STUDY ON MAPPING LAND USE USING OPEN MAPS AND OPEN DATA

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Abstract

Within the present changes of spatial trends the land use maps plays very important role to human and environmental interactions. So Land use maps represent a key resources to study many of these phenomena which are both causes and effects of the spatial planning. A large amount of effort and monetary resources are spent on mapping LU features over time and at local scales. However, both data gathering approaches are financially expensive and time consuming. In this regard, the OpenStreetMap (OSM) project has been one of the most successful representatives, providing LU features. The main objective of this paper is to develop an effective and affordable framework to map land uses at city scale. Kappa index analysis along with per-class user's and producers' accuracies are used for accuracy assessment. The empirical findings suggest OSM as an alternative complementary source for extracting LU information whereas exceeding 50% of the selected cities are mapped by mappers. Moreover, the results identify which land types preserve high/moderate/low accuracy across cities for urban LU mapping and also what type of the classes should be reliable for future needs. And main factors of mapping which is involved for worth output make a sense of high effectiveness and affordable. Time, cost and technical accessible give the results of the proposed method to measure effectiveness and affordable for main five DSD of Sri Lanka. The findings strength the potential of collaboratively collected LU features for providing accurate LU maps as well as updating/enriching existing inventories. Furthermore, such an effective and affordable method can be used for collecting a locally coverage of LU information specifically in countries in which Accurate could be maximized and minimized the cost and time.

Keywords: OpenStreetMap, Land use, Accuracy, Kappa. Confusion Matrix

1. Introduction

1.1 Background

Land is a vital importance and limited resource which can change with human movement. If human populations continue to increase at the present rate there will be twice changes reflect in the land resources. Therefore Land use maps derived from remote sensing imagery play a vital role in monitoring human environmental interactions such as landscape changes, ecological services (conservation) and Spatial planning and management. Land-use maps describe the arrangements, activities, and inputs people undertake within a particular land cover type to produce, modify or maintain it. (Yang, Shiuanfu, & Smith, 2017). So LUE in areas is operatively linked to the ratio of developed land to resident inhabitants. So here land use planning is importance for land use changes, determining the contraction of agricultural land, the consolidation of forests and other natural land and the expansion of land. While society benefits from economic development and conservation of natural areas, this trend has a number of adverse implications, related to expanding unsustainable use of land, rural-urban migration, abandonment of cropland, land marginalization, inadequate social security and health provision and decreasing food and environmental security. (Ferrara, Zitti, Perini , & Perini, 2015) Obviously land use mapping is a promising indicator reflecting the increased complexity of growth patterns and may anticipate future spatial trends. (Ferrara, Zitti, Perini , & Perini, 2015)

Another important for land use map is to prevent rapid urban expansion especially from the unplanned urbanization process, urban planners and decision makers need to regular assess development procedures using updated lad use maps. Though

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many spatial planners in developing countries lack access to updated maps an often rely on old data that are not applicable.

When we define the definition for open data and open maps this approach give idea about, Information System (GIS) analysis of data could aid local governance in observing the choice to use freely-available remote-sensed images, and the free and open source tools for Geographic spatial dynamics of urban areas, and to determine successful policies to manage such events in the long-term, and at low costs. (Baiocchi, Zottele, & Domi, 2017)

1.2 Existing situation of Sri Lanka in land use mapping

In Sri Lanka the existing method is they derived the images in Google maps/earth and compare it into ground truth next one is field visit and primary observation. However most of mapping applications in SriLanka have focus on areas at local scale without using earth Observation database for cross referencing. Below table shows that the existing land use Mapping in Sri Lanka from the land use policy department.

Table 1: Existing land use classes

Built up Areas	Agricultural Lands/ Cultivation Area	Forest Lands	Wet Lands(Boggy Area)	Water Bodies	Sandy Area	Rocky Area	Bare Lands
Homestead/ Home garden	Paddy	Dense Forest	Marsh	Lagoon	Sand dunes	Rock out crops	Unutilized lands
Urban Area	Tea	Open Forest	Swamp	Major Reservoirs	Sandy area	Quarries	Clay pits (clay extracted areas)
Industrial Area (a) Industrial Parks (b) Industrial sites	Rubber		Mangrove	Minor Reservoirs			Gravel pits (Gravel extracted areas)
Parks/Playground	Coconut	Scrub Land	Villa	Abandoned Tanks			Barren Lands/ Distorted surfaces
Botanical Garden	Seasonal crops	Forest Plantation		Natural Ponds			
Security Camp	Foliage/Flowering plants	Grass Land		Rivers/Streams			
Airport	Sugar cane			Lakes			
Cemetery	Oil palm			Canals			
Agricultural Farm	Cashew			Irrigation Canals			
Aquatic Farm	Cinnamon, Pepper			Salterns			
Livestock Farm	Banana, Pineapple, Mango						
	Mixed tree and other perennials						
	Sparsely used crop lands						
	Abandoned Paddy,rubber,tea						

1.2.2 Guidelines for the National Land Use Survey

Guidelines for the National Land Use Survey are given below as two parts. In the first part general guidelines are given and in the second part technical guidelines are presented.

1.2.3 Existing Updating system

Table 2-Existing Update system in SriLanka

Steps	Descriptions
1	Prepare an Index map for the District including sheet numbers (1:10,000 scale).
2	Demarcate D.S. boundaries on the Index Map.
3	Similarly prepare an Index Map for D.S. Division.
4	Indicate the availability of maps (digital and paper maps) by using different colours.
5	Obtain print outs of the 1:10,000 scale map sheets for field work (This will be provided by the Head Office)
6	Hand over this map sheets to the officers of the D.S. Division along with the Quality Control/Evaluation Sheets. Receipt should be acknowledged. Updating process (methodology) should be clearly briefed to the officers by District AD. In addition it is better to carry out a field work for a selected area as a sample with all officers to show the updating process.
7	Review the updating process by every 2 weeks and keep records on Quality Control/Evaluation sheets.
8	Updated field copies should be checked by the staff who is assigned to check the accuracy and confirm their checking by completing the relevant formats.
9	Develop data base (data should be gathered from the field) and hand over the digital coverage (in shp. format) to the Head Office

1.3 Research Problem statement

- **Obtain accurate and up-to-date land use maps at regional and sub-regional scale is a critical challenge for spatial studies in developing countries like Sri Lanka due to following constraints**

- Unavailability of up-to-date land use maps

A literature review explain the Needs to develop an integrative and innovative regional scale mapping that can be replicated for proposed a strategy to mapping using land use and management practices. Applicability of the integration of OSM and earth observation remote sensing data sets in achieving highly accurate land use maps (Yang, Shiuanfu, & Smith, 2017). There is a still a strong need for continental coverage land use map with a higher temporal resolution which will reflect the land use transition process at shorter intervals. (Yang, Shiuanfu, & Smith, 2017)

A present approach reveals that to demonstrate the use of OSM data for updating and enhancing the GL30 Land use and Land Cover product. GL30 exists at the global scale but it only has a small number of high level classes, e.g., only one urban class. And their future research will need to create a Web service to apply the procedure outlined here in real time to any user defined area (without having to install software and run scripts). This service will be based on the Web processing service (WPS) specifications issued by the Open Geospatial Consortium. So this approach highlights the need of up-to date land use maps (Antoniou, Fonte, Minghini, & See, 2017)

Another review explains that to find the overlapping areas with the classification conflict and the multiple correspondences in diverse nomenclatures. And Actions need to be taken to harmonize multiple correspondences from OSM data in land use maps. (Estima & Painho, 2013)

Need to applying data mining techniques as well as data fusion with other available datasets GMESUA for extracting the LU features of incomplete areas are of high importance. (Arsanjani & Zipf, 2015)

- Financial and human resource difficulties in collection large set of field data for prepare up-to-date land use maps

There are two major difficulties in generating land classification maps at the Regional scale: the necessity of large data-sets of training points and the expensive computation cost in terms of both money and time (Yang, Shiuanfu, & Smith, 2017)

In practice, there is a gap between remote sensing earth observations and their translation into subjective mapping products depicting how the land is used and affected by human activity. Remotely sensed data-sets can be used to monitor land cover dynamics, but are insufficient on their own for deriving land-use characteristics – the manner in which people utilize, and thus modify the land on the ground. (Yang, Shiuanfu, & Smith, 2017)

- Heavy computation and costly task involved in deriving land use maps from remote sensing imagery

A land-use map at the regional scale is a heavy computation task yet is critical to most landowners, researchers, and decision-makers, enabling them to make informed decisions for varying objectives. (Yang, Shiuanfu, & Smith, 2017)

- Lack of local knowledge and the techniques necessary for developing land use maps

One of the approaches reviews that more spatial data becomes available through GPS receivers and official sources, proprietary systems such as Google Maps may be suitable for trip planning and similar applications, and they cannot be used for most research and analytic purposes with the lacking of technical knowledge. (Leigh & Ball, 2017)

- **The emergence of open maps and open data creates new opportunities for mapping land uses at regional and sub-regional scale. However, the existing studies were often implemented over**

- Relatively regional scale areas less detailed

The finding is to collect vector data provided by volunteers that enables the creation of a map at a global scale. The flexibility of use, data availability, free access to the latest information on a daily basis, the large number of contributions and users of the data, and the existence of data not traditionally available in other types of more authoritative map databases makes OSM a valuable source of information for several applications, e.g. navigation

(Codescu, Horsinka, Kutz, & Mossakowski, 2011) And disaster response (Zook, Graham, Shelton, & Gorman, 2010)

Building type classification will be investigated for better correspondences in the two databases. Secondly, the proposed approach will be tested for larger cities. So here scale also mentioning as a local level context (Fan & Zipf, 2014)

Another reference point out that Research mostly focuses either on the data themselves while ignoring the social processes behind, or solely discusses the community-driven process without making sense of the data at a larger scale. (Mocnik, Mobasheri , & Alexand, 2018)

- Map only specific land use types

Here most of the approaches connect some kind of land use types. Proposed framework for only automated urban function zoning which takes advantage of social media geo-tagged photos uploaded by users and image annotations. (Wang, Fang, Yuan, Luo, & Yuany, 2017)

Another land use types are about the suggestions OSM and alternative complementary source for extracting Land Use information whereas the accuracy of the selected cities are mapped by mappers. This approach cross-compare the degree of completeness and the attribute accuracy of the OSM-based LU feature with the GMESUA data by means of a statistical assessment (Arsanjani & Zipf, 2015)

One of the approaches reveals that assessing the urban street greenery using Google street view for mapping another land use type. This approach highlights that the modified Green View Index maybe a relatively objective measurement of street-level greenery, and that Google street view in combination with Green View Index may be well suited in guiding urban landscape planning and management (Lia, Zhanga, & Lia, 2015)

- Use subjective or proprietary data sets to map land use

A study proves that use of proprietary data sets. The small businesses are typically underrepresented in national databases, which rely on secondary sources to develop data for marketing purposes. Using social media and other crowd sourced data (Lopez & Clarke, 2017)

ArcGIS is a proprietary Geographic Information System used to display the geographic information on a map and provides a common frame to work with different spatial ta obtained from various sources. So land use mapping the ArcGIS takes a big part of it. (Tejaswini & Sathian, 2018)

1.4 Research need

So, there is a need to develop framework to prepare accurate and up-to-date land use maps at city level scale while overcoming above mentioned constraints in developing countries like Sri Lanka.

1.5 Research Question

How to develop an effective and affordable framework to map land uses at city level scale?
How good is the quality of information which emergent through OSM data model?

1.6 Objective

To develop an effective and affordable framework to map land uses at city level scale.

1.7 Scope and limitation of the study:

- The develop framework will validate only for few selected urban areas in Sri Lanka.
- Only derived the land use map using OSM data (Not other maps)

2. Methods and Martials

2.1 Introduction

This chapter looks at the methodology regarding the detail methods for derived land use map which was proposed by author. And additionally finding the case study to select and mapping the land use maps.

2.2 Method of Study

Here this chapter mainly focus that the proposed method will comprise two steps. They are develop method for mapping and Test the develop method of effectiveness and affordability

2.2.1 Develop method

So within the existing method I proposed a new methodology using the options which will make value of land use. And also it include the steps of the proposed method for mapping.

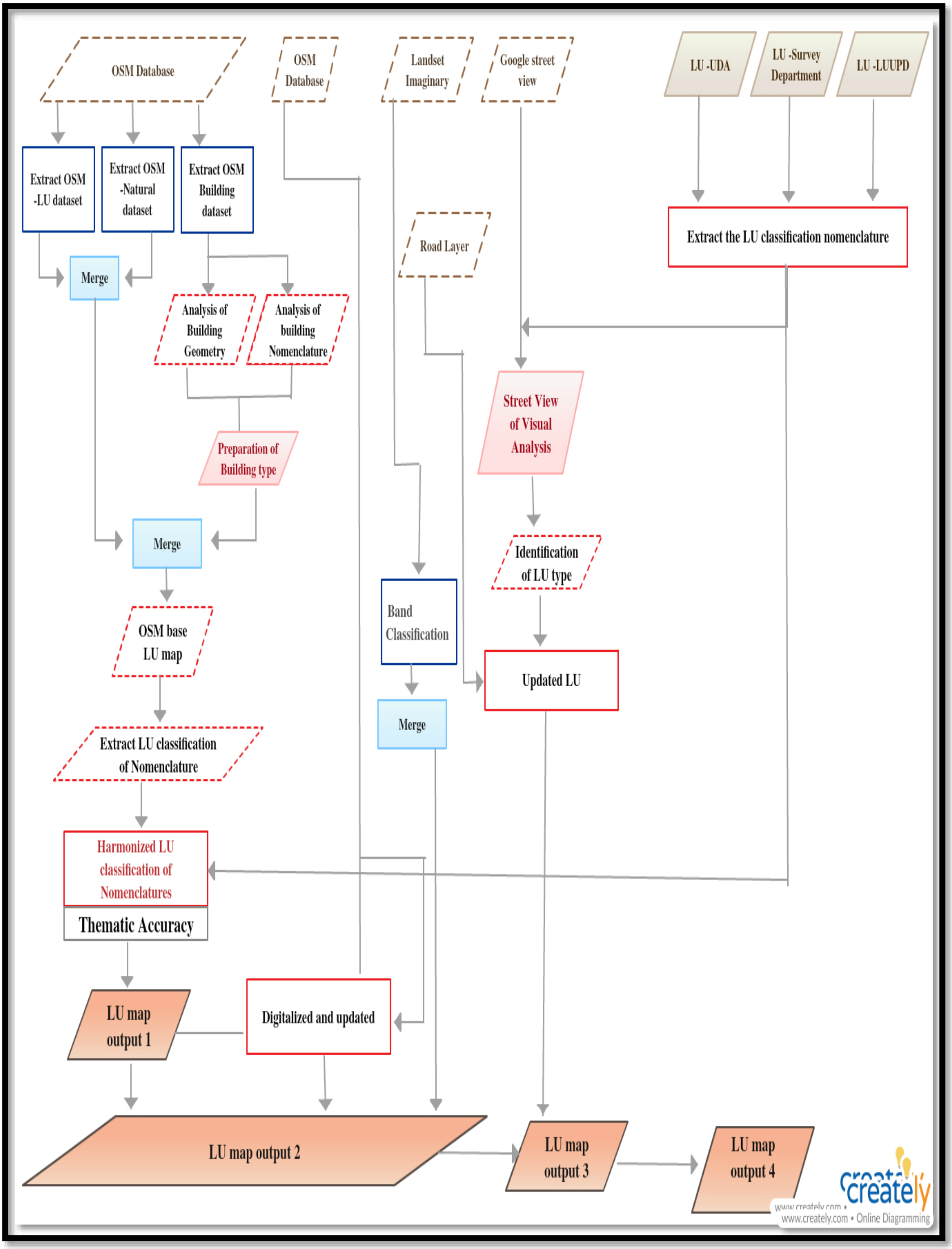


Figure 1: Proposed method

- **First step-Merge OSM natural Layer and LU layer**

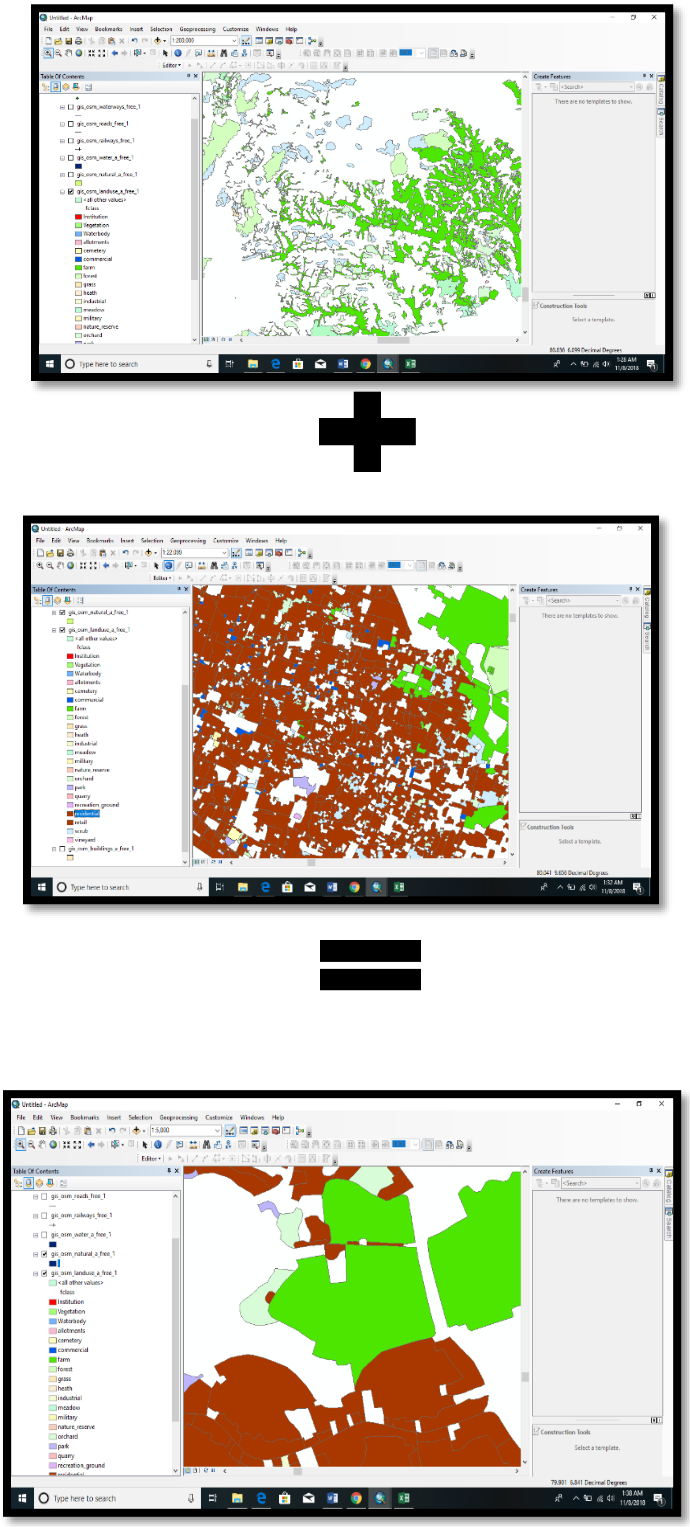


Figure 2: Illustration of first step

- **Second step – Extract building layer and analysis building type and geometry**

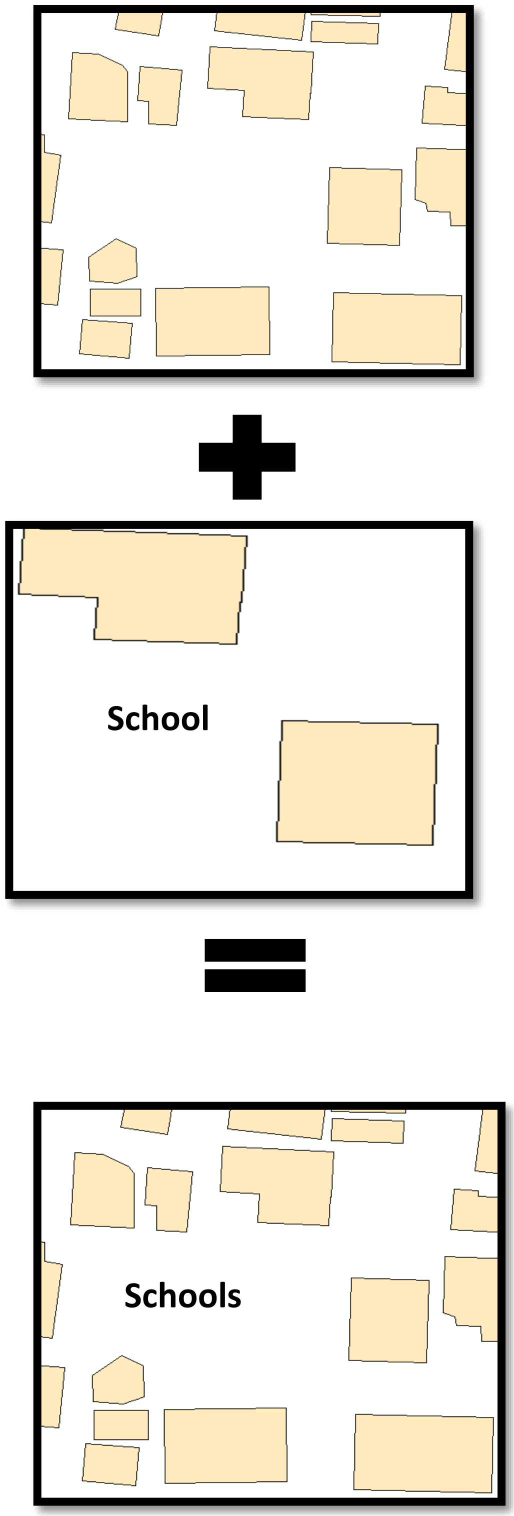


Figure 3: Illustration of Second step

- **Third step- Merge output1st step + Merge output 2nd step = OSM LU base map**
- **Forth step-Harmonization of LU classification of nomenclature**

The OSM has its own classification nomenclature, which is designed for fine scale LU classification, therefore the OSM –LU features must be translated to locally known nomenclatures and in this case, the UDA, survey department, LUUPD nomenclature.

Table 3: Harmonization of LU classification nomenclature

Classification of OSM	Classification of UDA	Classification LUUDP	Harmonized LU class
Residential.Apartments,house,hut,villa	Residential.Apartments ,house,hut,villa	Homestead/ Home garden, Urban Area,	Residential
Ware house, ,Manufacture, industry	Industrial Area (a) Industrial Parks (b) Industrial sites	Industrial Area (a) Industrial Parks (b) Industrial sites	Industry
Retail,commercial,clubhouse,Restaurants,hotel,	Commercial	-	Commercial
University,school,religious,temple,library,hospital,Bank,Private and government institutions, office	Institution, Government authorities	-	Institution
Greenfield, brown field,park,grass,nature reseaviour,farm,agriculture,forest,recreation ground	Greenfield, brown field,park,grass,nature reseaviour,farm,agriculture,forest,recreation ground	Paddy, Tea, Rubber, Coconut, Seasonal crops, Dense Forest, Scrub Land	Vegetation
Water,Basin,pond,river,Aquatic land	Lagoon, Major Reservoirs, Abandoned Tanks, Rivers/Streams	Lagoon, Major Reservoirs, Abandoned Tanks, Rivers/Streams	Water body

- **Fifth step - Output of 4th step + Google map dataset + land set imaginary dataset**
- **Sixth step - Merge the road layer and update the LU map 3**
- **Seventh step – Use Google street view and Update the land uses visual analysis**

2.2.2 Test the develop method of effectiveness and affordability

After the developing method this research test how it will be proven through effectiveness and affordability.

- Factors which was measure of effectiveness and affordability
  1. Accuracy
  2. Effectiveness (Ability to apply in Sri Lankan context considering the **Technical capacity** of officers who are involving in Land Use Mapping, **Data availability** to implement land use mapping, and Required time efficiently)
  3. Affordability (i.e. Cost for Data, Software and Technical Exports)

2.3 Novelty of this method

This novelty include the land use nomenclature in common literature reviews, But proposed method has four type of novelty introduction by Author.

- OSM natural dataset +OSM Land use dataset = Merge
- Building type + Building Geometry = Preparation of Building type
- Digitized and update the land set imaginary
- Street view visual analysis from Google Street View

2.4 How did calculate the effectiveness and affordable Effectiveness

1. Effectiveness
   - Accuracy

   For the accuracy assessment overall accuracy, users 'accuracy, Producers 'accuracy and kappa index are the important indicator by measuring of Confusion matrix.
   The kappa index proposed by Cohen intends to evaluate the degree of agreement between two or more datasets and observation provides an overall guide to quality of the map. The dataset converted from the vector to raster format at different pixel.

   - Measuring Time

   The time periods covered by the map data used are particularly important when assessing compliance with land related of usability. Here this resources important to indicate that what the time limitation for mapping. The following requirements must be met to ensure compliance:
   - ➢ First, definitive compliance maps should include OSM data of relevant attributes to demonstrate the use of land for mapping.
   - ➢ Second the map should edit with the categories of land use while using with the options of derived mapping
   - ➢ Third, export the data in software and classify and again map out the information which is need to attribute.
   - ➢ Assigning the data based on survey department.
   - ➢ Fourth, the Actual data used to support the Open maps should be consistent with other map sources and have been verified to give an indication of accuracy.

2. Affordability
   - Cost for data

   OSM is open-data, meaning it can be accessed and used at no cost by anyone and for any purpose, which makes it an alternative source of data when the availability and access to geo information is limited. (Grippa , et al., 2018)
   Cost mainly focus setup cost, field survey cost and image aquision cost.

   - Software and technical exports

   Technique depends on a combination of background knowledge and handle of the software which was related to the study. A variety of methods have been applied extensively for the land use change analysis throughout the selected towns in Sri Lanka.

And also cost, Time, software and technical exports will be measuring with others existing mapping methods of Sri Lanka in analysis part.

2.5 Test the developed method of effective and Affordable

2.5.1 Case study selection

For the case study selection I prepared a map which could identified the availability of OSM data. It was mainly consider the Google street view, building footprint, software of OpenStreetMap and Google earth images.

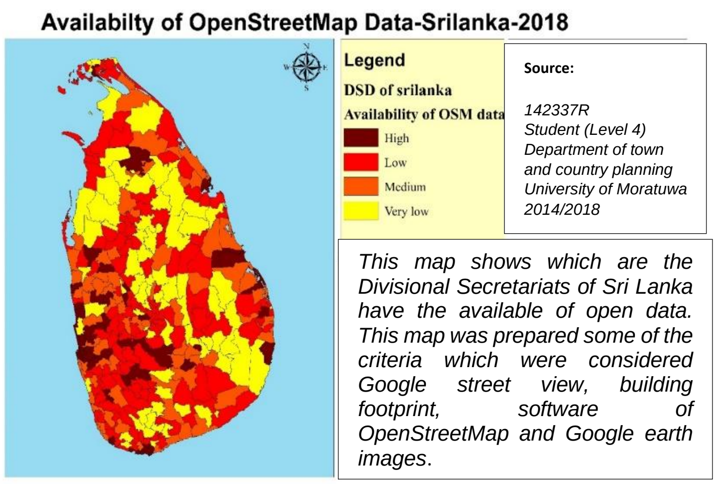


Figure 4: Availability of OSM dataset

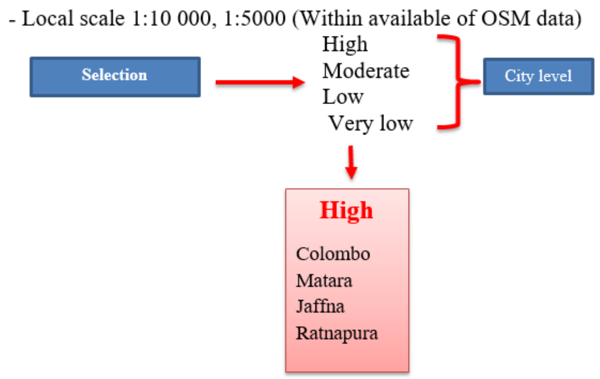
2.5.1.1 Digitizing method for case study selection

Here this output shows with some criteria for finding that how much OSM data available for DS division of SriLanka

1. If Google Street view available for all minor and major road access the area.
2. If Earth imaginary give proper view of the area from Google maps and earth

3. If the foot print give the information of the area and its elements (buildings ,shape, size)
4. If the application of the OSM software can access the area with its land use tags

With these consideration I gave the weighted for each DS division for finding the availability of the OSM data. If the weighted, below into 5 the category goes to very low. 5 to 10, the category goes to low category.10 to 15, labeled as medium. Above the 15 the category labeled as high.



2.6 Study area and Descriptions

Table 1: Description of Study area

No	Study area	Importance	Land extent(km^2)
1	Matara	Commercial and tourism town	1282
2	Jaffna	Main capital city of Northern Province which was lead to SriLankan Tamils on peninsula Island. Effected the civil war	1025
3	Colombo	major commercial and administrative hub of the SriLanka	995.5
4	Ratnapura	Can found some of the priceless gemstones in the world	1012
5	Biyagama	Busy city in Gampha District which was most attract commercial and residential clusters.	916.2

2.7 Description data and source

Table 2: Description of data and source

Area	Data types			
	Reference data		Open data	
	Year	Source	Year	Source
Matara	2015	Survey department, Sri Lanka	2018	OSM data base
Jaffna	2015	Survey department, Sri Lanka	2018	OSM data base
Colombo	2015	Survey department Sri Lanka	2018	OSM data base
Ratnapura	2015	Survey department Sri Lanka	2018	OSM data base
Biyagama	2015	Survey department Sri Lanka	2018	OSM data base

2.7.1 OSM Dataset

The present dataset utilized in the present study is the OSM snapshot for October 2018.The features tagged with water body, road layer, retail, residential, vegetation, institution, Industrial, and public spaces. In mapping we have to follow Sri Lanka guidelines which was prepared by OSM community. Land set imaginary and OpenStreetMap take the resolution of 30m.

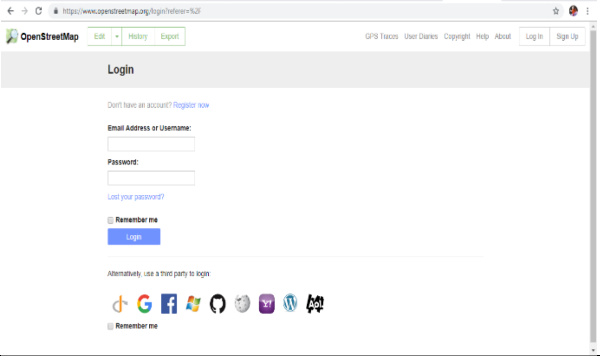
2.7.2 Datasets used based on survey department

The second dataset, attending reference data, which is based on survey department. It comprises LU data for selected town which were different with each other's. Each and every officer attached to the D.S. Division should update their own Division and digitize the changes of the layers with the assistance of the District staff. Updating of the maps should be carried out based on the 1:10,000 scale map index (based on the map sheets). Sheet wise updating will facilitate the edge matching process and will resolve the boundary conflicts.

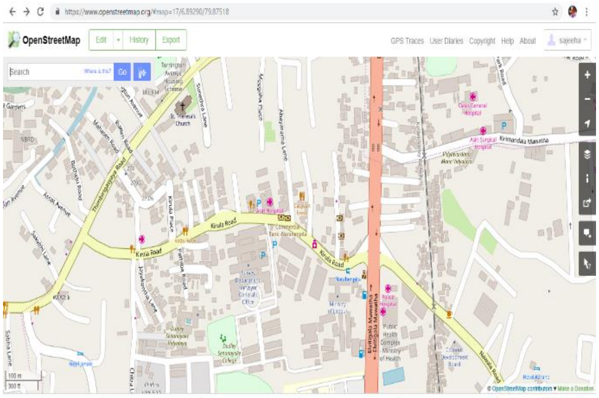
2.8 Data processing

Table 3: Steps of Data Processing

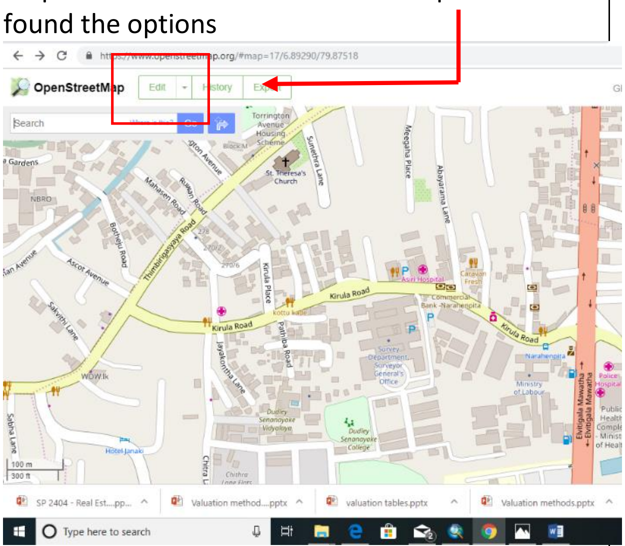
Step 1-Sign in with the relevant information in OpenStreetMap online Application.



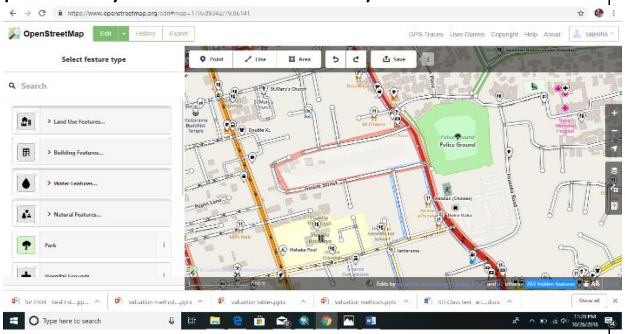
Step 2-After the signup we can access the area which we need.



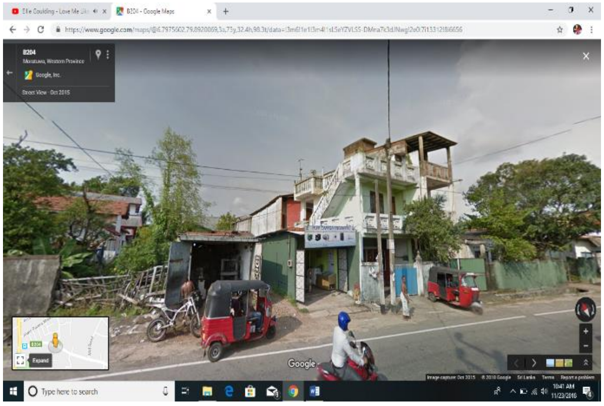
Step 3-Next we can click edit the map which I found the options



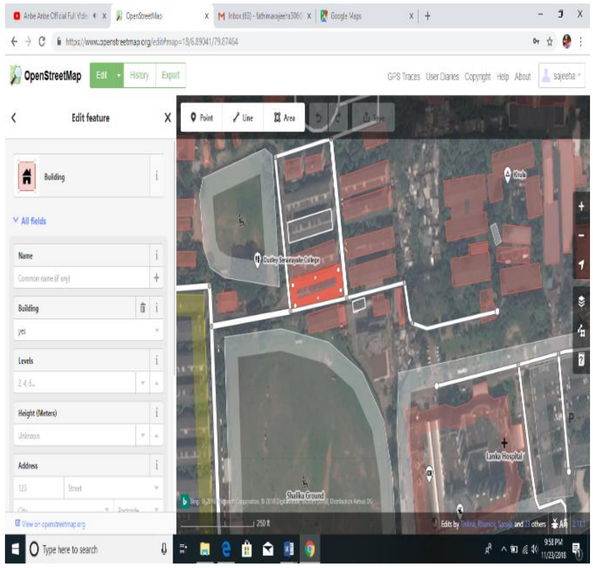
Step 4-We can edit the map with line, points and tags with the relevant guideline which was proved by the OSM community of Srilanka.

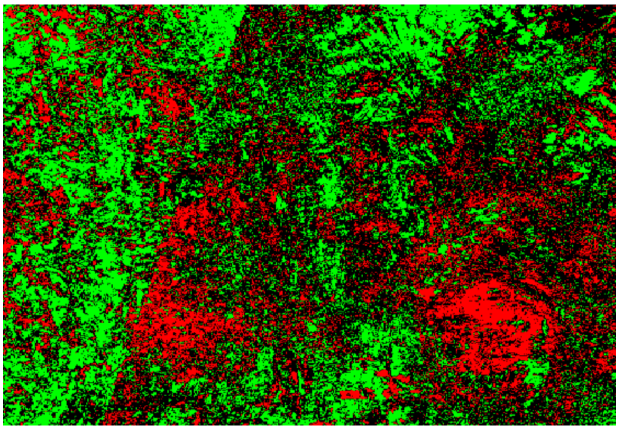
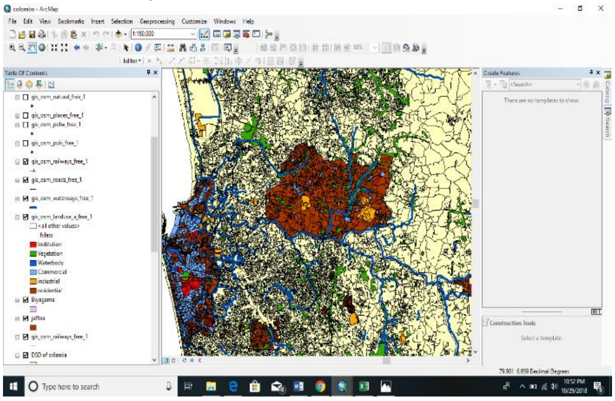


Step 5-Edit with street view visual classification. Tag with the relevant land use with identified land uses.



Step 6-Edit with Extract building layer and analysis building type and geometry. Tag with the relevant land use with identified land uses.



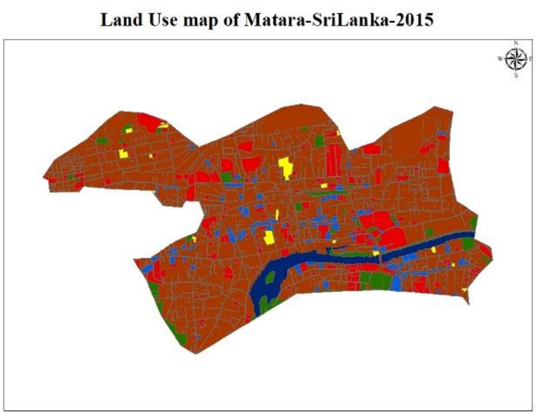
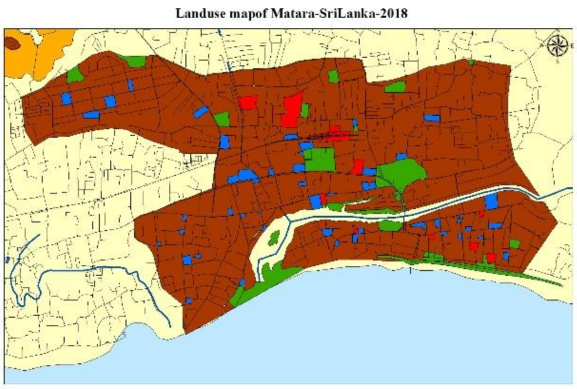
Step 6-Edit with land set imaginary dataset Tag with the relevant land use with identified land uses	Step 7-After the save options we can export the map as shp files. Then we can make other gabs within the options.
	

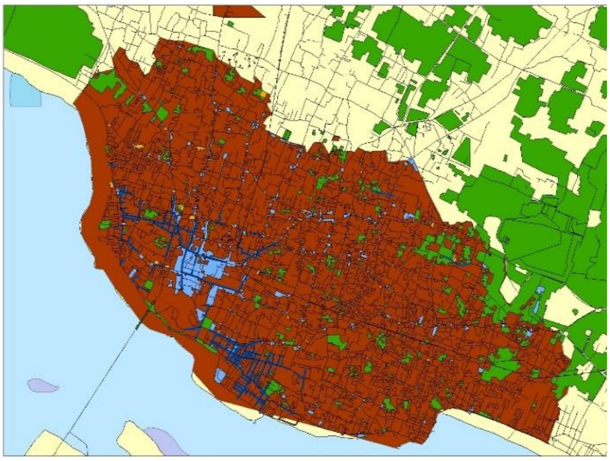
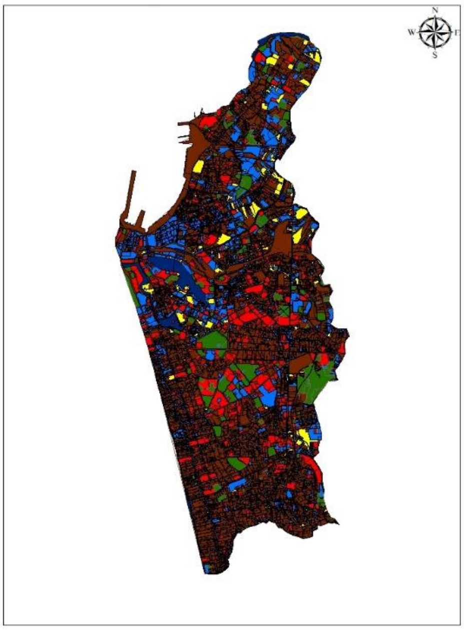
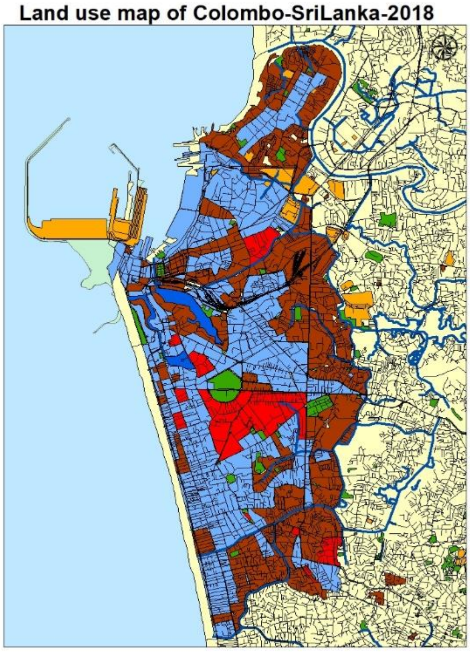
3. ANALYSIS AND FINDINGS

3.1 Accuracy Calculation

3.1.1 Visual comparison

Figure 5: The physical extent of the selected cities-Matara, Jaffna, Colombo, Ratnapura, Biyagama represented by actual datasets (Left) and contributed OSM features (Right)

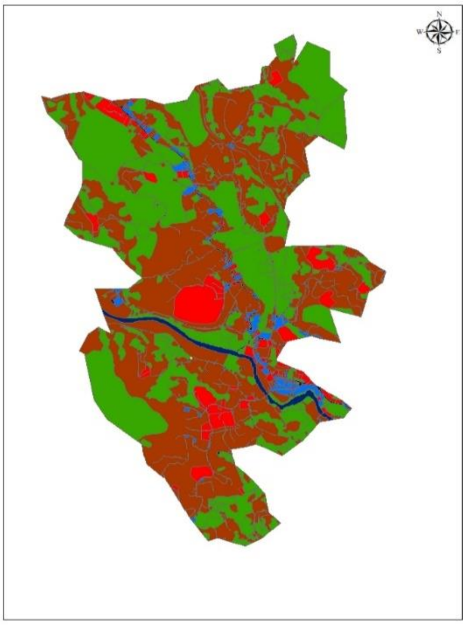
Matara	
Land use map based on survey department	Land use map based on proposed method
	

Jaffna	
Land use map based on survey department	Land use map based on proposed method
Land Use map of Jaffna-SriLanka-2015 	**Landuse Map of Jaffna-SriLanka-2018** 
Colombo	
Land use map based on survey department	Land use map based on proposed method
Land Use map of Colombo -SriLanka-2015 	**Land use map of Colombo-SriLanka-2018** 

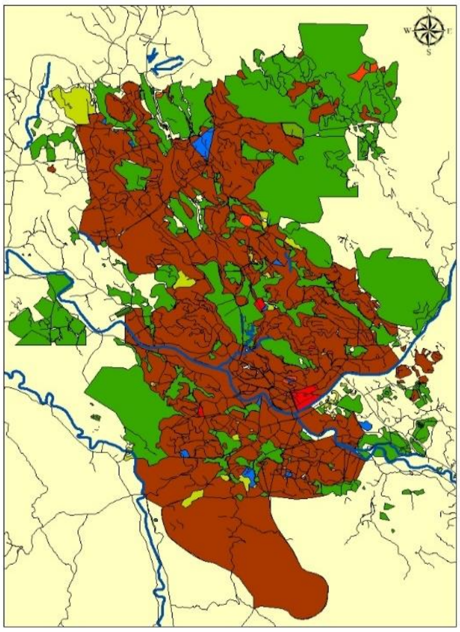
Ratnapura

Land use map based on survey department	Land use map based on proposed method

Land use map of Ratnapura-SriLanka-2015



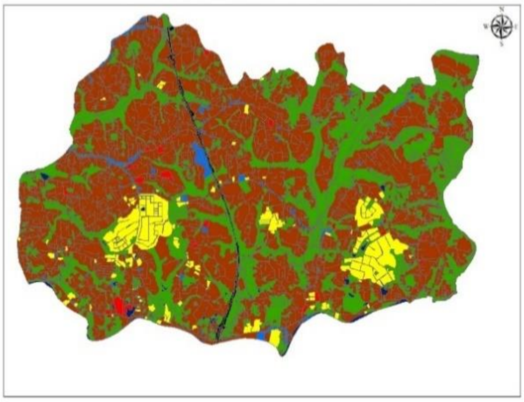
Land use map of Ratnapura-SriLanka-2018



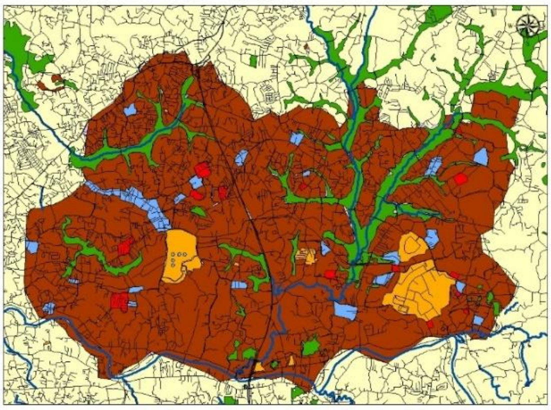
Biyagama

Land use map based on survey department	Land use map based on proposed method

Landuse Map Of Biyagama-SriLanka-2015



Land use map of Biyagama-SriLanka-2018



- Road
- Instititution
- Vegetation
- Commercial
- Waterbody
- Industrial
- Residential

0 5501,100 2,200 3,300 4,400 Meters

Source for land use based on Survey Department-

Survey Department, SriLanka

Source for LU map based on proposed method-

142337R
Student (Level 4)
Department of town and country planning
University of Moratuwa
2014/2018

3.1.2 Kappa index and Overall and per class application

Table 4: Analysis of Kappa index in five major city of SriLanka

City	Kappa index pixel size	Kappa index
Matara	0.76	81.40%
Jaffna	0.498	61.50%
Colombo	0.581	59.12%
Ratnapura	0.743	80.49%
Biyagama	0.521	64.20%

Table 5- The values of confusion matrix between OSM and actual land use features per town.

	City									
	Matara		Jaffna		Colombo		Ratnapura		Biyagama	
Land Class	Producer's Accuracy%	User's Accuracy%	Producer's Accuracy %	User's Accuracy %	Producer's Accuracy %	User's Accuracy %	Producer's Accuracy %	User's Accuracy %	Producer's Accuracy %	User's Accuracy %
Residential	81.1	94.3	79.4	70.6	92.7	39.7	97.3	93.01	85.6	65.9
Commercial	92.3	88.7	33.8	20	73.5	92.1	94.9	97.7	32.2	62.5
Institution	68.3	98.9	9.7	10	81.3	54.2	39.1	75	66.7	95.9
Industry	98.5	98.2	0	0	28.9	30.5	84.6	30.5	91.4	85.6
Vegetation	92.5	29.4	71.9	49.9	9.08	50.4	87.4	98.01	21.4	31.9
Water body	97.5	88.7	98.06	98.8	97.8	98.7	100	95.5	85.07	37.7
Overall accuracy	**88.53%**		**69.04%**		**65.16%**		**86.55%**		**62.4%**	
Kappa Index%	**81.40%**		**61.50%**		**59.12%**		**80.49%**		**64.20%**	

1. Matara

According to table 4, among the selected towns the highest Kappa index of 81.40% and overall accuracy of 88.53%.This means that the OSM-LU map and Actual data map match at 'Good' rank. Per class analysis of user's and producer's accuracies reveals that although above 92% vegetation, Commercial and water body have been correctly identified as such, only 29%of the area labeled as vegetation are actually vegetation while 88% of the areas labeled as water body and commercial are actually water body and vegetation. Furthermore, while 81% and 68% Residential and institution classes have been correctly recognized as such these classes have been mapped correctly at 94% and 98% rates.

To Sum up, the achieved user's accuracies conform that Commercial, Industries, Institution and water body classes have 'very high' degree of accuracy with the reference data ,While residential classified as 'high' accuracy. Therefore it could be concluded these five classes could be used of used for land use mapping purpose at a relatively good level of reliability. On the other hand if the vegetation class, its low user's accuracy value 29% conforms that this class retains as those which are not reliable.

2. Jaffna

Based on table 4 kappa index of 61.50% and overall accuracy of 69.04% are achieved, which means the map LU Features to OSM for Jaffna match a 'Moderately 'rank with the reference dataset. Analysis of the achieved per class user's accuracy reveal that the water body is categorized "very high" to the reference dataset. Residential is correctly labeled of 70.6% as ‘high’ category.20%, 10%, 0% and 49.9% of Commercial, Institution, Industry, and Vegetation, classes are remaining classes retain at moderate to low level of agreement with the reference data. Commercial, vegetation, institution and industry classes are not reliable with disagreements between the two dataset.

3. Colombo

A kappa index of 59.12% ranked as ‘moderately’ and overall accuracy of 65.16% for contributed features in Colombo are achieved according to above table. This means that 65.16% of contributions are correctly classified. Analysis of the achieved per class user’s accuracies reveals that 92%,98% of the commercial and water body classes have been correctly labeled by contributors which are ranked as ‘very high’. Moreover classes such as industry, water body and vegetation are positioned as’high’in the city with values of roughly 30%, 98% and 50.4% respectively. Residential and institution possess a low level of reliability to be used LU mapping, so that they are not recommended for usage.

4. Ratnapura

Based On table 4 Ratnapura Kappa index of 89.49% and overall accuracy of 86.53%.This means that the OSM-LU map and Actual data map match at ‘Good’ rank. Analysis of the achieved per class user’s accuracies reveals that roughly 93%, 97%, 98% and 95%of the residential, commercial, vegetation and water body classes have been correctly labeled by contributors which are ranked as ‘very high’. Moreover classes such as institution is positioned as’high’in the city with values of roughly 75% respectively. Industry class lack of sufficient accuracy. So that they are not recommended for usage.

5. Biyagama

A kappa index of 64.20% ranked as ‘Moderate’ and overall accuracy of 62.4% for contributed features in Biyagama are achieved according to above table. This means that 62.4% of contributions are correctly classified. Analysis of the achieved per class user’s accuracies reveals that 95.9%, 85.6% of the Industry and institution classes have been correctly labeled by contributors which are ranked as ‘very high’. Moreover classes such as Residential and commercial are positioned as’high’in the city with values of roughly 65.9% and 62.5% respectively. Vegetation (31%) and (water body) possess a low level of reliability to be used LU mapping, so that they are not recommended for usage.

3.2 Time, Cost and Technically Capacity

For the measuring of effectiveness and affordability, Time, cost and technical accessible are important factors to make a worth output. From this Radar analysis, obtain the overall or final priorities by simply calculating the average value of each options for each cities. And below tables shows how much the resources required to collecting the data. **Assume that, from the findings survey department and field analysis only calculating the cost for data and mapping.**

Figure 6: Radar analysis of Time and Technical Accessible of Matara

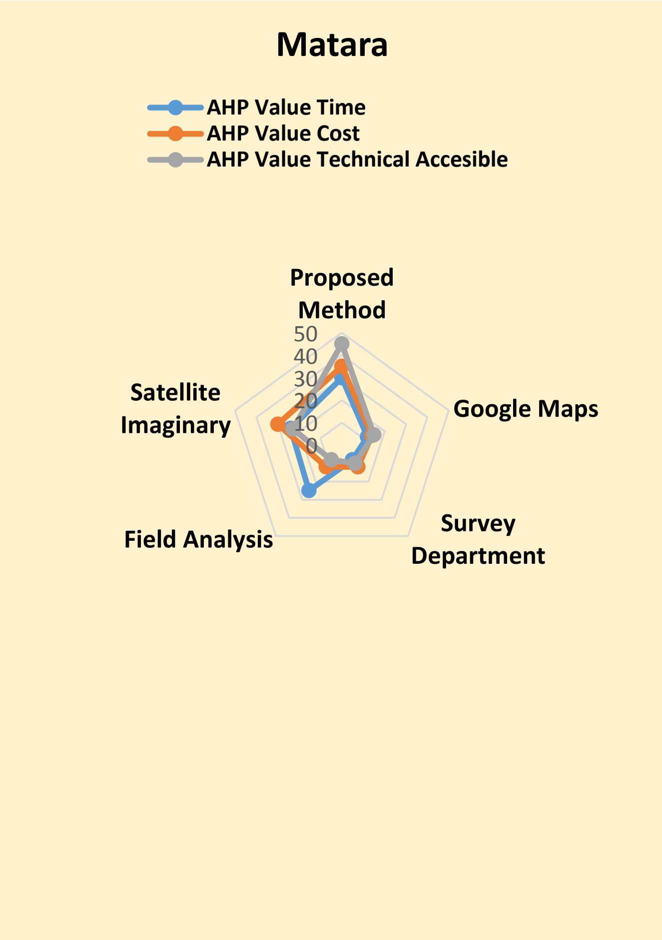


Figure 7: Radar analysis of Time and Technical Accessible of Jaffna

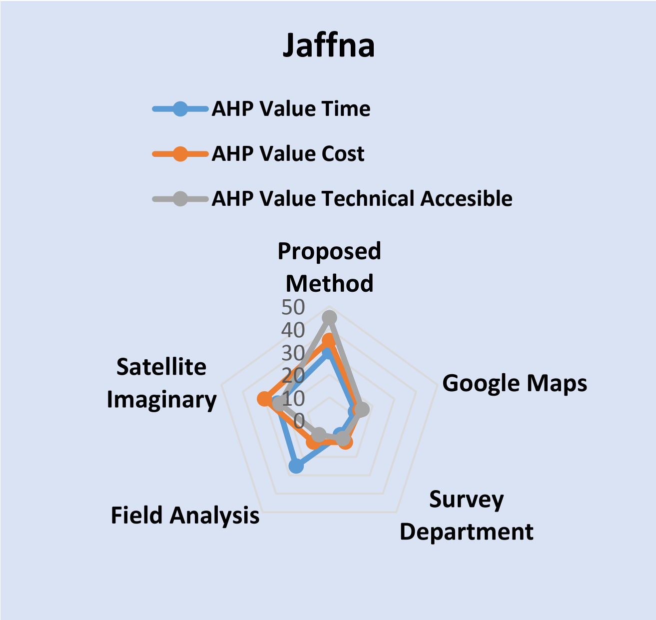


Figure 9: Radar analysis of Time and Technical Accessible of Ratnapura

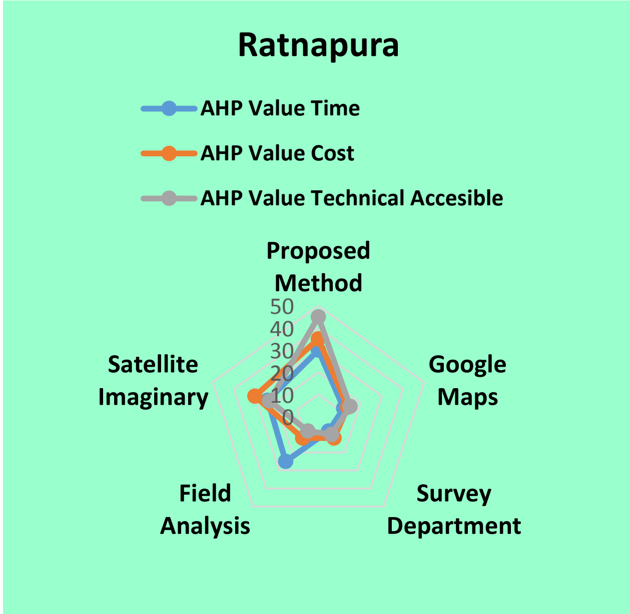


Figure 8: Radar analysis of Time and Technical accessible of Colombo

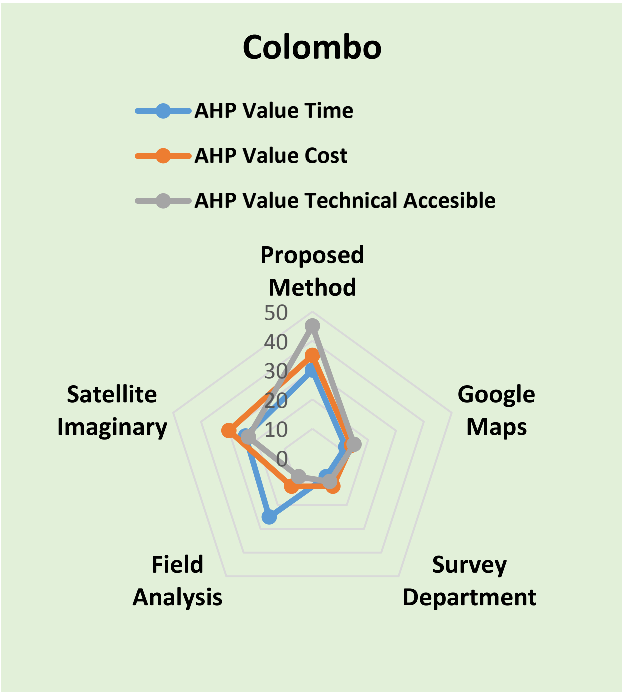
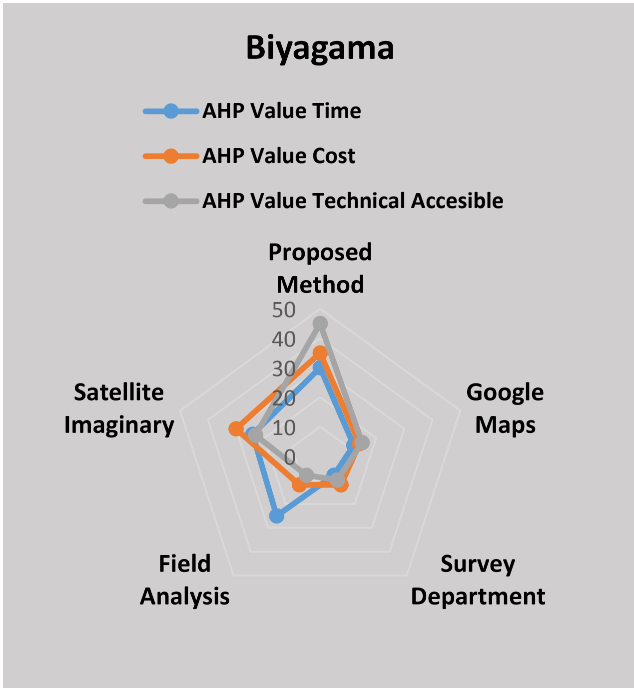


Figure 10: Radar analysis of Time and Technical Accessible of Biyagama



According to figure no 6 to 10, it is now possible to make a decision. The overall priorities obtained and whether the differences are large enough to make a clear choice to select and find out that which is more Gain for cost, Time and Technical accessible from existing method. From this analysis, we can show highest level cost and time are recommended for field analysis and survey department. Within this result I can express my final recommendation as follows: If the importance of the measuring factors is more than 50 % of the overall importance of the criteria in the decision, the best alternative is the proposed method.

4. Discussion and conclusion

In this study, main objective is to develop an effective and affordable framework to map land uses with using OSM data at city level scale. The framework derived based in terms of accuracy and affordability. The rules are based on two hypothesis. First of all the develop framework will validate only for few selected urban areas in Sri Lanka which have the highest amount of open data. Secondly only derived the land use map using OSM data (Not other maps).This means the building use or land cover map or not included in this approach. So this two scopes are proofed by using options for derived land use mapping. So this proposed approach is tested for OSM land use data in selected different towns in SriLanka at first. They are Matara, Jaffna, Colombo, Ratnapura and Biyagama.

The overall accuracies for the land use of Matara, Jaffna, Colombo, Ratnapura and Biyagama are 81.4%, 61.5%, 59.1%, 80.4% and 64.2%.And Kappa values are 81.4%,61%.,59.12%,80.4% and 64.20%. With respect to the individual per class analysis showed in analysis part which was reliable or not for usage. From the accuracies are contributed features have in general a ‘moderate ‘rank of kappa indices and their overall accuracies between 63% and 77%.Above that rank goes to “high’. So according to accuracies it is worth monitoring that compare the ground truth from the reference data with open data could be highly beneficial for producing compound Land use products.
But many of limitation and errors identified especially for it is not free from limitations due to main 3 assumptions elaborate in the classification accuracy assessment: The actual accuracy of our classification is unknown because it is impossible to perfectly assess the true class of every pixel; errors in reference data; positional errors; minimum mapping unit of reference grid; Accuracy in image classification is affected because of errors of inclusion and errors of exclusion.

In the future work, above errors will be investigated for the classification. This proposed method will be introduced and tested to regional scale study. And also this method can be motivate to identified density and Height of the buildings.

For the urban planning this method is very important and make a sense to the decisions for land use management. Because this method gives the worth accuracy of each class classification. And also this method make an efficient use of the time and cost for identify the accuracy of land use mapping. So this situation makes promoting the maintenance of urban data (geospatial data) using GIS an urgent issue. Particularly important in making geospatial data applicable to various aspects of urban planning is the incorporation of building attributes and land use attributes.

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