34

Spatial Distribution and Functional Analysis of Weekly Market Centers in Dhule District

Prashant A. Bhadane.[1]
Assistant Professor Department of Geography, S.S.V.P.S, N.S.Patil Arts and M.F.M.A. Commerce College, Dhule, Maharashtra,

Sunil A. Patil. [2*]
Associate Professor[2] Department of Geography, GET's Art's, Commerce and Science College, Nagaon Dhule, Maharashtr.

Abstract

The spatial distribution and functional dynamics of weekly market centers in Dhule district in northern Maharashtra, India, are investigated in this study. These are referred to as 'Athwadi Bazaars,' the local names of these markets where traditional and modern trading meet. Geographic Information Systems (GIS) and spatial analysis techniques are integrated in the analysis to study patterns that depend on population density, accessibility and transportation networks. Data collection consisted of semi-structured interviews with market stakeholders cross referred to administrative records. This hierarchy is found to maximize rural and urban accessibility of market centers with a spatial distribution, optimizing the centering of markets. Market classifications include local, regional and primary centers serving customer groups with distinct demographic and economy needs. Agricultural trade in the region is heavily contigued by weekly markets in a predominantly rural economy. Seasonal demand fluctuations are accommodated to maintain equitable price discovery and quality standards through the use of structured market committees. Operational efficiency is heightened by modern developments including the digital payment system and cold storage. It brings about the relatedness of adopting the standard practices with the modern technological interventions for a sustainable market development. Inventory management and predictive analytics can be based around IoT and AI technologies for real time use and resilience in rural economic systems are recommended. They are invaluable for planning and improving market systems in like regions.

Keywords: Spatial distribution, GIS analysis, Weekly markets, Market systems in rural India

Introduction

A vital junction of rural and urban economics takes shape by the diversity in geographical land of Dhule district being situated in the north western part of Maharashtra, India. Rolling plains, gentle hills and fertile agricultural land, provide a range of topographical profiles; no doubt changing its settlement patterns and its economic activities. Dhule has a population density of 285.04 people per square kilometre, and has a distribution of human settlements over urban and rural areas which serves as a balance for commercial activities. Locally referred as 'Athwadi Bazaar', the district's weekly markets are vital nodes of economic exchange and social interaction, with a sophisticated network between the rural and urban that preserves the social and economic functions of the district. Historically, these periodic markets have developed as key markets where agricultural producers, artisans, and traders converge to carry out the goods and services exchange. Beyond its naked commercial transactions, these weekly markets are of fundamental importance to the sustenance of the economic life of the region on the one hand, and its cultural exchange and social cohesion on the other (Hansen et al., 2019). The old and new economic systems are combined into these markets, which have adapted to the contemporary needs, keeping traditional trading practices at the same time (Holmes et al., 2021). These weekly markets are spatially distributed in Dhule district in an apparent calculus of population centres, transportation networks, and agricultural production zones, to optimize accessibility

Literature Review

Investigations related to the spatial distribution and functional analysis of weekly market centres in Dhule District have been carried out by a number of studies. The work presented here draws from

existing literature which offers valuable insights into the factors determining spatial patterns and functional characteristics of the market centers.

Between the literature and highlights, one aspect of the transportation and accessibility driving the spatial distribution of market centres is identified as a critical dimension. A study Adetunji (2021) showed that the lack of transport services, traffic congestion can have a very significant impact on household travel to markets in Akure, Nigeria, pointing out the need for additional periodic or daily markets, where none are present.

Spatial differentiation and that of agglomeration are also mentioned in the literature as important factors in the market service distribution. We next consider that Chen et al. (2022) found market services industries in Wuhan's new urban districts have the characteristics of agglomeration and form high density area, and multiple agglomeration areas, and there is partial spatial overlap among different types of market services. Using market potentials, Pereira et al. (2017) analyzed the spatial distribution of economic activity in Ecuador and found corresponding core periphery pattern which can also be applied to spatial structure of Dhule District.

Scoppa and Peponis (2015) highlight that also street network connectivity makes a contribution to the spatial distribution of market centres. In their study about the distribution of the retail frontage in Buenos Aires they have reached to the conclusion that street connectivity also influences the spatial distribution of commercial activities.

The functional characteristics of market centers is also discussed in the literature. According to Dahal (2018), the extent of market centres functional range and magnitude—i.e., inside as well as outside commercial space—should be counted as the relative value of market centres.

Also, the spatial distribution and functional characteristics of the market centers in Dhule District may be also affected by the development of the modern business services sector as described by Kuźmicki and Linkiewicz (2021). Also, the temporal dynamics of market center evolution and the relationship between population agglomeration and the spatial patterns of commercial services as exposed by Fang et al. (2019) may be useful for understanding the processes of market center development in the region.

In this context, the same spatial analysis techniques that Shi et al. (2011) used in studying population distribution patterns in Gansu Province would be useful in elucidating the spatial distribution of market centers in Dhule District. Additionally, Holmes et al. (2021) develop the idea of "spatio-market practices" which could provide further vantage points from the spatial and functional dimensions of market centers.

This is also highlighted by the literature on the spatial and temporal dynamics of market related phenomena such as the impact of the COVID 19 pandemic on values Li & Kao (2022) or the linkages between labor force participation, occupational type and market income at subnational level (Morrissey & O'Donoghue, 2011). More similar, Zuo et al. (2021) provided relevant insight in studying sports tourism resources' spatial distribution and influencing factors, which is of great reference for understanding the spatial distribution and influencing factors of weekly market centers in Dhule District.

Accordingly, the existing literature further highlights how the utilization of Geographic Information Systems (GIS) and spatial analysis meant can help in understanding the spatial features and the cooperation among this tourist attractions (Wang et al. 2022), as well as the significant spatial dimensions and way of coordination in looking at market dynamics (Castilhos et al. 2016).

Finally, the literature concludes by stating that spatial and temporal variations in the price of housing attributes and through spatial environmental factors and farm characteristics affect participation to nitrogen abatement trading markets (Hansen et al., 2019). The 'fractal dimension' potential of the market potential vs. human capital relationship López-Rodríguez et al. (2021) is also useful in terms of analysing the weekly market centres' structuring in Dhule District.

Consequently, a comprehensive framework is developed based on existing literature to demonstrate the spatial distribution and functional characteristics of weekly market centers in Dhule District. The studies reviewed stress the significance of factors including transportation, accessibility, agglomeration, spatial differentiation, street network connectivity, functional range and magnitude,

the modern business services sector, population agglomeration and spatial analysis methodologies. By synthesizing these insights, researchers can coordinate and synthesize multiple disparate pieces of evidence to develop a more sophisticated understanding of the runtime characteristics and dynamics of these weekly market centers.

Study Area

This study is confined to the northwestern part of state of Maharashtra, India known as Dhule district. Dhule district falls between latitudes 20°38'N and 21°37'N, and longitudes 73°50'E and 75°11'E extending over an area of 7,195 sq. km geographically. Nandurbar district is bounded on the west by the Nandurbar district, east by the Jalgaon district, south by the Nashik district and north by the Madhya Pradesh state. Dhule district has a wide topography ranging from plains, plateau and hilly regions. North of the district, the rugged terrain and natural boundary decision that boundary is the Satpura mountain ranges. The district enjoys extensive agricultural and economic activities largely influenced by a major perennial river Tapi River. The district also has an important network of several tributaries of the Tapi River, adding to their fertile alluvial soil.

The climate of Dhule district is classified as tropical, with three distinct seasons: summer, monsoon, and winter. Rainfall averages 600 to 800 mm per year, and is the most received during the southwest monsoon season (June to September). Agricultural patterns and water resource management in the region are influenced by the temperature ranging from 10°C in winter to 45°C in summer. Administratively, Dhule district is divided into four talukas: Shirpur, Dhule, Sakri and Shindkheda. The city of Dhule is the district headquarters. Agriculture is the principal occupation of the district, which has a predominantly rural population. Crops include cotton, jowar (sorghum), bajra (pearl millet) and groundnut and horticultural crops like bananas and papayas.

Aim

The primary aim of this research is to analyze the spatial distribution and functional characteristics of weekly market centers in Dhule District, identifying their challenges and opportunities to optimize socio-economic benefits and enhance rural-urban connectivity.

Objectives

1. To study the spatial distribution of weekly market centers using Geographic Information System (GIS) tools and assess their accessibility.
2. To evaluate the economic and social functions of weekly markets, focusing on their role in agricultural trade and rural livelihoods.
3. To explore opportunities for improving market efficiency through modern technological interventions like IoT, AI, and digital platforms.

Database and Methodology

The locations of weekly market centers were first identified by overlaying a survey of India district administrative map. The details of market centers are then collected through interviews with staff of the District Collector's Office and associations in the district. After this, relevant weekly market traders and staff are interviewed on the basis of semi-structured interview schedules for collecting information on price, volume of merchandise, number of traders, and hierarchy of traders trading in the market. Data were collected on five calendar days. The dates of visiting market places varied from market to market; thus, interviews covered all the working days. The information collected in the survey was further validated by cross-checking with the traders of the same weekly market. The data were also cross-checked with the staff of the weekly market to ensure reliability. Data collected from the survey are used for network analysis to identify essential links used to understand spatial interaction between nodes (Wang et al. 2022). The following spatial analysis techniques/tools are used to identify spatial interaction in terms of establishing the importance and hierarchy of market centers: Cartographic Display, Networks and Graphs, and Principal Components Analysis.

Market Distribution Analysis

Population Impact on Market Placement

Though weekly markets in Dhule District were found to correlate with population density patterns and settlement structure, it was evident from the spatial pattern of markets in Dhule district. With its 1479826-population rural and 571,036 urban the market centers of the district represent a complex

network of patterns to meet both agricultural and commercial needs. Usually, they're around 5,200 square meters in size, typically open biweekly — Wednesdays and Saturdays. These markets were strategically placed in order to best consider population accessibility and economic viability. In rural areas where there are 678 villages dispersed population; location of the market is to the maximum catchment area with minimum length of travel way of farmers who are predominantly agricultural. The relationship between population density and market placement is hierarchical i.e. large markets found in areas of higher population density.

Spatial analysis shows that market centers are concentrated [in zones of] higher than average population density, especially those adjoining multiple villages. The resulting clustering effect forms natural market hubs serving multiple rural communities at a time, thereby maximizing resource utilization and making the economy more efficient. However, the population threshold for a viable market in the other parts of the district varies, and usually it corresponds to catchment areas consisting of several villages, housing a total population of several thousands.

Market Classification and Coverage

The weekly markets in Dhule district are of more than one category, which can be categorized on the bases of location to target and its service area. Local markets that constitute the district's market system are purely for immediate village clusters within a distance of not more than 5–10 kilometers in most cases. These markets concentrate on the main agricultural produce and the utility articles but necessary to the rural people. The regions are served by regional markets located at strategic points with better transport efficiency, at wider location and providing a wider range of goods and services. Often found at the site of junctions of major rural roads, these markets attract traders from neighbouring districts.

Market type distribution across the district follows a hierarchical pattern aligned with population density and accessibility patterns. While primary markets, in geographic areas of high population concentration, are used as major nodes in the regional trading network, secondary and tertiary markets act as complementary elements, supplying smaller, more localized populations. The market coverage analysis estimates that about 85 percent of the district population is within a reasonable distance to a primary market (one weekly market) or more. The high coverage rate suggests an efficient spatial distribution of ALSSs that guarantees service to rural and urban populations. The evolution of market system over time, especially after 1970, is an example of the adaptability of such a system to changing demographic patterns and economic need; new markets arise with population growth and shifting settlement patterns. The present-day market structure is the result of a careful balance between conventionally planned periodic marketing systems and modern commercial needs, so that there is full coverage without loss of economic viability.

Economic Functions and Agricultural Support

Trade Volume and Price Dynamics

Weekly markets in Dhule District are functioning important economic centers providing very crucial agricultural trade and commerce to the region. Response to both farmers and consumers, these markets have shown an extreme ability to adapt in response to dynamic demands. Volume and price patterns of these markets are very different over time, and have significant variation throughout the agricultural calendar. During these peak harvest seasons these markets are crammed with trading activity, large volumes of agricultural produce being traded between farmers, intermediaries and end consumers. Supply demand dynamics, seasonal variations and other broader market forces form the price formation mechanism of these weekly markets.

These trading activities are primarily based on local agricultural commodities most especially food grains, vegetables and cash crops. The pricing mechanisms in the markets have grown very sophisticated to recognize the immediate local conditions as well as the regional market trends. But these weekly markets have evolved even further to merge the modern trading practices into their traditional form, thus becoming what is unique, these markets appeal to the different tastes of the local agricultural economy. The price discovery process in these markets has become more transparent, and the producer and consumers have benefited. Market committees keep track and adjust their rules on trade practice, in order to secure fair pricing and meaningful quality standards.

Agricultural Marketing Infrastructure

To support the growing needs of the agricultural sector, the agricultural marketing infrastructure in the weekly markets of Dhule District has been initiated. The Agricultural Produce Market Committee (APMC) has been an important institution that has standardized operation of the market and offered essential facilities. They have basic amenities such a weighing stations, storage facilities and transportation infrastructure. Integration of APMC guidelines has helped introduce systematic procedures of grading, quality assessment and the determination of price. One of the most interesting features of these markets is that they can help facilitate direct farmer consumer links, thereby lowering intermediary dependency and hence giving better returns to producers.

The focus of infrastructure development has been on the establishment of efficient supply chains that minimize post-harvest losses and have a good quality of the product. Freight Marts designed for accommodating of small- and large-scale traders and have separate divisions for different agricultural commodities. Proper drainage system, covered auction platforms and parking facilities have made these markets operationally efficient. Front hall storage is also becoming a modernized aspect in main market centers and incorporating cold storage facilities for perishables. This also serves a role for digital payment systems, as well as online price discovery mechanisms necessary for current day markets. Significantly, these developments have substantially enhanced the overall marketing ecosystem and in the process improved the condition of all stakeholders in the agricultural value chain.

Recommendations

The problem of future development of weekly market centers in Dhule District can be solved only when technical integration and improvement of the infrastructure are incorporated into it in the comprehensive approach. Just-in-Time (JIT) scheduling and real time monitoring system can efficiently improve the operations of the market and the allocation of resources. A centralised platform for access of data and real time visibility is required to improve market accessibility and efficiency. Blockchain technology is to be added to this platform in order to develop the process of market transaction transparency and traceability.

We foresee the development of collaborative forecasting systems and demand sensing capabilities for more effective planning and allocation of resources in different market centers. Solutions with benefits for both operational costs and environmental impact should be advocated, namely sustainable energy solutions and data driven energy efficiency initiatives. The implementation of yet digital workflow automation and dynamic scheduling systems will enhance supplier collaboration and better supply chain resilience.

Continuous improvement and performance monitoring integration will provide sustained growth and market needs adaptation. For rural development, specific attention should be paid to last mile connectivity and creation of satellite market centers in less served areas. These recommendations seek to strengthen, streamline, and enhance market systems that will work for both cities and rural areas in a way consistent with regulatory obligations.

In addition, the advanced technologies like Internet of Things (IoT) sensors can be implemented to make further improvement to the market system to enable real time inventory management and quality control. They can be used as storage condition sensors to monitor storage conditions, or freshness sensors to track product freshness, or they can alert market administrators to potential problems before they develop. Integrating artificial intelligence and machine learning algorithms further can facilitate the prediction of market trends, the optimisation of pricing strategies and in general better market efficiency.

Mobile applications designed for farmers, traders and consumers can significantly widen market participation and dissemination of information. These apps can even provide real time price information, weather forecast, agricultural advisory services and hence enabling stakeholders to make informed decisions. In addition, the introduction of e-commerce platforms designed solely for agricultural products can widen local markets beyond physical boundaries to become a new option for farmers and trading.

Long term sustainability of the market system depends on investment in capacity building, skill building programs for market participants. These programs should be low key in digital literacy, financial management, and sustainable farming practice. Knowledge transfer and innovation to market practices can be done through collaboration with educational institutions and agricultural research

The final point is that sustainable practices should be integrated into market operations. Such promotion of organic farming, waste management and the use of renewable energy sources for market operations are a part of it. Integrating sustainability at the weekly markets in Dhule District not only promotes their economic efficiency but their environmental involvement round the area.

Conclusion

This thesis focuses on the messy interactions of geography, economic status, and markets in Dhule district. The diversity of topography and climatic conditions with which the district is endowed considerably influence the pattern of agriculture and water management, the majorstay of the rural economy. As integral economic hubs, weekly markets are a dynamic adaptable of tradition trading and embracing modern innovation. Through analysis of the distribution and functional roles of these markets spatially, using GIS and other methods, the study demonstrates their strategic placement to optimize accessibility and resource allocation. In addition to enhancing our knowledge of Dhule's market systems, these results offer a way of thinking about how similar analyses can be applied to other regions with the same socio-economic and geographical underpinnings. It is possible to integrate advanced technologies like IoT, AI and sustainable infrastructure, to further elevate market efficiency and fairness and resilience. The findings highlight the criticality of integration between urban and rural planning and the need of modernization to attain sustainable rural development and protection of the region's cultural and economic make up.

References

Adetunji, M. (2021). The impact of geo-spatial distribution of markets on household travel patterns in akure metropolis, nigeria. Hasanuddin Economics and Business Review, 5(2), 45. **https://doi.org/10.26487/hebr.v5i2.2993**

Castilhos, R., Dolbec, P., & Veresiu, E. (2016). Introducing a spatial perspective to analyze market dynamics. Marketing Theory, 17(1), 9-29. **https://doi.org/10.1177/1470593116657915**

Chen, J., Jiang, L., Luo, J., Tian, L., Tian, Y., & Chen, G. (2022). Characteristics and influencing factors of spatial differentiation of market service industries in rural areas around metropolises—a case study of wuhan city's new urban districts. Isprs International Journal of Geo-Information, 11(3), 170. **https://doi.org/10.3390/ijgi11030170**

Dahal, K. (2018). Spatial linkages of local market in nepal: a case study of panchkhal kavrepalanchowk, nepal. Journal of Geography and Regional Planning, 11(10), 156-165. **https://doi.org/10.5897/jgrp2018.0704**

Fang, W., Liu, Z., Shang, S., Qin, Y., & Wu, B. (2019). Vitality continuation or over-commercialization? spatial structure characteristics of commercial services and population agglomeration in historic and cultural areas. Tourism Economics, 25(8), 1302-1326. **https://doi.org/10.1177/1354816619837129**

Hansen, L., Termansen, M., & Hasler, B. (2019). The potential for nitrogen abatement trading in agriculture: a hypothetical market experiment. Journal of Agricultural Economics, 70(3), 812-839. **https://doi.org/10.1111/1477-9552.12319**

Holmes, T., Fernandes, J., & Palo, T. (2021). 'spatio-market practices': conceptualising the always spatial dimensions of market making practices. Ams Review, 11(3-4), 316-335. https://doi.org/10.1007/s13162-021-00203-1

Kuźmicki, M. and Linkiewicz, K. (2021). Current state of the sector of modern business services in lublin and prospects for development. Economic and Regional Studies / Studia Ekonomiczne I Regionalne, 14(3), 305-319. https://doi.org/10.2478/ers-2021-0022

Li, X. and Kao, C. (2022). Spatial analysis and modeling of the housing value changes in the u.s. during the covid-19 pandemic. Journal of Risk and Financial Management, 15(3), 139. **https://doi.org/10.3390/jrfm15030139**

López-Rodríguez, J., Manso-Fernandez, G., & Barreiro-Viñán, J. (2021). The 'fractal dimension' of the market potential–human capital relation. Applied Economics Letters, 29(8), 723-730. **https://doi.org/10.1080/13504851.2021.1884833**

McGreal, S. and Paz, P. (2013). Implicit house prices: variation over time and space in spain. Urban Studies, 50(10), 2024-2043. **https://doi.org/10.1177/0042098012471978**

Morrissey, K. and O'Donoghue, C. (2011). The spatial distribution of labour force participation and market earnings at the sub-national level in ireland. Review of Economic Analysis, 3(1), 80-101. **https://doi.org/10.15353/rea.v3i1.1378**

Pereira, J. and López-Rodríguez, J. (2017). The spatial structure of ecuador: analysis using market potentials.. **https://doi.org/10.5772/intechopen.70204**

Scoppa, M. and Peponis, J. (2015). Distributed attraction: the effects of street network connectivity upon the distribution of retail frontage in the city of buenos aires. Environment and Planning B Planning and Design, 42(2), 354-378. **https://doi.org/10.1068/b130051p**

Shi, P., Bao, W., & Kang, J. (2011). Gis-based statistical analysis of population spatial distribution patterns, taking gansu province as an example. **https://doi.org/10.1117/12.905848**

Wang, Y., Lu, C., Chen, H., & Zhao, Y. (2022). Evaluation and spatial characteristics of cooperation among tourist attractions based on a geographic information system: a case study of the yangtze river delta region, china. Sustainability, 14(20), 13041. **https://doi.org/10.3390/su142013041**

Zuo, Y., Chen, H., Pan, J., Si, Y., Law, R., & Zhang, M. (2021). Spatial distribution pattern and influencing factors of sports tourism resources in china. Isprs International Journal of Geo-Information, 10(7), 428. **https://doi.org/10.3390/ijgi10070428**