GIS BASED MARKET SIZE ANALYSIS HOUSING PROPERTIES DEVELOPMENT USING REMOTE SENSING DATA

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Master of Civil Engineering

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DECLARATION

I hereby declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for any other degree at Universiti Tenaga Nasional or at any other institutions. This thesis may be made available within the university library and may be photocopies and loaned to other libraries for the purpose of consultation.

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Date: 07/11/2019

ABSTRACT

Spatial data is among other important information in the marketing strategy. Urban growth and its spread changed the geographical extend to understanding the demand and existence of stocks. A business needs to know growth and market size accurately in order to better plan in a way of avoiding randomness in decision making. Recent days businesses have utilized geo-locations but still, many people do not use spatial data effectively in order to increase the accuracy of the results and make the work more efficient and flexible with the use of Geomarketing. In this study, remote sensing data is explored to play as an active role in order to provide accurate data on the growth of the buildings associated with population increases. In this study remote sensing data is explored to play as an active role in order to provide accurate data on the growth of the buildings associated with population increases. The population growth require food and buildings construction need building materials. The building growth will determine by explore the difference between two satellite images which related to two different dates. The resulting data will provide accurate information that will enable decision-makers to plan business as a result of obtaining accurate market readings. As a result, the production, sales demand or establish service centers can be provided in better ways.

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DEDICATION

I would like to express my sincere appreciation to my wife, my great daughters, for their encouragement and supporting me throughout the study.

My utmost gratitude for my mother's spirit, my father, my father in law for his prayer for me, my mother in law, Brothers and sisters

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LIST OF ABBREVIATIONS

FMCG	Fast-moving consumer goods
POP VI	Population in a villa
POPAPA	Population in Apartment
V	The average units per villa
A	The average units per Apartment
P	The average units per palace
AVE	The average population per units
E	Non-inhabited buildings
POP PA	Population in Palace
CUM (n)	Cumulative population after n periods
Ex POP (n)	expected population growth after (n) period
POP (current)	Current population
DM	Daily Milk needs
AVE M	person's daily Milk consumption
CUM DM (n)	Cumulative milk market size a specific periods
DM (n-t)	previous period Market size
t	previous period

LIST OF PUBLICATIONS

1- Geomarketing using Remote Sensing A Study on Marketing and Planning Development Strategy at Northern Riyadh, iGRAD2018, Scopus journals.

CHAPTER 1

INTRODUCTION

1.1 Study Area

Riyadh city the capital of the Saudi Kingdom located in the middle of the country at the intersection of the transportation network, this city was significantly developed by 25 % between 2005 and 2016 Figure 1.1. It is extended towards the Northern direction more than to the other directions due to natural obstacles or industrial cities. The study area (i.e., 240 sq. km) located in the northern part of the town in which recently an essential urban growth and human activities based. Figure 1.1 shows the boundaries of the city in 2005 with yellow color while the blue boundaries at 2018, it shows how the town stretched and expanded. In general, Riyadh is about 30% of the Kingdom's population and is increasing horizontally because the people here prefer to live in separate buildings and have privacy.

Figure 1.1 The Growth in Riyadh City Since 2005

According to the 2013 census (Authority of statistics) on Riyadh City:

- The population was 5.7 million
- The population growth rate of 4% per year
- Number of housing 960000 units
- Number Schools was 3060
- Number of hospitals bed was 14137 beds
- The age group for Saudis under 14 years was 30%
- The age group for Saudis between 15-60 years was 60%
- The average number of the family was 5.97.
- Riyadh city area approximately 1400 sq. km

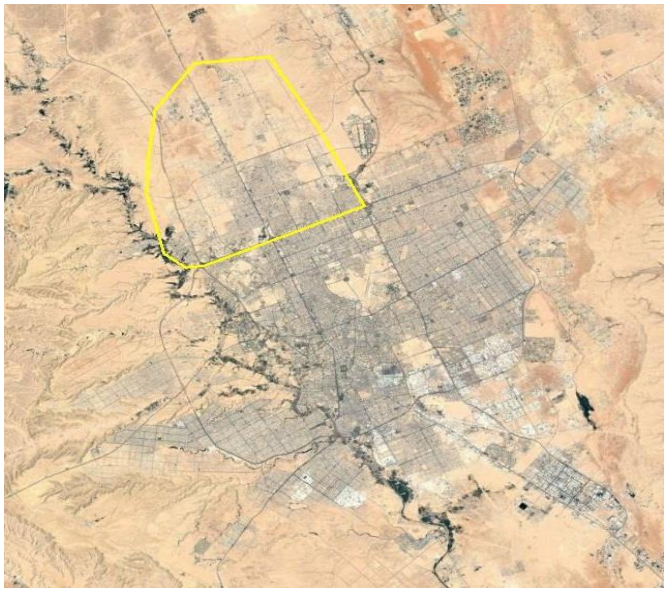


Figure 1.2. The Study Area at Northern Riyadh City

1.2 Problem Statement

Geographical Information Systems (GIS) play a major role in different application such as urban area planning and environment studies but need to improve its usage in business like marketing, sales demand and market research. Using GIS for the spatial representation of marketing problems helps the decision-makers arrive at conclusions better related to marketing planning issues. The improve of use the spatial information (Shawky, 2016) associated with high-resolution satellite images in planning and

decision-making will have a positive impact in the long term by being able to understand the temporary and long-term changes occurring in the global market especially in the midst of intense competition. The analysis of high-resolution satellite images for detection the urban growth associated with identify buildings type (villas, apartments, mall, etc.) and its construction level will provide a clear vision for the current market size and create more accurate expectations, this information will not be available through other methods to helps the decision-makers for better analyze situation to generate a forecast based on more accurate data, and contribute to the selection of the best location for the establishment of services.

In general, using Geomarketing in Arab countries needs to improve to better understand the market and its needs (European Commission, 2017). Therefore, this research presents the use of satellite images in Geomarketing in:

a) Improving market size reading
b) Supporting thinking at micro-geographic area
c) Supporting decision-making
d) Improving marketing strategy

This study was carried out in the north of Riyadh City as shown in Figure 1.2. In the Kingdom of Saudi Arabia, in an area that has a fast-growing and forms the vital area of the city, with the aim to improve plans and determining market size using spatial data. Many programs and projects may falter in the absence of accurate data that reflects the current reality that enables the governmental authorities and companies an Evaluate the needs of the community, determine market size and forecast for the future. Therefore, government agencies and companies are looking forward to having the data to help them to address the challenges and create appropriate plans to meet the community requirements. However, current data and methodologies can't solve the demands and needs of each geographical area. The proposed method will help decision-makers in building and developing plans more effectively and include the following.

1.3 Objective

In this research, the building growth and its effect on building materials market size will be studied. Growth in buildings will be used to study the population at districts level to expect growth and the cumulative number of community in a specific time; this

expectation also will help to calculate milk market size at the micro-geographic area, the population estimation also will use to set up a new methodology to determine the best site location in the study area.

The objective of this study is as follow:

1. To determine the effect of adding geospatial information to marketing and business.
2. To determine market size and develop forecasting methodology by using remote sensing
3. To improve the best site location methodology by Geomarketing.

1.4 Scope of Study

The overarching purpose of this research to examine using the High-resolution satellite images in Geomarketing and improve marketing strategy with a combination of other factors to have better results by distinguishing the buildings type (existing and new) and support decision-maker in their decisions. We will study the impact of buildings growth and the units per buildings to the market size for the studying products. This growth also affects the population increase which will study the community who live or can live in this area by having information about the family member. The population density will determine according to this methodology.

CHAPTER 2

LITERATURE REVIEW

The utilization of remote sensing and GIS give various advantage for the urban industry due to the power of GIS application in storing, querying and analyzing data on the ground which including the information required by the urban industry. This is the fact of GIS implementation can carry out computer and spatial data analysis methods developed in varying related disciplines which including surveying, geography, land management, and Urban planning, remote sensing (Mzainora, 2016). With a GIS-based details system, many data can be displayed correctly on maps to support the users who interested in urban area planning, business or such as retailers, buyers, sellers, decision-makers about searching for the best site location or be estimating market values.

Geomarketing is a field that uses geoformation in the process of marketing activities and business planning. A lot of fields can use geo-targeting such is marketing such as 4 ps marketing or geo-targeting. Geomarketing analysis information uses huge data such as location residential areas, marketing, and business, analyzes demographic information like gender, age, genre, their economic situations, and lifestyle. This data supports the users to improve their planning in order to achieve marketing aims (Suhaibah, 2016). One of the important applications of Geomarketing is market segmentation. It divides data into several ranges based on its geographic factors.

Geomarketing and geolocation theories may effectively and efficiently support the business establishment in best locations, allowing any businessman to implement his business and achieve profits. The benefits of the Geomarketing as a revolutionary methodology (Casalino, 2018):

- Establish a link or relation among geographic business elements and their relevant spatial data.
- Ability to recognize and analyze the composition of business phenomena through the use of Geomarketing

A lot of endeavors are constantly made to better recognize the consumer and customer distributions, In order to develop a more accurate way of marketing within these areas.

However, there are many barriers to marketing processes such as data restrictions, limited access, administrative boundaries, lack of market information and market size (Nicholas,

2014). (Amanda, 2014) studied how Geomarketing can be used to discover and acquire marketing skills and are effective in solving real problems. (Veland, 2018) built on data collected by researchers through questionnaires and government data, and he used the classification of companies how sites and spatial data in cities can affect decision-makers and the results are presented on appropriate maps. (Somnath, 2018) discussed the usage of Web-Based Geographical Information System (GIS), for business; especially through the Internet, with a plan to develop electronic-promotion and strategic marketing by implementing Web GIS tools for Geo business.

The subject of electronic-business is present study permeates the utilization of GIS to spread the greatest level of data to the clients. Furthermore, it represents the growing combination of GIS in target marketing, business management, and strategic decision-making processes. (Hosseini, 2016) used a model to select the best site for suitable places and took into account the following aspects: maximizing the well-being of the DP, minimizing the negative impacts on neighborhood life, minimizing the public expenditures on TH, minimizing the negative environmental impacts, and maximizing the well-being of the people involved in the TH process.

During the site selection process, this model help decision-makers in observing and comparing the indicator values of all alternatives. At times, decision-makers select other option that has weaknesses caused by limitations; based on the mentioned feature of this model, decision-makers can select the weak parts of a determined site and then control these weaknesses with suitable work. Spread around sites located in different micro-Geographic areas have the best social indicator value.

Zhang (2016) used a new method of using satellite imagery to estimate location adjustment factors where they do not exist. This method for estimating location modulation index was evaluated against a determined cost index database and results show that satellite imagery can be used to effectively select the best site adjustment elements. This work participates in the information by bringing an accurate way to assessing location modification index which can enhance cost estimation for select new projects.

A big-data approach to extract buildings from a DEM created from aerial laser scanning imagery. This process includes two steps. The first one is a Map Reduce process where neighboring points in a digital surface model are mapped into cubes. The second one uses anon-Map Reduce algorithm first to remove trees and other obstructions and then to

extract adjacent cubes. Present to this process, all of the adjacent elements belong to the same objectives which this belong to one or more adjacent buildings (Aljumaily, 2015). Housing market forecasts can provide insight into the essential sustainability of housing and construction. The home sales index (HSI) reflects one of the most important indexes for forecasting housing market trends in the real estate function, they have tried to develop relevant forecasting models for the HSI. There are many demands for effective HSI forecasting by identifying the various social factors influencing the HSI. He suggested a new way for forecasting model development with the provision of fundamental data and the pros and cons of each model to which the multiple regression analysis (MRA) and the artificial neural network (ANN) were applied. He compared it with ARIMA. Forecast HSI forecast data using ARIMA are more accurate than those of MRA and ANN (Han, 2018).

Li, (2017) suggested a new method for road feature extraction from aerial imagery data that consisted of multi-steps:

- Removal of elevated objects.
- Removal of shadows and vegetation.
- Extract road features from the fused data;
- Final extraction of road surfaces and centerlines.

This new method is suggested for data fusion of satellite images and to extract road features by utilizing color components, such as saturation. Housing growth provides economic expansion with Geolocation. In addition to their own experiences, employees should consider several factors during the selection of residential or commercial investments (Aktas, 2017). These factors may be evaluated using multicriteria decision-making analyses. The weights of many evaluation indexes were determined using the fuzzy analytic hierarchy process (FAHP) and fuzzy entropy (FENTROPY) methods (Bostancı, 2017).

Darani (2018), studied the multicriteria decision-making (MCDM) method by coupling the analyses of the hierarchy process (AHP) and the technique for order of preference by similarity to ideal solution (TOPSIS) methods under a fuzzy environment to select the best site for new parking. Boostani (2018), told that it is important to determine the factors that affect the best location of accommodation or new activity sites. He used his expert and the Fuzzy Delphi method, three main criteria including infrastructural factors, access,

and sustainability. To specify the weight of the identified factors, the fuzzy DEMATEL-based analytic network process (FDANP) method is used.

Recently Wu (2019), studied a shopper preference-based competitive location model (SPCLM) to find the best solutions to the location problem for the nearest retail. He used multi-criteria for this model construction: size, diversity of the tenant inside the shopping center, retail agglomeration near the shopping center, distance to metro stations, and distance between consumers and shopping center.

Geomarketing is a cornerstone of market segmentation. The segmentation gathers the data into groups based on their geographic factors. He suggested a method to improve the process to gather the data using a gather algorithm. In this study, the geomarketing is active in urban areas needs a three-dimensional (3D) way and this a constraint in GIS. To avoid this issue, He suggested a combination of market segmentation based on geographic factors and gathers algorithm for 3D geomarketing data management. He minimized the overlap areas during the segmentation (Suhaibah, 2016). Garud (2017), studied the food supply chain, foodshed, food miles for identified diets for PMR, this a basic scenario for FMCG consumption style and produce is mapped. Fukun (2019), present a new method called a DBA detection uses hierarchical structural constraints in remote sensing images. This way was managed in two main steps. (1) During keypoint generation (2) To match the screened key points.

2.1 Building Extraction

Jin used object-oriented segmentation and classification methodology by using texture, characteristics, feature, shape feature to extract the building in remote sensing images (Jin, 2012). Jian used object-oriented classification to have individual object-classes, and fuzzy determined rules system to be created for earthquake collapsed building extraction (Jian, 2013). Huang and lot of researcher used many indexes to extracted the building as result of the different scale of different type building and merged the results as a whole, Suggested novel morphological building index for automatic building extraction by using high-resolution images with optimization and improvements (Huang and Zhang, 2011), Jian yang used another method to extract the building information by combination the contoured transform and PCNN segmentation algorithm to obtain the multiscale and

multidirectional characteristic of the building. Other efforts have been made to extract buildings in automated ways. Applied the Perceptual grouping way to obtain the building. Lin and Nevatia detected the edges of the image to find the parallel lines from the edges. After that, they searched for the parallel lines to find a rectangle which meets the geometric and projective constraints as the building object, (Lin and Nevatia, 1998). A study proposed a building extraction method by combining edge preserving, smoothing bilateral filter with the line segment detector. Wang used a filtration for smooth the original satellite image, detected the line segments and grouped the lines to construct a rectangular building, so these methods are suitable for extracting simple square buildings, (Wang, 2015).

The proposed framework consists of two main stages: generating foreground and background area, minimizing the energy function, (Yihua and Yujie, 2016). The classification of high-resolution images was studied by a lot of researchers More recently, finer texture and more certain boundaries of the building can be obtained from HSR imagery and applied to build extraction, (Ok, 2013). So it is still difficult to discern building types from high-resolution images by computers programs because it is hard to find appropriate segmenting scales to completely capture even an individual building from complex patterns of combining pixels,(Zhang 2015), Elevation data and building contours have also applied in the classification of the building type. Airborne light detection and ranging (LiDAR) is particularly useful to collect the elevation data for the expression of building structural characteristics, (Kraus and Pfeifer, 1998).

In EMRS-SBP scheme, (Extended multiresolution segmentation) EMRS serves to guide the design of descriptor and SBP to generate a more natural classification is used for the classification of urban building type, (Junfei and Jinhua, 2017). Change detection for remote sensing images has been applied to many fields, such as urban area and so on. It has drawn great attention in recent years since it is an efficient way to find the differences between images with different dates, typical methods often firstly consider spectral features and then use threshold segmentation to detect the change. However, the thresholds are usually determined by experience, which brings about a series of problems, (Wen, Huang, 2016), Huo, J. Cheng introduced two different multiscale fusion strategies conducted the experiments on QuickBird high-resolution remote sensing images and completed the object-oriented change detection. But the robustness of this algorithm is not good enough, (Huo, Cheng, 2008). Qingle Guo and others studied a new method which is a multiscale segmentation and decision-level fusion, Multiscale segmentation

refers to segmenting the same image in different scales, and the segmentation results can reveal the multiscale land-cover features and spatial structure information of images, (Qingle Guo, Junping Zhang, 2017).

2.2 GIS

GIS used to support the decision-maker in many fields like working to decrease food waste, (San Martin1 2017), decision making is based on numerous data concerning the problem. It has been estimated that 80% of data used by managers and decision-makers are geographical (spatial) in nature, (Worral 1991), GIS using in the most critical and far-reaching decisions faced by operations managers are deciding where to locate new industrial facilities. This is a strategic decision involving irreversible allocation of the firm's capital, (Bhatnagar & Sohal, 2005), GIS is tools to solve the spatial decision problem typically includes a large set of feasible alternatives, (Rikalovic and Aleksandar, 2014). Amparo BAVIERA-PUIG told Geomarketing viewpoint, and the model shows that sociodemographic characteristics of the supermarket's trade area affect firms' location strategies, (Amparo Baviera-Puig, Juan Buitrago, 2016.

2.3 Forecasting

Arvydas and Simon, studied statistical estimates to confirm the claim that goodness-of-fit does not imply good forecasting performance and that increased model complexity does not necessarily yield greater forecasting accuracy. This, therefore, calls for the adoption of a Laconic or "Keep It Sensibly Simple "modeling approach. In other words, the recommendation is for analysts to make forecasts user-friendly so that they are easy to use and understand. Researchers should put simplicity at the core of them.

2.4 Best Site Location

The geographic information system can combine spatial data, especially competitor sites, with solutions designed to help open a new facility to enhance the competitiveness of the new entity. Competitive sites consist of several criteria and are primarily related to consumers and service providers. Here, customer behavior must be considered so that we

can meet their demands so that they can have all their requirements in one place (Rafael, 2012). The opening of a new branch for any company or service is one of the critical works that requires careful study and depends on scientific methodologies in which the review of the situation in various aspects to mitigate any risks that may result from the expansion of activity. The population density that will be used to determine the new location has been studied based on the data obtained from the Statistics Authority (Norat, 2013).

Xuefeng, (2010) used ArcGIS Geoprocessing to develop spatial analysis modeling and decision making by using implementation technology, modeling and multiple options using ARC GIS, using the classification and reclassification method, and calculating the required spaces to set up the new branch within the conditions and result. "Kazem" presented a study to select the best location for parking as a result of the traffic jam of Tehran city and performed the study of land use and peak areas of traffic and restrictions that prevent the establishment of this position such as cultural restrictions and historical monuments, all those features have been added all to the maps to determine the outputs that correspond with Determine the best location for parking (Kazem, 2015).

2.5. Research gaps:

Through the above, it becomes clear to us that there is a lack of using remote sensing data in the calculation of market size especially at the micro-Geographic area and the development of the using Geomarketing that would enhance the use of spatial and attribute data to determine the best locations for establishing service sites or centers, depending on the development of the Geomarketing concept, and that what has been presented from other researchers has not touched on the issue of using remote sensing data in developing market studies and sales planning with a reflection on the strategic decisions taken Companies in terms of an accurate reading of the market and building more accurate future forecasts.

Below we will be explaining how we can develop these concepts and uses to serve the industry and work to bridge an important gap in this area.

CHPATER 3

MATERIALS AND METHODOLOGY

3.1 Introduction

In this section, we will study the data used, the sources of these data, and how it will be processed and used in a manner appropriate to this study, what the variables which used and how can it affect the study, also explain the software that used. What are the satellite data and spatial data, their dates, how can estimate the population by using remote sensing, and how we can expect market size for a given product?

3.2 Workflow

This work started after selecting the studying area which the methodology will be applying to study it, we have to choose the period that we will investigate it then the suitable satellite images which be optical which will be used to extract existing buildings from the older image then determine the growth by extract the new buildings from the latest image, here we should have information about the family member per building unit or FMCG daily consumption (Milk) and buildings needs from the products for each building type to determine the market size and improve the forecasting. The following flowchart explains the process.

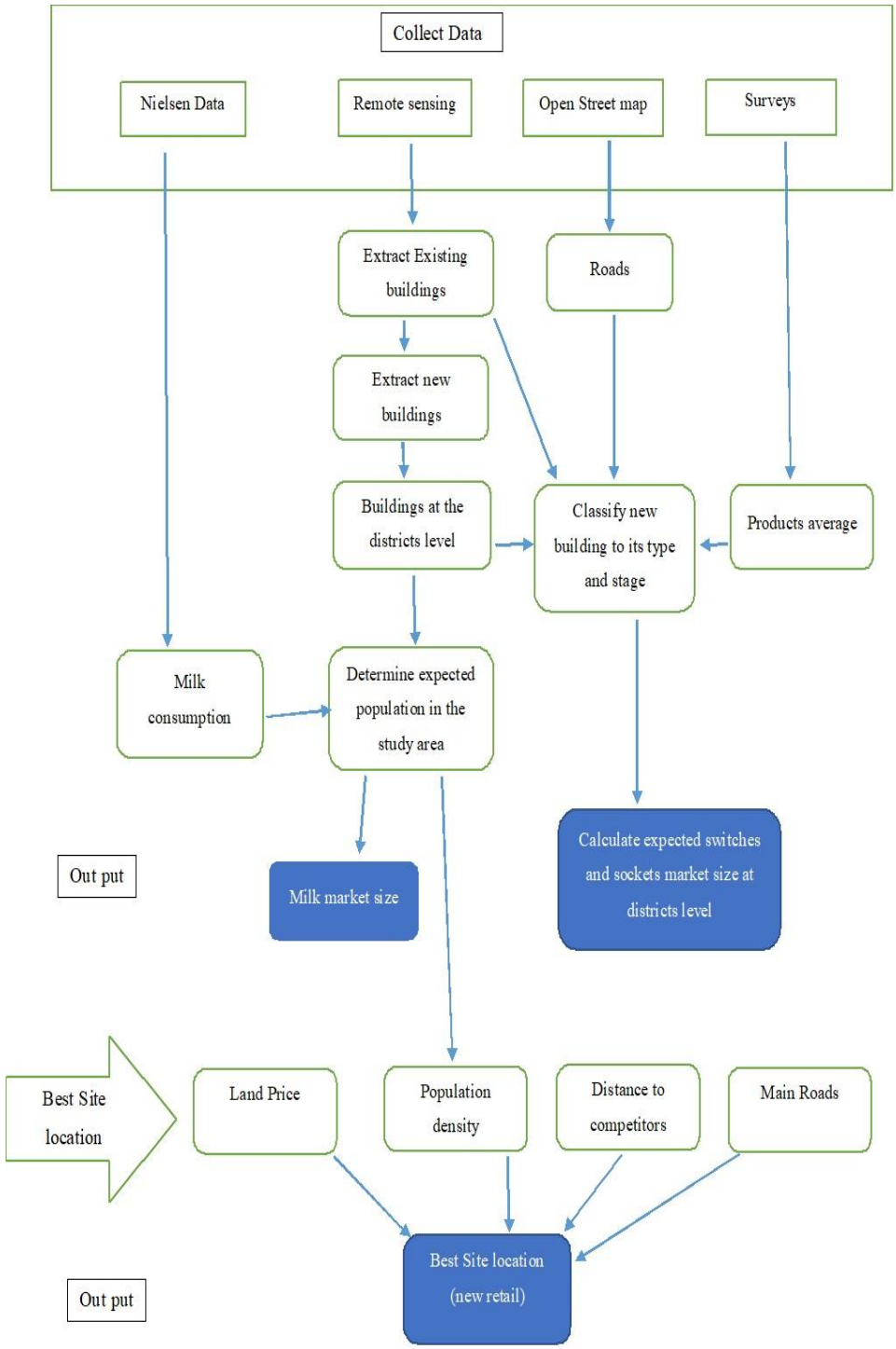


Figure 3.1 Workflow

3.3 Data Collection

3.3.1. Remote Sensing Data

The primary data used to conduct this study is the remote sensing data for determining to the urban growth that will require the use of two satellite images in two different dates for the studying area, the specification for it was:

- Satellite: Optical Spot 6
- Resolution: 1.5 m, color

The first image: its date was January 2016, it is used to create a feature class containing all the existing buildings at that date and classified it according to the building type and construction level.

The second image: as in Figure 3.1, its date was October 2016, it is used to create a feature class containing the new buildings which constructed after the date of the first image in order to know the exact number of new buildings that were created in the study area and which classified according to the building type and construction level, The construction level are:

a) Basements
b) Under construction
c) Construction completed

Here we have the all the building in the studying area, existing and new which classified depend on a field observation (explained in the methodology)

Extraction method: extract the buildings from satellite images were manually Firstly, digitize the first image and extracted the existing buildings, the growth was determined by digitize the second image to identify the difference between the two images, the difference was the growth (October 2016).

Figure 3.2 Shown Spot 1.5 m Satellite Image

3.3.2. Surveys

Since one of the objectives of this study aims to increase the accuracy of the identify market size by remote sensing, one of the building materials products was studied to estimate the expected demand of these products (switches and sockets) during a specific

period and determine the cumulative demand. To achieve this goal, a field survey of a sample of electricians and contractors (50 persons*)* was conducted in the study area to determine the average need for each building type. (Villa, apartment, palace, mall, mosque). For these products during the finishing phase.

The survey included the following questions:

1. The average number of pieces (switches and sockets) needed by each type of buildings, Table 3.1.
2. The expected time for these products to installing to those buildings type, table 3.2.

Table 3.1. The Average Number of Pieces For Each Building Type

Buildings type	Switches Average (pieces)
villa	193
Apartment	771
Esteraha	48
Mosque	104
tower	4188
Gas station	93
Industry	300
School	425
Mall	227
showroom	351
Palace	2000
warehouse	50
Governmental	1613

Table 3.2. The Duration of The Stage for Building Type

	Duration of the stage(month)		
Building type	Basement	Under construction	construction completed
Apartment	6	12	24
Esteraha	3	6	12
Gas Station	3	6	12
Governmental	6	12	24
Mall	6	12	24
Mosque	6	12	24
Palace	6	12	24
School	6	12	24
Showroom	3	6	12
Tower	6	12	24
villa	3	6	12
warehouse	3	6	12

3.3.3. Open Street Map

The road network in the study area was extracted using the open Street map where the road network in the area was extracted, checked, completed and classified into primary and secondary roads to help classify the buildings. The apartments are often built on the main roads, while the villas are inside districts alongside the secondary roads, the roads also help to demarcate the boundaries of the micro-geographic area, and the roads also will be taken into consideration for choosing the best location, Figure 3.2.

Figure 3.3 Road Network in The Study Area

3.3.4. Nielsen Data

Nielsen data used to estimate Milk market size as FMCG products by using Remote sensing data at the micro-geographic area.

a) The average per capita consumption of milk per day in Riyadh was 0.11 liters while in Saudi Arabia it is 0.09 liters per day in 2016 (Nielsen company)
b) Market size includes white/plain and flavored milk. Excludes powder milk & fermented milk drinks (Laban or yogurt)
c) This study only for residential sectors (Villas, Apartments, Palaces)

The following table shows the total consumption in Saudi Arabia and Riyadh City

Table 3.3. Milk Consumption in KSA and Riyadh City (Nielsen data)

KSA -MILK CONSUMPTION (Million Litre/ year)	2012	2013	2014	2015	2016	2017
Fresh Milk	506.8	458.1	483.5	518.7	550.3	579.7
Growth (%)	9.40%	-9.60%	5.50%	7.30%	6.10%	5.40%
Total KSA	807.4	888.6	945.1	997.7	1034	1077
Growth (%)	9.30%	10.10%	6.40%	5.60%	3.70%	4.10%
RIYADH ONLY	283	311	331	349	362	377

3.4. Variables

3.4.1. Buildings

Buildings Growth means Growth in market demand for a lot of products like buildings materials. Also, the population will live in the new buildings which food, water, and Milk will necessary for them, this variable will have it by Satellite images analysis.

3.4.2 Number of Residential Units per Residential Buildings Type

This variable changes according to the city and districts. It means the number of units that each residential building type contain, this factor info obtained from the authority of statistics.

3.4.3 Family Member

It's a critical variable to estimate the population in the study area which helps to calculate the expected FMCG demand like Milk market size. The family member obtained from the authority of statistics.

3.4.4 Vacant Buildings Percentage

According to the authority of statics, there were 12 % of vacant residential units in Riyadh in 2016 which should consider it when calculating the population in the studying area. This factor affects the expected community so when this factor increase that is mean the population will decrease.

3.4.5 Required Time for Products Installation

Required time for product installation variable is necessary to estimate the required time that each building type needs to install the products or required time that the residential buildings ready for living. This variable has been compiled from a survey of the experience of contractors and electricians as in Table 3.2. When this variable was increased the required time for products installation will increase and also the require time for living.

The geographical information system (GIS) used in this study in order to identify the existing and new buildings which determined depends on the experience and the interpretation of the images by manual digitizing. A point placed in front of each building and its classification according to the building type and the construction level, and this done for the images dated at January 2016 and October 2016 . The types of buildings determined according to the following:

a) The majority of the buildings that are next to the main roads are apartments, which are the features of the building systems in Saudi Arabia, especially in the main cities.
b) Villas located inside the districts next to secondary roads.
c) The Esteraha is a building consisting of a few rooms and one floor, it has a small garden with a pool and usually rented during the holidays.
d) Towers: It is a high building with more than ten floors like hotels that typically located next to some of the main roads such as King Abdul Aziz Road or the Northern Ring.
e) Mosques: Its shape is distinctive, especially the towards of Mihrab to the Qibla
f) Gas station.
g) Malls: which occupy large areas.
h) Showrooms: usually characterized by the large building and its positions near to the main roads.
i) Schools and government buildings: characterized by the occupied area and by the method of construction, consisting of four blocks in general and especially for schools.
j) Palaces and large villas: characterized by the large occupied area located inside the districts green areas within it.

All types of buildings identified by the satellite image and classified according to the construction level, table (3.2) and the construction level that includes:

a) Basement
b) Under construction
c) Construction is complete

For example, to explain this methodology to determine the market size, we can apply it to calculate the market needs for two kinds of products (FMCG like Milk and building materials like switches and sockets.

In the following will process and study:

a) Estimating the population in the study area at the Micro-Geographic area levels to using it to estimate the demand for a wide range of services and products.
b) Estimate the Milk market size and cumulative milk market size at the Micro-Geographic area levels.
c) Estimate the material of products (switches and sockets) market size and cumulative market size the Micro-Geographic area levels.

d) Carry out analysis to select the best site location for new services depend on the population density which estimated by using satellite images.

3.5 Softwares

3.5.1 ARC GIS 10.1

ArcGIS (Geographical information system) is a computer-based system that collects, maintains, stores, analyses, outputs and distributes data and spatial information? These systems collect, input, process, analyse, display and produce spatial and descriptive information for specific objectives, and assist planning and decision-making concerning agriculture, urban planning, housing expansion, as well as reading the infrastructure of any city through the creation of called Layers. This system introduces geographic information (maps, aerial photographs, and satellite images), descriptors (names, tables), processing them (revising the error), storing them, retrieving them, analysing them, and analysing them on a computer screen or on paper in the form of maps. , Reports, and graphs.

GIS helps to answer many of the specific questions of specificity (e.g., what is the agricultural pattern, what types of suitable crops to cultivate in the farm unit), measurements, location (What is the relationship between population distribution and Milk or water market size) and hydrological scenarios (what happens if the water used for irrigation).

3.5.2 ERDAS Imagine

ERDAS Imagine (Earth Resource Development Assessment System) is a digital image processing software used for analysis and study the satellite imagery, By using it for extraction of Digital Number values of the pixels of the image, and Import-export raster's and vectors satellite image, working with various bands of satellite data, to perform detailed analysis of multiple objects and information using the pattern recognition technique, Land use land cover analysis. Everything you do on ERDAS Imagine has a unique concept of Visual Interpretation of satellite imagery.

3.6 Methodology

3.6.1 Data transformation: Determine the volume of urban growth in the study area in general by means of remote sensing and linking it with the average number of family members per housing unit and dividing it according to the Micro-Geographic areas will give the ability to identify the population in each district, thus calculate their food needs, also determine the buildings growth in will necessarily lead To know the expected materials buildings market size which is a result of the use of satellite imagery data.

3.6.2 Satellite Images Analyses

3.6.2.1 January 2016 Satellite Images

The existing construction opportunities in the study area have been extracted to determine the number of existing buildings and classify it according to the building type.
The buildings under construction were not considered as part of the existing buildings on that date and were therefore considered part of the subsequent buildings.
A description of the existing building included in its attribute table which included the building type and construction level (here the construction stage is considered as completed), Table 3.4 shows the total existing building that detected in January 2016 by Satellite images analysis.

Table 3.4. Total Buildings Scanned in January with its Building Type

Building type	Number of existing buildings	percentage %
villa	44603	88.77
Apartment	3345	6.66
Esteraha	914	1.82
Showroom	526	1.05
Palace	277	0.55
Mosque	237	0.47
School	93	0.19
warehouse	88	0.18
Tower	85	0.17
Gas Station	43	0.09
Governmental	20	0.04
Compound	6	0.01
Industry	3	0.01
Mall	3	0.01
Grand Total	50243	100%

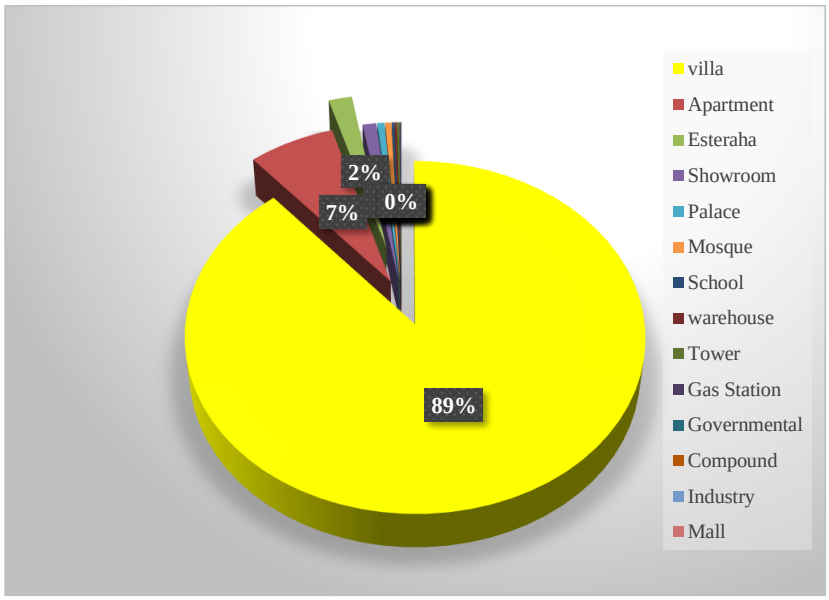


Figure 3.4 Buildings Type Segmentation For January 2016 Buildings.

Table 3.4 and figure 3.4 show that the villas reflect 89% of the existing buildings while the Apartments reflect only 8%.

3.6.2.2 October 2016 Satellite Images

The analysis of the following satellite image dating to October 2016 will determine the growth and trends in the study area. The new buildings classified according to the buildings type and construction level, Table 3.5.

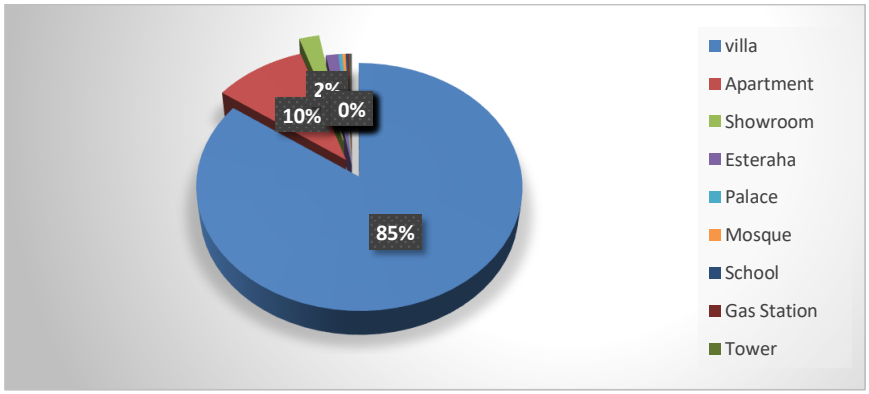


Figure 3.5 Buildings Type Segmentation for October 2016 Buildings

Table 3.5. Total Buildings Scanned in October with its Building Type

Building type	Number of new buildings	percentage %
villa	3626	84.96
Apartment	429	10.05
Showroom	94	2.20
Esteraha	57	1.34
Palace	18	0.42
Mosque	15	0.35
School	9	0.21
Gas Station	8	0.19
Tower	5	0.12
Governmental	3	0.07
warehouse	2	0.05
Compound	1	0.02
Mall	1	0.02
Industry	0	0.00
Grand Total	4268	100%

Also, the majority of the new buildings consist of villas by 85 %, apartments 10 % while the other buildings type include the percentage of the other building types.

3.6.3 Micro-Geographic Segmentation

The study area was divided into Small districts (micro-Geographic area) to identifying the growth at this level to understand the requirements for those areas by determining the business volume and improve the planning. The main roads were selected as the borders for those micro-Geographic areas and these areas were labeled with unique numbers starting from 1 to 44, the areas for those districts vary from 2.3 Sq. to 7.7 Sq., only one district its area 23.8 sq. Which contain a large university, districts 25.

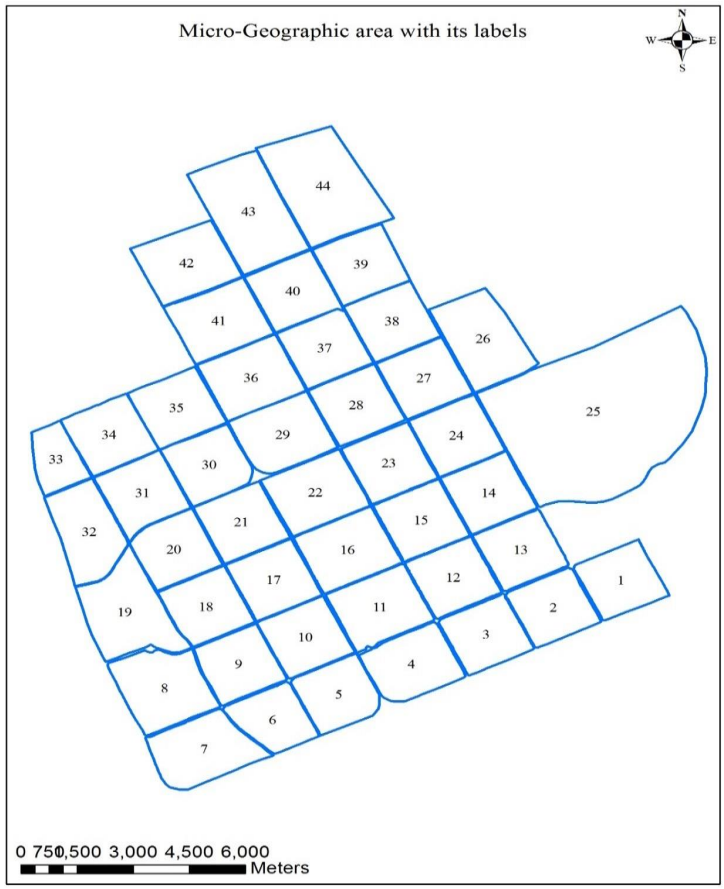


Figure 3.6 Micro-Geographic Area Segmentations

3.6.4 Population

Determine the building type and construction level will be valuable for urban area planning and improve business, in other meaning, by having information about the total Buildings with its geospatial information which detected by remote sensing, also we have the average family member per residential unit, this will give us a new tool by identifying the population at micro-geographic areas level, so the buildings will give us the reading and indicator for the population. By using the geospatial data, we will be able to have more accurate information about the community in the studying area and market needs at the districts level. Population information will support decision-makers in many sectors (i.e. governmental, business, etc.) by determining where the highest population density

areas are to study their requirements in the best way to have the right decision depending on the new data.

The total Buildings in January 2016 was 50243 buildings, the residential buildings were 48225 (95.98 % from total), While total new buildings in October 2016 was 4268 buildings, the residential buildings in October were 4037 Buildings (95.43 % from total).

According to the 2013 census (Authority of statistics) In KSA:

a) The average units per villa are 3.5 unit. (V)
b) The average units per Apartment are 15.5 units. (A)
c) The average units per palace are 1 units. (P)
d) The average population per unit is 5.97 person per unit. (AVE)
e) Percentage of non-inhabited buildings in Riyadh is 12 % (88% inhabited). (E).

Authority of statistics: depend on 2013 census:

a- Population in a villa: In general, the ground floor in villas is occupied by a Saudi family which have a driver and housekeeper at 50%.

POP VI = (V*AVE) + [(driver +housekeeper)*50%] *E 3.1

= (3.5 *5.97) + [(driver +housekeeper)*50%] *88%= 19.26 person

b- Population in Apartment:38 % of Apartments population is Saudi (25 % of this Saudi segments has a housekeeper)

POPAPA= {(A*AVE) + [(A*AVE)*38%]*25%}*E 3.2

= {(15.5*5.97) + [(15.5*5.98)*38%]*25%}*88% = (92.69+ 8.790825)*88%

= 89.16 person

c- Population in Palace

POP PA= (P*AVE) + (Driver + housekeeper + cooker + gardener)*E 3.3

= (1*5.97) + (Driver + housekeeper + cooker + gardener)*88% = (5.98 + 4)*88% = 8.77 person.

Table 3.6 Average Number of Units per Residential Type and Population per Building Type

Building type	Average No. units	Average population per building type
Apartment	15.5	89.16
Villa	3.5	19.26
Palace	1	8.77

After digitizing the existing and new buildings, this gives a unique identity by GIS tools, this identity contains Micro-Geographic code and coordinate system. The other information entered manually during the digitizing like building type and stage.

3.7 Discussion

What we have now, while digitizing the building will have the required information:

a) Districts code: to know how much building in each district.
b) Coordinate system: to create geospatial data
c) Building type: to Determine the number and type of buildings in each district, if we know the average population in each building type then will determine the population in each district and the study area, where we can expect the milk market size as FMCG study product, or the required products for each building type then expect the potential market size in district and area.
d) Building stage: This information was necessary to determine the required time for each building type to install the products or ready for living. In this study, I hypothesized that they needed time for products installing is the same time that the building will be prepared to live (the time difference will be ignored). This information is useful for the planning team and logistics operation.

3.8 Conclusion

The study area in this section has determined and its general specification and the data used in this research. Also. The methodology that used to extract and classify the construction, the relationship between the data collected with the buildings were

explained to determine Building needs to products or the expected population for each building then at districts levels.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter will study how we can use this methodology to determine the population at districts level and the expected growth, calculate the cumulative number of community in a specific time; also the population estimation will use to develop a methodology to determine the best site location in the study area. The expected need for an FMCG product (i.e. milk) in the study area will be estimated at the Micro-Geographic level and the expected growth according to time with the cumulative needs for the same periods. Also, determine the growth will help us to calculate the building needs from materials products and applying this methodology to estimate (i.e switches and sockets) market size.

Population analysis:

If we take into account the Authority of **statistics**, table 3.5 and 2013 census, we can expect the population in the residential buildings (Villa, Apartment, and palace) then by using the building stage the population growth and cumulative growth will calculate accordingly. In the following, the expected population which their buildings were detected by satellite image in January 2016 will be studying and analyzing, then the predicted population which can live in the buildings which scanned by satellite image in October 2016 (nine-month difference).

In addition to buildings type, the buildings that extracted by October satellite image will classify to:

a) Completed building: it is ready for a living or installs material products.
b) Under construction buildings: it will be prepared for living or installing after a period which differs according to building type.
c) Basement Buildings: it will be ready for living or installing after a period which changes according to building type. But will take time more than the buildings in the previous stage.

4.1.1 January 2016 Population

The residential buildings extracted by January 2016 satellite images shown in the following Table 4.1. It explains the number of residential buildings with the average population in those building according to building type, and this estimation depends on the table 3.6.

Table 4.1 Expected Population in the Study Area According to Building Type

Building type	NO. of building	Average population per building type (person)	Total population (person)
Villa	44603	19.2676	859392
Apartment	3345	89.16672	298262
Palace	277	8.7809	2432
		Sum	1160086

The majority of people live in Villas while who lives in Palace approaching zero. Figure 4.1, now we search where those people live; in which district; where the highest population live. GIS will help to give each building the district code which located in, here will know how much buildings in each district and how much people in each district.

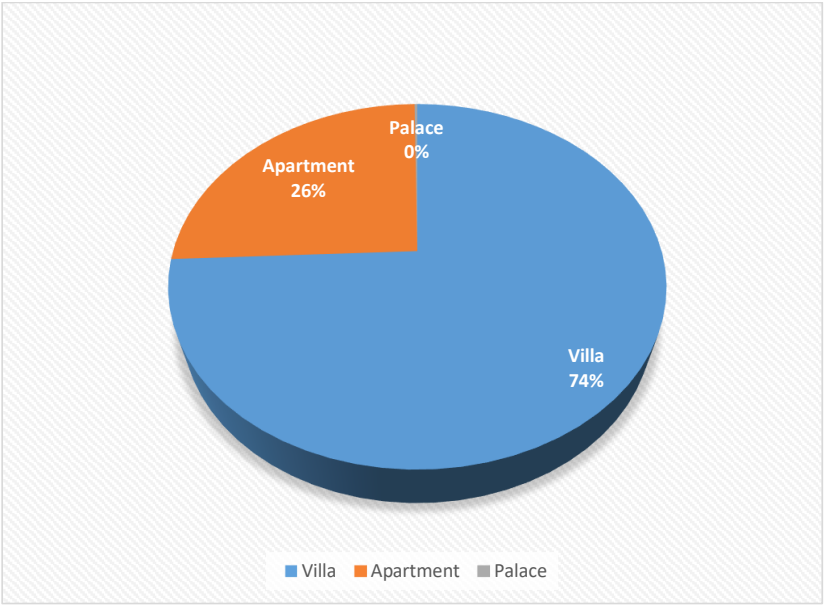


Figure 4.1 People Segmentation at January 2016

This methodology will help the decision-makers to have a good view of the expected demand in the area and change their plan accordingly.

Table 4.2. Expected Population at January 2016

	Building type			expected population per Building type			
District	Apartment	Palace	Villa	Apartment	Palace	Villa	Grand Total
1	176	20	1928	15693	176	37148	53017
2	205	10	2692	18279	88	51868	70235
3	183	11	2365	16318	97	45568	61982
4	148	49	1618	13197	430	31175	44802
5	99	5	729	8828	44	14046	22917
6	20	36	871	1783	316	16782	18882
7	9	16	783	803	141	15087	16030
8	31	17	608	2764	149	11715	14628
9	159	1	430	14178	9	8285	22471
10	576	4	2030	51360	35	39113	90508
11	130	15	1775	11592	132	34200	45923
12	122	14	2363	10878	123	45529	56531
13	37	6	1732	3299	53	33371	36723
14	34	0	266	3032	0	5125	8157
15	79	5	3192	7044	44	61502	68590
16	194	6	3243	17298	53	62485	79836
17	239	21	1701	21311	184	32774	54269
18	8	3	400	713	26	7707	8447
19	9	5	418	803	44	8054	8900
20	135	1	773	12038	9	14894	26940
21	163	7	1421	14534	61	27379	41975
22	110	6	3234	9808	53	62311	72172
23	87	4	2439	7758	35	46994	54786
24	20	0	337	1783	0	6493	8277
25	100	0	909	8917	0	17514	26431
26	1	0	85	89	0	1638	1727
27	17	0	365	1516	0	7033	8549
28	4	0	353	357	0	6801	7158
29	2	0	184	178	0	3545	3724
30	16	4	384	1427	35	7399	8861
31	41	1	612	3656	9	11792	15456
32	0	0	37	0	0	713	713
33	0	0	41	0	0	790	790
35	2	0	14	178	0	270	448
36	4	0	211	357	0	4065	4422
37	48	2	1604	4280	18	30905	35203
38	12	2	579	1070	18	11156	12244
39	2	1	329	178	9	6339	6526
40	58	0	449	5172	0	8651	13823
41	19	2	357	1694	18	6879	8590
42	17	0	150	1516	0	2890	4406
43	27	2	406	2408	18	7823	10248
44	2	1	186	178	9	3584	3771
Grand Total	3345	277	44603	298263	2432	859392	1160087

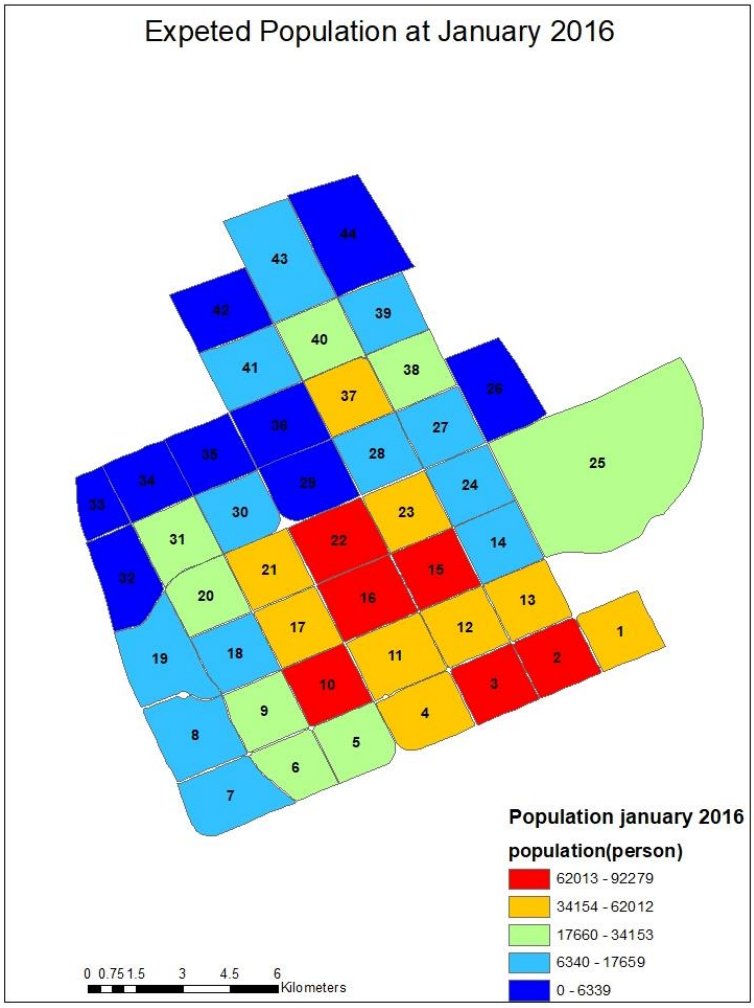


Figure 4.2 Expected Population at January 2016.

Map analysis: This figure shows the expected population according to January buildings, districts with dark Red are the highest population density while the dark blue colour reflects the lowest.

4.1.2 October 2016 Population

The urban growth in the study area will associate with an increase in the population who will live in the new buildings according to the completion of those constructions which was built after January 2016 and detected in the October 2016 Satellite image. The whole

buildings were 4073 while the residential was 4268 buildings. Below table explain the expected population that can live in those buildings as listed in Table 4.3.

Table 4.3 Expected Population According to Buildings Scanned at October 2016

	Building type			expected population per Building type (person)			
District	Apartment	Palace	villa	Apartment	Palace	villa	Grand Total
1	3		27	268		520	788
2	7		64	624		1233	1857
3	6		60	535		1156	1691
4	3		11	268		212	479
5			20			385	385
6	3		18	268		347	614
7		2	47		18	906	923
8	1	4	54	89	35	1040	1165
9	5		9	446		173	619
10	14		16	1248		308	1557
11	3		23	268		443	711
12	2		45	178		867	1045
13	5	9	101	446	79	1946	2471
14	6		58	535		1118	1653
15	31		130	2764		2505	5269
16	5		38	446		732	1178
17	7		42	624		809	1433
18	3	1	77	268	9	1484	1760
19	6		37	535		713	1248
20	28		145	2497		2794	5290
21	15		69	1338		1329	2667
22	8		44	713		848	1561
23	23		165	2051		3179	5230
24	16		141	1427		2717	4143
25	34		211	3032		4065	7097
26	17		97	1516		1869	3385
27	24		259	2140		4990	7130
28			29			559	559
29	1		3	89		58	147
30	13		41	1159		790	1949
31	14		117	1248		2254	3503
32			23			443	443
33			57			1098	1098
35	1		17	89		328	417
36	1		14	89		270	359
37	6		151	535		2909	3444
38	20		459	1783		8844	10627
39			133			2563	2563
40	39		225	3478		4335	7813
41	19		84	1694		1618	3313
42	8		34	713		655	1368
43	30	2	120	2675	18	2312	5005
44	2		111	178		2139	2317
Grand Total	429	18	3626	38253	158	69864	108275

Figure 4.3 shows the expected population according to October 2016 buildings, districts with dark red are the highest population density while the dark blue color reflects the lowest. But this map does not reflect the reality because there are different building construction stages that should consider it during the analysis. Its meaning the duration to complete the construction should be taking in our account, and this will let us determine the expected population growth in the following periods.

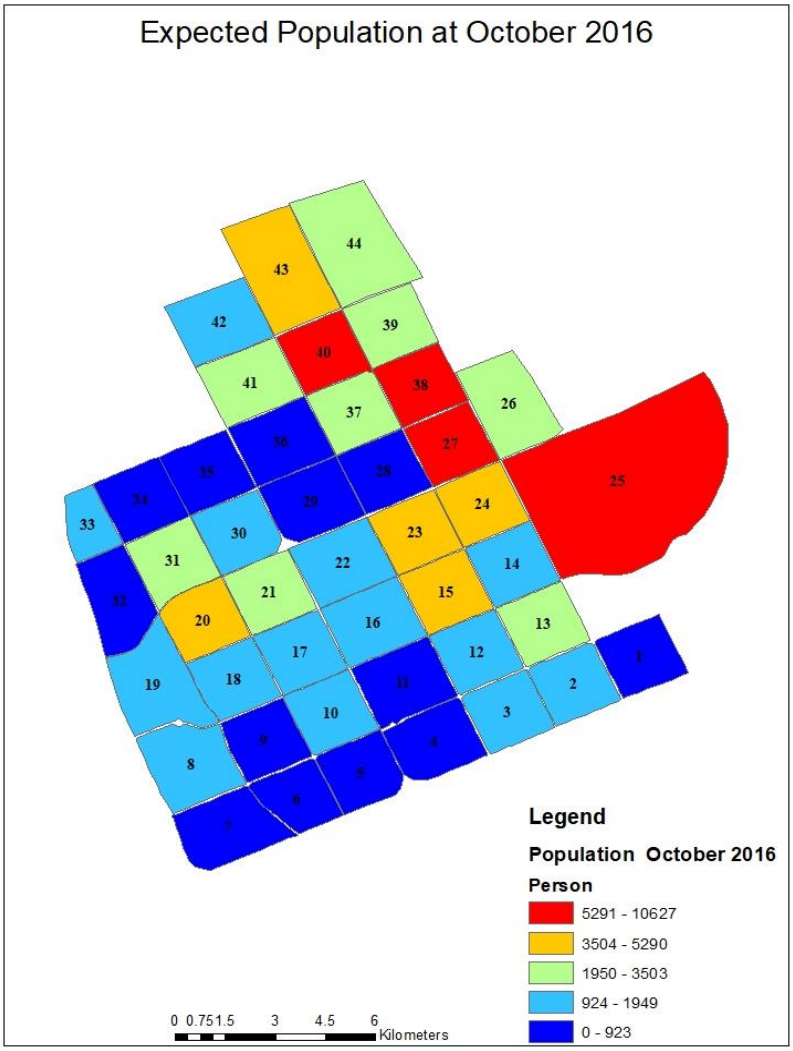


Figure 4.3 Expected Population at October 2016.

The details of the residential buildings according to its construction stage which detected in October image is shown in table 4.4, If we take into account the table 3.2 which explain the building duration) and table 4.4 below, the results are the constructions which will be ready to living depending on the required time to complete, which is helping to identify the buildings that will be ready for living in that time and its population capacity, table 4.5.

Table 4.4 Total Buildings for October 2016 Construction with its Buildings Stage

	Construction level			
Building type	Basement	Under construction	construction completed	Grand Total
Apartment	81	127	221	429
Palace	6	9	3	18
villa	764	640	2222	3626
Grand Total	851	776	2446	4073

Table 4.4 shows us the expected population after three months, six months, one and two years for October buildings depending on the districts. After three months (starting from October 2016) the expected of the new population is 62545 person, after six months the expected population will increase by 12331 people and so on, the total expected increase in population 108275 Depending on the October buildings.

Table 4.5 Expected Population According to The Construction Stage for October Buildings.

	Expected population according to the construction stage for October buildings (person)				
District	Three Month	Six Month	One Year	Two Year	Total population two years later
1	602	19	166		788
2	1351	96	320	89	1857
3	1332	77	193	89	1691
4	116	96	268		479
5	308		77		385
6	467		58	89	614
7	385	58	462	18	923
8	599	135	413	18	1165
9	383	19	128	89	619
10	658	58	574	268	1557
11	205	212	294		711
12	841	58	58	89	1045
13	1305	328	750	89	2471
14	949	58	557	89	1653
15	3746	308	947	268	5269
16	865	96	128	89	1178
17	1043	116	186	89	1433
18	995	212	455	98	1760
19	576	39	634		1248
20	2867	385	1593	446	5291
21	1573	443	561	89	2667
22	1164	135	263		1561
23	3180	347	1169	535	5230
24	2300	559	660	624	4143
25	4103	713	1836	446	7097
26	1896	328	626	535	3385
27	3782	925	1800	624	7130
28	193	308	58		559
29	19	39	89		147
30	641	135	906	268	1949
31	1696	135	1494	178	3503
32	19	39	385		443
33	328	231	540		1098
35	96	116	205		417
36	186	116	58		359
37	1727	751	699	268	3444
38	7320	1753	1376	178	10627
39	1580	424	559		2563
40	5153	732	1571	357	7813
41	1874	308	952	178	3313
42	773	96	320	178	1368
43	2375	829	990	811	5005
44	976	501	751	89	2317
Total population	62545	12331	26124	7275	108275

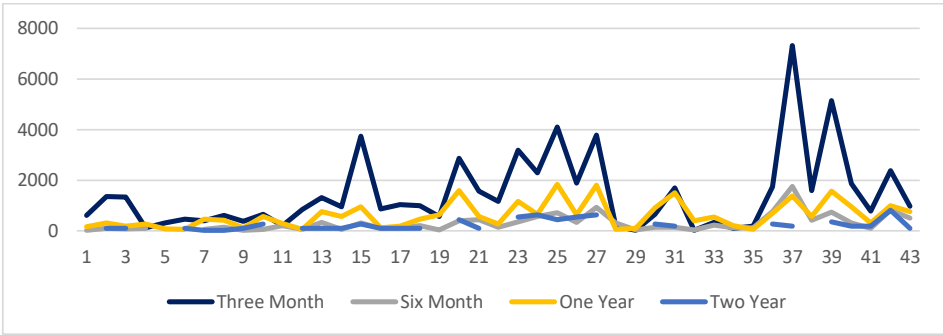


Figure 4.4 Expected Population According to the Construction Stage for October Buildings.

Figure 4.4 analysis: the majority of population growth will be three months later starting from October 2016, while the lowest growth will be two years later beginning in October 2016, so this is related to the buildings increasing which also the building types have an impact. The results in Table 4.5 explains in figures 4.5 to 4.8 as the population segmentation, as a visual map to be more readable.

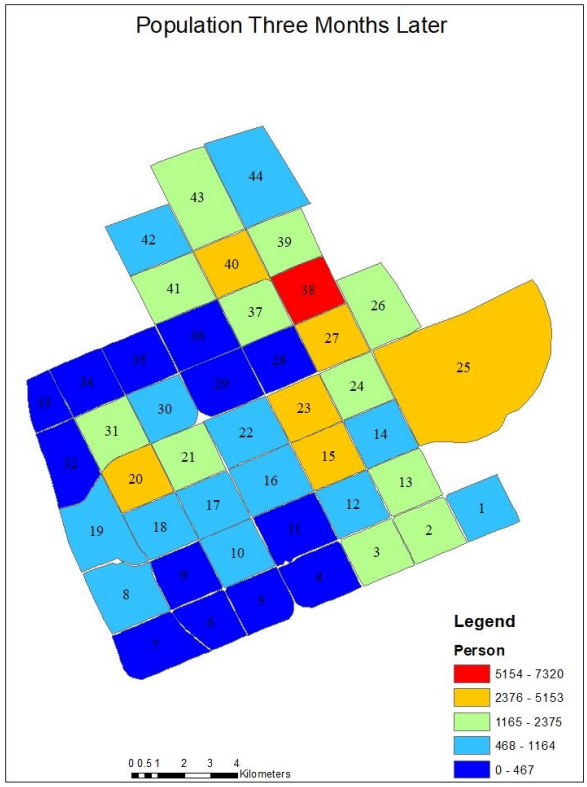


Figure 4.5 The Expected Increase in Population Three Months Later per Districts

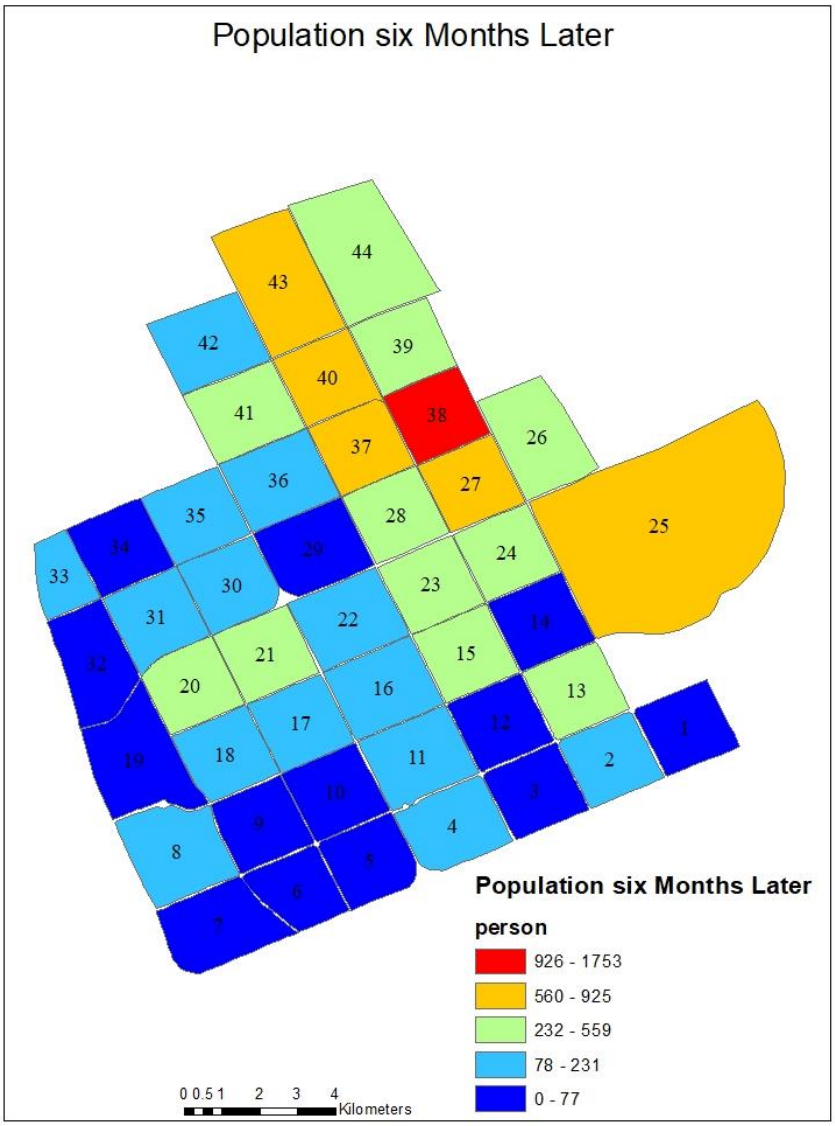


Figure 4.6 The Expected Increase in Population Six Months Later per Districts

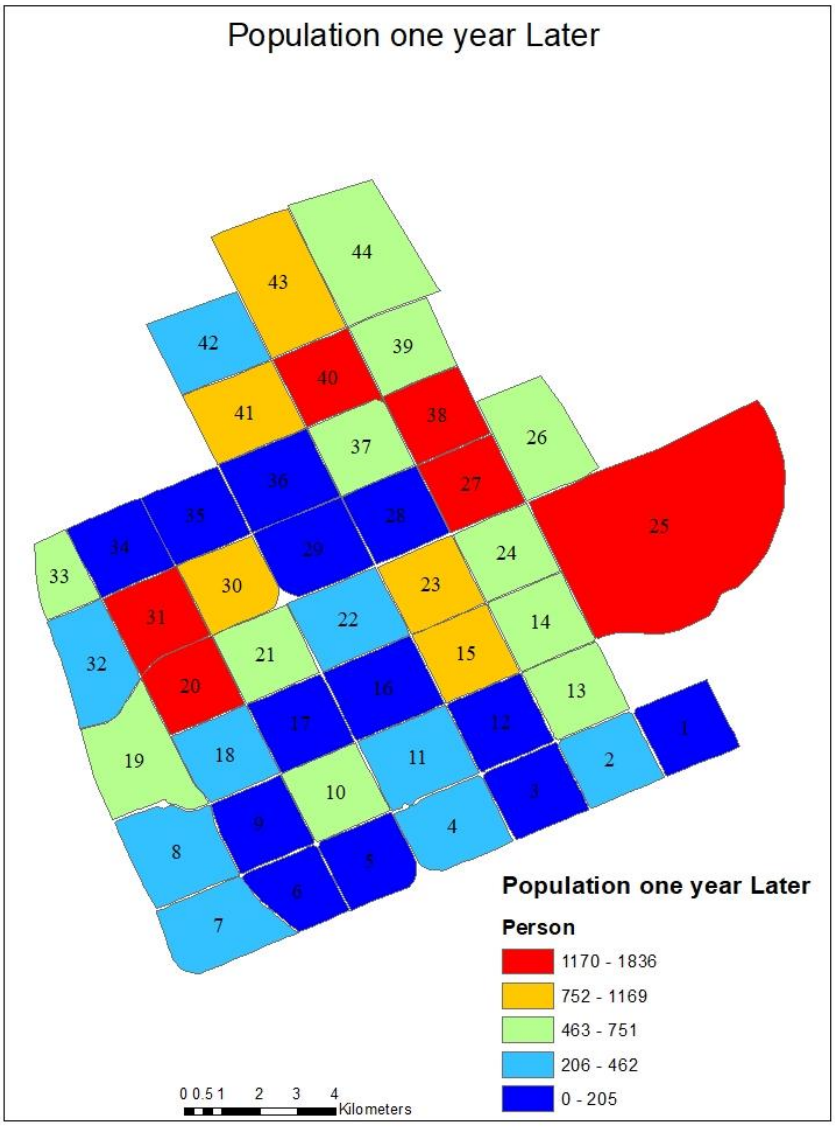


Figure 4.7 The Expected Increase in Population One Year Later per Districts

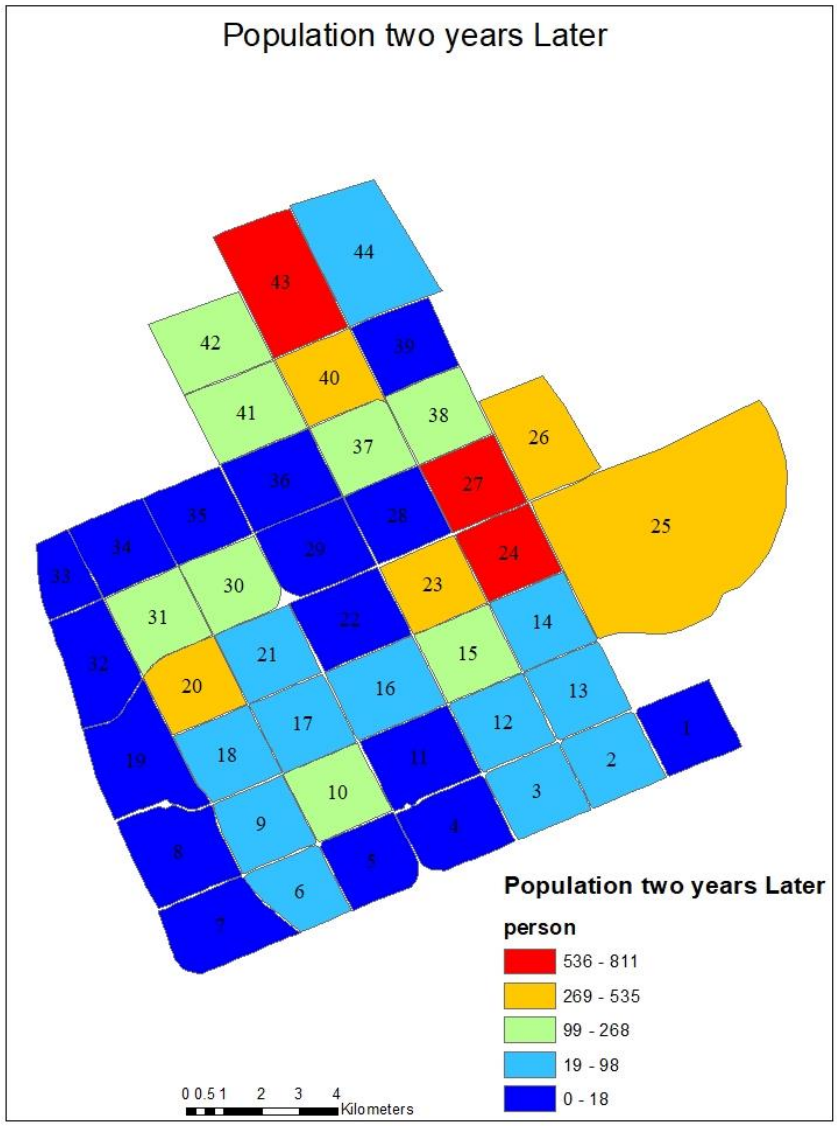


Figure 4.8 the Expected Increase in Population Two Years Later per Districts

Maps analysis: Figures 4.5 to 4.8 shows the expected population increases according to October 2016 buildings for the periods three months to two years. Districts with dark red are the highest population growth while the dark blue colour reflects the lowest.

4.2 Cumulative Population

Furthermore, if we want to know the cumulative population for the same periods (three months, six months, one year and two years), namely the expected population growth after three months was 1874 but the cumulative population is the population living in the studying area is the current population (January 2016) plus the expected population growth after three months 1160087plus 62545 this equal to 1222632 people. By applying this equation:

CUM (n) = POP (Current) + Ex POP (n) 4.1

n = after three-months, Ex POP (n) = expected population growth after (n) period

POP (current) = January 2016

CUM (3) = 1160087 + 62545 = 1222632 person

While the six-month population cumulative is three months cumulative plus six months expected growth 1222632 +12331= 1234963 people.

It is essential for forecasting and planning; the decision-makers will know with reliability and accuracy what the region needs to, what the market size when the market needs the services, the government will be able to improve its planning to meet the user's requirements.

Table 4.6 Expected Cumulative Population According to the Construction Stage for Total Buildings

		October Buildings influences			
District	January population	Three Month cumulative	Six Month cumulative	One Year cumulative	Two Year cumulative
1	53017	53619	53638	53805	53805
2	70235	71587	71683	72003	72093
3	61982	63314	63391	63584	63673
4	44802	44918	45014	45281	45281
5	22917	23226	23226	23303	23303
6	18882	19349	19349	19407	19496
7	16030	16415	16473	16935	16953
8	14628	15227	15362	15775	15793
9	22471	22854	22874	23001	23091
10	90508	91166	91224	91798	92065
11	45923	46128	46340	46634	46634
12	56531	57371	57429	57487	57576
13	36723	38028	38356	39105	39194
14	8157	9106	9164	9720	9809
15	68590	72337	72645	73592	73859
16	79836	80701	80797	80925	81014
17	54269	55313	55428	55614	55703
18	8447	9441	9653	10109	10207
19	8900	9476	9515	10148	10148
20	26940	29807	30192	31785	32231
21	41975	43548	43991	44553	44642
22	72172	73336	73471	73734	73734
23	54786	57966	58313	59481	60016
24	8277	10577	11136	11796	12420
25	26431	30534	31246	33082	33528
26	1727	3623	3950	4577	5112
27	8459	12241	13166	15055	15679
28	7158	7351	7659	7717	7717
29	3724	3743	3781	3871	3871
30	8861	9501	9636	10542	10810
31	15456	17152	17287	18781	18959
32	713	732	771	1156	1156
33	790	1118	1349	1888	1888
35	448	544	660	865	865
36	4422	4608	4723	4781	4781
37	35203	36930	37681	38380	38647
38	12056	19376	21130	22692	22871
39	6526	8106	8530	9089	9089
40	13734	18887	19619	21279	21636
41	8590	10465	10773	11725	11903
42	4406	5179	5276	5596	5774
43	10159	12533	13362	14441	15252
44	3771	4746	5247	5999	6088
Total population	1159633	1222178	1234509	1261087	1268363

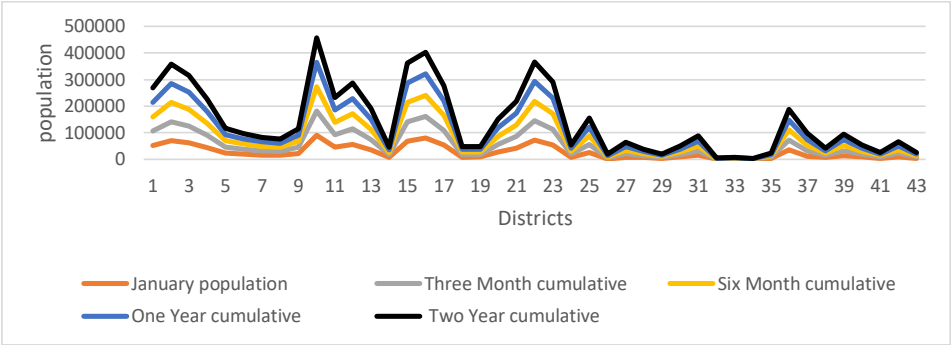


Figure 4.9 Expected Cumulative Population According to the Construction Stage for Total Buildings

Figure 4.9 analysis: the charts show us that the highest population cumulative was two years later after October 2016. While the lowest population cumulative was three months later after October 2016.

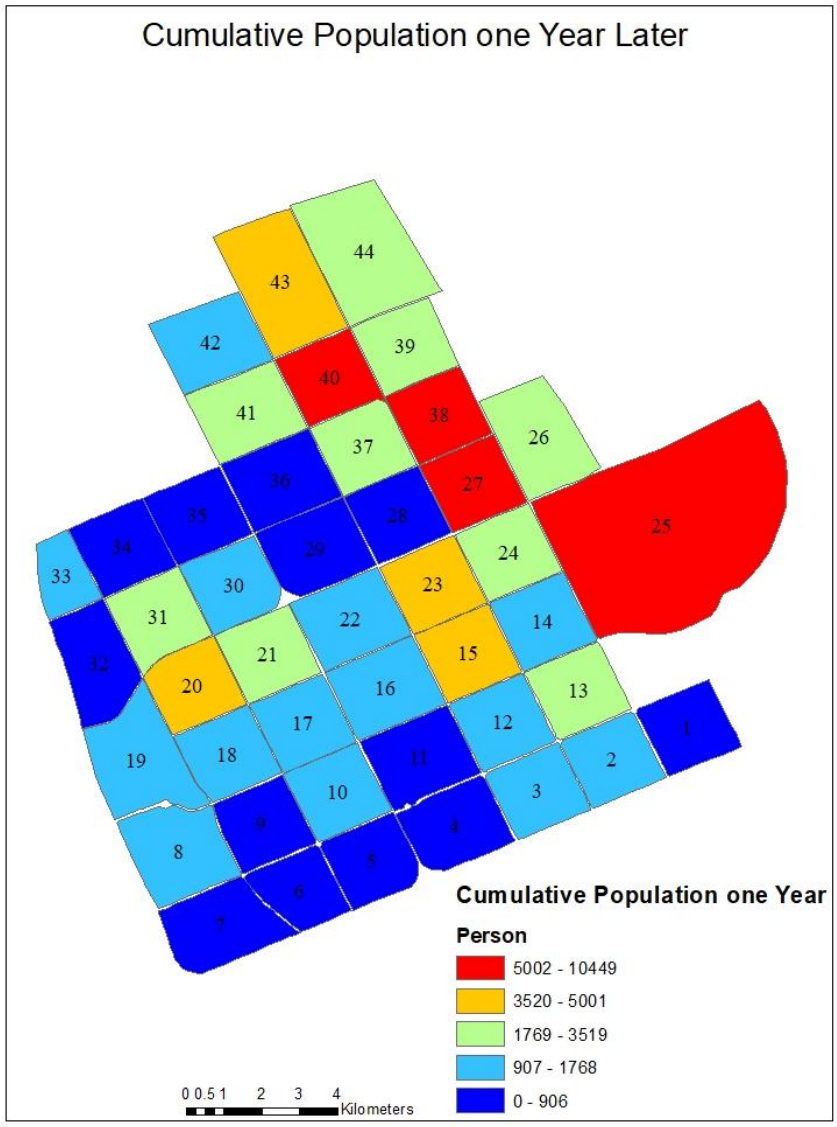


Figure 4.10 The Expected Cumulative Population one Year Later

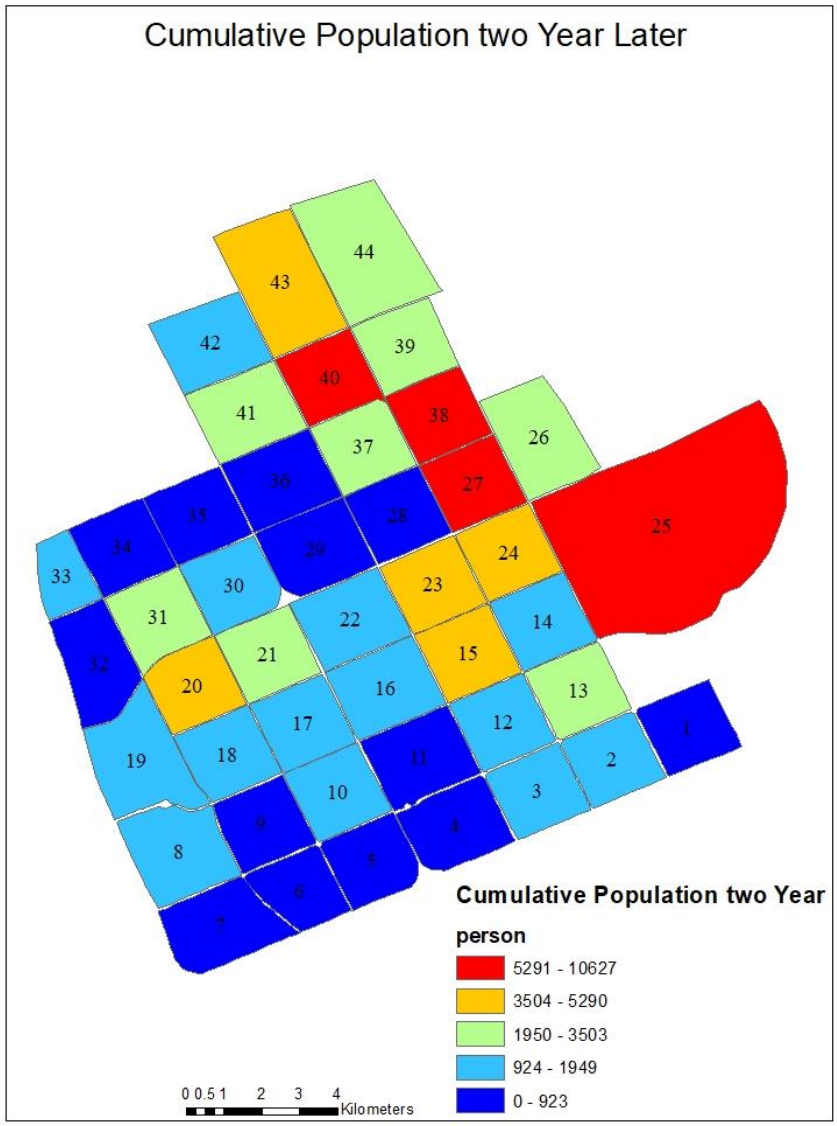


Figure 4.11 The Expected Cumulative Population Two Years Later

Maps analysis: The figures 4.10 and 4.11 show the expected cumulative population which calculated for all buildings that detected in January and October 2016. Districts with dark Red are the highest population growth while the dark blue colour reflects the lowest.

4.3 Milk Market Size

The information that obtained from Satellite images and Geomarketing which provide information about the existing buildings which detected at January 2016 and new buildings which built after January 2016 and detected at October 2016, these information will support the business and industry with the new tools which gives the required data about the new business volume with associated geospatial data for better understanding about the market situations, market size and the potential market, potential manpower or any required information that can support the decision- makers. The big challenge for the Science and the researchers are using it in industry or business, we studied the population forecasting according to the periods and micro-geographic areas, and this will be valuable for studying FMCG products like Milk. Which is an essential strategic product to find out how much people need it and what time it takes to need it, this kind of FMCG cannot keep for a long time it would, therefore, be useful to know how much people will need (Quantity), where and when? This is a challenge to improve planning, control production to meet the need of people for fresh milk daily and prevent any waste in the resources.

4.3.1 January 2016 Milk Market size

We will discuss in the following the milk market size depending on the population, which was estimated based on the existing buildings in the previous sections. The estimation population in January 2016 was 1160087 person in the studying area, table 4.2, by taking it in our account and consider the Nielsen survey, table 3.3. The following table 4.7 explains the milk consumption daily, and yearly in the study area for the population which lives in January 2016 buildings, we need this total volume to understand the expected market size Regardless of the subsequent increase in the population which we will study it for October buildings.

Table 4.7 Expected Daily and Yearly Milk Consumption According to January Buildings

District	Yearly Consumption(L)	Daily Consumption(L)
1	2128628	5832
2	2819950	7726
3	2488576	6818
4	1798797	4928
5	920137	2521
6	758093	2077
7	643585	1763
8	587320	1609
9	902225	2472
10	3633912	9956
11	1843824	5052
12	2269704	6218
13	1474442	4040
14	327498	897
15	2753899	7545
16	3205410	8782
17	2178918	5970
18	339136	929
19	357346	979
20	1081647	2963
21	1685292	4617
22	2897724	7939
23	2199670	6026
24	332302	910
25	1061201	2907
26	69336	190
27	343223	940
28	287399	787
29	149501	410
30	355751	975
31	620574	1700
32	28623	78
33	31717	87
35	17990	49
36	177549	486
37	1413392	3872
38	491577	1347
39	262025	718
40	554986	1521
41	344899	945
42	176900	485
43	411446	1127
44	151401	415
Total	46577525	127610

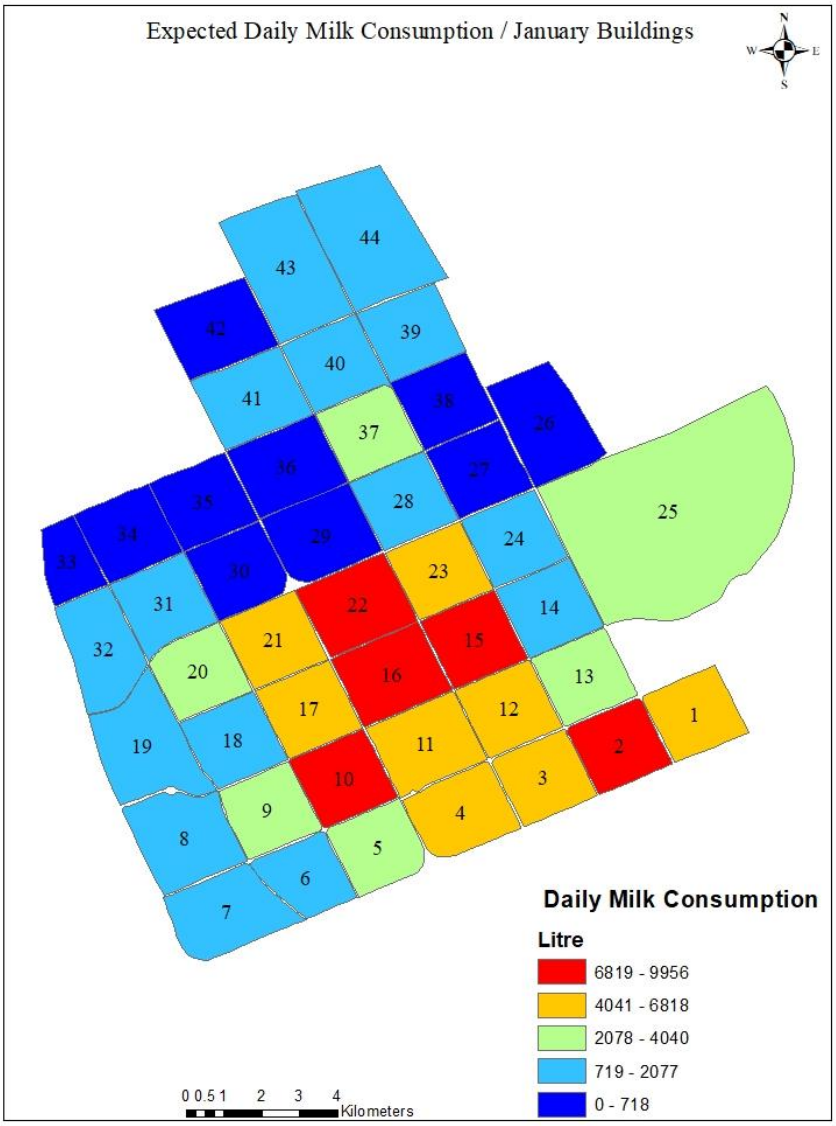


Figure 4.12 Expected Daily Milk Consumption According to January Buildings.

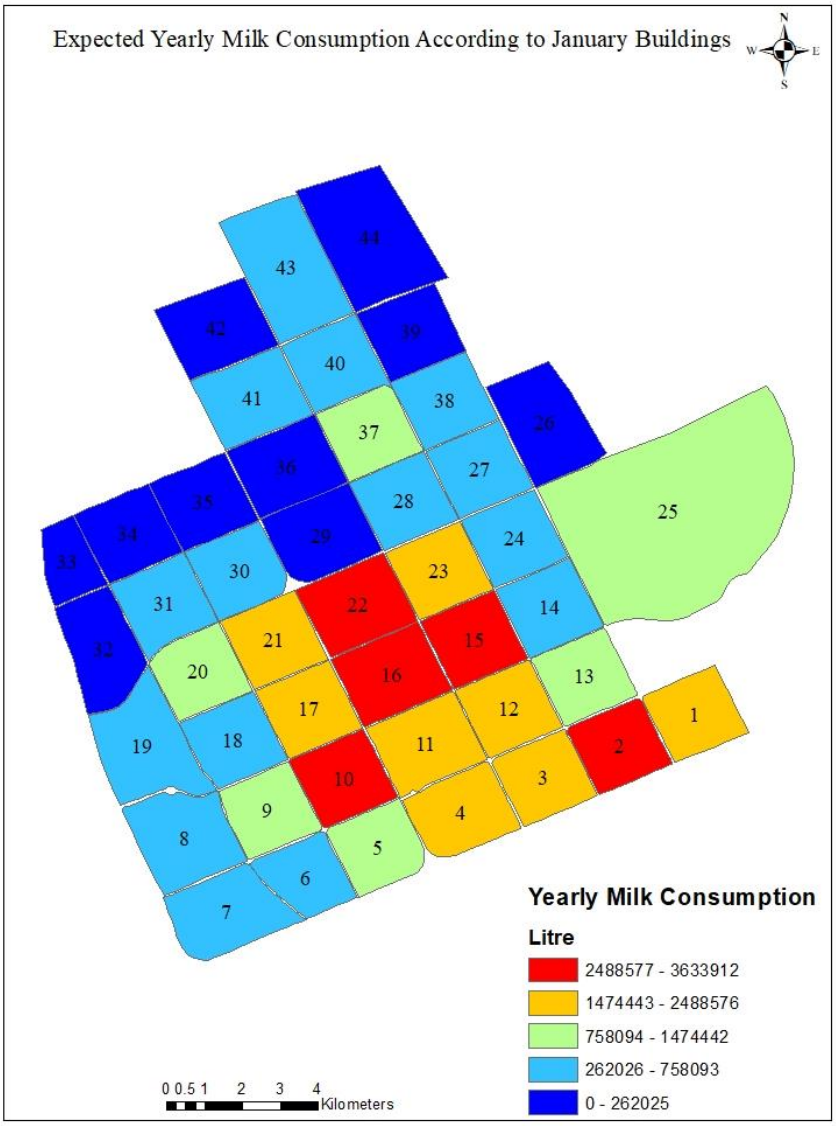


Figure 4.13 Expected Yearly Milk Consumption According to January Buildings.

Maps analysis: Figure 4.12 and Figure 4.13 show the highest districts potential that required the planning team, and decision maker's to focus in. The dark blue reflect the highest expected consumption while the medium yellow is the lowest potential market size.

4.3.2 October 2016 Milk Market Size

4.3.2.1 Daily Milk Market Size Forecasting

This section discusses the methodology of forecasting the demand for fresh milk according to the population growth studied, based on the increase in urban growth. As we reviewed, we have population growth depending on the new buildings and its stages, which will give us the chance to calculate the population's needs for different products like fresh milk continuously. Will consider the expected needs after three months, six months, one year, two years and the cumulative needs for the same periods, will study it daily and yearly.

A. Daily Milk market size after three months

At the beginning of 2016 (at January) the expected population was 1160087 person, (table 4.2), so we calculated its expected Milk needs (127609.68 L per day), the planned capacity of the study area can increase by 62545 persons after three months, here we can know the expected human milk needs after this period by applying this equation:

DM = Ex POP (n) * AVE M 4.1.

DM = Daily Milk needs

Ex POP (n) = expected population growth after (n) period, n = three month

AVE M = person's daily milk consumption

Daily Milk needs= population for this period * person's daily consumption (0.11 L) =62545*0.11= 6879.95 L/ day.

This means we will need after three months (starting from April 2016) 6879.95 L Milk every day for those new people in studying area, Figure (4.14), here the concerned companies must plan to meet these requirements.

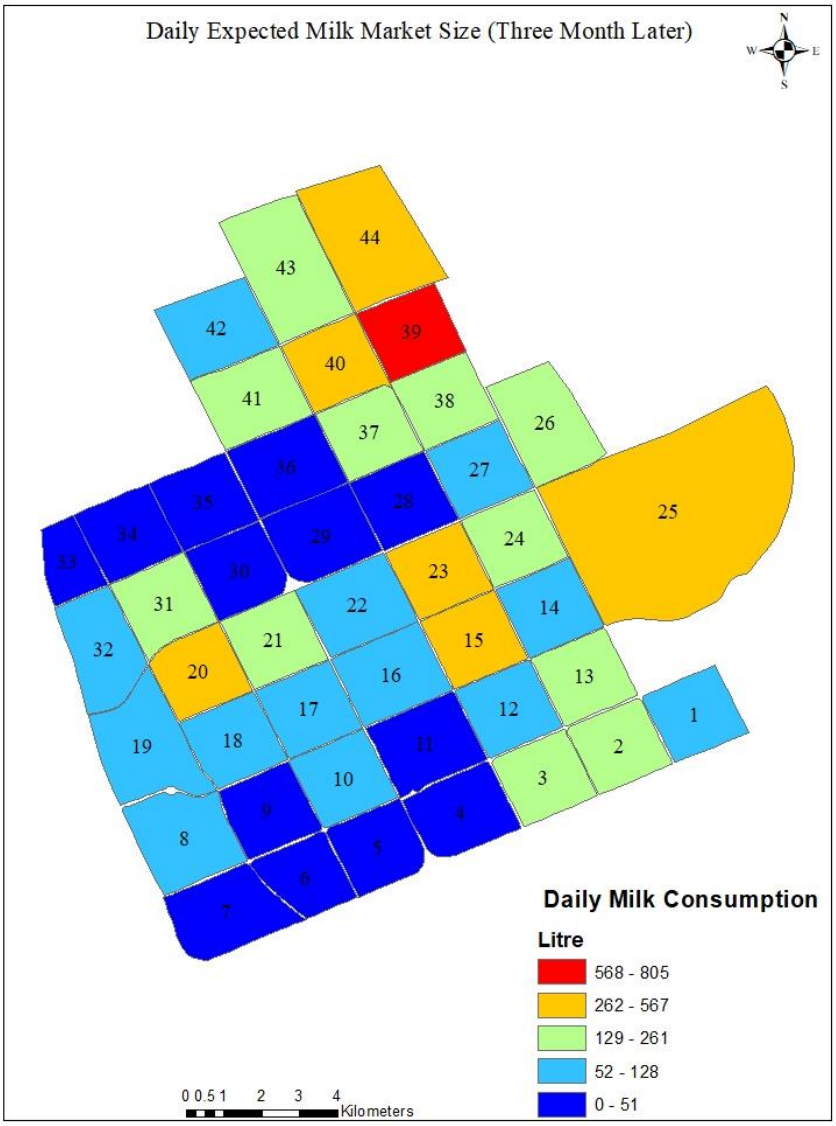


Figure 4.14 Daily Expected Milk Market Size (Three Month Later)

Then we can expect the cumulative market size for the same period (three months), we can calculate it with this equation:

CUM DM (n) = DM (n) + DM (n-t) 4.2

CUM DM (n) = Cumulative milk market size a specific period

DM (n-t) = previous period Market size

N = October

t = previous period (here January 2016)

Cumulative milk market size= Daily milk needs for this period + previous period Market size (here January) = 6879.95 + 127559.65 =127559.65 L per day, Figure 4.15

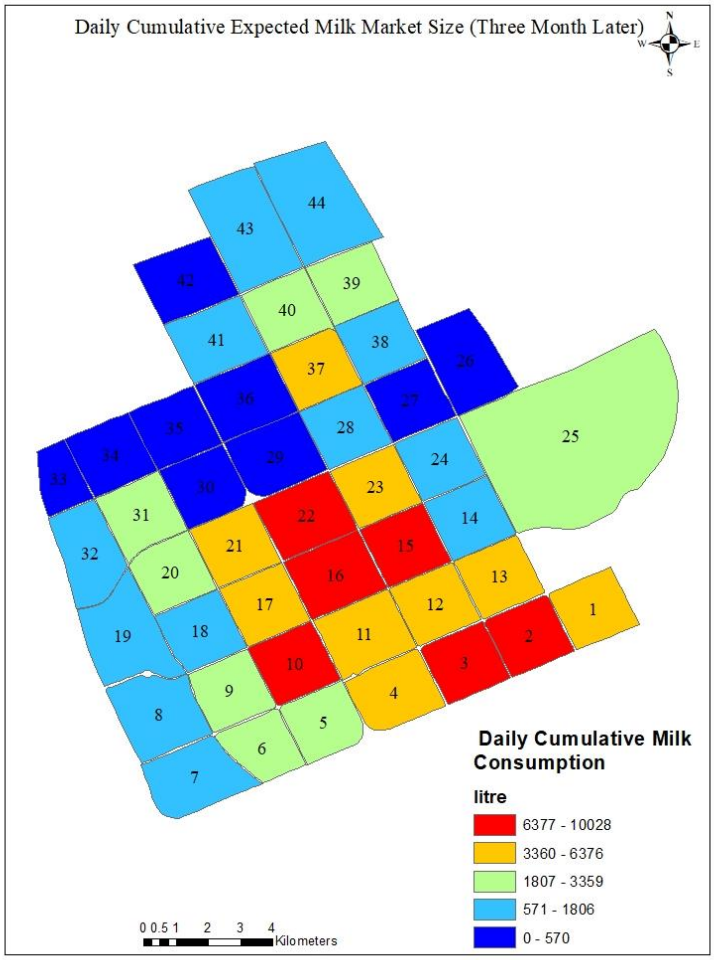


Figure 4.15 Daily Cumulative Expected Milk Market Size (Three Month Later)

The consumption at the districts level shown in the following table 4.8. It showed the difference between expected cumulative consumption and expected to increase for the same period as a result of the increase in population in each district.

Table 4.8 Daily Expected Milk Market Size Three Months later

District	Three Month later (litre)	Three months cumulative (Litre)
1	66	5898
2	149	7875
3	147	6965
4	13	4941
5	34	2555
6	51	2128
7	42	1806
8	66	1675
9	42	2514
10	72	10028
11	23	5074
12	92	6311
13	144	4183
14	104	1002
15	412	7957
16	95	8877
17	115	6084
18	109	1039
19	63	1042
20	315	3279
21	173	4790
22	128	8067
23	350	6376
24	253	1163
25	451	3359
26	209	399
27	416	1347
28	21	809
29	2	412
30	70	1045
31	187	1887
32	2	81
33	36	123
35	11	60
36	20	507
37	190	4062
38	805	2131
39	174	892
40	567	2078
41	206	1151
42	85	570
43	261	1379
44	107	522
Grand Total	6880	134440

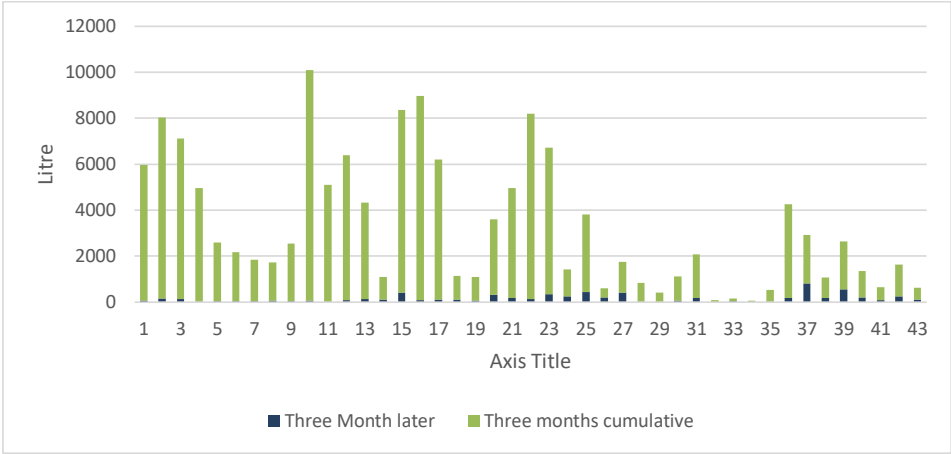


Figure 4.16 Difference between Market Size and Cumulative Market Size after Three Months

Figure 4.16 explains how we can distinguish between the cumulative market size and the increasing market size for the same period. The cumulative size will tell us how much the market size will be after the period that we want to prepare to forecast to it, while the increase in market size tells us only what the expected value that added to the market, the cumulative demand is higher than the other value.

B. Daily Milk market size for the others periods

With the same methodology, Milk market size can expect for different periods. For Milk market size, the table (4.9) shows the market size for varying periods, while the table (4.10) shows us the expected cumulative milk market size for the same periods.

Table 4.9 Daily Expected Consumption According to October Buildings at Districts Level (by Litre)

District	January	Three Month later	Six Month later	One Year later	Two Year later	Grand Total
1	5832	66	2	18	0	5919
2	7726	149	11	35	10	7930
3	6818	147	8	21	10	7004
4	4928	13	11	29	0	4981
5	2521	34	0	8	0	2563
6	2077	51	0	6	10	2145
7	1763	42	6	51	2	1865
8	1609	66	15	45	2	1737
9	2472	42	2	14	10	2540
10	9956	72	6	63	29	10127
11	5052	23	23	32	0	5130
12	6218	92	6	6	10	6333
13	4040	144	36	82	10	4311
14	897	104	6	61	10	1079
15	7545	412	34	104	29	8125
16	8782	95	11	14	10	8912
17	5970	115	13	20	10	6127
18	929	109	23	50	11	1123
19	979	63	4	70	0	1116
20	2963	315	42	175	49	3545
21	4617	173	49	62	10	4911
22	7939	128	15	29	0	8111
23	6026	350	38	129	59	6602
24	910	253	61	73	69	1366
25	2907	451	78	202	49	3688
26	190	209	36	69	59	562
27	931	416	102	208	69	1725
28	787	21	34	6	0	849
29	410	2	4	10	0	426
30	975	70	15	100	29	1189
31	1700	187	15	164	20	2085
32	78	2	4	42	0	127
33	87	36	25	59	0	208
35	49	11	13	23	0	95
36	486	20	13	6	0	526
37	3872	190	83	77	29	4251
38	1326	805	193	172	20	2516
39	718	174	47	61	0	1000
40	1511	567	81	183	39	2380
41	945	206	34	105	20	1309
42	485	85	11	35	20	635
43	1117	261	91	119	89	1678
44	415	107	55	83	10	670
Grand Total	127560	6880	1356	2924	800	139520

Table 4.10 Daily Expected Cumulative Consumption According to October Buildings (by Litre)

District	January	Three months cumulative	Six months cumulative	One year cumulative	Two year cumulative
1	5832	5898	5900	5919	5919
2	7726	7875	7885	7920	7930
3	6818	6965	6973	6994	7004
4	4928	4941	4952	4981	4981
5	2521	2555	2555	2563	2563
6	2077	2128	2128	2135	2145
7	1763	1806	1812	1863	1865
8	1609	1675	1690	1735	1737
9	2472	2514	2516	2530	2540
10	9956	10028	10035	10098	10127
11	5052	5074	5097	5130	5130
12	6218	6311	6317	6324	6333
13	4040	4183	4219	4302	4311
14	897	1002	1008	1069	1079
15	7545	7957	7991	8095	8125
16	8782	8877	8888	8902	8912
17	5970	6084	6097	6118	6127
18	929	1039	1062	1112	1123
19	979	1042	1047	1116	1116
20	2963	3279	3321	3496	3545
21	4617	4790	4839	4901	4911
22	7939	8067	8082	8111	8111
23	6026	6376	6414	6543	6602
24	910	1163	1225	1298	1366
25	2907	3359	3437	3639	3688
26	190	399	435	503	562
27	931	1347	1448	1656	1725
28	787	809	843	849	849
29	410	412	416	426	426
30	975	1045	1060	1160	1189
31	1700	1887	1902	2066	2085
32	78	81	85	127	127
33	87	123	148	208	208
35	49	60	73	95	95
36	486	507	520	526	526
37	3872	4062	4145	4222	4251
38	1326	2131	2324	2496	2516
39	718	892	938	1000	1000
40	1511	2078	2158	2341	2380
41	945	1151	1185	1290	1309
42	485	570	580	616	635
43	1117	1379	1470	1589	1678
44	415	522	577	660	670
Grand Total	127560	134440	135796	138720	139520

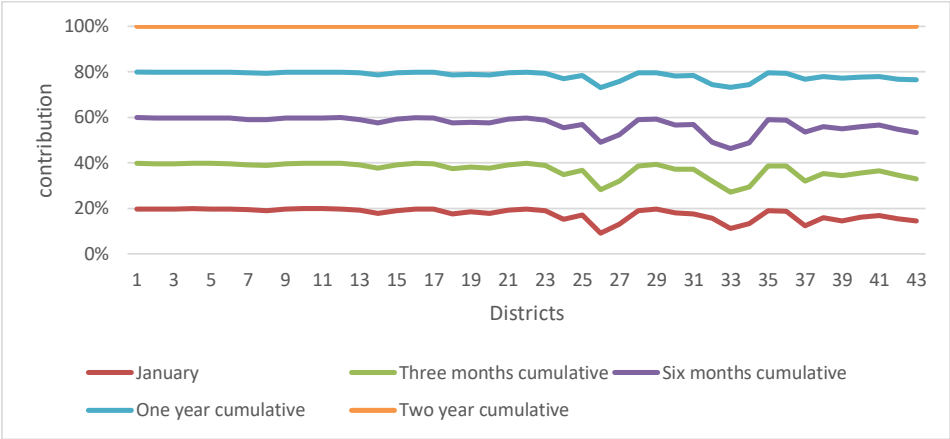
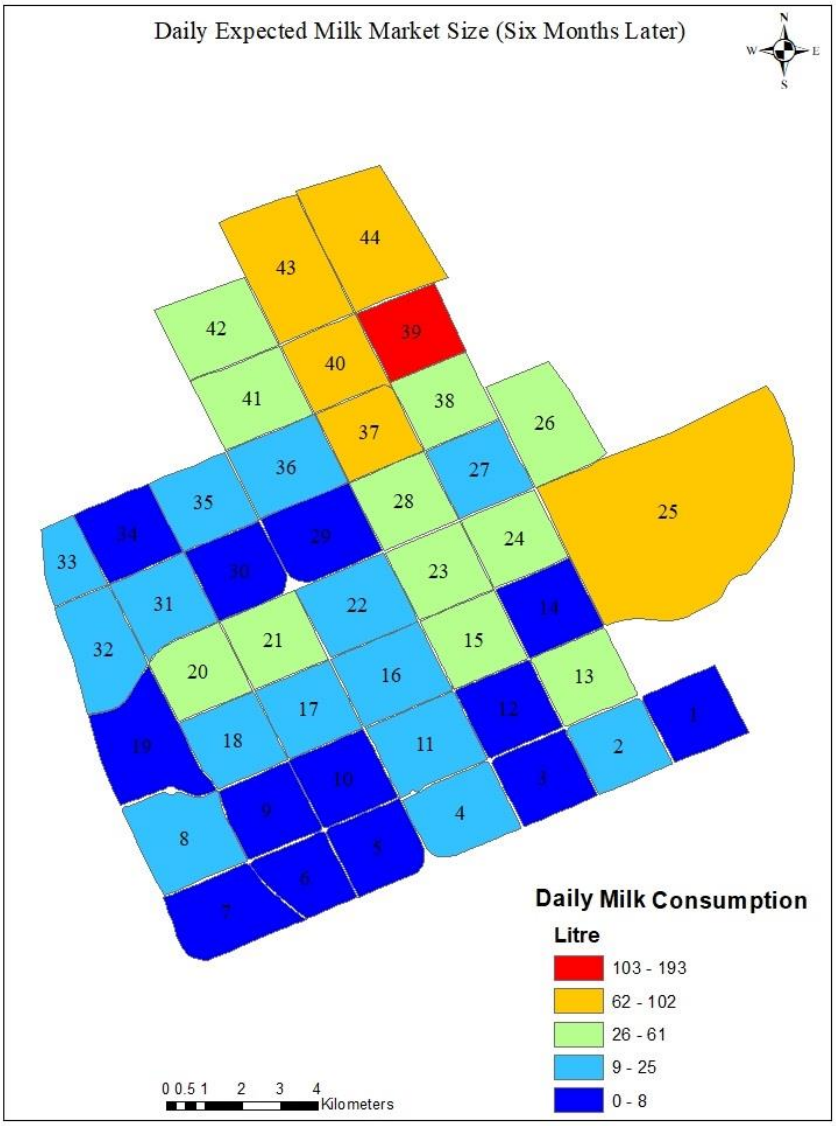
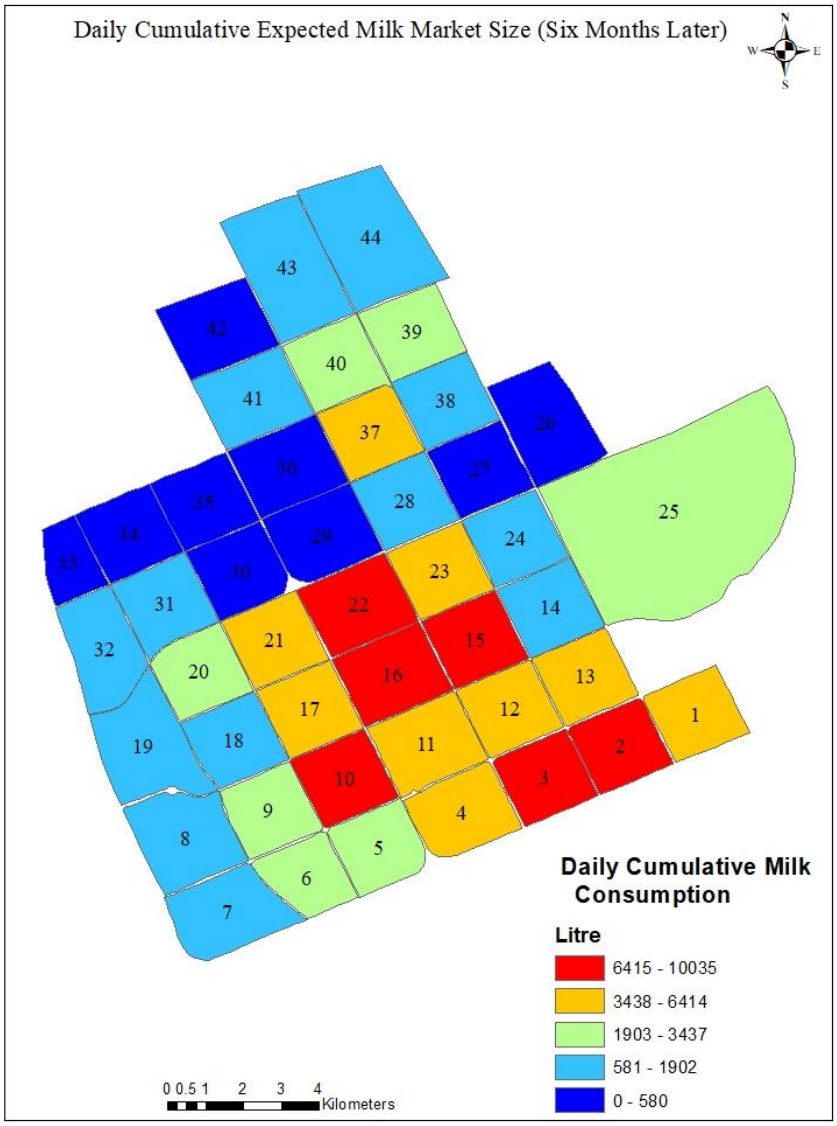


Figure 4.17 Contribution of Cumulative Daily Expected Milk Market Size over the Year

Figure 4.17 shows the contribution of population growth rates to the population's milk need according to time during the study period, two years after October 2016.



Figures 4. 18 Daily Expected Milk Market Size (Six Months Later).



Figures 4. 19 Daily Cumulative Expected Milk Market Size (Six Months Later).

Maps analysis: Figure 4.18 and 4.19 show the highest districts potential that required the planning team and decision maker's to focus on. The dark red reflect the highest expected consumption while the dark blue is the lowest potential market size, (district with no colour mean there are no buildings at that time), and by using this maps we can

determine where the decision makers have to take the right action on time to prevent any bottleneck in the future.

4.3.2.2 Yearly Milk Market Size Forecasting.

Knowledge of the expected annual market size will enhance the planning process and gives the ability to meet the requirements in time for having the necessary resources. With same mechanism which we used in the previous section (Daily Milk market size forecasting) to calculate the results for the yearly expected demand, Table 4.11 shows us the annual expected milk market size for the October population growth at districts level, its useful to have good knowledge about the people Milk needs for the required periods according to populations growth.

Table 4.11 Yearly Milk Consumption According to October Buildings Stage

District	January milk Demand	Three Month later	Six Month later	One Year later	Two Year later	Grand Total
1	2128628	24179	774	6674	0	2160256
2	2819950	54259	3868	12863	3580	2894520
3	2488576	53486	3094	7736	3580	2556472
4	1798797	4642	3868	10740	0	1818047
5	920137	12378	0	3094	0	935609
6	758093	18764	0	2321	3580	782758
7	643585	15472	2321	18566	705	680650
8	587320	24046	5415	16598	705	634084
9	902225	15382	774	5127	3580	927088
10	3633912	26410	2321	23027	10740	3696410
11	1843824	8222	8510	11802	0	1872356
12	2269704	33750	2321	2321	3580	2311676
13	1474442	52381	13151	30094	3580	1573648
14	327498	38104	2321	22344	3580	393846
15	2753899	150417	12378	38014	10740	2965447
16	3205410	34722	3868	5127	3580	3252706
17	2178918	41882	4642	7448	3580	2236469
18	339136	39939	8510	18278	3933	409795
19	357346	23118	1547	25438	0	407449
20	1081647	115103	15472	63938	17900	1294059
21	1685292	63164	17793	22542	3580	1792371
22	2897724	46721	5415	10542	0	2960402
23	2199670	127660	13925	46919	21480	2409654
24	332302	92363	22434	26500	25060	498660
25	1061201	164720	28623	73707	17900	1346151
26	69336	76118	13151	25150	21480	205235
27	339643	151840	37133	75830	25060	629505
28	287399	7736	12378	2321	0	309833
29	149501	774	1547	3580	0	155402
30	355751	25726	5415	36376	10740	434009
31	620574	68094	5415	59962	7160	761205
32	28623	774	1547	15472	0	46416
33	31717	13151	9283	21661	0	75812
35	17990	3868	4642	8222	0	34722
36	177549	7448	4642	2321	0	191959
37	1413392	69336	30170	28047	10740	1551685
38	484064	293893	70397	62743	7160	918257
39	262025	63435	17019	22434	0	364913
40	551406	206890	29397	66654	14320	868667
41	344899	75254	12378	38211	7160	477902
42	176900	31051	3868	12863	7160	231842
43	407865	95342	33265	43339	32573	612383
44	151401	39165	20113	30170	3580	244430
Grand Total	46559272	2511174	495100	1067117	292099	50924762

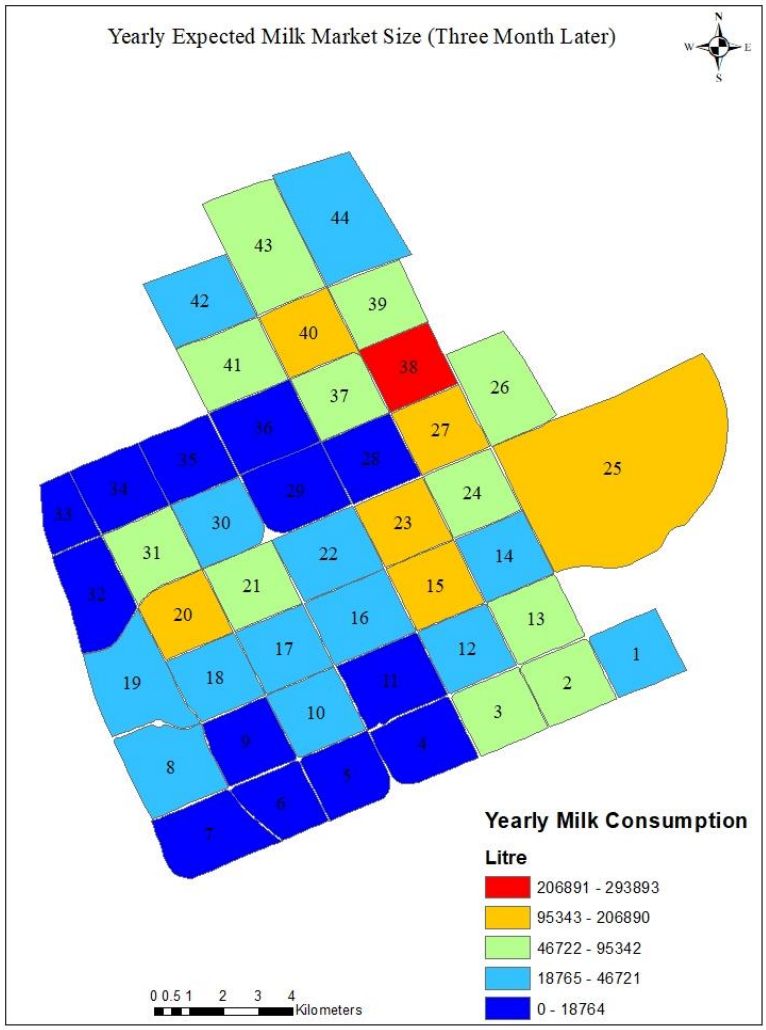


Figure 4.20 Yearly Expected Milk Market Size (Three Month Later)

4.3.2.3 Cumulative Yearly Milk Market Size Forecasting

We need to calculate the cumulative annual milk volume to form a broader idea of the actual need for the population based on the consumption data that previously estimated in the daily tables. Table 4.12 shows us the yearly cumulative expected milk market size for October growth at districts. This table provides us with the reading for the requirements to put it in our plan.

Table 4.12 Yearly Cumulative Consumption According to October Buildings (Litre)

District	January milk Demand	Three Month cumulative	Six Month cumulative	One Year cumulative	Two Year cumulative
1	2128628	2152808	2153581	2160256	2160256
2	2819950	2874209	2878077	2890940	2894520
3	2488576	2542062	2545156	2552892	2556472
4	1798797	1803439	1807307	1818047	1818047
5	920137	932515	932515	935609	935609
6	758093	776857	776857	779178	782758
7	643585	659057	661378	679944	680650
8	587320	611366	616781	633379	634084
9	902225	917607	918380	923508	927088
10	3633912	3660321	3662642	3685670	3696410
11	1843824	1852045	1860555	1872356	1872356
12	2269704	2303454	2305775	2308096	2311676
13	1474442	1526823	1539974	1570068	1573648
14	327498	365601	367922	390266	393846
15	2753899	2904316	2916694	2954707	2965447
16	3205410	3240131	3243999	3249126	3252706
17	2178918	2220799	2225441	2232889	2236469
18	339136	379075	387584	405863	409795
19	357346	380463	382010	407449	407449
20	1081647	1196749	1212221	1276159	1294059
21	1685292	1748457	1766249	1788791	1792371
22	2897724	2944445	2949860	2960402	2960402
23	2199670	2327331	2341255	2388174	2409654
24	332302	424665	447099	473599	498660
25	1061201	1225922	1254545	1328251	1346151
26	69336	145453	158604	183755	205235
27	339643	491482	528615	604444	629505
28	287399	295135	307512	309833	309833
29	149501	150275	151822	155402	155402
30	355751	381477	386893	423269	434009
31	620574	688668	694083	754045	761205
32	28623	29397	30944	46416	46416
33	31717	44868	54152	75812	75812
35	17990	21858	26500	34722	34722
36	177549	184997	189638	191959	191959
37	1413392	1482728	1512898	1540945	1551685
38	484064	777957	848354	911097	918257
39	262025	325460	342479	364913	364913
40	551406	758296	787693	854347	868667
41	344899	420153	432530	470742	477902
42	176900	207951	211819	224682	231842
43	407865	503207	536472	579810	612383
44	151401	190567	210680	240850	244430
Grand Total	46559272	49070445	49565546	50632663	50924762

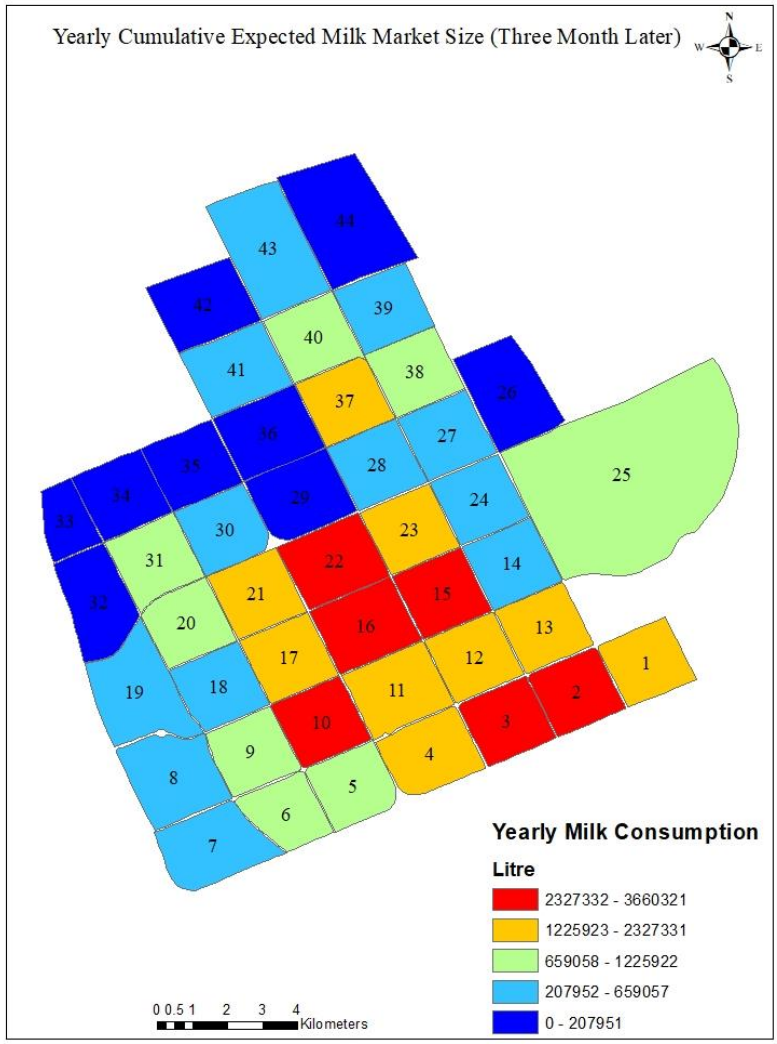


Figure 4.21 Yearly Cumulative Expected Milk Market Size (Three Month Later)

Analysis:

In this section, population data that were estimated based on the type and quantity of existing residential buildings and the size and type of growth in the residential building sector were used to determine the approximate milk market size in various periods, depending on the speed of establishing suitable conditions for the occupancy of the new buildings. This prior knowledge will enable a broad and comprehensive understanding of strategic requirements Of the population to meet their needs of the required products.

4.4 Building Materials

The High-resolution satellite image has been used to extract the new buildings built after January 2016. The number of these opportunities was 4268 and classified according to the building type and its construction level as in Table (3.2). Based on the new division of the study area, in each micro-geographic area using a geographic information system (GIS) to determine growth in micro-geographic.

By identifying the number of new buildings and the type of each building in each micro-geographic, and using Table 3.2 which explain the average number of (switches and sockets) needed by each building type, then we can calculate the market size in the studying area, it is possible to know the needs of each micro-geographic area for the products and their distributions using geographic information systems. Figure 4.22 explains the market size at the micro-geographic area level which using GIS to convert the data to a visual map to know the potential market size for each district.

Building materials are a critical factor in human activity and urban development; Logistic operations are the cornerstone to provide the sites with these materials and keeping sufficient stock to prevent any bottlenecks in the stock or to keep due to manufacturing excess quantities. To keep our resources, we have to forecast the market size for these materials by expecting when the activities to conduct on dates that are aware of the duration that we may need these materials. At this time, remote sensing provides new tools and readable data after analysing it; this information will give us about the expected time for product installation and how much we need. In the following, we will use satellite data for products forecasting and planning to study the switches and socket market size.

A survey conducted for this products to know the number of switches which each building needs during the finishing stage, groups that were targeted by this survey is the electricians and contractors at the sites, the question was:

a) How many products each building type needs?
b) Time to install the product (finishing stage)!

Results tabulated in Table (3.1 &3.2)

Determine the current building construction stage is very important to estimate the periods that building needs to install this product, the construction building stages are:

a) Basements
b) Under construction

c) Construction completes

Switches study targeted the building which began construction after January 2016 or in another meaning after the first images have taken, if we have the number of buildings for each building type then we can expect the quantities of the products that we need table 4.13.

Table 4.13 Total Construction Requirement for the Switches

		Time to installation (Month)				
Buildings type	Switches Average	Basement	Under construction	construction completed	Number of Buildings	Products Quantities
villa	194	12	6	3	3627	702410
Apartment	771	24	12	6	429	330919
Esteraha	49	24	12	6	57	2772
Mosque	105	24	12	6	15	1570
tower	4188	24	12	6	5	20942
Gas station	93	12	6	3	8	746
School	426	24	12	6	9	3830
Mall	227	24	12	6	1	227
showroom	351	12	6	3	94	33030
Palace	426	24	12	6	18	7660
warehouse	30	9	6	3	2	60
Governmental	1677	24	12	6	3	5031
					Sum	1109197

At the moment, we have become familiar with the expected building requirements of the products which can install in these buildings, but this information will be more valuable in case determine the time to install it and demand at the district level. By using Geospatial information, we studied that the new constructions distributed over the districts, and we have an idea about how many new constructions for each district, Table 4.14 show the expected switches and sockets market size at districts level. Identify the number and type of new buildings in each district will allow determining the expected need for the products required to these buildings based on previous surveys which carried out.

Table 4.14 Show the Expected Switches Market Demand

District	Market size	District	Market size
1	7543	23	52649
2	18571	24	41603
3	17702	25	71700
4	4796	26	34347
5	5902	27	71055
6	6503	28	5968
7	10379	29	2552
8	14016	30	18566
9	5600	31	34235
10	16506	32	4806
11	8279	33	11439
12	10609	35	4415
13	29885	36	5034
14	15861	37	34678
15	51532	38	104527
16	14027	39	25757
17	13533	40	75627
18	17652	41	52217
19	12571	42	13043
20	50431	43	48719
21	25789	44	23181
22	15395		
		Total	1109197 (piece)

The knowledge of the distribution of new buildings depending on the building type according to the districts is so essential that it helps to plan and organize the logistics activities better, Table 4.15

Table 4.15 The New Buildings Distribution Depending on the Construction Type

	the new buildings distribution at districts level depending on the construction type													
District	Apartment	Compound	Esteraha	Gaz Station	Governmental	Mall	Mosque	Palace	School	Showroom	Tower	villa	wherehouse	Grand Total
1	3											27		30
2	7								1	1		64		73
3	6		1							4		60		71
4	3									1		11		15
5					1					1		20		22
6	3									2		18		23
7								2	1			47		50
8	1							4		3		54	1	63
9	5											9		14
10	14								2	5		16		37
11	3						1			4		23		31
12	2									1		45		48
13	5						1	9	1	6		101		123
14	6											58		64
15	31			2					2	4		130		169
16	5									8		38		51
17	7											42		49
18	3							1				77		81
19	6								1	1		37		45
20	28		1							2		145		176
21	15		1				1			2		69		88
22	8									2		44		54
23	23		1	1						8		165		198
24	16			1			1			5		141		164
25	34		2		2		1			3		211		253
26	17		7							6		97		127
27	24		1			1				6		259		291
28										1		29		30
29	1		3							3		3		10
30	13		1	1			1			1		41		58
31	14	1	12									117		144
32										1		23		24
33			1							1		57		59
35	1									1		17		19
36	1		3							4		14		22
37	6		1	1			3			1		151		163
38	20						2					459		481
39												133		133
40	39		3				4			4		225		275
41	19									1	5	84		109
42	8		4	1								34		47
43	30		14					2	1	1		120	1	169
44	2		1	1								111		115
Grand Total	429	1	57	8	3	1	15	18	9	94	5	3626	2	4268

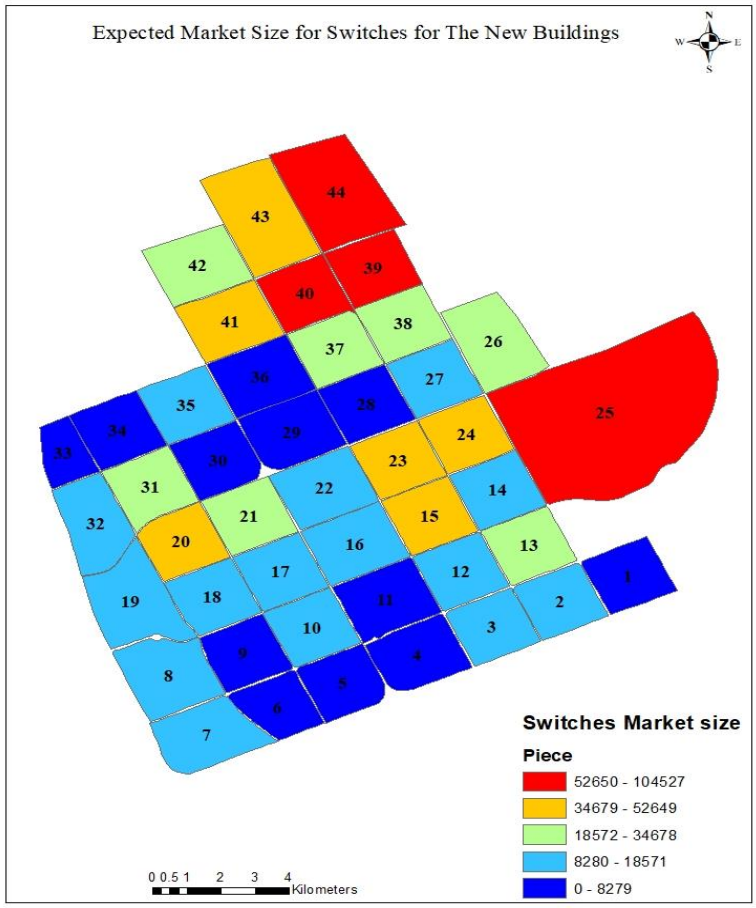


Figure 4.22 Expected Market Size for Switches for The New Buildings

4.4.1 The Increase in Market Size According to Periods

Estimating the market size in the studying area and Taking into account the time to products can be installed is very useful if we can do it, remote sensing gives the ability to have it, if consider tables 4.13 and 4.15, the results are the products increasing depending on the building stage and time to install it, table 4.16. This is meaning: three months starting from October 2016 (approximately at January 2017) we will need 445604 new switches while after two years, 67173 new switches will need to install it and so on, at this time we don't care for other buildings that Which can be built in the studying area but we can be taking into our account later.

Table 4.16 The Demand For New Products According to Building Stage and Building Type

	Expected market size according to the period (piece)				
District	Three Month	Six Month	One Year	Two Year	Grand Total
1	4261	1736	1546	0	7543
2	9102	4825	3447	1197	18571
3	9611	4632	2688	771	17702
4	1162	1320	2314	0	4796
5	3099	351	2452	0	5902
6	2905	1543	1284	771	6503
7	3873	581	4648	1277	10379
8	5387	2934	4844	851	14015
9	1162	2508	1159	771	5600
10	2130	5141	6495	2740	16506
11	1162	4307	2809	0	8279
12	7553	1352	932	771	10609
13	12989	5261	10864	771	29885
14	7746	2124	5219	771	15861
15	17394	21636	10188	2314	51532
16	6706	3282	3267	771	14027
17	6004	5019	1740	771	13533
18	9102	2902	4451	1197	17652
19	3099	3127	6345	0	12571
20	16619	15072	14882	3857	50431
21	7746	11445	5826	771	25789
22	5774	6755	2866	0	15395
23	25585	10360	12076	4628	52649
24	17645	11120	7438	5400	41603
25	25262	25273	17203	3962	71699
26	14987	8935	5797	4628	34347
27	30103	17761	17564	5627	71055
28	1937	3450	581	0	5968
29	545	387	1620	0	2552
30	4999	3096	8156	2314	18566
31	10460	7527	14705	1543	34235
32	194	387	4225	0	4806
33	3292	2324	5823	0	11439
35	1320	1162	1933	0	4415
36	1671	2636	727	0	5034
37	16603	8885	6876	2314	34678
38	63715	26318	12952	1543	104527
39	15880	4261	5616	0	25757
40	32585	25310	14542	3190	75627
41	9877	11164	29634	1543	52217
42	3385	4825	3290	1543	13043
43	11924	19747	9255	7793	48719
44	9050	5807	7553	771	23181
Grand Total	445604	308586	287833	67173	1109197

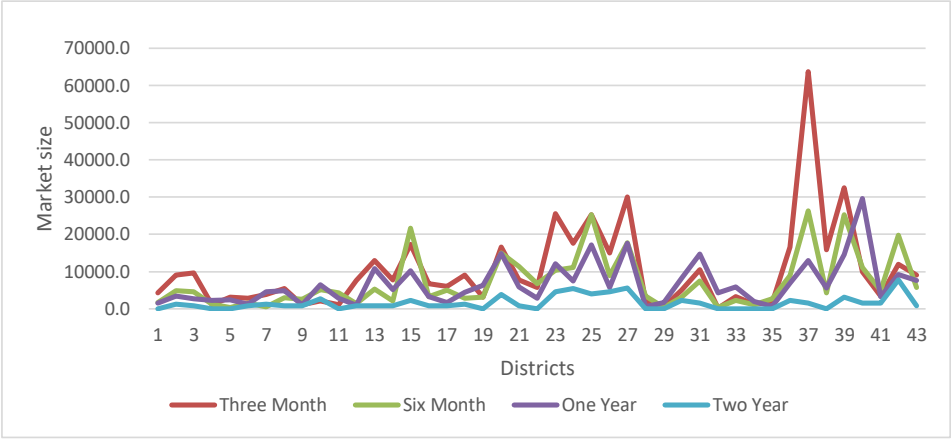


Figure 4.23 the Increase in Market Size

Analysis: This chart shows that the majority of the increase in the market size happen three months later starting in October 2016 while the lowest market size two years later.

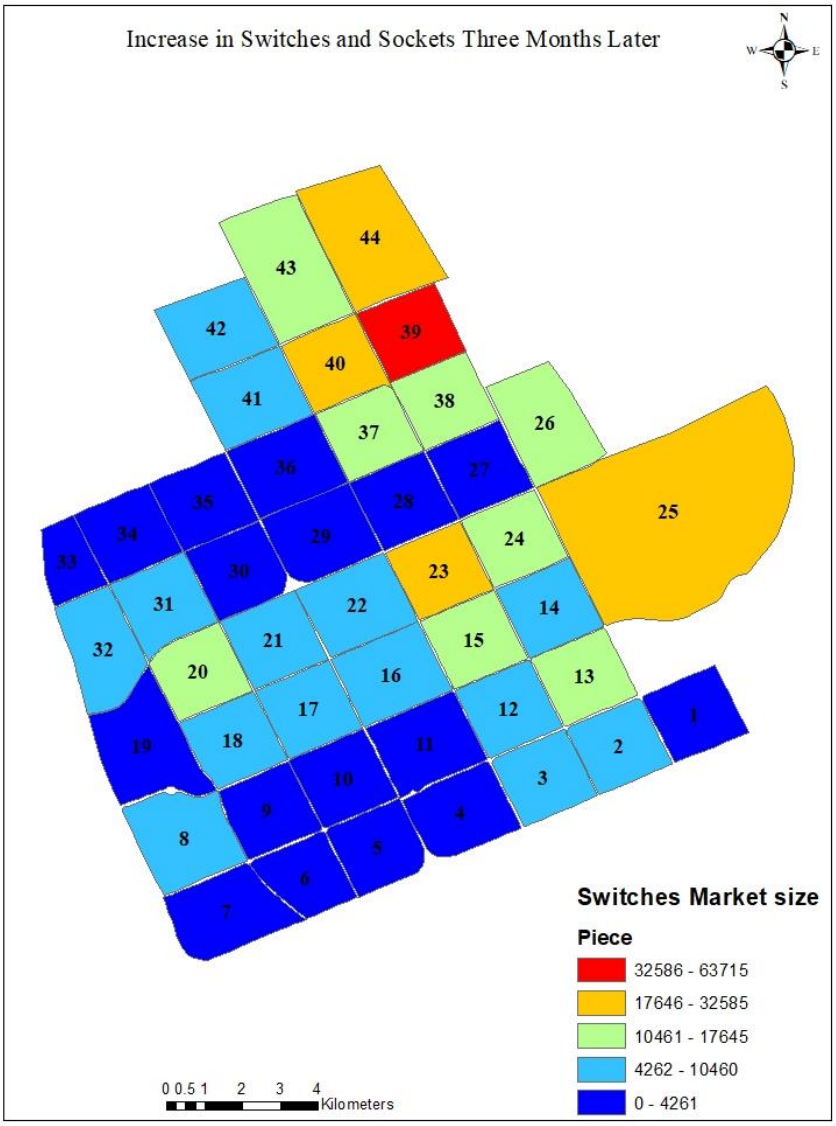


Figure 4.24 Increase in Switches and Sockets Three Months Later

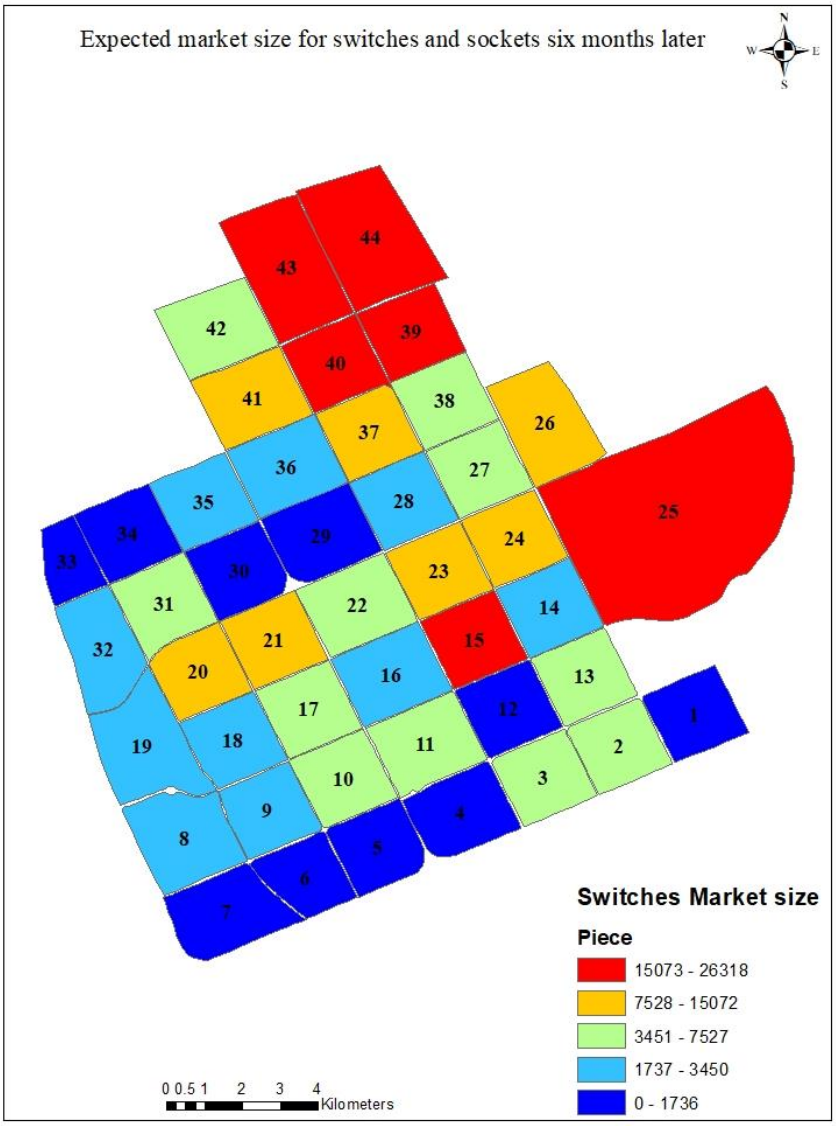


Figure 4.25 Increase in Switches and Sockets Six Months Later

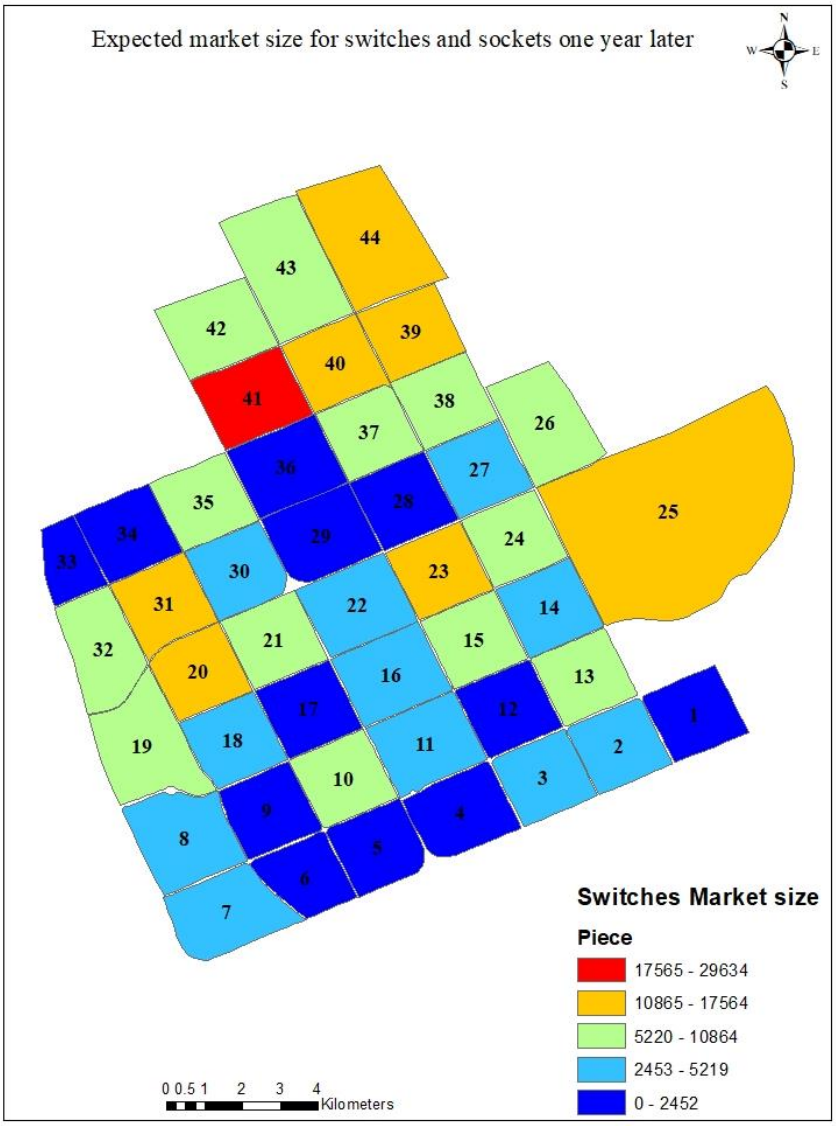


Figure 4.26 Increase in Switches and Sockets one Year Later

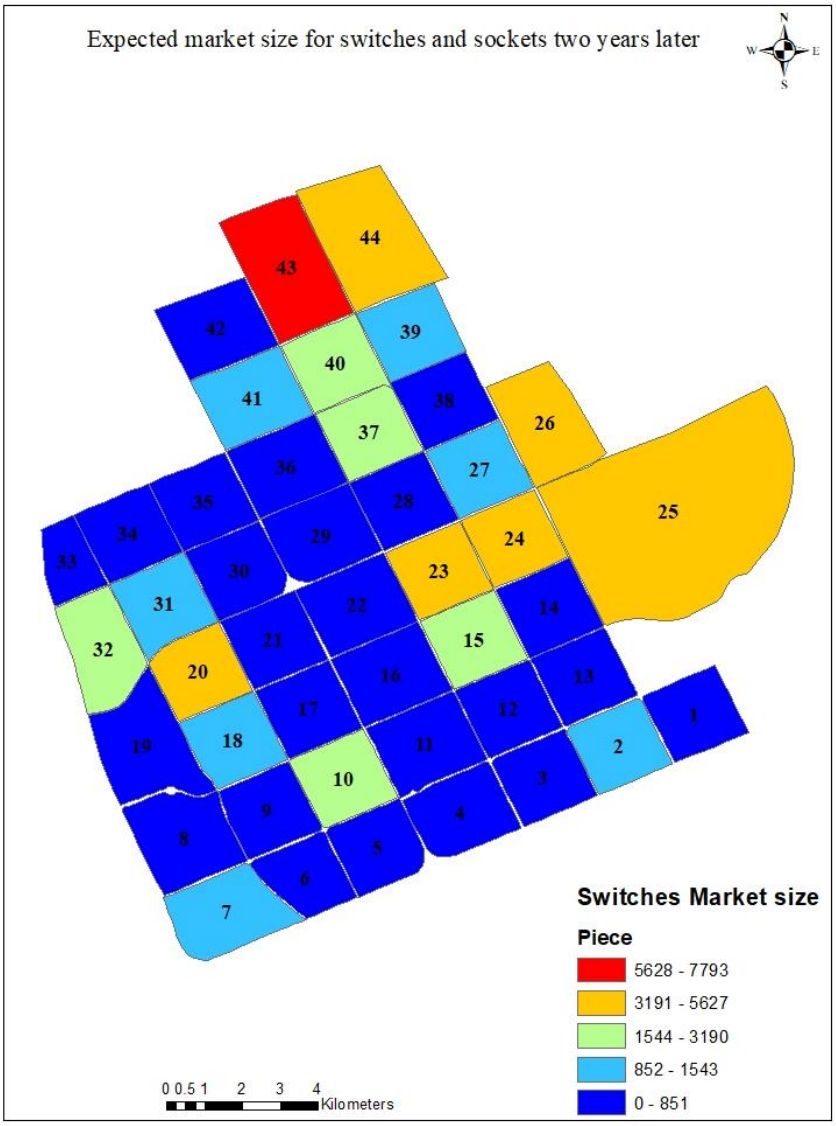


Figure 4.27 Increase in Switches and Sockets Two Years Later

Maps analysis: Figure 4.24 to 4.27 show the highest expected market size over time, those districts required the planning team and decision maker's to focus on, the dark red reflect the most upper expected switches and socket market size while the dark blue is the lowest potential market size, (district with no colour mean there are no buildings at that time), by using this maps we can determine where they have to take the right action on time to prevent any bottleneck in the future.

4.4.2 Cumulative Market Size for Switches and Sockets

Knowing the amount of expected increase in market size will lead us to understand the cumulative increase that may occur in the market, which requires identifying the priorities and preparing the necessary plans for that.

It's essential to know that, so we will have a full idea of the expected total number that we will need according to previous dates, table 4.17, here will have information about The total quantities of new products we will need, example: after two years the cumulative products that the studying area will need is 1109196 new switches.

Table 4.17 Cumulative Market Size According to Building Stage and Building Type.

District	Expected cumulative market size according to the period (piece)			
	Three Month	Six Months cumulative	One year cumulative	Two year cumulative
1	4261	5997	7543	7543
2	9102	13927	17374	18571
3	9611	14243	16931	17702
4	1162	2482	4796	4796
5	3099	3450	5902	5902
6	2905	4448	5731	6503
7	3873	4454	9102	10379
8	5387	8321	13164	14016
9	1162	3670	4828	5600
10	2130	7271	13766	16506
11	1162	5469	8279	8279
12	7553	8905	9838	10609
13	12989	18250	29114	29885
14	7747	9870	15089	15861
15	17394	39030	49218	51532
16	6706	9989	13256	14027
17	6004	11022	12762	13533
18	9102	12004	16455	17652
19	3099	6226	12571	12571
20	16619	31691	46574	50431
21	7747	19192	25018	25789
22	5774	12529	15395	15395
23	25585	35944	48020	52649
24	17645	28765	36203	41603
25	25262	50535	67738	71700
26	14987	23922	29719	34347
27	30103	47864	65429	71055
28	1937	5387	5968	5968
29	545	932	2552	2552
30	4999	8096	16252	18566
31	10460	17987	32692	34235

District	Three Month	Six Months cumulative	One year cumulative	Two year cumulative
32	194	581	4806	4806
33	3292	5616	11439	11439
35	1320	2482	4415	4415
36	1671	4307	5034	5034
37	16603	25488	32364	34678
38	63715	90032	102985	104527
39	15880	20141	25757	25757
40	32585	57895	72437	75627
41	9877	21040	50675	52217
42	3386	8211	11501	13043
43	11924	31671	40926	48719
44	9050	14857	22410	23181
Grand Total	445604	754191	1042023	1109197

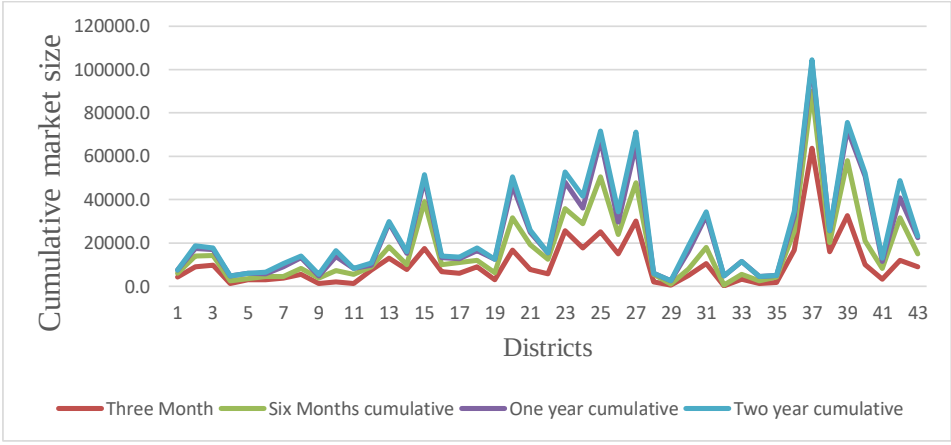


Figure 4.28 The Increase in Market Size

Analysis: This chart shows that the highest cumulative market size happened two years later starting in October 2016. While the lowest cumulative market size three months later starting in October 2016.

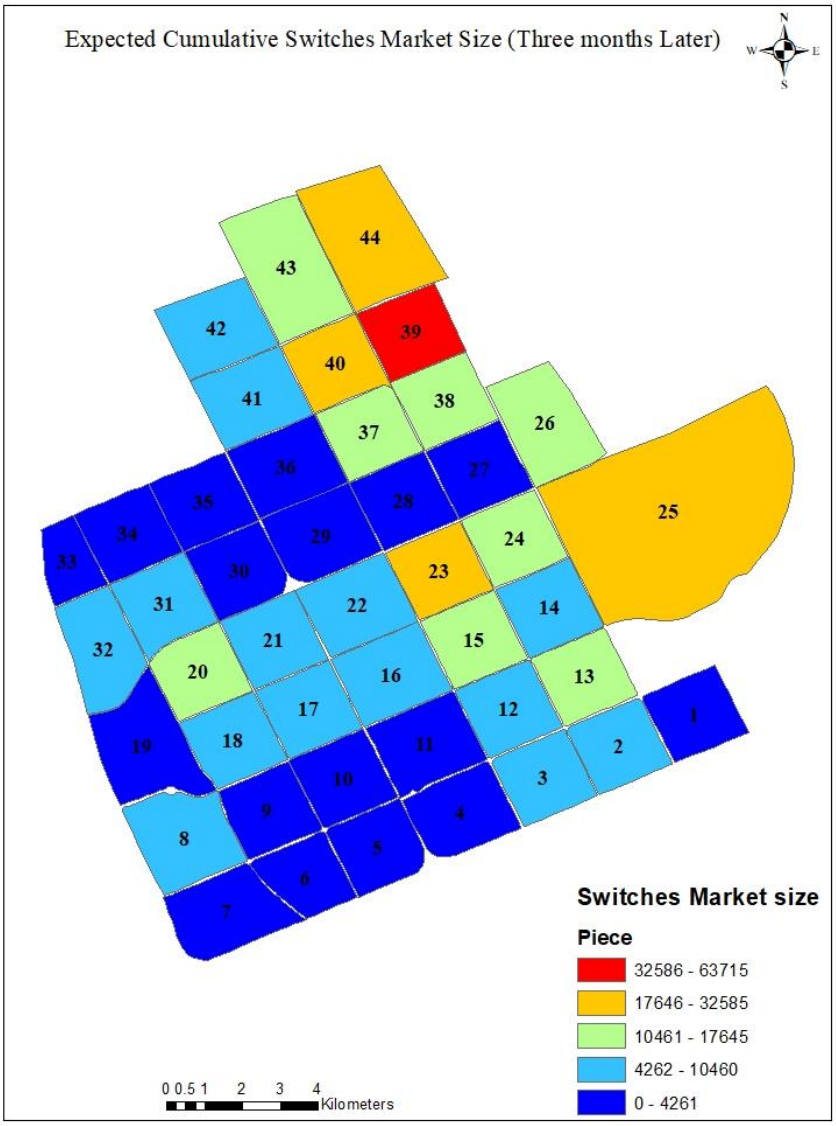


Figure 4.29 Expected Cumulative Switches Market Size (Three Months Later)

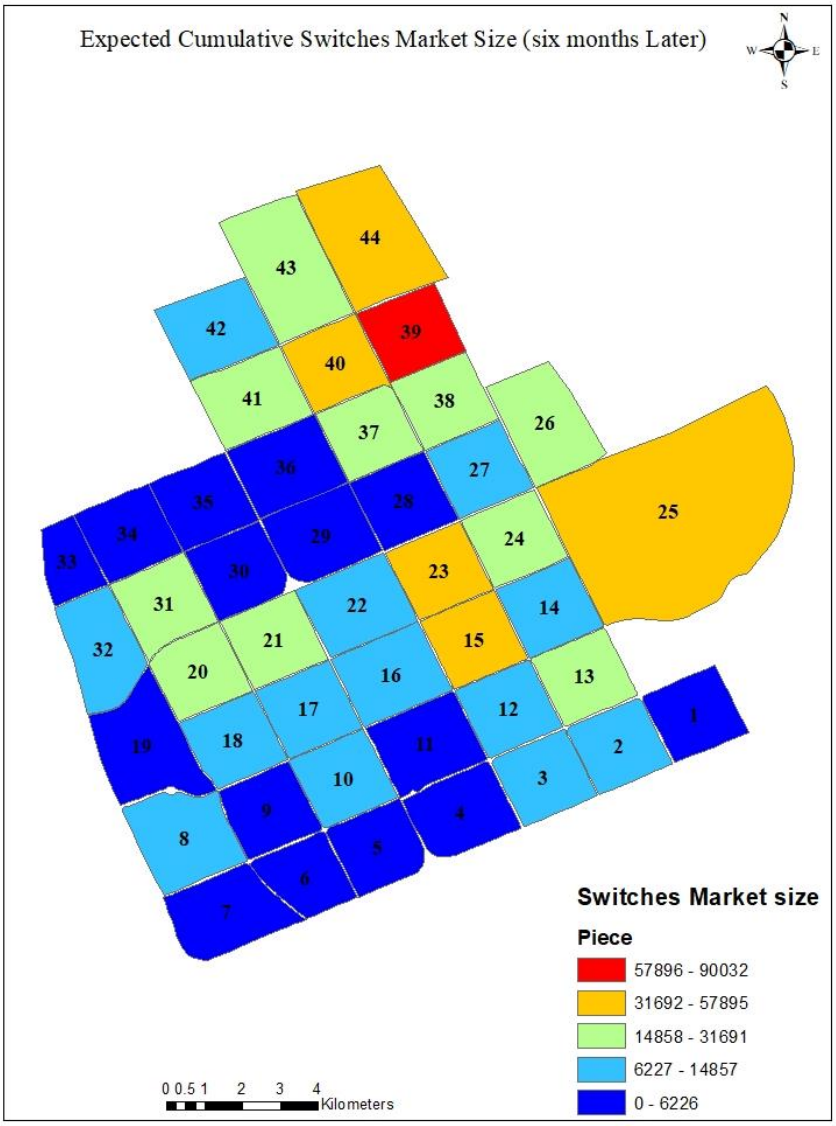


Figure 4.30 Expected Cumulative Switches Market Size (Six Month Later)

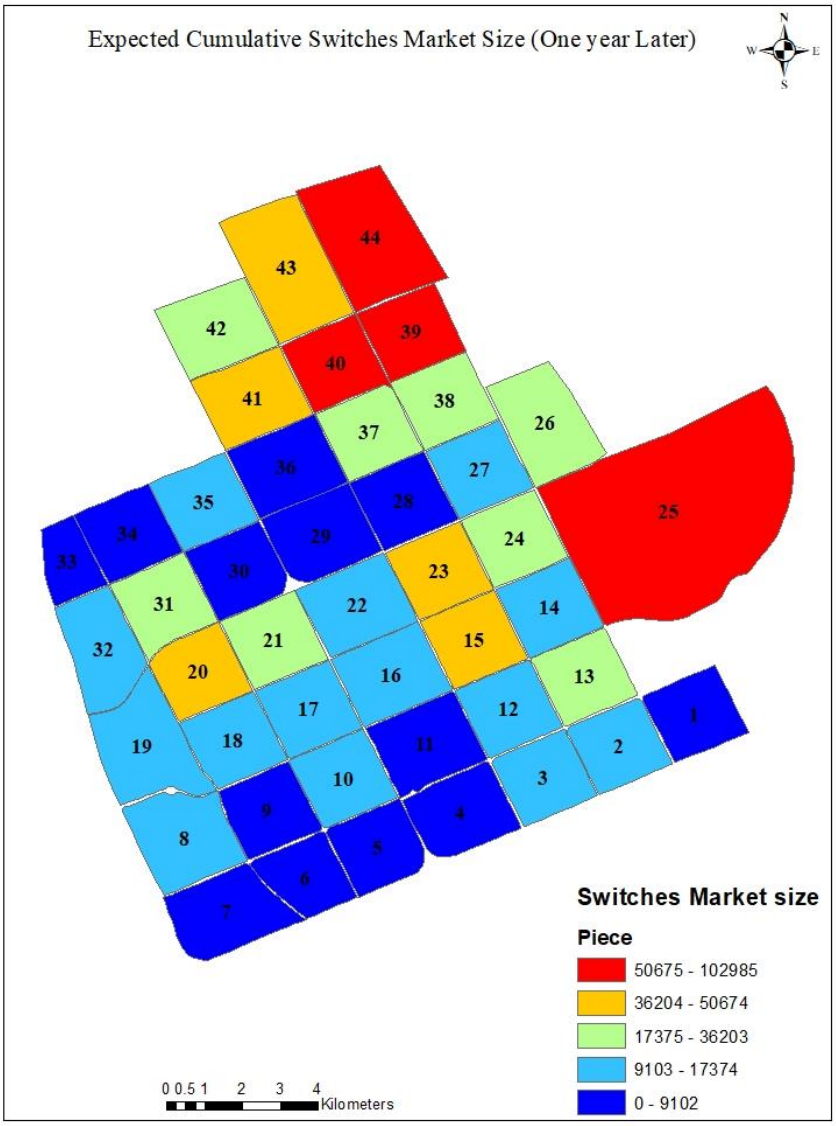


Figure 4.31 Cumulative Switches Market Size (One Year Later)

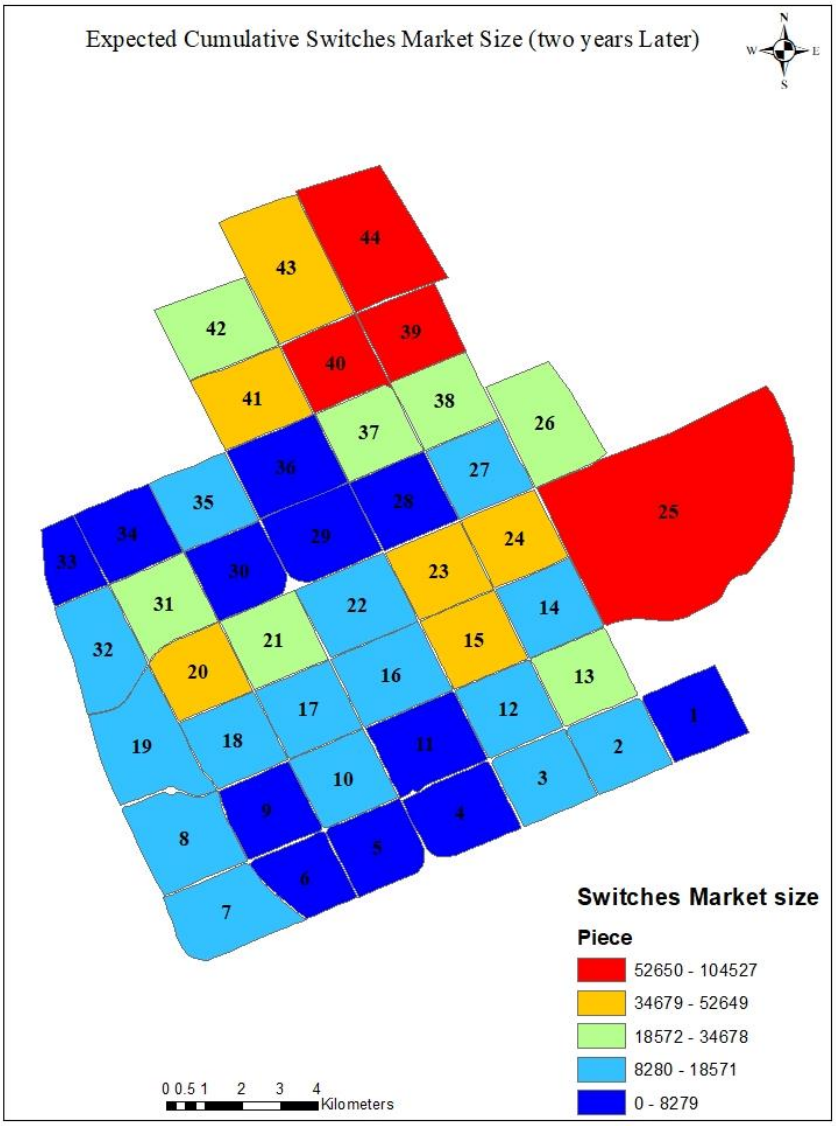


Figure 4.32 Cumulative Switches Market Size (Two Years Later)

Maps analysis: Figure 4.29 to 4.32 show the highest expected cumulative market size overtime to tell us the where the districts with the highest potential which is dark red, while the dark blue is the lowest potential market size, by using this maps we can determine where they have to take the right action on time to prevent any bottleneck in the future.

4.5 Determine the Best Site Location

Many studies carried out to select the best sites for new activities that can provide suitable conditions and meet the specific requirements. The select new location should have criteria, which vary according to the business situation. So far, the population density in these studies has not been given what should have been given to it, but in this research using remote sensing to analyses the high-resolution satellite images to provide us the necessary information that can estimate the population in the studying area (as shown in this study).

The question of choosing the best location for the establishment of facilities and services is a matter that depends on the requirements and needs of the stakeholders and varies according to the purpose. Selection becomes more complicated depending on the number of conditions required and vice versa. The significant development that is taking place in Riyadh city especially the study area requires us to develop the methods of study and research commensurate with the massive increase in urban and human activities taking into account the need for new Malls. Several factors can influence selection processes, including the following:

4.5.1 Land Value

The land value determined in many ways, including:

- The average value of land sales and purchases in the area, obtained from the Ministry of Justice website.
- Distance to the main roads where the land value rises.
- Distance to the city center which the prices downtown are highest.

Figure 4.33 shows the land price (value) calcification according to the previous three points; the Red color is the highest price segmentation while the dark blue is the lowest segmentation. The highest segmentation located beside the main two roads (Northern road and King Abdul Al Aziz Road) and between King Abdul Al Aziz Road and King Fahed Road.

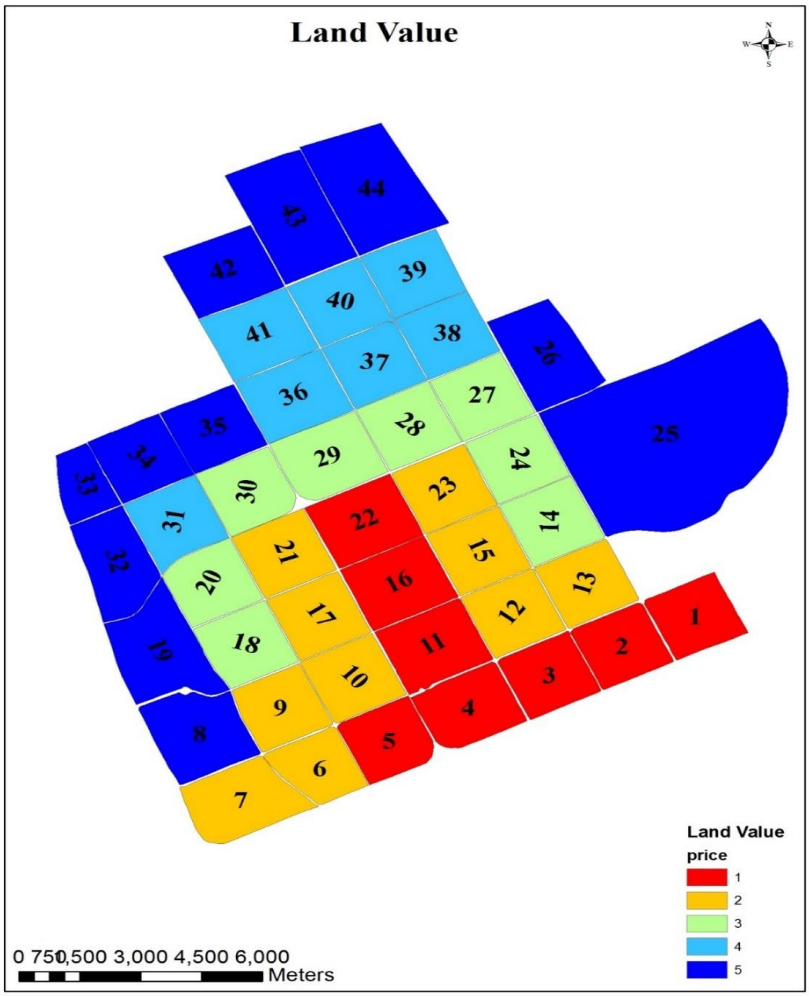


Figure 4.33 Land Price Classification

4.5.2 Population Factor

This factor is most important because people who will do the business, purchase and visited retail sites, therefore, a new way of finding out the population density has to be found. So, as we have seen, satellite imagery has helped us detect new and old buildings and calculate the population in areas better than other methods, which depend on tables or governmental data.

We studied the population in this research and calculated the estimation at districts level to know which places people live? Here the area with high population density will be attractive places for investment and establish new activities. By using ArcGIS the population data converted to population density, Figure 4.34, will guide the process to target the areas with high population density and give it top priorities. In figure 4.34 the dark blue reflects the high density which has the number (1) in the legend. Also, the population who lives in the buildings which scanned in January 2016 will be taking into account.

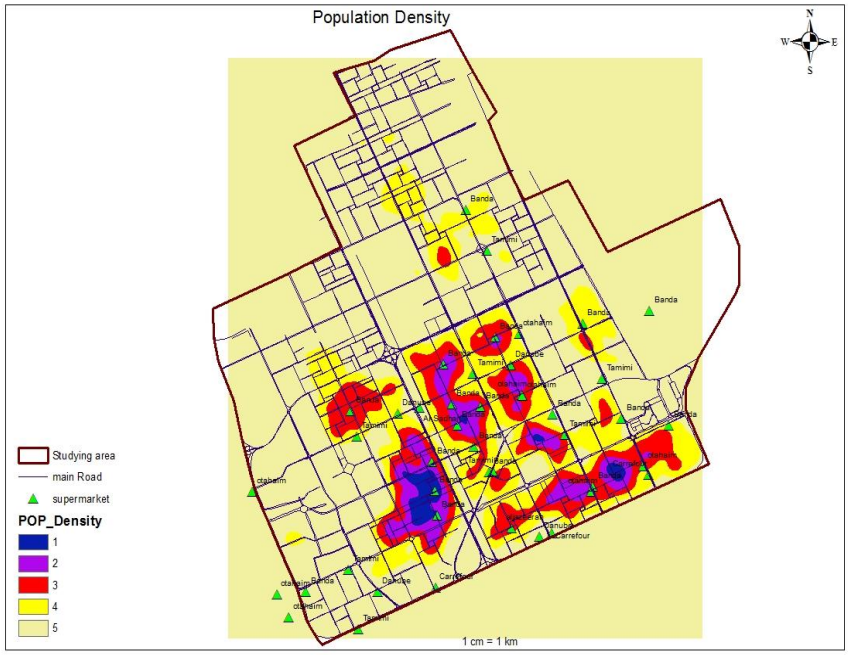


Figure 4.34 Population Density

4.5.3 Land Use

Land use map created by using the Spot 6 satellite image (October 2016) to distinguish the lands to take it in our account and avoid it.
This classification includes, Figure 4.35:

a) Garden
b) Mall
c) Palaces
d) Unknown area
e) Industry

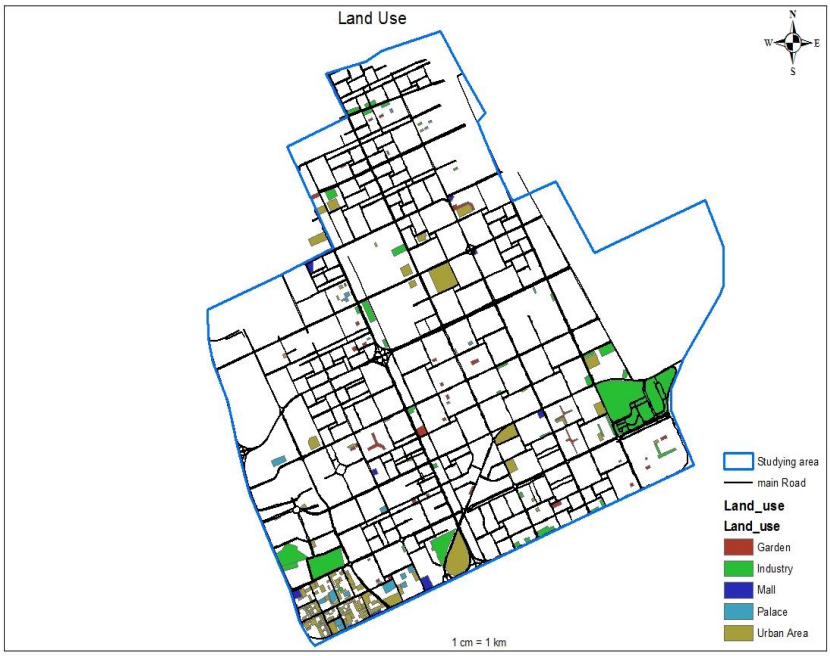


Figure 4.35 Land Use.

4.5.4 Distance To The Road Network

There is a wide road network in the study area, even within the small districts, which is a modern network and is continually being developed. Which will help the search and selection of the best location? So as not to put many phenomena on the maps and to avoid set all roads network have placed only the main road network, figure 4.36.

Figure 4.36 Main Roads.

4.5.5 Topographic Factors

The slope in the study area is very low, and the maximum value is 20%. The areas which very slopping is outside the study area. This factor will ignore because it does not affect the selection of sites.

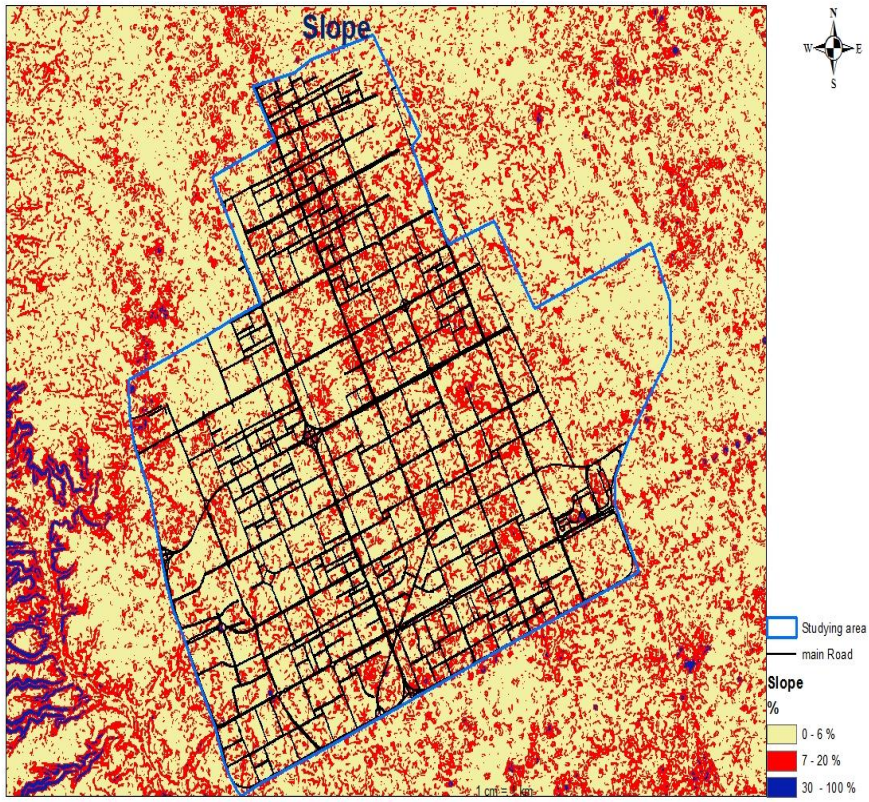


Figure 4.37 The Slop in The Study Area

4.5.6 Climate Factors

Mostly this factor has no significant effect because there is no difference between the temperatures in the study area. Where the temperature in the summer between 40 to 44 degrees.

4.5.7 Competitors (Distance from Current Markets)

When you create an activity that requires careful study of the market. So that the proposed activity should be away from competitors in a way that provides the right investment away from conflicts of interest with them, taking the current competitors and creating a map showing the distance to the competitors must be taken into account which is beneficial for investors.

The choice of the best site based on the required conditions will be more accurate by using remote sensing and Geomarketing, which provides the possibility of dealing with the places through equations given to the computer according to the required factors to offer a number of suggested sites that are compatible to the criteria for the establishment of sites required.

Afield survey for the Retail Stores in the study area was conducted to identify the competitors. The search included the branded stores and did not include the hundreds of small stores in the districts, this search was done in two ways:

a) Field visit
b) Stores websites

The information that recorded, only retail market name and its location

The following stores recorded in the study area, table 4.18:

While Figure (4.38) show the map of retails location in the study area

Table 4.18 the Retails in the Study Area

Retail brand	**number of retails**
Aljazeerah	1
Al-Sadhan	1
Banda	19
Carrefour	2
Danube	4
Otahaim	7
Tamimi	8
Total Retails	42

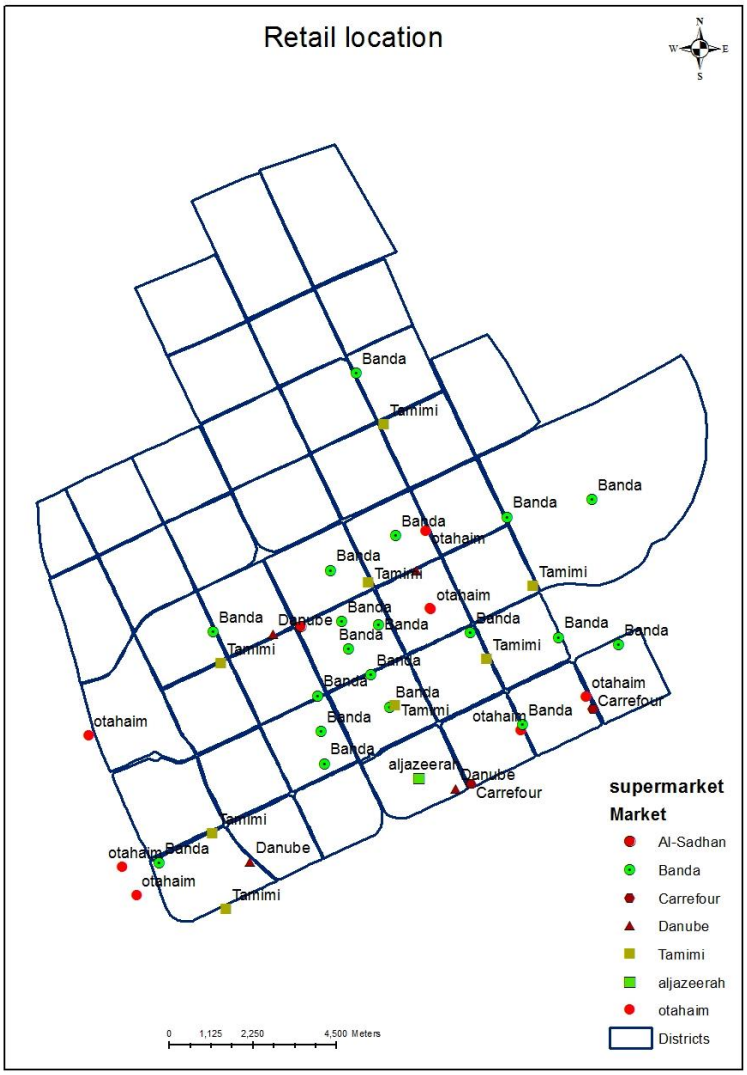


Figure 4.38 Retails (Competitors) Location in the Study Area

4.5.8 Land Area

This stage is a complex process, and it depends on dropping the sites of buildings, roads, and land use, by using ArcGIS the results are the lands which has not any activities. Here only the land which has enough area to build the retail building will consider, in Riyadh city the average area for the Malls is 25000 Meter square for that only the land with an area more than 25000 Meter square will take it into account as in Figure 4.39.

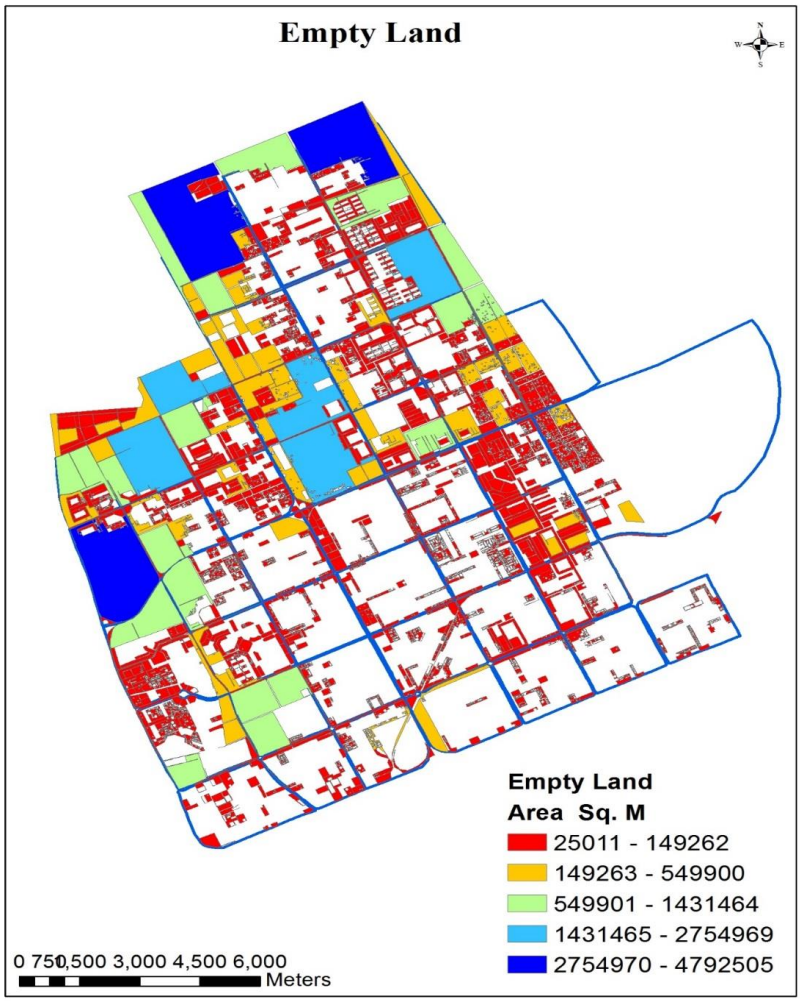


Figure 4.39 Empty Land in the Study Area

4.5.9 Select the Best Location For New Retail

After processing and preparing the required layers, we will be able to start by selecting the suitable sites for that.

We will weight the following layers:

a) Land price weight is 15 %

b) Distance to current market 25 %

c) Population density weight 60 %

We will use raster calculation to calculate the final results as in Figure 4.40. In this map, light blue (number 1) reflect the high priority.

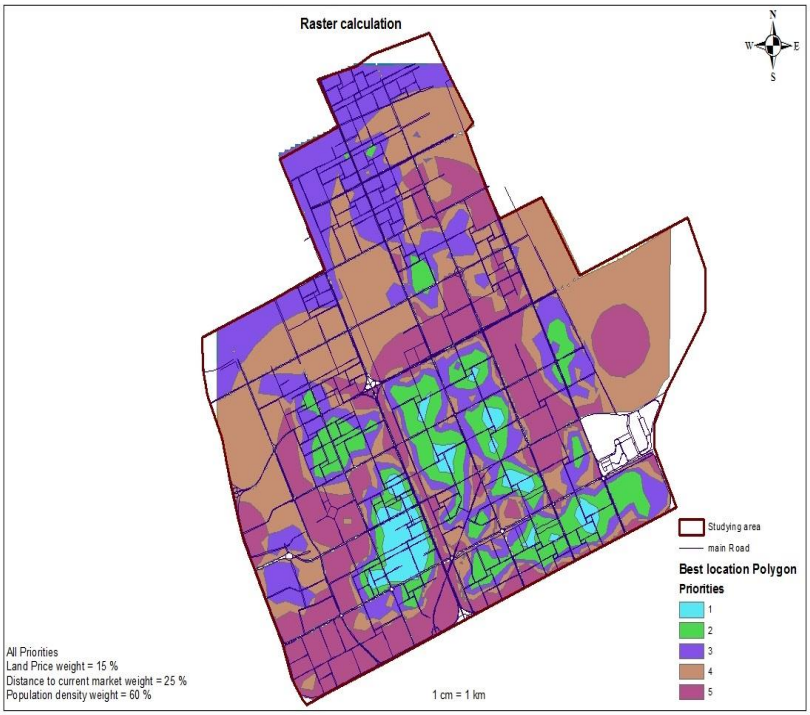


Figure 4.40 Raster Calculation

The results will be a raster, by converting it to layer and by taking the intersection with empty lands as in Figure 4.39, we take into account the flowing at this stage:

a) Distance to the main road is less than 100 meters (According to regulations, also site need a car parking)
b) Keep only the priority number one and two

The results are the best site location for new retail by considering the previous criteria as in Figure 4.41.

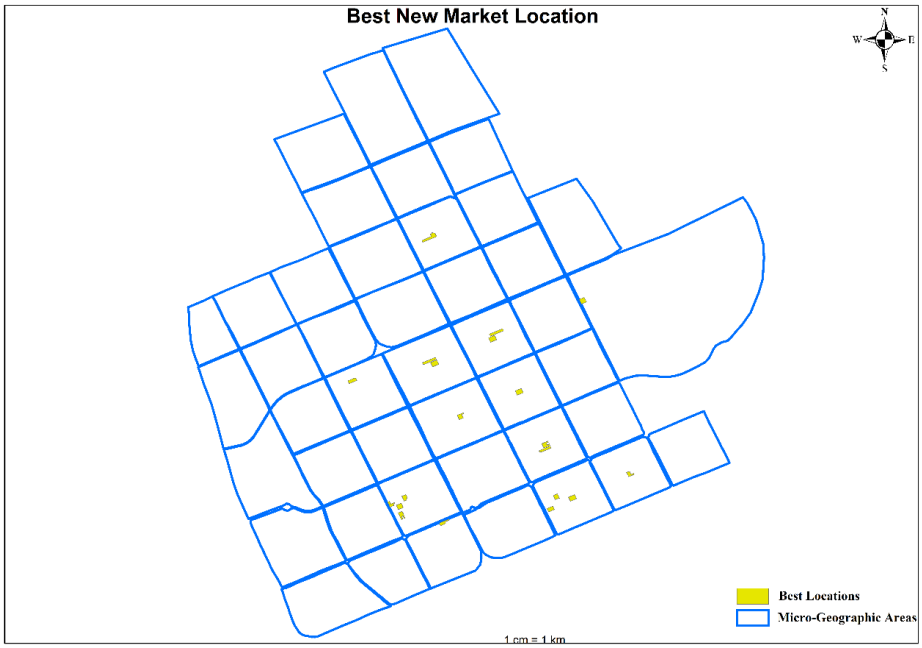


Figure 4.41 Best Site Locations

Conclusion:

It found that the use of remote sensing and GIS provides us with the necessary assistance to understand and improve our planning, increase the benefits of using it in industry. The high-resolution satellite images have provided what can be said as a qualitative leap in the search and put the science in the service of the community and the business world.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS FOR FUTURE WORK

5.1. Conclusion

The use of remote sensing in marketing, demand sales planning and develop a methodology to select the best location to establish new service centers or commercial center by developing the existing methods is a critical question that explored in this study. Different types of data have been used, it was processed and used in a manner appropriate to this study, also variables checked and used to determine its effect on the study, which supported the purpose.

1) Two different satellite images were used to calculate the building's growth and analyze the population increasing in micro-geographic areas using geospatial analyses. The locations of the new buildings have been linked to the variables studied in order to give a clearer idea for how spatial information can be used to identify growth at micro-geographic so that decision-makers can quickly access these markets.
2) GIS was used to store, manage and analyze data to determine the population in the study area and used this information an indicator for determining milk consumption at the micro-geographic level which could be used by FMCG distributors to improve demand planning, also another product was studied to calculate market size as a building material product.
3) The process of studying the best location for the establishment of a commercial market or any new service took a new form by calculating the population density reached as a result of determined the population in each small area as a result of the analysis of satellite images and statistics authority information, this will enable to add a new dimension to the new mechanism to determine the new location.

Thus, using remote sensing and GIS data for Geomarketing able to give an insight picture of urban growth and its concomitant increase in population and determine the best location to create a new market.

5.2. Recommendation

This research is based on the manual digitizing for the boundaries and components of the study area, including new buildings or under-construction buildings. It may take much time, the output preparation depends on equations and processes within the GIS sequence and logical but requires preparation for each. We can improve this research by enhancing the automatic extraction of the new buildings and classify it to its building type and stage. This improvement will allow the full usage of this new methodology and improve the visibility studies for the targeting products that we need to prepare to forecast and determine the market size for it. Besides, it is possible to increase efficiency through the development of scripts within the GIS program, which includes tabs for study parameters. This development in the program will allow the user to obtain the results immediately and shorten all the operations that will be done by the user and also through the model builder under GIS to shorten some processes by incorporating them in the one environment.

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