.96	99.37	0.00	5.519	0.54
173	Pa Lin Gyi	44.06	3826	86.83	4.46	75.21	113.11	161.47	154.57	244.04	130.14	0.00	5.637	1.17
174	Si Thar	43.57	943	21.64	3.07	74.76	108.71	154.84	158.29	242.68	103.10	0.00	5.314	2.24
175	Aing Ma	120.23	4297	35.74	3.58	71.41	94.15	162.39	143.44	249.57	127.13	0.00	5.488	1.91
176	Kwin Gyi	112.48	1746	15.52	2.74	71.82	91.09	159.10	144.72	247.90	120.29	0.00	5.350	2.61
177	Aing Me	22.91	2443	106.64	4.67	73.32	100.39	153.78	154.68	247.08	102.35	0.00	5.159	0.49
178	Inn Ywar Gyi	25.01	4867	194.60	5.27	76.28	117.68	152.99	162.26	248.82	126.85	0.00	4.941	0.33
179	Pa Lin Pyar	60.25	3518	58.39	4.07	74.55	102.59	154.95	156.00	243.86	110.90	0.00	5.289	1.22
180	Ta LOke Pin	16.79	2954	175.93	5.17	75.62	106.74	160.57	147.17	248.12	177.12	0.00	5.016	0.15
181	Ma Gyin Kone Gyi	31.75	5009	157.75	5.06	76.39	117.74	154.57	159.60	250.40	130.58	0.00	5.134	0.07
182	Ma Gyi Htu	27.88	3709	133.01	4.89	77.73	125.02	158.51	163.23	244.66	146.54	0.00	5.290	0.40
183	Kaing	11.73	1762	150.22	5.01	79.67	137.15	150.33	177.55	246.47	123.82	0.00	4.933	0.08
184	Le Lu	59.21	3689	62.31	4.13	78.77	129.69	150.83	172.86	249.11	147.85	0.00	4.564	0.43

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
185	Zee Kone(Zee Lone)	31.77	1694	53.31	3.98	72.74	97.56	161.65	148.06	222.64	74.18	0.00	6.021	2.05
186	Shwe Pan	125.62	5632	44.83	3.80	70.88	90.02	168.92	138.68	225.29	79.39	0.00	6.592	2.79
187	Ma Gyi Cho	23.17	3873	167.13	5.12	75.41	113.26	159.87	155.51	244.10	133.14	0.00	5.435	0.32
188	That Kone	15.35	3138	204.40	5.32	76.94	117.91	161.70	153.70	243.67	163.37	0.00	5.344	0.02
189	Kwet Thit	1.51	2794	1846.64	7.52	73.89	112.38	180.43	138.83	253.81	175.27	0.00	6.982	0.54
190	Zay	0.26	870	3390.46	8.13	74.14	124.12	184.02	143.55	252.10	159.99	0.00	7.435	0.69
191	Min	0.54	1145	2109.23	7.65	72.57	104.67	190.34	126.59	254.24	172.06	0.00	8.117	0.46
192	Hpa Yar Gyi	0.92	1785	1938.84	7.57	73.54	112.38	182.56	138.89	253.00	157.92	0.00	7.450	0.12
193	Lel Pyin	0.53	1486	2808.35	7.94	72.77	103.93	186.57	130.18	254.36	182.18	0.00	7.528	0.41
194	Myat Lay Kone	14.03	692	49.32	3.90	77.79	130.24	153.97	170.95	215.23	73.92	0.00	5.358	1.46
195	Ta Khun Taing	50.85	1995	39.23	3.67	79.22	137.17	152.85	174.20	228.63	107.32	8.25	5.156	1.49
196	Ta Ma Lan Pin	27.49	3280	119.30	4.78	80.02	144.28	152.27	182.12	239.40	119.98	33.95	5.350	0.57
197	Tet Wun	24.44	3446	141.00	4.95	79.78	142.47	151.35	182.47	228.78	99.49	31.37	5.345	0.40
198	Htone Pauk Chaing	20.54	3468	168.81	5.13	77.51	125.37	150.33	172.77	219.05	66.64	13.37	5.323	0.19
199	Tha Hmone Pin	46.68	2736	58.61	4.07	77.63	124.85	151.29	170.59	225.80	76.14	21.77	5.550	1.48
200	Pi Tauk Ngoke	4.80	1499	312.30	5.74	77.69	134.61	153.31	173.55	237.91	100.36	42.07	5.614	0.13
201	Twin Gyi	73.62	4137	56.19	4.03	78.34	131.43	153.33	171.41	234.96	90.66	12.45	5.640	1.61
202	Aing Zauk	24.26	3155	130.07	4.87	79.99	140.00	151.48	176.96	231.25	89.41	17.48	5.603	0.73
203	Mei Za Li Pin	24.82	2593	104.47	4.65	80.69	142.08	150.88	179.09	228.79	99.15	41.56	5.665	1.02
204	Wet Choke	20.63	1925	93.32	4.54	77.45	124.40	152.14	172.56	197.51	61.67	19.23	5.215	0.68
205	Chaung Net	50.71	2188	43.15	3.76	77.29	116.77	148.28	167.70	226.03	69.90	8.72	5.288	1.52
206	War Yon Kone	37.91	1121	29.57	3.39	79.51	135.84	151.36	176.06	227.93	103.35	43.60	5.512	2.12
207	Nyaung Kyat Pin	14.00	2235	159.68	5.07	82.96	159.59	148.34	195.90	190.78	79.87	43.26	4.972	0.10

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
208	Thar Hmyar	24.95	4021	161.17	5.08	80.61	139.92	146.83	180.57	215.30	77.04	27.34	5.183	0.10
209	Ywar Mun	39.85	4010	100.63	4.61	76.66	116.22	152.59	160.68	215.13	80.05	0.00	5.177	0.57
210	Yaw Ngan	34.59	3459	100.01	4.61	77.49	126.91	152.16	166.31	239.74	96.04	0.00	5.308	0.70
211	Si Thar	17.92	3201	178.66	5.19	81.16	142.78	149.85	179.18	233.78	95.91	0.00	5.360	0.17
212	Lay Ein	27.11	2196	81.02	4.39	78.88	133.04	151.43	170.77	237.03	86.86	0.00	5.510	1.11
213	Sa Khan Ma	71.72	2616	36.48	3.60	78.08	124.17	150.38	167.21	237.95	104.59	9.52	5.191	1.59
214	Pay Pin Kone	16.29	2769	169.99	5.14	76.95	110.81	160.55	157.19	227.00	101.51	0.00	6.121	0.98
215	Inn Kone (North)	26.13	1845	70.61	4.26	78.92	134.49	155.87	169.36	236.87	107.85	0.00	5.602	1.34
216	Bone Taw Pyayt	18.62	3288	176.60	5.17	77.95	130.92	158.28	164.60	242.29	121.84	0.00	5.611	0.44
217	Gway Pin	32.01	2533	79.12	4.37	76.36	120.76	150.13	163.66	245.99	105.66	0.00	4.913	0.54
218	Zay Thar	16.64	1317	79.14	4.37	80.32	138.67	151.52	176.25	243.83	101.11	0.00	5.576	1.20
219	Na Gway Chao	32.60	2553	78.32	4.36	78.53	126.50	147.75	170.74	234.34	86.34	0.00	5.085	0.72
220	Na-Kyar Htu	14.20	2193	154.44	5.04	78.21	129.19	153.10	166.71	245.00	134.25	0.00	4.926	0.11
221	Nat-Let Khoke Pin	31.84	3562	111.87	4.72	77.81	127.59	150.48	168.31	239.17	104.70	0.00	4.986	0.27
222	Te Gyi	34.27	1169	34.11	3.53	79.04	135.33	151.04	177.38	213.43	79.43	36.54	5.419	1.89
223	Kyauk Pon	13.07	1426	109.11	4.69	79.70	146.45	148.83	189.19	195.27	66.70	29.23	4.770	0.08
224	Yae Htwet	26.58	1607	60.45	4.10	77.72	118.53	148.20	168.11	203.64	56.48	12.82	5.150	1.05
225	Hpan Khar San	15.21	1545	101.60	4.62	78.70	135.75	151.91	177.65	197.61	76.15	35.96	5.138	0.52
226	Son Ma Gyi Pin	14.02	2161	154.08	5.04	79.44	134.09	149.77	178.11	207.54	73.22	27.28	5.273	0.24
227	Taung Bet Gyi	39.79	1899	47.72	3.87	80.41	136.03	150.43	179.40	195.99	84.26	44.97	5.255	1.39
228	Lin Ka Toe	14.56	1562	107.25	4.68	82.67	160.83	146.62	198.40	169.07	58.28	29.00	4.441	0.23
229	Aing Pauk Kone	22.67	1443	63.67	4.15	79.76	137.10	151.86	178.98	185.37	69.68	38.71	5.224	1.07
230	Ma Gyi Cho	17.40	1923	110.49	4.70	81.36	147.54	150.75	185.55	199.19	66.19	33.13	5.526	0.82

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
231	Moe Nan Taw	10.34	1075	103.98	4.64	80.08	128.91	156.58	171.01	205.73	62.89	26.07	6.491	1.85
232	Shan Kone	14.14	909	64.28	4.16	77.96	126.52	152.15	170.29	197.17	57.26	22.06	5.427	1.26
233	Sin Thay Kan	9.18	1182	128.69	4.86	78.70	128.70	153.34	171.56	220.65	69.65	25.48	6.000	1.14
234	Inn Kan	45.52	2269	49.85	3.91	77.79	106.35	153.81	157.64	208.85	75.90	17.37	5.914	2.01
235	Dant Da Lun Pin	15.91	3173	199.47	5.30	77.33	117.81	153.67	163.03	179.07	53.91	21.06	5.336	0.04
236	Hpet Than Taung	8.49	2120	249.82	5.52	78.06	118.14	153.57	164.24	213.21	63.45	33.83	6.185	0.66
237	Ah Lel	19.26	2807	145.71	4.98	77.64	117.47	154.02	161.38	220.44	98.54	0.00	5.300	0.32
238	Ban Kone	24.90	1812	72.78	4.29	77.23	116.27	151.39	163.12	224.15	102.35	0.00	4.925	0.64
239	Kyauk Ta Gar	39.06	1342	34.36	3.54	78.59	106.30	157.83	158.86	207.30	95.07	0.00	5.950	2.41
240	Se Gyi	77.81	4273	54.91	4.01	77.78	118.76	148.34	166.30	226.71	75.06	0.00	5.207	1.20
241	Htan Pin Kone Gyi	29.38	1818	61.87	4.13	77.31	117.46	149.67	166.83	222.49	75.63	0.00	5.161	1.04
242	Kyaung Kone	28.10	2530	90.03	4.50	76.47	117.36	156.14	162.81	236.98	113.91	0.00	5.324	0.82
243	Shwe Pan Taw	36.74	1804	49.10	3.89	76.05	107.84	154.11	157.15	217.75	91.08	9.22	5.339	1.44
244	Gway Kone	30.19	2098	69.48	4.24	78.21	124.59	149.39	169.78	206.58	66.19	19.10	5.222	0.98
245	Pa Gway Cho	13.59	2693	198.20	5.29	76.60	119.80	155.39	163.37	227.32	92.02	9.56	5.531	0.24
246	Taung Htauk	31.14	2529	81.22	4.40	77.15	116.89	150.32	164.01	227.02	78.19	3.44	5.324	0.93
247	War Pan	21.37	4006	187.49	5.23	76.81	113.81	153.39	160.67	235.27	91.86	0.00	5.562	0.33
248	Pa Let Khoke Pin	8.06	1875	232.65	5.45	76.22	114.78	154.92	161.45	236.80	90.86	0.00	5.624	0.17
249	Kyun Chaung	26.93	2164	80.36	4.39	77.79	117.64	149.09	166.78	229.82	87.88	0.00	5.135	0.75
250	Son Kone Gyi	56.71	2841	50.10	3.91	75.90	122.19	152.64	165.12	227.04	74.47	0.00	5.223	1.31
251	Hlyaw Chaung Gyi	68.78	3681	53.51	3.98	76.71	115.04	150.11	164.40	233.67	95.88	0.00	5.001	1.02
252	Tha Yet Chin	48.34	4226	87.43	4.47	77.58	121.00	149.25	167.75	236.87	87.92	0.00	5.189	0.72
253	Na-Bu Kwe	22.16	1956	88.28	4.48	76.52	120.27	150.58	166.86	236.98	84.70	0.00	5.177	0.70

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
254	Thit Hla Kyin	38.31	2939	76.73	4.34	77.01	122.16	149.30	167.27	236.75	84.65	0.00	5.105	0.76
255	Kwin Gyi	43.11	2601	60.34	4.10	77.41	120.70	148.54	169.73	231.56	80.25	0.00	5.084	0.98
256	U Yin	51.18	3883	75.88	4.33	76.41	124.75	151.02	166.31	239.51	97.72	0.00	4.934	0.60
257	Se Lel	60.19	3396	56.42	4.03	74.03	113.61	155.82	157.10	247.00	115.06	0.00	5.047	1.01
258	Myo Ma Kwet Thit	0.28	1704	6186.58	8.73	77.62	117.72	162.81	151.38	249.77	92.23	0.00	7.140	1.59
259	Ka Paung Kone	23.78	1550	65.18	4.18	76.20	120.33	148.30	167.31	239.69	83.69	0.00	4.921	0.74
260	Ku Lar Shin	27.48	2082	75.78	4.33	76.47	120.75	148.43	167.56	243.76	99.35	0.00	4.779	0.45
261	Pan Nyo	27.05	2477	91.56	4.52	74.89	117.07	150.44	163.10	235.00	81.46	0.00	4.896	0.38
262	Le Bu	48.07	6401	133.15	4.89	74.90	108.30	150.97	159.18	245.93	96.60	0.00	5.107	0.22
263	Tha Mone Kone Gyi	77.50	5930	76.52	4.34	76.44	114.67	151.69	163.95	230.68	89.30	0.00	5.185	0.85
264	Gwe Tauk Kone	28.63	3353	117.13	4.76	77.12	102.91	162.79	156.44	211.38	97.78	0.00	6.288	1.52
265	Myin Te Gyi	40.40	5571	137.90	4.93	76.73	118.27	148.28	167.43	219.49	66.94	0.00	4.950	0.02
266	Ywar Taw	27.42	1450	52.87	3.97	76.14	119.97	151.45	163.36	215.07	68.34	0.00	5.055	1.09
267	Kyauk Tan	79.00	5786	73.24	4.29	76.28	121.44	149.85	166.76	219.75	65.95	0.00	4.995	0.70
268	Myo Ma	0.58	1899	3288.87	8.10	78.99	130.71	159.24	164.54	248.21	87.27	0.00	6.753	1.35
269	Kan Gyi	0.32	1573	4927.09	8.50	78.84	118.78	159.40	155.93	232.66	123.08	0.00	6.015	2.49
270	Yan Aung Myin	0.24	1836	7634.46	8.94	78.19	116.11	160.83	152.76	242.92	75.07	0.00	7.241	1.70
271	Ta Mar Pin	0.55	1960	3594.18	8.19	77.38	125.57	165.21	155.82	223.03	66.67	0.00	7.065	1.12
272	Aung San	0.62	2951	4769.75	8.47	76.73	120.07	168.89	148.93	225.35	84.05	0.00	7.214	1.26
273	Zay Kwet Thit	0.56	2814	5030.01	8.52	77.45	121.18	167.19	150.10	242.22	87.33	0.00	7.469	1.05
274	Kan Thar	20.94	1581	75.49	4.32	73.88	111.70	152.94	157.56	245.47	111.99	0.00	4.744	0.42
275	Forest	502.47	0	0.00	#NUM!	70.53	99.17	176.42	138.21	247.08	123.20	0.00	0.00	0.00
276	Pat Lel Gyi	41.06	3750	91.33	4.51	73.71	120.57	172.95	152.77	251.23	133.69	0.00	6.549	2.03

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
277	Kyoet Chaung	60.52	4912	81.16	4.40	76.69	125.61	157.86	164.80	250.96	158.46	0.00	4.861	0.46
278	War Thone Pyu	24.67	1540	62.42	4.13	75.29	119.05	156.68	162.81	246.45	142.77	0.00	4.742	0.61
279	Leik Taik	44.11	1670	37.86	3.63	76.29	128.60	153.79	169.63	247.78	146.69	0.00	4.363	0.73
280	Nyar Taw	83.48	2113	25.31	3.23	76.19	123.09	158.91	164.63	237.94	130.92	0.00	5.148	1.92
281	Kan Thar	38.97	2547	65.35	4.18	76.67	130.31	156.82	166.44	249.64	165.05	0.00	4.485	0.31
282	Hmoke Shey	27.23	2127	78.11	4.36	77.88	128.01	153.63	170.09	249.88	149.73	0.00	4.711	0.35
283	Hle Pwe Gyi	44.55	1554	34.88	3.55	77.96	127.72	149.66	173.38	251.16	148.20	0.00	4.314	0.76
284	Yar Gyi Taw	27.65	2383	86.17	4.46	79.03	138.88	151.63	178.39	252.24	163.00	0.00	4.274	0.18
285	Yae Twin Kaung	87.49	2559	29.25	3.38	76.41	121.41	149.67	166.37	246.61	145.30	0.00	4.093	0.72
286	Pay Pin Yar	37.16	2521	67.84	4.22	77.99	133.63	149.39	176.89	248.20	142.78	0.00	4.185	0.03
287	Let Tet	49.80	2427	48.73	3.89	76.84	125.78	149.30	170.60	251.00	159.87	0.00	3.851	0.03
288	Kan Gyi Kone	59.61	3498	58.68	4.07	77.04	128.21	154.28	169.41	251.76	171.64	0.00	4.216	0.14
289	Yae Wai	24.43	3425	140.18	4.94	79.05	140.52	154.93	174.33	241.17	118.35	0.00	5.265	0.32
290	Koe Pin	11.86	1794	151.21	5.02	78.13	133.92	157.03	167.97	237.22	95.63	0.00	5.813	0.79
291	Pyar Tu	4.82	1062	220.49	5.40	78.32	131.55	156.19	165.71	248.69	143.37	0.00	5.173	0.22
292	Nyaung Kone	3.94	1365	346.67	5.85	79.73	133.78	151.15	170.85	244.38	163.25	0.00	4.372	1.48
293	Ohn Hne Tan	6.32	1208	191.17	5.25	78.50	125.25	151.71	165.34	245.49	113.96	0.00	5.319	0.07
294	Inn Ywar Gyi	6.81	559	82.08	4.41	78.38	130.84	152.67	169.15	234.75	100.06	0.00	5.288	0.88
295	Let Pan Shey	13.60	2556	187.88	5.24	77.99	131.90	155.55	169.34	236.73	91.75	0.00	5.700	0.46
296	Koke Ko Gwa	9.49	2606	274.47	5.61	77.81	132.82	156.61	168.97	239.46	122.02	0.00	5.250	0.37
297	Wet Chan Kan	17.20	1285	74.72	4.31	77.93	132.53	153.79	171.08	243.60	102.43	0.00	5.409	1.10
298	Shan Kaing	9.81	2079	211.93	5.36	77.04	122.10	153.14	163.93	221.75	92.09	0.00	5.103	0.25
299	Hin Ga Yaw	18.01	3903	216.70	5.38	77.05	126.97	154.56	164.99	228.40	81.15	0.00	5.523	0.14

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
300	Khin Te	20.38	4214	206.73	5.33	76.14	120.48	157.35	159.13	220.82	89.49	0.00	5.472	0.14
301	Ta Yoke Kaw	14.31	3903	272.72	5.61	76.77	128.42	159.13	162.94	216.20	81.40	0.00	5.690	0.08
302	In Kyin Kone	11.51	2150	186.75	5.23	77.20	129.45	157.74	162.79	240.97	113.58	0.00	5.550	0.32
303	Kywe Kan	7.14	453	63.42	4.15	77.17	132.05	157.82	164.92	245.44	105.61	0.00	5.734	1.58
304	In Kone	10.40	2650	254.69	5.54	76.23	119.91	158.47	157.71	238.06	103.95	0.00	5.748	0.21
305	Shwe Oe (1)	0.94	6432	6864.79	8.83	75.81	111.79	161.13	151.85	236.44	90.60	0.00	6.372	2.46
306	Maung Taing (2)	1.60	7132	4449.14	8.40	74.33	106.88	169.54	142.71	248.68	142.95	0.00	6.425	1.98
307	Maung Taing(1)	0.70	2617	3725.18	8.22	75.19	87.76	174.20	134.27	245.73	133.65	0.00	7.688	0.53
308	Shwe Oe (2)	0.86	4883	5692.85	8.65	76.15	114.26	165.23	149.56	244.06	113.94	0.00	6.613	2.03
309	Shwe Kyar Inn (1)	1.49	4881	3277.96	8.09	75.15	116.60	173.60	144.97	249.74	118.08	0.00	7.367	0.73
310	Taung Pyin (2)	0.85	4197	4938.85	8.50	74.69	98.45	169.81	134.49	246.39	163.38	0.00	6.333	2.17
311	Ohn Taw (2)	1.22	4536	3727.58	8.22	75.68	121.57	165.87	154.13	232.42	69.53	0.00	6.986	1.24
312	Taung Pyin (1)	1.83	4649	2534.49	7.84	75.20	119.99	171.94	148.46	248.84	133.50	0.00	6.786	1.05
313	Ohn Taw (1)	2.05	4952	2421.33	7.79	76.40	128.52	161.47	161.38	224.69	82.03	0.00	6.055	1.74
314	Kya Khat Kan	7.02	1289	183.53	5.21	76.53	121.22	158.81	160.95	242.70	105.65	0.00	5.871	0.66
315	Pan Taw Nge	9.39	2885	307.31	5.73	76.35	120.97	159.42	158.71	238.32	105.58	0.00	5.829	0.10
316	Tei Taw (1)	8.50	1274	149.80	5.01	76.96	127.66	158.06	161.99	225.95	91.54	0.00	5.660	0.65
317	Tei Taw (2)	16.62	2177	130.97	4.87	76.89	128.80	158.64	163.31	237.00	94.76	0.00	5.856	0.98
318	Let Pan Bu	22.94	965	42.06	3.74	75.67	126.00	159.68	162.72	237.75	90.05	0.00	5.853	2.11
319	Pan Thwin Lay	4.43	1896	428.34	6.06	75.54	120.94	163.84	155.37	239.17	88.08	0.00	6.521	0.46
320	Pan Thwin Gyi	14.52	4154	286.12	5.66	76.12	116.85	157.19	157.40	232.65	106.89	0.00	5.462	0.19
321	Aung Su	36.59	5080	138.82	4.93	75.17	118.52	159.58	158.76	232.32	100.87	0.00	5.573	0.64
322	Nga Min	34.39	7436	216.22	5.38	75.22	124.65	160.47	161.43	248.52	119.79	0.00	5.547	0.17

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
323	Thit Yar	15.30	1950	127.45	4.85	75.64	126.84	160.44	161.30	248.45	137.96	0.00	5.254	0.41
324	Zee Taw	18.97	7595	400.40	5.99	75.14	124.38	160.66	158.43	253.13	196.34	0.00	4.230	1.76
325	Pwint Hla Gyi	4.29	2495	581.04	6.36	75.56	122.62	165.29	154.17	249.74	102.57	0.00	6.628	0.26
326	Thi La	3.53	525	148.62	5.00	76.03	124.21	161.68	157.86	241.97	100.93	0.00	6.127	1.13
327	Nyaung Pin Hla	5.05	3077	609.14	6.41	76.27	119.95	158.70	157.48	237.29	96.58	0.00	5.908	0.50
328	Pauk	7.87	786	99.83	4.60	76.28	128.21	162.02	160.15	250.33	122.30	0.00	5.906	1.30
329	Bo Kone	4.28	1647	384.97	5.95	76.65	134.67	163.72	162.36	246.82	119.07	0.00	6.027	0.07
330	Chaung Net	19.45	7154	367.75	5.91	75.88	121.62	163.06	155.63	249.64	148.32	0.00	5.583	0.32
331	Ku Lar Kan	9.11	3117	342.24	5.84	76.01	126.32	161.82	158.60	250.65	151.59	0.00	5.320	0.52
332	Nyar Ga Moe	7.40	3843	519.45	6.25	75.84	117.11	160.89	153.46	251.46	163.88	0.00	5.179	1.07
333	Wet Ka Thay	17.28	3789	219.33	5.39	74.79	120.35	166.33	150.82	251.31	193.92	0.00	4.939	0.45
334	Su Kauk Gyi	14.33	2770	193.25	5.26	77.69	133.22	156.63	166.72	248.09	135.76	0.00	5.168	0.10
335	Sat Thwar	12.91	6881	533.10	6.28	77.72	137.32	157.67	166.01	251.29	129.81	0.00	5.408	0.87
336	Mi Au Aung	16.78	1643	97.91	4.58	78.80	133.07	152.25	171.69	219.96	82.86	0.00	5.274	0.69
337	Thi Ri Min Ga Lar	8.82	337	38.22	3.64	77.83	129.24	155.02	166.46	248.01	139.26	0.00	5.027	1.38
338	Sit Tar	17.93	4177	232.95	5.45	77.52	129.26	155.42	162.21	251.17	141.86	0.00	5.062	0.39
339	Kyan Su	8.91	1437	161.32	5.08	76.64	131.03	158.08	162.25	249.60	137.10	0.00	5.180	0.10
340	Pyint Nyin	4.08	1562	383.12	5.95	75.47	119.70	161.49	154.21	251.42	204.46	0.00	4.333	1.62
341	Lel Thar (1)	3.69	2885	782.79	6.66	75.80	128.79	164.81	155.21	250.13	143.82	0.00	5.732	0.93
342	Lel Thar (2)	12.47	3687	295.59	5.69	75.42	124.77	161.87	157.08	253.20	203.44	0.00	4.304	1.38
343	Kan Bay Gyi	17.72	3552	200.47	5.30	74.62	115.33	162.63	152.03	252.94	201.83	0.00	4.448	0.85
344	Pin Taing	10.13	4079	402.53	6.00	74.14	118.79	170.57	147.42	253.68	204.43	0.00	5.177	0.82
345	Kin Pun Taung	20.33	9112	448.23	6.11	72.84	109.83	169.67	147.32	252.54	190.79	0.00	5.170	0.94

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
346	Si Mee Htun	21.56	2754	127.72	4.85	74.90	126.86	163.26	158.49	252.32	159.84	0.00	5.095	0.25
347	Gone Nyin Ton	33.43	5530	165.41	5.11	75.20	123.68	160.41	159.57	252.77	198.04	0.00	4.176	0.93
348	Taung Hlyaung	30.89	4072	131.81	4.88	76.36	127.93	160.24	159.51	247.89	168.00	0.00	4.814	0.07
349	Koke Ko Kone	32.02	7927	247.55	5.51	73.47	117.53	166.76	152.14	253.08	185.61	0.00	4.914	0.60
350	Taik Pwe	35.68	2602	72.93	4.29	72.27	112.09	175.31	146.89	249.73	187.94	0.00	5.627	1.34
351	Ku Lar Ma	18.78	5258	279.98	5.63	73.45	117.27	167.70	152.40	252.71	154.49	0.00	5.600	0.03
352	Oe Pauk	12.39	2266	182.86	5.21	70.59	104.69	179.93	141.96	253.28	160.03	0.00	6.544	1.34
353	Thit Poke Kone	1.48	717	484.14	6.18	79.11	143.04	156.09	175.61	245.12	125.81	0.00	5.295	0.89
354	Kyet Shar	8.10	2248	277.48	5.63	76.87	123.73	157.55	161.24	251.08	129.78	0.00	5.486	0.14
355	Ta Loke Kone	5.50	3005	546.10	6.30	76.28	125.89	161.64	157.43	249.20	138.13	0.00	5.605	0.70
356	Shwe Kyar Inn (2)	0.11	1744	16208.99	9.69	76.61	101.27	161.20	141.95	254.47	94.28	0.00	7.181	2.51
357	Yae U	18.20	3389	186.23	5.23	77.40	137.63	158.25	170.16	243.44	122.14	0.00	5.324	0.10
358	Thone Se Chauk	41.15	6140	149.23	5.01	78.30	137.46	151.34	145.07	180.47	66.05	25.51	4.974	0.03
359	Hpaung Ka Taw	3.57	1634	458.06	6.13	80.98	130.57	151.22	106.98	220.38	97.15	36.60	6.496	0.37
360	Kyan Kaing Kyun	16.47	2071	125.74	4.83	82.66	113.41	148.41	85.58	192.13	139.97	67.72	6.002	1.17
361	Man Myay	32.88	4783	145.49	4.98	81.65	98.66	152.19	60.73	190.54	136.27	57.11	6.624	1.64
362	Pin Wa	26.20	7048	268.97	5.59	80.18	129.34	153.04	109.44	222.16	113.18	32.10	6.198	0.60
363	Ah Shay Kone	48.54	3268	67.33	4.21	79.44	129.79	149.50	171.50	208.21	80.72	28.22	5.268	1.06
364	Kamma	10.08	2687	266.65	5.59	79.54	154.11	148.26	175.53	208.11	74.92	31.40	4.819	0.77
365	Hpoe Koe	26.59	2885	108.48	4.69	79.86	154.27	147.41	185.05	165.75	46.34	28.74	4.280	0.41
366	Sein Pan Pin	19.50	4123	211.45	5.35	77.62	150.97	148.16	185.64	185.93	48.53	25.24	4.261	1.09
367	Shwe Toke Kan	25.30	2206	87.21	4.47	80.23	145.75	148.12	172.21	199.14	69.67	26.85	4.998	0.53
368	Ma Gyi Kan	49.65	4148	83.54	4.43	80.19	137.63	148.22	175.89	215.09	84.61	20.73	5.107	0.68

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
369	Koke Ko Gwa	37.58	3533	94.02	4.54	80.99	138.41	146.59	171.79	216.04	79.39	19.62	5.246	0.70
370	Oke Shit Kone	37.75	4013	106.31	4.67	79.98	140.94	149.16	150.53	219.52	100.73	35.40	5.312	0.65
371	Sa Khan Kan	29.66	2233	75.28	4.32	79.38	135.64	148.77	173.11	191.19	63.20	21.98	4.940	0.62
372	Chaung Son	24.46	2052	83.90	4.43	78.63	129.85	151.01	173.54	200.69	69.79	26.37	5.250	0.82
373	Hpaung Kwe	38.19	2305	60.36	4.10	80.63	140.53	146.96	175.89	230.41	110.12	26.98	4.940	0.84
374	Chaing	46.02	2572	55.88	4.02	79.12	134.44	150.78	172.88	223.38	90.36	24.32	5.348	1.32
375	In Taw	64.19	4926	76.74	4.34	79.18	130.80	150.73	173.75	197.81	65.98	24.33	5.313	0.97
376	Yone Kone	44.28	2094	47.28	3.86	79.19	134.32	148.14	174.03	235.58	109.05	17.04	4.893	1.04
377	Nyaung Pin Aint	78.35	3332	42.53	3.75	79.10	138.90	148.59	172.73	228.62	110.00	26.09	4.780	1.03
378	Na Gar	39.95	3557	89.04	4.49	79.45	131.60	152.52	173.08	222.72	84.24	26.98	5.799	1.31
379	Lay Taing Sin	21.59	1354	62.71	4.14	79.22	136.28	153.16	176.84	226.91	91.33	34.06	5.729	1.59
380	Wet Lut Ywar Ma	11.57	4357	376.64	5.93	80.00	112.76	154.93	54.86	239.87	168.84	39.00	6.619	0.69
381	Yone Seik Kyun	25.19	1113	44.19	3.79	81.74	80.44	147.98	61.52	171.44	140.85	67.77	6.103	2.31
382	Ba Seik	33.72	1639	48.61	3.88	77.95	124.76	150.77	157.48	191.32	55.56	14.19	5.247	1.36
383	Wet Ma Sut	66.79	2903	43.46	3.77	78.02	113.18	151.65	132.21	182.25	63.44	19.88	5.536	1.76
384	Kan Gyi	30.60	2779	90.83	4.51	77.57	125.72	148.42	169.86	231.40	103.33	19.05	4.782	0.27
385	Sar Taing	34.83	1081	31.03	3.44	77.75	120.15	150.93	149.30	191.46	57.04	11.30	5.329	1.89
386	Bu Kyun	5.34	2271	424.95	6.05	81.43	129.49	151.61	86.77	223.11	90.24	27.29	6.956	0.90
387	Bay Mei	19.70	2369	120.25	4.79	78.42	120.39	150.70	135.57	203.29	77.05	9.42	5.450	0.66
388	Twin Kone	2.59	1785	688.35	6.53	78.87	129.78	151.86	113.82	220.21	70.00	19.92	6.353	0.18
389	Thu Htay Kone	4.93	3220	652.93	6.48	78.99	128.44	150.92	118.75	209.62	65.72	15.30	6.049	0.43
390	Myay Ni Khin (North)	2.48	2446	985.30	6.89	78.74	122.60	151.97	111.15	221.08	59.19	10.09	6.608	0.29
391	Bo Kone	1.55	1739	1122.11	7.02	79.80	124.86	149.78	133.33	211.56	54.00	11.05	6.245	0.78

Table 1 (Continuted)

Block No.	VTName	Area Km^2	Total Population	PD	LPD	SRB2	SRB5	TNDVI	PC1	NIR5x5	NIR7x7	SWIR7x7	Estimated LPD	Residual
392	Myay Ni Khin (South)	2.33	2803	1205.26	7.09	77.49	120.31	158.09	34.25	234.66	73.64	17.26	7.917	0.82
393	Son Taik	0.94	2814	3004.31	8.01	79.53	125.71	154.01	62.93	231.07	68.28	21.57	7.619	0.39
394	Shwe Kyar Ngon	0.58	2039	3502.69	8.16	78.86	113.39	156.52	3.30	243.90	90.77	16.46	8.362	0.20
395	Ywar Thit	0.95	6192	6511.76	8.78	78.03	122.47	158.07	17.85	235.56	75.07	18.66	8.174	0.61
396	Myo Ma (North)	1.00	3913	3911.93	8.27	79.70	121.94	154.35	53.67	242.67	96.65	17.75	7.531	0.74
397	Myo Ma (South)	0.60	2227	3699.90	8.22	80.26	124.35	151.03	100.28	213.58	71.90	16.70	6.597	1.62
398	Oe Bo	3.16	2802	886.62	6.79	79.63	117.24	153.97	49.93	230.58	117.90	45.63	7.231	0.44
399	Thit Ta Pway	3.33	7047	2113.89	7.66	80.06	128.94	149.84	143.48	217.80	54.12	13.11	6.295	1.36
400	Nyaung Hla	5.78	3724	643.74	6.47	80.56	131.57	149.63	130.51	217.75	88.42	24.90	5.946	0.52

Table 2 Populated areas in the census block in Magway District.

No	VT Name	Township	Total Area km^2	Populated Area km^2
1	Ah Lel	Natmauk	19.26495	0.670803
2	Ah Lel Bo	Magway	65.260591	1.025713
3	Ah Shay Kone	Yenangyoung	48.537106	0.685548
4	Aing Gyi Kone	Magway	32.085597	0.702853
5	Aing Ma	Myothit	120.2295	0.71679
6	Aing Me	Myothit	22.907863	0.22709
7	Aing Pauk Kone	Natmauk	22.665004	0.348348
8	Aing Zauk	Natmauk	24.255393	0.806825
9	Aung Chan Thar	Magway	1.2124349	0.908495
10	Aung Min Galar	Magway	1.556129	1.152791
11	Aung Myit Thar	Magway	5.8850555	2.694112
12	Aung San	Natmauk	0.6186909	0.576324
13	Aung Su	Taungdwingyi	36.593087	0.828613
14	Aung Ya Danar	Magway	1.7960569	1.507491
15	Aw Zar Taw	Chauk	14.117916	0.364215
16	Ba Seik	Yenangyoung	33.715366	0.3931
17	Ban Kone	Natmauk	24.897451	0.465778
18	Bawt	Myothit	74.051729	0.459894
19	Bay Mei	Yenangyoung	19.700894	0.761796
20	Bo Kone	Taungdwingyi	4.2782103	0.4363
21	Bo Kone	Yenangyoung	1.5497625	0.070067
22	Bon	Magway	1.7447972	0.33788
23	Bone Taw Pyayt	Natmauk	18.618706	0.584936
24	Bu Kyun	Yenangyoung	5.3442131	0.555472
25	Byi Pin	Chauk	20.289266	0.852962
26	Chaing	Yenangyoung	46.023222	0.479712
27	Chauk Kyar	Myothit	8.6132575	0.349133
28	Chaung Net	Taungdwingyi	50.709745	1.772879
29	Chaung Net	Natmauk	19.453191	0.377443
30	Chaung Son	Yenangyoung	24.45739	0.377664
31	Chaung Tet	Chauk	29.604139	0.619139
32	Da Hat Kan	Magway	7.5796262	0.264561
33	Dan Dalun Pin	Myothit	27.41166	1.071379
34	Dant Da Lun Pin	Natmauk	15.907378	0.785573
35	Dat Myay Aww Zar	Chauk	4.8733119	1.112452
36	Gone Nyin Ton	Taungdwingyi	33.432303	1.702273
37	Gway Cho	Myothit	26.040004	0.403353
38	Gway Cho	Chauk	13.033478	1.347738

Table 2 (Continued)

No	VT Name	Township	Total Area Km^2	Settlement area Km^2
39	Gway Kone	Myothit	9.400964	0.48667
40	Gway Kone	Natmauk	30.194771	0.457334
41	Gway Pin	Natmauk	32.013483	0.468306
42	Gway Pin Gyi	Chauk	13.841046	0.441208
43	Gway Pin Ywar Thit	Chauk	23.840841	1.340317
44	Gwe Tauk Kone	Natmauk	28.62641	0.839348
45	Gyoe Gyar Kan	Magway	20.778565	0.51197
46	Gyoke Kone	Magway	35.635015	0.888548
47	Hin Ga Yaw	Taungdwingyi	18.010977	1.147715
48	Hle Pwe Gyi	Taungdwingyi	44.547763	0.268694
49	Hlyaw Chaung Gyi	Natmauk	68.784722	0.786838
50	Hmoke Shey	Taungdwingyi	27.231765	0.761061
51	Hpa Lan Taing	Myothit	7.3374402	0.657046
52	Hpa Yar Gyi	Myothit	0.9206513	0.575622
53	Hpa Yar Kone	Magway	22.420024	0.307528
54	Hpa Yar Pyo	Magway	33.334929	0.583285
55	Hpan Khar San	Natmauk	15.206323	0.395935
56	Hpaung Ka Taw	Yenangyoung	3.5672551	0.413582
57	Hpaung Kwe	Yenangyoung	38.189046	0.404888
58	Hpet Than Taung	Natmauk	8.4861064	0.518551
59	Hpoe Koe	Yenangyoung	26.593936	0.504831
60	Hpoe Lay lone	Magway	31.086138	0.600544
61	Hpoke Kone	Magway	14.948243	0.398164
62	Htan Pin Kone Gyi	Natmauk	29.382426	0.268824
63	Htan Ta Pin	Myothit	15.475881	0.811785
64	Htauk Shar Tan	Myothit	44.045874	1.147045
65	Htein Kan	Chauk	25.808099	0.687963
66	Htein San	Chauk	25.909609	0.687963
67	Htone Pauk Chaing	Natmauk	20.543321	0.513865
68	In Kone	Taungdwingyi	10.404602	0.517266
69	In Kyin Kone	Taungdwingyi	11.512628	0.566771
70	In Taing Gyi	Magway	42.030952	0.951115
71	In Taw	Yenangyoung	64.189685	0.890592
72	Inn Kan	Natmauk	45.516308	0.718482
73	Inn Kone (North)	Natmauk	26.127913	0.417926
74	Inn Ywar Gyi	Myothit	25.009658	0.75835
75	Inn Ywar Gyi	Taungdwingyi	6.8102966	0.262762
76	Ka Paung Kone	Natmauk	23.778883	0.277435
77	Kaing	Myothit	11.729368	0.372756
78	Kamma	Yenangyoung	10.076948	0.489385

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
79	Kan Bay Gyi	Taungdwingyi	17.718208	1.10935
80	Kan Gyi	Natmauk	0.3192557	0.263346
81	Kan Gyi	Yenangyoung	30.596653	0.543993
82	Kan Gyi Kone	Taungdwingyi	59.610984	1.519089
83	Kan Pyar	Magway	11.362147	0.545785
84	Kan Swie	Myothit	17.939273	0.221678
85	Kan Taw	Magway	20.863827	0.338502
86	Kan Thar	Magway	0.9870508	0.880302
87	Kan Thar	Taungdwingyi	20.944266	0.65903
88	Kan Thar	Natmauk	38.972746	0.342847
89	Kan Thar Gyi	Magway	17.735965	0.443804
90	Kayin	Magway	12.686704	0.337843
91	Khin Te	Taungdwingyi	20.383951	0.913091
92	Kin Pun Taung	Taungdwingyi	20.328733	1.999159
93	Koe Pin	Taungdwingyi	11.864113	0.758018
94	Koke Ko Gwa	Taungdwingyi	9.4946711	0.686032
95	Koke Ko Gwa	Yenangyoung	37.577807	0.534833
96	Koke Ko Kone	Taungdwingyi	32.021273	2.182201
97	Ku Lar Kan	Taungdwingyi	9.1077064	0.672179
98	Ku Lar Ma	Taungdwingyi	18.780022	1.034971
99	Ku Lar Shin	Natmauk	27.47527	0.39556
100	Kun Ohn	Magway	43.538969	0.274472
101	Kwet Thit	Myothit	1.5130149	0.66515
102	Kwin Gyi	Myothit	112.4789	2.635885
103	Kwin Gyi	Natmauk	43.107744	0.422456
104	Kya Khat Kan	Taungdwingyi	7.0232447	0.911247
105	Kyan Kaing Kyun	Yenangyoung	16.470176	0.936573
106	Kyan Su	Taungdwingyi	8.9078549	0.392906
107	Kyar Kan	Magway	70.568679	4.202417
108	Kyauk Pon	Natmauk	13.069616	0.327555
109	Kyauk Ta Gar	Natmauk	39.059232	0.352985
110	Kyauk Tan	Natmauk	35.865336	0.897669
111	Kyauk Tan	Chauk	78.999504	0.297344
112	Kyauk Ye	Chauk	26.80764	0.541574
113	Kyaung Kone	Natmauk	28.102871	0.611178
114	Kyaung Yar Taw	Chauk	17.990621	0.705056
115	Kyet Shar	Taungdwingyi	8.1015207	0.61766
116	Kyit Son Pway	Magway	41.380725	0.55558
117	Kyoet Chaung	Taungdwingyi	60.522467	2.262645
118	Kyoet Pin	Chauk	17.810987	0.574454

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
119	Kyun Chaung	Natmauk	26.929492	0.539522
120	Kyun Pyat	Magway	12.469223	0.266629
121	Kywe Kan	Taungdwingyi	7.1424244	0.1124
122	Kywe Tat	Chauk	14.364522	0.300185
123	Lat Pa Taw	Magway	14.310394	0.462439
124	Lay Ein	Natmauk	27.105434	0.496436
125	Lay Pin Kone	Chauk	23.985136	0.419326
126	Lay Taing Sin	Myothit	60.710282	1.75896
127	Lay Taing Sin	Yenangyoung	21.591809	0.189551
128	Le Bu	Natmauk	48.074153	1.14521
129	Le Lu	Myothit	59.20521	0.719264
130	Leik Taik	Taungdwingyi	44.105608	0.277931
131	Lel Pyin	Myothit	0.5291365	0.247302
132	Lel Thar (1)	Taungdwingyi	3.6855416	0.60503
133	Lel Thar (2)	Taungdwingyi	12.473378	0.882679
134	Lel Yar	Magway	27.414574	0.775115
135	Let Pan Bu	Taungdwingyi	22.943028	0.178125
136	Let Pan Kyun	Chauk	29.165641	0.771174
137	Let Pan Shey	Taungdwingyi	13.604456	0.599957
138	Let Pu To	Magway	14.111351	0.161369
139	Let Tet	Taungdwingyi	49.801006	0.424439
140	Lin Ka Toe	Natmauk	14.564618	0.391063
141	Lin Lei	Myothit	25.911701	0.640389
142	Lin Ta Kaing	Chauk	8.7908267	0.194507
143	Lint Myint	Magway	52.759246	0.872332
144	Ma Gyi Chay Htauk	Magway	40.004706	0.509179
145	Ma Gyi Cho	Myothit	23.173419	0.618998
146	Ma Gyi Cho	Natmauk	17.40381	0.477228
147	Ma Gyi Htu	Myothit	27.884845	0.765208
148	Ma Gyi Kan	Magway	8.0911684	2.284648
149	Ma Gyi Kan	Yenangyoung	14.405223	0.83879
150	Ma Gyi Kan	Chauk	49.653513	0.503762
151	Ma Gyi Kone	Chauk	17.58846	0.227168
152	Ma Gyin Kone Gyi	Myothit	31.753354	0.745592
153	Ma Nawt Kone	Myothit	11.369686	0.188333
154	Man Myay	Yenangyoung	32.875159	1.011327
155	Maung Taing (2)	Taungdwingyi	1.6030081	0.548831
156	Maung Taing(1)	Taungdwingyi	0.7025163	0.658341
157	May Hla Taung	Magway	19.946829	0.728258
158	Mei Za Li Pin	Natmauk	24.819669	0.407402

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
159	Mi Au Aung	Taungdwingyi	16.780658	0.091128
160	Mi Kyaung Ye	Magway	13.480766	1.009714
161	Min	Magway	62.258647	0.675616
162	Min	Myothit	0.5428532	0.152584
163	Min Kan Gyi	Magway	3.8342796	1.787835
164	Moe Nan Taw	Natmauk	10.338739	0.331402
165	Myat Lay Kone	Myothit	14.03194	0.147888
166	Myay Ni Khin (N)	Yenangyoung	2.4825027	0.05426
167	Myay Ni Khin (S)	Yenangyoung	2.3256367	1.739624
168	Myay Nu	Magway	9.2938985	0.206846
169	Myay Pa Don	Chauk	19.924795	0.406248
170	Myay Pin Thar	Myothit	44.028577	1.156727
171	Myay Sun	Chauk	23.022992	0.671582
172	Myin Kun	Magway	20.932699	1.271666
173	Myin Saing	Magway	28.729497	0.484376
174	Myin Te Gyi	Natmauk	40.398393	0.684612
175	Myin Thar	Magway	1.1020602	0.410732
176	Myit Thar Si	Magway	30.311883	0.344891
177	Myo Haung	Magway	1.5374867	0.235906
178	Myo Lu Lin	Myothit	18.935896	0.832791
179	Myo Ma	Natmauk	0.5774025	0.414639
180	Myo Ma (North)	Natmauk	1.0002745	0.613923
181	Myo Ma (South)	Yenangyoung	0.6019084	0.193881
182	Myo Ma Kwet Thit	Yenangyoung	0.2754351	0.259849
183	Na Be Kone	Myothit	7.7309552	0.369493
184	Na Gar	Natmauk	39.950394	0.516255
185	Na Gway Chao	Yenangyoung	32.596382	0.475249
186	Na Ywe Taw	Chauk	16.452083	0.398553
187	Na-Bu Kwe	Natmauk	22.156546	0.443931
188	Na-Kyar Htu	Natmauk	14.199349	0.524259
189	Nan Kat Kyun	Magway	16.19745	3.289952
190	Nat Kan	Magway	10.787629	0.294581
191	Nat-Let Khoke Pin	Natmauk	31.841436	0.685821
192	Nga Min	Taungdwingyi	34.390164	1.005145
193	Ngar Saung	Taungdwingyi	35.498727	0.904669
194	Nin Kyan	Magway	30.849014	0.761296
195	No (1) Ward	Chauk	6.3172699	0.354578
196	No (10) Ward	Chauk	0.3205149	0.283113
197	No (11) Ward	Chauk	0.1393827	0.134401
198	No (12) Ward	Chauk	0.2295412	0.220173

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
199	No (13) Ward	Chauk	0.5238921	0.392264
200	No (14) Ward	Chauk	4.0924191	1.633599
201	No (15) Ward	Chauk	2.302387	1.701301
202	No (2) Ward	Chauk	0.6266481	0.184248
203	No (3) Ward	Chauk	0.2996823	0.236868
204	No (4) Ward	Chauk	1.5929016	0.498013
205	No (5) Ward	Chauk	0.5344002	0.408059
206	No (6) Ward	Chauk	0.15172	0.146454
207	No (7) Ward	Chauk	0.5963167	0.238897
208	No (8) Ward	Chauk	0.4846691	0.263168
209	No (9) Ward	Chauk	0.234445	0.223968
210	Nwar Hla	Myothit	23.730928	0.480969
211	Nyar Ga Moe	Taungdwingyi	7.39824	1.103016
212	Nyar Taw	Taungdwingyi	83.478035	0.344257
213	Nyaung Chaung	Chauk	10.432422	0.288002
214	Nyaung Hla	Yenangyoung	5.7849842	1.096032
215	Nyaung Kaing	Myothit	19.359294	0.350205
216	Nyaung Kan	Magway	35.306395	0.848768
217	Nyaung Kone	Taungdwingyi	3.9375177	0.282255
218	Nyaung Kyat Pin	Natmauk	13.99694	0.55579
219	Nyaung Kyat San	Magway	7.020075	0.10664
220	Nyaung Pin	Magway	28.903061	0.398942
221	Nyaung Pin Aint	Yenangyoung	78.349298	0.652912
222	Nyaung Pin Hla	Taungdwingyi	5.0513681	0.837253
223	Nyaung Zin	Myothit	24.345949	0.554963
224	Nyaung Zin	Chauk	9.7723861	0.183198
225	Nyee Su	Chauk	6.2174195	0.490314
226	Oe Bo	Yenangyoung	3.1603327	1.51733
227	Oe Bo Myo Ma	Magway	2.9924019	0.248654
228	Oe Pauk	Taungdwingyi	12.391827	0.593938
229	Ohn Hmyar Gyi	Chauk	14.960067	0.571082
230	Ohn Hne Tan	Taungdwingyi	6.3189032	0.19588
231	Ohn Taw (1)	Taungdwingyi	2.0451547	0.855925
232	Ohn Taw (2)	Taungdwingyi	1.2168759	0.767184
233	Ohn Twe	Magway	49.82362	0.884597
234	Oke Shit Kone	Yenangyoung	37.748012	0.606042
235	Pa Day Thar	Chauk	2.3612854	0.342855
236	Pa Gway Cho	Natmauk	13.587545	0.695999

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
237	Pa Hta Na Go	Magway	33.248328	0.968801
238	Pa Khan Nge	Chauk	30.693459	1.267279
239	Pa Let Khoke Pin	Natmauk	8.0594885	0.50705
240	Pa Lin Gyi	Myothit	44.06314	0.952647
241	Pa Lin Pyar	Myothit	60.250889	0.742722
242	Pan Be	Chauk	6.8419851	0.253019
243	Pan Nyo	Natmauk	27.052467	0.285564
244	Pan Taw Nge	Taungdwingyi	9.387785	0.486529
245	Pan Thwin Gyi	Taungdwingyi	14.518169	1.065586
246	Pan Thwin Lay	Taungdwingyi	4.426342	0.43915
247	Pat Lel Gyi	Taungdwingyi	41.061121	1.098177
248	Pauk	Taungdwingyi	7.8736408	0.146053
249	Pay Kone	Myothit	17.510407	0.436824
250	Pay Pin Kone	Natmauk	16.289323	0.984219
251	Pay Pin San	Magway	103.94506	0.965102
252	Pay Pin Yar	Taungdwingyi	37.160985	0.589417
253	Pi Tauk Ngoke	Natmauk	4.7999272	0.182615
254	Pin Taing	Taungdwingyi	10.133421	1.334108
255	Pin Wa	Yenangyoung	26.203452	2.204673
256	Poke Pa Kan	Chauk	56.085153	0.922049
257	Pu Htoe	Magway	13.423521	0.270815
258	Pu TeeKone	Myothit	13.319057	0.64992
259	Pwint Hla Gyi	Taungdwingyi	4.294049	0.456851
260	Pyar Tu	Taungdwingyi	4.816629	0.189716
261	Pyi Taw Tar	Magway	0.793601	0.787169
262	Pyint Nyin	Taungdwingyi	4.077093	0.281908
263	Sa Khan Kan	Yenangyoung	29.66358	0.4143
264	Sa Khan Ma	Natmauk	71.720128	0.518831
265	Sa Lay	Chauk	10.905247	2.300339
266	Sa Lin Taung	Chauk	18.509576	0.608772
267	San Ma Gyi	Magway	41.187206	0.529296
268	Sar Lel	Chauk	32.665541	0.613724
269	Sar Shwe Kin	Magway	3.1921292	0.491931
270	Sar Taing	Yenangyoung	34.834046	0.6876
271	Sar Taing Kan	Magway	15.654783	0.490121
272	Sar Taung	Chauk	11.150539	0.477985
273	Sat Thwar	Taungdwingyi	12.907422	1.718743
274	Se Gyi	Natmauk	77.813627	1.282687
275	Se Kan	Chauk	8.2972827	0.192862
276	Se Lel	Myothit	63.808659	0.84963

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
277	Se Lel	Natmauk	60.193869	1.063039
278	Sein Pan Pin	Yenangyoung	19.498512	0.76693
279	Shan Kaing	Taungdwingyi	9.8096397	0.439147
280	Shan Kone	Natmauk	14.141398	0.291303
281	Shar Pin Hla	Magway	19.684291	0.298921
282	Shar Saung Kan	Magway	25.122758	0.46889
283	Shwe Kyar Inn (1)	Taungdwingyi	1.4890371	1.262214
284	Shwe Kyar Inn (2)	Taungdwingyi	0.1075946	0.097288
285	Shwe Kyar Ngon	Yenangyoung	0.582124	0.57282
286	Shwe Oe (1)	Taungdwingyi	0.9369554	0.573686
287	Shwe Oe (2)	Taungdwingyi	0.857742	0.583718
288	Shwe Pan	Myothit	125.61909	0.35363
289	Shwe Pan Taw	Natmauk	36.741154	0.723001
290	Shwe Toke Kan	Yenangyoung	25.29534	0.345115
291	Si Mee Htun	Taungdwingyi	21.562036	0.773756
292	Si Thar	Myothit	43.574939	0.357078
293	Si Thar	Natmauk	17.916379	0.648574
294	Sin Phyu Chi	Myothit	15.534687	0.916716
295	Sin Thay Kan	Natmauk	9.1848413	0.221102
296	Sit Ta Lin	Myothit	29.516964	0.66242
297	Sit Tar	Taungdwingyi	17.931242	0.607539
298	Son Kone Gyi	Natmauk	56.710854	0.906113
299	Son Ma Gyi Pin	Natmauk	14.024808	0.386718
300	Son Taik	Yenangyoung	0.9366535	0.648028
301	Su Kauk Gyi	Taungdwingyi	14.333972	0.561045
302	Su Kauk san	Magway	20.375918	0.308073
303	Su Pyit San	Magway	38.091442	0.323966
304	Su Tat Gyi	Myothit	32.618487	0.89882
305	Su Yit Kan	Chauk	20.858613	0.506724
306	Swei Pauk Kan	Chauk	15.517282	0.748482
307	Ta Khun Taing	Natmauk	50.850022	0.382341
308	Ta Loke Kone	Taungdwingyi	5.5026479	0.446678
309	Ta LOke Pin	Myothit	16.790613	0.621607
310	Ta Ma Lan Pin	Natmauk	27.494397	0.554418
311	Ta Mar Pin	Natmauk	0.5453268	0.502601
312	Ta Pauk Taw	Magway	25.355537	2.035681
313	Ta Yoke Kaw	Taungdwingyi	14.311136	0.629341
314	Taik Pwe	Taungdwingyi	35.678333	0.592539
315	Tat Kone	Magway	22.637428	0.375712
316	Taung Ba Lu	Chauk	18.966454	0.267775

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
317	Taung Bet Gyi	Natmauk	39.791905	0.224467
318	Taung Hlyaung	Taungdwingyi	30.894033	1.301601
319	Taung Htauk	Natmauk	31.136298	0.413913
320	Taung Khwin	Magway	29.448582	0.558899
321	Taung Pyin (1)	Taungdwingyi	1.8342974	1.310265
322	Taung Pyin (2)	Taungdwingyi	0.8497933	0.579287
323	Taung Thar	Chauk	18.756663	0.413494
324	Te Gyi	Natmauk	34.273441	0.242818
325	Tei Pin Kan Pauk	Magway	37.07812	0.446047
326	Tei Pin San	Myothit	16.604782	0.362333
327	Tei Taw (1)	Taungdwingyi	8.5046253	0.314276
328	Tei Taw (2)	Taungdwingyi	16.621803	0.610105
329	Tet Wun	Natmauk	24.439153	0.670801
330	Tha Hmone Pin	Natmauk	46.677686	0.515056
331	Tha Hpan Kone	Myothit	10.432604	0.352336
332	Tha Lone Thway	Chauk	13.703054	0.501497
333	Tha Man Taw	Magway	10.291334	0.295459
334	Tha Mone Kone Gyi	Natmauk	77.50011	1.935296
335	Tha Pyay San	Magway	29.233548	0.417179
336	Tha Yet Chin	Natmauk	48.335899	0.958648
337	Tha Yet Lay Pin	Magway	24.979344	0.742519
338	Than Bo	Chauk	20.831912	1.009873
339	Thar Hmyar	Natmauk	24.948878	0.726821
340	That Kone	Myothit	15.351983	0.591151
341	Thein Gar Gi Ri	Magway	1.4561105	1.314335
342	Thet Yin Taw	Magway	24.479664	0.24013
343	Thi La	Taungdwingyi	3.5325874	0.094793
344	Thi Ri Min Ga Lar	Taungdwingyi	8.8177355	0.073031
345	Thit Hla Kyin	Natmauk	38.30562	0.60224
346	Thit Poke Kone	Taungdwingyi	1.4809751	0.201993
347	Thit Ta Pway	Yenangyoung	3.3336604	0.40539
348	Thit To Kan	Chauk	23.004071	0.446316
349	Thit Yar	Taungdwingyi	15.299666	0.465895
350	Thit Yar Kauk	Magway	40.446212	1.130733
351	Thone Se Chauk	Yenangyoung	41.145321	2.474929
352	Thu Htay Kone	Yenangyoung	4.9315967	0.925442
353	Thway Net	Chauk	30.556951	0.996795
354	Twin Gyi	Natmauk	73.619877	1.039525
355	Twin Kone	Yenangyoung	2.5931527	0.179019
356	Twin Lat	Chauk	18.649966	0.612926

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
357	U Yin	Natmauk	15.152748	0.482707
358	U Yin	Chauk	51.175283	0.462315
359	Wa Thea San	Chauk	11.67229	0.464179
360	War Gyi Aing	Myothit	14.579805	0.767161
361	War Pan	Natmauk	21.366195	0.734052
362	War Thone Pyu	Taungdwingyi	24.670856	0.322153
363	War Yon Kone	Natmauk	37.910059	0.170982
364	Wet Chan Kan	Taungdwingyi	17.196776	0.314668
365	Wet Choke	Natmauk	20.62889	0.361486
366	Wet Ka Thay	Taungdwingyi	17.275487	0.664882
367	Wet Lut Ywar Ma	Yenangyoung	11.568	0.991649
368	Wet Ma Sut	Yenangyoung	66.79298	0.551374
369	Ya Thit	Chauk	16.784061	0.583747
370	Yae Htwet	Natmauk	26.584246	0.486361
371	Yae Pyayt	Myothit	77.329527	1.385577
372	Yae Twin	Chauk	33.53293	0.877398
373	Yae Twin Kaung	Taungdwingyi	87.487334	0.371815
374	Yae U	Taungdwingyi	18.197587	1.281891
375	Yae Wai	Taungdwingyi	24.433192	0.877206
376	Yan Aung Myin	Natmauk	0.2404884	0.230166
377	Yar Gyi Taw	Taungdwingyi	27.654572	0.710267
378	Yaw Ngan	Natmauk	34.586037	0.898965
379	Yin Nar Gwe Chaung	Magway	18.593416	0.187478
380	Yin Thar Si	Magway	20.035238	0.668162
381	Yone Kone	Yenangyoung	44.28486	0.358606
382	Yone Seik Kyun	Yenangyoung	25.188058	0.244402
383	Yone Taw	Myothit	39.73828	0.354087
384	Ywar Haung Kan	Magway	30.001774	0.417811
385	Ywar Ma	Chauk	12.611771	0.19389
386	Ywar Mun	Natmauk	39.84718	2.263976
387	Ywar Taw	Natmauk	27.424494	0.505021
388	Ywar Thar	Magway	41.879682	0.388415
389	Ywar Thit	Yenangyoung	0.9508945	0.885291
390	Ywar Thit Pwe Kyo	Magway	0.406985	0.405405
391	Zaung Taw Kan	Chauk	26.429425	0.617446
392	Zay	Myothit	0.2566023	0.115674
393	Zay Kwet Thit	Natmauk	0.5594427	0.530455
394	Zay Thar	Natmauk	16.641411	0.335883
395	Zee Kone(Zee Lone)	Myothit	31.774426	0.189827
396	Zee Kyun	Magway	12.632813	0.206107

Table 2 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
397	Zee Pwar	Chauk	8.9733283	0.509392
398	Zee Taw	Taungdwingyi	18.96836	1.125738
399	Zel Lel Zoe	Magway	1.9900767	0.495092
400	Forest	Taungdwingyi	502.46868	0.00

Table 3 Details of the references and estimated population data of each census blocks using binary dasymetric method (Magway District)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
1	Ah Lel	19.26	2807	145.71	0.67	4184.54	0.13	0.54	2275.10	118.10	27.61
2	Ah Lel Bo	65.26	5146	78.85	1.03	5017.00	0.36	0.67	3363.39	51.54	27.32
3	Ah Shay Kone	48.54	3268	67.33	0.69	4766.99	0.27	0.41	1964.72	40.48	26.85
4	Aing Gyi Kone	32.09	3342	104.16	0.70	4754.91	0.19	0.51	2433.56	75.85	28.31
5	Aing Ma	120.23	4297	35.74	0.72	5994.78	0.63	0.09	510.08	4.24	31.50
6	Aing Me	22.91	2443	106.64	0.23	10757.87	0.15	0.08	855.74	37.36	69.29
7	Aing Pauk Kone	22.67	1443	63.67	0.35	4142.41	0.15	0.20	839.35	37.03	26.63
8	Aing Zauk	24.26	3155	130.07	0.81	3910.39	0.15	0.66	2563.03	105.67	24.41
9	Aung Chan Thar	1.21	6280	5179.66	0.91	6912.53	0.04	0.87	6033.50	4976.35	203.31
10	Aung Min Galar	1.56	8290	5327.32	1.15	7191.24	0.04	1.12	8029.99	5160.23	167.09
11	Aung Myit Thar	5.89	10793	1833.97	2.69	4006.14	0.02	2.68	10729.08	1823.11	10.86
12	Aung San	0.62	2951	4769.75	0.58	5120.38	0.00	0.58	2949.92	4768.00	1.75
13	Aung Su	36.59	5080	138.82	0.83	6130.72	0.18	0.65	3983.69	108.86	29.96
14	Aung Ya Danar	1.80	8036	4474.25	1.51	5330.71	0.00	1.51	8028.31	4469.96	4.28
15	Aw Zar Taw	14.12	2031	143.86	0.36	5576.38	0.07	0.30	1647.52	116.70	27.16
16	Ba Seik	33.72	1639	48.61	0.39	4169.42	0.17	0.23	944.33	28.01	20.60
17	Ban Kone	24.90	1812	72.78	0.47	3890.27	0.12	0.34	1336.77	53.69	19.09
18	Bawt	74.05	1069	14.44	0.46	2324.45	0.37	0.09	213.70	2.89	11.55
19	Bay Mei	19.70	2369	120.25	0.76	3109.76	0.09	0.67	2074.52	105.30	14.95
20	Bo Kone	4.28	1647	384.97	0.44	3774.93	0.02	0.42	1574.49	368.02	16.95
21	Bo Kone	1.55	1739	1122.11	0.07	24819.20	0.01	0.06	1555.38	1003.62	118.49
22	Bon	1.74	1408	806.97	0.34	4167.16	0.01	0.33	1378.69	790.17	16.80
23	Bone Taw Pyayt	18.62	3288	176.60	0.58	5621.13	0.09	0.49	2781.15	149.37	27.22

Table 3 (Continute)

No	VTName	Area Km2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km2	Estimated Population	Estimated PD	Residual
26	Chaing	46.02	2572	55.88	0.48	5361.55	0.23	0.25	1351.08	29.36	26.53
27	Chauk Kyar	8.61	1894	219.89	0.35	5424.86	0.04	0.31	1669.84	193.87	26.02
28	Chaung Net	50.71	2188	43.15	1.77	1234.15	0.24	1.53	1886.02	37.19	5.96
29	Chaung Net	19.45	7154	367.75	0.38	18953.86	0.10	0.28	5346.21	274.82	92.93
30	Chaung Son	24.46	2052	83.90	0.38	5433.39	0.12	0.26	1397.83	57.15	26.75
31	Chaung Tet	29.60	2894	97.76	0.62	4674.23	0.14	0.47	2216.59	74.87	22.88
32	Da Hat Kan	7.58	1777	234.44	0.26	6716.79	0.04	0.23	1531.33	202.03	32.41
33	Dan Dalun Pin	27.41	6206	226.40	1.07	5792.54	0.13	0.94	5443.11	198.57	27.83
34	Dant Da Lun Pin	15.91	3173	199.47	0.79	4039.09	0.08	0.71	2867.61	180.27	19.20
35	Dat Myay Aww Zwar	4.87	2642	542.14	1.11	2374.93	0.02	1.09	2597.34	532.97	9.16
36	Gone Nyin Ton	33.43	5530	165.41	1.70	3248.60	0.16	1.54	5014.61	149.99	15.42
37	Gway Cho	26.04	4196	161.14	0.40	10402.81	0.13	0.28	2862.53	109.93	51.21
38	Gway Cho	13.03	2142	164.35	1.35	1589.33	0.06	1.29	2049.14	157.22	7.12
39	Gway Kone	9.40	2128	226.36	0.49	4372.57	0.04	0.44	1933.11	205.63	20.73
40	Gway Kone	30.19	2098	69.48	0.46	4587.46	0.15	0.31	1415.90	46.89	22.59
41	Gway Pin	32.01	2533	79.12	0.47	5408.86	0.16	0.31	1679.88	52.47	26.65
42	Gway Pin Gyi	13.84	2017	145.73	0.44	4571.54	0.07	0.37	1710.71	123.60	22.13
43	Gway Pin Ywar Thit	23.84	4978	208.80	1.34	3714.05	0.11	1.23	4560.16	191.28	17.53
44	Gwe Tauk Kone	28.63	3353	117.13	0.84	3994.77	0.14	0.70	2797.99	97.74	19.39
45	Gyoe Gyar Kan	20.78	1989	95.72	0.51	3884.99	0.10	0.41	1595.32	76.78	18.95
46	Gyoke Kone	35.64	3305	92.75	0.89	3719.55	0.17	0.71	2658.79	74.61	18.13
47	Hin Ga Yaw	18.01	3903	216.70	1.15	3400.67	0.08	1.06	3616.27	200.78	15.92
48	Hle Pwe Gyi	44.55	1554	34.88	0.27	5783.52	0.22	0.05	273.55	6.14	28.74
49	Hlyaw Chaung Gyi	68.78	3681	53.51	0.79	4678.22	0.34	0.45	2090.46	30.39	23.12

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
50	Hmoke Shey	27.23	2127	78.11	0.76	2794.78	0.13	0.63	1757.10	64.52	13.58
51	Hpa Lan Taing	7.34	3734	508.90	0.66	5683.01	0.03	0.62	3544.18	483.03	25.87
52	Hpa Yar Gyi	0.92	1785	1938.84	0.58	3100.99	0.00	0.57	1779.65	1933.03	5.81
53	Hpa Yar Kone	22.42	2027	90.41	0.31	6591.28	0.11	0.20	1298.25	57.91	32.50
54	Hpa Yar Pyo	33.33	3120	93.60	0.58	5349.01	0.16	0.42	2244.06	67.32	26.28
55	Hpan Khar San	15.21	1545	101.60	0.40	3902.16	0.07	0.32	1256.04	82.60	19.00
56	Hpaung Ka Taw	3.57	1634	458.06	0.41	3950.85	0.02	0.40	1571.70	440.59	17.46
57	Hpaung Kwe	38.19	2305	60.36	0.40	5692.93	0.19	0.22	1229.49	32.19	28.16
58	Hpet Than Taung	8.49	2120	249.82	0.52	4088.31	0.04	0.48	1957.13	230.63	19.19
59	Hpoe Koe	26.59	2885	108.48	0.50	5714.79	0.13	0.37	2139.53	80.45	28.03
60	Hpoe Lay lone	31.09	3742	120.38	0.60	6231.02	0.15	0.45	2792.22	89.82	30.55
61	Hpoke Kone	14.95	2080	139.15	0.40	5223.97	0.07	0.33	1699.95	113.72	25.42
62	Htan Pin Kone Gyi	29.38	1818	61.87	0.27	6762.80	0.15	0.12	833.55	28.37	33.50
63	Htan Ta Pin	15.48	3828	247.35	0.81	4715.53	0.07	0.74	3482.25	225.01	22.34
64	Htauk Shar Tan	44.05	3792	86.09	1.15	3305.89	0.21	0.93	3082.91	69.99	16.10
65	Htein Kan	25.81	4094	158.63	0.69	5950.90	0.13	0.56	3346.56	129.67	28.96
66	Htein San	25.91	2358	91.01	0.69	3427.51	0.13	0.56	1925.76	74.33	16.68
67	Htone Pauk Chaing	20.54	3468	168.81	0.51	6748.86	0.10	0.41	2792.12	135.91	32.90
68	In Kone	10.40	2650	254.69	0.52	5123.09	0.05	0.47	2396.73	230.35	24.34
69	In Kyin Kone	11.51	2150	186.75	0.57	3793.42	0.05	0.51	1942.39	168.72	18.03
70	In Taing Gyi	42.03	4361	103.76	0.95	4585.15	0.21	0.75	3419.21	81.35	22.41
71	In Taw	64.19	4926	76.74	0.89	5531.15	0.32	0.57	3175.42	49.47	27.27
72	Inn Kan	45.52	2269	49.85	0.72	3158.05	0.22	0.49	1561.63	34.31	15.54
73	Inn Kone (North)	26.13	1845	70.61	0.42	4414.66	0.13	0.29	1277.50	48.89	21.72
74	Inn Ywar Gyi	25.01	4867	194.60	0.76	6417.88	0.12	0.64	4088.79	163.49	31.12

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
75	Inn Ywar Gyi	6.81	559	82.08	0.26	2127.40	0.03	0.23	489.35	71.85	10.23
76	Ka Paung Kone	23.78	1550	65.18	0.28	5586.89	0.12	0.16	893.50	37.58	27.61
77	Kaing	11.73	1762	150.22	0.37	4726.95	0.06	0.32	1493.59	127.34	22.88
78	Kamma	10.08	2687	266.65	0.49	5490.56	0.05	0.44	2423.79	240.53	26.12
79	Kan Bay Gyi	17.72	3552	200.47	1.11	3201.88	0.08	1.03	3286.10	185.46	15.01
80	Kan Gyi	0.32	1573	4927.09	0.26	5973.14	0.00	0.26	1571.33	4921.85	5.23
81	Kan Gyi	30.60	2779	90.83	0.54	5108.52	0.15	0.39	2011.38	65.74	25.09
82	Kan Gyi Kone	59.61	3498	58.68	1.52	2302.70	0.29	1.23	2829.16	47.46	11.22
83	Kan Pyar	11.36	4763	419.20	0.55	8726.87	0.05	0.49	4291.03	377.66	41.54
84	Kan Swie	17.94	1499	83.56	0.22	6762.05	0.09	0.13	899.96	50.17	33.39
85	Kan Taw	20.86	2254	108.03	0.34	6658.75	0.10	0.24	1570.63	75.28	32.75
86	Kan Thar	0.99	7409	7506.20	0.88	8416.43	0.00	0.88	7404.51	7501.65	4.55
87	Kan Thar	20.94	1581	75.49	0.66	2398.98	0.10	0.56	1337.68	63.87	11.62
88	Kan Thar	38.97	2547	65.35	0.34	7428.98	0.19	0.15	1112.10	28.54	36.82
89	Kan Thar Gyi	17.74	2281	128.61	0.44	5139.66	0.09	0.36	1836.62	103.55	25.06
90	Kayin	12.69	2080	163.95	0.34	6156.70	0.06	0.28	1699.86	133.99	29.96
91	Khin Te	20.38	4214	206.73	0.91	4615.09	0.10	0.82	3764.70	184.69	22.04
92	Kin Pun Taung	20.33	9112	448.23	2.00	4557.92	0.09	1.91	8694.28	427.68	20.55
93	Koe Pin	11.86	1794	151.21	0.76	2366.70	0.06	0.70	1662.58	140.13	11.08
94	Koke Ko Gwa	9.49	2606	274.47	0.69	3798.66	0.04	0.64	2438.70	256.85	17.62
95	Koke Ko Gwa	37.58	3533	94.02	0.53	6605.80	0.19	0.35	2309.51	61.46	32.56
96	Koke Ko Kone	32.02	7927	247.55	2.18	3632.57	0.15	2.03	7385.04	230.63	16.93
97	Ku Lar Kan	9.11	3117	342.24	0.67	4637.16	0.04	0.63	2921.42	320.76	21.47
98	Ku Lar Ma	18.78	5258	279.98	1.03	5080.33	0.09	0.95	4807.25	255.98	24.00
99	Ku Lar Shin	27.48	2082	75.78	0.40	5263.43	0.14	0.26	1369.34	49.84	25.94

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km2	Estimated Population	Estimated PD	Residual
100	Kun Ohn	43.54	1518	34.87	0.27	5530.61	0.22	0.06	321.60	7.39	27.48
101	Kwet Thit	1.51	2794	1846.64	0.67	4200.56	0.00	0.66	2776.19	1834.87	11.77
102	Kwin Gyi	112.48	1746	15.52	2.64	662.40	0.55	2.09	1382.20	12.29	3.23
103	Kwin Gyi	43.11	2601	60.34	0.42	6156.86	0.21	0.21	1286.96	29.85	30.48
104	Kya Khat Kan	7.02	1289	183.53	0.91	1414.54	0.03	0.88	1245.77	177.38	6.16
105	Kyan Kaing Kyun	16.47	2071	125.74	0.94	2211.25	0.08	0.86	1899.26	115.31	10.43
106	Kyan Su	8.91	1437	161.32	0.39	3657.36	0.04	0.35	1281.29	143.84	17.48
107	Kyar Kan	70.57	7295	103.37	4.20	1735.91	0.33	3.87	6718.97	95.21	8.16
108	Kyauk Pon	13.07	1426	109.11	0.33	4353.46	0.06	0.26	1148.64	87.89	21.22
109	Kyauk Ta Gar	39.06	1342	34.36	0.35	3801.86	0.19	0.16	606.22	15.52	18.84
110	Kyauk Tan	35.87	1738	48.46	0.90	1936.13	0.17	0.72	1399.49	39.02	9.44
111	Kyauk Tan	79.00	5786	73.24	0.30	19458.94	0.08	0.22	4254.54	53.86	19.39
112	Kyauk Ye	26.81	1945	72.55	0.54	3591.38	0.13	0.41	1473.34	54.96	17.59
113	Kyaung Kone	28.10	2530	90.03	0.61	4139.55	0.14	0.47	1960.98	69.78	20.25
114	Kyaung Yar Taw	17.99	2649	147.24	0.71	3757.15	0.09	0.62	2324.28	129.19	18.05
115	Kyet Shar	8.10	2248	277.48	0.62	3639.54	0.04	0.58	2111.81	260.67	16.81
116	Kyit Son Pway	41.38	4279	103.41	0.56	7701.85	0.20	0.35	2706.85	65.41	37.99
117	Kyoet Chaung	60.52	4912	81.16	2.26	2170.91	0.29	1.97	4279.62	70.71	10.45
118	Kyoet Pin	17.81	2144	120.38	0.57	3732.24	0.09	0.49	1822.35	102.32	18.06
119	Kyun Chaung	26.93	2164	80.36	0.54	4010.96	0.13	0.41	1634.75	60.70	19.65
120	Kyun Pyat	12.47	2378	190.71	0.27	8918.76	0.06	0.21	1833.84	147.07	43.64
121	Kywe Kan	7.14	453	63.42	0.11	4030.26	0.04	0.08	311.34	43.59	19.83
122	Kywe Tat	14.36	1706	118.76	0.30	5683.17	0.07	0.23	1306.35	90.94	27.82
123	Lat Pa Taw	14.31	1787	124.87	0.46	3864.29	0.07	0.39	1519.44	106.18	18.70
124	Lay Ein	27.11	2196	81.02	0.50	4423.53	0.13	0.36	1607.47	59.30	21.71

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
125	Lay Pin Kone	23.99	2585	107.78	0.42	6164.65	0.12	0.30	1858.63	77.49	30.28
126	Lay Taing Sin	60.71	8740	143.96	1.76	4968.85	0.29	1.46	7275.40	119.84	24.12
127	Lay Taing Sin	21.59	1354	62.71	0.19	7143.21	0.11	0.08	589.60	27.31	35.40
128	Le Bu	48.07	6401	133.15	1.15	5589.37	0.23	0.91	5089.48	105.87	27.28
129	Le Lu	59.21	3689	62.31	0.72	5128.86	0.29	0.43	2189.17	36.98	25.33
130	Leik Taik	44.11	1670	37.86	0.28	6008.68	0.22	0.06	353.27	8.01	29.85
131	Lel Pyin	0.53	1486	2808.35	0.25	6008.86	0.00	0.25	1477.53	2792.35	16.00
132	Lel Thar (1)	3.69	2885	782.79	0.61	4768.36	0.02	0.59	2811.56	762.86	19.93
133	Lel Thar (2)	12.47	3687	295.59	0.88	4177.06	0.06	0.82	3444.93	276.18	19.41
134	Lel Yar	27.41	3075	112.17	0.78	3967.15	0.13	0.64	2546.59	92.89	19.27
135	Let Pan Bu	22.94	965	42.06	0.18	5417.53	0.11	0.06	348.35	15.18	26.88
136	Let Pan Kyun	29.17	2771	95.01	0.77	3593.22	0.14	0.63	2260.86	77.52	17.49
137	Let Pan Shey	13.60	2556	187.88	0.60	4260.31	0.07	0.53	2278.98	167.52	20.36
138	Let Pu To	14.11	794	56.27	0.16	4920.39	0.07	0.09	450.80	31.95	24.32
139	Let Tet	49.80	2427	48.73	0.42	5718.13	0.25	0.18	1015.29	20.39	28.35
140	Lin Ka Toe	14.56	1562	107.25	0.39	3994.24	0.07	0.32	1278.94	87.81	19.43
141	Lin Lei	25.91	2893	111.65	0.64	4517.57	0.13	0.51	2322.18	89.62	22.03
142	Lin Ta Kaing	8.79	1005	114.32	0.19	5166.90	0.04	0.15	782.92	89.06	25.26
143	Lint Myint	52.76	3797	71.97	0.87	4352.70	0.26	0.61	2667.76	50.56	21.40
144	Ma Gyi Chay Htauk	40.00	3027	75.67	0.51	5944.87	0.20	0.31	1853.02	46.32	29.35
145	Ma Gyi Cho	23.17	3873	167.13	0.62	6256.88	0.11	0.51	3167.40	136.68	30.45
146	Ma Gyi Cho	17.40	1923	110.49	0.48	4029.52	0.08	0.39	1581.97	90.90	19.60
147	Ma Gyi Htu	27.88	3709	133.01	0.77	4847.05	0.14	0.63	3051.75	109.44	23.57
148	Ma Gyi Kan	8.09	1876	231.86	2.28	821.13	0.03	2.26	1852.16	228.91	2.95

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km2	Estimated Population	Estimated PD	Residual
149	Ma Gyi Kan	14.41	6706	465.53	0.84	7994.85	0.07	0.77	6163.69	427.88	37.65
150	Ma Gyi Kan	49.65	4148	83.54	0.50	8234.05	0.25	0.26	2124.49	42.79	40.75
151	Ma Gyi Kone	17.59	1870	106.32	0.23	8231.81	0.09	0.14	1155.43	65.69	40.63
152	Ma Gyin Kone Gyi	31.75	5009	157.75	0.75	6718.15	0.16	0.59	3967.43	124.95	32.80
153	Ma Nawt Kone	11.37	987	86.81	0.19	5240.72	0.06	0.13	694.01	61.04	25.77
154	Man Myay	32.88	4783	145.49	1.01	4729.43	0.16	0.85	4029.51	122.57	22.92
155	Maung Taing (2)	1.60	7132	4449.14	0.55	12994.88	0.01	0.54	7063.51	4406.41	42.73
156	Maung Taing(1)	0.70	2617	3725.18	0.66	3975.14	0.00	0.66	2616.12	3723.93	1.25
157	May Hla Taung	19.95	5093	255.33	0.73	6993.40	0.10	0.63	4420.98	221.64	33.69
158	Mei Za Li Pin	24.82	2593	104.47	0.41	6364.72	0.12	0.29	1816.11	73.17	31.30
159	Mi Au Aung	16.78	1643	97.91	0.09	18029.66	0.08	0.01	138.47	8.25	89.66
160	Mi Kyaung Ye	13.48	4103	304.36	1.01	4063.53	0.06	0.95	3849.62	285.56	18.80
161	Min	62.26	3834	61.58	0.68	5674.82	0.31	0.37	2086.64	33.52	28.07
162	Min	0.54	1145	2109.23	0.15	7504.07	0.00	0.15	1130.36	2082.25	26.97
163	Min Kan Gyi	3.83	10419	2717.33	1.79	5827.72	0.01	1.78	10359.37	2701.78	15.55
164	Moe Nan Taw	10.34	1075	103.98	0.33	3243.80	0.05	0.28	912.69	88.28	15.70
165	Myat Lay Kone	14.03	692	49.32	0.15	4679.21	0.07	0.08	367.17	26.17	23.15
166	Myay Ni Khin (North)	2.48	2446	985.30	0.05	45079.00	0.01	0.04	1898.69	764.83	220.47
167	Myay Ni Khin (South)	2.33	2803	1205.26	1.74	1611.27	0.00	1.74	2798.28	1203.23	2.03
168	Myay Nu	9.29	845	90.92	0.21	4085.16	0.05	0.16	659.39	70.95	19.97
169	Myay Pa Don	19.92	2741	137.57	0.41	6747.11	0.10	0.31	2082.53	104.52	33.05
170	Myay Pin Thar	44.03	6872	156.08	1.16	5940.90	0.21	0.94	5598.51	127.16	28.92
171	Myay Sun	23.02	3195	138.77	0.67	4757.42	0.11	0.56	2663.32	115.68	23.09
172	Myin Kun	20.93	5224	249.56	1.27	4108.00	0.10	1.17	4820.16	230.27	19.29
173	Myin Saing	28.73	2549	88.72	0.48	5262.44	0.14	0.34	1805.81	62.86	25.87

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km2	Estimated Population	Estimated PD	Residual
174	Myin Te Gyi	40.40	5571	137.90	0.68	8137.45	0.20	0.49	3955.16	97.90	40.00
175	Myin Thar	1.10	6332	5745.60	0.41	15416.37	0.00	0.41	6278.71	5697.25	48.35
176	Myit Thar Si	30.31	1753	57.83	0.34	5082.76	0.15	0.20	991.42	32.71	25.12
177	Myo Haung	1.54	4688	3049.13	0.24	19872.29	0.01	0.23	4558.67	2965.02	84.12
178	Myo Lu Lin	18.94	3980	210.18	0.83	4779.11	0.09	0.74	3547.42	187.34	22.84
179	Myo Ma	0.58	1899	3288.87	0.41	4579.88	0.00	0.41	1895.27	3282.41	6.46
180	Myo Ma (North)	1.00	3913	3911.93	0.61	6373.76	0.00	0.61	3900.69	3899.62	12.31
181	Myo Ma (South)	0.60	2227	3699.90	0.19	11486.45	0.00	0.19	2203.57	3660.97	38.93
182	Myo Ma Kwet Thit	0.28	1704	6186.58	0.26	6557.65	0.05	0.21	1384.24	5025.66	1160.91
183	Na Be Kone	7.73	1703	220.28	0.37	4609.01	0.04	0.33	1533.35	198.34	21.94
184	Na Gar	39.95	3557	89.04	0.52	6890.00	0.20	0.32	2198.49	55.03	34.00
185	Na Gway Chao	32.60	2553	78.32	0.48	5371.92	0.16	0.31	1690.24	51.85	26.47
186	Na Ywe Taw	16.45	2362	143.57	0.40	5926.44	0.08	0.32	1886.30	114.65	28.91
187	Na-Bu Kwe	22.16	1956	88.28	0.44	4406.09	0.11	0.34	1477.66	66.69	21.59
188	Na-Kyar Htu	14.20	2193	154.44	0.52	4183.04	0.07	0.46	1906.98	134.30	20.14
189	Nan Kat Kyun	16.20	11889	734.00	3.29	3613.73	0.06	3.23	11655.78	719.61	14.40
190	Nat Kan	10.79	2177	201.81	0.29	7390.16	0.05	0.24	1789.27	165.86	35.94
191	Nat-Let Khoke Pin	31.84	3562	111.87	0.69	5193.78	0.16	0.53	2752.92	86.46	25.41
192	Nga Min	34.39	7436	216.22	1.01	7397.94	0.17	0.84	6201.10	180.32	35.91
193	Ngar Saung	35.50	3765	106.06	0.90	4161.74	0.17	0.73	3045.14	85.78	20.28
194	Nin Kyan	30.85	3752	121.62	0.76	4928.44	0.15	0.61	3010.57	97.59	24.03
195	No (1) Ward	6.32	2990	473.31	0.35	8432.56	0.03	0.32	2738.60	433.51	39.80
196	No (10) Ward	0.32	4830	15069.50	0.28	17060.32	0.00	0.28	4826.81	15059.55	9.95
197	No (11) Ward	0.14	1467	10524.98	0.13	10915.08	0.06	0.07	771.94	5538.29	4986.69
198	No (12) Ward	0.23	2026	8826.30	0.22	9201.85	0.00	0.22	2025.57	8824.43	1.88

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
199	No (13) Ward	0.52	2384	4550.56	0.39	6077.53	0.00	0.39	2380.00	4542.92	7.63
200	No (14) Ward	4.09	5049	1233.74	1.63	3090.72	0.01	1.62	5011.00	1224.46	9.28
201	No (15) Ward	2.30	7035	3055.52	1.70	4135.07	0.00	1.70	7022.57	3050.13	5.40
202	No (2) Ward	0.63	1149	1833.56	0.18	6236.15	0.00	0.18	1135.21	1811.55	22.01
203	No (3) Ward	0.30	992	3310.17	0.24	4187.98	0.00	0.24	990.68	3305.78	4.39
204	No (4) Ward	1.59	3023	1897.79	0.50	6070.13	0.01	0.49	2989.77	1876.93	20.86
205	No (5) Ward	0.53	3555	6652.32	0.41	8711.97	0.00	0.41	3549.50	6642.02	10.30
206	No (6) Ward	0.15	3189	21018.98	0.15	21774.76	0.07	0.07	1604.41	10574.80	10444.18
207	No (7) Ward	0.60	3111	5217.03	0.24	13022.32	0.00	0.24	3087.73	5178.00	39.03
208	No (8) Ward	0.48	2665	5498.60	0.26	10126.63	0.00	0.26	2653.78	5475.46	23.14
209	No (9) Ward	0.23	1611	6871.55	0.22	7193.00	0.08	0.14	1012.83	4320.10	2551.44
210	Nwar Hla	23.73	2954	124.48	0.48	6141.77	0.12	0.36	2240.02	94.39	30.09
211	Nyar Ga Moe	7.40	3843	519.45	1.10	3484.08	0.03	1.07	3733.33	504.62	14.82
212	Nyar Taw	83.48	2113	25.31	0.34	6137.86	0.08	0.26	1602.74	19.20	6.11
213	Nyaung Chaung	10.43	2840	272.23	0.29	9861.05	0.05	0.24	2339.83	224.28	47.94
214	Nyaung Hla	5.78	3724	643.74	1.10	3397.71	0.02	1.07	3644.34	629.97	13.77
215	Nyaung Kaing	19.36	1620	83.68	0.35	4625.86	0.10	0.26	1180.33	60.97	22.71
216	Nyaung Kan	35.31	4041	114.46	0.85	4761.02	0.17	0.68	3220.73	91.22	23.23
217	Nyaung Kone	3.94	1365	346.67	0.28	4836.05	0.02	0.26	1276.61	324.22	22.45
218	Nyaung Kyat Pin	14.00	2235	159.68	0.56	4021.31	0.07	0.49	1964.75	140.37	19.31
219	Nyaung Kyat San	7.02	610	86.89	0.11	5720.17	0.03	0.07	412.27	58.73	28.17
220	Nyaung Pin	28.90	2196	75.98	0.40	5504.56	0.14	0.26	1411.49	48.84	27.14
221	Nyaung Pin Aint	78.35	3332	42.53	0.65	5103.29	0.39	0.26	1349.46	17.22	25.30
222	Nyaung Pin Hla	5.05	3077	609.14	0.84	3675.11	0.02	0.82	2999.56	593.81	15.33
223	Nyaung Zin	24.35	1175	48.26	0.55	2117.26	0.12	0.44	923.14	37.92	10.34

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
224	Nyaung Zin	9.77	2188	223.90	0.18	11943.39	0.05	0.14	1615.36	165.30	58.60
225	Nyee Su	6.22	1671	268.76	0.49	3408.02	0.03	0.46	1573.41	253.06	15.70
226	Oe Bo	3.16	2802	886.62	1.52	1846.66	0.01	1.51	2786.83	881.82	4.80
227	Oe Bo Myo Ma	2.99	1406	469.86	0.25	5654.44	0.01	0.23	1328.43	443.93	25.92
228	Oe Pauk	12.39	2266	182.86	0.59	3815.21	0.06	0.53	2040.94	164.70	18.16
229	Ohn Hmyar Gyi	14.96	1584	105.88	0.57	2773.68	0.07	0.50	1384.45	92.54	13.34
230	Ohn Hne Tan	6.32	1208	191.17	0.20	6167.04	0.03	0.17	1019.20	161.29	29.88
231	Ohn Taw (1)	2.05	4952	2421.33	0.86	5785.55	0.01	0.85	4917.60	2404.51	16.82
232	Ohn Taw (2)	1.22	4536	3727.58	0.77	5912.53	0.00	0.76	4522.71	3716.65	10.92
233	Ohn Twe	49.82	3308	66.39	0.88	3739.56	0.24	0.64	2392.95	48.03	18.37
234	Oke Shit Kone	37.75	4013	106.31	0.61	6621.66	0.19	0.42	2783.29	73.73	32.58
235	Pa Day Thar	2.36	1733	733.92	0.34	5054.62	0.01	0.33	1681.99	712.32	21.60
236	Pa Gway Cho	13.59	2693	198.20	0.70	3869.26	0.06	0.63	2443.60	179.84	18.36
237	Pa Hta Na Go	33.25	4568	137.39	0.97	4715.11	0.16	0.81	3806.99	114.50	22.89
238	Pa Khan Nge	30.69	6161	200.73	1.27	4861.60	0.15	1.12	5445.71	177.42	23.30
239	Pa Let Khoke Pin	8.06	1875	232.65	0.51	3697.86	0.04	0.47	1735.36	215.32	17.33
240	Pa Lin Gyi	44.06	3826	86.83	0.95	4016.18	0.22	0.74	2960.30	67.18	19.65
241	Pa Lin Pyar	60.25	3518	58.39	0.74	4736.63	0.30	0.45	2108.66	35.00	23.39
242	Pan Be	6.84	1313	191.90	0.25	5189.33	0.03	0.22	1142.04	166.92	24.99
243	Pan Nyo	27.05	2477	91.56	0.29	8674.05	0.13	0.15	1316.11	48.65	42.91
244	Pan Taw Nge	9.39	2885	307.31	0.49	5929.76	0.04	0.44	2621.09	279.20	28.11
245	Pan Thwin Gyi	14.52	4154	286.12	1.07	3898.32	0.07	1.00	3891.79	268.06	18.06
246	Pan Thwin Lay	4.43	1896	428.34	0.44	4317.43	0.02	0.42	1809.93	408.90	19.45
247	Pat Lel Gyi	41.06	3750	91.33	1.10	3414.75	0.20	0.90	3067.68	74.71	16.62
248	Pauk	7.87	786	99.83	0.15	5381.59	0.04	0.11	578.07	73.42	26.41

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
251	Pay Pin San	103.95	5458	52.51	0.97	5655.36	0.51	0.45	2546.06	24.49	28.01
252	Pay Pin Yar	37.16	2521	67.84	0.59	4277.11	0.18	0.41	1738.90	46.79	21.05
253	Pi Tauk Ngoke	4.80	1499	312.30	0.18	8208.52	0.02	0.16	1309.49	272.82	39.48
254	Pin Taing	10.13	4079	402.53	1.33	3057.47	0.04	1.29	3944.48	389.25	13.27
255	Pin Wa	26.20	7048	268.97	2.20	3196.85	0.12	2.08	6664.40	254.33	14.64
256	Poke Pa Kan	56.09	4336	77.31	0.92	4702.57	0.28	0.65	3038.96	54.18	23.13
257	Pu Htoe	13.42	1582	117.85	0.27	5841.63	0.07	0.21	1197.83	89.23	28.62
258	Pu TeeKone	13.32	3481	261.35	0.65	5356.04	0.06	0.59	3141.72	235.88	25.47
259	Pwint Hla Gyi	4.29	2495	581.04	0.46	5461.30	0.02	0.44	2390.22	556.64	24.40
260	Pyar Tu	4.82	1062	220.49	0.19	5597.83	0.02	0.17	932.50	193.60	26.89
261	Pyi Taw Tar	0.79	5602	7058.96	0.79	7116.64	0.06	0.73	5205.45	6559.27	499.69
262	Pyint Nyin	4.08	1562	383.12	0.28	5540.82	0.02	0.26	1456.86	357.33	25.79
263	Sa Khan Kan	29.66	2233	75.28	0.41	5389.82	0.15	0.27	1444.76	48.70	26.57
264	Sa Khan Ma	71.72	2616	36.48	0.52	5042.10	0.36	0.16	820.98	11.45	25.03
265	Sa Lay	10.91	6695	613.92	2.30	2910.44	0.04	2.26	6569.78	602.44	11.48
266	Sa Lin Taung	18.51	4930	266.35	0.61	8098.27	0.09	0.52	4205.17	227.19	39.16
267	San Ma Gyi	41.19	3023	73.40	0.53	5711.36	0.20	0.33	1861.94	45.21	28.19
268	Sar Lel	32.67	4176	127.84	0.61	6804.37	0.16	0.45	3085.54	94.46	33.38
269	Sar Shwe Kin	3.19	5953	1864.90	0.49	12101.28	0.01	0.48	5789.62	1813.72	51.18
270	Sar Taing	34.83	1081	31.03	0.69	1572.13	0.17	0.52	812.59	23.33	7.71
271	Sar Taing Kan	15.65	6921	442.10	0.49	14121.01	0.08	0.41	5850.30	373.71	68.39
272	Sar Taung	11.15	2169	194.52	0.48	4537.80	0.05	0.42	1926.85	172.80	21.72
273	Sat Thwar	12.91	6881	533.10	1.72	4003.51	0.06	1.66	6657.03	515.75	17.35
274	Se Gyi	77.81	4273	54.91	1.28	3331.29	0.38	0.90	2998.27	38.53	16.38
275	Se Kan	8.30	1064	128.23	0.19	5516.90	0.04	0.15	840.44	101.29	26.94

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
276	Se Lel	63.81	4348	68.14	0.85	5117.52	0.31	0.53	2737.03	42.89	25.25
277	Se Lel	60.19	3396	56.42	1.06	3194.61	0.30	0.77	2451.50	40.73	15.69
278	Sein Pan Pin	19.50	4123	211.45	0.77	5375.98	0.09	0.67	3619.50	185.63	25.82
279	Shan Kaing	9.81	2079	211.93	0.44	4734.18	0.05	0.39	1857.19	189.32	22.61
280	Shan Kone	14.14	909	64.28	0.29	3120.47	0.07	0.22	692.91	49.00	15.28
281	Shar Pin Hla	19.68	2113	107.34	0.30	7068.77	0.10	0.20	1427.85	72.54	34.81
282	Shar Saung Kan	25.12	2827	112.53	0.47	6029.13	0.12	0.35	2083.79	82.94	29.58
283	Shwe Kyar Inn (1)	1.49	4881	3277.96	1.26	3867.02	0.00	1.26	4876.61	3275.01	2.95
284	Shwe Kyar Inn (2)	0.11	1744	16208.99	0.10	17926.12	0.10	0.00	40.42	375.71	15833.27
285	Shwe Kyar Ngon	0.58	2039	3502.69	0.57	3559.58	0.12	0.45	1599.54	2747.76	754.93
286	Shwe Oe (1)	0.94	6432	6864.79	0.57	11211.71	0.00	0.57	6411.64	6843.05	21.73
287	Shwe Oe (2)	0.86	4883	5692.85	0.58	8365.34	0.00	0.58	4871.54	5679.49	13.36
288	Shwe Pan	125.62	5632	44.83	0.35	15926.26	0.13	0.23	3636.99	28.95	15.88
289	Shwe Pan Taw	36.74	1804	49.10	0.72	2495.15	0.18	0.54	1354.65	36.87	12.23
290	Shwe Toke Kan	25.30	2206	87.21	0.35	6392.08	0.12	0.22	1408.58	55.69	31.52
291	Si Mee Htun	21.56	2754	127.72	0.77	3559.26	0.10	0.67	2384.05	110.57	17.16
292	Si Thar	43.57	943	21.64	0.36	2640.88	0.22	0.14	372.33	8.54	13.10
293	Si Thar	17.92	3201	178.66	0.65	4935.44	0.09	0.56	2774.88	154.88	23.78
294	Sin Phyu Chi	15.53	2261	145.55	0.92	2466.41	0.07	0.84	2080.73	133.94	11.60
295	Sin Thay Kan	9.18	1182	128.69	0.22	5345.96	0.04	0.18	942.40	102.60	26.09
296	Sit Ta Lin	29.52	3640	123.32	0.66	5495.00	0.14	0.52	2847.22	96.46	26.86
297	Sit Tar	17.93	4177	232.95	0.61	6875.27	0.09	0.52	3581.47	199.73	33.21
298	Son Kone Gyi	56.71	2841	50.10	0.91	3135.37	0.28	0.63	1966.16	34.67	15.43
299	Son Ma Gyi Pin	14.02	2161	154.08	0.39	5588.05	0.07	0.32	1779.95	126.91	27.17
300	Son Taik	0.94	2814	3004.31	0.65	4342.41	0.00	0.65	2807.73	2997.62	6.69

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
301	Su Kauk Gyi	14.33	2770	193.25	0.56	4937.21	0.07	0.49	2430.00	169.53	23.72
302	Su Kauk san	20.38	1882	92.36	0.31	6108.94	0.10	0.21	1269.03	62.28	30.08
303	Su Pyit San	38.09	1648	43.26	0.32	5086.96	0.19	0.14	687.39	18.05	25.22
304	Su Tat Gyi	32.62	5946	182.29	0.90	6615.34	0.16	0.74	4896.82	150.12	32.17
305	Su Yit Kan	20.86	2876	137.88	0.51	5675.67	0.10	0.40	2298.45	110.19	27.69
306	Swei Pauk Kan	15.52	2756	177.61	0.75	3682.12	0.07	0.67	2484.10	160.09	17.52
307	Ta Khun Taing	50.85	1995	39.23	0.38	5217.86	0.25	0.13	678.33	13.34	25.89
308	Ta Loke Kone	5.50	3005	546.10	0.45	6727.44	0.03	0.42	2834.93	515.19	30.91
309	Ta LOke Pin	16.79	2954	175.93	0.62	4752.20	0.08	0.54	2569.81	153.05	22.88
310	Ta Ma Lan Pin	27.49	3280	119.30	0.55	5916.11	0.13	0.42	2483.10	90.31	28.98
311	Ta Mar Pin	0.55	1960	3594.18	0.50	3899.71	0.00	0.50	1959.17	3592.65	1.53
312	Ta Pauk Taw	25.36	5508	217.23	2.04	2705.73	0.12	1.92	5192.51	204.79	12.44
313	Ta Yoke Kaw	14.31	3903	272.72	0.63	6201.72	0.07	0.56	3478.75	243.08	29.64
314	Taik Pwe	35.68	2602	72.93	0.59	4391.27	0.18	0.42	1831.64	51.34	21.59
315	Tat Kone	22.64	2062	91.09	0.38	5488.25	0.11	0.26	1451.11	64.10	26.99
316	Taung Ba Lu	18.97	1719	90.63	0.27	6419.56	0.09	0.17	1118.81	58.99	31.64
317	Taung Bet Gyi	39.79	1899	47.72	0.22	8460.04	0.20	0.03	225.29	5.66	42.06
318	Taung Hlyaung	30.89	4072	131.81	1.30	3128.45	0.15	1.15	3609.11	116.82	14.98
319	Taung Htauk	31.14	2529	81.22	0.41	6109.98	0.15	0.26	1590.43	51.08	30.14
320	Taung Khwin	29.45	2886	98.00	0.56	5163.73	0.14	0.41	2140.11	72.67	25.33
321	Taung Pyin (1)	1.83	4649	2534.49	1.31	3548.14	0.00	1.31	4639.70	2529.42	5.07
322	Taung Pyin (2)	0.85	4197	4938.85	0.58	7245.11	0.00	0.58	4187.20	4927.32	11.53
323	Taung Thar	18.76	2213	117.98	0.41	5351.95	0.09	0.32	1722.14	91.81	26.17
324	Te Gyi	34.27	1169	34.11	0.24	4814.30	0.17	0.07	349.83	10.21	23.90
325	Tei Pin Kan Pauk	37.08	2238	60.36	0.45	5017.41	0.18	0.26	1319.01	35.57	24.79

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
326	Tei Pin San	16.60	1923	115.81	0.36	5307.27	0.08	0.28	1491.98	89.85	25.96
327	Tei Taw (1)	8.50	1274	149.80	0.31	4053.76	0.04	0.27	1107.99	130.28	19.52
328	Tei Taw (2)	16.62	2177	130.97	0.61	3568.24	0.08	0.53	1891.33	113.79	17.19
329	Tet Wun	24.44	3446	141.00	0.67	5137.15	0.12	0.55	2835.49	116.02	24.98
330	Tha Hmone Pin	46.68	2736	58.61	0.52	5312.05	0.23	0.28	1509.91	32.35	26.27
331	Tha Hpan Kone	10.43	1608	154.13	0.35	4563.83	0.05	0.30	1377.98	132.08	22.05
332	Tha Lone Thway	13.70	2389	174.34	0.50	4763.73	0.07	0.44	2074.56	151.39	22.95
333	Tha Man Taw	10.29	1980	192.39	0.30	6701.44	0.05	0.25	1645.07	159.85	32.55
334	Tha Mone Kone Gyi	77.50	5930	76.52	1.94	3064.13	0.38	1.56	4772.30	61.58	14.94
335	Tha Pyay San	29.23	2016	68.96	0.42	4832.46	0.14	0.27	1319.73	45.14	23.82
336	Tha Yet Chin	48.34	4226	87.43	0.96	4408.29	0.24	0.72	3181.74	65.83	21.60
337	Tha Yet Lay Pin	24.98	3454	138.27	0.74	4651.73	0.12	0.62	2890.28	115.71	22.57
338	Than Bo	20.83	6089	292.29	1.01	6029.47	0.10	0.91	5491.42	263.61	28.69
339	Thar Hmyar	24.95	4021	161.17	0.73	5532.31	0.12	0.61	3350.98	134.31	26.86
340	That Kone	15.35	3138	204.40	0.59	5308.28	0.07	0.52	2746.23	178.88	25.52
341	Thein Gar Gi Ri	1.46	9560	6565.44	1.31	7273.64	0.00	1.31	9554.84	6561.89	3.54
342	Thet Yin Taw	24.48	1226	50.08	0.24	5105.56	0.12	0.12	607.22	24.81	25.28
343	Thi La	3.53	525	148.62	0.09	5538.40	0.02	0.08	429.80	121.67	26.95
344	Thi Ri Min Ga Lar	8.82	337	38.22	0.07	4614.51	0.04	0.03	135.24	15.34	22.88
345	Thit Hla Kyin	38.31	2939	76.73	0.60	4880.12	0.19	0.41	2019.02	52.71	24.02
346	Thit Poke Kone	1.48	717	484.14	0.20	3549.63	0.01	0.20	694.30	468.81	15.33
347	Thit Ta Pway	3.33	7047	2113.89	0.41	17383.25	0.01	0.39	6792.49	2037.55	76.35
348	Thit To Kan	23.00	3145	136.71	0.45	7046.58	0.11	0.33	2350.22	102.17	34.55
349	Thit Yar	15.30	1950	127.45	0.47	4185.49	0.07	0.39	1639.57	107.16	20.29
350	Thit Yar Kauk	40.45	4994	123.47	1.13	4416.61	0.20	0.93	4125.80	102.01	21.47

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
351	Thone Se Chauk	41.15	6140	149.23	2.47	2480.88	0.19	2.28	5660.32	137.57	11.66
352	Thu Htay Kone	4.93	3220	652.93	0.93	3479.42	0.02	0.91	3150.30	638.80	14.13
353	Thway Net	30.56	2959	96.84	1.00	2968.51	0.15	0.85	2520.25	82.48	14.36
354	Twin Gyi	73.62	4137	56.19	1.04	3979.70	0.36	0.68	2692.76	36.58	19.62
355	Twin Kone	2.59	1785	688.35	0.18	9971.02	0.01	0.17	1664.64	641.94	46.41
356	Twin Lat	18.65	2624	140.70	0.61	4281.10	0.09	0.52	2237.91	120.00	20.70
357	U Yin	15.15	2679	176.80	0.48	5549.95	0.07	0.41	2271.91	149.93	26.87
358	U Yin	51.18	3883	75.88	0.46	8399.03	0.25	0.21	1753.30	34.26	41.62
359	Wa Thea San	11.67	2012	172.37	0.46	4334.53	0.06	0.41	1769.09	151.56	20.81
360	War Gyi Aing	14.58	3736	256.24	0.77	4869.90	0.07	0.70	3399.67	233.18	23.07
361	War Pan	21.37	4006	187.49	0.73	5457.38	0.10	0.63	3443.01	161.14	26.35
362	War Thone Pyu	24.67	1540	62.42	0.32	4780.34	0.12	0.20	958.02	38.83	23.59
363	War Yon Kone	37.91	1121	29.57	0.17	6556.26	0.36	0.68	2412.76	63.64	-34.07
364	Wet Chan Kan	17.20	1285	74.72	0.31	4083.67	0.08	0.23	940.30	54.68	20.04
365	Wet Choke	20.63	1925	93.32	0.36	5325.24	0.10	0.26	1385.36	67.16	26.16
366	Wet Ka Thay	17.28	3789	219.33	0.66	5698.75	0.08	0.58	3315.70	191.93	27.40
367	Wet Lut Ywar Ma	11.57	4357	376.64	0.99	4393.69	0.05	0.94	4124.65	356.56	20.09
368	Wet Ma Sut	66.79	2903	43.46	0.55	5265.03	0.33	0.22	1159.18	17.35	26.11
369	Ya Thit	16.78	3159	188.21	0.58	5411.59	0.08	0.50	2720.65	162.10	26.12
370	Yae Htwet	26.58	1607	60.45	0.49	3304.13	0.13	0.36	1175.85	44.23	16.22
371	Yae Pyayt	77.33	4666	60.34	1.39	3367.55	0.38	1.01	3387.27	43.80	16.54
372	Yae Twin	33.53	2603	77.63	0.88	2966.73	0.16	0.71	2118.60	63.18	14.45
373	Yae Twin Kaung	87.49	2559	29.25	0.37	6882.46	0.12	0.12	3107.27	35.52	-6.27
374	Yae U	18.20	3389	186.23	1.28	2643.75	0.08	1.20	3165.40	173.95	12.29
375	Yae Wai	24.43	3425	140.18	0.88	3904.44	0.12	0.76	2965.14	121.36	18.82

Table 3 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
376	Yan Aung Myin	0.24	1836	7634.46	0.23	7976.86	0.13	0.10	829.06	3447.41	4187.06
377	Yar Gyi Taw	27.65	2383	86.17	0.71	3355.08	0.13	0.58	1931.00	69.83	16.34
378	Yaw Ngan	34.59	3459	100.01	0.90	3847.76	0.17	0.73	2810.90	81.27	18.74
379	Yin Nar Gwe Chaung	18.59	1112	59.81	0.19	5931.36	0.09	0.10	566.14	30.45	29.36
380	Yin Thar Si	20.04	3764	187.87	0.67	5633.36	0.10	0.57	3218.49	160.64	27.23
381	Yone Kone	44.28	2094	47.28	0.36	5839.27	0.22	0.14	811.51	18.32	28.96
382	Yone Seik Kyun	25.19	1113	44.19	0.24	4553.97	0.12	0.12	545.04	21.64	22.55
383	Yone Taw	39.74	1911	48.09	0.35	5396.98	0.20	0.16	848.22	21.35	26.74
384	Ywar Haung Kan	30.00	2582	86.06	0.42	6179.83	0.15	0.27	1667.88	55.59	30.47
385	Ywar Ma	12.61	1585	125.68	0.19	8174.74	0.06	0.13	1077.43	85.43	40.25
386	Ywar Mun	39.85	4010	100.63	2.26	1771.22	0.19	2.08	3677.16	92.28	8.35
387	Ywar Taw	27.42	1450	52.87	0.51	2871.17	0.13	0.37	1063.55	38.78	14.09
388	Ywar Thar	41.88	1985	47.40	0.39	5110.52	0.21	0.18	924.79	22.08	25.32
389	Ywar Thit	0.95	6192	6511.76	0.89	6994.31	0.00	0.88	6189.71	6509.35	2.41
390	Ywar Thit Pwe Kyo	0.41	6219	15280.66	0.41	15340.21	0.14	0.26	4010.38	9853.87	5426.79
391	Zaung Taw Kan	26.43	3236	122.44	0.62	5240.94	0.13	0.49	2559.60	96.85	25.59
392	Zay	0.26	870	3390.46	0.12	7521.16	0.00	0.11	864.70	3369.81	20.65
393	Zay Kwet Thit	0.56	2814	5030.01	0.53	5304.88	0.00	0.53	2813.23	5028.63	1.37
394	Zay Thar	16.64	1317	79.14	0.34	3921.01	0.08	0.25	997.33	59.93	19.21
395	Zee Kone(Zee Lone)	31.77	1694	53.31	0.19	8923.93	0.16	0.03	284.71	8.96	44.35
396	Zee Kyun	12.63	1070	84.70	0.21	5191.48	0.06	0.14	747.44	59.17	25.53
397	Zee Pwar	8.97	2683	299.00	0.51	5267.06	0.04	0.47	2460.10	274.16	24.84
398	Zee Taw	18.97	7595	400.40	1.13	6746.69	0.09	1.04	6993.11	368.67	31.73
399	Zel Lel Zoe	1.99	1643	825.6	0.5	3318.6	0.0	0.5	1618.2	813.1	12.5

Table 4 Populated areas in the census block in Minbu District.

No	VT Name	Township	Total Area km^2	Populated Area km^2
1	Ah Kyi	Saytottara	18.6805	0.38422122
2	Ah Lan Pei	Minbu	6.09438	0.70227806
3	Ah Lel Paing	Pwint Phyu	0.221385	0.39524586
4	Ah Lel Pon	Saytottara	132.016	0.30140986
5	Ah Nauk Kaing	Pwint Phyu	14.636	1.24863886
6	Ah Nauk Kan Baung	Salin	2.39947	0.62842436
7	Ah Nauk Lay Ein	Pwint Phyu	6.57824	0.39732959
8	Ah Nauk Paing	Pwint Phyu	0.171025	0.31255586
9	Ah Paw	Saytottara	38.56	0.28791826
10	Ah Shey Kan Baung	Salin	5.19829	0.34862796
11	Ah Shey Lay Ein	Pwint Phyu	5.32447	0.68641886
12	Ah Shey Paing	Pwint Phyu	0.738258	0.55367806
13	Aing Ma	Minbu	45.8224	0.41145826
14	Auk Hlaing	Salin	7.82448	0.54092516
15	Aung	Saytottara	146.482	0.24378436
16	Aye Chan Thar Forest	Salin	328.825	0
17	Bee Zat	Salin	5.54598	0.50035696
18	Bone Baw	Ngape	22.1104	0.37830231
19	Bu	Saytottara	108.481	0.57768486
20	Chaung Hpyu	Minbu	38.6043	0.52489486
21	Chaung Hpyu	Ngape	13.0588	0.49403606
22	Chaung Hpyu (East)	Salin	4.70365	0.54735406
23	Chaung Hpyu (North)	Salin	7.75877	0.61368558
24	Chaung Son	Pwint Phyu	103.95	0.38272886
25	Chi	Saytottara	224.149	0.30132004
26	Chin Pyit Kaing	Saytottara	24.9622	0.36368926
27	Dar Swei Kan	Salin	3.63427	0.42667896

Table 4 (Continued)

No	VT Name	Township	Total Area km^2	Populated Area km^2
28	Daunt Boe	Salin	9.70284	0.39116186
29	Don Chaung	Saytottara	122.916	0.55847346
30	Dway Kyin	Saytottara	156.133	0.23898286
31	Forest	Pwint Phyu	63.334	0.20002386
32	Goke Gyi	Ngape	13.9504	0.40381097
33	Gway Pin Zin	Salin	15.0612	0.42538816
34	Han Dauk	Saytottara	91.4127	0.34043666
35	Hma Yoe Kone	Salin	12.1861	1.15968226
36	Hpa Lan Kyin	Pwint Phyu	4.96721	0.39477976
37	Hpa Lan Taw	Minbu	7.89925	0.44233405
38	Hpa Lan Taw	Pwint Phyu	16.6813	0.73802286
39	Hpa Lan Yon	Minbu	42.9459	0.61652628
40	Hpa Yar	Minbu	139.515	0.58094296
41	Hpar Aing	Saytottara	67.6638	0.423561
42	Hpaung Lin	Salin	38.3565	0.910239
43	Hpyin Gyi	Saytottara	63.2864	0.346067
44	Hpyu Kone	Minbu	5.84427	0.411351
45	Hta Naung Kone	Pwint Phyu	7.95612	0.385633
46	Hta Naung Taw	Minbu	5.89928	0.359096
47	Htauk Shar Pin	Minbu	18.5197	1.131349
48	Htein Taw	Minbu	6.77038	0.452873
49	Htu Pauk	Salin	3.81463	0.322051
50	In Kyin Pin Hla	Salin	55.6941	0.79214
51	In Pin Hla (Sa Kaw)	Minbu	30.2814	0.319368
52	Inn Daung	Pwint Phyu	5.04904	0.530596
53	Ka Bae Magyi Chaung	Minbu	36.8396	0.452175
54	Ka Dee	Minbu	8.69189	0.372371
55	Ka Ni	Pwint Phyu	18.825	0.79895

Table 4 (Continued)

No	VT Name	Township	Total Area km^2	Populated Area km^2
56	Ka Paing (a)Oke Shit Kone	Salin	8.50858	0.503691
57	Ka Pyayt	Pwint Phyu	40.6453	1.07692
58	Ka Thet	Minbu	17.5125	0.325564
59	Ka Zin	Saytottara	41.7727	0.244178
60	Kaing Ma Gyi	Minbu	28.0275	0.425981
61	Kaing Taw Gyi	Minbu	36.6191	0.61203
62	Kan	Salin	14.1134	0.549515
63	Kan Chauk (Kyun Te)	Salin	31.1341	1.142349
64	Kan Ku Lar	Minbu	7.75207	0.480654
65	Kan Pyar	Salin	109.329	0.909228
66	Kan Swei	Pwint Phyu	15.9212	0.798218
67	Kan Taing	Saytottara	60.9076	0.250325
68	Kan Taw	Salin	4.41099	0.246498
69	Kan Thar	Minbu	4.40072	1.136823
70	Kan Thar Gyi	Pwint Phyu	25.3966	1.585669
71	Kan Thit	Minbu	13.6477	0.359728
72	Kan Yae	Minbu	14.0805	1.000553
73	Kaung Gyi	Saytottara	21.5253	0.611923
74	Khan Kone	Minbu	15.3549	0.439957
75	Khun Thar	Minbu	4.68384	0.347042
76	Khway Ma Laung	Saytottara	38.2329	0.315768
77	Kin Mun Chon	Salin	47.6781	0.26403
78	Kone Thar	Minbu	18.7394	0.814207
79	Kone Zaung	Pwint Phyu	13.4056	1.494805
80	Ku Hpyu	Salin	2.62289	0.351785
81	Ku Lar Bar	Minbu	5.41746	0.432383
82	Ku Lar Haung	Pwint Phyu	19.5393	0.513142
83	Ku Taw	Saytottara	102.921	0.397095
84	Ku Yin Chauk	Salin	29.7649	0.614739

Table 4 (Continued)

No	VT Name	Township	Total Area km^2	Populated Area km^2
85	Kya Pin	Salin	19.0389	0.758027
86	Kyan Seint	Saytottara	12.7395	0.287753
87	Kyar Kan	Minbu	7.92866	0.691558
88	Kyat Pei	Salin	9.55125	0.48561
89	Kyauk Oe	Salin	55.2746	0.292915
90	Kyauk San	Minbu	10.8884	0.600132
91	Kyauk Sit Pon	Minbu	15.5857	0.437119
92	Kyauk Tan	Minbu	24.9101	0.791734
93	Kyauk Ye Kyun	Salin	7.62312	0.564653
94	Kyaung Kone	Ngape	113.112	0.333432
95	Kyaung Kone	Pwint Phyu	24.0972	1.04054
96	Kyaung Kone	Salin	6.64057	0.445967
97	Kyaung Kyar	Salin	0.330887	0.45964
98	Kyaung Taw Yar (1)	Pwint Phyu	9.32502	1.293041
99	Kyaung Thaik	Saytottara	38.2783	0.30284
100	Kyaung Twin	Ngape	0.461835	0.575476
101	Kyee Kan	Minbu	68.5631	0.398425
102	Kyee Pin Kan	Minbu	11.4954	1.077703
103	Kyee Wa	Saytottara	2.48946	0.06705
104	Kyet Hin Khar Kyun(Yae Kyi)	Salin	19.964	0.876572
105	Kyet Tha Kaing	Salin	4.80473	0.337217
106	Kyit Kaing	Pwint Phyu	26.2877	0.964974
107	Kyo Wun	Salin	60.2052	0.668247
108	Kyone	Salin	11.9269	0.597369
109	Kyu Wun	Pwint Phyu	4.2826	0.375952
110	Kyun Pyar	Minbu	144.852	0.873939
111	Kyun Yin	Salin	21.2333	0.802751
112	Kywe Ta Kar	Pwint Phyu	150.23	0.645518
113	Kywe Ti	Pwint Phyu	27.3251	0.842868

Table 4 (Continued)

No	VT Name	Township	Total Area km^2	Populated Area km^2
114	Kywe U	Salin	160.745	0.285594
115	Laing	Ngape	22.1963	0.415369
116	Lel Hla Kone	Pwint Phyu	6.41513	0.352722
117	Lel Kaing	Pwint Phyu	13.4236	1.0097
118	Lel Ma	Salin	7.5053	0.483831
119	Let Khoke	Pwint Phyu	4.38978	0.555538
120	Let Khoke Pin	Minbu	10.1117	0.660548
121	Let Me	Salin	16.6832	0.493611
122	Let Pa Taw	Minbu	13.4914	0.31686
123	Let Pan Kyin	Saytottara	53.5064	0.32338
124	Lin De	Ngape	74.9262	0.483094
125	Lone Gyi	Saytottara	29.585	0.308561
126	Ma De	Pwint Phyu	20.3471	0.950484
127	Ma Gyi	Saytottara	17.2668	0.452885
128	Ma Gyi Pin Pu	Salin	19.0901	1.091452
129	Ma Gyi Thone Pin	Minbu	58.2022	0.487848
130	Ma Htein	Saytottara	127.683	0.311605
131	Man Aung	Ngape	24.544	0.403551
132	Man Dat Kaing	Saytottara	43.0261	0.363534
133	Man Kyoe	Minbu	9.0459	0.553706
134	Maung Ma Kan	Minbu	15.8429	0.528837
135	Me Ywar Kyun	Salin	4.543	0.421424
136	Me Za Li	Pwint Phyu	67.82	1.189657
137	Mei Bayt Kone	Minbu	14.1166	1.416239
138	Min	Minbu	6.0629	0.374647
139	Min Hla Kyin	Minbu	154.007	1.162947
140	Min Hlyin	Salin	12.4994	0.679866
141	Min Lwin	Ngape	107.922	1.065171
142	Min Myay	Pwint Phyu	8.34243	0.642272

Table 4 (Continued)

No	VT Name	Township	Total Area km^2	Populated Area km^2
143	Minbu No (1)	Minbu	2.76401	1.775274
144	Minbu No (2)	Minbu	1.86482	0.825961
145	Minbu No (3)	Minbu	1.52287	0.980852
146	Minbu No (4)	Minbu	4.8803	1.970388
147	Moe Wun	Salin	1.02824	0.349255
148	Mon Hnyin	Saytottara	21.063	0.073739
149	Mon Htaung	Minbu	55.4595	0.734157
150	Mone Myint	Pwint Phyu	12.4795	0.643573
151	Mone Za Le	Pwint Phyu	8.23426	0.685582
152	Mun Zaw	Saytottara	55.0663	0.663744
153	Myaung Kauk	Salin	1.2624	0.260576
154	Myaung U	Minbu	14.9819	0.378276
155	Myaung U	Saytottara	94.2179	0.36034
156	Myay Mi Kone	Salin	4.97182	0.498761
157	Myay Ni Kone	Saytottara	26.5438	0.755369
158	Myay Nu	Salin	52.1721	0.609384
159	Myin Tin	Salin	0.804888	0.570089
160	Myit Hpyar	Ngape	15.2745	0.460071
161	Myo Ma	Ngape	0.356624	0.429134
162	Na Be Kone	Pwint Phyu	14.1697	0.476486
163	Nan Kyu	Saytottara	21.136	0.327527
164	Nan Taw Kone	Minbu	12.742	0.53451
165	Nan Taw Kyun	Pwint Phyu	10.166	0.794348
166	Nat Gyi	Saytottara	50.9777	0.254875
167	Naung	Ngape	28.6621	0.24511
168	Nei Zaw	Ngape	4.24143	0.271542
169	Neik Ban Kyun	Minbu	5.37115	0.311447
170	Nga Hlaing Twin	Salin	83.4738	0.319057
171	Nga Le	Saytottara	22.7814	0.286113

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km2
172	Nga Than Khaung	Salin	22.1148	0.531382
173	No (1)	Saytottara	0.368857	0.457607
174	No (2)	Saytottara	0.996203	0.717227
175	Nwar Tat (Net Tat)	Salin	4.89799	0.274303
176	Nwe Ta Mei	Salin	2.81805	0.464457
177	Nyaung (Lin Zin)	Salin	30.5579	0.699247
178	Nyaung Cho	Pwint Phyu	8.93279	0.697638
179	Nyaung Inn	Salin	6.29421	0.757138
180	Nyaung Kone	Saytottara	41.9114	0.267461
181	Nyaung Pin	Pwint Phyu	7.57129	0.333656
182	Nyaung Pin	Salin	18.9448	0.523829
183	Nyaung Pin Lel Kyin	Salin	53.9789	0.449812
184	Nyaung Pin Zauk (Let Pa New)	Pwint Phyu	3.6477	0.639608
185	Oe Myay Htwin	Ngape	7.04101	0.264981
186	Oe Thei	Salin	9.37965	0.472878
187	Ohn War	Saytottara	18.4818	0.295431
188	Pa Be	Ngape	35.3529	0.269533
189	Pa Bway	Ngape	94.6973	0.256688
190	Pa Dan	Ngape	14.7539	1.324065
191	Pa Zi	Ngape	14.0176	0.329282
192	Paik Pin(Paik Thin)	Minbu	9.83506	0.31969
193	Pan Ei	Saytottara	22.197	0.359686
194	Pan Ei Hnyar	Saytottara	56.2363	0.225682
195	Pan Hlwar	Minbu	17.0771	0.459595
196	Pan Taw	Salin	11.3722	0.567269
197	Pan Tein	Ngape	27.7632	0.726663
198	Pauk Kone	Pwint Phyu	19.0267	1.083709
199	Pauk Lay Pin	Salin	18.907	1.151131
200	Pauk Ngu	Minbu	8.18	0.63864

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
201	Pauk Pin Htwin	Minbu	7.27777	0.281621
202	Paung	Minbu	12.4339	0.367634
203	Paung Ka Lay	Ngape	13.1579	0.467421
204	Paung Nar	Salin	0.751963	0.811773
205	Paung Pin Zin	Salin	0.396853	0.458168
206	Paung Tu	Salin	27.995	0.610563
207	Paung Yin Kone	Salin	3.94055	0.403289
208	Pay Kone	Minbu	8.72585	0.348521
209	Pay Kone	Ngape	6.85393	0.5898
210	Pay Taw	Pwint Phyu	8.69681	0.731793
211	Pin Lel Thet	Minbu	3.39479	0.402877
212	Pin U	Ngape	246.626	0.905505
213	Pu Daung	Minbu	31.1818	0.386961
214	Pu Htoe Hpyu	Salin	0.326405	0.439822
215	Pu Khet Taing	Salin	20.0674	0.299836
216	Pu Paing	Saytottara	28.1998	0.257722
217	Pya Tauk	Salin	12.3476	0.465892
218	Pyi Lone Kyaw	Pwint Phyu	16.8896	0.692105
219	Pyoe Khin Kone	Salin	8.68348	0.691472
220	Ra Day	Salin	6.20168	0.720585
221	Saku No (1)	Minbu	2.73184	1.161877
222	Saku No (2)	Minbu	1.46637	0.594507
223	Saku No (3)	Minbu	0.55028	0.620916
224	Sat Si	Ngape	32.1322	0.27843
225	Se Kan	Salin	20.3313	0.513459
226	Se Mone	Pwint Phyu	30.3456	1.073668
227	Se Taw	Pwint Phyu	12.2542	0.505613
228	Seik Gyi	Salin	6.50138	0.598593
229	Sha Shar (North)	Salin	10.9925	0.308383

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
230	Shan Su	Salin	12.1497	0.72042
231	Shar Taw (East)	Salin	11.1567	0.374171
232	Shar Taw (North)	Salin	3.27285	0.486374
233	Shauk Taung	Ngape	52.6034	0.56453
234	Shwe Bon Thar	Salin	6.30166	0.777437
235	Shwe Hlay	Pwint Phyu	15.9098	1.330973
236	Shwe Kyaung	Minbu	11.7927	0.40702
237	Shwe Set Taw (Forest)	Pwint Phyu	149.965	0.200024
238	Shwe Zan Thee	Salin	69.4368	0.778256
239	Si Thar	Ngape	20.1592	0.369935
240	Si Zwe	Salin	33.1032	0.778595
241	Sin Chaung	Saytottara	28.1667	0.266808
242	Sin Chi Taing	Ngape	23.465	0.855221
243	Sin Gaung	Minbu	41.9168	0.98276
244	Sin Hpyu Kyun (1)	Salin	0.93937	0.702629
245	Sin Hpyu Kyun (2)	Salin	0.925939	0.929653
246	Sin Kyone	Salin	3.09391	0.605353
247	Sin Lu (North)	Pwint Phyu	17.9766	0.669023
248	Sin Ma Kyun	Salin	29.4654	1.699609
249	Sit Ngan	Saytottara	145.466	0.326417
250	Son Kone	Salin	5.21051	1.036955
251	Su Pa Daung	Ngape	60.0769	0.419899
252	Sun Kyun Nyo	Salin	6.93752	0.586893
253	Sun Tet	Ngape	21.1614	0.275295
254	Swei Tei	Salin	28.1322	0.478278
255	Ta Hnyauk Tin	Salin	63.0949	0.278072
256	Ta Lin Gyi Kone	Salin	6.25435	0.545127
257	Ta Mar Chaung	Salin	6.52968	0.404619
258	Ta Nyaung	Salin	12.8368	1.830333

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
259	Ta Pwin	Saytottara	22.197	0.328149
260	Ta Taung Kan	Salin	7.01483	0.392467
261	Taung Bo	Salin	27.5235	0.548912
262	Taung Inn Ywar Thit	Pwint Phyu	4.5819	0.417087
263	Taung Man	Minbu	15.0038	0.615231
264	Taung Pyit Kone	Salin	33.1521	0.604726
265	Taung Ywar Htan Taw	Salin	2.38697	0.307837
266	Taw Gyi	Salin	6.74532	0.39371
267	Taw Na Lin	Salin	43.573	0.58678
268	Taw Seint	Salin	25.4012	0.999582
269	Tei Soke	Saytottara	17.6282	0.266835
270	Tei Zar	Saytottara	10.349	0.082764
271	Tha Man Yin	Pwint Phyu	7.05781	0.601935
272	Tha Myin Kin	Salin	7.26112	0.883739
273	Tha Nat Kone	Salin	3.40231	0.292325
274	Tha Nat Pin Su	Minbu	7.89536	0.444079
275	Tha Pyay Pin	Salin	4.57834	0.301567
276	Tha Yan Kaing	Saytottara	32.6278	0.28952
277	Tha Yet Chin	Salin	3.06449	0.98976
278	Tha Yet Kone	Salin	3.08595	0.574572
279	Tha Yet Oke	Pwint Phyu	17.0175	1.250787
280	Tha Yet Taw	Pwint Phyu	20.1325	1.428938
281	Tha Yet Taw	Salin	30.3878	0.571788
282	Than Kaing	Pwint Phyu	5.53698	0.353218
283	Than Se	Saytottara	92.2007	1.136913
284	Thar Yar Kone	Ngape	21.2121	1.976059
285	Thee Kone	Minbu	51.5191	0.524908
286	Thet Lel	Saytottara	182.901	0.23246
287	Thet Taw Shey	Pwint Phyu	0.908176	0.633303

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
288	Thin Baw Kyun	Minbu	12.364	0.211744
289	Thin Pan Taw (a)	Salin	42.3348	0.877368
290	Thit Khauk Taung	Salin	12.0673	0.399028
291	Tin Pyin	Ngape	94.1303	0.273074
292	U Yin	Minbu	5.65209	0.393313
293	U Yin Kyit	Pwint Phyu	17.981	1.446205
294	U Yin Zin	Minbu	10.8111	0.394745
295	Wun Ya	Salin	19.878	0.505431
296	Yae Ngan	Minbu	19.3564	0.419483
297	Yae Paw Gyi	Minbu	37.2176	0.581691
298	Yae Poke	Minbu	7.64028	0.445211
299	Yae Poke Gyi	Pwint Phyu	43.5541	0.485653
300	Yae Poke Ka Lay	Pwint Phyu	17.629	0.43277
301	Yae Pwa Kyun	Salin	10.5169	0.473528
302	Yae Thaung	Saytottara	17.9346	0.317604
303	Yae Twin Kone	Minbu	11.2244	0.590735
304	Yint Shey	Ngape	49.6026	0.832464
305	Yone Pin Kan	Salin	29.5009	1.503436
306	Ywar Hmat	Salin	1.96448	0.351007
307	Ywar Khaing	Pwint Phyu	9.8881	0.738023
308	Ywar Ma Kaw	Salin	4.3999	0.437798
309	Ywar Pale Kone Tan	Minbu	16.7574	0.534424
310	Ywar Thar Yar	Minbu	24.0767	0.985141
311	Ywar Thar	Minbu	7.70916	0.446332
312	Ywar Thit Kone	Pwint Phyu	4.83954	0.467613
313	Za Yat Hla	Salin	5.80969	0.352739
314	Zay Ma	Salin	0.239505	0.387351
315	Zee Aing	Minbu	54.9191	0.464992

Table 4 (Continued)

No	VTName	Township	Total Area Km^2	Populated Area Km^2
316	Zee Hpyu Pin	Salin	34.916	2.020637
317	Zee Kaing	Pwint Phyu	5.76544	0.808885
318	Zee Kone	Salin	19.7347	0.591023
319	Zee Kyun	Salin	17.0853	0.95138
320	Zee Taw	Pwint Phyu	5.02364	0.597289
321	Zee Taw Gyi	Ngape	4.52763	0.490875
322	Zin Pyun	Ngape	32.2434	0.643766

Table 5. Details of the references and estimated population data of each census blocks using binary dasymetric method (Minbu District)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
1	Ah Kyi	18.68	554	29.657	0.18	3007.64	0.009	0.175	551.23	29.51	0.15
2	Ah Lan Pei	6.09	3134	514.244	0.50	6239.87	0.025	0.477	3118.33	511.67	2.57
3	Ah Lel Paing	0.22	1043	4711.250	0.20	5342.64	0.010	0.185	1037.785	4687.69	23.56
4	Ah Lel Pon	132.02	874	6.620	0.10	8620.52	0.005	0.096	869.63	6.59	0.03
5	Ah Nauk Kaing	14.64	4449	303.976	1.05	4242.74	0.052	0.996	4426.755	302.46	1.52
6	Ah Nauk Kan Baung	2.40	1624	676.816	0.43	3790.85	0.021	0.407	1615.88	673.43	3.38
7	Ah Nauk Lay Ein	6.58	759	115.380	0.20	3846.82	0.010	0.187	755.205	114.80	0.58
8	Ah Nauk Paing	0.17	1119	6542.903	0.11	9943.84	0.006	0.107	1113.405	6510.19	32.71
9	Ah Paw	38.56	519	13.460	0.09	5904.81	0.004	0.083	516.405	13.39	0.07
10	Ah Shey Kan Baung	5.20	1081	207.953	0.15	7274.36	0.007	0.141	1075.595	206.91	1.04
11	Ah Shey Lay Ein	5.32	1454	273.079	0.49	2989.34	0.024	0.462	1446.73	271.71	1.37
12	Ah Shey Paing	0.74	1795	2431.399	0.35	5075.58	0.018	0.336	1786.025	2419.24	12.16
13	Aing Ma	45.82	1999	43.625	0.21	9454.47	0.011	0.201	1989.005	43.41	0.22
14	Auk Hlaing	7.82	3168	404.883	0.34	9293.01	0.017	0.324	3152.16	402.86	2.02
15	Aung	146.48	692	4.724	0.04	15813.35	0.002	0.042	688.54	4.70	0.02
16	Aye Chan Thar Forest	328.83	0	0.000	0.00	0.00	0.000	0.000	0	0.00	0.00
17	Bee Zat	5.55	1928	347.639	0.30	6419.54	0.015	0.285	1918.36	345.90	1.74
18	Bone Baw	22.11	699	31.614	0.18	3920.83	0.009	0.169	695.505	31.46	0.16
19	Bu	108.48	1515	13.966	0.38	4011.53	0.019	0.359	1507.425	13.90	0.07
20	Chaung Hpyu	38.60	2348	60.822	0.32	7227.48	0.016	0.309	2336.26	60.52	0.30
21	Chaung Hpyu	13.06	1698	130.027	0.29	5775.27	0.015	0.279	1689.51	129.38	0.65
22	Chaung Hpyu (East)	4.70	1292	274.680	0.35	3719.80	0.017	0.330	1285.54	273.31	1.37

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
23	Chaung Hpyu (North)	7.76	2400	309.327	0.41	5801.84	0.021	0.393	2388	307.78	1.55
24	Chaung Son	103.95	949	9.129	0.18	5194.17	0.009	0.174	944.255	9.08	0.05
25	Chi	224.15	738	3.292	0.10	7285.57	0.005	0.096	734.31	3.28	0.02
26	Chin Pyit Kaing	24.96	669	26.801	0.16	4087.61	0.008	0.155	665.655	26.67	0.13
27	Dar Swei Kan	3.63	905	249.018	0.23	3992.85	0.011	0.215	900.475	247.77	1.25
28	Daunt Boe	9.70	1267	130.580	0.19	6628.72	0.010	0.182	1260.665	129.93	0.65
29	Don Chaung	122.92	1673	13.611	0.36	4667.32	0.018	0.341	1664.635	13.54	0.07
30	Dway Kyin	156.13	878	5.623	0.04	22536.51	0.002	0.037	873.61	5.60	0.03
31	Forest	63.33	0	0.000	0.00	0.00	0.000	0.000	0	0.00	0.00
32	Goke Gyi	13.95	908	65.088	0.20	4455.63	0.010	0.194	903.46	64.76	0.33
33	Gway Pin Zin	15.06	1583	105.105	0.23	7024.18	0.011	0.214	1575.085	104.58	0.53
34	Han Dauk	91.41	1016	11.114	0.14	7235.81	0.007	0.133	1010.92	11.06	0.06
35	Hma Yoe Kone	12.19	3134	257.178	0.96	3265.75	0.048	0.912	3118.33	255.89	1.29
36	Hpa Lan Kyin	4.97	1133	228.096	0.19	5817.54	0.010	0.185	1127.335	226.96	1.14
37	Hpa Lan Taw	7.90	1652	209.134	0.24	6817.71	0.012	0.230	1643.74	208.09	1.05
38	Hpa Lan Taw	16.68	3887	233.015	0.54	7224.92	0.027	0.511	3867.565	231.85	1.17
39	Hpa Lan Yon	42.95	2813	65.501	0.42	6753.86	0.021	0.396	2798.935	65.17	0.33
40	Hpa Yar	139.52	15857	113.658	0.38	41628.26	0.019	0.362	15777.715	113.09	0.57
41	Hpar Aing	67.66	1910	28.228	0.23	8289.67	0.012	0.219	1900.45	28.09	0.14
42	Hpaung Lin	38.36	4803	125.220	0.71	6762.74	0.036	0.675	4778.985	124.59	0.63
43	Hpyin Gyi	63.29	390	6.162	0.15	2670.45	0.007	0.139	388.05	6.13	0.03
44	Hpyu Kone	5.84	778	133.122	0.21	3681.49	0.011	0.201	774.11	132.46	0.67

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
45	Hta Naung Kone	7.96	1672	210.153	0.19	9008.18	0.009	0.176	1663.64	209.10	1.05
46	Hta Naung Taw	5.90	1409	238.843	0.16	8857.64	0.008	0.151	1401.955	237.65	1.19
47	Htauk Shar Pin	18.52	4943	266.905	0.93	5307.49	0.047	0.885	4918.285	265.57	1.33
48	Htein Taw	6.77	1269	187.434	0.25	5018.80	0.013	0.240	1262.655	186.50	0.94
49	Htu Pauk	3.81	389	101.976	0.12	3187.82	0.006	0.116	387.055	101.47	0.51
50	In Kyin Pin Hla	55.69	3854	69.199	0.59	6508.86	0.030	0.563	3834.73	68.85	0.35
51	In Pin Hla (Sa Kaw)	30.28	931	30.745	0.12	7800.95	0.006	0.113	926.345	30.59	0.15
52	Inn Daung	5.05	2588	512.573	0.33	7828.85	0.017	0.314	2575.06	510.01	2.56
53	Ka Bae Magyi Chaung	36.84	1777	48.236	0.25	7047.36	0.013	0.240	1768.115	47.99	0.24
54	Ka Dee	8.69	1350	155.317	0.17	7833.03	0.009	0.164	1343.25	154.54	0.78
55	Ka Ni	18.83	2476	131.527	0.60	4134.06	0.030	0.569	2463.62	130.87	0.66
56	Ka Paing (a)Oke Shit Kone	8.51	1691	198.741	0.30	5568.60	0.015	0.288	1682.545	197.75	0.99
57	Ka Pyayt	40.65	5580	137.285	0.88	6363.35	0.044	0.833	5552.1	136.60	0.69
58	Ka Thet	17.51	625	35.689	0.13	4978.49	0.006	0.119	621.875	35.51	0.18
59	Ka Zin	41.77	519	12.424	0.04	11754.15	0.002	0.042	516.405	12.36	0.06
60	Kaing Ma Gyi	28.03	1091	38.926	0.23	4828.36	0.011	0.215	1085.545	38.73	0.19
61	Kaing Taw Gyi	36.62	2413	65.895	0.41	5856.71	0.021	0.391	2400.935	65.57	0.33
62	Kan	14.11	1767	125.200	0.35	5055.92	0.017	0.332	1758.165	124.57	0.63
63	Kan Chauk (Kyun Te)	31.13	3709	119.130	0.94	3936.01	0.047	0.895	3690.455	118.53	0.60
64	Kan Ku Lar	7.75	1671	215.555	0.28	5954.46	0.014	0.267	1662.645	214.48	1.08
65	Kan Pyar	109.33	3849	35.206	0.71	5427.21	0.035	0.674	3829.755	35.03	0.18
66	Kan Swei	15.92	3959	248.662	0.60	6618.25	0.030	0.568	3939.205	247.42	1.24

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
67	Kan Taing	60.91	810	13.299	0.05	16103.16	0.003	0.048	805.95	13.23	0.07
68	Kan Taw	4.41	1253	284.063	0.05	26960.98	0.002	0.044	1246.735	282.64	1.42
69	Kan Thar	4.40	2546	578.542	0.94	2717.77	0.047	0.890	2533.27	575.65	2.89
70	Kan Thar Gyi	25.40	5514	217.116	1.39	3979.37	0.069	1.316	5486.43	216.03	1.09
71	Kan Thit	13.65	1095	80.233	0.16	6856.43	0.008	0.152	1089.525	79.83	0.40
72	Kan Yae	14.08	2903	206.172	0.80	3626.35	0.040	0.761	2888.485	205.14	1.03
73	Kaung Gyi	21.53	594	27.595	0.41	1442.10	0.021	0.391	591.03	27.46	0.14
74	Khan Kone	15.35	1712	111.495	0.24	7135.33	0.012	0.228	1703.44	110.94	0.56
75	Khun Thar	4.68	725	154.788	0.15	4931.36	0.007	0.140	721.375	154.01	0.77
76	Khway Ma Laung	38.23	914	23.906	0.12	7896.74	0.006	0.110	909.43	23.79	0.12
77	Kin Mun Chon	47.68	585	12.270	0.06	9139.75	0.003	0.061	582.075	12.21	0.06
78	Kone Thar	18.74	2087	111.370	0.61	3398.01	0.031	0.583	2076.565	110.81	0.56
79	Kone Zaung	13.41	6703	500.015	1.29	5176.94	0.065	1.230	6669.485	497.51	2.50
80	Ku Hpyu	2.62	1248	475.811	0.15	8223.46	0.008	0.144	1241.76	473.43	2.38
81	Ku Lar Bar	5.42	965	178.128	0.23	4153.06	0.012	0.221	960.175	177.24	0.89
82	Ku Lar Haung	19.54	1193	61.056	0.31	3810.06	0.016	0.297	1187.035	60.75	0.31
83	Ku Taw	102.92	1228	11.931	0.20	6231.26	0.010	0.187	1221.86	11.87	0.06
84	Ku Yin Chauk	29.76	1775	59.634	0.41	4280.05	0.021	0.394	1766.125	59.34	0.30
85	Kya Pin	19.04	3363	176.638	0.56	6026.85	0.028	0.530	3346.185	175.76	0.88
86	Kyan Seint	12.74	664	52.121	0.09	7568.78	0.004	0.083	660.68	51.86	0.26
87	Kyar Kan	7.93	1719	216.808	0.49	3497.21	0.025	0.467	1710.405	215.72	1.08
88	Kyat Pei	9.55	2234	233.896	0.29	7822.52	0.014	0.271	2222.83	232.73	1.17

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
89	Kyauk Oe	55.27	691	12.501	0.09	7438.82	0.005	0.088	687.545	12.44	0.06
90	Kyauk San	10.89	2767	254.124	0.40	6915.63	0.020	0.380	2753.165	252.85	1.27
91	Kyauk Sit Pon	15.59	1923	123.382	0.24	8110.67	0.012	0.225	1913.385	122.77	0.62
92	Kyauk Tan	24.91	3103	124.568	0.59	5244.12	0.030	0.562	3087.485	123.95	0.62
93	Kyauk Ye Kyun	7.62	1256	164.762	0.36	3444.60	0.018	0.346	1249.72	163.94	0.82
94	Kyaung Kone	113.11	1188	10.503	0.13	8905.02	0.007	0.127	1182.06	10.45	0.05
95	Kyaung Kone	24.10	4380	181.764	0.84	5211.08	0.042	0.798	4358.1	180.86	0.91
96	Kyaung Kone	6.64	1087	163.691	0.25	4419.72	0.012	0.234	1081.565	162.87	0.82
97	Kyaung Kyar	0.33	1237	3738.436	0.26	4764.73	0.013	0.247	1230.815	3719.74	18.69
98	Kyaung Taw Yar (1)	9.33	5515	591.420	1.09	5045.67	0.055	1.038	5487.425	588.46	2.96
99	Kyaung Thaik	38.28	572	14.943	0.10	5563.30	0.005	0.098	569.14	14.87	0.07
100	Kyaung Twin	0.46	2421	5242.132	0.38	6448.23	0.019	0.357	2408.895	5215.92	26.21
101	Kyee Kan	68.56	1224	17.852	0.20	6169.33	0.010	0.188	1217.88	17.76	0.09
102	Kyee Pin Kan	11.50	4701	408.946	0.88	5356.17	0.044	0.834	4677.495	406.90	2.04
103	Kyee Wa	2.49	824	330.995	0.07	12289.37	0.003	0.064	819.88	329.34	1.65
104	Kyet Hin Khar Kyun	19.96	4016	201.162	0.68	5936.01	0.034	0.643	3995.92	200.16	1.01
105	Kyet Tha Kaing	4.80	975	202.925	0.14	7106.78	0.007	0.130	970.125	201.91	1.01
106	Kyit Kaing	26.29	3783	143.908	0.76	4945.42	0.038	0.727	3764.085	143.19	0.72
107	Kyo Wun	60.21	4881	81.073	0.47	10424.51	0.023	0.445	4856.595	80.67	0.41
108	Kyone	11.93	1922	161.148	0.40	4837.11	0.020	0.377	1912.39	160.34	0.81
109	Kyu Wun	4.28	842	196.610	0.18	4786.05	0.009	0.167	837.79	195.63	0.98
110	Kyun Pyar	144.85	3659	25.260	0.67	5429.47	0.034	0.640	3640.705	25.13	0.13

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
111	Kyun Yin	21.23	2263	106.578	0.60	3754.60	0.030	0.573	2251.685	106.04	0.53
112	Kywe Ta Kar	150.23	2642	17.586	0.45	5930.49	0.022	0.423	2628.79	17.50	0.09
113	Kywe Ti	27.33	2648	96.907	0.64	4119.20	0.032	0.611	2634.76	96.42	0.48
114	Kywe U	160.75	840	5.226	0.09	9816.56	0.004	0.081	835.8	5.20	0.03
115	Laing	22.20	728	32.798	0.22	3380.62	0.011	0.205	724.36	32.63	0.16
116	Lel Hla Kone	6.42	445	69.367	0.15	2914.25	0.008	0.145	442.775	69.02	0.35
117	Lel Kaing	13.42	4308	320.927	0.81	5320.65	0.040	0.769	4286.46	319.32	1.60
118	Lel Ma	7.51	1827	243.428	0.28	6437.46	0.014	0.270	1817.865	242.21	1.22
119	Let Khoke	4.39	2159	491.824	0.36	6072.89	0.018	0.338	2148.205	489.37	2.46
120	Let Khoke Pin	10.11	3114	307.960	0.46	6761.86	0.023	0.437	3098.43	306.42	1.54
121	Let Me	16.68	1804	108.133	0.29	6144.67	0.015	0.279	1794.98	107.59	0.54
122	Let Pa Taw	13.49	2292	169.886	0.12	19617.14	0.006	0.111	2280.54	169.04	0.85
123	Let Pan Kyin	53.51	872	16.297	0.12	7068.99	0.006	0.117	867.64	16.22	0.08
124	Lin De	74.93	1527	20.380	0.28	5394.43	0.014	0.269	1519.365	20.28	0.10
125	Lone Gyi	29.59	603	20.382	0.11	5555.69	0.005	0.103	599.985	20.28	0.10
126	Ma De	20.35	4882	239.936	0.75	6505.34	0.038	0.713	4857.59	238.74	1.20
127	Ma Gyi	17.27	1250	72.393	0.25	4943.43	0.013	0.240	1243.75	72.03	0.36
128	Ma Gyi Pin Pu	19.09	3888	203.666	0.89	4361.54	0.045	0.847	3868.56	202.65	1.02
129	Ma Gyi Thone Pin	58.20	2671	45.892	0.29	9279.97	0.014	0.273	2657.645	45.66	0.23
130	Ma Htein	127.68	895	7.010	0.11	8021.08	0.006	0.106	890.525	6.97	0.04
131	Man Aung	24.54	1132	46.121	0.20	5561.92	0.010	0.193	1126.34	45.89	0.23
132	Man Dat Kaing	43.03	602	13.992	0.16	3681.73	0.008	0.155	598.99	13.92	0.07

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
132	Man Dat Kaing	43.03	602	13.992	0.16	3681.73	0.008	0.155	598.99	13.92	0.07
133	Man Kyoe	9.05	2934	324.346	0.35	8295.59	0.018	0.336	2919.33	322.72	1.62
134	Maung Ma Kan	15.84	2341	147.763	0.33	7119.54	0.016	0.312	2329.295	147.02	0.74
135	Me Ywar Kyun	4.54	662	145.719	0.22	2990.06	0.011	0.210	658.69	144.99	0.73
136	Me Za Li	67.82	8016	118.195	0.99	8099.98	0.049	0.940	7975.92	117.60	0.59
137	Mei Bayt Kone	14.12	3971	281.300	1.22	3265.05	0.061	1.155	3951.145	279.89	1.41
138	Min	6.06	1305	215.244	0.17	7473.22	0.009	0.166	1298.475	214.17	1.08
139	Min Hla Kyin	154.01	4072	26.440	0.96	4228.79	0.048	0.915	4051.64	26.31	0.13
140	Min Hlyin	12.50	2465	197.209	0.48	5137.10	0.024	0.456	2452.675	196.22	0.99
141	Min Lwin	107.92	1693	15.687	0.87	1956.89	0.043	0.822	1684.535	15.61	0.08
142	Min Myay	8.34	2409	288.765	0.44	5447.17	0.022	0.420	2396.955	287.32	1.44
143	Minbu No (1)	2.76	7868	2846.589	1.58	4994.76	0.079	1.496	7828.66	2832.36	14.23
144	Minbu No (2)	1.86	2962	1588.357	0.63	4732.11	0.031	0.595	2947.19	1580.42	7.94
145	Minbu No (3)	1.52	6629	4352.965	0.78	8489.71	0.039	0.742	6595.855	4331.20	21.76
146	Minbu No (4)	4.88	10606	2173.227	1.77	5990.86	0.089	1.682	10552.97	2162.36	10.87
147	Moe Wun	1.03	559	543.647	0.15	3745.86	0.007	0.142	556.205	540.93	2.72
148	Mon Hnyin	21.06	1615	76.675	0.07	21901.57	0.004	0.070	1606.925	76.29	0.38
149	Mon Htaung	55.46	3088	55.680	0.53	5781.34	0.027	0.507	3072.56	55.40	0.28
150	Mone Myint	12.48	2405	192.716	0.44	5422.17	0.022	0.421	2392.975	191.75	0.96
151	Mone Za Le	8.23	2927	355.466	0.49	6028.12	0.024	0.461	2912.365	353.69	1.78
152	Mun Zaw	55.07	498	9.044	0.46	1073.92	0.023	0.441	495.51	9.00	0.05
153	Myaung Kauk	1.26	426	337.452	0.06	7035.24	0.003	0.058	423.87	335.77	1.69

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
154	Myaung U	14.98	972	64.878	0.18	5452.95	0.009	0.169	967.14	64.55	0.32
155	Myaung U	94.22	1207	12.811	0.16	7528.89	0.008	0.152	1200.965	12.75	0.06
156	Myay Mi Kone	4.97	1339	269.318	0.30	4482.20	0.015	0.284	1332.305	267.97	1.35
157	Myay Ni Kone	26.54	1236	46.565	0.56	2225.64	0.028	0.528	1229.82	46.33	0.23
158	Myay Nu	52.17	2935	56.256	0.41	7169.72	0.020	0.389	2920.325	55.97	0.28
159	Myin Tin	0.80	3232	4015.466	0.37	8733.60	0.019	0.352	3215.84	3995.39	20.08
160	Myit Hpyar	15.27	1145	74.962	0.26	4403.05	0.013	0.247	1139.275	74.59	0.37
161	Myo Ma	0.36	1644	4609.897	0.23	7175.59	0.011	0.218	1635.78	4586.85	23.05
162	Na Be Kone	14.17	1450	102.331	0.28	5244.84	0.014	0.263	1442.75	101.82	0.51
163	Nan Kyu	21.14	667	31.558	0.13	5231.23	0.006	0.121	663.665	31.40	0.16
164	Nan Taw Kone	12.74	2351	184.508	0.33	7028.69	0.017	0.318	2339.245	183.59	0.92
165	Nan Taw Kyun	10.17	2703	265.886	0.59	4548.02	0.030	0.565	2689.485	264.56	1.33
166	Nat Gyi	50.98	1726	33.858	0.05	31466.89	0.003	0.052	1717.37	33.69	0.17
167	Naung	28.66	367	12.804	0.05	8139.98	0.002	0.043	365.165	12.74	0.06
168	Nei Zaw	4.24	517	121.893	0.07	7228.93	0.004	0.068	514.415	121.28	0.61
169	Neik Ban Kyun	5.37	1052	195.861	0.11	9441.50	0.006	0.106	1046.74	194.88	0.98
170	Nga Hlaing Twin	83.47	1546	18.521	0.12	12987.99	0.006	0.113	1538.27	18.43	0.09
171	Nga Le	22.78	584	25.635	0.09	6783.66	0.004	0.082	581.08	25.51	0.13
172	Nga Than Khaung	22.11	2609	117.975	0.33	7873.66	0.017	0.315	2595.955	117.39	0.59
173	No (1)	0.37	1965	5327.268	0.26	7628.61	0.013	0.245	1955.175	5300.63	26.64
174	No (2)	1.00	4549	4566.338	0.52	8795.39	0.026	0.491	4526.255	4543.51	22.83
175	Nwar Tat (Net Tat)	4.90	819	167.211	0.07	11025.94	0.004	0.071	814.905	166.38	0.84

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
175	Nwar Tat (Net Tat)	4.90	819	167.211	0.07	11025.94	0.004	0.071	814.905	166.38	0.84
176	Nwe Ta Mei	2.82	2025	718.582	0.26	7657.88	0.013	0.251	2014.875	714.99	3.59
177	Nyaung (Lin Zin)	30.56	2366	77.427	0.50	4739.37	0.025	0.474	2354.17	77.04	0.39
178	Nyaung Cho	8.93	1896	212.252	0.50	3810.18	0.025	0.473	1886.52	211.19	1.06
179	Nyaung Inn	6.29	2234	354.929	0.56	4009.95	0.028	0.529	2222.83	353.15	1.77
180	Nyaung Kone	41.91	1459	34.812	0.07	21635.07	0.003	0.064	1451.705	34.64	0.17
181	Nyaung Pin	7.57	1089	143.833	0.13	8149.25	0.007	0.127	1083.555	143.11	0.72
182	Nyaung Pin	18.94	707	37.319	0.32	2183.41	0.016	0.308	703.465	37.13	0.19
183	Nyaung Pin Lel Kyin	53.98	1842	34.124	0.25	7374.25	0.012	0.237	1832.79	33.95	0.17
184	Nyaung Pin Zauk	3.65	2042	559.805	0.44	4645.30	0.022	0.418	2031.79	557.01	2.80
185	Oe Myay Htwin	7.04	454	64.479	0.06	6989.22	0.003	0.062	451.73	64.16	0.32
186	Oe Thei	9.38	1198	127.723	0.27	4390.63	0.014	0.259	1192.01	127.08	0.64
187	Ohn War	18.48	839	45.396	0.10	8793.87	0.005	0.091	834.805	45.17	0.23
188	Pa Be	35.35	830	23.478	0.07	11940.90	0.003	0.066	825.85	23.36	0.12
189	Pa Bway	94.70	249	2.629	0.06	4394.28	0.003	0.054	247.755	2.62	0.01
190	Pa Dan	14.75	5509	373.393	1.12	4901.06	0.056	1.068	5481.455	371.53	1.87
191	Pa Zi	14.02	457	32.602	0.13	3535.56	0.006	0.123	454.715	32.44	0.16
192	Paik Pin(Paik Thin)	9.84	468	47.585	0.12	3910.89	0.006	0.114	465.66	47.35	0.24
193	Pan Ei	22.20	1238	55.773	0.16	7753.87	0.008	0.152	1231.81	55.49	0.28
194	Pan Ei Hnyar	56.24	320	5.690	0.03	12471.84	0.001	0.024	318.4	5.66	0.03
195	Pan Hlwar	17.08	1471	86.139	0.26	5667.04	0.013	0.247	1463.645	85.71	0.43
196	Pan Taw	11.37	1619	142.365	0.37	4408.50	0.018	0.349	1610.905	141.65	0.71

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
196	Pan Taw	11.37	1619	142.365	0.37	4408.50	0.018	0.349	1610.905	141.65	0.71
197	Pan Tein	27.76	2457	88.498	0.53	4665.43	0.026	0.500	2444.715	88.06	0.44
198	Pauk Kone	19.03	1696	89.138	0.88	1919.24	0.044	0.840	1687.52	88.69	0.45
199	Pauk Lay Pin	18.91	3091	163.484	0.95	3249.90	0.048	0.904	3075.545	162.67	0.82
200	Pauk Ngu	8.18	1186	144.988	0.44	2703.96	0.022	0.417	1180.07	144.26	0.72
201	Pauk Pin Htwin	7.28	503	69.115	0.08	6164.46	0.004	0.078	500.485	68.77	0.35
202	Paung	12.43	1010	81.230	0.17	6025.89	0.008	0.159	1004.95	80.82	0.41
203	Paung Ka Lay	13.16	1203	91.428	0.27	4498.92	0.013	0.254	1196.985	90.97	0.46
204	Paung Nar	0.75	2987	3972.270	0.61	4882.72	0.031	0.581	2972.065	3952.41	19.86
205	Paung Pin Zin	0.40	1722	4339.138	0.26	6670.70	0.013	0.245	1713.39	4317.44	21.70
206	Paung Tu	28.00	2808	100.304	0.41	6839.79	0.021	0.390	2793.96	99.80	0.50
207	Paung Yin Kone	3.94	976	247.681	0.20	4801.60	0.010	0.193	971.12	246.44	1.24
208	Pay Kone	8.73	1620	185.655	0.15	10909.30	0.007	0.141	1611.9	184.73	0.93
209	Pay Kone	6.85	931	135.834	0.39	2388.55	0.019	0.370	926.345	135.16	0.68
210	Pay Taw	8.70	2501	287.577	0.53	4703.17	0.027	0.505	2488.495	286.14	1.44
211	Pin Lel Thet	3.39	1450	427.125	0.20	7148.02	0.010	0.193	1442.75	424.99	2.14
212	Pin U	246.63	4082	16.551	0.71	5786.12	0.035	0.670	4061.59	16.47	0.08
213	Pu Daung	31.18	1011	32.423	0.19	5408.24	0.009	0.178	1005.945	32.26	0.16
214	Pu Htoe Hpyu	0.33	1295	3967.464	0.24	5400.39	0.012	0.228	1288.525	3947.63	19.84
215	Pu Khet Taing	20.07	523	26.062	0.10	5239.82	0.005	0.095	520.385	25.93	0.13
216	Pu Paing	28.20	349	12.376	0.06	6048.74	0.003	0.055	347.255	12.31	0.06
217	Pya Tauk	12.35	1698	137.517	0.27	6386.63	0.013	0.253	1689.51	136.83	0.69

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
218	Pyi Lone Kyaw	16.89	3591	212.616	0.49	7297.57	0.025	0.467	3573.045	211.55	1.06
219	Pyoe Khin Kone	8.68	1662	191.398	0.49	3381.84	0.025	0.467	1653.69	190.44	0.96
220	Ra Day	6.20	2333	376.188	0.52	4481.70	0.026	0.495	2321.335	374.31	1.88
221	Saku No (1)	2.73	4965	1817.456	0.96	5161.91	0.048	0.914	4940.175	1808.37	9.09
222	Saku No (2)	1.47	2939	2004.269	0.39	7450.25	0.020	0.375	2924.305	1994.25	10.02
223	Saku No (3)	0.55	3590	6523.951	0.42	8529.50	0.021	0.400	3572.05	6491.33	32.62
224	Sat Si	32.13	584	18.175	0.08	7448.36	0.004	0.074	581.08	18.08	0.09
225	Se Kan	20.33	1355	66.646	0.31	4323.07	0.016	0.298	1348.225	66.31	0.33
226	Se Mone	30.35	3315	109.242	0.87	3794.45	0.044	0.830	3298.425	108.70	0.55
227	Se Taw	12.25	1551	126.569	0.31	5075.43	0.015	0.290	1543.245	125.94	0.63
228	Seik Gyi	6.50	1971	303.166	0.40	4945.19	0.020	0.379	1961.145	301.65	1.52
229	Sha Shar (North)	10.99	462	42.029	0.11	4263.59	0.005	0.103	459.69	41.82	0.21
230	Shan Su	12.15	2851	234.656	0.52	5478.52	0.026	0.494	2836.745	233.48	1.17
231	Shar Taw (East)	11.16	968	86.764	0.17	5558.52	0.009	0.165	963.16	86.33	0.43
232	Shar Taw (North)	3.27	4035	1232.870	0.29	14091.16	0.014	0.272	4014.825	1226.71	6.16
233	Shauk Taung	52.60	2808	53.381	0.36	7703.57	0.018	0.346	2793.96	53.11	0.27
234	Shwe Bon Thar	6.30	2405	381.645	0.58	4165.13	0.029	0.549	2392.975	379.74	1.91
235	Shwe Hlay	15.91	5034	316.409	1.13	4451.13	0.057	1.074	5008.83	314.83	1.58
236	Shwe Kyaung	11.79	1502	127.367	0.21	7256.17	0.010	0.197	1494.49	126.73	0.64
237	Shwe Set Taw Reserved Forest	149.97	0	0.000	0.00	0.00	0.000	0.000	0	0.00	0.00
238	Shwe Zan Thee	69.44	3251	46.820	0.58	5622.31	0.029	0.549	3234.745	46.59	0.23
239	Si Thar	20.16	785	38.940	0.17	4620.06	0.008	0.161	781.075	38.75	0.19

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
240	Si Zwe	33.10	3160	95.459	0.58	5461.73	0.029	0.550	3144.2	94.98	0.48
241	Sin Chaung	28.17	488	17.325	0.07	7307.15	0.003	0.063	485.56	17.24	0.09
242	Sin Chi Taing	23.47	3122	133.049	0.66	4764.98	0.033	0.622	3106.39	132.38	0.67
243	Sin Gaung	41.92	3858	92.039	0.78	4928.86	0.039	0.744	3838.71	91.58	0.46
244	Sin Hpyu Kyun (1)	0.94	2638	2808.265	0.50	5248.65	0.025	0.477	2624.81	2794.22	14.04
245	Sin Hpyu Kyun (2)	0.93	2817	3042.317	0.73	3860.87	0.036	0.693	2802.915	3027.11	15.21
246	Sin Kyone	3.09	2582	834.543	0.41	6370.13	0.020	0.385	2569.09	830.37	4.17
247	Sin Lu (North)	17.98	2654	147.636	0.47	5658.86	0.023	0.446	2640.73	146.90	0.74
248	Sin Ma Kyun	29.47	5673	192.531	1.50	3783.05	0.075	1.425	5644.635	191.57	0.96
249	Sit Ngan	145.47	1155	7.940	0.13	9138.13	0.006	0.120	1149.225	7.90	0.04
250	Son Kone	5.21	1762	338.163	0.84	2105.31	0.042	0.795	1753.19	336.47	1.69
251	Su Pa Daung	60.08	1264	21.040	0.22	5748.72	0.011	0.209	1257.68	20.93	0.11
252	Sun Kyun Nyo	6.94	2867	413.260	0.39	7410.78	0.019	0.368	2852.665	411.19	2.07
253	Sun Tet	21.16	377	17.815	0.08	5008.58	0.004	0.072	375.115	17.73	0.09
254	Swei Tei	28.13	1723	61.247	0.28	6192.19	0.014	0.264	1714.385	60.94	0.31
255	Ta Hnyauk Tin	63.09	887	14.058	0.08	11364.79	0.004	0.074	882.565	13.99	0.07
256	Ta Lin Gyi Kone	6.25	1224	195.704	0.35	3546.76	0.017	0.328	1217.88	194.73	0.98
257	Ta Mar Chaung	6.53	1226	187.758	0.20	5992.33	0.010	0.194	1219.87	186.82	0.94
258	Ta Nyaung	12.84	7088	552.163	1.63	4347.64	0.082	1.549	7052.56	549.40	2.76
259	Ta Pwin	22.20	765	34.464	0.13	5970.73	0.006	0.122	761.175	34.29	0.17
260	Ta Taung Kan	7.01	859	122.455	0.19	4463.66	0.010	0.183	854.705	121.84	0.61
261	Taung Bo	27.52	2172	78.914	0.35	6225.49	0.017	0.331	2161.14	78.52	0.39

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
262	Taung Inn Ywar Thit	4.58	774	168.926	0.22	3565.78	0.011	0.206	770.13	168.08	0.84
263	Taung Man	15.00	2101	140.031	0.42	5060.13	0.021	0.394	2090.495	139.33	0.70
264	Taung Pyit Kone	33.15	2628	79.271	0.40	6493.67	0.020	0.384	2614.86	78.87	0.40
265	Taung Ywar Htan Taw	2.39	587	245.918	0.11	5444.60	0.005	0.102	584.065	244.69	1.23
266	Taw Gyi	6.75	1452	215.260	0.19	7496.67	0.010	0.184	1444.74	214.18	1.08
267	Taw Na Lin	43.57	2287	52.487	0.39	5913.29	0.019	0.367	2275.565	52.22	0.26
268	Taw Seint	25.40	4685	184.440	0.80	5859.49	0.040	0.760	4661.575	183.52	0.92
269	Tei Soke	17.63	391	22.180	0.07	5852.28	0.003	0.063	389.045	22.07	0.11
270	Tei Zar	10.35	534	51.599	0.08	6452.05	0.004	0.079	531.33	51.34	0.26
271	Tha Man Yin	7.06	2128	301.510	0.40	5294.70	0.020	0.382	2117.36	300.00	1.51
272	Tha Myin Kin	7.26	2799	385.478	0.68	4093.81	0.034	0.650	2785.005	383.55	1.93
273	Tha Nat Kone	3.40	2513	738.616	0.09	27226.08	0.005	0.088	2500.435	734.92	3.69
274	Tha Nat Pin Su	7.90	1710	216.583	0.24	7006.61	0.012	0.232	1701.45	215.50	1.08
275	Tha Pyay Pin	4.58	570	124.499	0.10	5613.36	0.005	0.096	567.15	123.88	0.62
276	Tha Yan Kaing	32.63	520	15.937	0.09	5810.34	0.004	0.085	517.4	15.86	0.08
277	Tha Yet Chin	3.06	3077	1004.082	0.79	3896.24	0.039	0.750	3061.615	999.06	5.02
278	Tha Yet Kone	3.09	729	236.232	0.37	1946.34	0.019	0.356	725.355	235.05	1.18
279	Tha Yet Oke	17.02	7182	422.036	1.05	6835.03	0.053	0.998	7146.09	419.93	2.11
280	Tha Yet Taw	20.13	4495	223.271	1.23	3657.70	0.061	1.167	4472.525	222.15	1.12
281	Tha Yet Taw	30.39	4445	146.276	0.37	11956.51	0.019	0.353	4422.775	145.54	0.73
282	Than Kaing	5.54	927	167.420	0.15	6051.14	0.008	0.146	922.365	166.58	0.84
283	Than Se	92.20	2056	22.299	0.94	2194.50	0.047	0.890	2045.72	22.19	0.11

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
286	Thet Lel	182.90	779	4.259	0.03	24016.71	0.002	0.031	775.105	4.24	0.02
287	Thet Taw Shey	0.91	2393	2634.952	0.43	5523.00	0.022	0.412	2381.035	2621.78	13.17
288	Thin Baw Kyun	12.36	480	38.822	0.01	40953.53	0.001	0.011	477.6	38.63	0.19
289	Thin Pan Taw (a)	42.33	4437	104.807	0.68	6550.58	0.034	0.643	4414.815	104.28	0.52
290	Thit Khauk Taung	12.07	924	76.571	0.20	4643.13	0.010	0.189	919.38	76.19	0.38
291	Tin Pyin	94.13	454	4.823	0.07	6214.89	0.004	0.069	451.73	4.80	0.02
292	U Yin	5.65	826	146.141	0.19	4273.40	0.010	0.184	821.87	145.41	0.73
293	U Yin Kyit	17.98	8272	460.041	1.25	6637.88	0.062	1.184	8230.64	457.74	2.30
294	U Yin Zin	10.81	1640	151.696	0.19	8422.31	0.010	0.185	1631.8	150.94	0.76
295	Wun Ya	19.88	3009	151.373	0.31	9852.43	0.015	0.290	2993.955	150.62	0.76
296	Yae Ngan	19.36	1764	91.133	0.22	8037.96	0.011	0.208	1755.18	90.68	0.46
297	Yae Paw Gyi	37.22	2004	53.845	0.38	5250.65	0.019	0.363	1993.98	53.58	0.27
298	Yae Poke	7.64	1553	203.265	0.25	6333.94	0.012	0.233	1545.235	202.25	1.02
299	Yae Poke Gyi	43.55	2990	68.650	0.29	10468.12	0.014	0.271	2975.05	68.31	0.34
300	Yae Poke Ka Lay	17.63	1259	71.416	0.23	5409.33	0.012	0.221	1252.705	71.06	0.36
301	Yae Pwa Kyun	10.52	2112	200.820	0.27	7722.00	0.014	0.260	2101.44	199.82	1.00
302	Yae Thaung	17.93	811	45.220	0.12	6897.40	0.006	0.112	806.945	44.99	0.23
303	Yae Twin Kone	11.22	2327	207.316	0.39	5955.81	0.020	0.371	2315.365	206.28	1.04
304	Yint Shey	49.60	1914	38.587	0.63	3026.38	0.032	0.601	1904.43	38.39	0.19
305	Yone Pin Kan	29.50	6018	203.994	1.30	4617.11	0.065	1.238	5987.91	202.97	1.02
306	Ywar Hmat	1.96	557	283.536	0.15	3689.16	0.008	0.143	554.215	282.12	1.42
307	Ywar Khaing	9.89	3297	333.431	0.54	6128.26	0.027	0.511	3280.515	331.76	1.67

Table 5 (Continute)

No	VTName	Area Km^2	Total Population	PD	Settlement Area	Settlement_ PD	0.5% (Multi)	Net Populated Area Km^2	Estimated Population	Estimated PD	Residual
308	Ywar Ma Kaw	4.40	1435	326.144	0.24	6035.13	0.012	0.226	1427.825	324.51	1.63
309	Ywar Pale Kone Tan	16.76	1953	116.546	0.33	5840.31	0.017	0.318	1943.235	115.96	0.58
310	Ywar Thar Yar	24.08	4372	181.586	0.79	5568.59	0.039	0.746	4350.14	180.68	0.91
311	Ywar Thar	7.71	1471	190.812	0.25	5972.20	0.012	0.234	1463.645	189.86	0.95
312	Ywar Thit Kone	4.84	1877	387.847	0.27	7014.48	0.013	0.254	1867.615	385.91	1.94
313	Za Yat Hla	5.81	983	169.200	0.15	6436.81	0.008	0.145	978.085	168.35	0.85
314	Zay Ma	0.24	1685	7035.344	0.19	8994.98	0.009	0.178	1676.575	7000.17	35.18
315	Zee Aing	54.92	1627	29.625	0.26	6140.36	0.013	0.252	1618.865	29.48	0.15
316	Zee Hpyu Pin	34.92	8403	240.663	1.82	4615.48	0.091	1.730	8360.985	239.46	1.20
317	Zee Kaing	5.77	3255	564.571	0.61	5346.05	0.030	0.578	3238.725	561.75	2.82
318	Zee Kone	19.73	2037	103.219	0.39	5209.73	0.020	0.371	2026.815	102.70	0.52
319	Zee Kyun	17.09	1946	113.899	0.75	2589.98	0.038	0.714	1936.27	113.33	0.57
320	Zee Taw	5.02	1687	335.812	0.40	4246.54	0.020	0.377	1678.565	334.13	1.68
321	Zee Taw Gyi	4.53	1386	306.120	0.29	4765.32	0.015	0.276	1379.07	304.59	1.53
322	Zin Pyun	32.24	2612	81.009	0.44	5886.31	0.022	0.422	2598.94	80.60	0.41

CURRICULUM VITAE

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