AN EVALUATION OF THE APPLICABILITY OF LOCATIONAL ATTRACTIVENESS MODELING OF RETAIL ACTIVITIES IN SMALL COMMERCIAL TOWNS : SPECIAL REFERENCE TO PILIYANDALA TOWN IN WESTERN PROVINCE OF SRI LANKA

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ABSTRACT

Retailing is the dynamic and evolving urban function in many small towns in Sri Lanka especially the towns originated and evolving to provide services for the surrounding residential population. This function is closely related to the economy of such towns. Location decisions of those activities in the towns are taken by the retail investors and by retail dealers merely based on their observations and experience. Meantime planners use zoning as a planning tool of managing land use of such towns. They use existing land use and trends in land use patterns as a basis and employ many raster based analysis methods in defining zones. Anyway there are criticisms that those created zoning plans dose not leveraging the economy and the wealth of such towns.

This study attempted to develop a modeling framework for decision making in identifying most attractive areas in a town for retail activities which can be used for the planners and for retail investors as well.

Retailing dense area of the Piliyandala town in the Colombo district of Western Province, Sri Lanka used for the study. This area was divided in to possible retail segments through prominent boundaries. Gravity of each segment based on level of retail attraction was calculated through the model.

This gravity levels (Probability) of each segment was calculated using two views of attraction. They are attraction based on the identified parameters on individual site and the attractiveness derived from the location of the catchment area. The model gives exact boundaries for the retail zones as it taken the retail segments trough the prominent boundaries.

As possible applications of the model by changing variables (attraction parameters) can be examine how the gravity levels are changing in the segments. In that way many planning intervention can be tested before implementing them by using this model.

Key words : Zoning Plans; Retail Attraction model; Retail gravity.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

As cities are always in a continuous process of evolution the form and the structure of them are also evolving. There is positive relationship in between spatial physical characteristics and its functional socio economic and environmental qualities *(Thamarasi, 2013)*. Commercial activities are the most dynamic and evolving function in most of the townships and it is the most important activity of any town as it is closely relate with the economy of it. The composition, spatial distribution and organization of commercial activities are important elements of urban form which is closely related to the urban spatial structure and urban morphology. It is common knowledge that a fundamental role in the urbanization process is played by retail activity *(Fiasconaro et al, 2016*). Indeed a city's social life and physical shape is greatly influenced by such retail activities and vice versa.

Most of the town centers of Sri Lanka had been originated and evolving to provide services for the residential area around them. Sometimes specializations of some commercial activities may serve for a wider catchment which is going beyond the immediate residential catchment of the surrounding. Mostly Common town center activities can be found on those types of townships. Especially the commercial activities are arranged based on socio economic forces. It can be observed that in many of such town centers similar kind of retail commercial activities are formed and functioned.

Mostly in Sri Lankan context, locating retail activities are not based on informed decision making. It relies on individual investors decisions based on their knowledge and experience. We can observe that some retail establishments are starting and vanished in few days and meantime some are surviving for a long time with remarkable developments. These scenarios are reluctantly researched in planning point of view although some are done in marketing field.

There may be so many reasons behind the successfulness of retail businesses and in planners point of view they are much interested in spatial attributes. Meantime planners need to zone retail activities in planning those cities to meet functional efficiency. Many development plans done in Sri Lanka has defined commercial zones to practice in regulatory terms.

Any way in the Sri Lanka Urban Development Sector Study Report" done by Asian Development Bank in 2009 has revealed that present urban development planning is effectively divorced from economic planning and does not support generation of wealth *(ADB, 2009).* Therefore urban development plans need to be economic plans too. In facing this argument, in one aspect, it needs to put right areas in to the right zone (correct spatial configuration). Especially the retail sector in small towns needs to be correctly positioned in the zones as it playing the fundamental role of the economy of the town

1.2 Introduction of the research

This study will focused on developing a modeling framework for planners in identifying suitable retail areas for zoning and for other planning interventions and it would also be beneficial for the retail investors too. This will be done by modeling the locational attractiveness of retail activities or the retail gravity. First it will identify through literature surveys and perception surveys with expertize what are the essential retail activities that need to be exists in a Sri Lankan town to serve for the residential population around them. Then it will understand what are the parameters that affecting on retail gravity in Sri Lankan service center type small town centers. This study will also focus on analyzing the correlations between these spatial configurations and retail locations of a city to make informed decision making on zoning and locating retail activities. It will develop a modeling framework for identify the most suitable areas for retail and finally it will check the validity of the developed model based on the real ground success and failures.

1.3 Research Problem

In our context, Investment decisions related to setup of retail activities are purely based on the market forces, trends and individual investor's knowledge rather than informed

decision making based on locational attractiveness driven by spatial configurations. Lack of systematic modeling framework for planners in identifying those urban lands which are suitable for retail areas zoning is taken as the main issue addressing by this study.

1.4 Research Question

The research problem of this study is the lacking of systematic modeling framework for identifying most attractive spaces for retail activities in small commercial towns in Sri Lanka. Its need to answer the following questions in addressing the research problem of this research.

What are the most important factors affecting on retail gravity in small towns in Sri Lanka? Since this is the base for the study.

What will be the appropriate method for identifying retail locations and retail zones (How to model)?

How to check the validity and applicability of the model.

1.5 Objectives of the research

The main objective of this research is to develop a mechanism to evaluate the attractiveness of locations for retail activities of small commercial towns in Sri Lanka

1.6 Methods and procedures

Anticipated procedures of the study can be described as follows.

In achieving the objectives, this study will select Piliyandala town of Colombo district of Sri Lanka which is having a huge residential catchment and acting as a service center for the locality.

For this study its needs a comprehensive database to examine the spatial structure of retail commercial locations in the Divisional Secretariat Division (DSD) of Kesbewa. Building layer developed by Urban Development Authority in Arc GIS shape file format acquired for the study.

Boundary of the possible retail area delineated through a raster analysis in Arc GIS format. It calculated the point density of existing retail establishments and the boundary

was formed accordingly. Identified possible retail area of the town further subdivides in to segments in order to calculate the retail gravity which will be helpful in deciding spatial zones.

Literature reviews done in the study explores possible spatial parameters that can be effect on retail attractiveness. It conducts a survey to identify spatial parameters which are having higher correlation with retail attractiveness. Correlation analysis done with survey result shows what are the most correlated parameters with the retail success are.

Then the regression analysis done with the most correlated parameters taking as independent variables and taking success or fails are as the dependent variable. A formula developed based on the result of regression analysis which is wider applicable for deciding the attraction of a retail establishment. Then another formula also developed removing insignificant parameters which were identified in regression analysis for the same.

As this study need to identify most attractive areas for retail activities of a town to zone as retail, next step is to sub divided the study area in to segments. Average values of the most correlated parameters of those segments assigned though another survey. Then attractiveness level as a probability value in each segment calculated by applying the formula developed in the regression analysis.

Attraction is defined by parameters of the individual retail establishment and also by the location of it in the catchment area. Therefore the locational attraction defined by the road network of the catchment area also considered. Huff model which is explained in the literature review chapter used for this and calculated the probability defined by location in each segment.

Final gravity level was calculated using both of these probability levels of each segment. The Validity of the developed model evaluated by discussing the successfulness of the establishments within the most attractive and least attractive segments.

Possible applications of the model other than using in deciding most suitable areas for zone as retail were discussed and concluded with suggestions for further researches.

1.7 Conclusion & Recommendations & Limitations

Conclusions are drawn from the research results and findings with respect to research objectives. Some recommendations will be given including suggestions for further research.

Limitations under following points discussed at the end

- Research study area will be limited only to the town center or the existing dense commercial area. The entire urban area will not be considered because of the time limitation & the field survey was difficult to manage.
- Deciding success or fail of each sample establishment was based on the ideas of retail owners, Customers and the researcher.
- Scales and values under scales for the parameters assigned based observations.
- Attractiveness for other land uses was not considered.
- Retail catchment of the Piliyandala town taken as the Kesbewa DSD but the actual catchment would be differing.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The main objective of the study is to develop a modeling framework to be used for informed decision making for retail site selection and for retail area zoning of small commercial towns in Sri Lanka. In achieving the objectives of the research literature related to the study comprehensively studied. It may more concern on identifying what is retail and its classifications, what are the service center type small towns and their retail services, how is Zoning doing in current practice, Retail site selection procedure and practice, Parameters influencing in retail attractiveness.

2.2 Retail and type of retail outlets.

Retail is the process of selling consumer goods and services with the intention of earning a profit. Retiling is applied when large number of individuals with small quantity orders who is mostly they are the end user. Retail involves the sale of goods directly to the consumer for his end use in small quantities. Retailing is having a long history it starts from peddlers who bring the goods to the buyers' location. Over the time retailing has developed up the modern sophisticated shopping malls. Much type of retail outlets can be found namely in the forms of departmental stores, Discount stores, Supermarkets, Warehouses, Mam and pop stores, specialty stores, Malls and dollar stores. (Cottrell 1973, P. 49, 51 63)

2.3 Spatial patterns of urban retailing

There are many classifications has been done for retail shop location in many studies. These classifications are based on forms and function of retailing.

2.3.1 Berry's typology

Berry's typology (Berry, 1963) gives a more realistic picture of urban retailing with a basic classification of retail configurations of the urban commercial structure that

resulted from technological and transportation evolutions. First typology is the **Nucleation's**. They correspond to a mixture of planned and unplanned shopping areas, occurring at various transportation foci. Berry identified five different types of retail nucleation: CBD, regional shopping center, community center, neighborhood center, convenience or isolated store cluster. Second one is the **Ribbons**. These are retail structures located along arterial route ways. These are easily accessible, automobile-oriented and this is usually fit with any category of commercial activity. Third typology is **specialized shopping areas**. These are retail configurations devoted to a specific category of retail and are mostly located at focal points of the transportation network.

2.3.2 Dawson and Sparks classification

(Dawson and Sparks 1987)This is a **five category classification** which aims the matching of consumers' needs and requirements with the type of shops. This classification is a contrary to place-based theories. It did not consider the spatial location of the commercial establishment. This is considered as post hierarchical classification.

Table 2. 1 Dawson and Sparks classification

Consumer Need	**Retail Response**
Essential Shopping	- Local convenience shops (convenience) - Corporate mass merchandisers (price, utility)
Fun/Leisure Shopping	- Specialist shopping areas (product range, style…) - Large leisure/Shopping complexes (leisure activity, style) - Fashion/lifestyle retailing in planned cluster (multipurpose activity)
Purposive Shopping	- Large, Target Shopper Units (product range) - Wide range of variety stores (value)
Time-pressured Shopping	- Home Shopping (time) - Petrol Station Shops / Convenience stores (time)
Innovative Shopping	- Home based facilities (Access) - Catalogue Showrooms (Range)

2.3.3 Browns Classification

This is further development of "post hierarchical" taxonomy of urban retail locations by combining the form – or shape – of a shopping area with the types of retailing functions (Brown, 1991). He reasserts the locational dimension that was emphasized in both the hierarchical model and Berry's classification. He identifies three different forms of shopping areas:

Clusters correspond to "compact agglomeration of retail outlets". These may be either planned or unplanned.

Linear shopping areas are assemblage of retailing facilities that extend along major, and even minor, roads.

Isolated forms of retail are single, often freestanding, outlets separated from other commercial establishments.

2.3.4 Retail classification in Sri Lankan Context

This study need to get an idea of how our small towns commercial nature and how can it be classified the retail activities. In line with this aspect when we are considering our Sri Lankan small commercial towns retail business, (Bandara et al ,2010) introduced a classification of prominent urban activities found in "Rathnapura" and "Galle" cities to observe the changes over a period of time. The urban activities found in the two cities were classified into five groups, based upon their generally implied competitiveness in urban locations, as shown on table 2.2 below.

Table 2. 2 Classification in Sri Lankan context

Category	**Activities (Categorized based on the level of the competitiveness for the space**
Commercial – High	Super Markets, Banks, Other financial agencies, Street vending, Jewelries, etc…
Commercial – Medium	Groceries, Pharmacies, Hotels (tea boutiques), etc…
Commercial – Low	Storages, Hardware, Vehicle spare parts, Vehicle repairing, etc…

Residential	Individual dwellings (with gardens), Collective dwellings, etc…
Agriculture	All types of agricultural activities

(Ratnayake 2015) identified three main forms of retail from a case study of Katubedda junction of Sri Lanka, traditional street-based retails; informal sector traders; and shopping malls. The findings reveal that the majority of the retails (87%) were traditional street based retail. and their growth has been surprising during the last decade. The findings also indicate that retail shops, particularly street-based small shops have contributed to convert residential lands uses into commercial land users. Retailing sector, more particularly; traditional street-based retail sector helps to make the urban street busy and vibrant.

This study is about the location of those retail establishments in small commercial towns in Sri Lanka which are mostly the street based and having the classifications as described above.

2.4 Service center type towns in Sri Lanka and there retail activities

Towns are originated, Surviving and evolving to provide different town center services or functions such as commercial, political, administration, transport, leisure and social services including Health and education (UN Habitat, 2018).

In Sri Lankan context those services and functions serve large population beyond the towns MC or UC limits. Sometimes towns may have one or more dominated services or functions inherent for them. Service center type small towns in Sri Lanka means in this study are that towns which are dominated by commercial activities especially the retail services for residential population within and around the town.

Many studies have proven that retailing form in developed countries and less developed countries are different. (Goodman et al, 2012) In developed countries mostly the car based shopping mall are dominant. In less developed countries as ours street based independent shops in linear form alone the major roads and market places such as “pola” are the dominant (Rathnayake, 2015).

“pola ” are usually opens air market it is traditionally it is temporary structure created at the time of operation by vendors. But now in many towns there are “pola” structures has constructed permanently with a high roof structures. Those are operating in daily or weekly or twice a week basis.

Street based retail shops are usually permanent individual structures mostly small in size and forms along main roads and by roads in towns. There are many supermarkets located at the center in many of our towns. Shopping malls are there in many towns also but this study relates to the small towns and mostly shopping malls are not available in such towns. State owned supermarkets have been introduced such as LakSathosa in 1990s in many towns. At today many private sector modern supermarkets are established as trend in retail sector such as Cargills, Keells, Arpico, Laughs etc during last two decades.

2.5 Zoning as a planning instrument

Zoning can be defined as the physical delineation of urban areas into ‘districts’ (zones/areas). The purpose of zoning may be regulating the use of land and buildings, height, plot coverage and density of population etc (Vagale, 1983). Zoning would give a distinct character, function and intensity of development to each part or section in a city. Zoning is by far the most controversial and the most difficult process in Urban Planning. But Zoning is necessary for enforcing building bye-laws and sub-division regulations in managing urban growth. It serve as legal and management tools for implementing development plans for cities and regions (Vagale 1983).

2.6 Land Use Zoning

The purpose of town planning is guiding and controlling development and use of land to provide a quality living environment, facilitating economic development and promoting healthy, safety, convenience and general welfare of the community. In that view, Zoning is to plan a town making different sections devoted to different purposes classifications i.e. residential, industrial, commercial etc. It refers either to the land use

provision in the state Land Use Plan, regional Master Plans, Urban Development Plan of any area.

Zoning regulates both the nature of land use and the physical dimension of uses including height, setbacks and minimum areas.

The primary planning function of each zone is to preserve the devoted areas by eliminating non compatible uses therein. Zoning defines specific areas in a city where land use and building specifications are controlled by law according to what is deemed appropriate for that area. For example, an area zoned for residential use would have land use and building restrictions that would prohibit industrial uses within that area (Catanese et al 1979; Krueckeberg, 1983).

2.6.1 Different Methods applied for Land use Zoning

There are lots of literatures relating to zoning and land use zoning can be found but it's very rare to find literature relating how to zone, how to identify most suitable land for different zones. There's no any fully equipped method to demarcate different land use zones in Sri Lankan context. This is the key issue that this study is dealing with.

For the urban land use zoning in Sri Lanka UDA is employing the ground based knowledge of the officers. They use GIS based analysis, especially development pressure analysis and environmental sensitivity and carrying capacity analysis but finally defining exact boundary of each zone is based on traditional manual methods. All the criteria's in demarcating zoning districts totally based on the manual methods. This will lead to delay in planning process and mistakes can be happened. Then the output zones may not be able to be implemented and less practical.

There are some applications which can be applied as bases for urban land use zoning were described below.

One method for Land use zoning done by comparing the various land qualities and grading that land in to four zones of suitability for different urban purposes (Pathan et

al 1989). The land qualities considered here for the study is land use/land cover pattern, physiographic, slope, soil, flooding, drainage and proximity to transportation.

The basic concept of this approach is to make a grid by dividing the entire study area into number of cells. Each cell is recognized by its row and column. The cell size depends upon the scale one selects for the study. The grid is to be overlaid over each thematic map and the information is to be systematically extracted on a cell-by-cell basis. The information collected is tabulated. The inter-relationship between different parameters is studied depending upon its suitability for the construction or conservation. Finally urban land use zoning is done by grading the land in the metropolitan region into four suitability zones with delineated boundaries of them.

Another research (satar 2008) used community participation for zoning of Merauke District, Papua, Indonesia. First Finding revealed that the areas identified for conservation zones in government planning system have missed important areas , this area covered forest along river, forest along northern part which important as water supply for 3 main river in Merauke District. Here in this planning approach, some area declared as important area for conservation but not include as important area from government point of view. Second finding in the study is that the area within community activities need detail zoning, this fact is important because local community activities based on how their river, swamp and forest are protected from degradation and pollution. Third finding is the area for conservation and mixed used area should have buffer zone which used sustainability approach to maintain.

An important fact from this research is combination of participatory and GIS techniques are able to identify this area more accurate to find better zoning for development zone and conservation zone.

Lamb (2009) introduced new methodology with the use of Geographical Information System (GIS) software for the town of Day in Saratoga County, New York of United States. He used map overlaying process. He used a set of environmental inventory information such as wetlands, slopes exceeding 25 percent, frequently flooded lands,

state or county owned forest lands and the Nature Conservancy property on Clute Mountain and created an **environmental limitations composite map**.
Again taking into account the factors affecting on development such as distance to settlements, proximity to highways, and attraction of lakeshores and area of the traditional town "center" that contains services and created a composite "**development opportunities map**". Then the two composites are combined into a single map which shows the intensity of development that each area of town.

In this method it introduced a methodology to identify which areas are suitable for development and which areas need to protect or conserve. Then the problem of how to do the further segmentation of this development opportunity area in to different urban uses is still unsolved.

After considering all above methods for land use zoning it is clear none of them provided exact boundary delineation for different zones. In most cases above finding boundaries of the zone is based on existing developing trend and observations. These decisions are taking not from a rational decision making process. Planners have no tools to define boundaries.

2.7 Retail site selection

As emphasized in the beginning of this study retail commercial activities are the most evolving and dynamic function in any town. Therefore retail activates are seen as an inseparable part of the urbanization process. Retail decision making falls under three main aspects. Where to put? What to put and how big will it needs to be? Specially this study more interested in location problem. Site selection is the most critical strategic decision that a retailer has to be taken (Cottrell 1973).

Site location is significant with the success and profitability of a retail establishment. Retailer needs to carefully evaluate many variables and competition between other alternative sites before taking the final decision in selecting a site. In our context these

decision are merely taking based on individual retailers own decision based on knowledge and experience.

From the planners point of view retail areas need to be zoned and current practice of zoning has described in the previously.

There are many retail theories to study they are ecological theories and normative spatial theories.

In this world from 1920s variety of models developed for retail site selection. Urban ecologists used biological process to explain spatial dynamics concepts like centralization, decentralization, nucleation's, segregations, invasion and succession, those concepts mostly used to describe dynamics involved in urban process. (Reissman 1964)

Under those aspects many location theories were developed in the world, first developed Concentric Zone theory, then developed theory of axial and developed his sector theory. Then another conceptualization developed by Harris and that is Multiple Nuclei theory, by observing British cities developed sector-zone theory by combining concentric structure and multiple nuclei theory.

Central place theory developed 1933 by Christallar is a mostly used theory in the fields of economic geography and planning.

2.8 Spatial Interaction Models (SIMs)

SIM's are distinct from location theories as they are mathematical development to calculate the commercial attraction of two activities with respect to visiting populations and the distance between them. The concept of spatial interaction first adopted by Reilly 1931 based on newton's gravity model. Then it has been done many modifications as a marketing and planning tool. SIMs basically assumes that the space relationship between two spaces (cities, areas, or shopping centers) is considered to be in direct proportion with populations they have (cover, serve or attract) and in inverse proportion with the square of the distance between them. Then this basic theory further developed

by the entry of multiple centers, probabilistic calculus related to centers and consumers, differentiated population groups and other measures of attraction like floor space and turnover.

Spatial interaction models are very popular in marketing field, under the 'gravity models' modifications to Reilly's 'Law of Retail Gravitation' contributed by converse attraction of competing retail locations to two factors only, namely store size and distance between stores and consumers' homes. retail agglomerations can be characterized by their marketing mix components, This marketing mix component determined by parameters such as site location, selling style, pricing and merchandise strategy, available parking or entertainment facilities, etc. (Berman et al 2001).

Reillys' gravity model is in capable to deal with multiple retail centers and for trade area analysis. A catchment area model introduced by (Huff 1984) calibrating three main variables i.e. Distance, attractiveness and competition. The probability (Pij) that a consumer located at i would choose to shop at retail center j is calculated according to the following formula.

$$P_{ij} \frac{\frac{S_j}{T_{ij}^{\lambda}}}{\sum_j^n \frac{S_j}{T_{ij}^{\lambda}}}$$

Pij: Probability of a consumer at point i travelling to retail location j - Probablity
Sj: Size of retail – Attraction
Tij: Distance from consumer at point i to travel to location j

$\boldsymbol{\lambda}$ *= a parameter which is to be estimated empirically to reflect the effect of travel time on various kinds of shopping trips*

The Huff Model can be used (Market analysis tool Help guide Arc map)

- To delineate probability-based markets for store locations in the study area
- To model the economic impact of adding new competitive store locations

- To forecast areas of high and low sales potential, which can guide new store location placement or refined marketing or advertising initiatives

This study will use this model considering the local situations to identify most attractive retail areas of a town.

2.9 What are the parameters for retail attraction in previous studies?

Attraction is a multifunctional and it representing a variety of measures. Attractiveness here is the consumer's attitudes, perceptions and patronage behaviors that make them pull or draw towards a place or a retail establishment. (Teller et al 2012). Then the attraction of a place is important for city planners and policy makers to make decisions for creating flexible, adaptable and diverse local economic structures by enhancing the competitiveness of the paces (Ezmale et al 2011).

There is a vast array of factors influencing in the successfulness of any retail business. (Zehirc et al 2013) provides a comprehensive literature review for understanding the selection criteria of retail location criteria and are classified into seven categories (1) performance measures (2) population structure (3) economic factors (4) competition (5) saturation level (6) magnet and (7) store characteristics. He also gave the relevant variable under each criterion and the references studies for all of them in the retail context. (Table 2.3)

Table 2. 3 Selection criteria of retail location

criteria for choosing a retail location	Relevant variables
Performance measures	Store sales or demand , Store profit , Store patronage or brand loyalty , Market share , Price elasticity of store
Population structure	Gender, Age, Education level, Marital status, Occupation

	Household size, The number of households in the trade area, Population size (The number of persons residing in a trade area), Population density, Population growth rate Customer size, Customers density, Travel time (or distance), Social classes & subcultures (ethnicity, nationalities represented, racial composition)
Economic factors	Household monthly income, The amount of money that will be available for buy my goods and services, Total disposable income, The willingness to spend their money The purchasing power of the residents of a community (2012)., The regularity and frequency of their income The source of income, House ownership, House value The percentage of homeowners as against renters Rentals, Elasticity of rental contract period The numbers of persons employed in a family The type of house, The per cent of household heads with college degree
Competition	The spatial proximity to competitors The size and/or numbers of competitor stores in trade area Settlement with comparison to competitors Relative competitive strength Stiffness in competition The quantity, quality and extent of aggressiveness in competition
Saturation level	Consumption level, The number of people in the area who are likely customers for the particular

	line(s) of merchandise, The average per capita expenditure for these goods, The total space devoted to selling those goods in all stores in the section
Store characteristics	Ease in Accessibility, Parking convenience, Pedestrian crossing, Sidewalk width, Road width, Existence of alternative roads. Topographic barriers (rivers, highways, lakes, street, hill, etc.) Distance to main road Vehicle traffic density Passenger traffic, Personal recruitment or operation hours Store visibility, Corner location or located near road intersection
Magnet	Crowd point (hospital, market, hotel, foot courts, temple etc.), Culture and education organization (school, studying centre, library etc.), Relaxation (recreation centre, department store, KTV and club, cinema, or theatre, park, financial organization, beauty parlours, museum, athletic, zoo etc.),Government and business organization (office building, government office,etc.), Vehicle maintenance (gas station, parking area, garage etc.)

In this study its need to identify retail establishments attributes in the context of retail in service center type small towns in Sri Lanka. Here it considers mainly the characteristics of the retail establishments and the location based gravity from the catchment area of the study. Other criteria's influencing for the attractiveness is not considered in this study in order to reduce the complexity.

New set of criteria's that suits for the towns that are addressing in this study has developed based on the variables in the Store characteristics criteria given by (Zehirc.C et al 2013) above.

Specifications for developments which considered in deciding the allowable developments in Colombo municipal council area (UDA, 2008), especially some selected parameters in form C, Form C1 & C2 city of Colombo Development Plan (Amendment 2008) of Urban Development Authority, Sri Lanka, taken in to those set of parameters.

Attributes that need to be considered for the attraction for retail business in the towns in our small service center type town's context has been given below.

1. Accessibility
2. Distance to Bus Halt/ Public mode
3. Clustering
4. Lot size
5. Frontage
6. Floor area
7. Pedestrian Movements
8. Onsite Parking
9. Land suitability
10. Infrastructure availability (Water,)
11. Infrastructure availability (Electricity)
12. Visibility to public areas
13. Floor Level
14. Closeness to town center
15. Closeness to core activities of the town
16. Attractiveness of the built form
17. Availability of public car park

These criteria's were identified from the observations and discussions done by the researcher with the Local Authority revenue offices and the planners who involved in planning matters in the Kesbewa Urban council area.

CHAPTER THREE

RESEARCH DESIGN

3.1 Introduction

This chapter will describe the background of selecting an empirical study and how the selected case study area fits in achieving the objectives sets for the study. Then it will describe how the methodology arranged with research question, data collection and analysis and the way approaching the conclusion and recommendations.

As described in the first and second chapters most of our Sri Lankan townships are originated, evolving and surviving to provide day today retail commercial requirements of the surrounding residential population. This study is dealing with locating of those types of commercial activities in an urban area from the point of view of retailers as well as from the point of view of the planner. In working with this the study area need to be comprised with following characteristics.

- Remarkable residential population catchments to be existed
- Commercial area could be demarcated and need to be surrounded by residential areas
- Dominant purpose of the town should be providing services for the residential areas surrounded by

In this view, suitability of Piliyadala as the case study area can be evaluated as follows.

3.2 Rational of selecting “Piliyandala” town as the case study area

This study was done as empirical study and Piliyandala town was selected as the study area. Piliyandala is having a remarkable residential population in its surrounding and the commercial area of the town can be clearly demarcated and also the main purpose of the origin and the survival of the town is based on providing services for the residential catchment of the town. Those reasons and rational behind this selection can be described with facts and figures as follows.

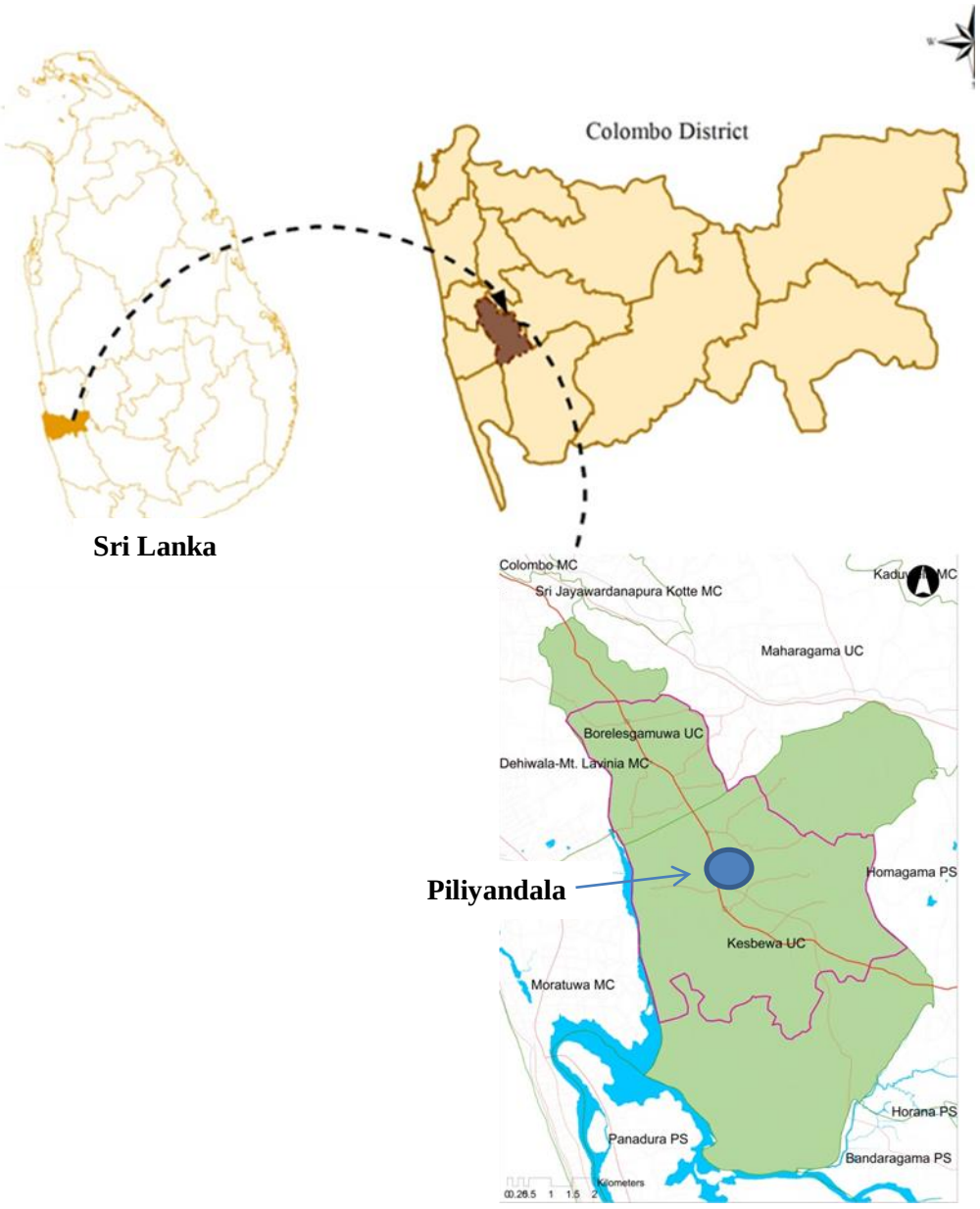

Figure 3. 1 Location of Piliyandala as the case study

This town is in Colombo district of Western province in Sri Lanka. Currently it is a suburban township of Colombo Core area located at a distance of 20 KM from Colombo. This town is located in the Horana corridor which is one of the seven transport and developments corridors connecting Colombo with the rest of the area of the province and the country. Geographically this town is situated in the center of the

Kesbewa Divisional Secretariat Division (DSD) and as main town center of the Kesbewa DSD is Piliyandala. Majority area of the DSD can be treated as the residential catchment of the town except those edged areas connected with nearby towns namely Boralesgamuwa, Maharagama,& Kottawa.

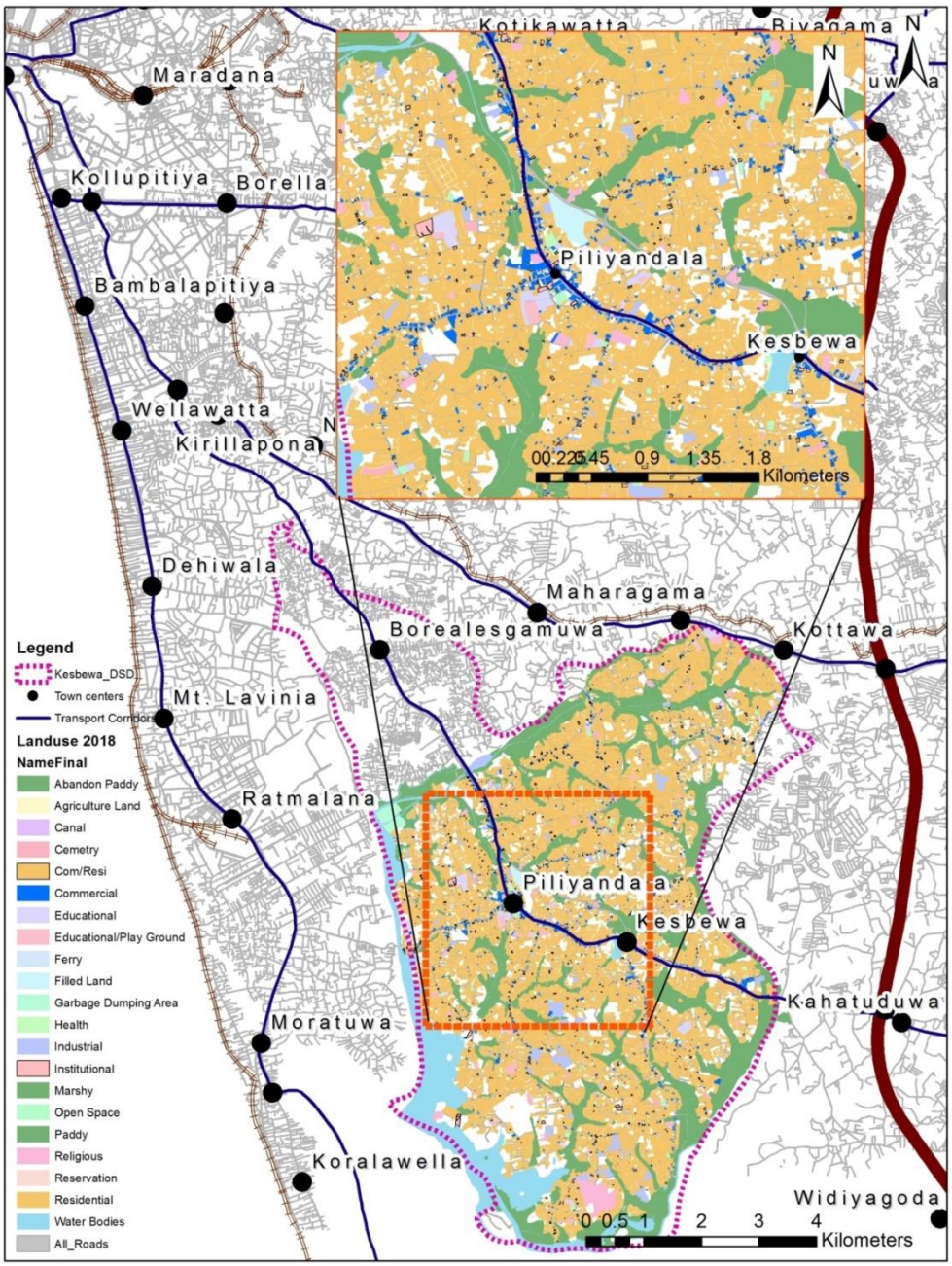

Figure 3. 2 Spatial configurations of Piliyandala as the case study

Analyzing demographic data of the Kesbewa DSD and neighboring other DSDs' it's reviled that Kesbewa is having the highest population growth rate compared to others. It can see in the Table 3.1 and in the Graph 3.1 below.

Table 3. 1 Demographic data comparison with surrounding DSDs

DSD	Population in 2001	Population in 2012	Density per sqkm	AAGR (2001-2012)
Colombo	380,946	323,257	17959	-1.9544
Dehiwala	101,830	88,962	11120	-1.2576
Kesbewa	**209,619**	**245,232**	**3832**	**1.4759**
Maharagama	185,193	196,423	5169	0.9466
Moratuwa	177,563	168,280	8414	-0.554
Rathmalana	108,716	95,506	7347	-1.1514
Sri Jayawardanapura Kotte	116,366	107,925	6349	-0.7131
Thimbirigasyaya	266,154	238,057	9919	-1.1924

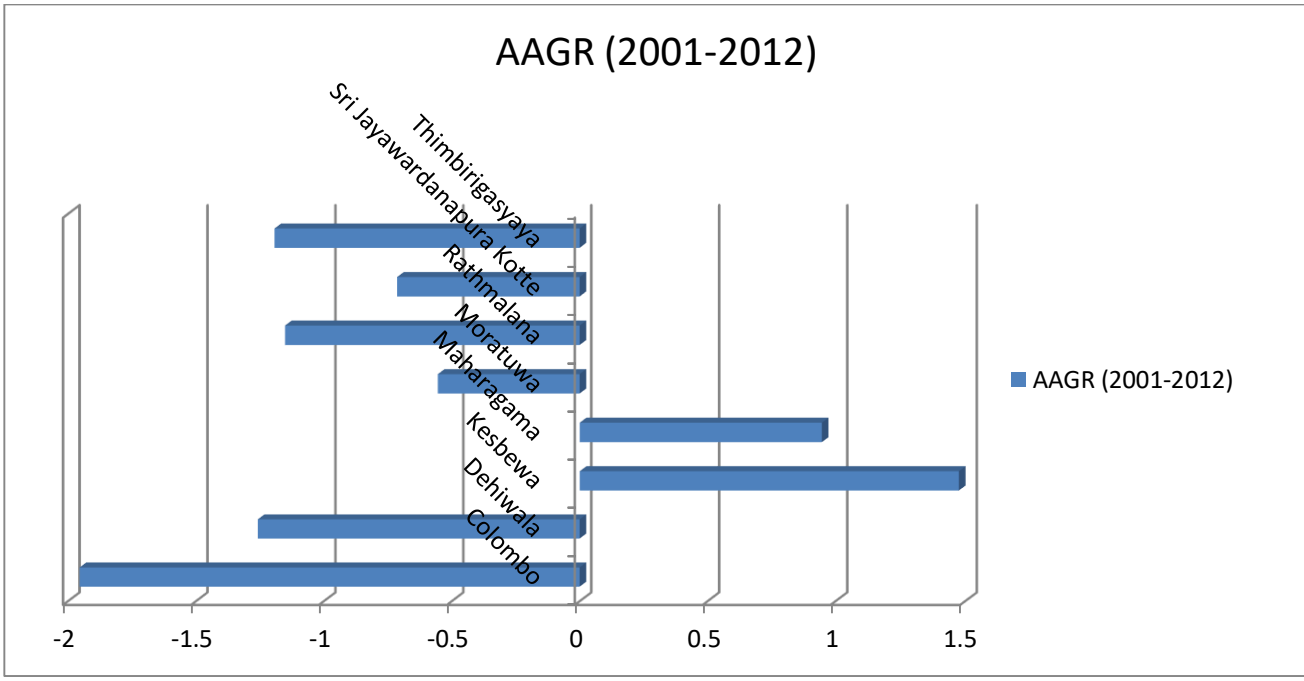

Figure 3. 3 Average annual growth rate comparison with surrounding DSDs

Those figures proves that Kesbewa area is a growing residential area On the other hand considering the land use of the Kesbewa UC area, majority (50%) of lands occupied for residential uses.

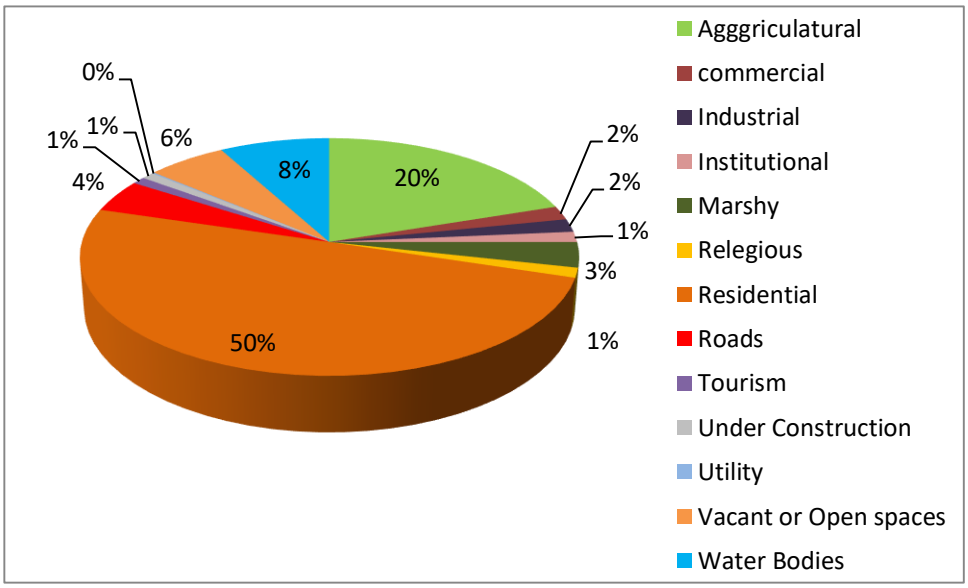

Figure 3. 4 Land use composition

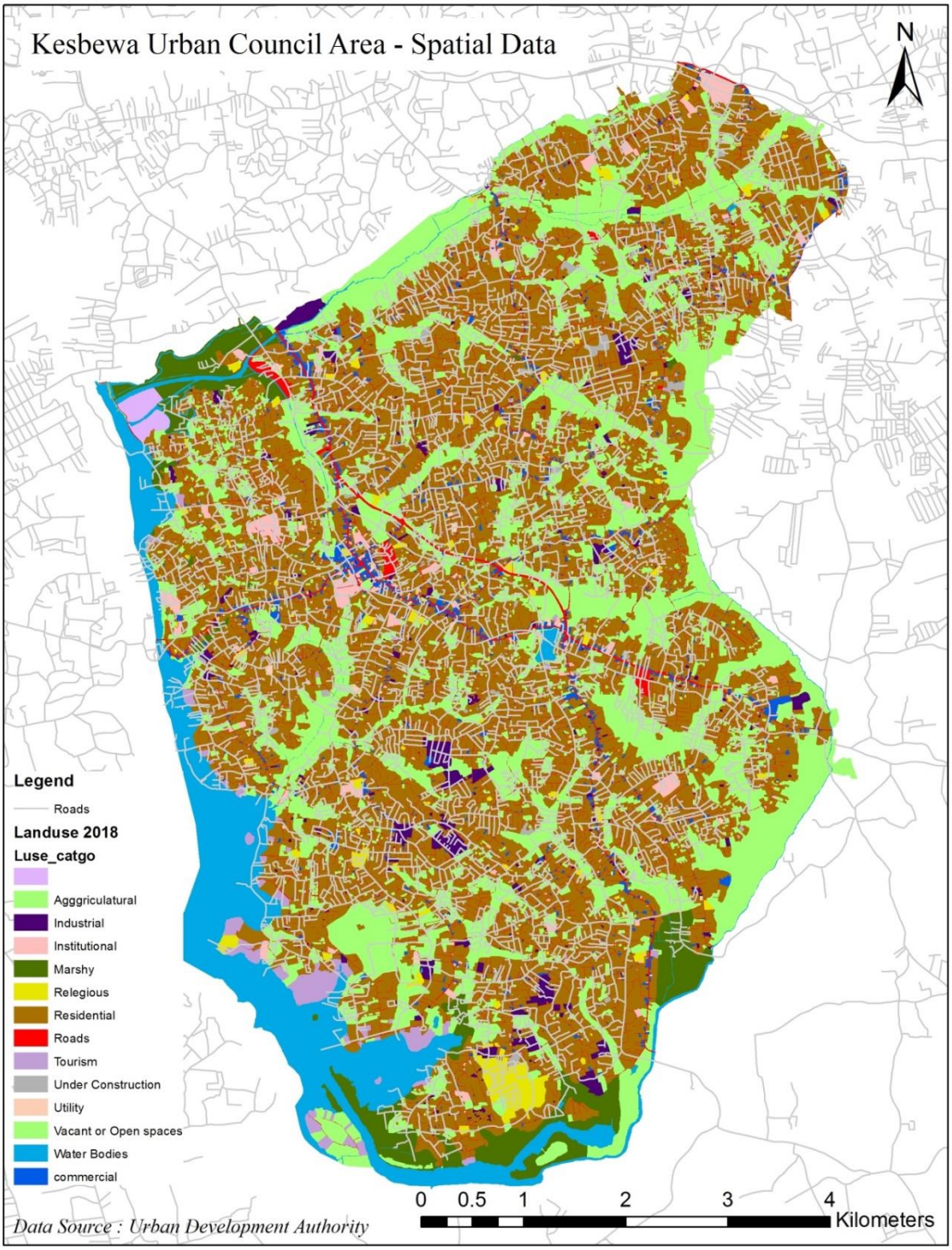

Figure 3. 5 Land use in Kesbewa UC area

With this basic demographic and land use analysis above it can be concluded that this town of Kesbewa DSD fulfilling the 1st requirement mentioned above for selecting as the case study area in this study.

Again Land use map coupled with Google image of the town it can be clearly demarcated the town area separating surrounding areas in view of the use, Lot size, Building density etc (2nd requirement fulfilled).

Building map and the uses of the building of the town area reviled that the majority commercial and other services are concentrated in to Piliyandala town area. Many of buildings at the town center are used for providing retail goods and services which are existing and surviving for the benefit of the surrounding residential populations (3rd requirement fulfilled).

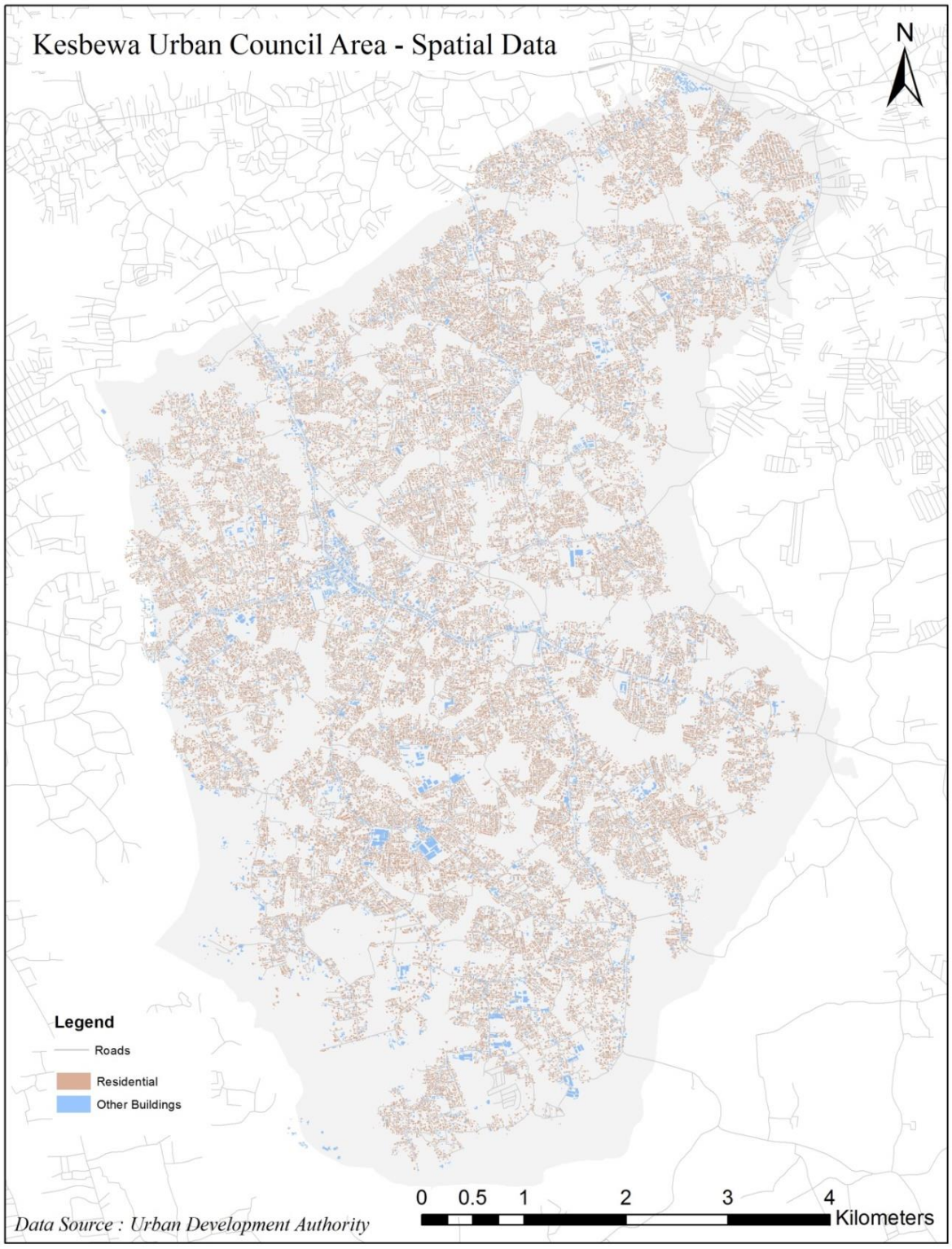

Figure 3. 6 Building use in Kesbewa UC area

3.3 Methods and Procedures

Two main questions need to be answered in this study. From the retail investors point of view guiding for decision making where to locate retail business in a town by identifying what are most important factors affecting on retail attractiveness. Then from planners point of view how to identify which areas are the most suitable areas for retail establishments. In line with the questions two objectives were established to be achieved in the study. They are analyzing the correlation between the retail locations and the spatial configurations of a city to make informed decision making then to develop a mechanism to evaluate the attractiveness of locations for retail activities of small commercial towns in Sri Lanka

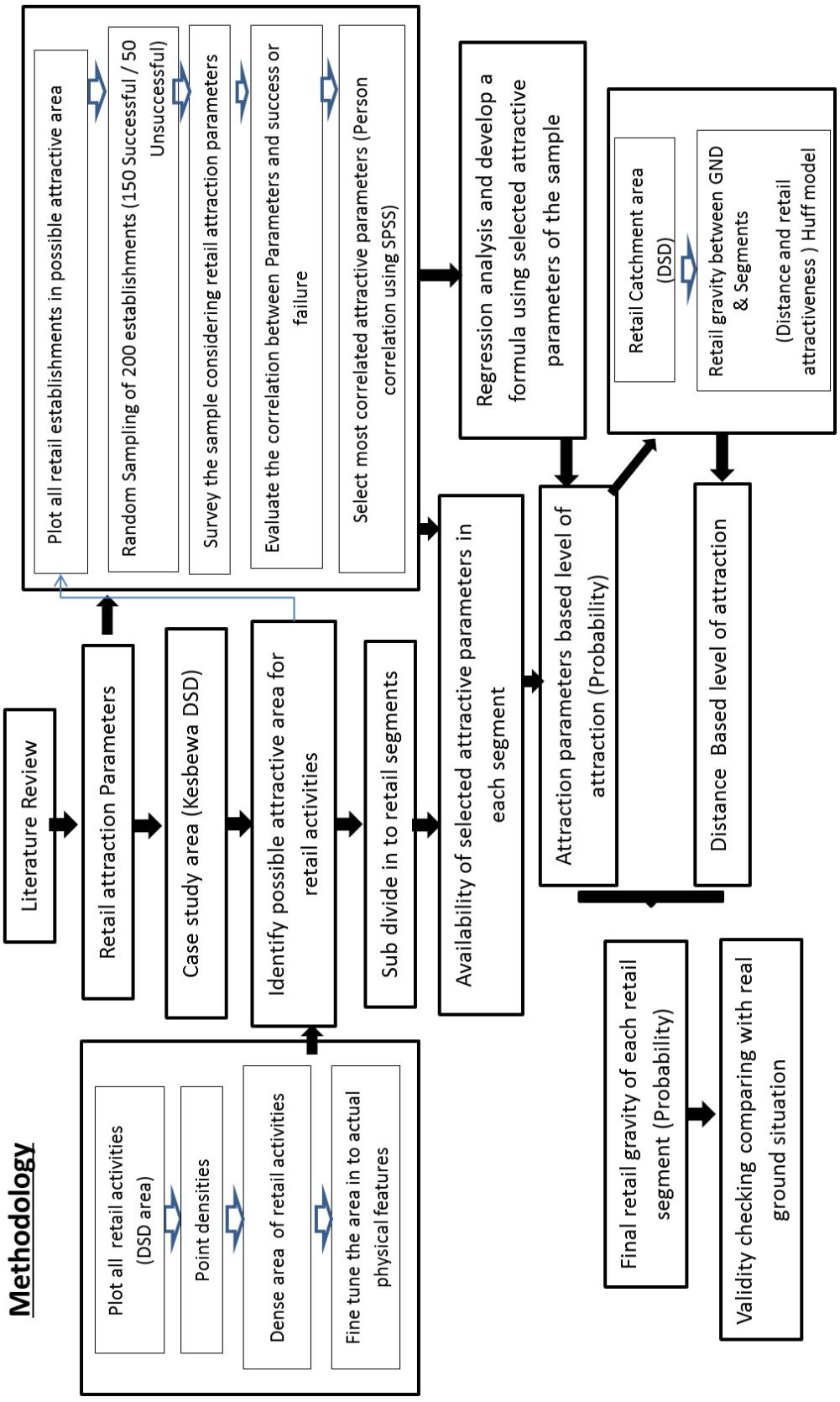

Figure 3. 7 Methodology flow chart

For this study its needs to develop a comprehensive database to examine the spatial structure of retail commercial locations in the Divisional Secretariat Division (DSD) of Kesbewa. Building layer and Population data in Grama Niladhari Division developed by Urban Development Authority in Arc GIS shape file format acquired for the study.

Boundary of the possible retail area delineated through a raster analysis in Arc GIS format. It calculated the point density of existing retail establishments and the boundary was formed accordingly.

Literature reviews done in the study explores possible spatial parameters that can be effect on retail attractiveness. It conducts a survey to identify spatial parameters which are having higher correlation with retail attractiveness. This survey had selected 200 number of sample which is equally distributed throughout the possible retail area of the case study area. Slovin's formula was used to find out what is the sample size and it was 200 no of retail shops. The sample consists of 150 number of success retail establishments and 50 number of unsuccessful retail establishments.

The database developed for the whole sample. Correlation analysis was done for the database using SPSS software. The analysis result showing what are the most correlated parameters with the retail success or failure.

Using the database developed for the sample and the selected most correlated+ parameters above with the help of SPSS, Binary logistic regression analysis was done in order to develop a formula.

Then the study area was sub divided in to segments giving due consideration for Land use Land lots shape and size, prominent boundaries, Accessibility and Retail Density of the area. Then checked the availability with average values of each selected parameters above values were given as same as in the above survey.

Using the formula developed above the level of attractiveness of the segments been calculated and probability of attractiveness level of each segment calculated.

Locational attraction defined by the road network of the catchment area also considered. Huff model which is explained in the literature review chapter used for this and calculated the probability defined by location in each segment.

Final gravity level was calculated using both of these probability levels of each segment.

Finally the most successful segments for retail activates will be derived from the models developed above. The results will based on the inherent qualities (parameters affecting for retail success) coupled with the attractiveness generating from the location of segments and residing location of the population who's coming to obtain services from the town (LA area taken as the Retail catchment of the town).
The validity of the developed model was evaluated by discussing the successfulness of the establishments within the most attractive and least attractive segments.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

4.1 Introduction

This chapter will describe how the data collection and analysis done in the study. It will describe how the literature reviews used as secondary data for the study and how the primary data collection is organized for the study. How the sampling was done and methods used for the data collection and analysis will be deeply explain in this chapter. Step by step descriptions of the Model development and the method for validity checking are discussed in this chapter. Applications of the model with examples have given at the end of chapter.

Piliyandala town center is taken as the case study area of this study. As mentioned in the previous chapter this study is dealing with the location problem of retail business in service center type small towns in Sri Lanka

4.2 Data collection

As Secondary data Building layer, Road network, Land blocks layer with land use of Kesbewa UC area in Esri Arc GIS shp, format were acquired from Urban Development authority. Some of the spatial data collected for the study given in Figure 4.1

Primary data collected through the Field surveys in the study area regarding the retail establishments and the spatial parameters of the retail segments identified in the study. Interview method with questionnaires for the sample and observation methods used in primary data collections.

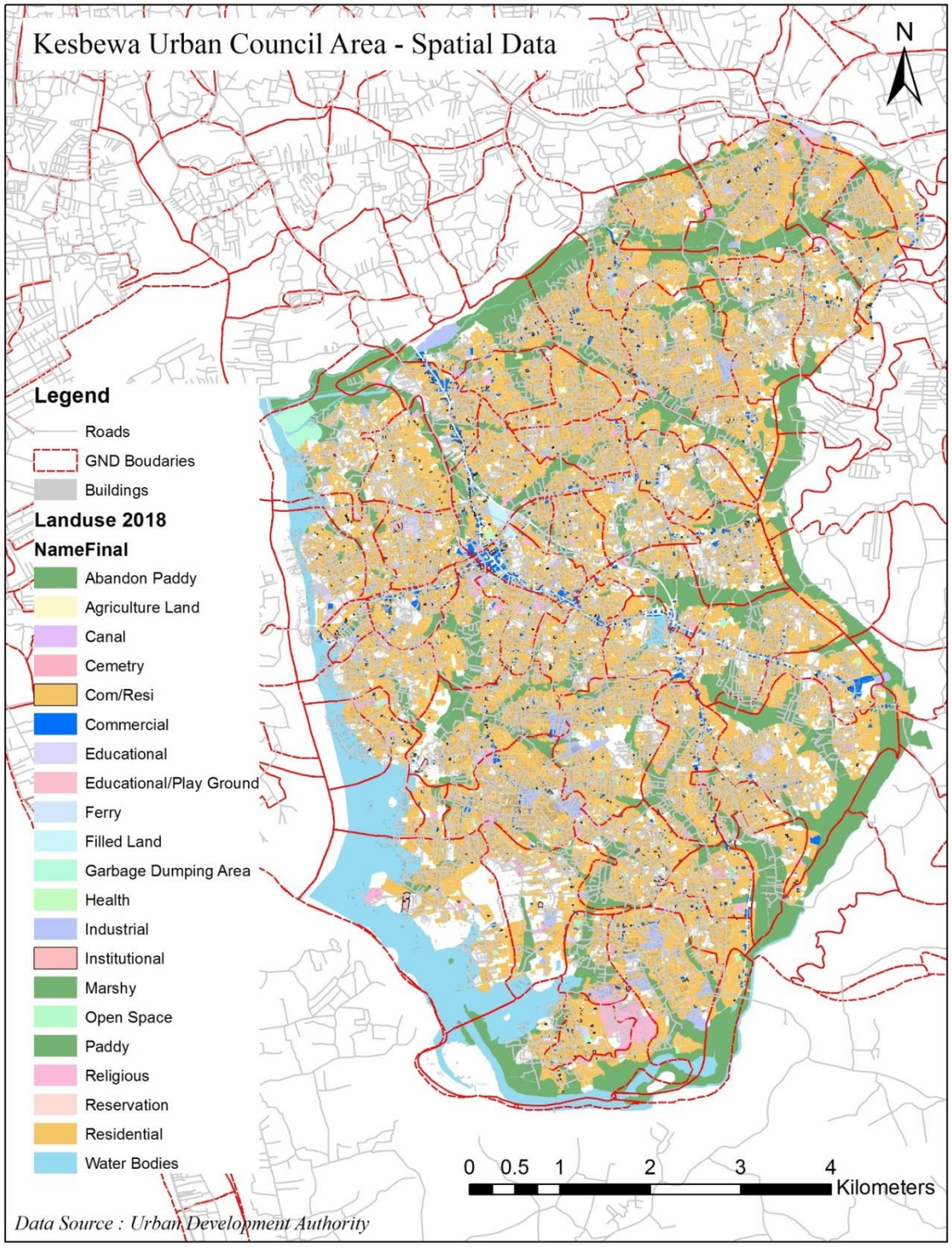

Figure 4. 1 Spatial Data collection for the study

4.3 Identifying possible attractive area for retail activities

As methodology flow chart explains in the previous chapter, starting point of this study is to delineate a boundary of the town that is having a possibility for retail activities.

For this task its' follows following steps

Convert building polygons to Point

Point density under spatial analysis tool in Esri ARC map

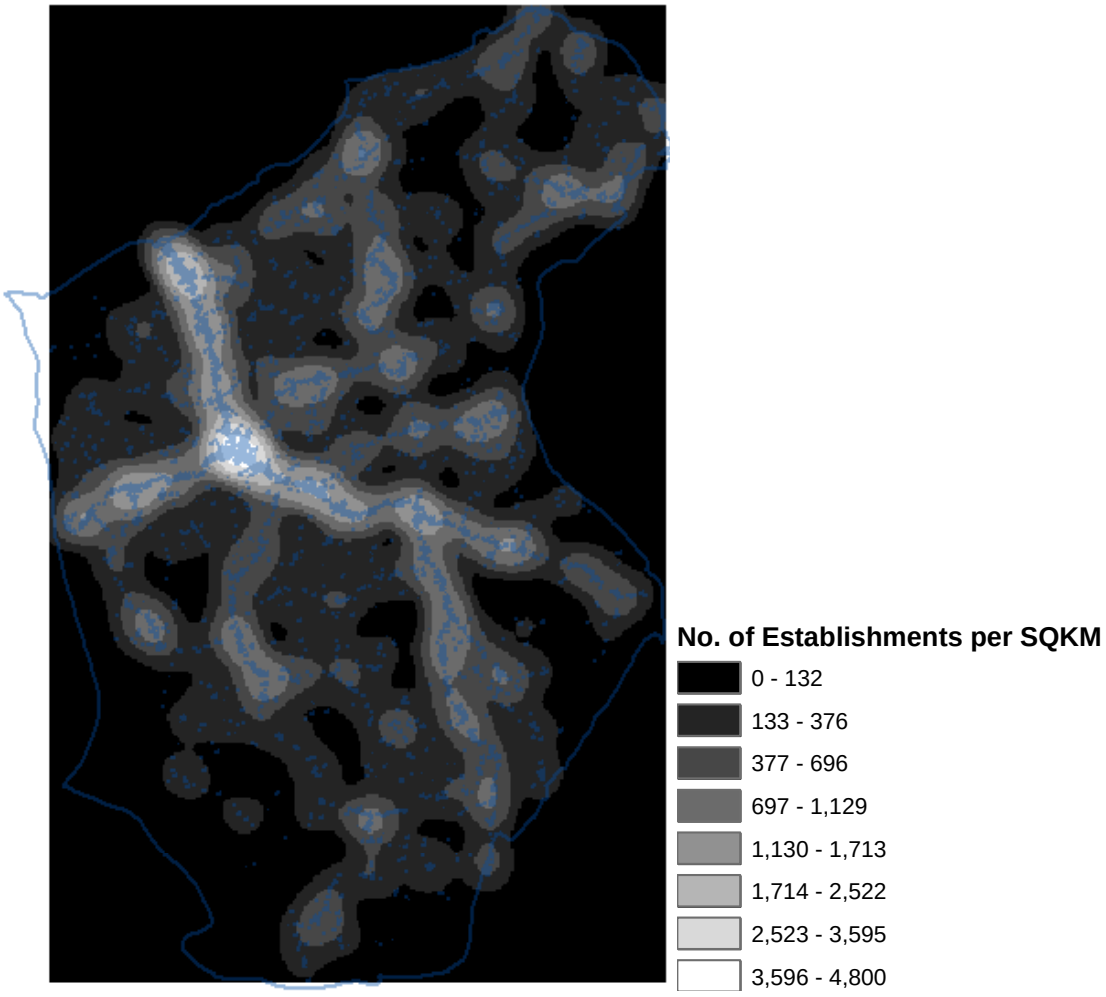

Figure 4. 2 Building density of Kesbewa UC area

Piliyandala town area can be taken as the densest area of the Kesbewa DSD.

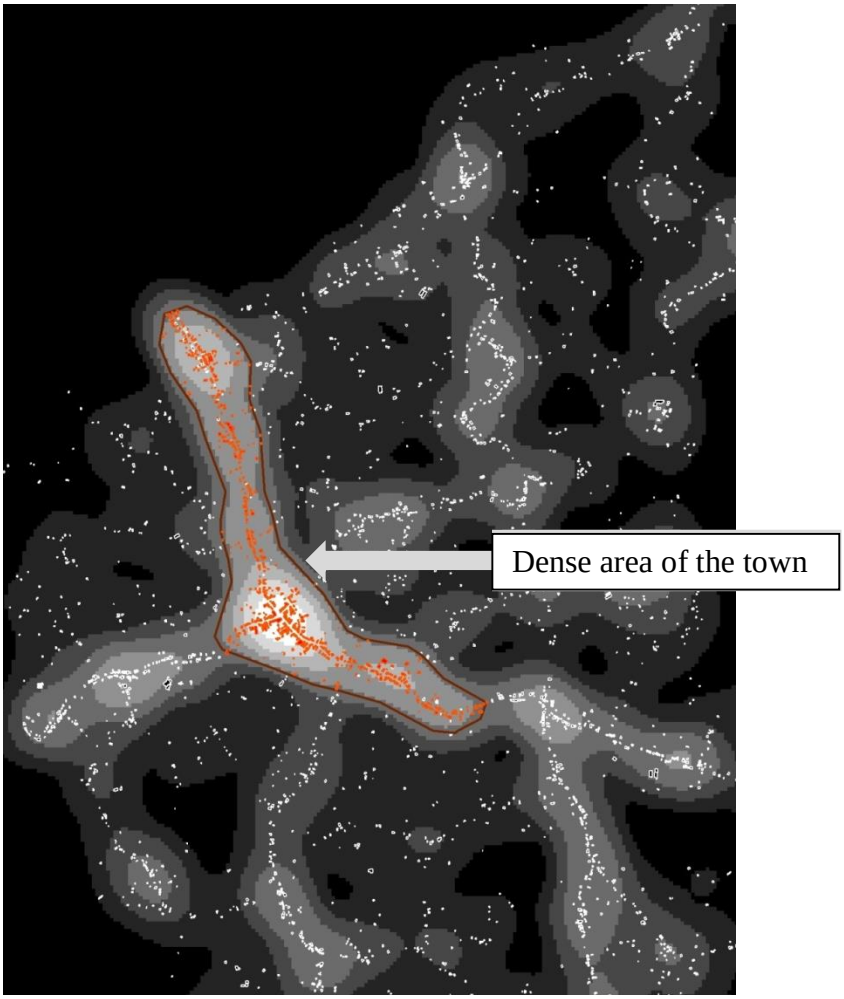

Figure 4. 3 Building density of Kesbewa UC area and Selection of study area

This area should be buildable area without natural feature barriers. As Kesbewa DSD area consists of lot of low laying areas. Buildable high lands can be distinguished by prominent boundaries. This town area is surrounded by low laying areas. Since this delineated area is raster analysis it does not clearly identified the buildable dense area. Therefore the identified town area was further demarcated with prominent physical boundaries shown in Satellite maps with due consideration of land lot boundaries' taken from land use layer.

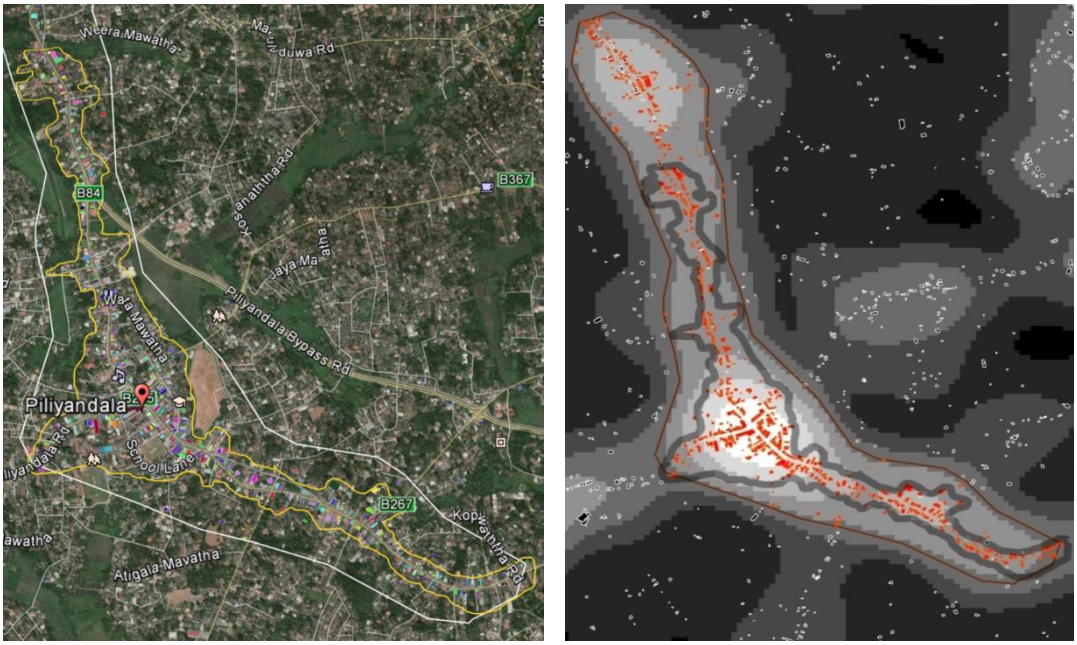

Figure 4. 4 Demarcation of the study area

4.4 Identifying attractive Parameters affecting on retail successfulness

In the literature review chapter it was identified several factors affecting retail attractiveness giving due consideration for factors relevant to our small towns. (Teller et al 2012), (Ezmale et al 2011), (Zehirc et al 2013)

1. Accessibility
2. Distance to Bus Halt/ Public mode
3. Clustering
4. Lot size
5. Frontage
6. Floor area
7. Pedestrian Movements
8. Onsite Parking
9. Land suitability
10. Infrastructure availability (Water,)
11. Infrastructure availability (Electricity)
12. Visibility to public areas
13. Floor Level
14. Closeness to town center
15. Closeness to core activities of the town
16. Attractiveness of the built form
17. Availability of public car park

4.5 Scaling of parameters

Most of the selected parameters are not binary questions which give two answers; hence, most of them are likert type questions. Then, it needs to give scale values which represent a set of answer options or answer choices for each parameter. Those 5 point choices are pre-determined based on the level of availability in the entire study area. Each parameter and how the determination of scale values of each parameter can be explained as follows.

4.5.1 Accessibility

The retail establishments of this study area consists of 4 lane roads that is Horan - Colombo main road and Katubedda road, two lane roads are Maharagam road, Kottawa road and Madapatha road. Single lane roads connected with said main roads are the mostly available roads in the town (Figure 4.5). Mean time some retail establishments get access from non moterable roads also. Scale values were assigned based on those available means of access as shown in **Appendix 1**. The assumption here is that wider access roads are more vehicular oriented and narrow roads are more pedestrian friendly and gives higher accessibility for consumers of retail establishments and getting higher attraction.

4.5.2 Distance to Bus Halt/ Public mode

Bus transportation is the one and only mode of public transportation available in this town. Then it considered the distance to the bus halt from the establishments. In the basic analysis of the distance to the bus halt from the retail establishments of the town (Figure 4.5), it's revealed that the longest distance to the bus halt is 400m and all are located within a distance of 400m. Here it assumes closer establishments to the bus halts are more attractive and scale values are given accordingly as shown in **Appendix 1**

4.5.3 Clustering

Sets of retail outlets located in a nearby geographical area are referred to as retail agglomerations or retail clusters. As explored in literature review this clustering effect may increase the attractiveness of retail establishments. In this study area it's found some clustering of equal retail establishments in some places and it revealed that this

clustering was ranging from 2 to over 5 establishments in each location and scale values are given accordingly as shown in **Appendix 1**

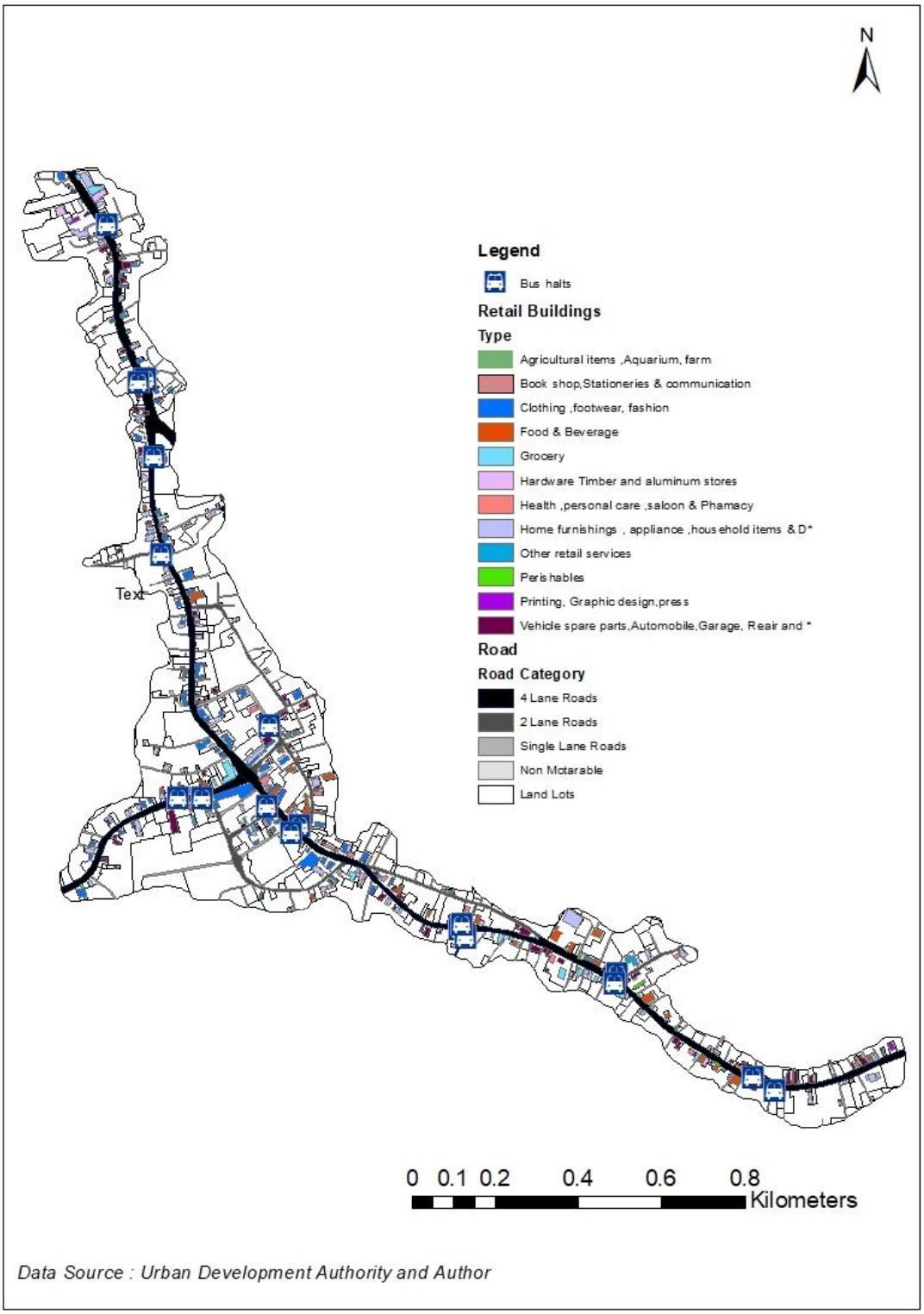

Figure 4. 5 Some Spatial data used in deciding scale values

4.5.4 Lot size

Lot size also taken as an attraction parameter and assumption here is comparatively large lots gets more attraction. This study areas retail lot sizes are vary from 1 Perch to 40 Perch and more than 60% of the lots are below10 perch. Then the scale values are given accordingly as shown in **Appendix 1**

4.5.5 Frontage

Lot frontage also taken as an attractive parameter with the assumption of wider frontages gets more attraction. Mostly occurred frontage size here in this study area is vary from 1m to 10m Then the scale values are given accordingly as shown in **Appendix 1**

4.5.6 Floor area

Retail establishments get attracted through the floor area. These study area retail establishments are having floor area vary from 25 sqm to over 100 sqm. Accurate data are not available.

Then the scale values are given accordingly as shown in **Appendix 1**

4.5.7 Pedestrian Movements

As literature review explained areas of a town gets higher pedestrian movements get higher retail attraction without efforts. Comparatively other areas pedestrian movements researcher decided the level of pedestrian movements in likert scale values 1 to 5 based on Very less ,Less, Fair, High very high respectively. Then the scale values are given accordingly as shown in **Appendix 1**

4.5.8 Onsite Parking

It has observed that availability of parking is a most important attractive criterion for retail success. When considering the onsite parking availability of study area very few retail establishments provides them. Average parking availability is ranging from 1 to 3. Considering those facts scale values for onsite parking availability is taken as shown in **Appendix 1**

4.5.9 Land suitability

Land must be suitable for retail activities. Therefore the answer for this criterion is binary (Yes or No). The surrounding of the study area consists of many not suitable lands consists of low laying areas. Considering the importance of the criteria this was taken as a parameter for the study. Anyway it was revealed at the survey all the retail establishments in this study area are established in suitable lands (High Lands), then the scale values are given 0 or 5 accordingly as shown in **Appendix 1**

4.5.10 Infrastructure availability (Water / Electricity)

Basic infrastructure is needed to be available for functioning as well as for the attraction of the establishment. This is also a binary question then the scale values are given accordingly as shown in **Appendix 1** and here also it was revealed at the survey all the establishments within the area taken for the study electricity and water connections are available.

4.5.11 Visibility to public areas

In the literature review it was emphasized that the visibility of the business location for the general public also a very important parameter. Here it was observed the areas where general public gathering in the town and checked the visibility of each surveyed establishment in to those areas. Attraction level was given based on the visibility in Likert scale values 1 to 5. Options to select given as Week, Fair, Moderate, Good, Very good.

Then the scale values are given accordingly as shown in **Appendix 1**

4.5.12 Floor Level

The towns considered in this study are small towns in Sri Lanka which are originated and evolving to provide services for the surrounding residential areas. Thus, as described in literature most of the activities are properly functioning at the ground level. In this case study area also it was observed upper levels are not functions well. Because of this background most of the building are G level or G+1 or G+2 level and very few building can be found goes beyond that level of height and couldn't find any building over G+5 level. Therefore maximum values of 5 given for those ground level retail

establishments and for those in first floor level it's given as 2 and 1 for the second floor level and taken beyond that as 0 attractions. Then the scale values are given accordingly as shown in **Appendix 1**

4.5.13 Closeness to town center

In those types of towns town center is most attractive for retail activates. Here the town center is taken as the junction that Horana – Colombo road and the Moratuwa road meets. For the study area the afar retail establishments is at a distance of 1.5Km. But over 80% of area is within 400m. Considering this the scale values are given accordingly as shown in **Appendix 1**

4.5.14 Closeness to core activities of the town

As literature reviewed Core activities of any town creates attraction for retail activates around them. This town having main core activities as Hospital, bus stand, Divisional secretariat office and UC and Piliyandala Mahawidayalaya. Here also 80% of the study area falls within a distance of 400 meters for those core activities. Then the scale values given as beyond 400 metes 0 scale values and value 5 is given for the areas within 100 meters. Scale values are given accordingly as shown in **Appendix 1**

4.5.15 Attractiveness of the built form

As per the literature attractiveness of the built form is also an important parameter in this analysis. Attraction level was given based on the attraction of the built form in likert scale values 1 to 5. Options to select given as Unattractive, Fair, Moderate, Good, Very good compared to others. Then the scale values are given accordingly as shown in **Appendix 1**

4.5.16 Availability of public car park

Public parking availability in nearby location is also increases the attractive level of a particular retail business. In this study area very few no of public parks are available. Road side parking spaces also consider as public parking's. Considering the available public car parks and the average distance for them the scale values are given accordingly as shown in **Appendix 1**

4.6 Sampling

Random sampling technique used in this survey. First it needs to decide sample size for the study. This study area consists of 555 retail buildings, many buildings at the town center consists of mixed used buildings or having more than one retail establishment(vertical/Horizontal). Then the total numbers of retail establishments are more than 555 and done an approximation to 1200 establishments were there in the study area.

Slovin's formula was used to find out what is the sample size of the population of 1200 retail buildings

Plug data into the formula**.** In this exercise, we'll use a 95 percent confidence level (giving alpha level of 0.05) with a population size of 1200

$n = N / (1 + N e^2)$
Where

n = Sample size

N = Population size

E = Confidence level (alpha level)

Sample size =1200/(1+1200*0.05^2)

Sample size = 300

According to the result of the **Slovin's** formula the sample size need to be 300, but considering the time factor and as this a individual exercise, manageable sample size was taken as 200 establishments.

Then the challenge is how to select the sample, mainly two requirements need to be fulfilled by the sample

Sample should be evenly distributed throughout the study area

It should be properly represent the all categories of the retail establishments

200 no of samples were selected randomly, distributed throughout the study area. This random sampling was done at the survey. Basic principle were used in the survey to pick up the retail shops in to the sample, i. e every establishments after 4 establishments in the town center (High dense retail area) and one after two establishments selected in less dense areas. (Figure 4.6)

According to the available data from UDA the area consists 555 Retail establishments falls under 9 categories identified in this research. Finally flashing back the selected sample can be put into the table as shown in table 4.1

Table 4. 1 Composition of the sample

Type no	Retail Category	No of Establishments withinstudy area	No of establishments selected in to the sample		Total	%
			Success	Unsuccessful		
1	Groceries, Food cities,food & Bevarage, , appliance ,Prishables,household items & Departmental stores, ,	120	44	18	62	52%
2	Clothing ,footwear, fashion	113	17	5	22	19%
3	Vehicle spare parts,Automobile,Garage, Repair and service centers, Battery, Cousin works Gas centers & Tire shops, Equipment hireling, Grinding mills, saw mills	92	24	6	30	33%
4	Book shop, Stationeries & Communication	21	10	4	14	67%
5	Health ,personal care ,Beauticare shops, saloon & Pharmacy, Opticians	23	13	6	19	83%
6	Hardware Timber and aluminum stores, Home furnishings,Electrical items, Computer accessories, Phone, tools machines and equipment, Gifts, bric-a-bracs and Jewelry	148	32	7	39	26%
7	Agricultural items ,Aquarium, farm	6	2	0	2	33%
8	Printing, Graphic design,press, Studio	11	5	2	7	64%
9	Other retail services (Teller shop,Astrology,professional services, matrimonial service, Loundary, etc)	21	3	2	5	24%
	Total	555	150	50	200	36%

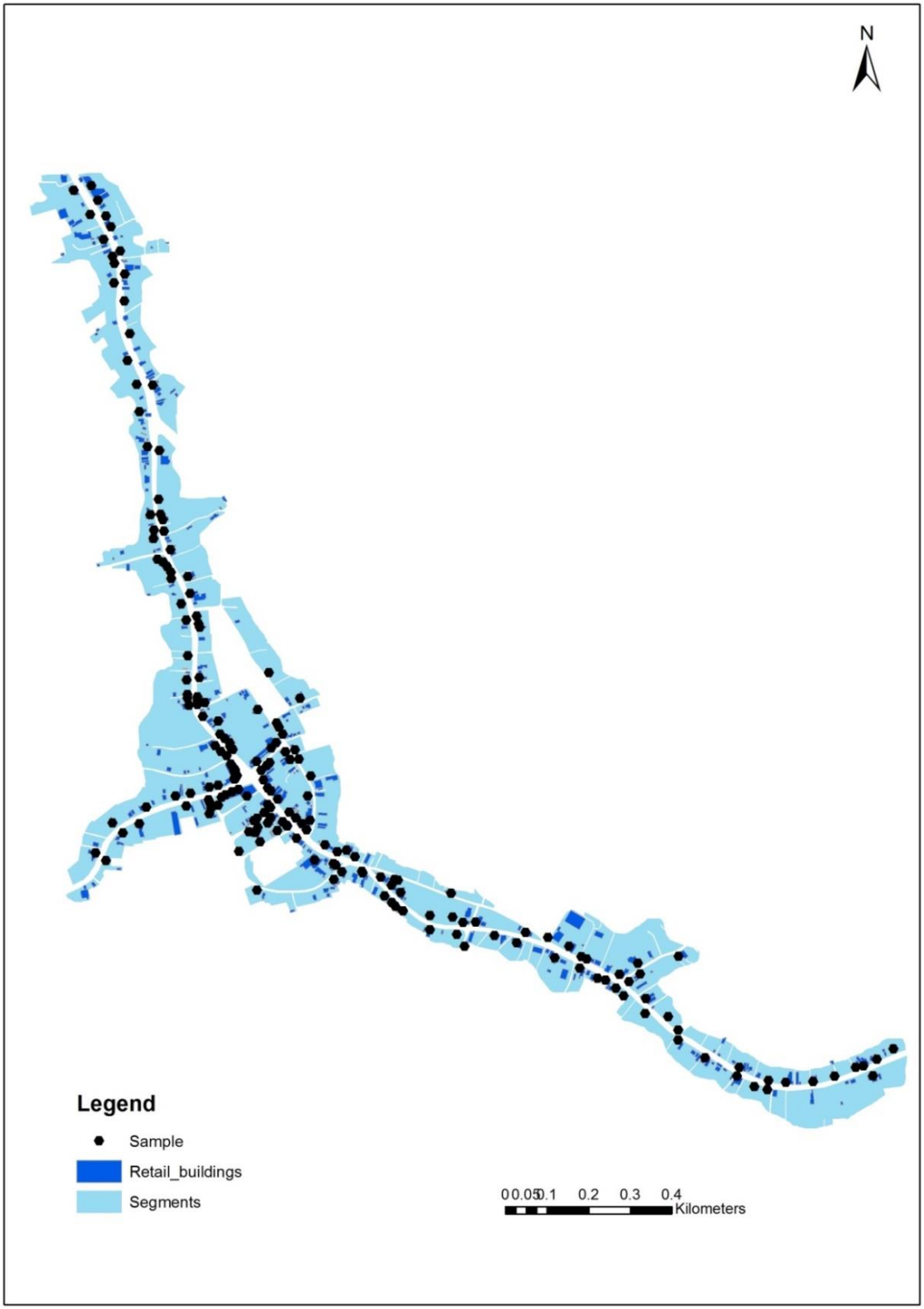

Figure 4. 6 Distribution of the sample in Study area

4.7 Initial survey to decide successfulness

This study needs to decide the successfulness of each retail establishment that going to be taken in to the sample and to check the availability or unavailability of those attractive parameters in each and every establishments of the sample.

In that view the initial survey was done to answer the question of successfulness. The answer of successful or not is defiantly a controversial conclusion. In order to eliminate this controversial nature it takes the views of three parties. i.e. Retail owners view, View of the customers visited the establishments at the time of survey and finally the view of the researcher with a thorough understanding of the successfulness level in comparison with the other equal category establishments of the study area. For deciding a particular establishment as a success or failure following initial survey shown in the table 4.2 below was done for each establishment which was taken in to the sample.

Researcher used the knowledge from the experience in town taken from continues visits and by discussions with revenue offices of the Kesbewa Urban council. Then the acquired knowledge of what is the average level of successfulness in every category of retail establishments functioning in Piliyandala town used to decide every retail establishment surveyed whether it is successful or not . Then based on the view of the owner and customers of each retail establishment final decision was taken by the researcher.

Table 4. 2 Survey sheet used for deciding success or failure

Shop ID		
Name of the Shop		
Category		
Owners idea	Successful	Unsuccessful
Customers idea		
1		
2		
3		
4		
5		
Researchers observation		

Question asked from the shop owner

Do you think your retail establishment is success or failure in this location?

Question asked from customers

Is this establishment success of fail compared to other similar establishments in this town?

3 or 5 customers of each establishment were interviewed and majority's idea was taken for the consideration.

When they are giving marginal answers researcher forced them to give yes or no answers because it is a must to decided success or failure.

Survey to assign scale values for each retail establishments in the sample

4.8 Detailed survey about availability of attraction parameters

After conducting the initial survey filled the questionnaire and the scale values as assigned in the table 4.1 this was done by observations and by taking physical measurements whenever required. All 200 establishments were visited and database developed as shown in table 4.3 below. Survey results and the database developed is given in **Appendix 2**. According to the survey result 50 establishments are unsuccessful and 150 establishments are successful.

Table 4. 3 Format of the database

Retail Establishment	**Successful or Not**	**Attractive Parameter**					
		1	**2**	**3**	**4**	**…**	**17**
1							
2							
3							
……							
200							

4.9 Correlation of the parameters with successfulness

Next step is to calculating the correlation of each parameter with success of the retail business. For that SPSS Statistics software used spearmans's correlation was calculated taking successful or not as the dependent variable and the 17 parameters as independent variables and the calculated correlation with the significant of 98% is given in the table below. SPSS Correlation table given in Annexure ii

Table 4. 4 Calculated correlations with the significant value

Correlations				
#	**Attraction Criteria**	**Spearman Correlation**	**Significant (2 Tailed)**	
1	Accessibility	**-0.281****	**0.000**	7
2	Distance to Bus Halt/ Public mode (Meters)	**0.141***	**0.047**	10
3	Clustering (Number of equal establishments within 100 m)	**0.100**	**0.159**	
4	Lot size, Perches	**0.297****	**0.000**	5
5	Frontage Meters	**0.291****	**0.000**	6
6	Floor Area	**0.271****	**0.000**	8
7	Pedestrian Movements in front of the shop	**0.339****	**0.000**	2
8	Availability of on site parking No of lots	**0.316****	**0.000**	4
9	Land suitability	**.**[a]		
10	Infrastructure availability (Electricity)	**.**[a]		
11	Infrastructure availability (Water)	**.**[a]		
12	Visibility to public areas	**0.301****	**0.000**	3
13	Floor level	**0.209****	**0.003**	9
14	Closeness to town center	**0.133**	**0.061**	
15	Closeness to core activities of the town	**.076**	**0.282**	
16	Attractiveness of the built form	**.401****	**0.000**	1
17	Distance to available public car park	**.120**	**0.090**	

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

a. Cannot be computed because at least one of the variables is constant.

Most correlated 10 numbers of parameters identified and listed below. Identifying attractive parameters affecting on retail successfulness (Spearman correlation and significant value of each parameter)

1. Attractiveness of the built form
2. Pedestrian Movements in front of the shop
3. Visibility to public areas
4. Availability of onsite parking
5. Lot size
6. Frontage
7. Accessibility
8. Floor Area
9. Floor level
10. Distance to Bus Halt/ Public mode

According to the Spearman's correlation those 10 are the most correlated parameters with the successfulness.

4.10 Regression analysis based formula development for retail attractiveness.

Using the database developed for the sample above regression analysis was done in order to develop a formula. SPSS statistical software used for this task.

Regression analysis used for the development of formula using values of the selected most correlated parameters. Regression analysis is a statistical technique using for the estimation of relationships between dependent variables with independent variables. It evaluates the strength of those relationships and then based on the strength it can be used for the modeling of the relationships of those variables.

Regression analysis is having few variations i.e , linear(Univariate/Multivariate), Binary logistic regression(Univariate/Multivariate) and Nonlinear. Most fitted model for this analysis is Binary logistic regression in Multivariate, because this dataset having 10 independent variables or the attraction parameters and one categorical dependent variable i.e. success or unsuccessful. This successfulness is the dependent variable and it would be measured on a dichotomous scale .

This analysis is doing to understand the relationship of the successfulness of retail establishments and parameters identified that will be effect on successfulness. As the successfulness of retail establishments is a function of many variables Binary logistic regression in Multivariate is the most fitted method here.

The mathematical representation of Binary logistic regression is:

$$P(Y) = \frac{e^{b_0+b_1x_1+b_2x_2+\ldots+b_nx_n}}{1+e^{b_0+b_1x_1+b_2x_2+\ldots+b_nx_n}}$$

P: probability of Y occurring

e: natural logarithm base 2,7182818284

b_0: interception at y-axis

b_1: line gradient

b_n: regression coefficient of Xn

X_1: predictor variable

X_1 predicts the probability of Y.

Binary logistic regression analysis done for the database of the 200 retail sample of the study area and the results were as follows.

Dependent Variable: Success or Fail

Independent Variables:

Identified by the correlation analysis

1. Attractiveness of the built form (Builtform)
2. Pedestrian Movements in front of the shop (Pedestrian)
3. Visibility to public areas (Visibility)
4. Availability of onsite parking (Parking)
5. Lot size (Lotsize)
6. Frontage (Frontage)
7. Accessibility (Access)

8. Floor Area (F_area)

9. Floor level (F-level)

10. Distance to Bus Halt/ Public mode (Bus halt)

Table 4. 5 Model Summery

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	130.771[a]	.376	.556

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 4.5 contains the Cox & Snell R Square and Nagelkerke R Square values, which are both methods of calculating the explained variation. The explained variation in the dependent variable based on the model ranges from 37.6% to 55.6%, depending on whether you reference the Cox & Snell R2 or Nagelkerke R2 methods, respectively. Nagelkerke R2 is a modification of Cox & Snell R2, the latter of which cannot achieve a value of 1. For this reason, it is preferable to report the Nagelkerke R2 value can be treated as good fitting model.

4.10.1 Variables in the equation

The "Variables in the Equation" table shows the contribution of each independent variable to the model and its statistical significance. This table is shown below (Table 4.6)

The Wald test ("Wald" column) is used to determine statistical significance for each of the independent variables. The statistical significance of the test is found in the "Sig." column. From these results it can be seen that all the parameters are showing values which are close to 0 and added significantly to the model/prediction. Those results in the "Variables in the Equation" table can be used to predict the probability of an event occurring Putting it all together. Based on the results above, we could report the results of the study as follows (N.B., this does not include the results from your assumptions tests):

Table 4. 6 Contribution of each independent variable to the model

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Built form	.767	.213	12.911	1	.000	2.153
	Pedestrian	.672	.192	12.214	1	.000	1.959
	Visibility	.624	.323	3.742	1	.053	1.866
	Parking	.977	.326	9.003	1	.003	2.657
	Lot size	1.693	.929	3.322	1	.068	5.438
	Frontage	.422	.339	1.550	1	.213	1.525
	Access	.371	.445	.697	1	.404	1.450
	F_Area	-2.173	1.020	4.542	1	.033	.114
	F_Level	.586	.320	3.362	1	.067	1.797
	Bus halt	.814	.290	7.881	1	.005	2.257
	Constant	-13.636	3.407	16.016	1	.000	.000

Variable(s) entered on step 1: Built form, Pedestrian, Visibility, Parking, Lot size, Frontage, Access, F_Area, F_Level, Bus halt.

Then the equation will be

Success = -13.636 + [(.371 * Access) +(0.814*Bus halt)+ (1.693*Lot size) +(0.422*Frontage) +(-2.173*F_area) +(0.672*Pedestrian) +(0.977*Parking) +(0.624*Visibility) +(0.586*F-level) +(0.767*Built form)]

Then the probability of being successful of a retail establishment can be expressed as follows

$$P(Y) = \frac{e^{b_0+b_1x_1+b_2x_2+\ldots+b_nx_n}}{1+e^{b_0+b_1x_1+b_2x_2+\ldots+b_nx_n}}$$

This equation need to be applied for the geographical segments of the town in order to identify the suitable areas for retail activities in the town.

After the regression analysis it was observed that some variables in the equation are not significant at the level of 05% confidence level. They are Accessibility (0.404), visibility to public areas (0.053), Lot size (0.068), Frontage (0.213), Floor area (0.33) and Floor level (0.067). Then eliminating those insignificant variables the regression analysis was done again and the results were as follows.

Table 4. 7 Contribution of each independent most significant variable to the model

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Bushault	.492	.246	3.989	1	.046	1.636
	Pedestrian	.740	.170	19.035	1	.000	2.095
	Parking	.841	.237	12.549	1	.000	2.318
	Builtform	.592	.187	10.070	1	.002	1.807
	Constant	-5.620	1.272	19.523	1	.000	.004

a. Variable(s) entered on step 1: Bushault, Pedestrian, Parking, Builtform.

Then the new equation will be

Success = -5.620 + [+(0.492*Bus halt)+ (0.740*Pedestrian) +(0.841*Parking) +(0.592*Builtform)]

Then the probability of being successful of a retail establishment can be recalculated using equation expressed above.

4.11 Segmentation of the study area

Ultimate objective of this study is to identify areas of the town which are more suitable for retail activities. Now most significantly correlated parameters are identified based on the correlation analysis using sample data. Then the equation has also been developed for the successfulness based on those selected parameters using binominal logistic regression analysis. Now the next step is to sub divide the study area in to segments and apply this model for the geographical area wise suitability identification for the retail activities.

This segmentation was done based on the consideration of Land use, Land lots, prominent boundaries, Accessibility and building densities etc. Accordingly 86 number of segments identified in the study area Figure 4.7

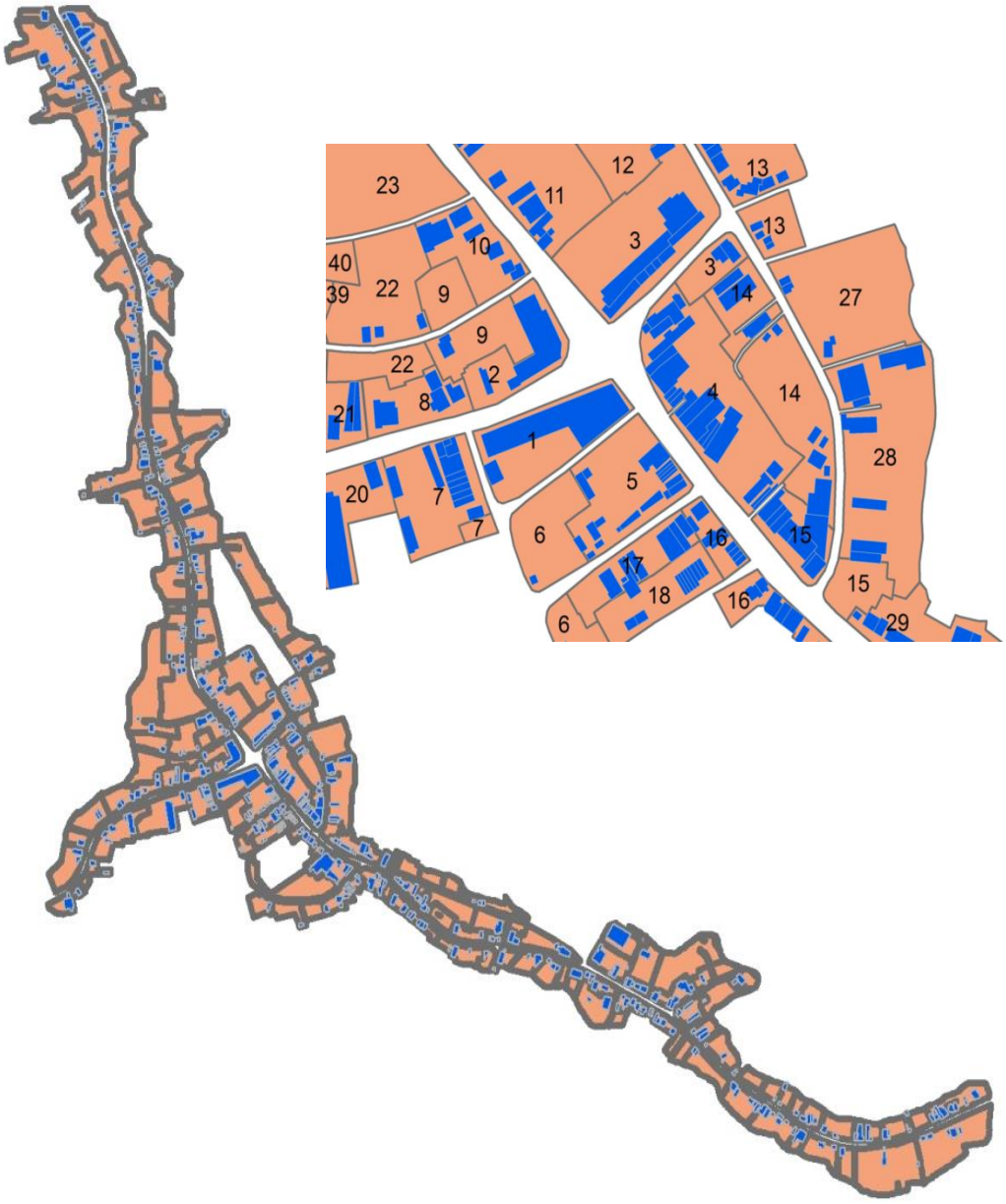

Figure 4. 7 Segmentation of the study area

10 maps which showing the attraction level of each segment under 10 selected parameters which are having higher correlation with the retail success is given in **Appendix 3**

4.12 Survey to assign average attraction values of each segment

Another survey was conducted to assign average most correlated parameter values for each segment. Here also same scale values used for the individual establishments survey used for the segments also. Another database developed as shown in **Appendix 4**

Here it considered the average values based on the knowledge obtained from individual retail establishments' survey. Observations and data base in arc GIS environment used for assigning scale values for each segment under each parameter.

For an example when calculating values for the distance to the bus halt average distance to the nearest bus halt from all establishments of the segment were considered.

4.13 Attraction parameters based attraction of the segments

From the 2nd survey above, values of the 10 parameters for all 86 no of segments of the study area stored in Arc GIS shape file of the segments. Calculation was done using the successfulness formula (Model) developed above

$$P(Y)=\frac{e^{-13.636 + [(.371 * Access) +(0.814*Bus\ halt)+ (1.693*Lotsize) +(0.422*Frontage) +(-2.173*F\_area) +(0.672*Pedestrian) +(0.977*Parking) +(0.624*Visibility) +(0.586*F\text{-}level) (0.767*Builtform)]}}{1 + e^{-13.636 + [(.371 * Access) +(0.814*Bus\ halt)+ (1.693*Lotsize) +(0.422*Frontage) +(-2.173*F\_area) +(0.672*Pedestrian) +(0.977*Parking) +(0.624*Visibility) +(0.586*F\text{-}level) (0.767*Builtform)]}}$$

The result of applying above formula is given in **Appendix 4** as a "column Probability (Parameter based, 10 parameters)"

Now every segment having a probability to describe its level of attraction based on the selected most correlated 10 parameters and the binary logistic regression analysis in the study. It was shown in the Figure 4.8.

Natural interval classification method in ARC gis used for this.

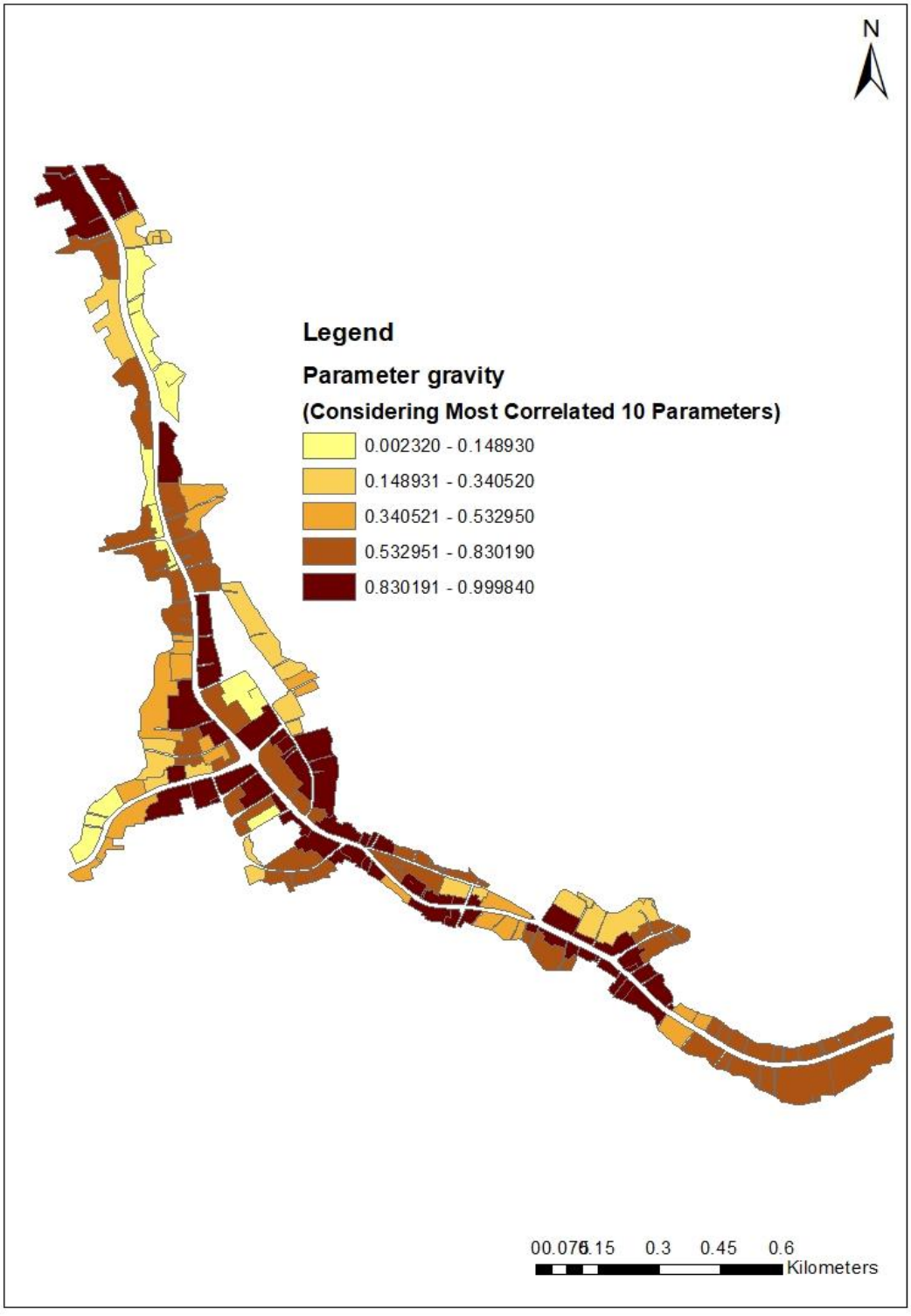

Figure 4. 8 Attraction parameters based attraction

This map can be used for the planners in zoning retail commercial area as well as for the retail investors in decision making in location retail business in the town. Darker areas shows the most attracted areas for retail business in Piliyandala town

4.14 Gravity based attraction of the segments

The above formula has considered the inherent qualities (attraction parameters) of individual segment of which are highly correlated with level of retail attractiveness of them. Then as described in the previous chapters this study needs to go further step to identify the most attractive retail areas by considering the retail gravity. Gravity means the attractiveness of the segments derived from the distance of the people (retail customers of the town).

Huff model used in arc GIS for this to forecast areas of high and low sales potential, this can guide new retail location placement. And to account for differences (Probabilities) in the attractiveness of a segment relative to others, here a measure of total attractiveness values used in conjunction with the distance measure

Huff gravity Model

$$P_{ij} \frac{\frac{S_j}{T_{ij}^{\lambda}}}{\sum_j^n \frac{S_j}{T_{ij}^{\lambda}}}$$

Pij: Probability of a consumer at point i (**catchment area – Kebewa DSD**) travelling to retail location j (**Segment centers**)

Sj: Size of retail location (**Attraction parameter based attraction** of each segment)

Tij: Distance from consumer at point i to travel to location j taken from road network

λ = *a parameter which is to be estimated empirically to reflect the effect of travel time on various kinds of shopping trips.*

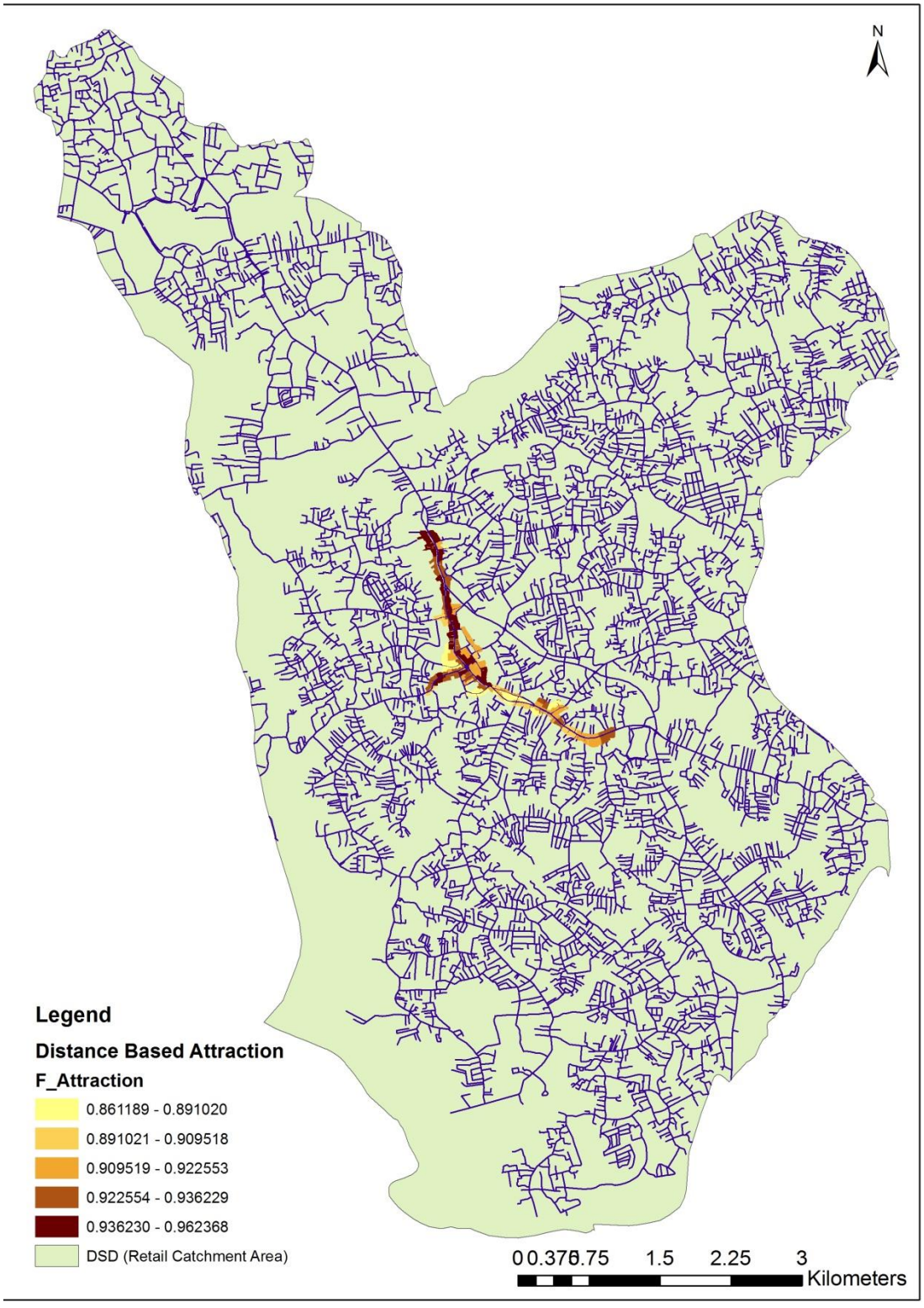

Figure 4. 9 Distance Based attraction using Huff model

Huff model used and in Market analysis tool box in Esri Arc GIS software and run the model with above parameters and the results were given in **Appendix 4.** Column called "Probability (Distance based)". Network dataset of the DSD area created to be used in the Huff model.

Figure 4.9 & Figure 4.10 shows the level of attractiveness of each segment derived from the locational gravity of the customers in the retail catchment area (Kesbewa DSD) based on road network.

Then in calculating final gravity of each segment of the town those 2 probabilities derived from two analyses (Parameter based and distance based) multiplied to get one value. Values given in the **Appendix 4**

Resultant final map of the analysis given in Figure 4.11

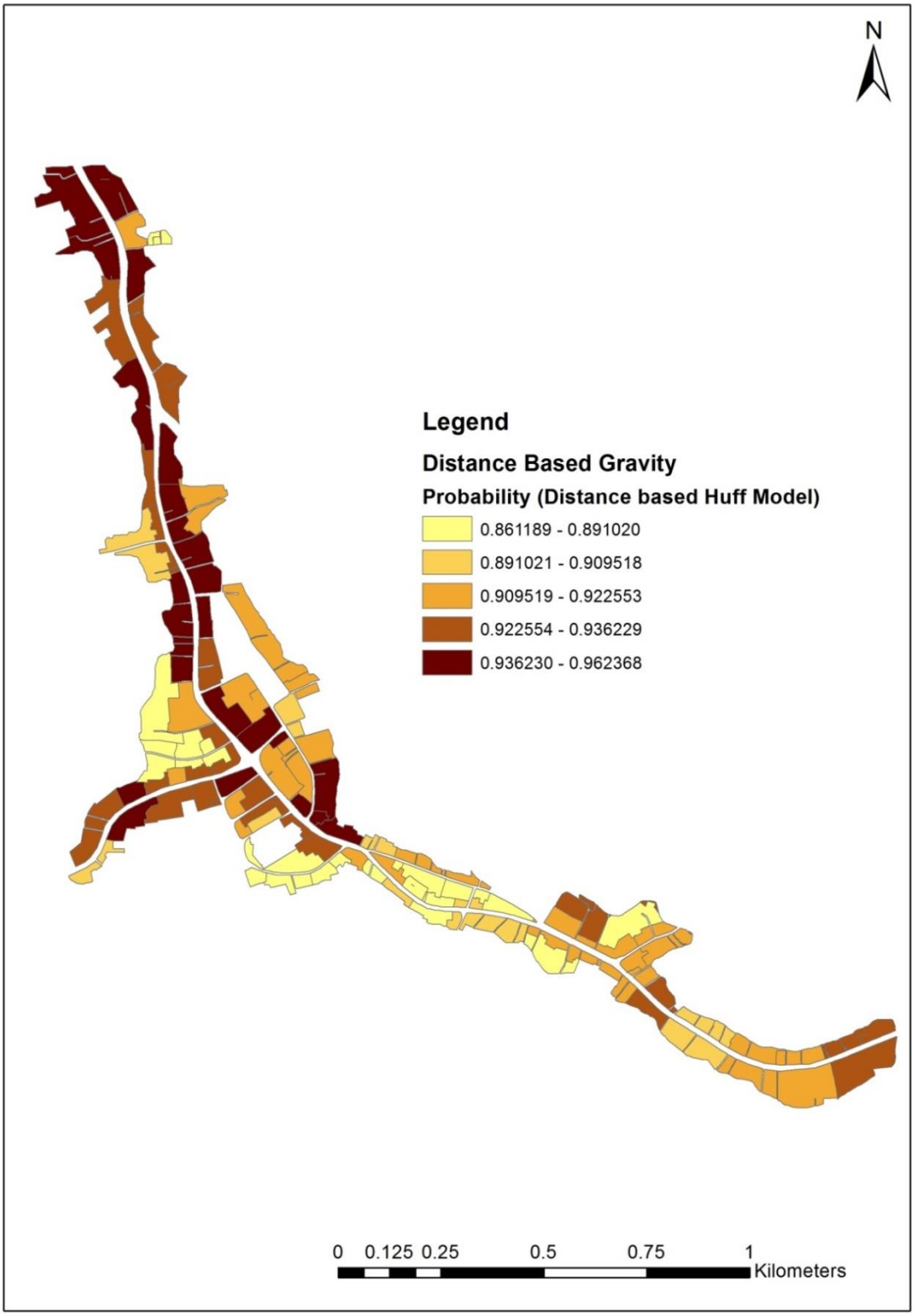

Figure 4. 10 Distance Gravity based attraction

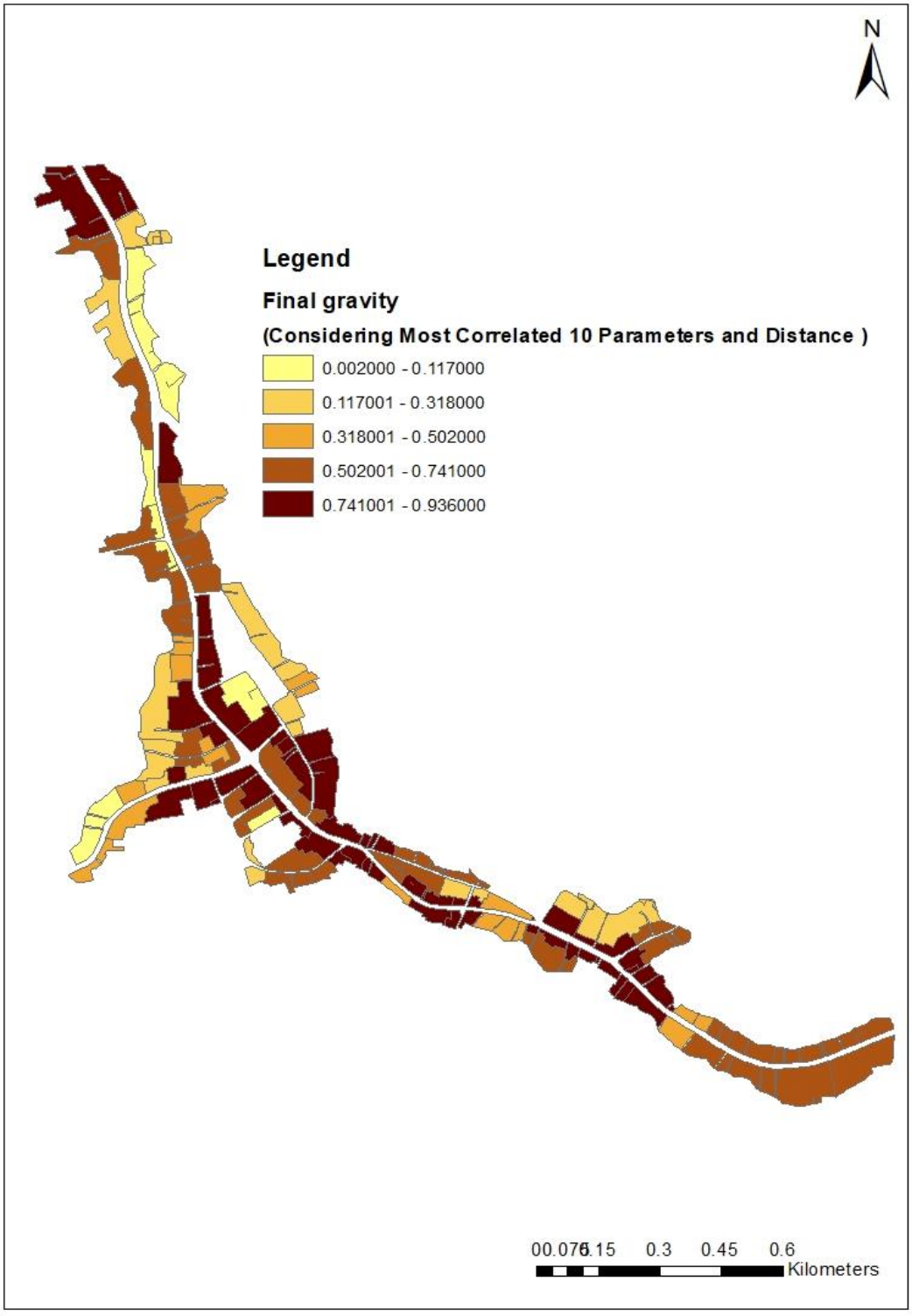

Figure 4. 101 Final retail Gravity **(Most Correlated 10 Parameters based probability x Distance based probability)**

Since it was identified some parameters were not significant as described in the paragraph 4.10.1 above, Those insignificant variables at the level of 05% confidence level i.e Accessibility (0.404), visibility to public areas (0.053), Lot size (0.068), Frontage (0.213), Floor area (0.33) and Floor level (0.067) were removed done the regression analysis again and the results were given in paragraph 4.10.1 above. Then based on this analysis another equation developed taking only the most significant variables.

The equation will be

$$P(Y) = \frac{e^{-5.620 + [+(0.492*\text{Bus halt}) + (0.740*\text{Pedestrian}) + (0.841*\text{Parking}) + (0.592*\text{Builtform})]}}{1 + e^{-5.620 + [+(0.492*\text{Bus halt}) + (0.740*\text{Pedestrian}) + (0.841*\text{Parking}) + (0.592*\text{Builtform})]}}$$

New map derived using those probability values in given in Figure 4.12 below. Here it considers only the variable of Distance to bus halt, Pedestrian movement in front of the shops, Parking availability and the built form. (Calculations given in Appendix 4)

Then it was multiplied by distance probabilities and the resultant final map of the attraction or the gravity derived from the study has given in Figure 4.13 below.

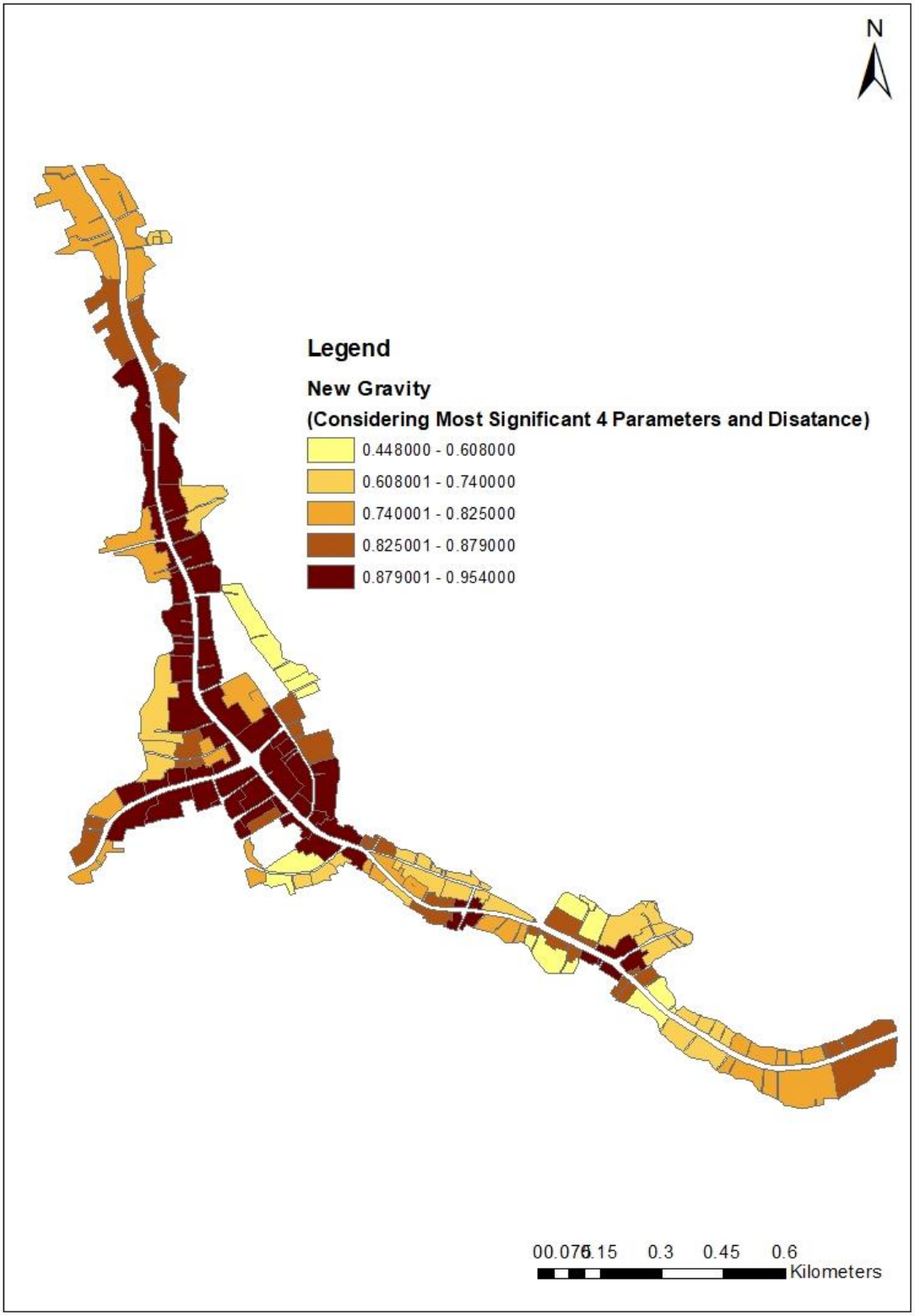

Figure 4. 12 Final Gravity (Derived from most significant 4 parameters and the Distance gravity)

4.15 Validity checking of the developed model

For the validity checking of the developed model and the result of each segment taken 20 most attractive segments of the study area and checked the percentage of successful establishments taken from the initial sample survey done in this study.

Here it has been calculated the probability or the level of attraction based on 10 most correlated parameters and then based on the most significant 4 parameters found in the regression analysis. Table 4.8 Shows the results of 20 most attractive segments and 20 most unattractive segments for these two ways.

Table 4. 7 Successful level comparisons

	Total Study area	20 Most attractive Segments		Balance 69 Segments		20 Most unattractive segments	
		10 Parameters	4 Parameters	10 Parameters	4 Parameters	10 Parameters	4 Parameters
Number of establishments (sample)	200	48	63	124	121	28	16
Success establishments in the sample	150	36	50	96	91	18	9
Unsuccessful establishments in the sample	50	12	13	28	30	10	07
Success percentage	75%	75%	**79%**	77%	75%	64%	56%

First considered the formula developed from the most correlated 10 parameters. Then the most attractive 20 segments consist of 48 numbers of establishments in the sample

and among them 36 are successful as a percentage, 75% establishments are successful ones (Figure 4.14). All 124 balancing segments showing only 75% success (Table4.8). On the other hand if we take the **20 most unattractive** segments selected by the developed model it shows only a 64% of the samples are success retail establishments. In the total study area consists of 200 samples and 150 were successful retail establishments and as a percentage 75% are successful (Table4.8).

Secondly considered the formula developed from the most Significant 4 parameters. Then the most attractive 20 segments consist of 63 numbers of establishments in the sample and among them 50 are successful as a percentage, 79% establishments are successful ones (Figure 4.14). All 121 balancing segments showing only 75% success (Table4.8). On the other hand if we take the **20 most unattractive** segments selected by the developed model it shows only a 56% of the samples are success retail establishments.

As the Successful percentage of the second model (79%) higher than the first model the model developed by removing insignificant variables identified by regression analysis can be taken as the accurate model for the study.

Finally it can be concluded that the model and the methodology adapted in this study is valid as sample data proves that establishments within the derived most attractive areas are more successful than that of the average level of successfulness.

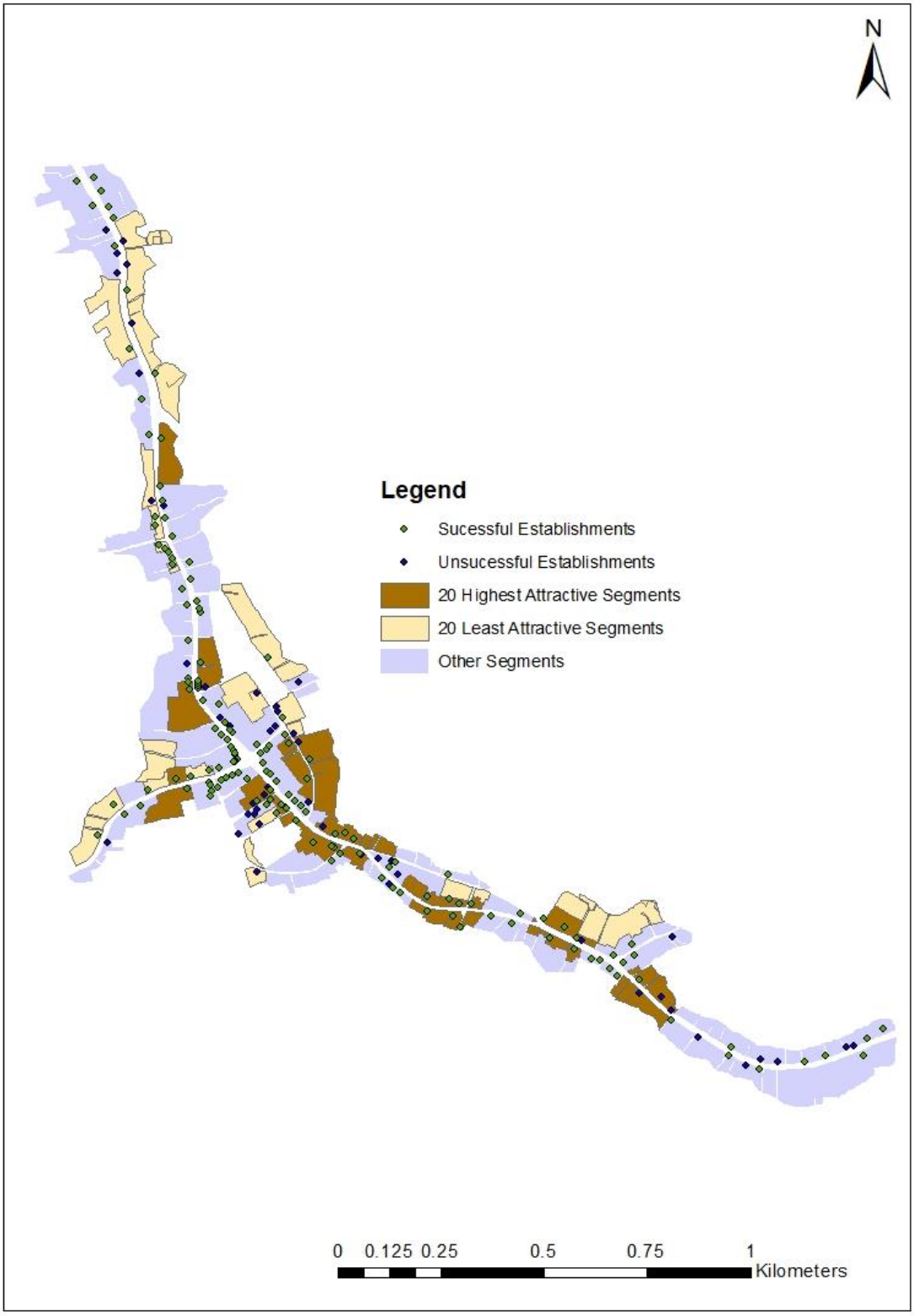

Figure 4. 113 Sample establishments in the Twenty Most attractive segments considering most correlated 10 parameters

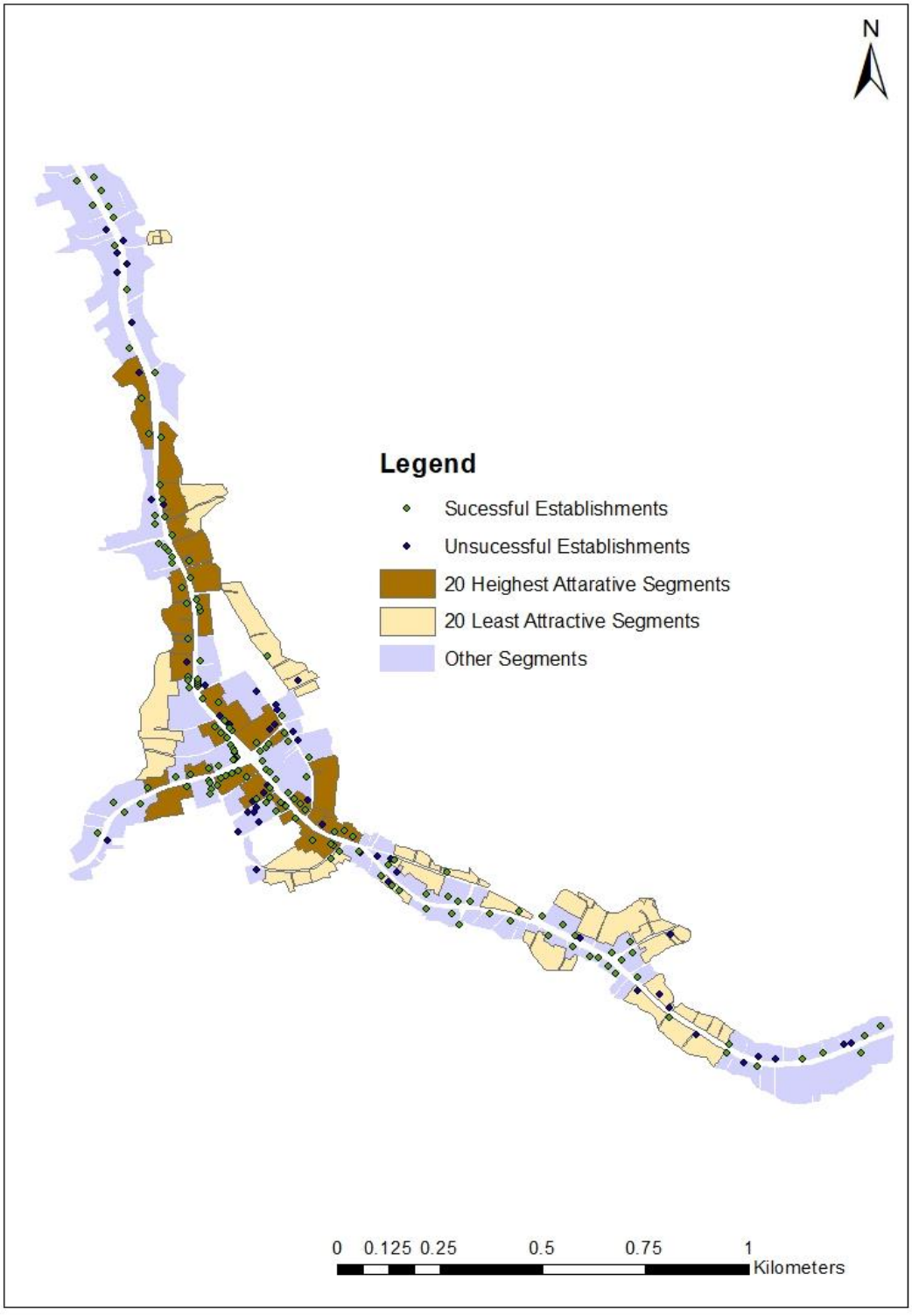

Figure 4. 12**4** Sample establishments in the Twenty Most attractive segments considering most Significant 4 parameters

4.16 Possible applications of the model

The ultimate objective of this study is to develop a modeling framework for planners to make decisions in identifying most suitable areas to zone as retail zones. i.e commercial zone of small towns addressed in this study. Using the final gravity Figure 4.13 above they can easily get an idea about what are the segments that can be zone as retail. Meantime retail investors also can use this in deciding on where to put their business in the town.

On the other hand for the planners they can use this one by one scale value changes in the independent variables when all other independent variables are kept unchanged and check the changes in gravity levels of the retail segments.

As examples

- Bus halts location changes
- Apply land pooling (amalgamations) to increase frontage and lot size variables
- Introducing new roads and links to improve accessibility
- Improve built form
- Providing more parking

Those changes can be applied to the model and can be examine how the gravity levels are changing in the segments.

For example, Segment 47 located closer to the town center and the gravity of it is only **0.505** according to the developed model. The existing situation of the segment the scale values of most variables are getting average level values. (i.e Distance to bus halt – 3, Pedestrian Movement – 3, Parking – 2, and Built form – 1) For the increasing of attractiveness of this segment it is difficult to change the first three parameters but the Built form of the segment can be increased by applying some kind of planning intervention. Planners can introduce some fazard improvement project and increased scale value of the built form up to 5. Then the resultant probability (retail gravity) will be increasing up to **0.808** (Table 4.9)

Table 4. 8 Applications of the model

Segment Number	Most correlated 10 parameters										Probability (Parameter based)	Probability (Distance based)	Retail gravity
		Bus halt	Pedestrian	Parking			Built Form						
47		3	3	2			1				0.587	0.862	0.505
New 47		3	3	2			5				0.938	0.862	**0.808**

The usefulness of the model will be the planners can check the validity of the proposed developments before implementing them.

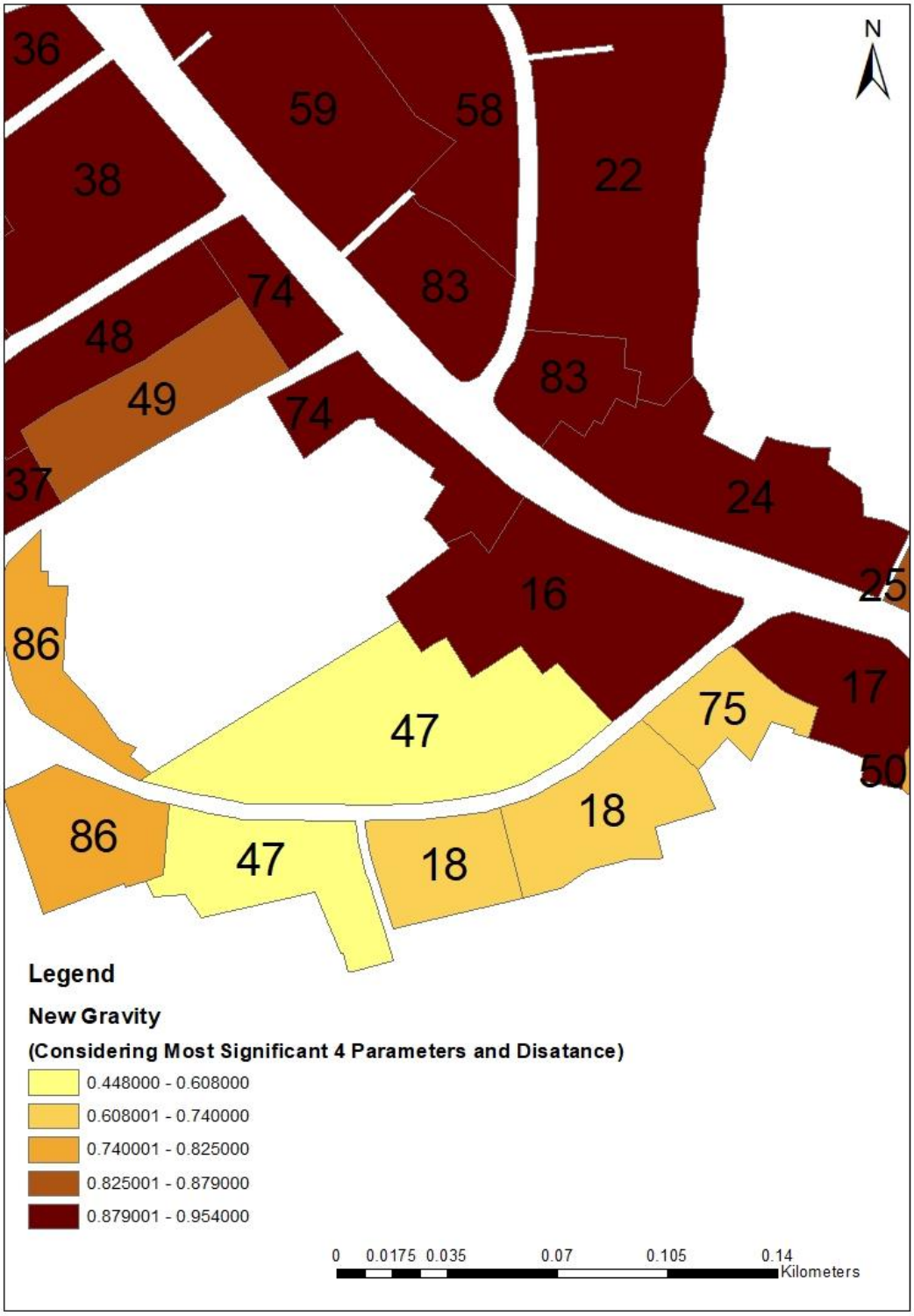

Figure 4. 135 Gravity in the segments Close to town center

CHAPTER FIVE

CONCLUTION AND RECOMENDATIONS

5.1 Conclusion

As emphasized at the beginning of the study commercial activities are the most dynamic and evolving function of towns and closely relate with the economy of them. Most of the small towns in Sri Lanka had been originated and evolving **t**o provide services for the residential area around them. The majority of such services fall under retail category. In most of such towns similar kind of retail commercial activities are formed and functioned.

For the functional efficiency those activities need to be located correctly in a town. In practice locating those activities are not based on informed decision making. Mostly those decisions are taken by individual investors based on their knowledge and observations. Despite of this situation of the retail investors on the other hand planners also not having an applicable tool in deciding on locating of those retail activities. Land use zoning is the popular tool applying in Sri Lankan urban development planning context. Hence the Planners should zone retail activities in planning those cities in functionally efficient manner.

There is a criticism in current zoning in urban development plans that they are effectively divorced from economic planning and does not support generation of wealth *(ADB, 2009).* Addressing this in one aspect, its need to put right areas in to the right zone in supporting economic development.

Lacking of methodology in decision making in retail location for planners and for the retail investors was taken as the problem of this study. Then the study focused on developing a modeling framework to identify the most attractive areas in a town for retail activities. The outcome of the model is useful for the planners in identifying suitable retail areas for zoning and for other planning interventions and it would also be beneficial for the retail investors too as described in the chapter 04.

5.1.1 Key findings of the study

Through the literature surveys first identified **what are the parameters affecting on successfulness of a retail establishment** in a Sri Lankan service center type small town.

Survey done in the study area and developed a database for 200 sample regarding the **successfulness and the level of availability of the parameters**.

The study area divided in to segments and another database developed for the availability of the parameters of each segment.

Correlation analysis were done to find out what are the **most correlated parameters** with successfulness.

Using those most correlated parameters a formula **developed for the successfulness** by doing a regression analysis.

Using the above formula **probability of being successful** were calculated for each segment.

Then the probability of being success of each segment also calculated based on the distance from consumers using Huff model in arc GIS.

Final level of attraction of each segment calculated multiplying those two probabilities.

Then removing insignificant parameters identified in the regression analysis new formula were developed and done the regression analysis and follow the same procedure again. This was taken as the final outcome of the research.

The Validity of the developed model evaluated by discussing the successfulness of the establishments taken in to the sample survey within the most attractive and least attractive segments.

Possible applications of the model in relation to the objectives of the study were also discussed in chapter 04. **Validity of planning interventions can be checked before implementing them** by applying them in to the model and observing the changes in the attractiveness level.

Planners can use this in zoning retail areas and one of another advantage of this model is that it **gives exact boundaries for the retail zones** as it taken the retail segments trough the prominent boundaries. This benefit can't be get from the raster analysis (suitability analysis) described in the literature review.

5.2 Recommendations & Limitations

This research is done individually and due to time and capacity limitations many limitations can be identified. Based on these limitations it gives some suggestions for further researches.

The study area of this Research will be limited only to the Piliyandala town center or the existing dense commercial area. The entire urban area will not be considered because of the time limitation & the field survey was difficult to manage. The attractiveness for the retail activities studied for the dense area of the town taken from a raster analysis. There is possibility for the changes in the attractiveness levels when the study area expands.

The successful or not, decision at the survey was taken by the ideas of the retailer and his customers coupled with researchers observation and knowledge obtained in the research activities. This decision is debatable since it influencing on the final output of the model.

Parameters for retail attractiveness were identified through the literature then the Scales and the values for them were assigned based on the observations of the researcher. This parameter identification and the scaling can be another research area to be addressed.

Retail catchment of the Piliyandala town taken as the Kesbewa Urban Council area but the actual catchments is going beyond that as some parts of the Urban Council area does not come to Piliyandala for retail activities they may be attract by other towns close by.

In the validity checking it used the sample data taken for the initial survey; it can be done for the all establishments within most attractive segments. And also it can be conducted same study in a similar type another town for the compressions and for

validity checking further. Again for the time and capacity limitations that part was not done in this study.

There many other competitive land uses that can be zoned for them in the same area were not considered in this study. Ex. Institutional Zones, Recreational zones etc.

Based on this study applying the methodology adapted, it can be recommended to conduct a research for a town to prepare a total zoning plan (with all possible zones). Same methodology to calculate the attraction probability can be adopted for all other prominent land users. Then based on the attraction for each use a comprehensive zoning plan with exact boundaries can be developed.

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APPENDIXES

Appendix 1 Scale values of the parameters

	Parameter		Scale
1	**Accessibility**		
	Only pedestrian access		5
	1 Lane road		4
	2 lane Road		3
	4 lane Road		2
2	**Distance to Bus Halt/ Public mode (Meters)**		
	0 - 50		5
	51 - 100		4
	101 - 200		3
	201 - 300		2
	301 - 400		1
	> 400		0
3	**Clustering (Number of equal establishments within 100 m)**		
	0		0
	1 - 2		2
	3 - 5		4
	> 5		5
4	**Lot size, Perches**		
	< 1		0
	1 - 2		1
	3 - 5		2
	6 - 10		3
	> 11		5
	Parameter		
5	**Frontage Meters**		
	>1		0
	1 - 5		2
	6 - 10		4
	> 11		5
6	**Floor Area sqm**		
	>25		1
	25-100		2
	100-200		3
	>500		5

7	**Pedestrian Movements in front of the shop**		**Scale**
	Very less		0
	Less		1
	Fair		2
	High		4
	Very high		5
8	**Availability of onsite parking No of lots**		
	No space for parking		0
	1 - 2		1
	3 - 5		2
	6 - 10		4
	> 11		5
9	**Land suitability**		
	Yes		5
	No		0
	Parameter		
10	**Infrastructure availability (Water)**		
	Yes		5
	No		0
11	**Infrastructure availability (Electricity)**		
	Yes		5
	No		0
12	**Visibility to public areas**		
	Week		0
	Fair		1
	Moderate		2
	Good		4
	Very good		5
	Parameter		
13	**Floor level**		
	Ground		5
	First		2
	Second		1
	Third and Above		0

14	**Closeness to town center (Meters)**		**Scale**
	0 - 50		5
	51 - 100		4
	101 - 200		3
	201 - 300		2
	301 - 400		1
	> 400		0
	Parameter		
15	**Closeness to core activities of the town**		
	Ds office, LA, Bus stand, Police station, Hospital		
	No such activities within 400 m		0
	Yes ,distance over 300m		1
	Yes ,distance over 200m		2
	Yes ,distance over 100m		3
	Yes within 100m		5
16	**Attractiveness of the built form**		
	Unattractive		0
	Fair		1
	Good		3
	Very good		5
17	**Availability of public car park**		
	Not within 400 m		0
	Yes ,distance over 300m		1
	Yes ,distance over 200m		2
	Yes ,distance over 100m		3
	Yes within 100m		5

Appendix 2 Sample Survey Database

#		Name	Sucess_fai	Access	Bushault	Cluster	Lotsize	Frontage	F_Area	Pedestrian	Parking	Landsuit	Infra_Elec	Infra_Wate	Visibility	F_Level	D_to_Cente	D_to_Co_A	Builtform	P_parking
1	1	Upul Hotel	0	2	2	4	1	2	1	2	0	5	5	5	2	5	3	3	1	3
2	5	Dharmarathne Optcians	0	3	3	2	1	2	1	2	0	5	5	5	5	5	4	5	1	3
3	6	Samsung Shanghai	0	2	3	5	2	2	2	2	2	5	5	5	2	5	5	5	5	3
4	2	Deepthi Textile	0	3	3	4	1	2	1	2	0	5	5	5	2	5	5	5	1	3
5	2	Nethmi Shoe point	1	3	5	5	1	2	1	2	0	5	5	5	2	2	5	5	3	3
6	6	Cell Mart Mobilr	0	3	5	5	0	2	1	2	0	5	5	5	2	5	5	5	1	3
7	4	Sarasavi Book Shop	1	2	5	5	3	4	3	5	0	5	5	5	2	5	5	5	5	3
8	6	Olanka Computers	0	1	4	5	5	4	5	4	0	5	5	5	2	5	4	5	3	3
9	5	I G Pool palar	0	2	5	5	3	2	3	4	0	5	5	5	1	2	5	5	3	3
10	2	J M W Shoes	1	3	5	5	3	4	3	4	2	5	5	5	5	5	5	5	3	5
11	6	Syrix Computers	1	3	5	5	5	4	5	2	2	5	5	5	5	5	5	5	3	3
12	8	Sarasi communication , Stu	0	3	5	5	2	2	2	2	0	5	5	5	5	5	5	5	1	3
13	1	U PCool spot	1	3	5	5	3	2	3	4	2	5	5	5	5	5	5	5	1	3
14	1	Yellow favour hotel	1	5	4	4	2	2	2	4	4	5	5	5	5	5	5	5	3	3
15	4	Sanwa Communication	0	3	4	5	0	0	1	2	1	5	5	5	4	5	5	5	1	3
16	6	H A Trade center , electric	1	3	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
17	1	New Isusru Codds center	1	3	3	4	3	2	3	5	0	5	5	5	5	5	5	5	3	3
18	6	Sanadamini Mobile	1	3	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
19	1	Green Harvest	0	3	4	4	2	2	2	4	0	5	5	5	5	5	5	5	0	3
20	4	Sarasi Communication	1	5	3	2	1	4	1	5	0	5	5	5	5	5	5	5	0	3
21	8	Sarasi Studio	1	5	3	0	1	2	1	5	0	5	5	5	5	5	5	5	3	3
22	3	Santech Computer solution	0	5	3	2	0	4	1	5	1	5	5	5	4	2	5	5	5	3
23	5	Saloon Beauty gedara	1	5	3	2	2	4	2	5	1	5	5	5	5	5	5	5	5	3
24	6	Hiran Enterprises Hardwar	0	5	3	2	5	4	5	5	4	5	5	5	5	5	5	5	1	3
25	1	Singer Homes	1	5	3	4	5	4	5	5	4	5	5	5	4	5	5	5	5	3
26	3	Gamini Motorcysle spares	1	5	3	4	5	4	5	5	2	5	5	5	5	5	5	5	5	3
27	5	Chathurika Saloon	0	3	3	2	0	2	1	2	0	5	5	5	2	5	4	5	1	3
28	1	Willsons super foods	1	5	3	4	3	4	3	5	2	5	5	5	5	5	4	5	5	3
29	3	Ranil Audio and Buffel sho	1	5	3	0	3	4	3	5	4	5	5	5	5	5	4	5	3	2
30	1	New Piliyandala stores	1	5	4	2	5	4	5	5	2	5	5	5	5	5	4	5	3	2
31	1	Sri Sai Bhawav Restaurant	1	5	4	2	1	4	1	4	1	5	5	5	5	5	4	5	5	2
32	6	Siripiyasa tiles	1	5	4	4	2	4	2	4	0	5	5	5	5	5	4	3	3	2
33	1	Lionco Hospitality	1	5	4	4	5	4	5	4	4	5	5	5	5	5	4	3	5	2
34	6	elegant Homes Piliyandala	1	5	4	4	5	5	5	4	2	5	5	5	5	5	3	3	3	2
35	3	Kathriarachchi Motors	1	5	3	2	3	4	3	4	4	5	5	5	5	5	3	3	5	2
36	2	Liyakara Fashion house	1	5	3	2	1	2	1	4	0	5	5	5	5	5	5	3	3	2
37	1	Cargills food city	1	5	3	2	5	4	5	4	5	5	5	5	5	5	3	3	3	2
38	3	Auto Radiator one	1	5	4	2	1	2	1	2	1	5	5	5	5	5	1	1	3	1
39	6	Rasika Granite center	0	5	3	2	1	2	1	2	0	5	5	5	5	5	1	1	3	1
40	4	Telepoint (Communication	1	5	3	2	1	2	1	2	1	5	5	5	5	5	2	2	3	1
41	1	Mini retail shop	0	5	3	4	1	2	1	2	1	5	5	5	5	5	2	2	1	1
42	6	Cenesco Furniture	0	5	5	0	5	5	5	4	0	5	5	5	5	5	2	2	1	1
43	2	Sampath Jacketenter	1	5	5	2	1	2	1	4	1	5	5	5	5	5	2	2	5	1
44	3	Every cool auto AC	0	5	5	4	1	2	1	4	0	5	5	5	5	5	2	2	5	1
45	3	Rathna Iron works	1	1	4	2	1	2	1	2	0	5	5	5	2	5	2	2	3	1
46	6	Salpila Enterprises Intelocl	1	5	4	2	3	2	3	2	1	5	5	5	5	5	2	2	3	1
47	1	Oshani Grovery	0	5	3	2	0	2	1	2	0	5	5	5	5	5	3	3	5	1
48	3	Sampath Auto parts	1	5	3	4	5	4	5	2	4	5	5	5	5	5	3	3	3	2
49	3	Ranjith Bicysle sales & Re	1	5	5	2	5	5	5	2	2	5	5	5	5	5	3	3	5	2
50	2	Lihini Fashion Tailers	1	5	5	2	5	4	5	4	2	5	5	5	5	5	3	3	5	2

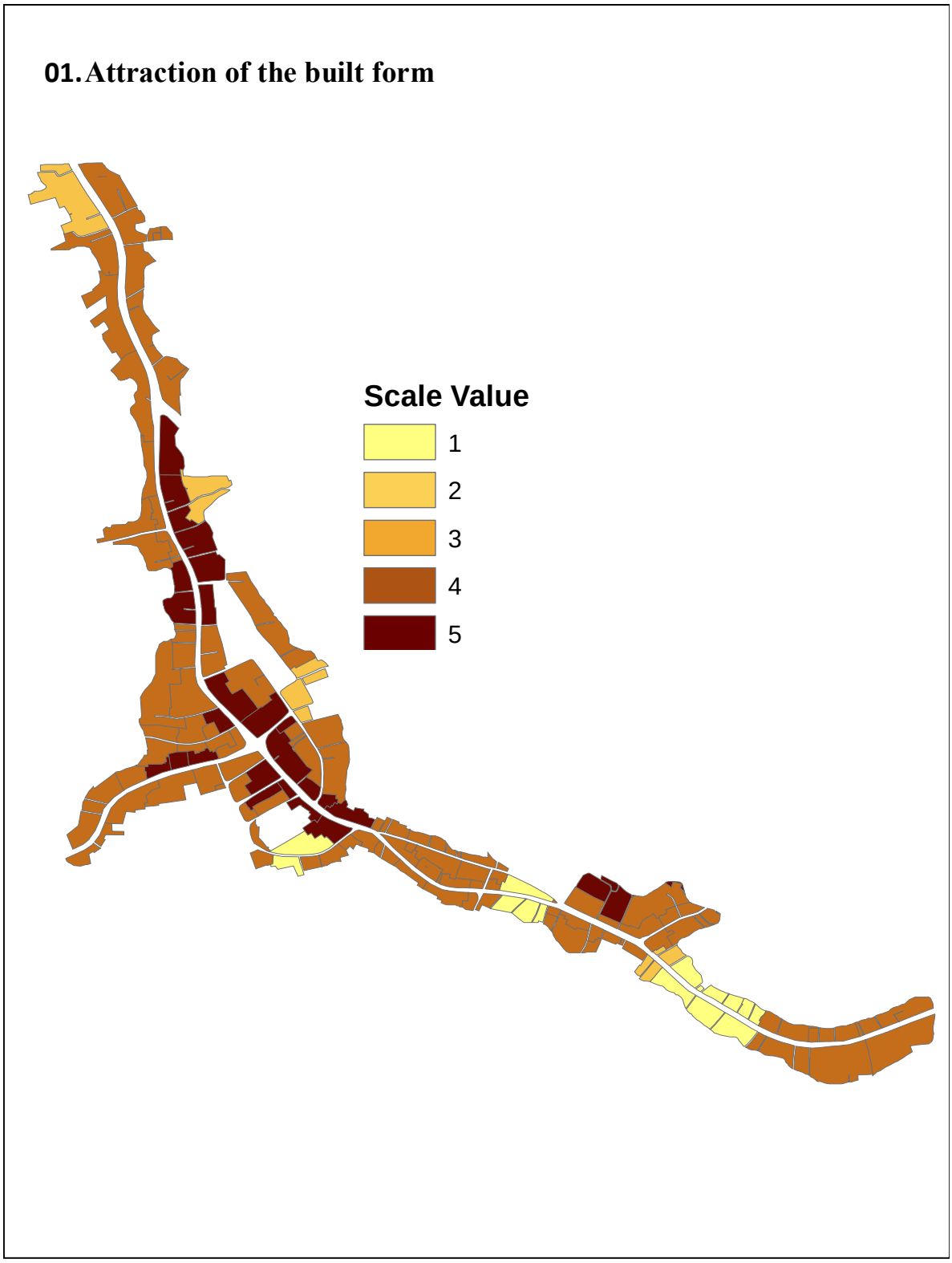
#	Retail_Cat	Name	Sucess_fai	Access	Bushault	Cluster	Lotsize	Frontage	F_Area	Pedestrian	Parking	Landsuit	Infra_Elec	Infra_Wate	Visibility	F_Level	D_to_Cente	D_to_Co_A	Builtform	P_parking
51	1	Ever Choise Restauranr	1	5	5	2	5	4	5	4	4	5	5	5	5	5	3	3	5	2
52	2	Pahasara Pirikara	1	5	5	2	3	4	3	4	4	5	5	5	5	5	3	3	5	2
53	5	Kiran kSaloon	1	5	5	2	5	5	5	4	4	5	5	5	5	5	3	3	5	2
54	3	Dilanka Enterprises	1	5	4	0	5	4	5	4	4	5	5	5	5	5	4	5	3	2
55	6	Siyasa Bathware	1	5	4	5	3	4	3	4	0	5	5	5	5	5	3	3	5	2
56	6	Sunethra Electronics	1	5	3	4	5	4	5	4	1	5	5	5	5	5	3	3	5	2
57	3	A M Leather	1	5	4	0	1	2	1	4	1	5	5	5	5	5	3	3	3	2
58	6	Sithijaya Ceramic	1	5	4	4	5	4	5	4	2	5	5	5	5	5	3	3	3	2
59	3	Sisenndrs Rifrigerator	0	5	3	0	1	2	1	2	1	5	5	5	5	5	2	2	1	1
60	6	Supun Lee weladasala	1	5	2	0	5	4	5	4	2	5	5	5	5	5	2	2	3	1
61	3	Dewmini Threewheel serv	1	5	2	0	5	4	5	2	4	5	5	5	5	5	2	2	3	1
62	1	N.P.Golden Grain	1	5	5	0	5	4	5	2	4	5	5	5	5	5	2	2	5	1
63	3	W S Motors	1	5	3	4	2	2	2	2	1	5	5	5	5	5	2	1	3	1
64	3	Laksiri Refrigerators	0	5	3	2	3	2	3	2	1	5	5	5	5	5	2	2	3	1
65	1	Pussella Meat shop	1	5	3	0	3	4	3	2	2	5	5	5	5	5	1	1	3	0
66	1	Pubudu Grocerry	0	5	3	2	1	2	1	2	0	5	5	5	5	5	1	1	3	0
67	2	Imoa Fashion	0	5	4	0	1	2	1	2	1	5	5	5	5	5	1	1	3	0
68	6	Wedage Wood products	1	5	4	2	2	2	2	2	1	5	5	5	5	5	1	1	3	1
69	7	Pots and plants	1	5	5	0	5	5	5	2	2	5	5	5	5	5	1	1	5	1
70	6	Harith paint center	1	5	5	2	5	4	5	2	2	5	5	5	5	5	1	1	3	1
71	1	Deshan super market	1	5	5	2	5	5	5	4	4	5	5	5	5	5	1	1	3	1
72	5	Piliyandala Pharmacy	1	5	4	4	1	2	1	5	0	5	5	5	5	5	5	5	3	5
73	2	Fashion Wear	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
74	1	Ranmadiya Jewwllers	1	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
75	1	Cream House hotel	1	5	5	2	2	2	2	5	0	5	5	5	5	5	5	5	3	3
76	3	S T D Enterprises	1	5	3	4	3	4	3	4	1	5	5	5	5	5	4	5	3	2
77	1	Prasad Grocery	0	5	3	4	3	2	3	2	2	5	5	5	5	5	4	5	3	3
78	6	Janatha Ceramic	1	5	3	4	3	2	3	4	1	5	5	5	5	5	4	5	3	3
79	6	M N Electricals	1	5	3	4	2	2	2	4	0	5	5	5	5	5	4	5	3	3
80	1	Susiko Bakers	1	5	3	4	2	2	2	4	2	5	5	5	5	5	4	5	3	3
81	6	Jayaloka Electricals	1	5	4	4	3	4	3	5	2	5	5	5	5	5	5	5	5	3
82	6	New Ranjith Cycle	1	5	4	2	5	4	5	5	2	5	5	5	5	5	5	5	3	3
83	5	Oselka Pharmacy	1	5	4	4	3	4	3	5	2	5	5	5	5	5	5	5	5	3
84	5	Bridal saloon	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
85	1	Dynamic Food	1	5	4	5	2	2	2	5	0	5	5	5	5	5	5	5	3	3
86	2	Sale corner Textile	1	5	4	4	1	2	1	5	0	5	5	5	5	2	5	5	3	3
87	1	Little lion	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
88	6	Shimmer Electricals	1	5	4	5	2	2	2	5	0	5	5	5	5	5	5	5	3	3
89	5	Maya Saloon	1	5	4	5	1	2	1	5	0	5	5	5	5	5	2	5	3	3
90	4	Bell Communication	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
91	6	Lakmini Jewllers	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	3
92	2	Class Selection Textiles	1	5	5	5	1	2	1	2	0	5	5	5	5	2	5	5	3	5
93	5	Ran Med Phamacy	1	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
94	6	Rasika Trade centre , Elect	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
95	5	Royal Pharmacy	1	5	4	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
96	2	M O B Fashion	0	3	4	5	2	2	2	4	0	5	5	5	5	5	5	5	0	3
97	1	Kanchani tradecenter groce	0	3	5	5	1	2	1	2	0	5	5	5	5	5	5	5	1	3
98	2	Maxies Shoes	1	3	5	4	1	2	1	2	0	5	5	5	5	5	5	5	3	3
99	4	Pawara bookshop	0	3	5	4	1	2	1	2	0	5	5	5	4	5	5	5	1	3
100	2	Nelum Textile	0	3	4	4	5	4	5	2	2	5	5	5	2	5	4	5	3	3

#	Retail_Cat	Name	Sucess_fai	Access	Bushault	Cluster	Lotsize	Frontage	F_Area	Pedestrian	Parking	Landsuit	Infra_Elec	Infra_Wate	Visibility	F_Level	D_to_Cente	D_to_Co_A	Builtform	P_parking
101	5	Medical Center Dr.	1	2	3	4	3	4	3	2	1	5	5	5	2	5	5	5	3	3
102	5	Dilanka Saloon	0	2	2	2	2	2	2	1	0	5	5	5	1	5	3	5	3	1
103	5	Suwasetha Aurveda	1	5	5	2	3	2	3	5	0	5	5	5	5	5	5	5	3	3
104	1	Royal Cafe	1	5	5	5	3	2	3	5	0	5	5	5	5	5	5	5	3	3
105	5	Dhama Mobile &	1	5	5	4	1	4	1	4	1	5	5	5	4	5	5	5	5	3
106	6	Singer	1	5	4	4	5	5	5	5	4	5	5	5	5	5	5	5	5	3
107	3	Panda Auto Traders	1	5	5	5	3	4	3	2	2	5	5	5	5	5	4	5	3	2
108	3	Ganganath Gass center	1	5	5	2	5	4	5	2	2	5	5	5	5	5	4	5	5	2
109	5	Aru Phamacy	1	5	4	4	5	4	5	4	2	5	5	5	5	5	5	5	5	3
110	1	Dinadi hotel	0	5	5	2	2	2	2	2	0	5	5	5	5	5	4	5	1	2
111	8	Rusara Creations Digital	1	5	4	2	5	5	5	4	4	5	5	5	5	5	5	5	5	2
112	3	Sakura International	1	5	4	2	1	5	1	4	5	5	5	5	5	5	5	5	5	3
113	1	Multi food and Muilty	1	5	5	5	2	2	2	5	0	5	5	5	5	5	5	5	3	3
114	2	Pabasara Textile	1	5	4	5	3	2	3	5	2	5	5	5	5	5	5	5	3	3
115	6	Rasika Trade center	1	5	5	5	5	4	5	5	0	5	5	5	5	5	5	5	5	3
116	7	Chamathka Aquarium	1	3	4	2	5	4	5	2	2	5	5	5	5	5	5	5	3	3
117	1	Hotel de Lalith	0	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	1	3
118	4	Prasad Book Shop	1	3	4	4	3	2	3	4	1	5	5	5	5	5	5	5	3	3
119	6	Chandula super	1	5	5	5	5	4	5	5	2	5	5	5	5	5	5	5	5	3
120	4	Minre Book shop	1	5	5	4	3	2	3	4	1	5	5	5	5	5	2	2	3	1
121	9	Raymen Master clearnes	1	5	3	2	3	2	3	4	2	5	5	5	5	5	4	5	5	3
122	1	Heladiwa Trade center	0	5	3	2	2	2	2	2	1	5	5	5	5	5	3	3	3	2
123	6	Sriyakanthi Furniture	1	5	3	2	5	4	5	2	4	5	5	5	5	5	5	5	3	2
124	3	Tyre Discount ltd	1	5	4	2	5	5	5	2	4	5	5	5	5	5	3	3	3	2
125	8	Star Ads printing	1	5	5	2	3	4	3	2	1	5	5	5	5	5	3	3	3	1
126	1	S D K Family	1	5	3	2	3	4	3	2	2	5	5	5	5	5	3	3	3	2
127	5	S.G.H.Helaosuhala	1	5	3	5	3	2	3	4	1	5	5	5	5	5	3	3	3	2
128	1	Bakers Hut	1	5	3	5	2	2	2	4	1	5	5	5	5	5	4	5	5	2
129	9	Thisari Saloon	0	5	3	4	1	2	1	1	0	5	5	5	2	2	4	5	3	2
130	2	Beasuty lovers	1	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	5	3
131	1	City Mobile	1	5	5	5	0	2	1	5	0	5	5	5	5	5	5	5	3	3
132	1	Wasana Bakers	1	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	1	3
133	4	Luminex book shop	1	5	5	5	2	2	2	5	0	5	5	5	5	5	5	5	3	3
134	1	Maxcity fancy	1	5	5	5	1	2	1	5	1	5	5	5	5	5	5	5	5	3
135	9	Lalsiri Furanal service	0	5	5	0	2	2	2	5	0	5	5	5	5	5	5	5	1	3
136	1	Niluka Jewllers	1	5	4	5	1	2	1	5	1	5	5	5	5	5	5	5	5	3
137	2	Helanka	1	5	4	5	5	5	5	5	4	5	5	5	5	5	4	5	5	3
138	1	Shanghai Chinese	1	5	4	5	1	2	1	5	1	5	5	5	5	5	4	5	3	3
139	8	Kushani Studio	0	5	5	2	0	2	1	4	0	5	5	5	5	5	4	5	1	2
140	3	Hiran motor traders	1	5	4	4	1	2	1	2	1	5	5	5	5	5	3	3	3	1
141	1	Susan electricals	0	5	4	2	5	4	5	2	2	5	5	5	5	5	5	5	5	1
142	9	Rathna Tailers	1	5	5	2	2	2	2	4	1	5	5	5	5	5	3	2	3	1
143	1	S.T Curtn	1	5	5	0	5	4	5	4	4	5	5	5	5	5	5	5	5	1
144	3	Dinushi tyre traders	1	5	4	2	1	2	1	2	1	5	5	5	5	5	2	2	1	1
145	1	Fish stall	1	5	5	0	0	2	1	2	0	5	5	5	5	5	3	2	1	1
146	8	Axis Advertising	1	5	5	0	1	2	1	2	1	5	5	5	5	5	1	1	3	1
147	1	Nihal Stores grocery	1	5	5	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
148	3	Sanchili Gringing mills	1	3	5	5	1	2	1	5	0	5	5	5	5	5	5	5	1	5
149	1	Delmo Chicken	1	3	5	5	1	2	1	5	0	5	5	5	5	5	5	5	3	5
150	1	Fish stalls	1	2	5	5	1	2	1	4	0	5	5	5	2	5	5	5	1	5

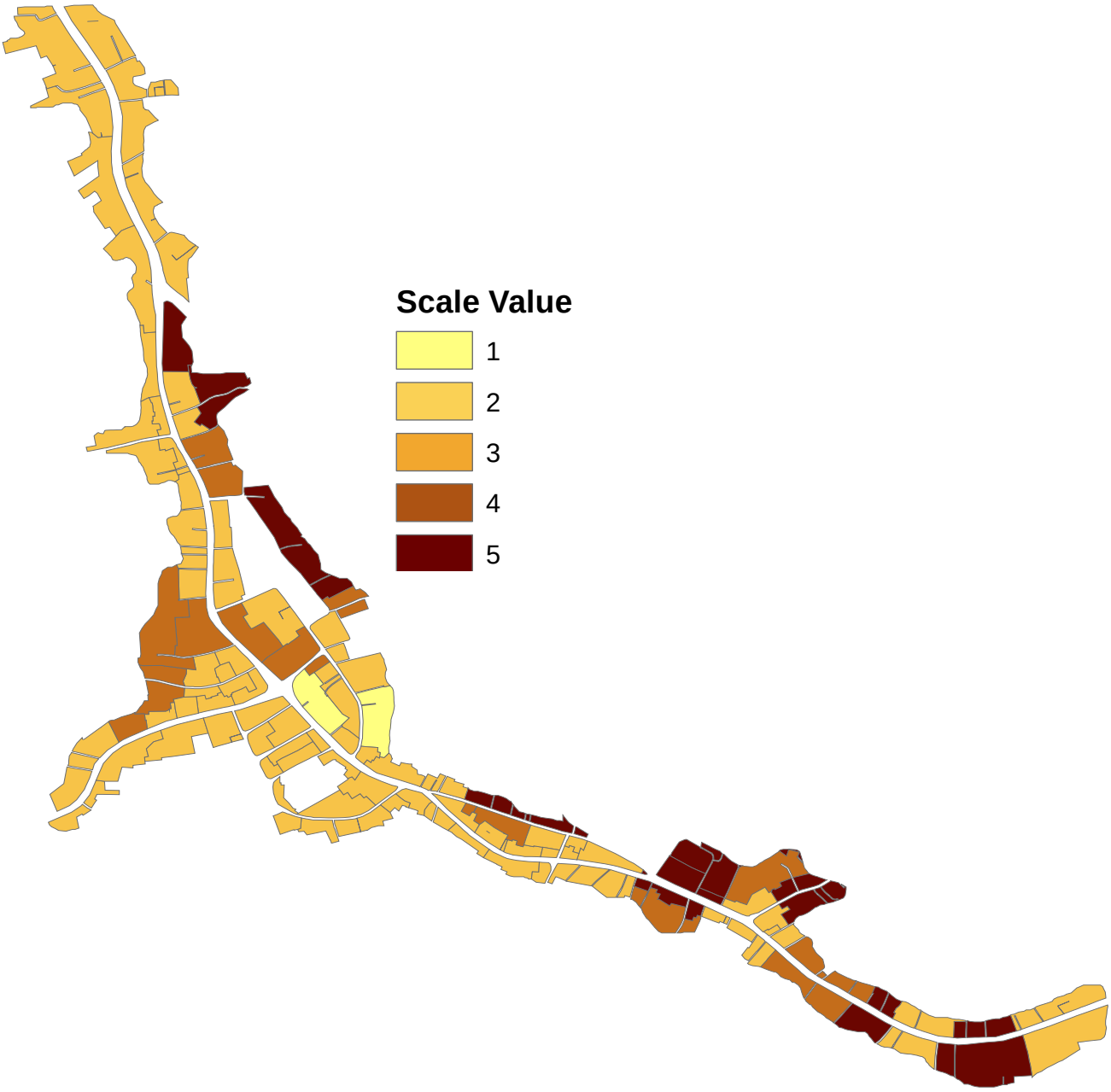
#	Retail_Cat	Name	Sucess_fai	Access	Bushault	Cluster	Lotsize	Frontage	F_Area	Pedestrian	Parking	Landsuit	Infra_Elec	Infra_Wate	Visibility	F_Level	D_to_Cente	D_to_Co_A	Builtform	P_parking
151	1	Bulath Kade	1	3	5	5	0	0	1	5	0	5	5	5	5	5	5	1	5	
152	1	Fruit stall	1	3	4	5	1	2	1	5	0	5	5	5	2	5	5	5	5	
153	3	Chanura Iron works	0	3	5	4	2	2	2	2	0	5	5	5	2	5	3	2	3	2
154	2	Samanala Bag center	1	3	5	4	2	2	2	2	1	5	5	5	2	5	3	3	3	2
155	6	Thanul Furniture Palace	1	3	3	2	5	5	5	2	2	5	5	5	2	5	2	2	5	1
156	1	Arpico super center	1	5	5	2	5	5	5	2	5	5	5	5	5	5	2	2	5	2
157	1	Keeth meat shop	1	5	5	5	2	2	2	2	1	5	5	5	4	5	5	5	5	1
158	1	Game kade	0	3	5	5	0	2	1	2	0	5	5	5	2	5	5	5	3	1
159	1	Sajini Pharmacy &	1	5	5	2	5	5	5	2	4	5	5	5	5	5	5	5	5	1
160	9	Sudath Tailors	1	5	5	4	3	4	3	2	1	5	5	5	5	5	2	2	3	1
161	6	Lanka Hardware	1	5	5	4	3	4	3	2	2	5	5	5	5	5	5	5	3	1
162	1	Sahana grocery	1	5	5	5	3	4	3	2	2	5	5	5	5	5	2	2	3	1
163	4	City Communication	1	5	5	5	5	4	5	4	1	5	5	5	5	5	2	2	1	1
164	1	K B H Bake house	1	5	5	4	3	2	3	2	1	5	5	5	5	5	2	2	3	1
165	6	Samarasinghe Wood sale	1	5	4	4	5	4	5	2	4	5	5	5	2	5	2	2	3	1
166	6	Prsad Harware	1	3	5	4	5	4	5	2	4	5	5	5	2	5	2	2	3	1
167	5	Anu Saloon	0	5	3	2	2	4	2	1	2	5	5	5	2	5	1	1	3	1
168	1	New Nipun Super	1	5	5	5	5	5	5	2	4	5	5	5	5	5	2	2	3	1
169	1	Supreen tea	0	5	4	2	1	2	1	2	0	5	5	5	5	5	2	2	3	1
170	1	Morawaka Hotel	1	5	4	4	3	4	3	2	1	5	5	5	5	5	2	2	3	1
171	1	Greenland Fodd center	0	5	3	2	2	2	2	2	2	5	5	5	5	5	1	1	3	0
172	1	Vegitable shop	0	5	2	2	2	2	2	2	1	5	5	5	5	5	1	1	1	1
173	3	Nico Tyre Center	1	5	3	2	3	4	3	2	2	5	5	5	5	5	1	1	3	1
174	1	Rizara Food cabin	0	5	5	2	2	2	2	1	0	5	5	5	5	5	1	1	3	1
175	1	9 to 9 Cake shop	1	5	3	0	1	2	1	2	0	5	5	5	5	5	5	5	3	1
176	4	Anil Book shop &	1	5	3	2	3	4	3	2	1	5	5	5	5	5	5	5	3	1
177	3	Hemachandra Electricals	1	5	4	4	2	2	2	2	2	5	5	5	5	5	1	1	3	1
178	4	Abimani book Shop	0	5	4	2	3	4	3	4	1	5	5	5	5	5	1	1	3	1
179	1	Sassir Froot shop	0	5	3	2	1	2	1	2	0	5	5	5	5	5	0	0	1	0
180	3	Jayantha Enterprises	1	5	5	4	5	5	5	2	2	5	5	5	5	5	1	1	5	1
181	3	Janaka motor works	0	5	4	2	0	2	1	2	0	5	5	5	5	5	1	1	0	1
182	6	Piliyandala Steel	1	5	3	2	5	5	5	2	4	5	5	5	5	5	1	1	3	1
183	1	Sameera Stores Grocery	1	5	4	4	2	2	2	2	0	5	5	5	5	5	1	1	1	1
184	8	Star sign Digital	1	5	3	2	5	5	5	2	1	5	5	5	5	5	1	1	3	1
185	1	Jayasingha stores	0	5	4	4	1	2	1	2	0	5	5	5	5	5	1	1	1	1
186	2	Sahana Enerprises	1	5	4	4	2	2	2	2	1	5	5	5	5	5	1	1	5	1
187	4	Royal Stationaries	0	5	4	2	1	2	1	2	0	5	5	5	5	5	1	1	1	1
188	6	Sameena Fancy items	1	5	5	5	2	2	2	5	0	5	5	5	5	5	5	5	5	5
189	6	New Fancy Point	1	5	5	5	2	2	2	5	0	5	5	5	4	5	5	5	5	3
190	5	Saloon (No name)	0	3	4	5	3	4	3	2	2	5	5	5	2	2	4	5	3	3
191	2	Fashion Point	0	3	5	5	2	2	2	2	0	5	5	5	2	2	4	5	3	3
192	2	Lady Center	1	5	5	5	3	2	3	5	0	5	5	5	5	5	5	5	5	3
193	2	Prsad Textiles	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3
194	6	Young Generation	0	5	5	5	2	2	2	5	0	5	5	5	4	2	5	5	3	3
195	6	CDI Ceramic	1	5	3	2	5	4	5	2	4	5	5	5	5	5	3	3	3	2
196	6	PC Sri Lanka	1	5	5	4	2	2	2	2	2	5	5	5	4	5	3	3	1	2
197	3	Ruwan Decel Center	1	5	3	4	5	4	5	2	5	5	5	5	2	5	3	3	3	2
198	1	Jubili Food Center	1	5	3	2	5	5	5	2	4	5	5	5	4	5	3	3	5	2
199	4	Aloka Communication	1	5	5	2	5	4	5	2	4	5	5	5	4	5	3	3	3	2
200	3	Saman Motor Traders	1	5	3	4	5	4	5	2	5	5	5	5	5	5	3	3	3	2

#	
Retail_Cat	Retail Category
Sucess_fai	Success or Unsuccessful
Access	Accessibility
Bushault	Distance to Bus Halt/ Public mode (Meters)
Cluster	Clustering (Number of equal establishments within 100 m)
Lotsize	Lot size, Perches
Frontage	Frontage
F_Area	Floor Area
Pedestrian	Pedestrian movements in front of the shop
Parking	Availability of onsite parking No of lots
Landsuit	Land suitability
Infra_Elec	Infrastructure availability (Electricity)
Infra_Wate	Infrastructure availability (Water)
Visibility	Visibility to public areas
F_Level	Floor level
D_to_Cente	Closeness to town center
D_to_Co_Ac	Closeness to core activities of the town
Built form	Attractiveness of the built form
P_parking	Distance to available public car park

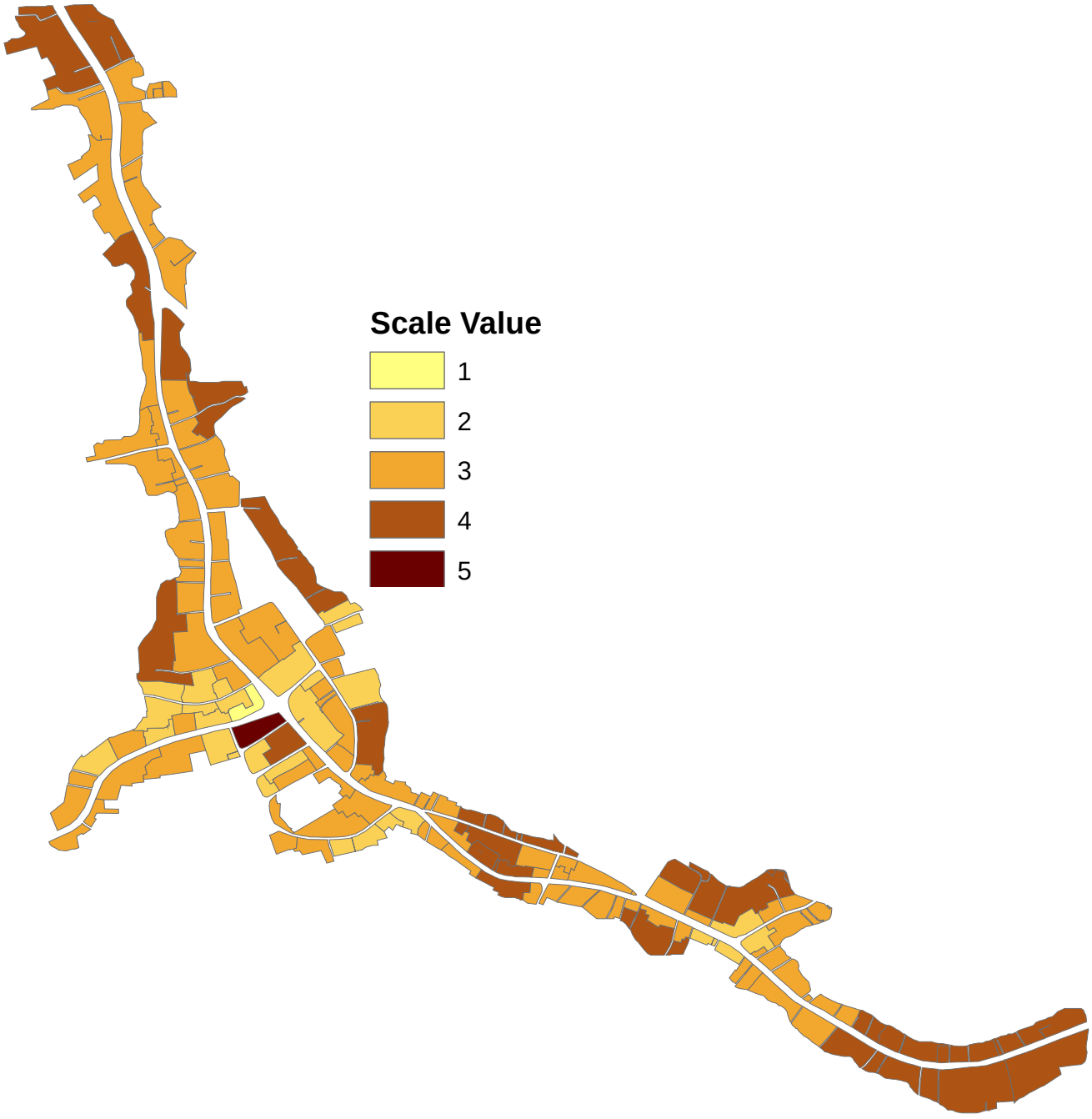
Appendix 3 Survey and evaluation of attractive parameters



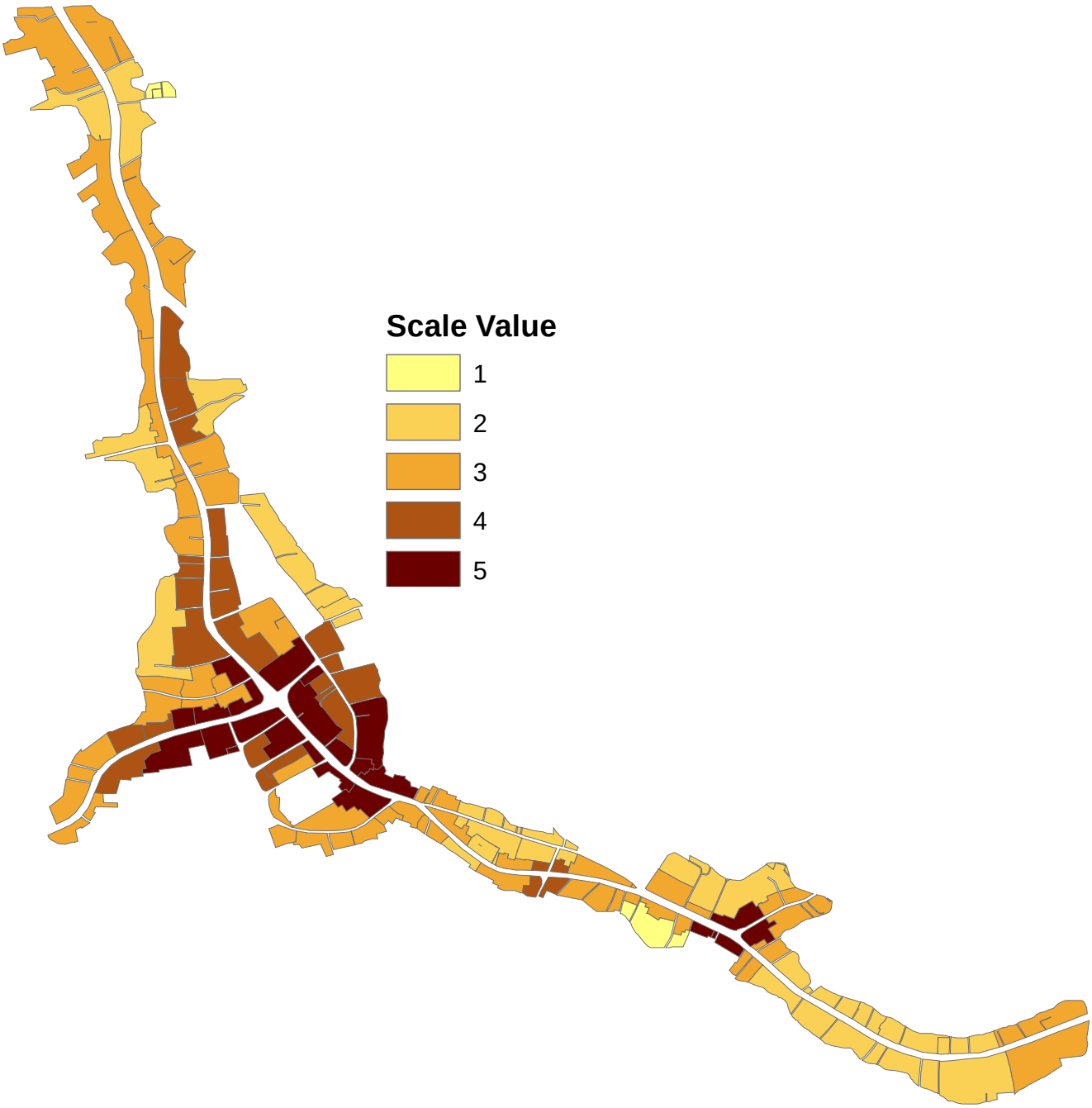
02. Frontage



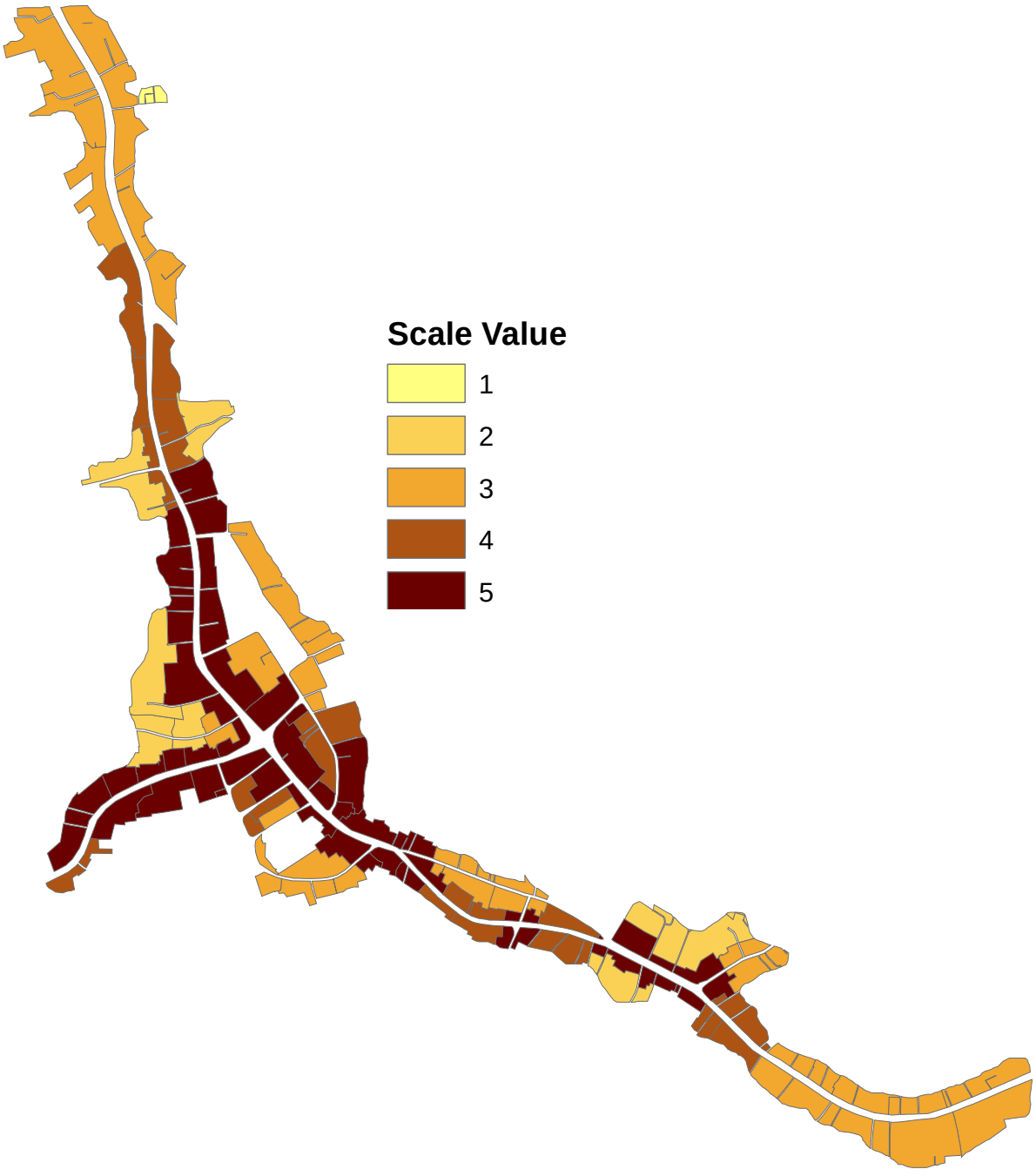
03. Availability of onsite parking



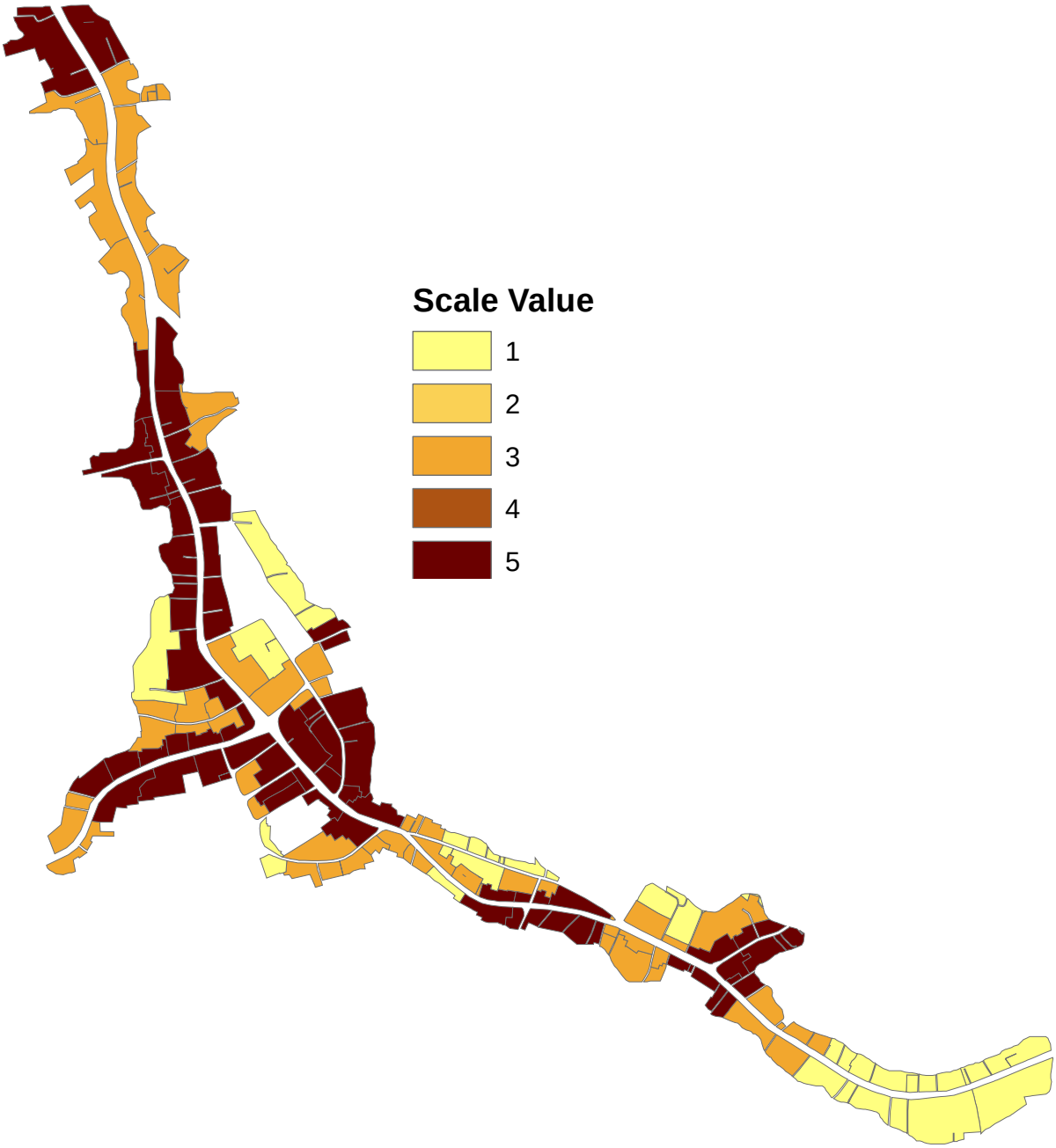
04. Pedestrian Movements



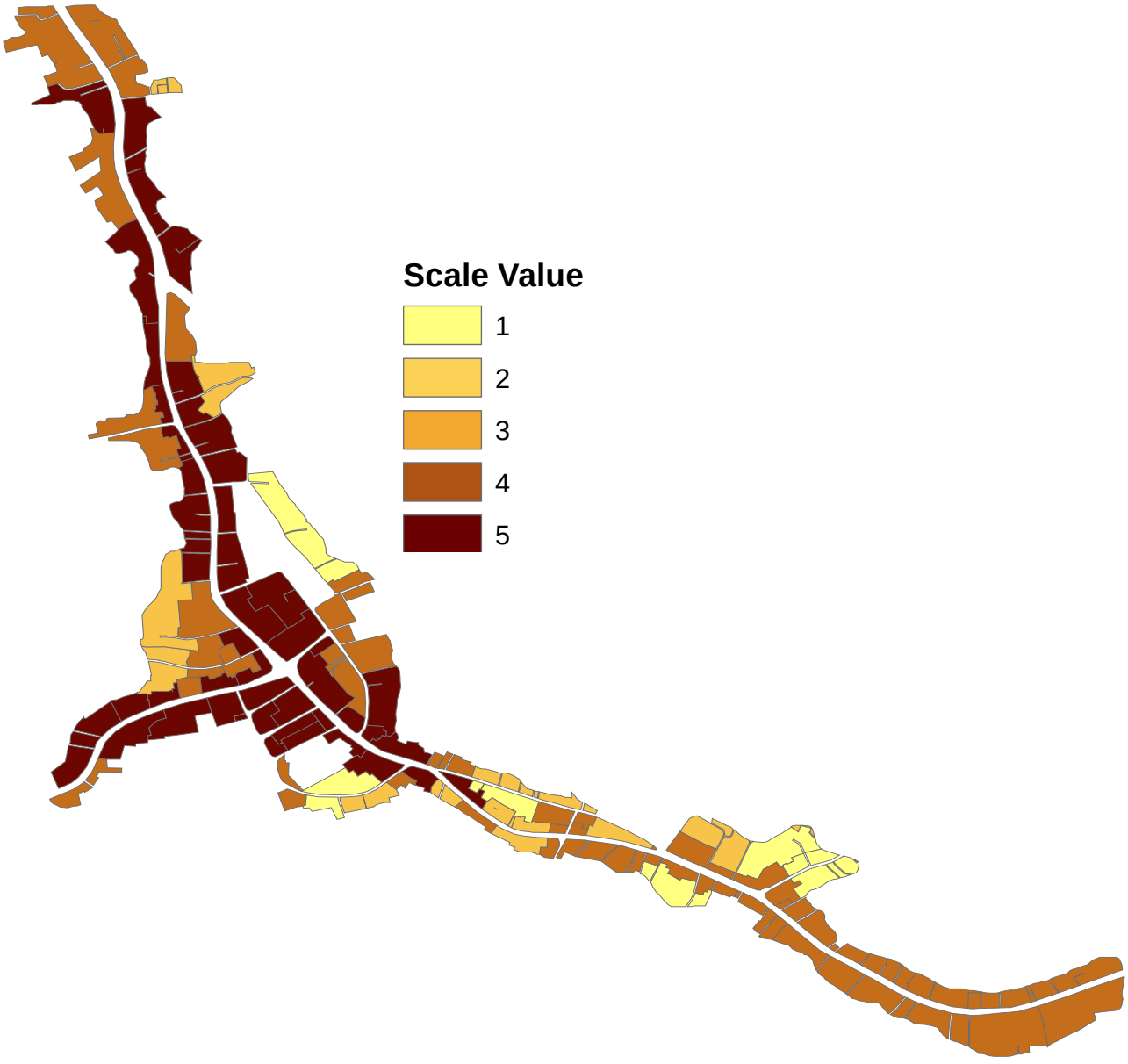
05. Visibility to public areas



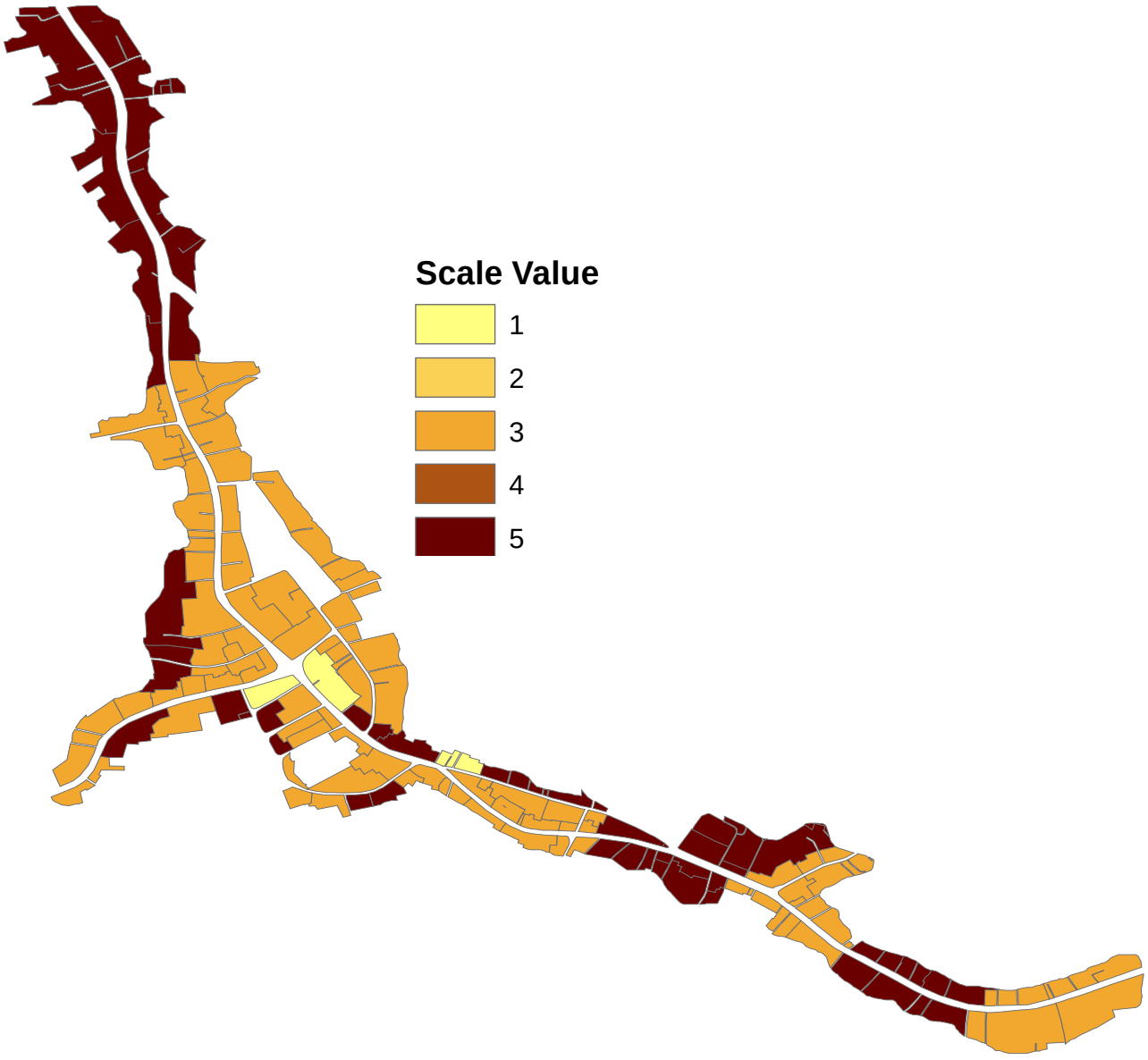
06. Distance to Bus Halt



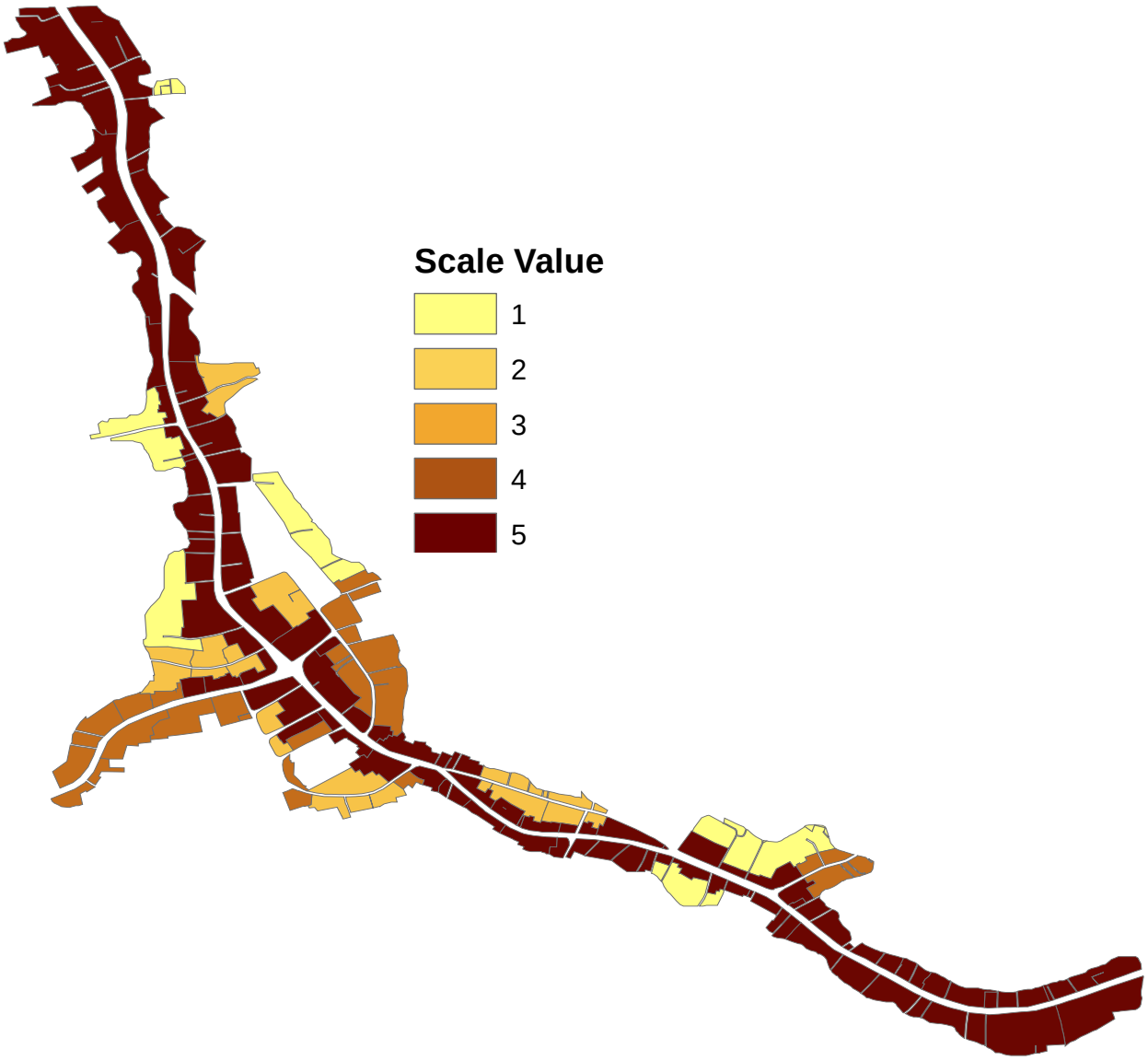
07. Floor Area



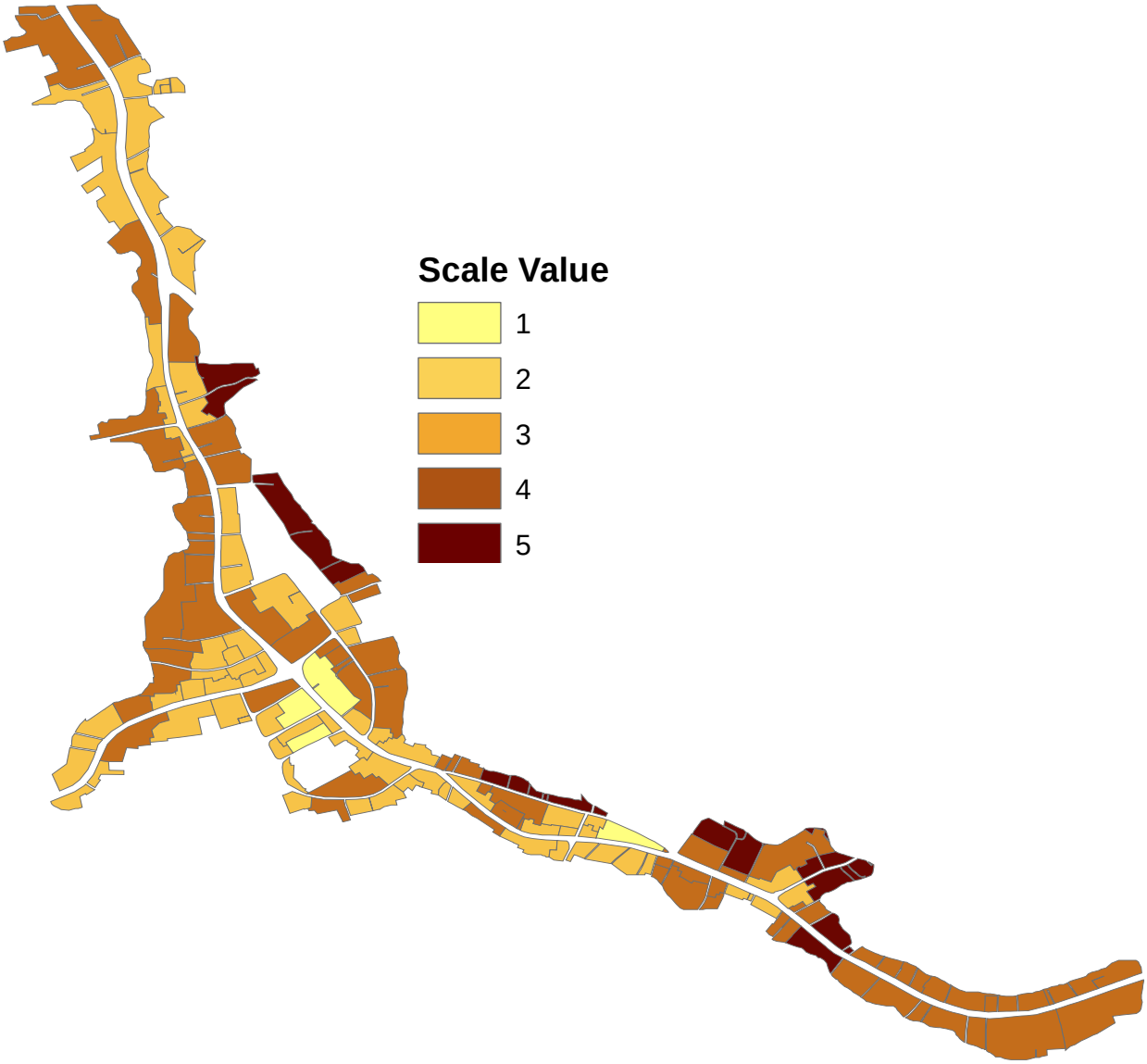
08. Floor level



09. Accessibility



10. Lot size



Appendix 4 Attraction probability Calculation

Segment Number	Most correlated 10 parameters										Most correlated 10 parameters				Most Significant 4 Parameters			
	Access	Bushault	Pedestriar	Parking	Visibility	F_Level	Built_form	Lot_size	Frontage	F_Area	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity
1	2	5	4	3	4	4	5	3	3	5	0.950	0.72112	0.9395	0.678	5.283	0.995	0.940	0.935
2	2	5	4	4	4	5	5	3	4	3	7.281	0.99931	0.9370	0.936	6.124	0.998	0.937	0.935
3	2	5	3	3	5	4	5	3	3	5	0.902	0.71136	0.9478	0.674	4.543	0.989	0.948	0.938
4	5	5	1	3	1	5	3	2	2	2	1.631	0.83631	0.9377	0.784	1.879	0.867	0.938	0.813
5	2	3	3	3	3	5	3	2	2	3	-0.691	0.33381	0.9276	0.310	2.375	0.915	0.928	0.849
6	2	5	3	3	4	5	3	2	2	5	-2.785	0.05814	0.9355	0.054	3.359	0.966	0.935	0.904
7	2	5	3	4	4	5	4	3	3	5	1.074	0.74536	0.9624	0.717	4.792	0.992	0.962	0.954
8	5	5	1	3	1	5	3	2	2	2	1.631	0.83631	0.9465	0.792	1.879	0.867	0.947	0.821
9	2	5	3	3	4	5	1	2	2	3	0.027	0.50675	0.8977	0.455	2.175	0.898	0.898	0.806
10	5	3	1	2	2	3	3	2	2	1	0.651	0.65724	0.8723	0.573	0.054	0.513	0.872	0.448
11	2	4	3	3	4	4	2	4	2	3	2.780	0.94159	0.9146	0.861	2.275	0.907	0.915	0.829
12	5	2	2	2	2	3	3	2	2	2	-1.664	0.15923	0.9285	0.148	0.302	0.575	0.929	0.534
13	4	5	5	3	5	4	5	2	2	5	0.873	0.70537	0.9257	0.653	6.023	0.998	0.926	0.923
14	5	3	3	4	3	4	3	2	2	3	0.813	0.69275	0.8843	0.613	3.216	0.961	0.884	0.850
15	2	5	5	2	5	4	5	2	2	5	-0.846	0.30027	0.9359	0.281	5.182	0.994	0.936	0.931
16	2	5	5	3	5	4	5	3	3	5	2.246	0.90430	0.9357	0.846	6.023	0.998	0.936	0.933
17	5	5	5	2	5	4	5	3	3	5	2.382	0.91544	0.9176	0.840	5.182	0.994	0.918	0.912
18	3	3	3	2	3	5	3	2	2	2	0.876	0.70599	0.8734	0.617	1.534	0.823	0.873	0.718
19	3	3	2	3	1	5	2	2	2	2	-0.834	0.30280	0.8693	0.263	1.043	0.739	0.869	0.643
20	2	3	2	3	4	4	1	5	3	3	2.642	0.93352	0.9282	0.867	0.451	0.611	0.928	0.567
21	2	5	4	3	5	4	3	3	3	3	4.386	0.98770	0.9212	0.910	4.099	0.984	0.921	0.906
22	4	5	5	4	5	4	3	3	3	5	2.431	0.91916	0.9417	0.866	5.680	0.997	0.942	0.938
23	4	4	4	2	4	4	3	3	2	3	2.291	0.90813	0.9114	0.828	2.766	0.941	0.911	0.857
24	4	5	5	3	5	5	5	3	3	5	3.574	0.97272	0.9387	0.913	6.023	0.998	0.939	0.936
25	2	4	3	3	5	3	3	3	3	3	2.314	0.91003	0.9037	0.822	2.867	0.946	0.904	0.855
26	4	2	2	3	2	3	3	3	3	2	1.057	0.74212	0.9171	0.681	1.143	0.758	0.917	0.695
27	2	2	3	4	3	4	3	3	2	3	0.579	0.64084	0.9292	0.595	2.724	0.938	0.929	0.872
28	4	3	3	3	5	4	3	2	2	5	-3.633	0.02576	0.9292	0.024	2.375	0.915	0.929	0.850
29	4	4	3	2	5	4	3	2	2	5	-3.796	0.02197	0.9273	0.020	2.026	0.883	0.927	0.819
30	4	5	4	2	5	4	5	2	2	5	-0.776	0.31518	0.9348	0.295	4.442	0.988	0.935	0.924

Appendix 5 Attraction probability Calculation. cont…….

Segment Number	Most correlated 10 parameters										Most correlated 10 parameters				Most Significant 4 Parameters			
	Access	Bushault	Pedestrian	Parking	Visibility	F_Level	Built_form	Lot_size	Frontage	F_Area	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity
31	3	3	3	2	2	4	2	2	3	2	-0.679	0.33648	0.8907	0.300	0.942	0.720	0.891	0.641
32	2	5	4	3	5	4	3	3	2	5	-0.382	0.40564	0.9421	0.382	4.099	0.984	0.942	0.927
33	4	3	3	3	4	4	3	2	2	3	0.089	0.52224	0.9019	0.471	2.375	0.915	0.902	0.825
34	4	4	4	3	5	5	3	3	2	5	0.132	0.53295	0.9428	0.502	3.607	0.974	0.943	0.918
35	2	3	3	3	3	5	3	2	2	5	-5.037	0.00645	0.9328	0.006	2.375	0.915	0.933	0.853
36	2	5	5	5	5	3	3	3	2	5	1.658	0.83997	0.9416	0.791	6.521	0.999	0.942	0.940
37	5	3	4	4	4	5	3	3	3	5	0.464	0.61396	0.9226	0.566	3.956	0.981	0.923	0.905
38	4	4	5	4	5	4	5	3	3	5	3.151	0.95895	0.9268	0.889	6.372	0.998	0.927	0.925
39	2	4	5	3	5	4	5	3	3	5	1.432	0.80721	0.9417	0.760	5.531	0.996	0.942	0.938
40	3	2	3	3	3	4	3	2	2	5	-6.066	0.00232	0.9181	0.002	1.883	0.868	0.918	0.797
41	2	4	5	3	5	4	5	3	4	5	1.854	0.86460	0.9420	0.814	5.531	0.996	0.942	0.938
42	3	4	4	3	5	4	4	4	3	5	2.057	0.88665	0.9308	0.825	4.199	0.985	0.931	0.917
43	2	4	4	3	5	5	5	3	4	5	1.768	0.85421	0.9376	0.801	4.791	0.992	0.938	0.930
44	5	2	2	3	3	3	2	2	2	2	-0.830	0.30365	0.9130	0.277	0.551	0.634	0.913	0.579
45	4	5	5	3	5	4	4	3	3	5	2.221	0.90212	0.9335	0.842	5.431	0.996	0.933	0.929
46	4	5	5	2	5	5	4	3	3	5	1.830	0.86176	0.9332	0.804	4.590	0.990	0.933	0.924
47	3	3	3	2	3	4	1	2	2	1	0.929	0.71687	0.8615	0.618	0.350	0.587	0.862	0.505
48	3	5	4	2	4	4	5	3	3	5	0.344	0.58516	0.9298	0.544	4.442	0.988	0.930	0.919
49	4	5	3	3	3	4	3	2	2	5	-3.253	0.03722	0.9095	0.034	3.359	0.966	0.910	0.879
50	2	3	3	3	5	4	3	2	2	2	2.144	0.89511	0.8790	0.787	2.375	0.915	0.879	0.804
51	2	2	2	3	4	4	3	3	2	3	-0.446	0.39031	0.8981	0.351	1.143	0.758	0.898	0.681
52	2	4	3	4	4	4	3	2	2	2	3.311	0.96480	0.8835	0.852	3.708	0.976	0.883	0.862
53	3	3	3	2	3	5	3	2	2	2	0.876	0.70599	0.9201	0.650	1.534	0.823	0.920	0.757
54	4	2	2	3	2	3	3	3	3	2	1.057	0.74212	0.8673	0.644	1.143	0.758	0.867	0.658
55	2	3	2	4	4	4	3	3	2	2	3.518	0.97120	0.8902	0.865	2.476	0.922	0.890	0.821
56	2	4	3	3	4	5	1	1	2	2	-0.307	0.42385	0.8612	0.365	1.683	0.843	0.861	0.726
57	3	3	2	3	3	4	3	2	2	3	-1.578	0.17108	0.8849	0.151	1.635	0.837	0.885	0.740
58	4	5	4	3	4	4	3	3	2	3	4.082	0.98341	0.9152	0.900	4.099	0.984	0.915	0.900
59	4	4	5	2	5	3	5	3	3	5	0.611	0.64817	0.9186	0.595	4.690	0.991	0.919	0.910
60	4	3	4	3	3	4	2	3	3	4	-0.688	0.33448	0.9095	0.304	2.523	0.926	0.909	0.842

Appendix 6 Attraction probability Calculation. cont…….

Segment Number	Most correlated 10 parameters										Most correlated 10 parameters				Most Significant 4 Parameters			
	Access	Bushault	Pedestrian	Parking	Visibility	F_Level	Built_form	Lot_size	Frontage	F_Area	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity	Attraction Binary Regression	Probability (Parameter based)	Probability (Distance based)	Retail gravity
61	4	4	2	2	3	4	2	3	3	3	-0.022	0.49450	0.9123	0.451	0.694	0.667	0.912	0.608
62	2	5	3	3	5	4	5	3	2	5	0.480	0.61775	0.9455	0.584	4.543	0.989	0.945	0.936
63	2	5	3	3	4	4	3	2	2	5	-3.371	0.03321	0.9307	0.031	3.359	0.966	0.931	0.899
64	2	3	2	3	3	5	2	3	3	3	-0.015	0.49625	0.9066	0.450	1.043	0.739	0.907	0.670
65	2	2	2	4	3	5	2	3	4	3	0.570	0.63876	0.9086	0.580	1.392	0.801	0.909	0.728
66	2	2	2	4	3	4	3	3	4	3	0.751	0.67940	0.9202	0.625	1.984	0.879	0.920	0.809
67	2	2	2	4	3	5	3	3	2	3	0.493	0.62081	0.9176	0.570	1.984	0.879	0.918	0.807
68	5	4	2	3	2	4	3	3	2	3	1.047	0.74020	0.9056	0.670	2.127	0.893	0.906	0.809
69	4	3	2	3	2	3	2	2	3	2	-0.589	0.35686	0.8903	0.318	1.043	0.739	0.890	0.658
70	3	4	5	3	5	4	5	3	3	5	1.803	0.85851	0.9362	0.804	5.531	0.996	0.936	0.933
71	5	3	3	3	3	4	3	2	2	3	-0.164	0.45909	0.8868	0.407	2.375	0.915	0.887	0.811
72	2	5	5	3	5	4	5	2	2	3	4.477	0.98876	0.9177	0.907	6.023	0.998	0.918	0.915
73	4	4	4	3	5	4	3	3	3	5	-0.032	0.49200	0.9405	0.463	3.607	0.974	0.940	0.916
74	4	5	5	3	5	4	5	3	3	5	2.988	0.95203	0.9360	0.891	6.023	0.998	0.936	0.934
75	4	3	3	2	5	4	3	3	3	3	1.851	0.86424	0.8910	0.770	1.534	0.823	0.891	0.733
76	2	5	4	3	5	4	3	2	2	3	2.271	0.90645	0.9061	0.821	4.099	0.984	0.906	0.891
77	2	3	3	3	5	5	3	3	4	3	3.094	0.95664	0.9188	0.879	2.375	0.915	0.919	0.841
78	2	5	5	2	5	4	3	2	2	3	1.966	0.87718	0.9174	0.805	3.998	0.982	0.917	0.901
79	3	3	2	3	3	5	2	3	3	3	0.356	0.58807	0.9203	0.541	1.043	0.739	0.920	0.681
80	2	3	2	3	3	5	3	2	2	5	-5.709	0.00331	0.9393	0.003	1.635	0.837	0.939	0.786
81	2	3	2	3	3	5	3	2	2	3	-1.363	0.20375	0.9180	0.187	1.635	0.837	0.918	0.768
82	3	3	2	3	3	5	3	5	5	5	1.007	0.73243	0.9404	0.689	1.635	0.837	0.940	0.787
83	2	5	5	3	5	5	5	2	2	5	0.717	0.67195	0.9390	0.631	6.023	0.998	0.939	0.937
84	3	3	2	3	2	4	2	2	3	2	-0.374	0.40757	0.9189	0.375	1.043	0.739	0.919	0.679
85	3	3	1	3	1	5	3	2	2	2	-0.739	0.32322	0.8879	0.287	0.895	0.710	0.888	0.630
86	4	2	3	3	3	4	3	2	2	3	-1.349	0.20603	0.8855	0.182	1.883	0.868	0.885	0.769