CHAPTER IV
RESULTS AND DISCUSSIONS

This study intended to classify the landscape through unmanned aerial vehicles, analyze and compare with the satellite image with high resolution and accuracy as the indicators for data comparison. Results are derived as follows:

4.1 Geometric Correction

From huge data acquired by the unmanned aerial vehicle, the researcher had divided the data into 30 set of photographs. Each set needed to be rectified and prevent the mixed up of data so data could be identified from which set to make correction easier afterward as well as rearrange the photo for better understanding mosaic. The Mean from rectifying 30 photos can have RMS Error average 0.1675. The standard RMS Error cannot be exceeded 1.00. Later, when all photos had been classified, they would be subjected to UTM or Universal Transverse Mercator in the World Geodetic System 1984 (WGS 1984) to make one giant photo before putting through more rectified process, at least twice, using the model Polynomial Order1. In the calculation for new coordinate to reduce miscalculation and the least acceptable after the mosaic is implied that RMS Error sill occurred equaled 0.9770.

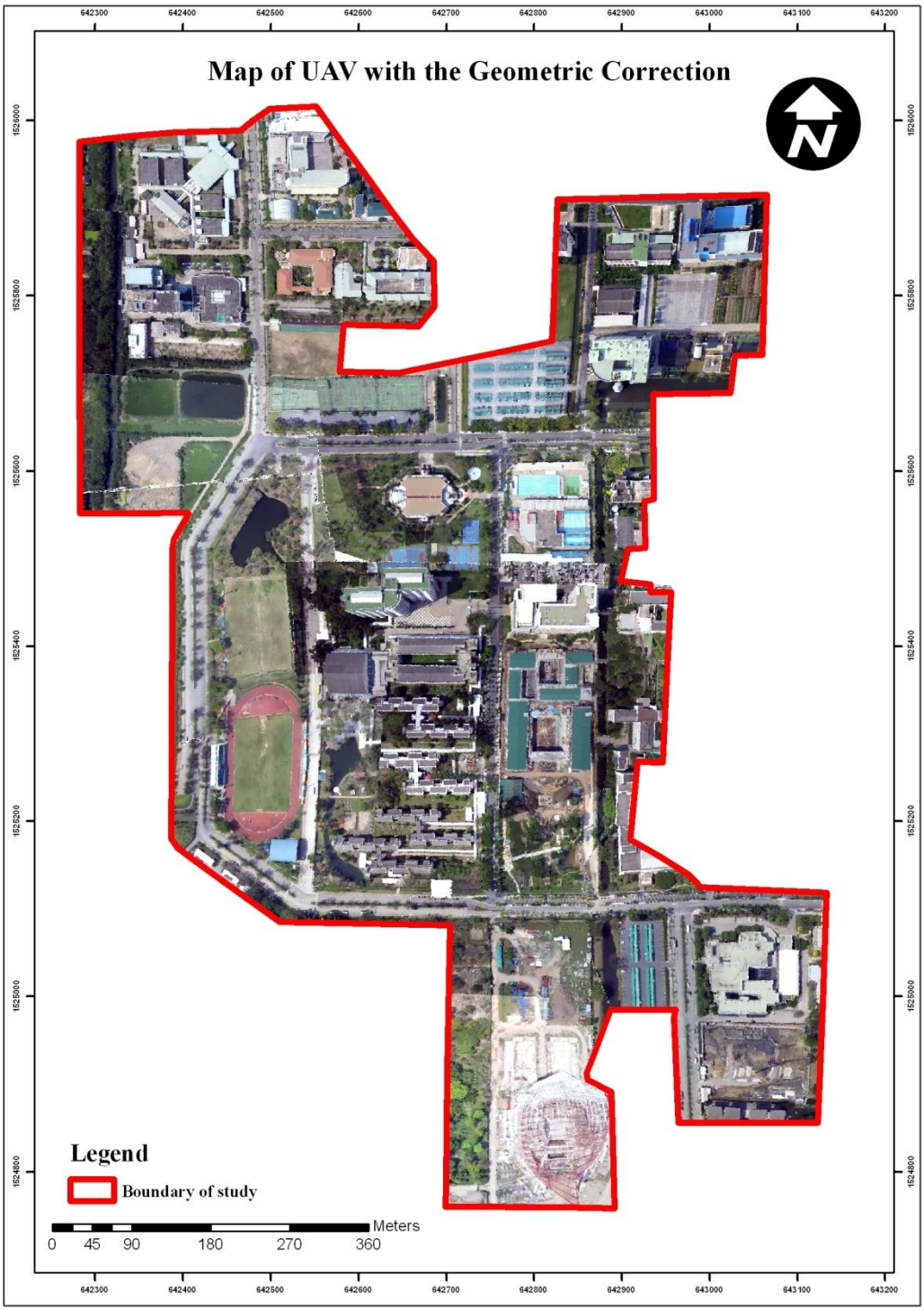

Figure 4.1 Map of Unmanned Aerial Vehicles with Geometric Correction

Source: Analysis

4.2 Landscape classification with GeoEye

The landscape classification at Mahidol University with GeoEye found buildings in total area was 89,943.81 square meters, car park 22,459.02 square meter, roads 66,419.84 square meters, bicycle lane 5,865.00 square meters, green areas 196,638.10 square meters, sport 55,029.37 square meters, water source 36,900.97 square meters and walking site 23,063.79 square meters and other areas 127,850.90 square meters as shown in Figure 4.2

Figure 4.2 Map of landscape classification with GeoEye satellite

Source: Analysis

4.3 Landscape classification with unmanned aerial photography

The landscape with unmanned aerial photography at Mahidol University showed the building area 115,499.87 square meters, car park 22,727.90 square meters, roads 72,789.83 square meters, bicycle lane 5,680.60 square meters, green areas 186,447.14 square meters, sport 44,444.22 square meters, water source 31,314.34 square meters, walking site 11,597.95 square meters and other areas 128,423.28 square meters as being illustrated below:

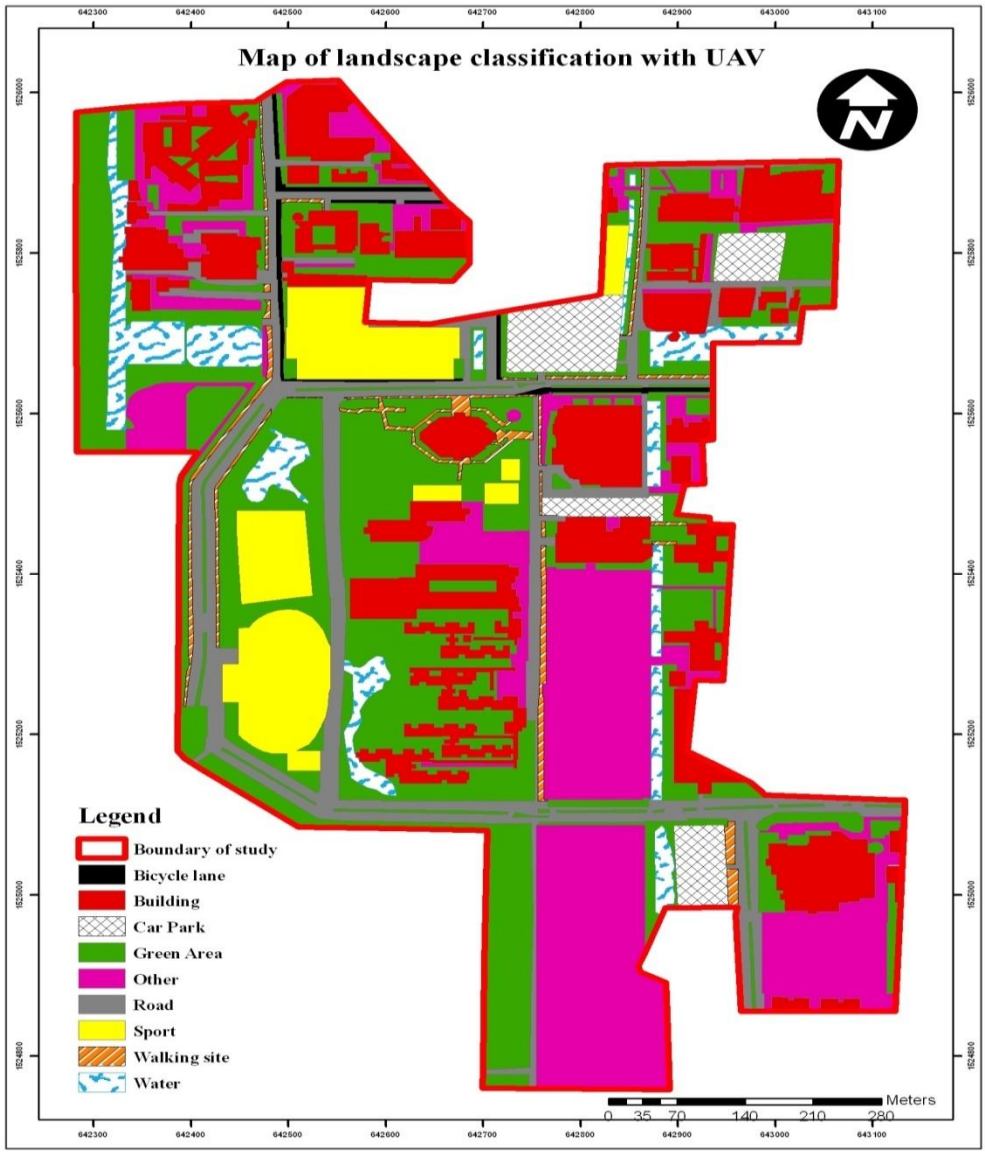

Figure 4.3 Map of landscape classification with UAV

Source: Analysis

Table 4.1 Landscape areas through GeoEye and Unmanned Aerial Photography

List of Nomenclature	Area of GeoEye (m^2)	Area of UAV (m^2)
1. Bicycle Lane	5,865.00	5,680.60
2. Building	89,943.81	115,499.87
3. Car Park	22,459.02	22,717.90
4. Green area	196,638.10	186,447.14
5. Road	66,419.84	72,789.83
6. Sport	55,029.37	44,444.22
7. Walking site	23,063.79	11,597.95
8. Water	36,900.97	31,314.34
9. Other	127,850.90	128,423.28
Total	**624,170.80**	**618,915.13**

Source: Analysis

4.4 Overlap areas from photography

The photography comparison between photography from GeoEye and unmanned aerial vehicles with the application of Overlay Technique was done to locate the overlay area or similar areas, using percentage. The findings indicated 3 landscapes with the most overlay area: car park 20,143.17 square meters, sport 41,129.29 square meters, other areas 85,416.46 square meters, respectively. The landscape classification with the least overlay area is: walking site 3,838.89 square meters, bicycle lane 1,775.68 square meters, respectively. As for overall area with landscape classification, the overlapped areas are 46.56%.

Table 4.2 Overlap areas of GeoEye and Unmanned Aerial Photography

List of Items	Intersect Area/m^2	Percent
1.Bicycle Lane	1,775.68	18.21
2.Building	64,105.33	45.61
3.Car Park	20,143.17	81.21
4. Green area	123,805.86	48.19
5.Road	34,942.14	33.79
6.Sport	41,129.29	70.62
7. Walking site	3,838.89	12.47
8.Water	17,964.71	35.95
9. Other	85,416.46	50.29
Total	**393,121.53**	**46.56**

Source : Analysis

From Table 4.2 shows large overlay such as car park and sport as much as 81.21 % and 70.63%, respectively which indicated similar landscape classification in the same area. This is meant for interpretation of the landscape classification quite similar as well. As for area with small overlay such as walking site 12.47 % which may not be interpreted as the landscape classification in the dissimilar areas. This may cause by nearby objects blocking the view or the location of camera at the time of shooting, including the light and shadow that also affected the landscape classification.

4.5 Accuracy assessment classification

The landscape classification with GeoEye in 2010 and data from unmanned aerial photography in 2011 with commercial program ArcGIS Desktop 9.2 were taken into account and identified database as Shapfile. Then results were concluded and conducted classification accuracy from the Ground Truth Visit as compared to data interpretation to find the landscape accuracy also. Total 75 points were randomly check and assigned the accuracy over 80% of the sampling areas as being shown in Table 4.3.

Table 4.3 Accuracy Assessment of Error Matrix from GeoEye

Visual interpretation classification	Ground truth										
	Landscape	Bicycle Lane	Building	Car Park	Green area	Road	Sport	Walking site	Water	Other	**Total**
	Bicycle Lane	**6**	0	0	0	2	0	0	0	0	8
	Building	0	**9**	0	1	0	0	0	0	0	10
	Car Park	0	0	**5**	0	0	0	0	0	0	5
	Green area	0	0	0	**10**	0	0	0	0	0	10
	Road	0	0	0	0	**9**	0	0	0	0	9
	Sport	0	0	0	0	0	**7**	0	0	0	7
	Walking site	0	0	0	1	2	0	**7**	0	0	10
	Water	0	0	0	0	0	0	0	**8**	0	8
	Other	0	0	0	1	0	0	0	0	**7**	8
	Total	6	9	5	13	13	7	7	8	7	**75**

Source : Analysis

Overall Accuracy of the landscape classification areas equaled 90.66 % and Kappa Index was 0.89.

Table 4.4 Accuracy assessment of Error Matrix from UAV

Visual interpretation classification	Ground truth										
	Landscape	Bicycle Lane	Building	Car Park	Green area	Road	Sport	Walking site	Water	Other	**Total**
	Bicycle Lane	**6**	0	0	1	1	0	0	0	0	8
	Building	0	**9**	0	1	0	0	0	0	0	10
	Car Park	0	0	**5**	0	0	0	0	0	0	5
	Green area	0	0	0	**10**	0	0	0	0	0	10
	Road	0	0	0	1	**7**	0	0	0	1	9
	Sport	0	0	0	0	0	**7**	0	0	0	7
	Walking site	0	0	0	1	2	0	**7**	0	0	10
	Water	0	0	0	1	0	0	0	**7**	0	8
	Other	0	0	0	1	0	0	0	0	**7**	8
	Total	6	9	5	16	10	7	7	7	7	**75**

Source: Analysis

Overall Accuracy of the landscape classification areas equaled 86.66 % and Kappa Index was 0.84.

4.6 Kappa Index assessment

Accuracy analysis with Error Matrix and Kappa Index indicated the Overall Accuracy of unmanned aerial Vehicle 86.66 % and Kappa Index equaled 0.84. For overall Accuracy of GeoEye, it was 90.66 % with Kappa Index of 0.89. The Kappa Index of unmanned aerial vehicles and GeoEye indicated the degree of agreement from 0.81–0.99 in the almost perfect agreement level.