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Assessment of the Efficacy of Bakery Distribution in Dammam Using GIS, Saudi Arabia

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Abstract

This research focuses on the use of GIS in the spatial analysis of the study and the spatial distribution analysis of bakeries, one of the most significant public services in the KSA, and their efficacy in Dammam. The study relies on the most important and practical aspects of GIS such as the spatial analysis to investigate the characteristics of the spatial distribution of bakeries and its patterns as well as the assessment of the efficacy of their distribution according to the Local Standard. The findings and the recommendations of the study encompass variations in the areas of municipalities and the number of bakeries therein: 0.53 km² in the center of Dammam, about 3.14 km² to the east and 4.92 km² for the municipality in the west of Dammam. However, the general average in all provinces is 2.92 km². Such a variation amounts to some variation in the average people served by each bakery. There is also a strong correlation between the spatial organization of bakery locations and the (main and arterial) road network in Dammam. In addition, some bakeries do not commit to the standards of planning: roughly 35 bakeries breach the standard of proximity to gas stations. Analogously, 6 bakeries breach the standard of proximity to the sale points of natural gas cylinders and 3 bakeries breach the standard of proximity to industrial regions.

Keywords: *Geographical Distribution; Directional Distribution; Standard Distance, Automatic Self-Correlation; Buffer; Moran's Indicator*

Introduction

The Geography of Service is a branch of applied geography. It has been developed out of the interest in the interaction of the direct needs of urban and rural communities alike. Services emerged conspicuously in geographical studies in the 1960s in the developed countries. However, it was not duly considered in the Arab world, despite its significance as a modern trend that strongly pushed geography toward the applied field, until the 1980s. Economic geography has recently increasingly been interested in services; it evaluates their general image in terms of their adequacy and efficacy so that their development is traced (Sarmis & Helen, 2006, p.84). The study of services is significant because it is associated with economic planning, which makes it geographically salient (Adam, 2002, p.12). Services are a set of activities and operations provided by certain bodies to serve and meet the needs of customers. The need to services increases as the social, educational and cultural standards and population density go up. Some services are highly significant in everyday life: bakeries, water, education, health and

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energy, whatever the standard of living in society is. They all affect the cycle of development and the facilitation of the basic human needs of services. The geographical interest in services is a paramount factor of the efficacy of such services and an essential indicator of the benefits received by individuals. The implicit meaning in the identification or selection of the location of a given service indicates that certain individuals will benefit more than others from the services. To pinpoint the users of the services, the geographical entrance of services should be known through groups of inhabitants. This is called the spatial distributional indicator of service pattern (Albaghdady, 1994, p. 6).

The geographical interest in service pattern and accessibility was initiated in the sixth decade of the twentieth century by the American geographer Bryan Berry (Berry, 1972) and the 1970s by the geographer Peter Hagget in his study on the distributional pattern of post offices and communication services on Angles Island (Hagget, 1965). The geographical study of services is interested in the explanation of three main aspects of the phenomenon (Alghamdy, 1986, p.11)

- Distribution, number, patterns, direction of spread and accessibility of services.
- Locations of services: to identify the geographical locations of services in terms of their centrality and flexibility to provide the surrounding areas with services.
- Re-distribution of services system: it requires the study of the status quo of the present services and their locations, the ability to re-locate them to suit the general distribution of population and finally to assess the services and their development.

To understand the spatio-distributional indicators of services, locations of services and the individuals' places of residence should be focused on. Consequently, kilometer distance and distance effects are called Location Benefits. They denote the use of a good service for a low cost. It is obvious that the longer the distance, the more travel cost or the travel time cost and the lower the service use (Meselhi, 2008, p.37).

The current study focuses on one sector of public services, namely, bakeries that are momentous for the promotion of the quality of life in the KSA. The availability of all types of bakeries is a foundation of sustainable development. Analogously, the improvement of the quality of life in the Saudi cities is among the main objectives of the Kingdom's vision of 2030.

The study highlights the use of GIS in spatial analysis to investigate and analyze the spatial distribution of bakeries, one of the most significant public services in the Kingdom. Another point is the assessment of their efficacy in Dammam. To do so, the study relies on the most prominent practical aspects of GIS represented by spatial analysis. The study does not feature the marketing characteristics of bakeries in terms of productivity and frequency rates since it is more concerned with the analysis of locations (Location Theory) of bakeries in Dammam. That point is significant for understanding the nature of the spatio-distributional indicators of services. Therefore, locations of services are underscored (Meselhi, 2007, p.37) because location is an important area of geographical studies and simultaneously a relative phenomenon to which other surrounding phenomena are attributed. Such phenomena set several rules that govern it and other locations. Geographers, thus, can detect the rules governing the mechanism of exchanges which contribute to the revival of a given place (Beshre, 2010, p.5). Employment in bakeries is not considered in the present research because it highly resembles gas station employment that has been investigated by the researcher in her study on gas stations in Al-Khubz city, given that all employees come from South-East Asia (Sherif, 2020, p.35).

Review of the Literature

Several studies have handled some services using GIS in principle and bakery services in particular. Such studies can be divided into two sections:

First: Geographical studies related to the analysis of some services using GIS.

Second: Geographical applied studies on bakeries.

First: Geographical Studies Related to the Analysis of Some Services Using GIS

Several studies have handled some services in terms of the analysis of the pattern of distribution and efficacy of services in certain provinces in the Kingdom. Al-Rahili (1424H) aims to use GIS to assess the status-quo of the locations of governmental female schools in Mecca in all grades according to a set of natural, human and social criteria. Besides, Al-Sheikh (1429H) focuses on the investigation of the pattern of the geographical distribution of public and typical gardens in Jeddah using cartographic analysis in GIS. Al-Duwaikat and Al-Faisal study the analysis of the pattern of robbery distribution in Ha'il in Saudi Arabia using GIS. It is indicated that robbery locations and culprits' places of residence are closely related. The general direction of robbery in Ha'il is toward the northwest in the direction of the new urbanism. The study also demonstrates the areas of the hot points of robbery in the city. Shawish (2014) discusses some aspects of the spatial analysis of the main road networks in Al-Ta'if governorate in the KSA in terms of the analysis of the network pattern and the use of GIS in its analysis, processing and problems. Additionally, Abdel-Karim (2014) analyzes public services spatially and identifies the planning needs via application to Hafr Al-Baten. The study focuses on the observation of the geographical distribution of public services and their assessment in Hafr al-Baten according to the principles of urban planning in the KSA. Al-Huweish (2014) examines the spatial variation of health services in the KSA between 1913 and 1931 to analyze the components of a health service so that such components and their variation are spatially identified in the KSA provinces. On the other hand, Mansour (2014) handles the spatial modeling of the indicators of the quality of life in the KSA governorates via the geographical distribution of the indicators of the quality of life using the spatial analysis model to help decision makers make developmental policies in the KSA. Al-Kahtani (2018) analyzes the primary schools of Abha in Asir province focusing on the geographical distribution and processing of primary schools using GIS.

Second: Applied Studies on Bakeries

Al-Sadimi (2005) studies mills and bakeries, especially mills and the baking industry in Tanta. Al-Sadimi highlights the development, industry and settlement of bakeries in the different districts of Tanta. He also explores the development of the characteristics of the loaf of bread, the value added, problems of the baking industry and suggestions for solving them. In addition, Azaz (2006) handles the baking industry in Al-Matarya. The study underpins the factors influencing the baking industry, bakery distribution, production and problems and their solutions. Al-Me'adawi (2006) investigates bread production in Kafr El-Sheikh, especially the factors influencing bread production, bakery distribution and bread production and problems. It is found that the production of subsidized bread is inappropriate for human use. Analogously, Al-Habishi (2011) is an economic geographical study of the baking industry in Mecca. It underlines the factors influencing bread production, bakery distribution and bread problems in Mecca.

Criteria of the Study

The Study Relies on the Following Criteria

1. Bakery/person: this criterion measures the relationship between the number of bakeries and the served population.
2. Bakery/1000m: it measures the distance between bakery location and the maximum distance covered on foot (1000 m max. for each bakery), given that the distance is represented by a diameter surrounding a bakery (Ministry of Municipal and Rural Affairs, 1426H, Guide to the Planning Standards of Services, Riyadh, p.11).

Aims of the Study

The present study gives salience to the causes of spatial variation on the efficacy level of bakery distribution in a city in the KSA to achieve the following goals:

1. To detect the characteristics of spatial distribution of bakeries and its pattern
2. To find out the relative distribution of bakery locations within specific areas by getting away from the points of the spatial center.
3. To recognize the area of spatial concentration of bakeries in Dammam
4. To identify the pattern of spatial distribution in the area under study
5. To assess the efficacy of bakery distribution in the area under study according to the Local Standard

Question of the Study

Is there a fundamental difference in the effective distribution of bakeries on the city provinces?

Hypothesis of the Study: There is no difference in the distribution of bakeries on the provinces of the city (i.e. they are effectively distributed on the area under study).

Alternative Hypothesis: There are fundamental differences in the distribution of bakeries in the city provinces. That is, they are not effectively distributed on the provinces of the area under study.

Methodology and Techniques of the Study

The study adopts the analytical descriptive inductive approach which is associated with the spatial analysis of the phenomenon under study. In addition, GIS is employed to analyze the spatial distribution of bakeries in the area. The spatial analysis done by GIS transforms raw data into useful ones depending on the analytical techniques and processes of the collection, measurement and classification of the spatial data. The most salient of them is conformity, spatial and cartographic modeling and distance analyses. They are utilized to understand the spatial patterns and variations. The techniques of directional distribution is used to analyze the characteristics of bakery spatial distribution (Standard Deviation Ellipse), the pattern of distribution and their relation to the distribution of the city provinces, which is the first aim of the study. Besides, the buffer distance technique is utilized to explain the proportional distribution of bakery locations within specific buffers away from the central points. Standard distance is also employed to analyze the area of the spatial concentration of bakeries in Dammam along with the autocorrelation — the use of Moran's I to identify and explain the

spatial distribution pattern of bakeries in Dammam and to test the hypothesis of the study. To achieve the latter aim, the buffer technique is applied to assess the efficacy of bakery distribution in the area under study according to the Local Standard (based on population: the minimum service buffer is 4 thousand people and the maximum is 15 thousand people; and based on area: maximum service buffer is 1000 m). In addition, it is used to assess bakeries according to the planning standards in the Kingdom.

Therefore, the study discusses the following main points:

1. The geographical distribution of bakeries, the relation between its direction and the direction of provinces in Dammam, the relation between distribution and the map of population density and Kernel Analysis of density
2. The proportional distribution of bakeries in several buffers that are equidistant from the point of the spatial center of the city provinces.
3. The buffer of the spatial concentration of bakeries in Dammam— standard distance
4. Spatial autocorrelation— Moran's-I to test the hypothesis of the study
5. Assessment of the efficacy of bakery distribution according to the standards of planning in the KSA.

Spatial Framework of the Study

Dammam is situated along the coast of the Arabian Gulf to the east and northeast. It is bordered by Khabar governorate and Al-Zahran from the south and the sand of Al-Dahnaa Desert whose borders intersect with Abqaiq governorate to the west. Astrologically, it is located between the latitudes 26° 11' and 26 ° 30' to the north and the longitudes 49 ° 50' and 50 ° 20' to the east. Its area is about 800 km², Figure (1).

Geographically, Dammam is a low coastal plain along the Arabian Gulf shore. The region is part of the Gulf that functions as a continental shelf in parts of which sedimentary layers have been deposited. They help store oil and ground water in large amounts between layers. It is about 389 km² away from Riyadh. It is characterized by its location on regional international roads leading to Kuwait and the UAE, and regional local ones leading to Mecca and Riyadh. It is significant since it is a momentous oil region with a fundamental role in the national economy.

From the Human side, the first settlement in Dammam goes back to 2000 years BC and the early 9th century AD. Its significance and development grew after the discovery of oil in 1922. It developed out of an urban block with a homogenous traditional fabric, old mud buildings and narrow streets. Then, it suddenly developed into scattered blocks to the east of the old ones. Afterwards, such blocks developed in a ring-pattern until they got fused to take a geotape format parallel to the coast. The city continued to develop until it got to the block it is today. The urban structure of Dammam appears as a connected fabric that gets narrower to the north to include Al-Katif. It approaches Al-Zahran to the west and extends to the south to include Khobar. The urban structure of Dammam takes two different patterns: traditional in the old regions with a conventional fabric because it encompasses old mud buildings and narrow zigzagged streets; and modern areas that appear in a perpendicular grid fabric. The urban development on the coast of the Arabian Gulf tends to fuse with the settlement of Al-Katif to form an urban geotape with a connected fabric (Sherif, 2019: 4).

Dammam has 83 provinces (with an area of about 424, 04 km², 53% of the total area of the urban buffer of Dammam governorate). Three provinces are under development (Ministry of

Municipal and Rural Affairs, the Secretariat of the Eastern Region, Urbanism and Project Agency). The population of Dammam is 903,312 people according to the census of 1431H and the data of the Secretariat of Dammam.

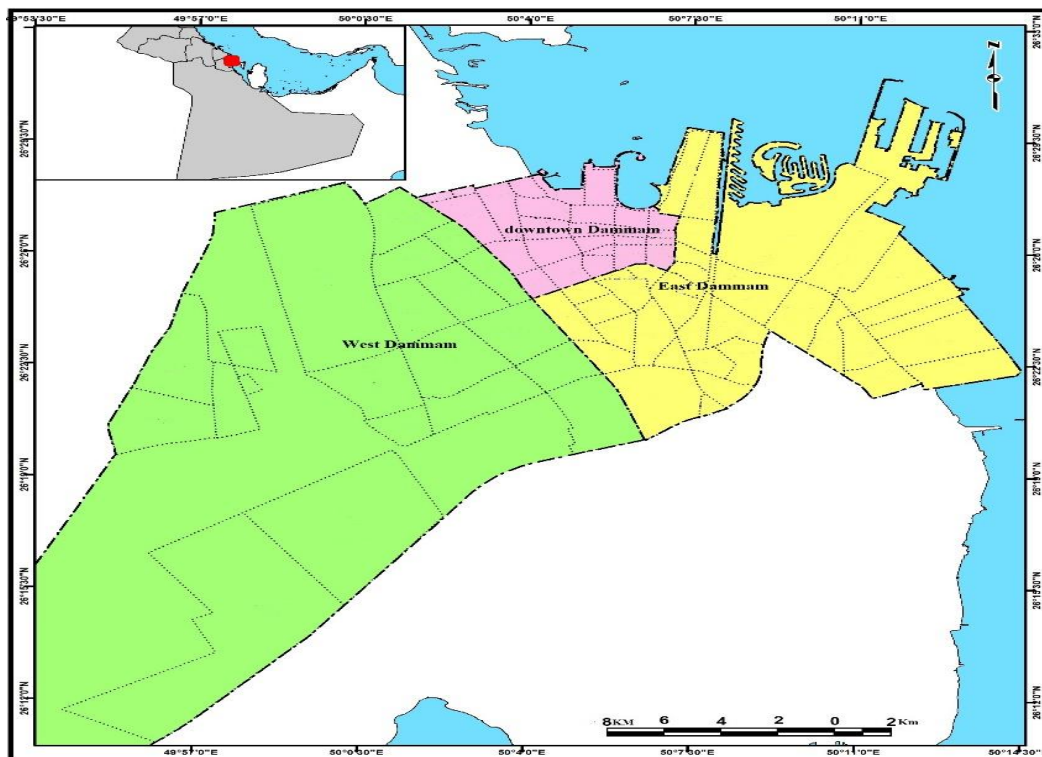


Figure (1): The Astrological and Geographical Locations and the Administrative Division of Dammam in 2022.

Source: Done by the Researcher Depending on the Secretariat of Dammam, Urbanism and Project Agency, the General Department of Urban Planning, Report of the Urban Buffer of Dammam and the Unpublished Data of 2017, Using ARC GIS 10.6.1.

1- The Geographical Distribution of Bakeries and the Relationship between its Direction and the Distribution of Provinces in Dammam

a. The Geographical Distribution of Bakeries

Distribution is the necessary starting point of any geographical study. It is an important step for the understanding of the behavior of any geographical phenomenon. Distribution means the order or the organization resulting from the distribution of phenomena in a place according to a certain pattern. That is, distribution is the current image or the total sum of a set of relations upon which the location and size of a phenomenon and its distance from other phenomena depend (Kheir, 2000, p.240).

From studying Table (1) and Figure (2) show the following results:

1. The city provinces are divided into three municipalities: 26 provinces to the center of Dammam, 36 to the east and 21 to the west. 176 bakeries in Dammam are distributed with varying proportions as follows: 42.4% (72 bakeries) in the center, 31.8% (62 bakeries) for the east and 25.8 % (42 bakeries) for the municipality in the west of Dammam. Since the

municipalities and the bakeries therein vary in area, the average area covered by the service of a bakery is 0.53km² for the center of Dammam, about 3.4km² for the east and about 4.92 km² for the municipality of the west of Dammam. The general average in all provinces is 2.49 km². In addition, the variation of the distribution of population and their density has led to the variation of the average people served by a bakery. The maximum value in the municipality of the center of Dammam rose to 5,917 people, while the general average in all provinces is 5,314 people. However, the average in the municipality of the east of Dammam reduces to 4,030 people for a bakery.

2. Since Dammam Center municipality has the highest rate of people 47.16% of the total people of the city although its area is no more than 8.86% of the total area of provinces, its density of population rose up to 11,336 people/ km². That is, it is five times the density in the provinces of Dammam (2130 people/km²). As a result, the population served by one bakery has increased to 5, 9177, while the area covered by the service of one bakery has decreased to 0, 53 km². Al-Souk in the municipality of the center is one of the biggest provinces in the city in terms of density (33,037 people/ km²). Its area is no more than 0. 51 km² because it is one of the oldest provinces. Conversely, it has no bakeries.

Table (1): Distribution of Population in the Municipalities of Dammam in 2022.

176	42	62	72	Number of bakeries
100.0	25.8	31.8	42.4	Percentage of bakeries
424.04	216.83	169.63	37.58	Municipality area/km2
100.00	51.14	40.0	8.86	Area percentage
2.49	4.92	3.14	.53	Average served by each bakery Area/km2
83	21	36	26	Number of neighborhoods
100.00	25.30	43.37	31.33	Percentage of the number of neighborhoods
903312	227428	249883	426001	Number of population/ persons
100.00	25.18	27.66	47.16	Percentage of population
2130	1049	1473	11336	Population density: persons/km2
5314	5414	4030	5917	Number of residents served by one bakery/km2

Prepared by Researchers based on Data from the Dammam City Municipality and Cartographic Analysis of Figure (2).

3. The municipality of the east of Dammam occupies the second place among the three municipalities of the city in terms of the number of bakeries (62). However, it comes in the first place in terms of the number of provinces, and the second place in terms of area and population (40% and 27.66% respectively) due to the low population in most of its provinces—especially the architecturally modern—and the decrease of their density (1,473 people/km²) owing to the expansion of area. Therefore, the number of people served by one bakery goes down relatively (4,030 people), while the area covered by service expands (3, 4 km²). Al-Iskan in the municipality of Shark is the biggest province of the municipality in terms of density (19, 226 people/km²). Its area is no more than 0.54 km² due to the urban expansion of Al-Naseem (The second largest province, 25.07 km², after King Fahd district in the west of Dammam in terms of area). Its population is no more than 7,040 people. Thus, its population density does not exceed 279people/km². The two provinces are devoid of any bakeries.

4. The municipality of the west of Dammam, the most architecturally modern, comes in the third place among the municipalities of Dammam in terms of the number of bakeries (42 bakeries); however, it comes in the first place in terms of area (216.83 km²). Because of the decrease in population (227,428) and bakeries on the one hand, and the expansion of area on the other, the scope of area covered by the service of one bakery rises up (4.92 km²), while the number of the population served goes down (5,414 people). Such a municipality has the biggest provinces in Dammam (King Fahd, 35.87km²), whereas Badr is the biggest in terms of population (71,385 people).

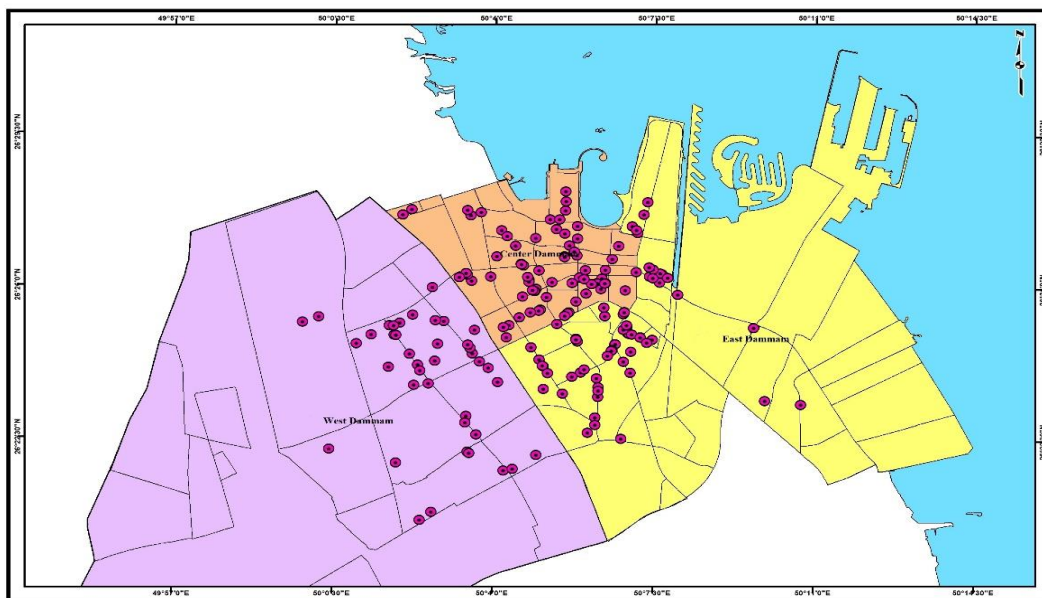


Figure (2): Geographical Distribution of Bakeries in Dammam in 2022.

Source: Done by the Researcher Using ARC GIS 10.6.1.

The Relation between the Map of Population Density and the Distribution of Bakeries in Dammam

The average of the service provided by bakeries in Dammam is 2,130 people/ bakery. The distribution of population in the area under study varies widely, and so does the area covered by the service of bakeries. Therefore, the density of population is a geographical variable that should be considered when bakery services are distributed in Dammam. Densely populated areas need a higher rate of service than low and sparsely populated ones to guarantee distributive equity (Jakle, 1999, 8-9). To test the consistency between the distribution of bakery services and the distribution of population density, the general density in every buffer of bakery services in the area under study is measured, Figures 3 and 4. The services are classified into the following categories:

A very sparsely populated buffer (less than 2,473people/km²). It has the provinces of the Eastern Shore, the Western Shore, Al-Nuras, Northern Khaledya, Al-Bustan, Al-Fanar, Southern Khaledya, Al-Naseem, the First Industrial region, Al-Nahda, Al-Muntazah, Al-Husam, Al-Safa, King Faisal city, Al-Saif, Al-Sadafa, Al-Fardous, Hager, Al-Nuzhah, Al-Rayan, Al-Waha, Tuhama, Al-Salam, Al-Jawhara, Al-Buhaira, the Second Industrial region, Al-Khedrya Industrial Region, Al-Hafreya, Al-Athir, Al-Manar, Al-Naddy, Tiba, Al-Shu'la, Al-Amal, Al-Anwar, Al-Rabeya, Al-Daheya, Al-Matar, Al-Manara, Al-Shark, Al-Fursan and Al-Hadaba. There are 65 bakeries (36.9% of the total bakeries in Dammam) in that buffer.

A sparsely populated buffer (2474: <6624 people/ km²). It has the provinces of Al-Salam, Northern Raka, Prince Mohamed Bin Saud, Al-Dana, Al-Hamraa, the Eastern Shore, Al-Athir, Al-Nasiriya, Al-Safa and Tuhama. There are 25 bakeries (14.2% of the total bakeries in Dammam) in that buffer.

A buffer with medium population density (6620: < 11, 510 people/ km²). It has the provinces of Al-Mazroueya, Al-Tabishy, Al-Itisalat, Badr, Uhud, Al-Rawda, Al-Azizeya and Al-Anoud. 32 bakeries (18.2% of the total bakeries in Dammam) are distributed on that buffer (more than 19, 540 people/ km²). It encompasses the City of Workers, Al-Kadiseya, Ibn Khaldoun, Al-Amamera, Al-Galaweya, Granada, Al-Rabeie and Al-Zuhour. 31 bakeries (17.2% of the total bakeries in Dammam) are distributed on that buffer.

A very densely populated buffer (more than 19,540 people/ km²). It has the provinces of Al-Souk, Al-Adama, Al-Khalij, Al-Nakil, Al-Kazaz, Granada, Al-Badeya, Al-Iskan and Al-Dawasir. 23 bakeries (13.1% of the total bakeries in Dammam) are distributed on such a buffer.

To sum up, the distribution of bakery services on the map of population density shows that 90 bakeries are located in the sparsely populated buffers. Besides, 32 bakeries are located in regions with medium population density. However, only 54 bakeries are found in densely and very densely populated buffers. This indicates that the distribution of bakery services in Dammam is inconsistent with the distribution of the medium and dense population. Thus, the number of bakeries in those buffers needs to be increased.

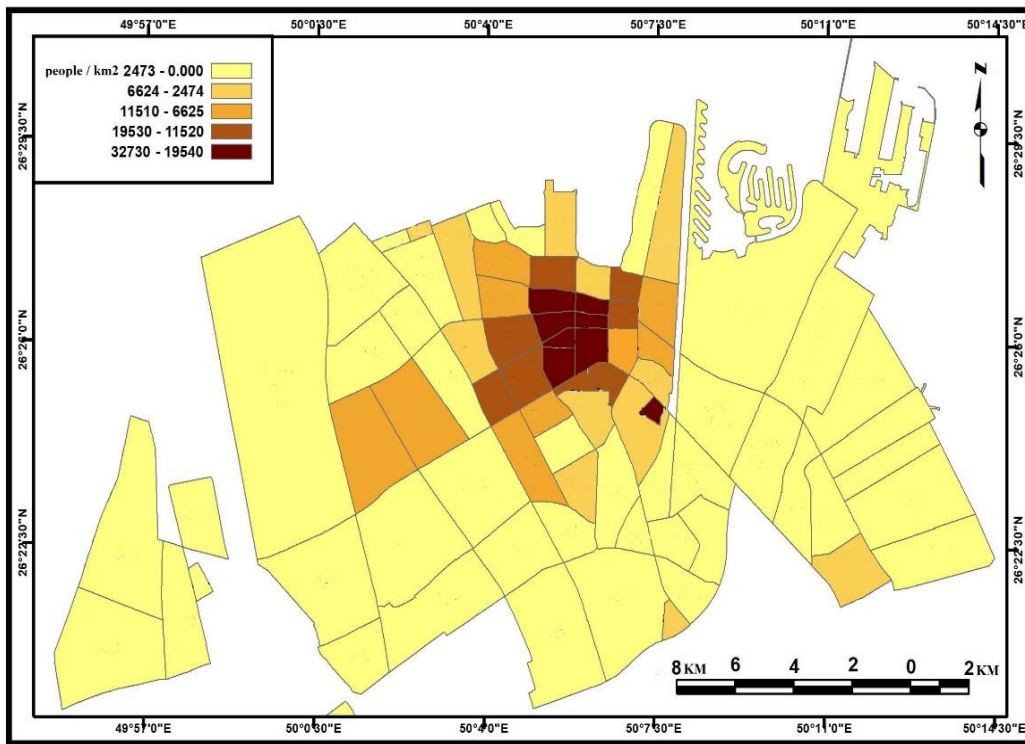


Figure (3): Population Density in Dammam in 2022.

Source: Done by the Researcher Depending on the Data of the Secretariat of Dammam Using ARC GIS 10.6.1.

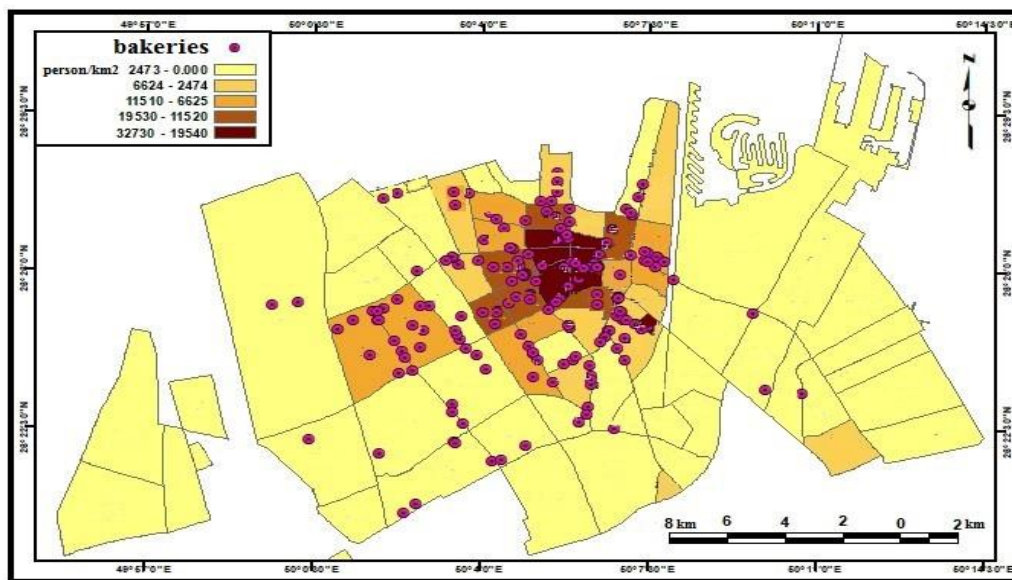


Figure (4): The Relationship between the Distribution of Bakery Services and the Map of Population Density in Dammam in 2022.

Source: done by the Researcher Depending on the Data of the Secretariat of Dammam Using ARC GIS 10.6.1.

Kernel Density Analysis for Measuring the Spatial Density of Bakeries in Dammam

Findings of the statistical test show the density of bakeries in the geographical area of residential provinces. This is done by calculation of the density of points around the centers so that the maximum concentration is around the main epicenter in Dammam. The concentration reduces with distance from the center. The geographical analysis of Figure (5) shows the following:

Most of the buffers with high concentration are located in old provinces. They have 18 highly densely populated provinces accounting for a half of the population of Dammam. However, the architectural mass goes down to 12% of the total architectural area in the area under study. During field study, it is observed that old provinces take a multistoried architectural pattern that hosts several families. Therefore, a building may have several families concentrated in a limited space. This category includes Al-Souk, Al-Idama, Al-Khalij, Al-Nakhil, Al-Kazaz, Granada, Al-Badeya, Al-Iskan, Al-Dawasir, the City of Workers, Al-Kadiseya, Ibn Khaldoun, Al-Amamira, Al-Galaweya, Al-Rabie and Al-Zuhour. There are 54 bakeries (30.7 % of the total number of bakeries in Dammam) in that buffer. In the second place comes the category of medium spatial concentration of bakeries in Dammam. It encompasses Al-Mazroueya, Al-Tabishy, Al-Itisalat, Badr, Uhud, Al-Rawda, Al-Azizeya and Al-Anoud. 32 bakeries (18.2% of the total bakeries in Dammam) are distributed inside that buffer.

It is noticed that the spatial concentration of bakeries goes down toward the outskirts, despite the obvious increase of the number of provinces to more than a half of the provinces in Dammam. Most of them are modern. There is also a significant decrease in population density to be less than one fourth of the population of Dammam. Conversely, the architectural mass marks the highest spatial concentration of buildings, that is, two thirds of the architectural area of Dammam because of the expansion of the projects spanning over wide swathes, including tourist resorts, multiple residential projects and residential houses mostly inhabited by one

family. That is the core difference is in terms of architectural mass between old and modern provinces. They include the eastern shore, the western shore, Al-Nuras, Northern Khaledya, Al-Bustan, Al-Fanar, Southern Khaledya, Al-Naseem, the First Industrial province, Al-Nahda, Al-Muntazah, Al-Husam, Al-Safa, King Faisal city, Al-Saif, Al-Sadafa, Al-Fardous, Hagar, Al-Nuzhah, Al-Rayan, Al-Waha, Tuhama, Al-Salam, Al-Jawhara, Al-Buhaira, the Second Industrial province, Khadereya Industrial, Al-Hafreya, Al-Athir, Al-Manar, Al-Naddy, Tiba, Al-Shu'la, Al-Amal, Al-Anwar, Al-Rabeya, Al-Daheya, Al-Matar, Al-Amana, Al-Shark, Al-Fursan and Al-Hadaba. There are 65 bakeries (36.9% of the total number of bakeries in Dammam) inside that buffer. To sum up, the distribution of bakeries on the geographical area shows that old and middle regions in Dammam need more bakeries to be consistent with the density of the architectural mass and the high and medium density of population.

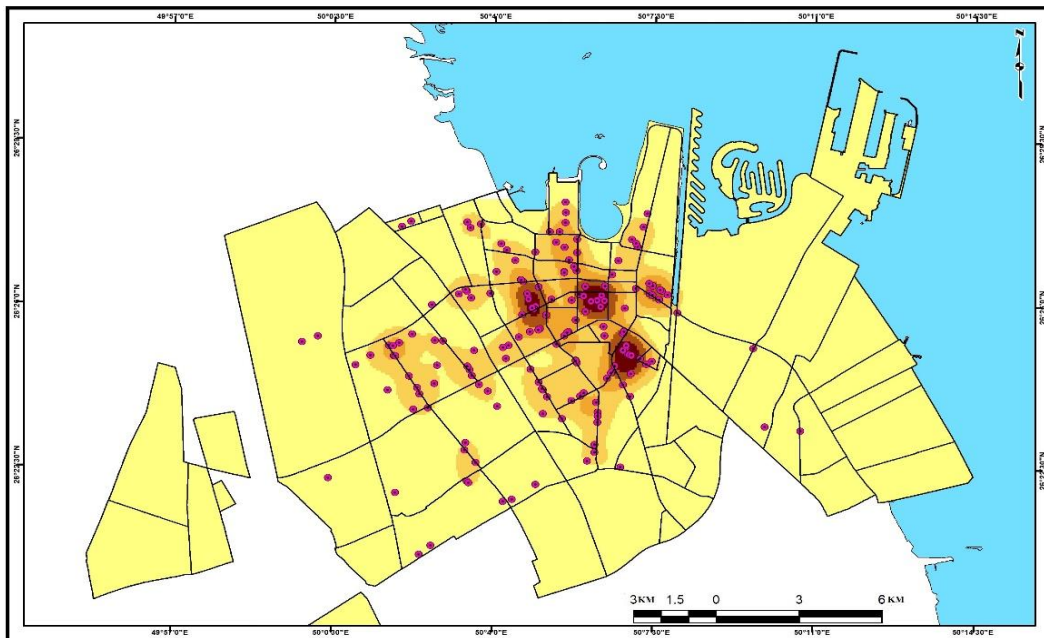


Figure (5): Kernel Analysis for Measuring the Spatial Concentration of Bakeries in Dammam in 2022.

Source: Done by the Researcher Depending on the Data of the Secretariat of Dammam Using ARC GIS 10.6.1.

The Relationship between the Direction of Geographical Distribution of Bakeries and the Direction of Province Distribution in Dammam

Directional Distribution (Standard Deviational Ellipse)

The cartographic analysis in Figure 6 shows that the direction of the geographical distribution of bakeries in Dammam is from the northeast to the southwest approximately. They are distributed on an area of about 55.33 km² (area of the oval shape=radius of the smallest diameter X radius of the biggest diameter X 3.14), that is, 13.05 % of the total area of provinces is in the city solely.

The maximum service provided by such bakeries cover an area of about 34.2 km² (61.76% of the total area of the direction of distribution. The distribution is consistent with the distribution

of old provinces in the city that developed along the coast of the Arabian Gulf east to the city and inward toward the west. However, the direction of province distribution is from the east to the west approximately. The area within that direction is 143.97 km² roughly (33.17 % of the total area of provinces). 154 bakeries are distributed in that direction (90.6% of the total number of bakeries). The service covers about 52.3 km² of the area of the buffer, indicating the higher efficacy of bakery distribution within the general direction of their distribution (from the northeast to the south) than their counterparts in the second buffer (toward the provinces from the east to the west). This can be explained by the new urban development in Dammam on the account of the coast to the east where the new sketches are and toward the west where the desert hinter-land of the city is. In addition, the areas of the eastern province, mostly directed from the east to the west, are small, while the area expands widely and shifts into the longitudinal direction from the north to the south in the west of the city.

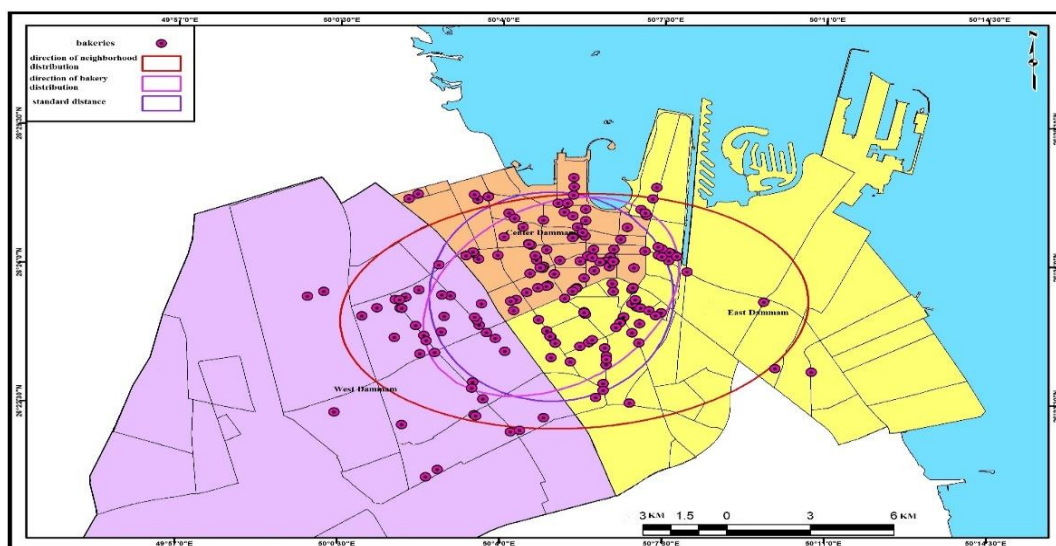


Figure (6): The Relationship between the Direction of Geographical Distribution of Bakeries and the Direction of Province Distribution in Dammam.

Source: Done by the Researcher Depending on Table 1 and Figure 2, Using ARC GIS 10.6.1.

2- Proportional Distribution of Bakeries Inside Several Buffers that Equidistantly Depart from the Point of the Spatial Center of Provinces in Dammam

By analyzing Figure 7, the findings in Table 2 are reached. It shows the numeral and accumulative distribution of bakeries and the accumulative area of its (maximum) service buffer within buffers of 2-10 km. Such distances are chosen after doing several experiments on different distances. It is found that such distances are appropriate for the illustration of the objective of the study.

The analysis of Table 2 and Figure 7 shows that the number of bakeries increases by distance from the central bakery in the provinces of the city and to a buffer of 4km that hosts 98 bakeries (55.7% of the total number of bakeries (i.e., 176 bakeries). This is consistent with the increase of the number of provinces (characterized by small areas and density of population and representative of the old nucleus of the city). However, the number of bakeries goes down, especially in a buffer of 8-12 km², to 7 bakeries. The rationale underlying this is perhaps the modernity of the provinces diverging from the central bakery, the expansion of its area and its

longitudinal extension, unlike its counterparts close to the central bakery (old provinces in Dammam), not to mention the decline in the population therein.

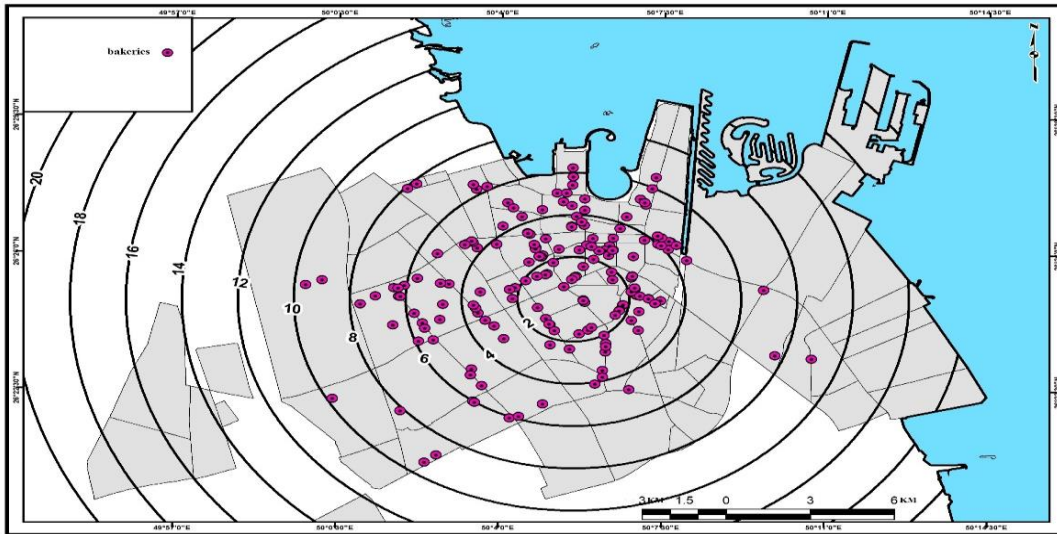


Figure (7): The Proportional Distribution of Bakeries in Equidistant Buffers.

Source: Done by the Researcher Depending on the Data of the Secretariat of Dammam and Figure 2 Using ARC GIS 10.2.

Table (2): The Proportional Distribution of Bakeries in Several Buffers.

Range categories/ KM	Number of bakeries	Cumulative number	Cumulative range area	Area covered by maximum service range	Cumulative area of maximum service range
2:0.0	28	28	12.56	42	42
4:2.001	70	98	37.7	12.56	54.56
6:4.001	49	147	61	37.40	91.96
8:6.001	20	167	78.8	60.16	152.57
10:8.001	7	174	95.8	69.76	222.33
12:10.001	0	174	107.17	59.63	281.96
14:12.001	0	174	114.66	48.40	330.36
16:14.001	1	175	122.1	26.74	357.1

Prepared by the Researcher based on the Cartographic Analysis of Figure (4).

Table (2) and Figure (7) show that the maximum service buffer of bakeries, in a buffer of 6 km² (147 bakeries), covers an area of 37.40 km² approximately (61.8% of the total area of the buffer (61 km²). The percentage of the coverage of the maximum service buffer gradually goes down by departure from the point of the central bakery of the city provinces to reach a buffer area of 10km² and 174 bakeries (99% of the number of bakeries in Dammam, which covers 72.8% of a buffer area of 10 km²). The correlation factor between the two variables is 0.90, which is a significant direct relation. The coefficient of identification (2.) shows that 81% of the changes in the percentage of coverage of the maximum service buffer of bakeries in Dammam is caused by the changes in the buffer area or by departure from the central bakery of the city provinces. The remaining percentage of the changes (19 %) can be explained by

other factors, including the direction of the urban expansion of the city, population, multiplicity of economic activities, variation in land use and the strategy used by the Ministry of Health in the construction and distribution of bakeries.

The relationship between the departure from the central bakery and the number of bakeries in the old provinces is arguably completely direct. The more distance away from the central bakery of the city provinces, the more bakeries and the higher the percentage of coverage. This is confirmed by the correlation coefficient (an integral one) between the percentage of accumulative coverage of the service buffer and the area of the region extending to a buffer of 4 km² where old provinces are concentrated in Dammam. It can also be said that the relationship between distance from the central bakery and the number of bakeries in the modern provinces is indirect. The more distant a bakery is from the central bakery, the less bakeries and the less percentage of coverage. This is confirmed by the value of the correlation coefficient (-0.99) between the accumulative percentage of coverage of the service buffer and the area of the region extending between a buffer of 4 km² and a buffer of more than 10 km² where the modern provinces in Dammam.

3- Standard Distance

The cartographic analysis of Figure 8 shows that the radius of the circle of standard distance is 4.4 km², that is, 70% of 123 bakeries are concentrated in that region. This justifies the concentration of bakeries in the older provinces and their gradual decrease by distance from the core of Dammam where the more modern city provinces are located. The area of such a circle is about 60.24 km². The total area served by bakeries based on the maximum service buffer within the circle of standard distance is about 36.2 km² (60.6 % of the total area of such a circle). This is to indicate that the distribution of bakeries within a circle with a radius of 4.4 km² (a standard distance circle) is effective. Therefore, the distribution of bakeries beyond such a circle is ineffective.

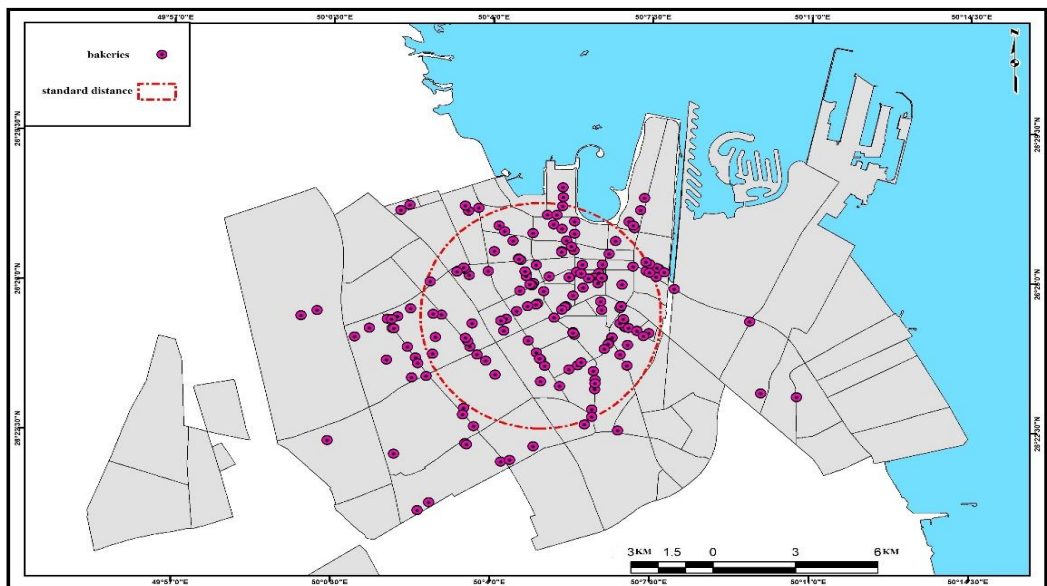


Figure (8): The Buffer of the Spatial Concentration of Bakeries in Dammam.

Source: Done by the Researcher Using ARC GIS 10.6.1.

4- Results of the Spatial Autocorrelation—Moran's-I Analysis that Tests the Hypothesis of the Study

As indicated earlier, the study aims to identify the nature of the geographical distribution of bakeries and their characteristics in terms of the spatial organization of the provinces of Dammam. Thus, Moran's-I is employed (the coefficient value is ± 1) to investigate such nature and to answer the research question:

Question of the Research: Are bakeries in Dammam effectively distributed on its population?

Hypothesis of the Research: bakeries are effectively distributed on the population of the city, that is, there are no fundamental differences in the distribution of bakeries on the population of the city.

The alternative Hypothesis: bakeries are ineffectively distributed on the population of the city, that is, there are fundamental differences in the distribution of bakeries and the population of the city.

Figure (9) shows that the pattern of geographical distribution of bakeries in Dammam is clustered to the effect that Moran's-I is -0.035714. It is a negative value signaling that the phenomenon under study, bakeries, is not surrounded by similar neighboring phenomena (distribution of population on the provinces). It also indicates that the spatial autocorrelation of the distribution is statistically significant at a reliability level of 99% (± 2.85) with a Z-score of 3.84. The P-value = 0.0001 shows that it is less than 0.1, that is, it is beyond the parameter of reliability. Therefore, the research hypothesis is rejected. Conversely, the alternative hypothesis that bakeries are ineffectively distributed on the inhabitants of the city, that is, there are fundamental differences in the distribution of bakeries and the population in Dammam is accepted.

Moran's Index:	-0.035714
Variance:	0.004406
z-score:	3.842473 ■
p-value:	0.000122

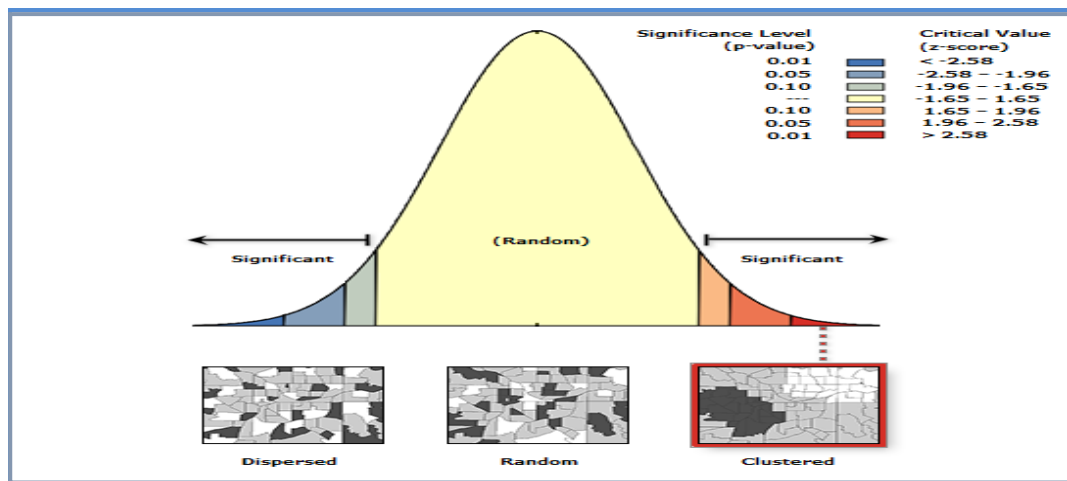


Figure (9): The Result of the Analysis of the Distribution of Bakeries and the Distribution of Population in Dammam.

Source: Done by the Researcher Using ARC GIS 10.6.1.

The cartographic analysis of Figure 10 shows the result of the cluster and Outlier analysis (Ansel in Local Moran's-I). Such a method is used for the categorization of the spatial units into homogenous groups in terms of the values representing the characteristics of the geographical distribution of the phenomenon. It is found that the geographical distribution of bakeries in the core of Dammam, including the bakeries of Al-Rawda (an extension of the core area), Uhud, and Badr, is obviously cumulative or statistically significant (H-H) and correlated with the number of population within its service buffer. This corroborates the inefficacy of bakery distribution on the population of such provinces and the decline of the efficacy of bakery distribution on the remaining provinces of Dammam.

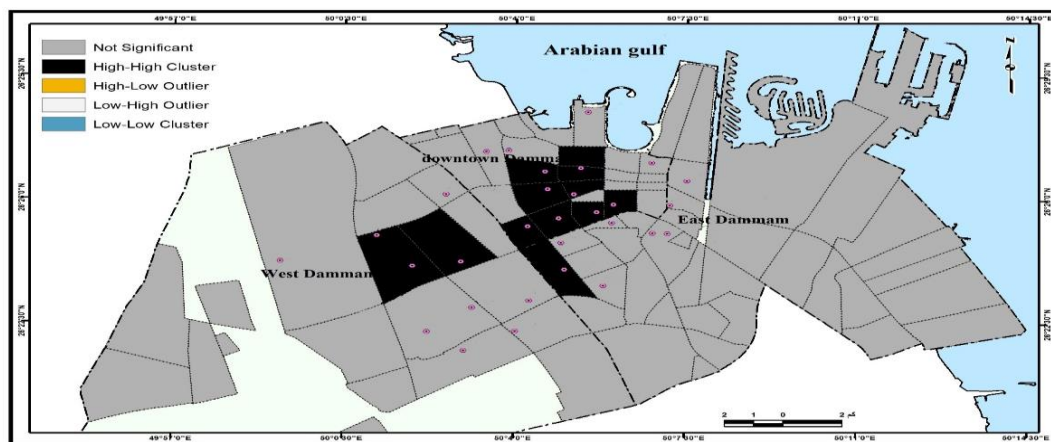


Figure (10): Results of the Cluster Analysis of the Relationship between Population and Bakeries in Dammam.

Source: Done by the Researcher Using ARC GIS 10.6.1.

5- Assessment of the Efficacy of Bakeries in the Area Under Study According to the Local Standard

The study relies on the standards which measure the proliferation of concrete capabilities of bakeries:

-bakery/person: it measures the relationship between bakeries and the population served. The Ministry of Municipal and Rural Affairs set forth planning rates for bakeries: 4000 to 15, 000 people a bakery in the residential provinces.

Bakery/1000m: it measures the distance between the location of a bakery and the maximum distance possible covered on foot: 1000m a bakery, given that the distance represents a radius of a circle surrounding the bakery

A. The Relationship between the Number of Bakeries and the Population Served in the Provinces of Dammam

1. Given the number of the population served by a bakery (4000 people) according to the Local Standard, the total population of the city is 903,312 people and the total number of bakeries is 176. The analysis of Table 3 shows that the number of bakeries required to serve that population is about 226. This means that there is significant lack of service (roughly 56 bakeries). Since the maximum number of the population served by a bakery is 15,000, the number of bakeries required to serve that population is roughly 60. That is, there is a surplus of service estimated as 120 bakeries.

Table (3): The Distribution of Population, Bakeries and Service Buffers in the Municipalities of Dammam.

Municipality	Central Dammam	West Dammam	East Dammam	Total
Number of population/persons	426001	249883	227428	903312
Number of bakeries	72	62	42	176
The average population served by one bakery/ Persons	5917	4030	5414	5314
The number of bakeries needed for the minimum service range is 4000 persons	107	62	57	226
The number of bakeries needed for the maximum service range is 15,000 persons	28	17	15	60
Area/km2	37.58	169.63	216.83	424.04

Prepared by Researchers based on Data from the Dammam City Municipality and Cartographic Analysis of Figures No. (6 And 7).

- 2- The analysis of the relationship between the number of bakeries and the number of population in the provinces of the city shows that it is a medium direct relationship (0.74) that is statistically significant with a reliability level of 95%. However, it is a weak indirect relation (-0.065) between the number of bakeries and the area of provinces, eventually reflecting the low efficacy of the distribution of bakeries in accordance with the area of provinces in the area under study.

Table (4): The Result of the Analysis of the Correlation between the Number of Bakeries, Population and the Area of Provinces in Dammam.

		Number of population/ Persons	Area/km2	Number of bakeries/bakery
Number of population/ Persons	Pearson Correlation	1	-.135-	.737**
	Sig. (2-tailed)		.223	.000
	N	83	83	83
Area/km2	Pearson Correlation	-.135-	1	-.065-
	Sig. (2-tailed)	.223		.562
	N	83	83	83
Number of bakeries/bakery	Pearson Correlation	.737**	-.065-	1
	Sig. (2-tailed)	.000	.562	
	N	83	83	83
**. Correlation is significant at the 0.01 level (2-tailed).				
Prepared by researchers using (SPSS) program				

- 3- Table 3 shows that the Dammam Center municipality needs 28 bakeries because the maximum number of the population served exceeds more than 5,917 people. However, it needs 107 bakeries to serve all population for the minimum of service buffer, 4000 people. According to the maximum service buffer of the number of population (150 thousand people), each municipality to the east and west of Dammam needs nine and five bakeries respectively due to the decrease in the number of population there. Conversely, if measured in proportion to the minimum service buffer (4 thousand people, municipalities will need more than this.

On the other hand, the case is more complicated in the provinces of Dammam. It is observed that although some provinces desperately need bakeries, other provinces have bakeries that serve a small number of people. This can be traced as follows.

- A. Most of the provinces in the municipality of the east of Dammam need at least one bakery (based on the maximum service buffer, 15,000 people) the inhabitants there outnumber the maximum service buffer, including but not exclusive to Al-Nakhil (one bakery for a population of 18,432 people) and Al-Azizeya (one bakery for a population of 17,280 people). Or, there is no bakery to serve the population of a province, for example, Al-Dawasir (14,162 people), Al-Dana (4,470 people), and Al-Salam (2,304 people).
- B. Despite the decline in the number of population in most provinces of the municipality to the east of Dammam, it has only 62 bakeries (35.2 %) of the total bakeries serving the inhabitants of its provinces (249,883 people), that is, about 17 bakeries according to the maximum service buffer (15,000 people). Therefore, most provinces of such a municipality need at least one bakery in the future in light of the prospective increase of population in such provinces that undergo constant urban growth. However, some provinces have one bakery despite the small number of people there, for example, Al-Itisalat and Al-Jamieen because of their geographical location that allows them to serve the inhabitants of the adjacent provinces.
- C. The analysis of the figures mentioned in Table 3 shows that the municipality of the west of Dammam has 57 bakeries. Namely, one bakery serves about 5,414 people based on the minimum service buffer (4000 people). Therefore, the provinces in the west of Dammam need more bakeries to cope with the total size of population. The salient problem here is that the distribution of bakeries on the provinces in the west of Dammam is not fair, even compared with the maximum. Although the population of Al-Shu'la is 17,661, which outnumbers the maximum, it has no bakeries. This means that bakeries are not effectively distributed on the provinces of Dammam according to the Standard of Population.

B. The Relationship between the Number of Bakeries and the Area of Service Buffer in the Provinces of Dammam

1. The result of the correlation coefficient in Table (4) shows that the relationship between the number of bakeries and the area of provinces is very weakly indirect (-0.065). Given the identification factor (2ج), it is implied that only 0.4% roughly of the variation in the number of bakeries is justified by the changes in the area of provinces. The remaining percentage of such changes (99.6%) can be explained by other factors, on top of which is the state's strategy of the construction and distribution of bakeries (as per the Local Standard of Population, not the area). Other factors include the available area and the extension of road networks and their direction in light of the architectural and economic changes in Dammam.
2. Table 5 shows the relationship between the number of bakeries and the area of service buffer in the provinces of Dammam, given that the maximum area of the service buffer for each bakery is 2.01 km² according to the Local Standard. Since the total area of the provinces of the city is 424.4 km², and the total number of bakeries is 176, the required number of bakeries to serve that distance is 211 bakeries approximately. This means that there is a deficit of 41 bakeries, indicating the relative higher efficacy of bakeries, compared to the number of population, than its counterpart compared with the area of Dammam in accordance with the maximum service buffer (15,000 people/2.01 km²). Therefore, the average area/km² served by a bakery varies in Dammam Center municipality at 3.13 km², which is less than the general average of Dammam (14.13 km²). Nonetheless, the average rises for the municipalities of the east and the west (21.20 km² and 21.20 km² respectively).

3. In the provinces of Dammam, the case is more complex. It is observed that although some provinces desperately need bakeries, other provinces have more bakeries than required compared with the area of a province. This can be traced as follows:
 - A. It is observed that most of the provinces in the center of Dammam (26 provinces distributed over an area of about 37.58 km²) are characterized by a small area that is no bigger than the biggest province, Al-Khaderey Industrial (3.8 km²). The average of the area served by one bakery (out of 72 bakeries) is no more than 3.13 km². The total area covered by the maximum service buffer of such bakeries is about 24.12 km² (64.2 % of the total area of Dammam Center municipality). This signals the expansion of the geographical power of the bakeries located in Dammam Center municipality and the rise of their efficacy.

Table (5): The Relationship between the Number of Bakeries and the Area of Service Buffer in the Provinces in Dammam.

Municipality	Central Dammam	West Dammam	East Dammam	Total
Number of population/ Person	426001	249883	227428	903312
Number of bakeries	72	62	42	176
The bakery serves one population / person	5917	4030	5414	5314
Area/km2	37.58	169.63	216.83	424.04
Average served by one bakery area/km2	3.13	21.20	21.68	14.13
Number of bakeries needed for the maximum service area (2.01 km2)	19	84	108	211

Prepared by Researchers based on Data from the Dammam Municipality and Cartographic Analysis of Figures (6 And 7).

- B. Given that the municipality of the east of Dammam is big in area, and so are most of its provinces (36 provinces are distributed over an area of about 169.93 km²), for example, the biggest province, Al-Naseem exceeds 25.22 km², the average area served by one bakery (of 62 bakeries) exceeds about 21.20 km². The total area covered by the maximum service buffer of such bakeries is 16.08 km² roughly (9.5 % of the area of the municipality of east Dammam).
- C. The analysis of the figures mentioned in Table 5 shows that the municipality of west Dammam has 42 bakeries. That is, one bakery serves an area of about 21.68 km², more than the area of the maximum service buffer according to the Local Standard. This is explained by the expansion of most provinces of such a municipality (the area of King Fahd province is about 35.87 km², the biggest area in the city). Based on the maximum area of service buffer (2.01 km²), the number of bakeries required to serve the area of the provinces of such a municipality is 108. The total area covered by the maximum service buffer of such bakeries according to the Local Standard is 20.1km² (9.3 % of the total area of the municipality of west Dammam (216.83 km²). Therefore, the provinces of such a municipality are found to require an increase in the number of bakeries there, and their manner of their service is demonstrated.

The analysis of Figure 11 shows that the pattern of geographical distribution of bakeries in Dammam is clustered with a Moran's-I of -0.034483, which is a negative value indicating that the phenomenon (of bakeries) under analysis is not surrounded by similar neighboring phenomena (the area served). It also shows that the spatial autocorrelation of distribution is

statistically significant at a reliability level of 99% (± 2.85), given that the Z-score = 3.52. It is observed that the P-value = 0.0001 is less than 0.1, namely, it is beyond the parameter of reliability. Thus, the research hypothesis is rejected, while the alternative hypothesis stating that bakeries are not effectively distributed over the area served by bakeries in the area under study; that is there are fundamental differences in the distribution of bakeries and area in Dammam.

Moran's Index:	-0.034483
z-score:	3.520887 ■
p-value:	0.000430

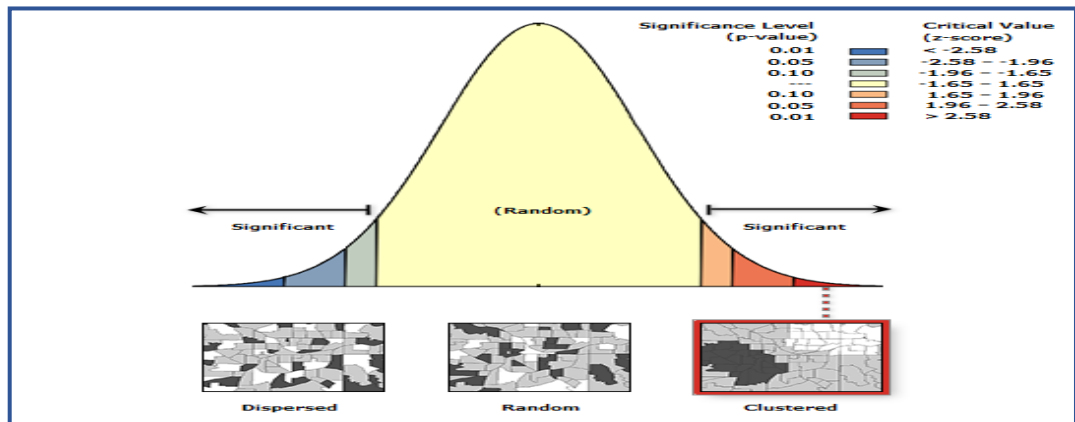


Figure (11): The Relationship between the Distribution of Bakeries and the Area Served by a Bakery.

The cartographic analysis in Figure 12 that shows the result of the clustered analysis of the relationship between bakeries and the area of provinces in Dammam indicates that the geographical distribution of bakeries does not demonstrate a certain concentration. That is, it is not statistically significant at 0.05, which corroborates the inefficacy of the distribution of healthcare bakeries according to the Standard of Area in all provinces of Dammam.

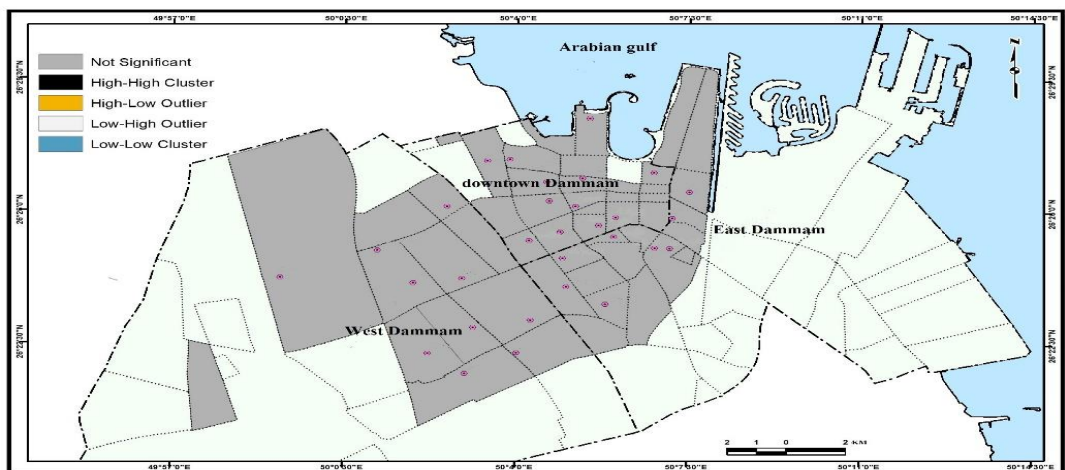


Figure (12): The Result of the Clustered Analysis of the Relationship between Bakeries and the Area of the Provinces in Dammam.

Source: Done by the Researcher Using ARC GIS 10.6.1.

C. The Relationship between the Maximum Service Buffer (1000 M) and the Actual Area Served by Each Bakery

The cartographic analysis of Figure 13 shows the overlap between the service buffers of bakeries in the old provinces with small areas in the city, especially those located in the parameter of the circle of the Standard Distance where 120 bakeries (70% of the total number of bakeries in the city) are located. See Figure 2. It also shows the expansion of the geographical buffer of the bakeries situated in Dammam Center municipality to serve regions beyond its administrative borders. Such an overlap gradually shrinks by distancing from the core of the city toward the outskirts where modern provinces are. The western modern provinces are characterized by the expansion of area and the low population. This ultimately indicates the inefficacy of the distribution of bakeries in the provinces of Dammam.

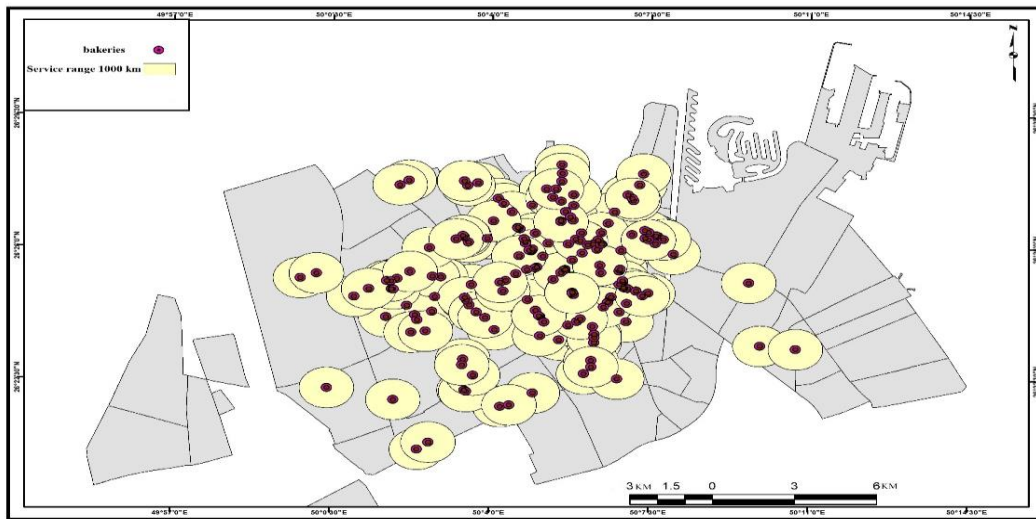


Figure (13): The Distribution of the Maximum Service Buffer (1000 m) for each Bakery and the Actual Area Served.

Source: Done by the Researcher Using ARC GIS 10.6.1.

Table 6 shows the difference between the actual area served by a bakery and the local service buffer in Dammam. The analysis of Figure 13 shows a number of facts that can be outlined as follows:

- 1- The actual area covered by a service buffer for one bakery varies between 35.874 km² in Al-Daheya to the west of Dammam serving its people only and 0.392km² in the province of Iskan Dammam to the east. The general average for each bakery is 5.362 km². That is, the actual service buffer exceeds the local service buffer (2.01 km²) by two times the area.
4. Some provinces have several bakeries as in Badr that has two bakeries serving more than 35,000 people, and Al-Shefaa that encompasses two bakeries serving the people of Iskan Dammam, Al-Shefaa and the City of Workers (45,000 people).
5. Some bakeries serve the people of several provinces, for example, the bakery of Al-Jamieen which serves Al-Jamieen, Al-Rayan, Al-Waha and Al-Nuzhah (15.8 thousand people). The bakery in Ibn Khaldoun is another example. It serves Ibn Khadoun and Al-Marikabat (17.9 thousand people). Besides, the bakery in Ibn Rushd serves Al-Tabishy, Al-Nasereya and Prince Mohamed Bin Suoud provinces (27.8 thousand people).

6. Some bakeries serve smaller areas than the local service buffer (2.01 km²). For example, the bakeries in Al-Nakhil, Al-Kadiseya, Al-Khalij, Al-Adama, Al-Itisalat, Al-Anoud and Al-Badeya, in Dammam Cenetr municipality where population concentrates at the core of the area under study, collectively serve more than 170 thousand people. Their service buffers overlap, indicating the increase of the efficacy of the service buffer of bakeries in the center of Dammam (the core and old nucleus of the city).
7. The bakery in Al-Manar serves the people in Al-Manar and the people of Al-Fersan which is 7.85 km away from it. This means that the service buffer of a bakery is less effective as it departs from the bakery of the city westward or eastward.

D. The Spatial Organization of the Locations of Bakeries and its Relationship with the Main Road Network in Dammam

The spatial organization of bakery locations plays an essential role in the identification of the efficacy of a bakery and its readiness to duly do its tasks. The efficacy of the spatial organization of bakery locations is associated with some factors and considerations, for example, the reduction of the time spent on moving to a bakery location. To do so, the location should be selected in an area with a medium expected service buffer, on main or arterial roads, that allows for flexible entry and exit. It should help with covering the served area with the required quality and caliber of service in consistence with the size and nature of the uses of land and the density of population in the region. Figure 14 shows the main road network and the locations of bakeries in Dammam.

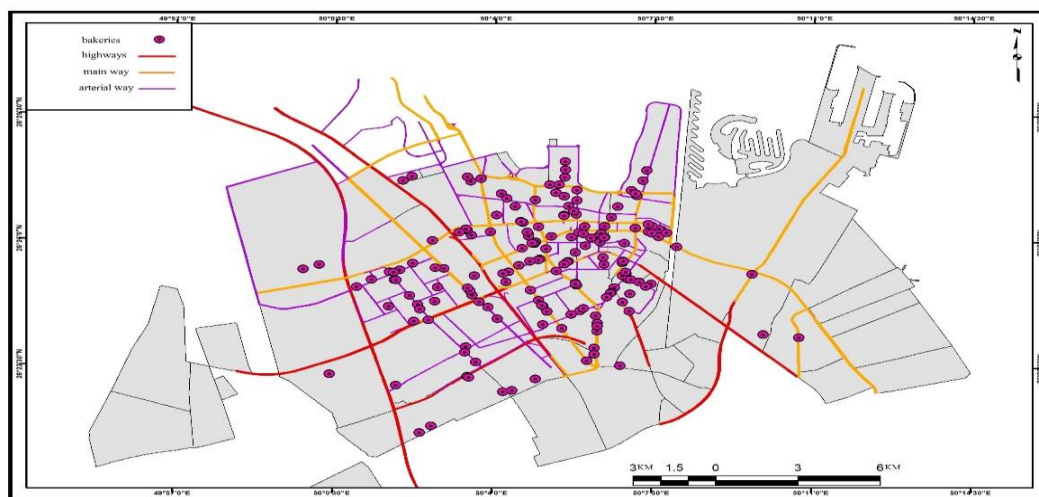


Figure (14): The Main Road Network and the Bakery Locations in Dammam.

Source: Done by the Researcher Using ARC GIS 10.2.

The analysis of Figure 14 shows that there is a strong and positive correlation between the spatial organization of bakery locations and the arterial and main road network in Dammam. That is, the locations of most bakeries are shown to be effective compared with the main road network in Dammam, highlighting the great role of transport roads and the economic significance of the concentration and pervasion of bakery services in Dammam.

The Planning Standards of Bakery Locations in Dammam

The Ministry of Municipal and Rural Affairs set forth conditions to enhance bakery locations against other institutions. That is, it stipulates that the location should not be close to a

dangerous institution that does not abide by safety rules and principles. In addition, the location should be away from industrial non-nutritional facilities that have a negative bearing on the environment as in the following table.

Table (6) Assessment of the Efficacy of Bakeries according to the Planning Standards in Dammam.

Type of standard used	Distance from the standard in metres	Number of bakeries matching the standard distance	Number of bakeries that violate the standard distance
Fuel station	Not less than 100 metres	151	25
Gas cylinder sales and distribution center	Not less than 100 metres	170	6
Industrial area	Not less than 200 metres	173	3

Source: Royal Commission in Jubail and Yanbu — Royal Commission in Jubail, 1435H, p.19, Ministry of Municipal and Rural Affairs, 2019. Standards conformity has been applied depending on the Arc Map.

The table and the cartographic analysis of Figure (15) show that all bakeries have committed to the conditions set for the planning standards except the standard of proximity to gas stations which comes on top of infringement standards. About 25 bakeries (14.2%) of the total bakeries) breach the standard of distance from gas stations, which necessitates the maximization of safety levels in such bakeries to cope with the set standards. The standard of distance from the points of sale of natural gas cylinders comes in the second place in terms of infringing bakeries (6). Finally, 3 bakeries broke the standard of proximity to industrial zones. It is observed that generally most bakeries commit to planning standards, which is taken as a strength point in bakery assessment according to the planning standards in Dammam.

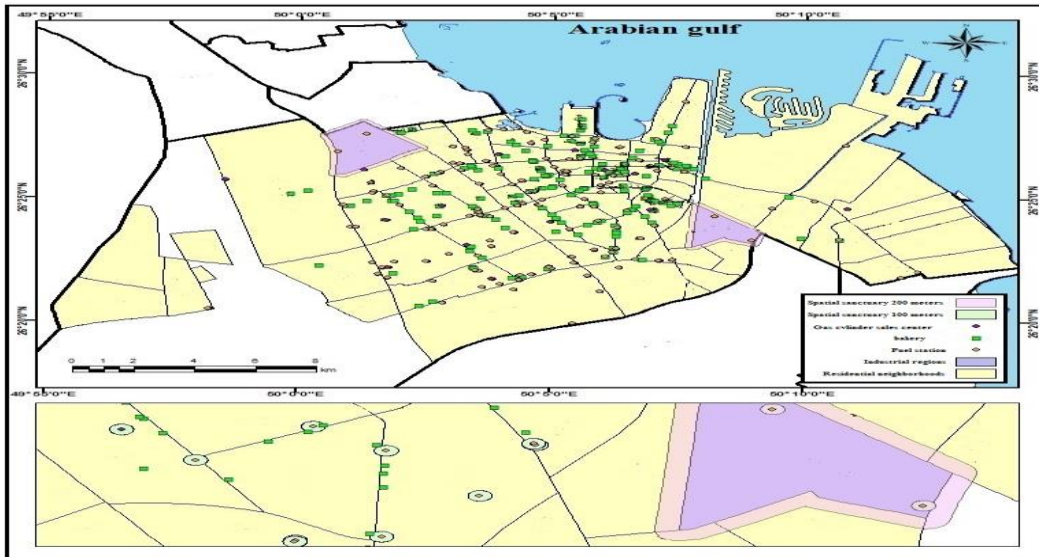


Figure (15): Assessment of the Distribution of Bakery Locations in Dammam according to the Conditions of Planning in 2022.

Conclusion

The study boils down to the following finding. Bakeries in Dammam are variably distributed on the municipalities of the city: 42.4% (72 bakeries) for the center, 31.8% (62 bakeries) for the east and 25.8% (42 bakeries) for the municipality of west Dammam. Since the areas of municipalities and the number of bakeries there vary, the average area served by one bakery varies between 0.53 km² for the center of Dammam, about 3.14 km² for the east and about 4.92 km² for the municipality of west Dammam. However, the general average in all provinces is 2.92 km². The variation in the distribution of population and its density amounts to a variation in the average population served by one bakery. It peaked in Dammam Center municipality to 5,917 people, while the general average in all provinces is 5,314 people. It gets below that general average in the municipality of east Dammam (4,030 people per bakery). It is demonstrated that there is inconsistency between the distribution of bakeries and the map of population density.

The distribution of bakeries on the map shows that 90 bakeries are located in the sparsely populated buffers, 32 bakeries belong to the medium densely populated buffers and only 54 bakeries belong to the densely populated buffers, not the highly or the very highly densely populated ones. Therefore, the distribution of bakery services is inconsistent with the distribution of medium and high population density. That is, the number of bakeries in the area of high and medium population density needs to be increased. The cartographic analysis shows that the direction of bakery distribution in Dammam is from the northeast to the southwest. They are distributed within an area of 55.33 km² (13.05 % of the total area of the provinces of the city only). The maximum service buffer of such bakeries covers an area of about 34.2 km² (61.76 % of the total area in the direction of distribution). Such a distribution agrees with the distribution of old provinces that developed parallel to the coast of the Arabian Gulf east of the governorate inward to the west. With regard to the direction of distribution of the provinces of the city, it is roughly from the east to the west. The area inside that direction is estimated as 143.97 km² (33.17 % of the total area of the provinces). 154 bakeries (90.6 % of the total number of bakeries) are distributed therein. Their service buffer covers an area of about 52.3 km² (36.3%) of the buffer area. That is, the distribution of bakeries in the buffer of that general direction (from the northeast to the southwest) is effective. The distribution of bakeries is consistent with the distribution of the old provinces in the city. That is, the distribution of bakeries in the buffer of the general direction (from the northeast to the southwest) is effective.

In addition, the study shows that the number of bakeries increases with distance from the central bakery in the provinces of the city to a buffer of 4 km that encompasses 98 bakeries. Then, the number of bakeries goes down, especially in a buffer of 8 to 10 km, to no more than 7 bakeries. The relationship between distance from the central bakery and the number of bakeries in the old provinces is "completely" direct. The more distance from the central bakery in the provinces of the city, the more bakeries and the more coverage. The relationship between the distance from the central bakery and the number of bakeries in the modern provinces is indirect. The more distance from the central bakery, the less bakeries and the less coverage. The analysis of Moran's-I shows that there is no correlation between the distribution of population and that of bakeries. Thus, the research hypothesis is rejected, whereas the alternative hypothesis stating that bakeries are not effectively distributed on the population of the city, that is, there are fundamental differences in the distribution of bakeries and that of population in Dammam.

The analysis of the relationship between the distribution of population, bakeries and service buffers, based on the minimum population served by a bakery (4000 persons) according to the Local Standard, shows that the number of bakeries required to serve such population is 226 bakeries approximately. Given that the maximum population served by each bakery is 15,000 people, the required number of bakeries to serve such population is roughly 60 bakeries. Therefore, bakeries are not effectively distributed in the provinces of Dammam according to the Standard of Population. The analysis of the correlative relationship between the number of bakeries and the area of provinces shows that it is a very weakly indirect relationship (-0.065). The identification coefficient (2J) indicates that only 0.4 % of the changes in the numbers of bakeries can be explained by changes in the area of the provinces. The remaining proportion of the changes (99.6%) can be explained by other factors on top of which is the Kingdom's strategy of the construction and distribution of bakeries according to the Local Standard of population, not area, not to mention the available area and the extension of the road network and its directions in light of the architectural and economic changes in Dammam. Most of the provinces of Dammam Center municipality are characterized by small area. Hence, the average of the area served by one bakery (out of 72 bakeries) is no more than 3.13 km². The total area of the maximum service buffer of such bakeries is 24.12 km² (64.2% of the total area of Dammam Center municipality). Therefore, the geographical buffer of the bakeries in Dammam Center municipality is wide and more effective. However, the efficacy of the geographical buffer of the bakeries inside the municipalities of the west and the east of Dammam is low.

The study of the relationship between the maximum service buffer (1000 m) and the actual area served by each bakery shows that there is an overlap between the small service buffers of bakeries in the old provinces, especially those within the circle of the standard distance where 120 bakeries are concentrated (70 % of the total number of bakeries in the city). Some provinces have more than one bakery as in Badr, and some bakeries serve more than one province as the bakery of Al-Jamieen which serves Al-Jamieen, Al-Rayan, Al-Wahah and Al-Nuzhah. Nonetheless, some bakeries serve a smaller area than that of the local service buffer (2.01 km²) as in the provinces of Dammam Center municipality.

There is a strong correlation between the spatial organization of bakery locations and the (main and arterial) road network in Dammam. That is, the locations of most of the bakeries are effective compared with the main road network in Dammam. Some bakeries in Dammam do not conform to the standards of planning. About 35 bakeries broke the standard of proximity to gas stations. 6 bakeries broke the standard of proximity to the points of sale of natural gas cylinders, while 3 bakeries broke the standard of proximity to industrial zones.

Recommendations of the Study

Based on the findings and the aspects impeding the promotion of the quality of bakery distribution in Dammam, not to mention the attempt to enhance services to upgrade the quality of life in the cities of the Kingdom of Saudi Arabia, some recommendations are outlined as follows:

1. The number of bakeries in provinces with high population density should be increased so that pressure on bakeries is reduced and sustainability is guaranteed. The increase is consistent also with the area and number of population in the provinces of the city. In addition, practical solutions concerning the bakeries infringing the planning standards must be found since they have dire consequences on the population of Dammam.

2. The private sector has to be encouraged to support service by the construction, equipment and operation of bakeries in the city.
3. A GIS unit should be created to support and make decisions for bakeries in Dammam. In addition, there must be partnerships with the Municipal and Rural Affairs and the department of geography and GIS in order to provide advice and academic studies.
4. Departments of geography have to be created in universities of the Kingdom to guide post-graduate students (MAs and PhDs), researchers and the interested staff members to the assessment of the efficacy of service distribution in principle and bakeries in particular in the cities of the Kingdom. Therefore, decision-makers can find indicators to help them promote the quality of the service sector in the cities of Saudi Arabia.

Finally, it is recommended that the geographical distribution of bakeries in Dammam desperately need reconsideration to cope with the new and prospective urban growth in the east and west of the city.

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References

Arabic References

- General Administration of Cultural and Media Affairs, (1419 AH): Civil Defense and its 74 Years' Journey, General Directorate of Civil Defense, Ministry of Interior, Saudi Arabia.
- Bishr, Mahmoud Muhammad Jamal, (2010), Spatial Analysis of the Distribution of Civil Defense Service in Muscat Governorate Using Geographic Information Systems, Geographic Messages Journal, Letter No. 356, Kuwait Geographical Society, Kuwait.
- Al-Khalifa, et al., (1413 AH - 1993 AD), Factors for Utilizing the Services of Private Treatment Institutions, "A Field Study," Imam Muhammad bin Saud Islamic University.
- Al-Baghdadi, Mustafa (1994): A systematic study on the relationship of geography to services, Girls' College Yearbook, Ain Shams University, no. 17.
- Al-Ghamdi Abdul Aziz (1986), Study of Mosque Sites in the City of Mecca, Mecca Cultural and Literary Club, Mecca.
- Abdul Karim, Ashraf Ahmed Ali, (2014): Spatial analysis of the distribution of public services and identification of planning needs, an applied study on the city of Hafar Al-Batin, Saudi Geographical Society, King Saud University.
- Al-Rabdi, Muhammad Saleh, (1419 AH), The Riyadh Region, a Historical, Geographical, and Social Study, Services in the Riyadh Region, Part (7), edited by Abdullah Al-Wali'i, The Emirate of the Riyadh Region.
- Al-Rabiah, Badr Abdulaziz, (2007), The Development of Bakeries in the Kingdom of Saudi Arabia over a Hundred Years, King Abdulaziz House, Riyadh.

- Al-Ruhaili, Basma bint Salama (1427 AH): Using Geographic Information Systems in Assessing the Current Status of Government Girls' School Sites in the City of Mecca, Master's Thesis, Umm Al-Qura University, Mecca.
- Al-Rumaihi, Saeed (1999 AD): Distribution of Civil Defense Services in the City of Riyadh, King Faisal University.
- Al-Zahrani, Ramzi Ahmed, (1424 AH - 2003 AD) The geographical distribution of health services in the Makkah Al-Mukarramah region, Geographical Research, No. (55), Saudi Geographical Society.
- Al-Zahrani, Ramzi Ahmed, (2006 AD) Spatial autocorrelation of bakery distribution, Journal of Gulf and Arabian Peninsula Studies, issue (123), Kuwait University.
- Al-Zahrani, Ramzi Ahmed, (2000), Living Standards in the Kingdom of Saudi Arabia, a Study in Residential Characteristics, Issue 241, Kuwait Geographical Society, Kuwait.
- Shawish, Adel Muhammad, (2014): Some aspects of the spatial analysis of the main road network in Taif Governorate in the Kingdom of Saudi Arabia, a study in transportation geography.
- Al-Qahtani, Hassan bin Muhammad Misfer, (2018): Spatial Analysis of Primary Schools in the City of Abha, Asir Region, Part 18, Issue 127, Society for Culture and Development, Kingdom of Saudi Arabia.
- Al-Huwaish, Abdul Karim bin Khalaf, (2014 AD): Analysis of spatial variation of health services in the Kingdom of Saudi Arabia for the period (1413-1431 AH), Journal of Gulf and Arabian Peninsula Studies, vol. 40, issue. 153, Kuwait University, Scientific Publishing Council, Journal of King Faisal University.
- Al-Hubaishi, Sanaa Bint Saleh (2011): Bread making in the city of Mecca, a study in economic geography, Umm Al-Qura Journal for Social Sciences, Umm Al-Qura University.
- Al-Dwikat, Qasim and Al-Faisal, Khalid bin Hamad (2010): Analysis of the pattern of distribution of theft crimes in the city of Hail, Saudi Arabia, using geographic information systems, Journal of the Association of Arab Universities for Arts, Volume 4, Issue 3.
- Al-Sudaimi, Mohamed Zaki Hamed (2005): Mills and bakeries in the city of Tanta, Center for Geographical and Cartographic Research, Menoufia University.
- Sheikh, Amal Bint Yahya (1429 AH): Analysis of the distribution pattern of typical public parks in the city of Jeddah using Geographic Information Systems technology, a working paper within the Third National Conference on Geographic Information Systems in the Kingdom of Saudi Arabia, Al-Khobar.
- Al-Asiri, Fayez Muhammad (1422 AH): Awareness of the importance of geographic information systems in civil defense work, a working paper within the research of the Nineteenth Civil Defense Conference, King Fahd Coastal City, Jeddah.
- Al-Asiri, Fayez Muhammad (1424 AH): A model for rapid response in determining the location of an accident using geographical information systems for bakeries in the city of Riyadh, doctoral thesis, King Saud University, Riyadh.
- Al-Maadawi, Mahrous Ibrahim (2006 AD): Bread production in Kafr El-Sheikh Governorate, a study in the geography of production, Arab Geographical Journal, issue 48, year 38, vol. 2, Cairo.
- Moselhi, Fathi Mohamed (2007) The Geography of Services, Theoretical Framework and Arab Experiences, Dar Al Majed for Publishing and Distribution, Cairo.
- Bin Salma, Nasser bin Muhammad (1422 AH): The importance of geographic information systems in planning the redistribution of bakeries and units in the city of Riyadh, Kuwait Geographical Society, Geographical Letters, No. (262), Kuwait.
- Sharif, Sharif Abdel Salam (2019) Banking services in the city of Dammam, a study in the geography of communications, Journal of the College of Arts - Port Said University.

- Khair, Safouh (2000): Geography: Its Subject, Methods, and Objectives, Dar Al-Fikr, Damascus, Syria.
- Othman, Badr Al-Din Taha (1424 AH): Supporting decision-making and spatial analysis in geographic information systems, Kuwait Geographical Society, Geographical Letters, Issue No. (277), Kuwait.
- Azaz, Salwa Muhammad (2006 AD) Bread making in the Matareya neighborhood, Geographical Research Bulletin, Department of Geography, Ain Shams University, Egypt.
- Moselhi, Fathi Muhammad (2007): The Geography of Services, Theoretical Framework and Arab Traders, Dar Al Majid for Publishing and Distribution, 2nd edition.
- Ministry of Economy and Planning, General Statistics Department, preliminary results of the General Census of Population and Housing: (1431 AH).
- Ministry of Municipal and Rural Affairs (1426 AH): Guide to Planning Standards for Services, Riyadh, first edition.
- Ministry of Municipal and Rural Affairs, Eastern Province Secretariat, Geographic Information Systems Department, (1428 AH), Dammam City Map (neighborhoods, cities, land uses), Dammam.

English References

- Adam, (2002), Geography of Service: Progress in the Geography of Service, Progress Report, School of Geographical Sciences. University of Bristol. Bristol. U.K.
- Berry, B, (1972), Classification Handbook Methods and Application, New York.
- Hagget P. (1965): "Location Analysis in Human Geography, London.
- Jakle.D. R (1999): The Strategy of Equality. Allen and Unwin. London.
- Rubenstein ,James M. (2003): An Introduction to Human Geography ,The Cultural Landscape. New Jersey ,Pearson Education ,Inc.
- Sarmistha. B & Helen. L, (2006): Economic Geography: Past, Present, and Future, Route Ledge, U. S. A, New York.