



## Asian Journal of Management and Commerce

E-ISSN: 2708-4523

P-ISSN: 2708-4515

AJMC 2023; 4(1): 49-52

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[www.allcommercejournal.com](http://www.allcommercejournal.com)

Received: 09-11-2022

Accepted: 14-12-2022

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## Identification of warehouse location in Jabalpur region of Madhya Pradesh

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### Abstract

Delivery of any product ordered online requires logistics services to reach the end consumer. To ensure the smooth flow of these products, the logistics companies build warehouses near the vicinity of cities. The location of these warehouses is to be chosen strategically to minimize transportation costs and increase serviceability. With the rise in online sales and services via platforms of ONDC, Flipkart, Meesho, Amazon, and others, it is relevant to start preparing cities to accommodate such development. The study evaluates the emerging city of Jabalpur to determine the potential locations of warehouses. The data was collected considering the population w.r.t pin-codes. K-mean clustering was used to determine the nearest warehouse locations. The optimum number of warehouse requirements came to be three, depending on its capacity requirements. The actual site could vary from the theoretical location as per the ground condition.

**Keywords:** Logistics, warehouse, k-mean clustering

### Introduction

The internet penetration within tier-2 and below cities have increased significantly, leading to more consumption of online shopping applications. This change in consumer shopping have led to the launch of various online platforms. The ONDC scheme is one such initiative by the Government of India that will help the MSME sector to cater larger population. Generally, popular websites such as Amazon, Flipkart, Myntra and others have there warehouses in the outskirts of tier-1 cities. Its purpose is to cater a certain region with the help of in-house or third party logistics service provider. As the demand from other cities are increasing continuously, most of these firms are using similar supply chain strategies. The location of warehouse is an important factor effecting the supply chain cost viz. transportation cost. The approximate breakup of logistic cost includes 58% of transportation cost, 23% inventory carrying cost, 11% warehousing cost and others. When the location of warehouse is optimized, these expenditures come down dramatically. K-mean clustering is one of the algorithms to arrive at the site for warehouse. It creates the clusters of demand location and returns the location of centroid for those clusters. This is helpful to improve the overall performance of the supply chain.

### Literature review

Ghosh, N. (2019) <sup>[1]</sup> have studied the e-commerce logistic facilities in Madhya Pradesh which focuses on the GIS based supply chain network. Decentralization is focused for the logistics facilities. Sharma, L. (2022) <sup>[6]</sup> studied the supply chain management practices for agro-processing industry in Jabalpur districts. Better Customer relationship management and operational efficiency is needed to improve the customer service level. Sharma, L., Pal, D., & Chaurasia, P. (2022) <sup>[3]</sup> studied the supply chain actors in Jabalpur region for agro-processing industry. The information sharing is more focused between these actors to provide customers with better value proposition. Tiwari, D., Dubey, S., Chopra, P. K., & Jain, M. (2015) <sup>[5]</sup> studied the malls of Jabalpur and Gwalior city to find the impact of merchandising on customer satisfaction.

Majority of the researches are done with respect to the agriculture sector near the Jabalpur region. Being one of the emerging tier-2 cities with rising population attracts significant number of online orders. Our study is to provide the overview of locations which can be used to optimize the transportation cost.

**Scope of the study**

This study focuses on the Jabalpur region. The findings are useful for the retail businesses in formulating the supply chain strategy, and also to improve customer service level.

**Methodology**

**1. Data collection**

The data for population distribution of Jabalpur along with their latitudes and longitudes were collected from Cybo Company.

**Table 1:** Population of Jabalpur as per pin-codes

Pin Code	Population	Area (km <sup>2</sup> )	Latitude	Longitude
482001	256472	51	23.1597	79.9756
482002	678409	84	23.2093	79.8910
482003	187143	102	23.0991	79.8480
482004	260657	44	23.2297	79.9324
482007	6656	0.402	23.1664	79.9492
482008	94461	19	23.1221	79.9169
482009	13066	4.052	23.2043	79.9788
482010	30939	4.02	23.2326	79.9793
482011	124030	21.9	23.2115	80.0063
482020	38916	47.9	23.1111	79.9703
482021	2955	117.5	23.036	79.9748
482051	2992	281.3	22.9584	79.8317
482056	1840	123.6	22.9147	79.9211
483053	41329	64.6	23.1476	79.8100
483105	57527	88.3	23.3882	79.8291
483113	193195	876	23.1761	79.7204
483220	20325	276	23.3059	79.9684

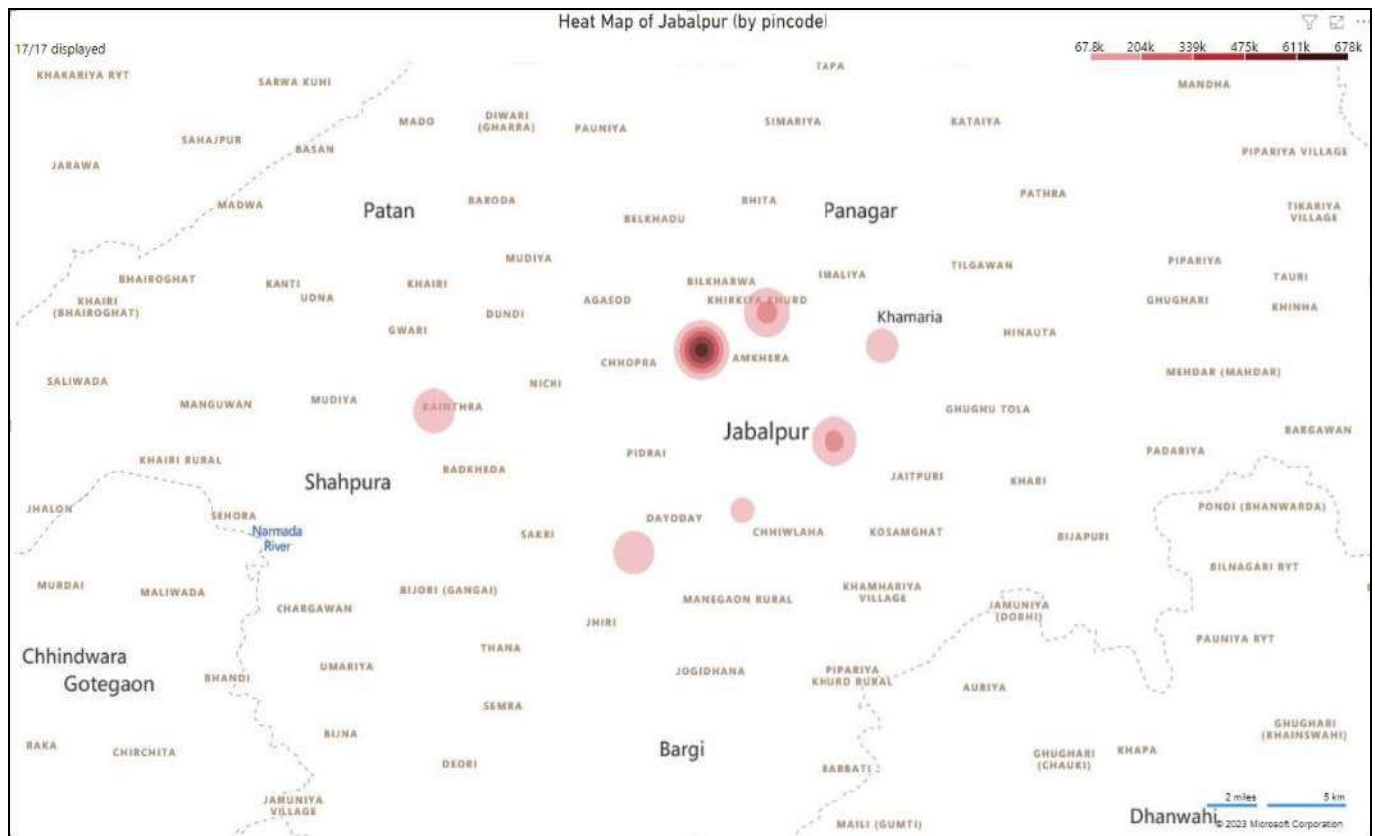
**2. K-mean clustering**

It is an unsupervised machine learning algorithm that uses iterative approach to arrive at the centres of the given unlabelled dataset. Number of centres required is decided by the user, or an elbow method is used to calculate the optimized centres. It reduces variance in mean distances of centroid from data points in each iteration to achieve

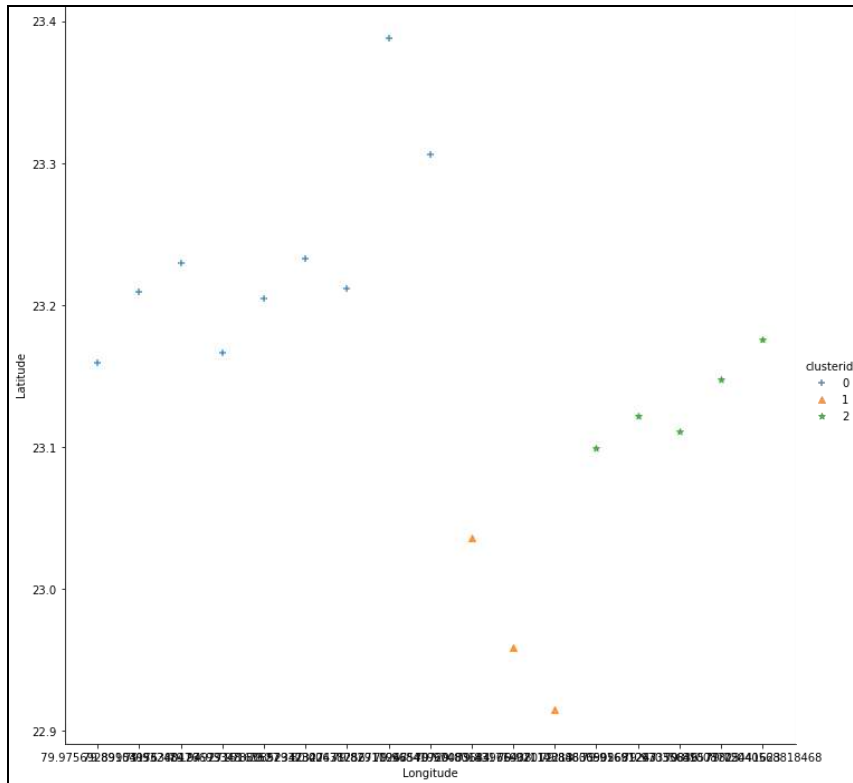
optimization. Teknomo, K. (2006) [4]

**3. Data analysis**

The population of Jabalpur city was plotted on Heat map to visualize the distribution as pin-code. The collected data was used in the k-mean clustering algorithm.



**Fig 1:** Visualization of population through heat map



**Fig 2:** Representation of the three clusters obtained using K-mean clustering

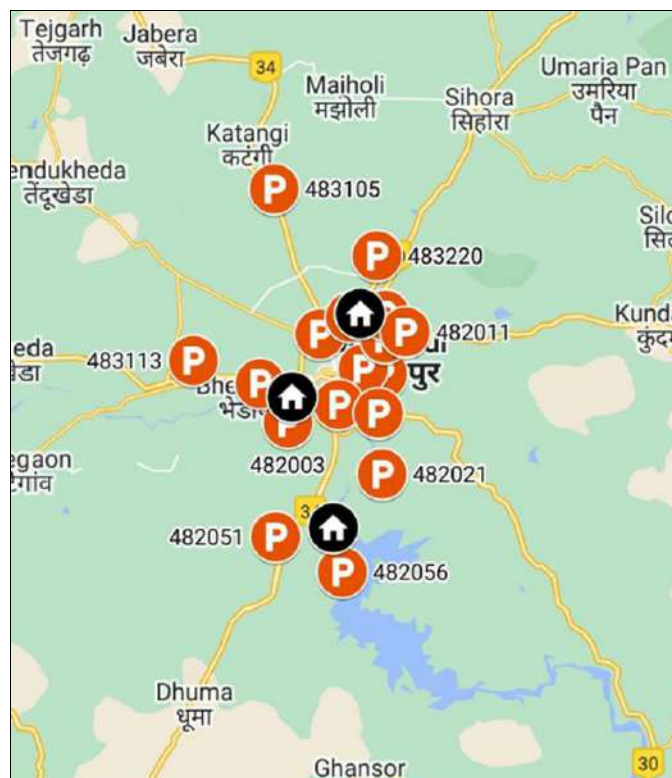
**Table 2:** Centroid of the cluster formed in K-mean algorithm

Cluster ID	Latitude	Longitude
0	23.2128	79.9452
1	23.1409	79.7928
2	22.9698	79.9092

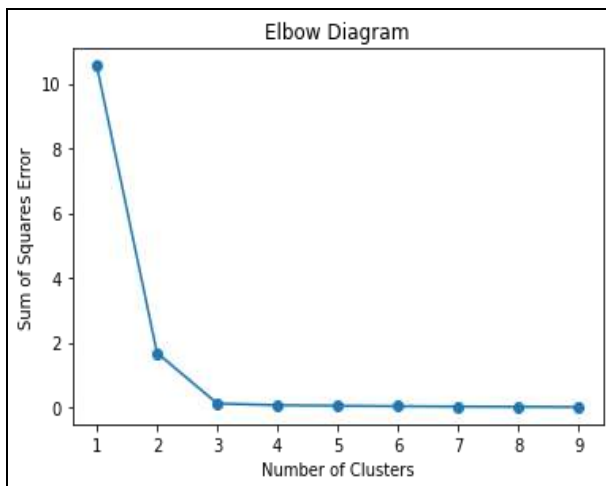
**Results & Discussion**

Jabalpur district covers 367 km<sup>2</sup> of area with over 1.2 million population. The unlabelled data used was the longitude and latitude of all pin-codes. It is represented by

“P” in the Fig 3. The warehouse locations are represented by its icon. We can see that population density is greater in northern part of city. Hence, the warehouse requirement is also more.



To find the optimum number of warehouses needed, we plotted the elbow diagram. It uses the sum of square error of distance between data points and cluster centres. It can be seen that the error has drastically reduced when the number of clusters is increased to three. Further increment does not affect the error significantly. Hence, three warehouses shall be used to optimize the overall transportation cost.



**Fig 4:** Elbow diagram representing the cluster requirements

### Conclusions

The understanding of logistics cost is an important criterion in determining the supply chain cost. Supply chain surplus can be created in a more efficient manner, if transportation cost is controlled. It depends mainly on the distance between the delivery point and inventory location. This study is used to determine these locations for Jabalpur city. Three number of warehouses are required to attain least error. Efforts can be made in the future work to include the population density criteria and area-wise online ordering pattern to improve the location of warehouses.

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