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Investigating the Condition and Methods of Regeneration the Historical Context of the City of Masjid Suleiman by Mathematical Models (Case Study: Tembi Market)

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ABSTRACT

Background: In this article, by using the strategic SWOT technique, an attempt has been made to answer this key question that according to the strengths, weaknesses, opportunities and threats of the historical context of Masjid Suleiman (Tambi historical market), it is suitable what the best strategy for recreating this texture is? Quantitative strategic planning matrix (QSPM) was used to determine the priority of strategies.
Objectives: Investigating the Condition and Methods of Regeneration the Historical Context of the City of Masjid Suleiman by Mathematical Models in Tembi Market.
Methodology: This research is descriptive and analytical in terms of its practical purpose and method, and to collect the required information and data, document reviews, as well as field studies, questionnaires and interviews with relevant experts have been used.
Results: The findings of the research show that the state of the historical fabric of Tembi market in Masjid Suleiman is among four aggressive, defensive, conservative and competitive states, and according to the SWOT model, it is in a competitive state, that is, strategies should be developed to overcome threats through strengths. In addition, in the prioritization that has been done using the Quantitative Planning Matrix (QSPM), among the developed strategies, the highest attraction is related to paying more attention to the functional values of the fabric as an important part of the main center of the city of Masjid Suleiman and strengthening the building against natural disasters.
Conclusion: Promoting the role of valuable historical-cultural and religious elements and the transparency and sustainability of urban management policies and programs and regional reconstruction. The lowest attraction is related to the strategy of increasing the attention of urban management to the environment.

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1. INTRODUCTION

The city center is one of the main factors and manifestations of historical and cultural values and the embodiment, symbols, signs and memories of identity for the whole city and its residents. The central and old fabric of cities are the beating heart and often the gathering place of commercial activities, social interactions and the intersection of vital arteries of the city, which have always played a significant role in giving identity to urban life throughout history (Abachi et al., 2019- Shahzada et al, 2024). Simultaneously with the emergence of numerous issues caused by different dimensions of wear and tear (physical, infrastructure, economic, etc.) in the central tissues, paying attention to worn-out tissues and fixing their instability has become a serious and central issue, especially from the 19th century until today (Abbasi et al., 2019- Hoseinpour et al, 2024- Mousavi et al, 2024). In fact, studies and experiences in the field of renovation and improvement of dilapidated urban tissues show the evolution of common urban renewal approaches and their replacement with new approaches such as urban regeneration centered on the revival of damaged tissues (Amdi and Rafiyan, 2019, 47). By reviewing the subject literature, we find out that the programs of revitalization, renovation, improvement, renovation, etc. in general, urban regeneration has a long history. The first generation of urban renewal programs in the 20th century were physical deterministic programs. The latest generation of intervention programs in urban contexts is the regeneration program. This program started in the late 1970s with the approval of the Inner Urban Areas Law in England and reached its peak in the 1990s (Amini et al., 2019). Urban regeneration is a process that leads to the creation of new urban spaces by maintaining the main physical and activity spatial features. Urban regeneration is a comprehensive and integrated vision and a set of measures to solve urban problems in such a way that permanent improvement in the economic, physical, social and environmental conditions of the changed context is created (Aminzadeh et al., 2013- Mousavi et al, 2022- Rasoli et al, 2023). According to the mentioned details Investigating the condition and methods of regeneration the historical context of the city of Masjid Suleiman by mathematical Models was necessary.

Urban regeneration also means a comprehensive, integrated vision and a set of actions that lead to solving urban problems. So that the constant improvement in economic, physical, social and environmental conditions creates a texture that has undergone changes and leads to the creation of new urban spaces by maintaining the main characteristics, physical space and activity (Ariana et al., 2019). Today, one of the most suitable management and planning tools and techniques is the strategic planning approach, which, due to its capabilities and unique features in creating a simple and structured planning process, is used in organizations related to the organization and control of cities as a suitable tool that is evaluated (Azadkhani and Baghlani, 2018, 21). In the city of Masjid Suleiman, there have been various researches about the historical context. But the main point has been the lack of a strategic view and a clear vision for the continuation of the sustainable regeneration of the tissue. Based on this, in this study, an attempt has been made to provide strategies through strategic planning with the help of the opinions of local experts and experts in the city, who have somehow been related to the phenomenon of regeneration in various aspects of executive, planning and management of the city. The sustainable reconstruction of the historical context of Tembi market in Masjid Suleiman city is discussed, therefore the necessity of choosing a strategic planning method as a future-oriented planning is clearer. For this purpose, we first form the SWOT matrix for it. Then we use the IE matrix to determine the organizational strategy and the QSPM matrix to identify the most important strategy. Based on this, the key question is, considering the weaknesses, strengths, opportunities, and threats of the historical fabric of Tembi market in Masjid Suleiman, what is the most suitable strategy for the reconstruction of this fabric?

Urban regeneration is basically a process of focusing on all the elements of an area, which leads not only to the construction of an environmentally friendly city, but also to the solution of social equality and economic growth, which leads comprehensively in a sustainable urban space (Azadkhani and Baghlani, 2018, 58). Urban regeneration is a comprehensive and integrated approach and measures to solve urban problems in the target area, which ultimately leads to a sustainable economic, physical, social and environmental progress and improvement (Azimi Amoli and Jamdar, 2017, 19- Mousavi et al, 2023- Hoseinpour et al, 2024- Mousavi et al, 2024). Today, urban regeneration is a global issue, and in a broad way, having an effective urban regeneration program has become one of the most important solutions for all cities in the world who want to stop horizontal and extensive development and create internal and dense development (Azizi, 2001). The review of the studies conducted on urban regeneration during the period of 1990 to 2012 indicates an integrated review focusing on the planning subsystem and the social subsystem of urban regeneration, which includes a wide range of topics that overlap and therefore cannot simply be classified in a certain context (Chiu et al., 2019). In the country of Iran, the history of intervention in urban decline areas goes back to the beginning of the last century. In the following decades, this category has continued in such areas and with a time gap and

dispersion. In particular, the need to pay attention to historical and cultural values in the intervention process of cities was legally considered from the 1360s of Hijri with the approval of the statute of the country's cultural heritage organization (Ebrahimzadeh et al., 2018). According to (Fanni and Shirzadi, 2019, 31) The goal of regeneration is to move towards a sustainable city, and for this purpose, three main goals are pursued, which include strengthening the city's competitive power, housing safety, and improving the quality of the urban environment. Urban regeneration is essentially an interventionist activity (Ferretti and Grosso, 2019, 25). (Hashempour et al., 2019) as well as (Jackson, 2018) have worked on the regeneration of the base culture as a tool to be used for the regeneration of deprived areas. Investigated the physical indicators of sustainable urban regeneration in worn-out tissue. (Karimzadeh et al., 2018) Found in their article that the gentrification experience of the dilapidated fabric of the Razavi shrine is a kind of state-oriented approach to urban regeneration and gentrification. (Keating and Frantz, 2004, 38) investigated the factors affecting the regeneration of historical neighborhoods with an emphasis on the approach of urban branding in Siah Sang neighborhood of Shiraz, which data analysis using Pearson's correlation test shows that all four factors have a significant positive correlation with The regeneration of the neighborhood has a black stone. The result of the research of (Lazarević et al., 2016, 58) includes the practical method of applying the contextual approach in the category of regeneration, as well as the value and importance of using the proposed solutions in all dimensions of the context, especially the physical and historical dimension. The findings of (Leary and McCarthy, 2013, 55) indicate the prioritization of the dimensions that influence tourism-oriented urban regeneration, respectively, on social dimensions, economic dimensions, cultural dimensions, and physical dimensions. (Liu and Jiangming Zhu, 2019, 98) Concluded in their article about the historical context of Shiraz that the enumeration of the criteria and the process of selecting the scope of the re-creation goal and re-reading the contextual characteristics led to the presentation of a multi-layered strategic model in defining the methods and policies of action in the historical context. (Lotfi et al., 2018) Found that none of the construction projects selected completely and comprehensively from the economic, social, cultural, environmental and physical point of view could act as a stimulus for urban development within the historical context of the city. Also, (Lotfi, 2012), (Martí and Mayor, 2019, 65), (Mehdipour and Rashidinia, 2013, 77), (Mishkini et al., 2017), (Monjezi and Asadi Azizabadi, 2018, 41), (Moradi et al., 2008), (Nejad Ebrahimi and Nejdaghi, 2019, 11), (Pardaraz consulting engineers, 2017) and (Parizadi et al., 2018) with considering on the above searches, the results of the research are consistent with previous researches in many aspects, but the difference of this article with other studies is the emphasis on regeneration indicators in wider dimensions and the use of strategic planning methodology (QSPM).

The subject of the article is Investigating the condition and methods of regeneration the historical context of the city of Masjid Suleiman by mathematical Models (case study: Tembi Market) and given that such a study has not been conducted so far, its conduct is sufficiently innovative.

1.1. Background and theoretical foundations of research

In the background of the research, the conducted research relevant to the subject of the manuscript (scientific articles and related printed reports) is reviewed and the results and achievements are briefly stated. In the background, the difference between the approach and method of the present manuscript and previous articles should be stated. In the theoretical foundations of the research, the definitions, concepts, and theoretical topics related to the subject, that have been used in the research, must be highlighted. The theoretical foundations of the research actually form the analytical support of the article and the hypothesis of the article relies on it. Theoretical foundations should not only include basic definitions and concepts that do not have much effect on the research method and its results.

2. METHODOLOGY

The current research is an applied research and a descriptive-analytical research method. The method of collecting information is both documentary and field, so for the development of strategies, an open questionnaire was given to 15 professors and experts with preference for professional and practical experience, who benefited from a complete understanding of the historical context and scope of the study and through this questionnaire, a list of common weaknesses, strengths, opportunities and threats was compiled, and then, each internal and external factors were weighted and the SWOT matrix was extracted from it. Finally, with the QSPM technique, priority strategies are presented. The analysis process includes the following steps: first step; Identification of internal and external factors: internal factors are related to the internal environment, which includes strengths and weaknesses. External factors include opportunities and threats that are influential in the process of recreating the historical context. The second step; Determining the weights of internal and external factors: after identifying internal and external factors and categorizing them in the form of strengths and weaknesses, opportunities and threats, the importance of each of them should be determined. The third step; Creating the assessment

matrix of internal and external factors and the fourth step of designing the SWOT analytical model.

2.1. Study Area

The studied area is Tembi Market. Tembi Market is one of the registered national monuments of Iran in Masjid Suleiman, which dates back to the Qajar period and was registered in the collection of historical monuments of Iran on 2009/3/16 under registration number 25976. The address of this registered national monument is Masjid Suleiman, central sector, Jahangiri district, Tembi village. Khuzestan province has many touristic, ancient and natural attractions, and Tembi market in Masjid Suleiman city is one of the historical and spectacular monuments of this province. Tembi market is a village in the central part of Masjid Suleiman city in Khuzestan province of Iran. This village is located in Tembi Gelgir district and according to the census of Iran Statistics Center in 2005, its population was 937 people (222 households), (Qasimzadeh et al., 2014). Figure 1 shows the satellite photo of the Tembi Market.

Fig 1. Satellite photo of Tembi market
(Rasouli et al., 2018)

3. RESULTS

3.1. Strategic analysis of the sustainable reconstruction of the historical context of Tembi Market in Masjid Suleiman

The technique or SWOT matrix, which is sometimes called TOWS, is a tool to recognize the threats and opportunities in the external environment of a system and to recognize its internal strengths and weaknesses in order to assess the situation and develop a strategy to guide and control that system. This method is a direct result of the Harvard Business School model. In fact, it is the best strategy for organizations and a valuable tool for strategic analysis (Rasouli et al., 2018). In order to strategically analyze the sustainable reconstruction of the historical context of Tembi market in Masjid Suleiman, 13 internal strengths against 51 internal weaknesses and 22 external opportunities against 33 external threats were identified and analyzed. In total, 35 strengths and opportunities can be identified as advantages and 84 weaknesses and threats can be identified as limitations facing the sustainable reconstruction of the mentioned historical context, which were included in the experts' questionnaire for prioritization and weighting. Table (1) shows the weighting and ranking of internal factors (strengths and weaknesses).

3.2. Evaluation of internal factors (IFE)

As it is clear, according to the experts, the functional value of Structure as a very important area, due to being in the vicinity of historical mosques, the existence of commercial cores with the ability to be converted into important commercial centers, the architectural, artistic and historical values of Structure and its urban spaces, functional value Structure as the commercial center of the city due to the presence of the market and the functional values of Structure as an important part of the city respectively with a weighted score of 0.340, 0.252, 0.241, 0.230 and 0.200 as the most important strengths and the lack of budget and credits according to the volume of performance and activity of the municipality. region, the low price of land and real estate in this area compared to other areas of the city, the inadequacy of municipal facilities and equipment in the implementation of infrastructure and executive projects, "the existence of the problem of common and similar endowment properties and the instability of social capital due to durable neighborhood ties to The order with a weight score of 0.129, 0.114, 0.104, 0.092 and 0.090 is considered as the most important weak points for the sustainable reconstruction of the historical fabric of Tembi market. Table 1 shows the weighting and ranking of internal factors in this study.

Table 1. Weighting and ranking of internal factors (strengths and weaknesses)

Row	Internal strategic factors	Relative weight	rank	Final weight
S_1	The presence of valuable historical-cultural and religious elements in the region and as a result, the promotion of its important role and position in the city of the country	0.030	4	0.120
S_2	The existence of historical memory and the function of identity and memory of existing buildings and spaces at the level of the historical region	0.039	3.4	0.133
S_3	Locating the backbone and historical centrality of the city in the region	0.020	4	0.080
S_4	Functional values of texture as an important part of the city	0.040	5	0.200
S_5	The functional value of structure as the commercial center of the city due to the existence of the market and business lines in structure	0.050	4.6	0.230
S_6	The functional value of structure as a religious center of the city due to its proximity to mosques and holy places and religious schools in the region	0.085	4	0.340
S_7	The architectural, artistic and historical values of the context and its urban spaces and the existence of many valuable historical buildings and elements in the depth of the historical context	0.069	3.5	0.241
S_8	The presence of uninhabited buildings	0.021	3	0.063
S_9	Existence of open and barren space resulting from various destructions with the possibility of organizing and reusing	0.065	3	0.195
S_{10}	The possibility of reconstructing and spatially organizing the texture	0.013	4	0.052
S_{11}	The existence of a suitable platform for creating job opportunities in tourism affairs	0.040	4.4	0.176
S_{12}	The existence of old and authentic middle classes in the region and the existence of the reference group in some areas	0.056	3.3	0.185
S_{13}	commercial core with the ability to become an important commercial center	0.063	4	0.252
S_{14}	The existence of the high potential of the centrality of the city and as a result the existence of high commercial, commercial and service capabilities and traction especially in the edges of the region	0.017	4	0.068
S_{15}	The existence of the capacity to expand related activities	0.049	3	0.147
S_{16}	The existence of traditional social support systems in parts of the region	0.022	4.3	0.095
S_{17}	Stability and relative balance between the number of men and women and the balance of the sex ratio	0.033	4.4	0.145
S_{18}	Having a level and a growing trend with literacy	0.035	3	0.105
S_{19}	Existence of platforms and relative fields of people's participation in the administration of urban affairs	0.051	3	0.153
S_{20}	The existence of high potential and talent of the historical-cultural context regarding valuable spaces and elements and the ability to generate income for the region through attracting tourists	0.039	3.3	0.129
S_{21}	The presence of appropriate communication and interaction between the municipality, the city council and the council assistants in the region	0.047	3.5	0.164
S_{22}	Increasing attention of urban management to environmental and historical-cultural aspects	0.030	4	0.120
S_{23}	The existence of five-year municipal plans and formulation of policies, strategies and macro goals at high levels of urban management	0.039	3	0.117
W_1	Extensive physical wear and tear in the depth of the historical fabric and the inadequacy of plans in motivating the desire for physical renovation of the region and the consequence of this is the serious vulnerability of the fabric in dealing with earthquakes.	0.019	4	0.076
W_2	The poor quality of a large part of the historical structure and the spread of wear and tear due to the rules and methods inhibitory action	0.005	2.5	0.012
W_3	Failure to define and introduce homogenous activities that are appropriate and compatible with the physical structure of the tissue and lack of suitable programs	0.015	4	0.060
W_4	Lack of green and open spaces and spaces for spending leisure time , extreme poverty of green space as breathing and resting space	0.011	2	0.022
W_5	Lack of cultural and recreational centers in the region despite the existing capacities and facilities	0.013	3.5	0.045
W_6	Lack of a suitable sewage and surface water disposal system in the region and as a result the formation of Running water in the region	0.012	4	0.048
W_7	The low level of environmental health in the region	0.007	3.7	0.026
W_8	Severe weakness of service uses within the scope of historical context - Shortage The staff of T	0.011	2.6	0.029
W_9	The lack of tendency to renovate buildings in the depths of the neighborhoods due to the pattern of occupying and living in them and the migration of the original and native classes.	0.008	4	0.032

Row	Internal strategic factors	Relative weight	rank	Final weight
W_{10}	The presence of many dilapidated and abandoned buildings in the region and the problem of physical insecurity in significant parts of it.	0.014	4	0.056
W_{11}	The fineness of the parts and their disproportionate combination as an obstacle to consolidation and integration for renovation and improvement	0.007	5	0.035
W_{12}	The presence of environmental pollution in the area due to the high level of underground water and lack of proper disposal of surface water	0.007	3.5	0.024
W_{13}	and severe wear and tear of urban facilities and equipment in the region and the impossibility of proper collection of garbage and waste materials	0.016	3	0.048
W_{14}	The existence of corners resulting from the tortuousness of the existing roads in this area and as a result the presence of unsafe and defenseless spaces.	0.010	2.5	0.025
W_{15}	of services at the regional level and their concentration in the area Peripherals and edges of tissue	0.009	3	0.027
W_{16}	Non-fulfillment of previously approved projects within the scope of historical and cultural context	0.010	2.8	0.028
W_{17}	Weaknesses and defects in waste collection due to access and management problems	0.008	4	0.032
W_{18}	Long life of existing buildings within the scope of historical context	0.012	3	0.036
W_{19}	Lack of proper use of the region's capacities and talents of centrality and religious and cultural position	0.012	3.3	0.040
W_{20}	Degradation of residential values due to disruption of activities due to residential and tourist activities and instead of increasing commercial activities without increasing communication capacity and as a result increasing the volume of traffic and air, sound and visual pollution	0.007	3.5	0.024
W_{21}	The gradual evacuation of the tissue from the original and old residents and Loss of identity of the population and disruption of population distribution in the region	0.010	4	0.040
W_{22}	The high level of employment in the informal sectors due to the weakness in skills and literacy (human capital) of the residents of context and the weakness in the economic capital (low-income housing, non-productive employment...)	0.020	2	0.040
W_{23}	Economic inefficiency of scattered and small enterprises	0.013	3	0.039
W_{24}	The settlement of people with service and elementary jobs in the region and as a result the social stratification system collapses weakness	0.020	3	0.060
W_{25}	Unstable residence in the area (high rate of renters) combined with lack of feeling of belonging to the place and as a result weakness in social participation, urban commitment and citizenship and behaviors based on it	0.014	4	0.056
W_{26}	Instability of social capital caused by durable neighborhood ties combined with ethnic diversity without social cohesion and integration and...	0.021	4.3	0.090
W_{27}	Weakness in social norms and emergence of social anomie	0.009	2.5	0.022
W_{28}	The existence of the ability to cause harm and increase social damage and social insecurity in the region due to the reduction of informal supervision	0.011	2.8	0.031
W_{29}	Loss of quality of life and lack of minimum living facilities and services needed for life	0.021	3	0.063
W_{30}	Private and endowment common ownership and as a result the problems and obstacles of reconstruction and renovation of buildings	0.011	4	0.044
W_{31}	The low price of land and real estate in this area compared to other areas of the city	0.026	4.4	0.114
W_{32}	The economic weakness of the residents and the weakness of the construction budgets of the old context	0.008	3.8	0.030
W_{33}	Functional isolation of historical and cultural context due to its closed functional system	0.014	3.5	0.049
W_{34}	Lack of proper and efficient use of the potential and cultural talents of the region	0.022	4	0.088
W_{35}	The lack of a single attitude in connection with the intervention in the historical context of the eclecticism of the modernist and cultural attitude...	0.010	4	0.040
W_{36}	Inadequacy of specialized staff and expert manpower of urban management in the region with assigned functions	0.011	3	0.033
W_{37}	Lack of proper mechanisms and tools to communicate with people and citizens	0.012	4	0.048
W_{38}	The incompatibility of the approved organizational chart with the existing situation and the lack of legal status of many organizational positions at present	0.019	2.5	0.047
W_{39}	The lack of research and research and the lack of appropriate expert forces as the technical and scientific arm of the management complex	0.016	3.8	0.061
W_{40}	Existence of extreme bureaucratic bureaucracy	0.008	2.8	0.022
W_{41}	The multiplicity and dispersion of municipal income sources and lack of reliance on stable and fixed income sources	0.009	3	0.027

Row	Internal strategic factors	Relative weight	rank	Final weight
W_{42}	Inadequacy of municipal facilities and equipment in project implementation infrastructure and executive	0.026	4	0.104
W_{43}	Lack of funds and credits in proportion to the volume of performance and activity of the municipality of the region	0.030	4.3	0.129
W_{44}	Absence of land and real estate management database in the district municipality	0.012	4	0.048
W_{45}	Poverty and low socio-economic base of most of the region and the inability to pay city taxes and financial participation	0.020	2.5	0.050
W_{46}	Lack of inter-departmental management institution to define and implement plans and construction projects at regional levels	0.009	2	0.018
W_{47}	The idealistic attitude of the plans and as a result the inconsistency of some rules and regulations of urban planning and construction with the existing realities of the region	0.011	2	0.022
W_{48}	F. Balance between preserving the values and strengths of the historical context and renovation and case-by-case reconstructions contrary to them.	0.020	4	0.080
W_{49}	Existence of interested and influential groups and forces and their serious non-adherence to the rules and regulations of the plans	0.011	4	0.044
W_{50}	Weakness and lack of appropriate tools and mechanisms to attract and attract citizens' participation in the administration of affairs and urban management in the area	0.010	4.3	0.043
W_{51}	The existence of the problem of common and similar endowment properties in the way of reconstruction and renovation and serious delay in the path of renovation and reconstruction of the fabric	0.023	4	0.092
Total		**1**	**-**	**5.909**

Source: Authors, 2025

3.3. Evaluation of external factors (EFE)

According to the results of table (2), according to the experts, the motivation and desire of the residents to renovate and rebuild the dilapidated buildings, the existence of a tendency to strengthen the markets and provide commercial support services in the main axes of the structure, "the possibility of using waste and demolished land for the construction of parking lots, the existence Important places in the tourism sector and the presence of human resources with regional urban planning expertise, respectively, with a weighted score of 0.342, 0.284, 0.255, 0.240 and 0.238 as the most important opportunities and the continuation of abandonment and isolation of the historical context from the city, the continuation of scattered movements and non-structural and threats to the regional complex in terms of the coherence and integrity of physical development, the tendency to commercialize the tissue as much as possible without providing the necessary infrastructure and support services, the spread of special diseases caused by problems and non-targeted destruction that does not conform to the structural ideas of the region With a weighted score of 0.238, 0.205, 0.200, 0.180 and 0.159, respectively, it is considered as the most important threats to the sustainable reconstruction of the historical context of Tembi market.

Table 2. Weighting and ranking of external factors (points of opportunity and threat)

Row	External strategic factors	Relative weight	rank	Final weight
O_1	The existence of tendency to expand commercial and service activities in the region	0.045	3	0.135
O_2	The existence of central capacities and centrality in the region	0.033	4	0.132
O_3	The tendency of urban management and public and government institutions to modernize and improve the region	0.019	4.5	0.085
O_4	The motivation and desire of the residents to renovate and restore the dilapidated building	0.078	4.4	0.342
O_5	The collective memory of the people of Masjid Suleiman regarding the historical area and the possibility of creating motivation in helping to restore the fabric	0.052	3	0.156
O_6	Actual and potential tourism capacities and talents in the region and the possibility of their exploitation	0.049	4	0.196
O_7	Existence of the religious-cultural heart of Masjid Suleiman	0.063	3	0.189
O_8	The possibility of using the space to strengthen the backbone of the fabric and meet regional, urban and regional needs	0.035	5	0.175
O_9	The existence of the possibility and tendency to strengthen public transportation and pedestrian axes and the backbone of the fabric in parts of the region	0.037	3.3	0.122
O_{10}	The existence of tendency to strengthen the order of markets and provide commercial support services in the main axes of context	0.071	4	0.284
O_{11}	The possibility of using waste and destroyed land to build a parking	0.058	4.4	0.255

Row	External strategic factors	Relative weight	rank	Final weight
O_{12}	The presence of important places in the tourism sector	0.060	4	0.240
O_{13}	Creating some traditional houses in the form of restaurants, hotels and tourism houses - Ecotourism	0.038	4.4	0.167
O_{14}	The tendency to invest in the region due to the centrality of the city	0.025	3	0.075
O_{15}	Tendency to support and advise civil and non-governmental organizations	0.042	4	0.168
O_{16}	The desire of people and foreign and domestic tourists to visit tourist places	0.028	4.5	0.126
O_{17}	The tendency of public institutions and organizations to invest in the worn-out fabric of the region	0.052	4	0.208
O_{18}	The tendency and desire of urban management to modernize and improve the historical context	0.031	3	0.093
O_{19}	Tendency to support, support and create the necessary platform for attracting and attracting private sector investments in the region	0.029	4	0.116
O_{20}	The existence of human resources with expertise in regional urban planning and the ability to attract them in different levels of urban management	0.068	3.5	0.238
O_{21}	Striving for financial self-reliance of the municipality and providing sources of income with the necessary legal mechanisms	0.049	4	0.196
T_1	Tendency towards more and more commercialization of fabric without providing necessary infrastructure and support services	0.050	4	0.200
T_2	Continuation of severe physical wear and lack of building strength against natural disasters	0.037	4	0.148
T_3	Violation of the rules and ideas of previously approved plans and not emphasizing regularity	0.031	3.5	0.108
T_4	Continuation of spontaneous and unplanned development and chaos in structure and function, especially in the main edges of the historical area	0.028	3	0.084
T_5	The continuation of scattered and non-structural movements and the threat to the regional complex in terms of the coherence and integrity of physical development	0.041	5	0.205
T_6	Untargeted destruction that does not conform to the structural ideas of the region	0.053	3	0.159
T_7	Destruction and serious vulnerability of valuable bodily elements as a result of being adjacent to decayed and old tissues	0.038	4	0.152
T_8	Existence of used and defenseless spaces due to past interventions and lack of proper use of created spaces	0.023	2.7	0.062
T_9	The presence of many ruined spaces at the texture level and wide visual and environmental pollution at the level of the region	0.042	3.5	0.147
T_{10}	The existence of the problem of shared and similar endowment properties in the way of renovation and renovation and serious delay in the renovation and renovation of buildings	0.040	3.6	0.144
T_{11}	Continuation of preservation-restoration views and a museum look at the texture and historical area and preventing infrastructure and fundamental developments in the direction of active protection and modernization of the texture	0.035	4	0.140
T_{12}	Continuation of desertion and isolation of the historical fabric from the city and urban life and development and the intensification of decay and depression	0.054	4.4	0.238
T_{13}	Continuation of tendency towards economic-commercial view of historical region and neglect of sustainable development and cultural-identity view of context and region	0.030	4	0.120
T_{14}	The spread of special diseases caused by problems	0.040	4.5	0.180
T_{15}	Reducing the tendency to settle in the region and against the migration of destitute and low-income people, including villagers to the context	0.032	3.5	0.112
T_{16}	Continuous increase of criminal gangs and strengthening of criminal behavior due to the social and economic problems of the region	0.028	4.4	0.123
T_{17}	Weakness of motivation for large private sector investment due to the lack of clarity in the policies and plans of plans and urban management	0.025	4	0.100
T_{18}	Uncertainty of investors from the point of view of investment return period and economic cost	0.031	4.5	0.139
T_{19}	Lack of coordination of renovation programs with economic facilities in the city	0.019	3.7	0.070
T_{20}	Continuation of the trend of housing low-income groups with the motivation of obtaining cheap housing	0.040	2	0.080
T_{21}	The lack of organization of tourist facilities and their lack of response to needs and as a result reducing the motivation of foreign and domestic tourists	0.032	4	0.128
T_{22}	Reducing the tendency to live in the middle to upper classes and finally creating a vicious cycle	0.024	4.5	0.108
T_{23}	The tendency towards confusion and more and more incoherence of the activity system of the tissue and the pathological desire to commercialize in the region	0.034	3	0.102

Row	External strategic factors	Relative weight	rank	Final weight
T_{24}	The lack of transparency and sustainability of urban management policies and plans and the high investment risk for the private sector and the renovation and reconstruction of the region	0.019	3	0.057
T_{25}	The lack of an inter-departmental management institution to define and implement construction plans and projects at the regional level and the inadequacy of the existing structures and management organization	0.028	3	0.084
T_{26}	The existence of a lack of trust and confidence in the people and their passive attitude towards the issue of participation in the field of urban management	0.038	3	0.114
T_{27}	The extreme weakness of the municipal structure and urban management and in contrast to the uncertainty and non-implementation of some important projects in the region	0.029	2.6	0.075
T_{28}	Lack of coordination and inter-departmental and organizational conflicts by the responsible bodies and institutions in the renovation and improvement of the historical context and its reaction in the form of large unorganized and unplanned interventions or passivity and further destruction and erosion of the context	0.041	2	0.082
T_{29}	Lack of transparency, necessary rules and regulations regarding support and attraction of private sector investment in construction and development of the region (lack of rules and regulations encouraging and encouraging renovation and improvement in the context and even the existence of contrary rules)	0.022	4	0.088
T_{30}	Limitation of participation to a kind of forced participation pattern and the lack of spread of spontaneous and organized participation patterns in the region	0.026	3	0.078
T_{31}	The major reliance of the municipality's income sources on construction and the small share of other income headings in the municipality's income budget	0.015	3	0.045
T_{32}	Existence of interested and influential groups and the dominance of relations over rules in complying with city rules and regulations	0.018	4.3	0.077
T_{33}	The lack of clarity of specific rules, regulations and instructions in relation to the proposals of upstream projects and the indecision of the municipality in dealing with this issue	0.023	4	0.092
Total		**1**	**-**	**7.539**

Source: Authors, 2025

3.4. Determining the position of strategies

After determining the final score of the internal and external factors of re-creating the historical fabric of Tembi market in Masjid Suleiman, the position of the strategies can be determined. Table (3) shows the weighting factor and percentage of influence of internal and external factors. Among the external and internal factors, threat points with a weight of 4.068 and a weight percentage of 0.29 are the first priority and weaknesses with a weight of 2.395 and a weight percentage of 0.23 are the last priority.

Table 3. Weighting factor and percentage of influence of internal and external factors

	Internal factors		External factors	
	W	S	T	O
Final weight	3.616	2.395	3.436	4.068
Weight percent	27	19	24	30

Source: Authors, 2025

Therefore, according to the final weights of internal and external factors, it shows more points in threats (Figure 2).

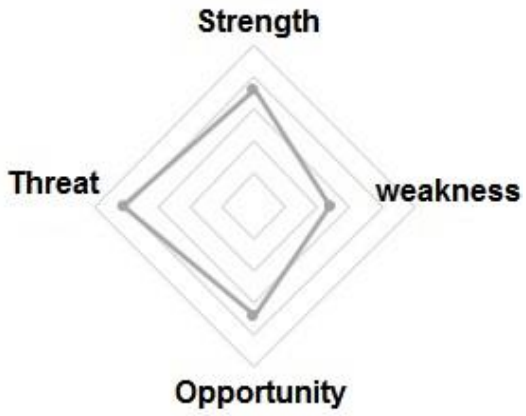

Fig 2. Determining the strategy of recreating the historical context of Tembi market in Masjid Suleiman
(source: authors, 2022)

Formulation of the strategy is based on the combination of four factors involved in the strategic planning model, which, of course, during the implementation of some strategies, according to the situation under study, four categories of strategies can be formulated, which are different in terms of the degree of activism:

SO strategies (offensive strategy): by taking advantage of strengths, it tries to take advantage of opportunities.

ST Strategies (Competitive or Diversification Strategies): Uses strengths to avoid threats.

WO strategies (revision strategy): reduce weaknesses by taking advantage of opportunities.

In table (4), the weighting factor and the effectiveness percentage of the four strategies are given. The most weight is the ST strategy or competitive strategy with a weight of 7.684 and it is the first priority. The weight percentage of this strategy is equal to 0.28, which has a higher weight percentage than other strategies, therefore, the proposed strategy resulting from the SWAT technique is the ST or competitive strategy (diversity) with a final weight of 7.648. It means that strategies should be developed to avoid future threats through strengths (Figure 3).

Table 4. Weighting factor and the percentage of effectiveness of the four strategies

	The sum of the coefficients of the composite factors			
	SO	ST	WT	WO
Final weight	7.052	7.684	6.463	5.831
Weight percent	26	28	24	22

Source: Authors, 2025

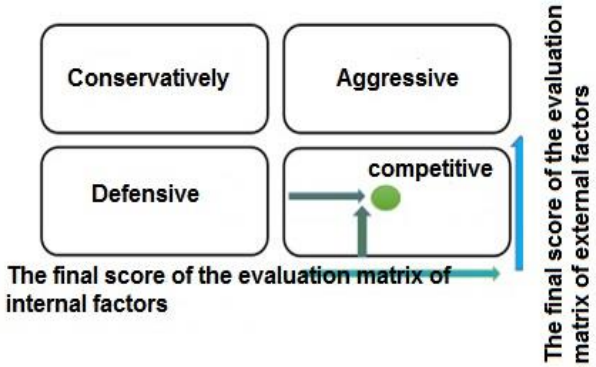

Fig 3. Determining the strategy of recreating the historical fabric of Tembi Market in Masjid Suleiman
Source: Authors, 2025

4. DISCUSSION

4.1. Determining the priority of strategies with quantitative strategic planning matrix

One of the techniques and methods of evaluation, monitoring and supervision to realize the strategy is the use of quantitative strategic planning matrix or QSPM. The QSPM matrix is used to evaluate the sustainability feasibility of the proposed solutions in the face of local conditions and the existing situation. If in this matrix, a strategy cannot face internal and external conditions, it should be removed from the list of strategies that can be prioritized. Table 5 shows the selection of the best strategies in order of more points.

Table 5. Selection of the best strategies in order of more points

Row	Selected strategies	Score	Priority
1	Valuing commercial cores with the ability to become important commercial centers and controlling the commercialization of the fabric without providing the necessary infrastructure and support services	3.387	3
2	Organizing and reusing open and barren spaces in the city and people's participation in the field of urban management	3.544	4
3	Paying more attention to the functional values of fabric as an important part of the city of Masjid Suleiman and strengthening the building against natural disasters	4.878	1
4	Promotion of the role of valuable historical-cultural and religious elements and the transparency and sustainability of urban management policies and programs and regional reconstruction	4.143	2
5	Increasing the attention of urban management to environmental and historical-cultural aspects and the reconstruction of historical textures and its restoration	2.132	5

Source: Authors, 2025

Therefore, in this part, after evaluating the internal and external matrices, competitive strategies have been selected as strategies that can be presented in the historical context of Tembi market in Masjid Suleiman. By scoring the competitive strategies through the QSPM method, the strategies were written in the order of their score and priority, and finally the strategies that got the most points were selected as the best strategies in the historical context of Tembi market in Masjid Sulaiman, and in line with the two final strategies and presentation The solution or implementation policies have been discussed. According to the obtained results, strategies 3 and 4 have obtained the most points (among the compiled strategies, the highest point is related to paying more attention to the functional values of the fabric as an important part of the city of Masjid Suleiman and strengthening the building against natural disasters with a score of 4.87 and Enhancing the role of valuable historical, cultural and religious elements and the transparency and sustainability of policies and programs of urban management and regional reconstruction with a score of 4.14. Also, the lowest score is related to strategy 5, increasing the attention of urban management to environmental and historical-

cultural aspects and The reconstruction of historical structures and its restoration is with a score of 2.13 (Table 5). Therefore, it can be said that with more attention to the functional values of the structure of Tembi market as an important part of the city of Masjid Suleiman and strengthening the building against natural disasters and promoting the role of valuable historical elements. Cultural and religious and the transparency and sustainability of urban management policies and programs and the reconstruction of the region led to regeneration. Therefore, the two-way relationship of urban regeneration and the competitiveness of the historical context of Tembi market is an undeniable necessity. If regeneration takes place, finally the competition will happen. If we improve the components of competitiveness, a re-creation will emerge in its heart and content (Yeghfouri and Thani Mohammad Akbari, 2018). Therefore, if we pay attention to the existing capabilities and problems, the historical texture of Tembi market in Masjid Suleiman city can compete with other places in the country and we will witness changes not only in the historical texture, but also in the whole Masjid Suleiman city, including this Changes; Economic, social, physical and environmental regeneration of the historical fabric, investing as much as possible and increasing the share of employment towards higher standards of living. A comparison of the attractiveness of strategies for re-creating the historical fabric of Tembi market in the city of Masjid Sulaiman is shown in Figure 4.

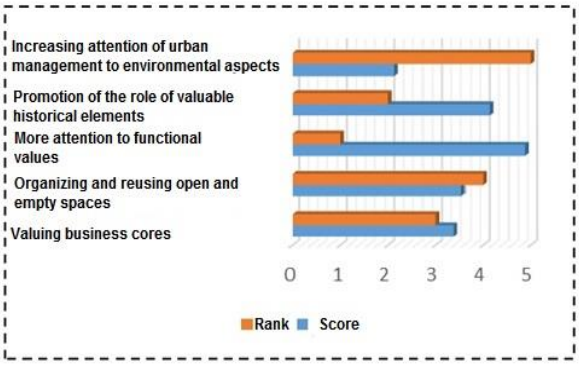

Fig 4. Comparing the attractiveness of strategies for re-creating the historical context of Tembi market in the city of Masjid Suleiman

5. CONCLUSION

The results of this article show that the organizations responsible for the reconstruction of the historical context of Tembi market in the city of Masjid Suleiman are facing many weaknesses and threats in order to strategize the reconstruction programs of the mentioned historical context; at the same time, there are strengths and opportunities ahead. Also, the evaluation matrix of internal factors (IFE) showed that the historical fabric of Tembi market is facing an internal disorder, and on the other hand, the evaluation matrix of external factors (EFE) showed that the person responsible for recreating the historical fabric of Tembi market has not been able to take advantage of the opportunities at his disposal. In order to stay away from the threats that are in front of it (it has not shown a good reaction to external factors). The results obtained from the evaluation matrix of internal-external factors (IE) showed that the reconstruction of the historical context of Tembi market is not in a favorable situation, because defensive strategies have been prioritized. The Quantitative Strategic Planning Matrix (QSPM) also showed that the first priority is the strategy of paying more attention to the functional values of the fabric and strengthening the building against natural disasters with a score of 4.87, and strategies to promote the role of valuable historical-cultural and religious elements and transparency and sustainability. Policies and programs of urban management and reconstruction of the region with a score of 4.14 are in the next priority. Also, the lowest score is related to the strategy of increasing the attention of urban management to environmental and historical cultural aspects and the reconstruction of the historical fabric of Tembi market and its restoration with a score of 2.13. In other words, in order to improve and improve the existing situation, in the direction of recreating the historical context of Tembi market with regard to its potential in Masjid Suleiman city, several strategies can be applied, based on the findings of the research, paying more attention to the functional values of the context of Tembi market and Strengthening buildings against natural disasters and enhancing the role of valuable historical, cultural and religious elements and transparency and sustainability of urban management policies and programs and regional reconstruction are top priorities. Therefore, the proposed strategy resulting from the SWAT technique is the ST or competitive strategy with a final weight of 7.648. The city managers' lack of proper understanding of culture as a value-creating capital has caused many historical and cultural capitals in cities to be neglected and degraded. Therefore, if we pay attention to the existing capabilities and problems, the historical context of Masjid Suleiman will be able to compete with other places in the country and we will witness changes not only in the historical context but also in the entire city of Masjid Suleiman. Among these changes; Economic, social, physical and environmental regeneration of the historical fabric, more investment and increased employment towards higher standards of living are more important. In general, to solve the problems of the historical context, there is a need for comprehensive studies in all dimensions and indicators of reconstruction. The results of this study are consistent with (Seo and Joo,

(2019), 28), (Yeghfouri and Thani Mohammad Akbari, 2018, 45) and (Zarrabi and Mahboobfar, 2014, 73).

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Geographical Analysis of the Role of Public Transportation on the Spatial Distribution of Covid-19 Disease Outbreaks (Case Study: Sadeghieh Neighborhood of Tehran)

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ABSTRACT

Background: The study of the spatial distribution of epidemics and the investigation of their seasonal spread trend in geographical structures are done using statistical analysis to control society during the epidemics.
Objectives: The Covid-19 (SARS-CoV-2) disease, which has been prevalent since late December 2019, affected all bases and elements of urban and rural communities. For this reason, many studies were conducted to control this disease during the period. In the present study, public transportation systems were investigated as systems that transmitted the disease to new areas and increased the number of infected areas.
Methodology: In this study, by collecting data from Sadeghieh neighborhood in Tehran, an attempt was made to investigate temporally the spatial distribution trend of the number of infected people with Covid-19. The research was analytical and descriptive. Sadeghieh neighborhood in Tehran was selected as the study area.
Results: The relationship between the spatial distribution of the number of Covid-19 infected people and the transportation system in this neighborhood was investigated in a seasonal trend. For this purpose, the number of passengers entered Sadeghieh subway stations, separately for each season within 2020-2021 and the infected people with Covid-19 in this neighborhood were considered as the statistical population.
Conclusion: The results of this study showed that in spring, summer and winter, the incidence of the disease followed the same trend as the number of subway passengers. But in autumn, a sudden increase and sinusoidal fluctuations were observed in the incidence rate; and the measured variables did not follow the same trend.

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1. INTRODUCTION

This is not the first time in history that a pandemic has affected cities. Similar cases of widespread pandemics occurred before Covid-19 pandemic (Matthew and McDonald, 2006). Previous research focused more on the quality of life of the poor and marginalized, who are more vulnerable at the time of pandemics (Wade, 2020). But, during Covid-19 pandemic, tackling the pandemic and keeping cities alive are a matter of concern (Connolly et al., 2020a; Sharifi and Khavarian-Garmsir, 2020). For the earliest days of Covid-19 pandemic crisis, the scientific community sought to identify improvement programs and policies with a variety of topics, including mechanisms for the spread of the virus, its environmental, economic and social effects. Due to the high concentration of population and economic activities in cities, they are often the foci of infection with Covid-19. Accordingly, researchers tried to discover the dynamics of the pandemic in urban areas and to understand the effects of this disease on cities (Sharifi and Khavarian-Garmsir, 2020; Mousavi et al, 2025). The health of people in society is affected by the environment in which they live (Pinter-Wollman et al., 2018). Contact host demographic networks (Mossong et al., 2008), Contact patterns in the area, population density (Kraemer et al., 2015), population h
eterogeneity (Dushoff & Levin., 1995) and mobility (Merler & Ajelli., 2009) play an important role in the geographical spread of infectious diseases (Changruenngam et al., 2020). Traveling affects not only the spread of the disease, but also the speed of its spread (Ni and Weng, 2009; Dalziel et al., 2013; Changruenngam et al., 2020). In general, the role of population displacement and transportation infrastructure which increases inter-urban and inter-city connection has also been proven as a key factor in the spread of infectious diseases in the past such as Ebola (Connolly et al., 2020b; Sharifi and Khavarian-Garmsir, 2020). Travel restrictions are very effective in local and international travels in the early stages of the pandemic. In the next step, travel restrictions are reduced and behavioral changes are highlighted. Restrictions on travels delay the international spread of the disease (Muley et al., 2020). All published data showed reduced mobility was considered as an effective factor in reducing the spread of the virus and its cross-border transfer. Quarantine policies in Wuhan, China which restricted outdoor activities were a successful example (Pirouz et al., 2020; La et al., 2020; Aloi et al., 2020). These restrictions also affected peoples' travel behavior. So people preferred to use their own cars and avoid public transportation systems (Arellana et al., 2020). Public transportation, as crowded and closed places, accelerates transference of Covid-19 (Smieszek et al., 2019; Luo et al., 2020). Long-distance travels are a major factor in the spread of a disease. Mobility and length of stay spatially transmit a pandemic (Belik et al., 2011; Bayramzadeh and Fari, 2019; Poletto et al., 2013; Muley et al., 2020). In addition to analyzing the impact of public transportation systems on the spatial distribution of Covid-19, it is important to examine the seasonal trend of this relationship. Changes in seasonal and environmental factors have a direct effect on the disease. Recognition of seasonal patterns in the occurrence of disease dates back to the time of Hippocrates. Factors such as the functioning of the human immune system, seasonal changes in the levels of vitamins such as vitamin D and melatonin and infection of the pathogen cause changes in the rate of infection. Environmental changes directly affect the abundance, survival and severity of the pathogen (Auda Fares, 2011). Awareness of seasonal changes and time trends of the disease are important for prediction, crisis management and immunization programs (Knottnerus, 1992; Fleming et al., 1991; Turabian, 2017; Mousavi et al, 2025). Two points are important in the seasonal increase of diseases: simultaneous occurrence of many phenomena in a season and human behaviors such as increased social interactions or exposure to disease agents and polluted environments. In epidemiology, the study of time series includes cases of seasonal variations (those that occur regularly at certain times of the year) and periodic changes (those that appear too much or happen over several years). Awareness of these changes can be related to their causes such as agent ecology, climate, atmospheric phenomena, humans' concentration and activity and exposure to various factors. In order to detect seasonal changes, time intervals are measured in small units such as days, weeks, months and seasons (Pascal & Dobson, 2005; Turabian, 2017). In this study, the human mobility factor on the spatial expansion of Covid-19 over a one-year period from March 20th, 2020 to March 20th, 2021 was investigated.

2. METHODOLOGY

On normal days, 200 and 54 trains run from Sadeghieh to Farhangsara and Karaj stations, respectively and during holidays, 130 and 37 trains run to Farhangsara and Karaj stations, respectively. Sadeghieh station is one of the busiest stations in Tehran. In some days during 2020-2021, according to the statistics of Tehran Urban and Suburban Railway Operation Company, the number of people entering Sadeghieh station has reached over 19000. The existence of shopping malls and private companies has caused a large number of people to enter this neighborhood for shopping or working every day. In this research a linear equation and a cross-correlation coefficient were used. Research

data was entered into GIS and its density maps were prepared. A Forecast function was used to estimate the future incidence. The number of infected people was measured in 14 day groups.

2.1. Study Area

This study was descriptive and analytical. The study area, Sadeghieh (Fig.1) is a neighborhood in west Tehran. From Sadeghieh subway station, two trains move; one to east Tehran, Farhangsara station and the other to Alborz province, Karaj station.

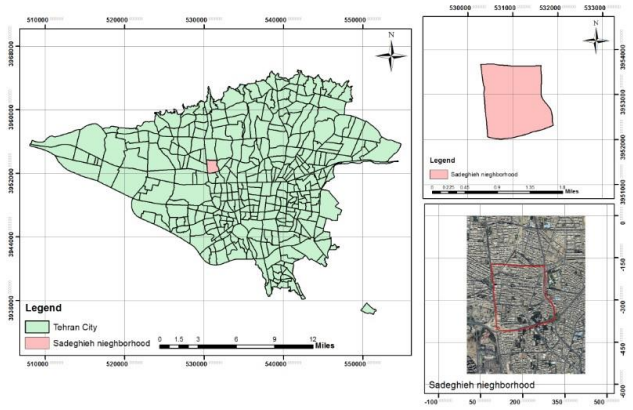

Fig 1. Sadeghieh Study neighborhood
(Source: Authors, 2025)

3. RESULTS

First, to show the number of Covid-19 infected people separately for each season within 2020-2021, its data was entered into GIS and its density maps were prepared. In order to investigate the spatial spread of the disease and its relationship with the number of subway passengers, a linear equation and a cross-correlation coefficient were used.

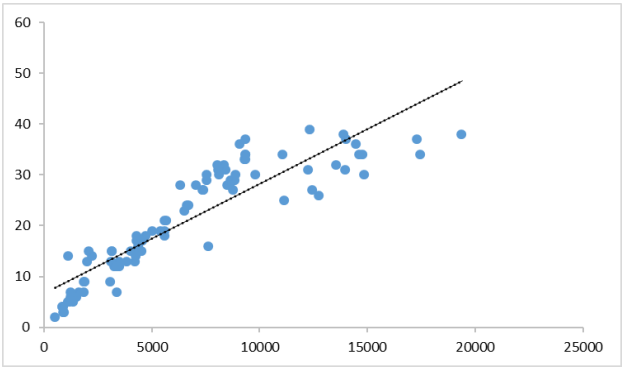

Fig 2. Linear distribution of infected people with Covid-19 and the number of passengers in Sadeghieh subway station in Tehran in spring
(Source: Authors, 2025)

According to the information in (Fig. 2) in spring, the spatial prevalence of Covid-19 showed a positive trend with the number of passengers. The best fitted model was linear with R^2= 0.8115 and the equation y = 0.0022x + 6.593.

The best fitted model in summer was a linear type with R^2= 0.7082 and the linear equation y= 0.0039x + 19.438 (Fig. 3). The dispersion of points in this season showed an increase in the number of infected people. The linear model in autumn showed that the relationship between the variables followed a sinusoidal trend. As R^2 obtained from this equation was equal to 0.6022 and its linear equation was y=0.0086x + 38.114.

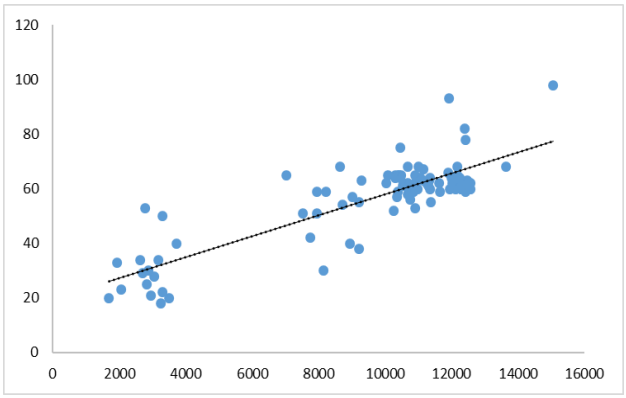

Fig 3. Linear distribution of infected people with Covid-19 and the number of passengers in Sadeghieh subway station in Tehran in summer
(Source: Authors, 2025)

The influence of other factors caused the measured variables in this equation not to have a positive trend (Fig. 4). High mobility and density in Sadeghieh neighborhood, seasonal changes and suitable temperature for pathogen multiplication maximized the incidence in this season.

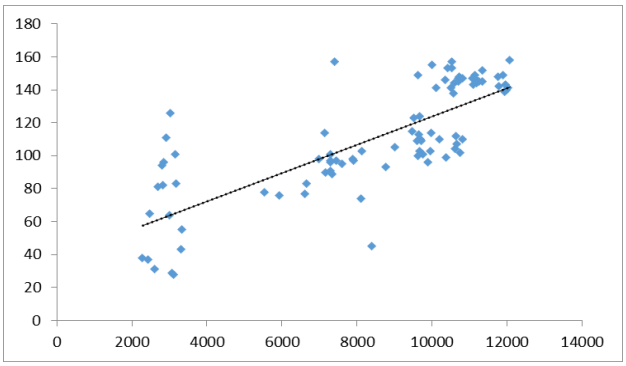

Fig 4. Linear distribution of infected people with Covid-19 and the number of passengers in Sadeghieh subway station in Tehran in autumn
(Source: Authors, 2025)

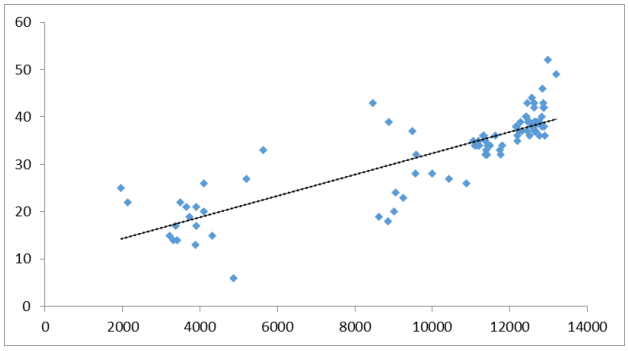

Fig 5. Linear distribution of infected people with Covid-19 and the number of passengers in Sadeghieh subway station in Tehran in winter.
(Source: Authors, 2025)

In winter, the linear distribution of variables followed a positive trend that $R^2 = 0.7055$ and its equation was $y = 0.0023x + 9.8497$ (Fig. 5). Despite the increase in the number of passengers in this season, the incidence decreased, which showed seasonal changes had a significant effect on the incidence.

The linear distribution of the measured variables in spring and summer showed the relationship between the variables but in autumn, the variables did not go through the same process. As showed in fig. 4, in autumn, despite the decrease in the number of subway passengers, there was a significant increase in the number of infected people. As the highest average of infected people belonged to this season; and despite declaring quarantine and reducing the use of public transportation which was one of the factors of disease transmission to different regions showed an increasing trend. Despite the decrease in population size, the number of cases increased in daily trips which was affected by an increase in the number of susceptible individuals in this season. From autumn to winter, the linear distribution of variables moved toward equilibrium and the curves showed the relationship between population density and incidence.

4. DISCUSSION

After calculating the slope of the line, a Forecast function was used to estimate the future incidence. Figure 6 showed an increase in the infection with a slow trend. The dotted lines are the upper and lower limits of the forecast and the middle line is the average of the forecast.

Figure 7 shows the percentage of infected people with Covid-19 and the percentage of passengers entering Sadeghieh subway station. In autumn, the number of infected people was more than the number of passengers. Using the cross-correlation coefficient between the studied indicators in Sadeghieh neighborhood with an error rate of 0.05, the number of passengers per day was measured by the number of infected people in 14 days.

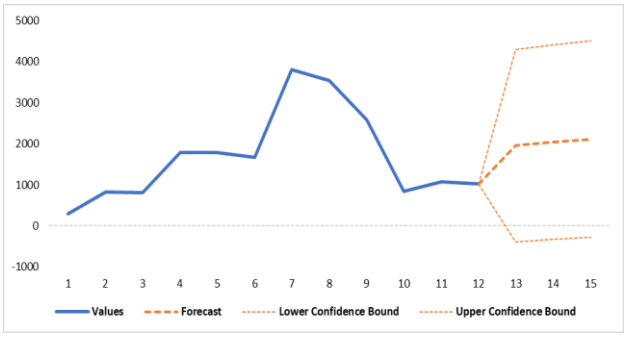

Fig 6. Infected cases and predicted cases in Sadeghieh neighborhood of Tehran
(Source: Authors, 2025)

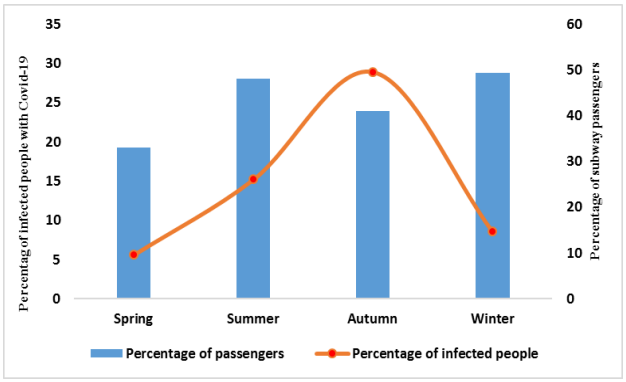

Fig 7. The percentage of infected people with Covid-19 and the number of passengers of Sadeghieh subway station in Tehran in the four seasons within 2020-2021
(Source: Authors, 2025)

Figure 8 shows cross-correlation among the indices and the upper and lower limits of the correlation coefficient.

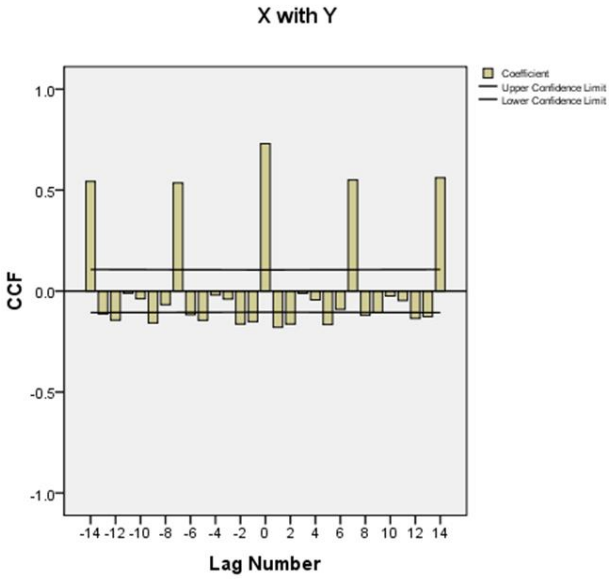

Fig 8. Cross correlation between indicators of passengers and the number of infected people with Covid-19 in Sadeghieh neighborhood
(Source: Authors, 2025)

According to Fig 8 The highest correlation coefficient was related to the simultaneous situation and to 7-day and 14-day delays. The highest coefficients were due to the onset of mild symptoms on the first day of infection and the onset of complete symptoms within 14 days after infection. It showed the sensitivity of infected people and their referral to medical centers. According to the results of this test, a person who carried a disease whose symptoms have not yet appeared could infect those around him for fourteen days.

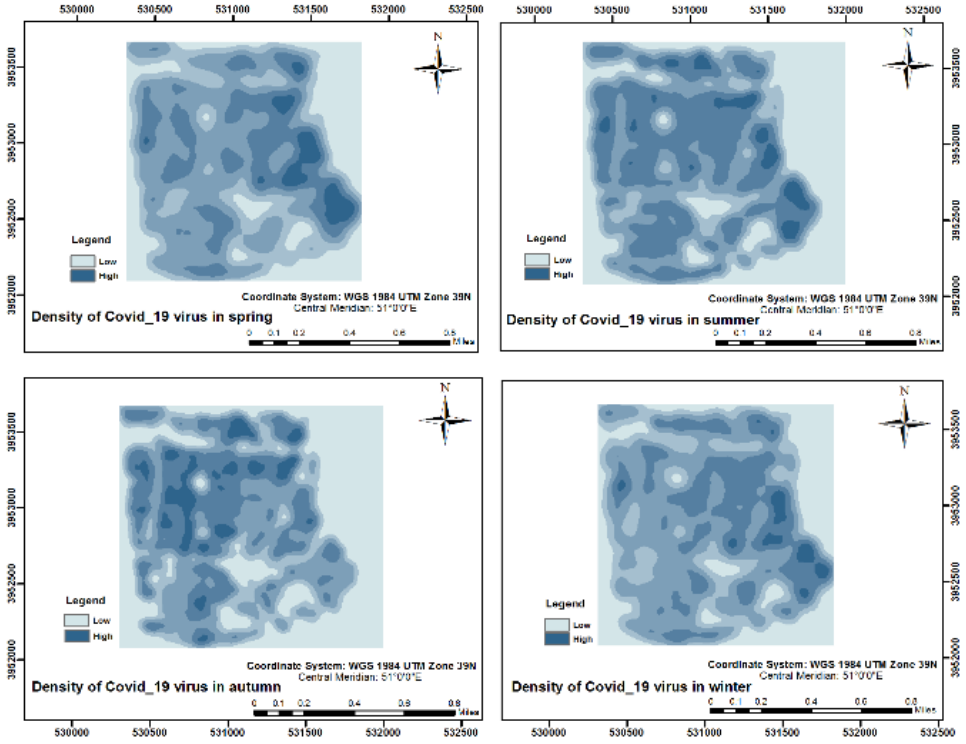

Fig 9. Spatial distribution of infected people with Covid-19 in Sadeghieh neighborhood in different seasons within 2020-2021

(Source: Authors, 2025)

Figure 9 shows the spread of Covid-19 disease in different seasons in Sadeghieh neighborhood within 2020-2021. The scattering of points increased from spring to summer. Based on the data used in the preparation of this map, this increase was seen from late spring; and it continued uniformly throughout the summer. The trend in summer was almost the same every day. In autumn, the spatial spread of the disease reached a critical stage; and it has been declining since late autumn. In winter, the dense points reduced. The trend was almost the same throughout winter. Except autumn, when maximum density and sudden changes in the spread of the disease were observed, in other seasons of the year, the spread of the disease and its increase and decrease occurred uniformly. Even in summer, the incidence increased throughout the day. Therefore, temporally only in autumn, the spread of this disease had a sudden and different increase compared to other seasons.

Examination of diagrams and maps showed that the spread of the disease was affected by both human mobility and seasonal factors. As, at certain times of the year, the rate of spread of the disease increased to some extent that control of human mobility could not reduce its incidence (Changruenngam et al., 2020). This limited mobility during peak periods of the disease caused an increasing spread in geographical locations. Increasingly infected environments put more people at risk. High density plus the number of people who enter Tehran every day has caused the administrative, medical, and commercial places and also entertainment centers in this city to be crowded and overcrowded. This mobility and population density increase during the day. The arrival of carriers in subway stations and their departure to different areas, caused the spread of the disease in the city.

5. CONCLUSION

Mobility and population density in subway stations was in the same trend with the number of infected people with Covid-19 according to the results obtained from the calculation of the slope of the line. Using cross-correlation coefficient, it was determined the number of passengers per day was positively correlated with the number of infected people on the same day

and on the seventh and fourteenth days in the study area. Therefore, the mobility of human society was one of the important factors in the spread of this disease in society. The spread of the virus increased with the onset of summer holidays. Decreased immune levels and favorable weather conditions helped the virus to be multiplied in autumn. In addition to increasing the incidence, the number of deaths also increased. In this case, adhering to health protocols- using masks and social -distancing - was not effective. Only by enforcement and strict quarantines, could society be prevented.

In a study entitled Significance of geographical factors to the COVID-19 outbreak in India, using the variable linear regression, Gupta et al. (2020) examined factors such as temperature, rainfall, evapotranspiration, sunlight, humidity, wind speed, topography and population density and the relationship with the approved Covid-19 items. The relationship between sunlight and temperature was positive. Of course, the spatial relationship between Covid-19 and climatic, topographic and social factors had to be done in the long run.

In another study, Changruenngam et al. (2020), examined the effect of human mobility on the transmission dynamics of human influenza in Belgium and Martinique spatially and temporally. Using modeling, they provided a geographical and temporal pattern of the epidemic. The results of their study showed that the disease first spread to densely-populated urban areas and then to neighboring areas and villages. They considered human mobility to be an important factor in the spread of infectious disease.

In this study, the spatial prevalence of Covid-19 and the impact of public transportation systems (subways) on the spatial spread of this disease was investigated in different seasons in Sadeghieh neighborhood of Tehran temporally. Using line slope calculations, it was found that, in most days of the year, the spread of the disease follow followed the same trend with the number of subway passengers.

Disease distribution maps showed a gradual increase and decrease in the number of infected people with Covid-19 in most seasons. The increase of the number of cases in summer and autumn was due to changes of the immune system and climate changes that affected the frequency of pathogens. Also, the presence of more people outside the home due to summer vacations and increase of travels and closed spaces at home and work due to cold in autumn, lack of ventilation in closed spaces and the simultaneous increase in diseases such as colds and the flu could be mentioned.

In a society like Iran, due to the level of incomes, it is not possible not to use public transportation or reduce the number of people who use it. In subways, the seats are marked in order to distance people, and the use of masks is mandatory in subway stations and trains. But overcrowding at stations and trains prevents distances among people. Therefore, in order to protect people and comply with health protocols, other measures must be considered.

Managing the current state of transportation systems, especially in times of increased morbidity and mortality, is one way to protect people against this crisis. Quarantine and control must be done before the onset of the disease.

Wu et al. (2020), in their research, considered proper management of transportation networks as a factor in controlling Covid-19 disease and introduced public transportation systems as the most important factor in transmitting the disease from one place to nearby areas (Rahimi rise et al.,2020). Controlling public transportation with the help of intelligent systems can be an effective way to identify people who have carried the disease or have traveled with infected people with Covid-19 in a train or bus.

Also, as a program to increase safety of people in times of crises such as the outbreak of Covid-19, creating suitable and safe routes for walking and cycling was recommended in order to increase the choice of people and reduce the number of passengers of public transportation systems.

Floating working hours and telecommuting can reduce congestion in transportation at certain times of the days. Creating more facilities for online shopping will prevent the presence of people in the passages and shopping centers, which are usually crowded areas of the city.

Estimating the number of effected people in the future can provide solutions for better control and improvement of community conditions. In this case, it will be possible to take effective measures such as vaccination or quarantine before the infection increases

DECLARATIONS

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Socio-Economic Status of Male Bhaja Seller in Bettiah City, (Bihar) India

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ABSTRACT

Background: Street vendors are a crucial component of the informal economy in urban areas, representing a substantial share of the overall informal sector workforce. These vendors play a key role in providing affordable goods and services to urban populations, often filling gaps left by formal retail sectors.
Objectives: This research is focused specifically on bhaja sellers in Bettiah City to determine their socioeconomic status. Bhaja sellers occupy a significant niche within the broader community of street vendors, contributing not just economically but also culturally to the urban fabric.
Methodology: The study draws on primary data obtained through direct interviews with bhaja sellers, offering insight into their lives and work.
Results: The research reveals that bhaja selling is a male-dominated occupation, with all observed participants being men. These vendors, much like others in the street vending sector, face considerable challenges in their work.
Conclusion: The majority of respondents expressed that bhaja selling, while a necessary means of livelihood, is a demanding and strenuous occupation, akin to the broader challenges faced by street vendors in maintaining their daily operations amidst various socioeconomic pressures.

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1. INTRODUCTION

India has a variety of street vending activities. Bhaja selling is a popular street vending activity in India. This study focusses on those who sell Bhaja. Bhaja-sellers, like other street vendors, sell their product from one location to another. As a result, we divide Bhaja sellers into three categories based on their working style: mobile sellers, stationary sellers, and multipoint sellers. Bhaja sellers meticulously arrange all Bhaja ingredients on their Thella. Bhaja-sellers use a variety of ingredients to make the bhaja, including Bhuja (Lai), grams, mustard oil, pickle, green chilli, onion, boiled potato, tomato, namkeen, and others. This is referred to as 'Bhaja' in the local dialect, but it is also known as 'Jhalmudi', "Bhel," and other names throughout the country.

However, street vending is a worldwide phenomenon and the most visible example of informal segmentation in any industry within India. As a result, a lot of people engage in street vending because it is characterised by low-income levels, ease of entry, unskilled knowledge, and self-employment. Millions of people make a living by selling a variety of goods and services on the streets of developing nations like India. The perspective of

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street vendors on the socio-political landscape is not only captivating, but it also demonstrates how various forces regulate their social life and livelihood on the street. Therefore, it indicates that not only uneducated people are engaged in these types of occupations; sometimes some educated people or individuals also choose this occupation.

According to the National Policy of Urban Street vendors, 2004 by Govt. of India, Street vendors defined as "A street vendor is broadly defined as a person who offers goods for sale to the public without having a permanent built-up structure but with a temporary static structure or mobile stall (or head load). Street vendors may be stationary by occupying space on the pavements or other public/private areas, or may be mobile in the sense that they move from place to place carrying their wares on push carts or in cycles or baskets on their heads, or may sell their wares in moving trains, bus etc. In this policy document, the term urban vendor is inclusive of both traders and service providers, stationary as well as mobile vendors and incorporates all other local/region specific terms used to describe them, such as hawker, pheriwalla, rehri-patriwalla, footpath dukandars, sidewalk traders etc."

Conceptually, street vendors are one of the important components of the urban informal economy, representing a significant portion of employment in this sector. Despite their importance, they face numerous challenges and discrimination from local government and urban policies. As a visible aspect of the informal economy, street vendors provide easy access to a variety of goods and services, yet they are often characterized by low incomes. Millions worldwide rely on street vending for their livelihoods, contributing to job creation and income generation for the poor. These vendors typically remain mobile, carrying their goods in pushcarts or baskets, although they can become stationary when occupying public spaces. Many street vendors struggle to secure formal employment due to socio-economic factors, often starting their businesses with minimal investment. They deliver essential products for daily consumption, such as fruits, vegetables, and milk, making their presence crucial, especially in regions like Bihar and Bettiah, where formal job opportunities are limited.

Street and Road side vending is an economic activity and it consists of a large percentage of rural and urban dwellers in developing countries. There has been continuous growth of road side vendors not only in India but also in the entire world. These roadside vendors are characterized by low-income group. Street vending is one of the important income and employment source and it provide good and service to poor at affordable price and convenient to urban poor population in town and cities.

The current investigation specifically focuses on the socio-economic status of Bhaja sellers, who constitute an essential segment of street vendors. While numerous studies have explored the circumstances of street vendors nationwide, this study distinguishes itself through its examination of relevant literature.

Street vending plays a crucial role in the urban economy, particularly in developing countries. It provides affordable goods and services to urban populations, especially the lower-income segments, and offers employment opportunities to those who might otherwise struggle to find work in the formal sector. For instance, Cross and Morales (2013) highlight the importance of street vending in cities like Mexico City and Bangkok, where it serves as a significant source of income for many families and contributes to the local economy by offering a variety of goods and services at affordable prices.

Furthermore, Bhowmik (2010) discusses how street vending acts as a buffer in times of economic crises, absorbing labor displaced from formal sectors. In cities like Mumbai, street vendors are estimated to contribute significantly to the local economy, with their aggregate turnover running into millions of dollars annually (Bhowmik & Saha, 2012).

For instance, Nidan's (2010) research on street vendors in Patna revealed that many individuals opt for vending due to a lack of alternative employment opportunities, easy entry, and minimal investment. The study noted a predominant involvement of males (78%), with females encountering challenges such as inadequate facilities and harassment. Prakasham (2013) emphasized the need for legal literacy among vendors to mitigate harassment from municipal and police personnel in Chandigarh. Street vending is not just an economic activity but also a cultural phenomenon. It reflects the cultural diversity and vibrancy of urban spaces. Turner and Schoenberger (2012) note that street vendors often sell culturally specific goods, contributing to the cultural richness of cities. In Hanoi, Vietnam, for example, street food vendors are not only a critical component of the local economy but also a key part of the city's cultural heritage.

The socio-cultural importance of street vending is also evident in the way it provides social cohesion and community support. Many street vendors operate within tightly knit networks, providing mutual aid and support (Brown, 2006). This social aspect is crucial for vendors who often face precarious working conditions and insecurity.

Roever and Skinner's (2016) research compiled evidence on urban policies and government practices related to street vending in Ahmedabad, Peru, and Lima, highlighting the adverse impacts of workplace insecurity, harassment, and merchandise confiscation on vendors. Koley and Chakraborty's (2018) study on street vendors near Tatanagar Rail station in Jamshedpur underscored spatial and daily marketing concerns, revealing disparities in living conditions between male and female vendors.

Recchi (2020) conducted a global study on informal street vending practices, developing a theory that explained the sector's dynamics. Dhas (2020) found that while Madurai's street vendors had low education and economic status, they prioritized educating their children. The study recommended interventions for improvement, involving collaboration between vendors, family members, local organizations, NGOs, and the government. Imam (2021) highlighted the unskilled and uneducated background of street vendors in Bodh Gaya, emphasizing the fluctuating income tied to local events. Parmar and Patel's (2022) examination of Vadodara's street vendors uncovered insecure work conditions, including heavy workloads and low earnings. Regulating street vending poses a complex challenge for urban authorities. Many cities struggle to balance the needs and rights of street vendors with urban planning and public space management. In some contexts, street vending is illegal, leading to conflicts between vendors and authorities. For example, in Lagos, Nigeria, street vending is often subject to sporadic crackdowns despite its legality under certain conditions (Bromley, 2000; Shahzada et al, 2024).

Several scholars have argued for more inclusive and supportive regulatory frameworks. Roever and Skinner (2016) suggest that integrating street vendors into urban plans can benefit both vendors and the wider community. They advocate for policies that provide secure vending locations, legal recognition, and protection from harassment, which can enhance vendors' livelihoods and the overall urban environment. Despite the wealth of literature on street vendors, there is a notable absence of research on bhaja sellers. Consequently, the present study aims to fill this gap by investigating the socio-economic conditions of bhaja sellers in Bettiah City, offering insights and recommendations to address the challenges they face.

2. METHODOLOGY

The study utilizes primary data gathered directly from Bhaja sellers in Bettiah city through semi-structured interviews. A semi structured questionnaire was employed to assess the socio-economic status and the various challenges faced by these sellers. Due to time and budget limitations, as well as the study's focus on a relatively small geographic area, data was collected from a targeted group of 36 Bhaja sellers using purposive sampling. Since most of the bhaja sellers were mobile vendors, we interviewed anyone observed in the study area. This research is descriptive in nature, aiming to provide a comprehensive overview of the conditions faced by Bhaja sellers. To enhance the depth of the study, the researchers not only interviewed sellers on the streets but also conducted field visits to Banuchhapar, a locality where a significant number of Bhaja sellers reside. These visits allowed the researchers to directly observe their housing and living conditions, adding valuable context to the data collected through interviews (Plate 1 to 3).

2.1. Limitations of Data Collection

- Respondents were hesitant to disclose information regarding income and assets.

2.2. Significance of the study

This study seeks to explore and shed light on the socio-economic conditions of Bhaja sellers in Bettiah City. The findings will offer a clearer understanding of their work environment, challenges, and overall livelihood, which can inform policymakers in the development of effective and efficient policies aimed at improving the well-being of these street vendors. Additionally, the study serves as a valuable resource for future researchers interested in examining the lives of Bhaja sellers. By providing insights into the subsistence strategies of these street vendors, the study also offers critical information that can guide policy formulation and support for this marginalized group.

2.3. Study Area

Bettiah Nagar Parishad, established as a municipality in 1869, serves as the administrative headquarters of the West Champaran District and is located 225 kilometres northwest of Patna. Bettiah holds historical significance as the seat of the 17th-century Bettiah Raj family and was one of the key centres of British administration during their rule in India. The city has a rich cultural heritage and played a pivotal role in India's national movement, notably as the starting point of Mahatma Gandhi's Satyagraha Movement in 1917.

The area governed by the Municipal Council spans approximately 8.01 square kilometres, with a population of 132,896 according to the 2011 census, compared to 116,670 in the 2001 census. This results in a population density of 165 persons per hectare in 2011, up from 145 persons per hectare in 2001. In 2022, Bettiah was upgraded to a Nagar Nigam, comprising a total of 46 wards spread over an area of 11.2 square kilometres.

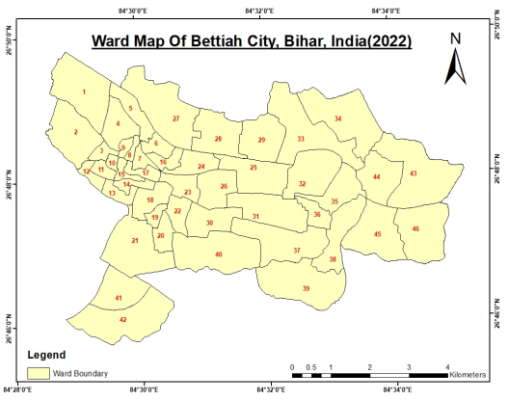

Fig 1. Study area

(Source: Authors, 2025)

3. RESULTS

Table 1. Educational Qualification details of Bhaja-Sellers

S. No.	Educational Qualifications	Percentage
1	Illiterate	69.50
2	Primary	30.50

Source: Calculation based on primary survey by the researchers

Education is a crucial socio-economic indicator that reflects an individual's knowledge and behaviour. In this study, respondents were categorized into four educational levels: illiterate, primary, secondary, and graduate. Among the 36 Bhaja sellers surveyed, 25 are illiterate, while 11 have completed primary schooling. None of the respondents have attained secondary education or a college degree. The analysis reveals that a significant majority of the respondents, 69.50%, are illiterate, while 30.50% have only primary education. This data suggests that street vending, such as Bhaja selling, is predominantly undertaken by individuals with little to no formal education, likely due to their inability to secure employment in the formal sector.

Table 2. Classification of Bhaja-Sellers on the basis of age group

S. No.	Age Group	Percentage
1	18-24	19.50
2	25-34	19.50
3	35-44	22.20
4	45-54	25.00
5	55-64	11.00
6	Above 65	2.80

Source: Calculation based on primary survey by the researchers

The age distribution of respondents was examined as part of the socioeconomic analysis, with participants categorized into six age groups. The findings show that 19.5% of the respondents were in the 18-24 age group, another 19.5% were in the 25-34 group, and 22.5% fell within the 35-44 age range. The largest proportion, 25%, belonged to the 45-54 age group, followed by 11% in the 55-64 category, and the remaining 2.8% were aged 65 and above. Among the 36 respondents, 4 were aged 55-64, and 1 was over 65, indicating that older individuals are also engaged in Bhaja-selling. Since street vending is a form of self-employment, it offers job opportunities over a longer period. The observation that 39% of vendors were aged 15 to 34 years highlights the significant involvement of younger generations in Bhaja-selling.

Table 3. Classification of Bhaja-Sellers on the basis of Religion

S. No.	Religion	Percentage
1	Hindu	97.30
2	Muslim	2.70

Source: Calculation based on primary survey by the researchers

Religion is a crucial and influential social factor in society. The Bhaja-selling occupation among respondents is divided into four religious groups: Hindu, Muslim, Sikh, and Christian. The study found that an overwhelming majority, 97.3%, of respondents are Hindu, while the remaining are Muslim. None of the respondents identified as Sikh or Christian. Of the 36 total respondents, 35 are Hindu, and only one is Muslim. This indicates that Bhaja-selling in Bettiah city is predominantly a Hindu occupation.

Table 4. Classification of Bhaja-Sellers on the basis of category

S. No.	Caste	Percentage
1	General	2.78
2	OBC	69.44
3	SC	27.78

Source: Calculation based on primary survey by the researchers

It was observed that 69.44 percent of the respondents belonged to the OBC category, 27.78 percent were under SC category, 2.78 percent of the respondents were from the general category. The caste analysis indicates that street vending is not confined to socially weaker communities, and it has, in fact, given employment opportunities for socially upper communities also.

Table 5. Marital status of Bhaja-Sellers

S. No.	Marital status	Percentage
1	Single	13.90
2	Married	77.80
3	Widowed	8.30

Source: Calculation based on primary survey by the researchers

The classification of the respondents by marital status pattern revealed that 78 percent of the respondents were married and 14 percent of them were unmarried. It is a significant factor that 8 percent of vendors were found to be widowed and no one is separated.

Table 6. Nature of family of Bhaja-Sellers

S. No.	Nature of family	Percentage
1.	Nuclear	50
2	Joint	40
3	Extended	10

Source: Calculation based on primary survey by the researchers

The concept of a joint and nuclear family system is an important factor that reflects a society's social character. We observe that the Bhaja sellers practice both the nuclear family system and the joint family system, which includes the extended family system. The survey revealed that 40 percent of the respondents were practicing the

joint family system, 10 percent were extended family, and 50 percent were in the nuclear family.

Table 7. Family size classification of Bhaja-Sellers

S. No.	Family size	Percentage
1	3-5	38.88
2	6-10	58.33
3	Above 10	2.77

Source: Calculation based on primary survey by the researchers

Bhaja-seller groups family sizes into three categories: 3-5, 6-10, and above 10. Out of 36 respondents, 14 fall into the 3-5 family size category, 21 fall into the 6-10 family size category, and one falls into the family size category above 10. On a percentage basis, 38.88% of respondents belong to the family size group 3-5, 58.33% to the family size group 6-10, and 2.77% to the family size group above 10.

Table 8. Native place of Bhaja-Sellers

S. No.	Native place	Percentage
1	Local	8.40
2	Nearby Bettiah	5.50
3	Other district	86.10

Source: Calculation based on primary survey by the researchers

There is a general assumption that locals are involved in street vending. Contrary to this perception, the survey results revealed that 86.10 percent of the Bhaja-sellers are migrants. Another 13.90 percent of the Bhaja-sellers are local or from nearby Bettiah city.

Table 9. Migration of Bhaja-Sellers

S. No.	District	Percentage
1	Sitamarhi	30.56
2	East Champaran	41.67
3	West Champaran	13.89
4	Sheohar	2.78
5	Nalanda	2.78
6	Muzaffarpur	8.32

Source: Calculation based on primary survey by the researchers

According to table 6, 86.10% of Bhaja sellers are migrants from other districts of Bihar, while 13.90% are locals from Bettiah and surrounding areas like Banuchhapar, East Kargahiya, and Baswariya. The majority of Bhaja sellers (72.23%) come from two districts: East Champaran and Sitamarhi. This is because these two districts are the closest to Bettiah. Other Bhaja sellers hail from Muzaffarpur, Sheohar, and Nalanda districts.

Table 10. Identity Card Type of Bhaja-Sellers

S. No.	Identity Card Type	Percentage
1	Adhar card	100
2	Voter ID	100
3	Ration card	97.30
4	ATM Card use	38.90

Source: Calculation based on primary survey by the researchers

Identity, in any form, is vital for a businessman. This is especially important for Bhaja sellers in urban areas. We attempted to determine whether they possessed any legal or related identity cards, such as a ration card, an Adhar card, a voter identity card, a Pan card, or an ATM card. The table shows the distribution of respondents based on their possession of various identity items. The majority of Bhaja sellers have ration cards, Adhar cards, and voter identification cards. Approximately 100% of respondents stated that they possessed these identification cards. In contrast, none of the Bhaja sellers owns a PAN card. Only 38.90 percent of respondents had an ATM card.

Table 11. Category of sale of Bhaja-Sellers

S. No.	Category of sale	Percentage
1	Stationary	27.80
2	Mobile	63.80
3	Multi-point sale	8.20

Source: Calculation based on primary survey by the researchers

Street vendors execute their business by selling in a single location, moving from one point to another, or moving continuously through the streets. We found that 27.80 percent of Bhaja sellers engaged in stationary sales, 63.80 percent in mobile (moving) sell, and the remaining 8.20 percent in multi-point sells.

Table 12. Health issue of Bhaja-Sellers

S. No.	Health Issue	Percentage
1	Private hospital	5.60
2	Govt. hospital	41.60
3	Local doctor	52.80

Source: Calculation based on primary survey by the researchers

For Bhaja sellers, health issues are an important socioeconomic factor. According to the above field survey data, Bhaja-sellers prefer only government hospitals and local doctors for medical issues. A total of 94 percent of Bhaja sellers either go to the government hospital (41 percent) or a local doctor (53 percent) for treatment of their family members. Only 6% of Bhaja sellers seek treatment in a private hospital, which is a small proportion of the total. The majority of Bhaja-sellers choose to receive treatment at a government hospital or from a local doctor due to their low income and inability to afford the high costs of private hospitals.

Table 13. Previous Occupation of Bhaja-Sellers

S. No.	Previous Occupation	Percentage
1	Agricultural work	22.20
3	Initial	33.30

4	Labour	44.50

Source: Calculation based on primary survey by the researchers

An analysis of the previous occupations of the Bhaja-sellers revealed that 22 percent of the respondents were previously involved in agricultural work, 33 percent began Bhaja-selling work as their first job, and the remaining 45 percent were daily wage workers in industrial work, welding work, on construction sites, etc. The majority of respondents had previously worked as labourers, indicating that Bhaja-selling was a more convenient, suitable, and popular daily wage job because it allowed for more flexible working hours and was easier to work than other daily wage jobs.

Table 14. No of earning members of Bhaja-Sellers

S. No.	No. of Earning member	Percentage
1	1	36.10
2	2	33.30
3	3	27.80
4	Above 3	2.80

Source: Calculation based on primary survey by the researchers

Table 14 presents the number of members of the Bhaja-sellers family who are currently employed. This aspect of the study is significant from an economic standpoint. According to the findings of the study, 69 percent of people who sold Bhaja had at least one or two members of their family who were employed. The percentage of respondents who had three members who earned money was 28 percent, while only three percent of Bhaja sellers had more than three members who earned money.

Table 15. Type of Bhaja Thella of Bhaja-Sellers

S. No.	Bhaja Thella	Percentage
1	Own	100
2	Rented	0

Source: Calculation based on primary survey by the researchers

Table 15 shows the field survey data of Bhaja sellers based on Bhaja Thella. We discovered that 100% of respondents owned their own Bhaja Thellas (Plate 4). No Bhaja sellers had rented Thella. Bhaja street vending, according to the study, requires little investment. One of the respondents clearly stated that a Bhaja Thella costs between 10,000 and 12,000 rupees. This is a minimum and affordable investment.

Table 16. Type of house of Bhaja-Sellers

S. No.	Types of Houses	Percentage
1	Kachha	61.10
2	Pucca	5.50
3	Semi- Pucca	33.40

Source: Calculation based on primary survey by the researchers

Table 16 above categorizes Bhaja-sellers according to house types. This is also a critical component of the socioeconomic research on Bhaja-sellers. According to the study, the majority of respondents lived in semi-pucca and kachha types of homes. Few responders owned a pucca house. Ninety-four percent of the respondents had semi-Pucca and kachha houses. Six percent of the rest had pucca houses. This demonstrates that a significant portion of the respondents are impoverished, living in semi-private homes in Kachha, and have extremely low standards of living.

Table 17. Indebtedness of Bhaja-Sellers

S. No.	Indebtedness	Percentage
1	Yes	27.80
2	No	72.20

Source: Calculation based on primary survey by the researchers

Street vendors often get into debt traps as a result of their high levels of debt. They require credit for both their economic and noneconomic activities. They borrow money from a variety of sources to meet their financial needs because they have limited access to bank credit. However, in the case of Bhaja-selling street vending, opposite trends emerged. According to the current study, 28% of Bhaja-sellers were indebted, while the majority of respondents (72%) were not indebted (Table 17). During the Covid pandemic, the condition of Bhaja sellers deteriorated dramatically. Government lockdown guidelines forced them to leave their street vending jobs and return to their hometowns. Without work, they had to make do with terrible living conditions. They relied on high-interest loans from moneylenders to make ends meet.

Table 18. Working hours of Bhaja-Sellers

S. No.	Working Hours	Percentage
1	8 – 10 Hours	44.50
2	Above 10 Hours	55.50

Source: Calculation based on primary survey by the researchers

On average, the Bhaja-sellers work varying numbers of hours each day. Almost 45 percent of the vendors work eight to ten hours per day. Because buying and assembling the products are considered preparatory tasks, the vendors do not account for the hours they spend on them. The majority of the vendors worked longer hours, and they did so at strange times like early in the morning and late at night. If we were to count these hours, the actual working time would double. However, 55.50 percent of the vendors estimated and calculated that they worked 10 hours a day on vending.

Table 19. Opinion of Bhaja-Sellers about Bhaja – selling

S. No.	Opinion about Bhaja–Selling	Percentage
1	Good and moderate	5.50

2	Difficult	94.50

Source: Calculation based on primary survey by the researchers

A lower proportion of respondents thought the Bhaja-selling work was good and moderate (Table 19). Nearby 95 percent of the vendors said the Bhaja-selling work was difficult. The majority of respondents believed that street vending work, specifically Bhaja-selling, was challenging due to the year-round nature of the work. They had to work during the hot summer, the monsoon, and the cold winter seasons. According to the previous study, the majority of respondents were mobile sellers, so this type of street vending is more difficult than others.

Table 20. Basic Amenities used by Bhaja-Sellers

S. No.	Amenities	Percentage
1	Mobile	100
2	TV	8.30
3	Gas	100
4	Two-Wheeler	5.50

Source: Calculation based on primary survey by the researchers

Amenities reflect the quality of life of each person. Table 20 lists the amenities possessed by Bhaja-sellers. All surveyed Bhaja-sellers were found to possess mobile phones and Gas cylinders. However, only a minority possessed smartphones. Only a small number of respondents own basic amenities such as televisions and motorcycles. None of the respondents had a refrigerator. This study indicates that they had a significantly low standard of living. They were unable to afford entertainment sources such as television.

Table 21. The UPI payment option provided by Bhaja-Sellers

S. No.	UPI Payment	Percentage
1	Yes	36.11
2	No	63.89

Source: Calculation based on primary survey by the researchers

Table 21 illustrates the availability of UPI payment facilities among bhajan-sellers. The data reveals that 36 percent of the respondents have access to UPI, enabling them to accept digital payments, while the remaining 64 percent do not have this facility. A deeper analysis indicates that access to UPI is closely linked to smartphone ownership. All bhajan-sellers who had smartphones were able to use UPI, highlighting the role of technology in facilitating modern payment methods. This finding suggests that digital inclusion among street vendors is largely dependent on access to affordable technology, which can significantly impact their ability to participate in the digital economy.

Table 22. Habits of Bhaja-Sellers

S. No.	Habits	Percentage
1	Smoking	19.50
2	Tobacco	100

Source: Calculation based on primary survey by the researchers

The prevalence of specific personal habits, such as smoking, drinking, and gambling, can significantly influence the financial well-being of bhajan-seller families, as shown in Table 22. The study found that 20% of bhajan-sellers engaged in smoking, while none reported drinking or gambling. However, several vendors mentioned that they use both cigarettes and other forms of tobacco, indicating a widespread reliance on tobacco products among these vendors.

The habitual use of tobacco, particularly smoking, poses serious health risks and can exacerbate the financial strain on bhajan-seller families. The costs associated with purchasing tobacco products, coupled with potential medical expenses arising from health complications related to smoking, can further deplete the already limited resources of these households. Additionally, while the absence of drinking and gambling habits among the surveyed bhaja sellers is a positive finding, the pervasive use of tobacco remains a concern. This behaviour not only affects their personal health but also has broader implications for their economic stability, potentially reducing their ability to invest in other essential areas such as education, nutrition, and savings.

Table 23. Bhaja Sellers' Investment Sources

S. No.	Source of investment	Percentage
1	Friend and relative	11
2	Own saving	66.70
3	Parents	22.30

Source: Calculation based on primary survey by the researchers

Additionally, 22 percent of the respondents borrowed money from their parents, highlighting the role of family support in launching these small enterprises. This familial financial assistance underscores the close-knit nature of these communities, where family resources are often pooled to help members establish a means of livelihood. The remaining 11 percent of respondents turned to friends and relatives for loans, further reflecting the reliance on social networks within the community for financial backing.

Interestingly, none of the respondents reported needing to borrow from moneylenders or banks, which is noteworthy considering the challenges often faced by small entrepreneurs in accessing formal credit. The ability to gather the necessary 15,000 to 18,000 rupees from personal and social resources suggests that while bhaja selling requires some initial capital, the barriers to entry are relatively low compared to other occupations. This financial approach allows bhaja sellers to begin their work without the burden of

significant debt, enabling them to maintain greater control over their earnings and business operations.

The current study is primarily based on field data collected through a primary survey of street vendors, specifically bhaja sellers, in Bettiah City, located in the West Champaran District of North-West Bihar. The key findings of the study are summarized as follows:

Gender Distribution: The study revealed that 100% of the bhaja selling workforce is male, with no female involvement. This indicates a significant gender disparity in the bhaja selling business, with men dominating the field.

Age Distribution: A majority of the street vendors (58%) fall within the productive age range of 31 to 60 years. Additionally, 12% of the vendors are over the age of 60, indicating that the enterprise also engages older individuals. The relatively small proportion of vendors (6%) aged 15 to 30 suggests moderate youth involvement, implying that the younger generation finds bhaja selling somewhat appealing.

Education Levels: The study found that a large majority (70%) of the participants lacked literacy skills, and only 30% had completed primary education. This demonstrates that education is not a significant factor in determining engagement in bhaja selling work. Most vendors undertake this labor primarily to support and manage their families.

Marital Status: The survey found that 14% of the respondents were unmarried, while 78% were married. Notably, 8% of the vendors were widowed, and none reported being separated. This data provides insight into the social and familial contexts of the vendors.

Social Background: While street vending is traditionally associated with socially weaker communities, the study found that it also provides employment opportunities for individuals from socially upper communities.

Geographic Origin: A significant majority (86%) of the bhaja sellers came from other districts, with only 14% originating from Bettiah and its surrounding areas like Banuchhapar, East Kargahiya, and Baswariya. This finding challenges the assumption that most bhaja sellers are local residents.

Documentation: The vast majority of bhaja sellers possess essential identification documents such as ration cards, Aadhaar cards, and voter identity cards, which are crucial for accessing various services and benefits.

Education and Aspirations for Children: Despite being mostly illiterate and economically disadvantaged, many bhaja sellers are investing in their children's education. They remain hopeful that their children will secure jobs in the formal sector, indicating a strong desire for upward social mobility.

Housing Situation: The study found that 72% of street vendors live in rented homes after relocating from other districts, while only 28% own their homes. None of the respondents reported living on the streets, suggesting some level of housing stability.

Personal Habits: Among the street vendors, 20% smoke regularly, and all respondents reported consuming tobacco products. However, none of them engage in drinking or gambling, highlighting a focus on certain personal habits over others.

Sales Strategies: The survey identified three primary sales strategies among the vendors: 28% engage in single-point sales, 64% in mobile (moving) sales, and 8% in multi-point sales. This diversity in sales approaches reflects the varying methods vendors use to reach their customers.

Work Hours: The study found that 45% of the vendors work long hours, with shifts exceeding eight hours daily. The remaining 55% work more than eight hours each day, indicating the demanding nature of bhaja selling.

Perceptions of the Occupation: The majority of respondents view bhajan-selling as a challenging occupation, similar to other forms of street vending. However, 6% of the bhaja sellers described their work as both good and moderate, indicating a range of perceptions about the job's difficulty and rewards.

4. DISCUSSION

The government has initiated several programs aimed at supporting street vendors, including the Pradhan Mantri Street Vendors Atmanirbhar Nidhi (PMSVAnidhi), which provides a loan of Rs. 10,000 as working capital to help vendors restart their businesses after the impact of the Covid-19 pandemic. However, the government could further enhance support by establishing a dedicated ministry under the Ministry of Labour to specifically focus on the welfare of street vendors.

Additionally, steps should be taken to strengthen self-help groups (SHGs) among street vendors. Educational programs should be implemented not only for the vendors themselves but also for their children, ensuring that the next generation has access to better opportunities. To help street vendors fully benefit from government initiatives, it is essential to launch awareness campaigns that inform them about the available programs and how to access them.

Local authorities also play a critical role in improving the conditions for street vendors. They should ensure the safety of vendors by providing essential amenities like toilet facilities and safe drinking water. Regular health checks and improvements in hygiene conditions should be conducted to maintain the well-being of these communities. For bhaja sellers, in particular, there is a need to build shelters and improve their living conditions within the community.

Financial assistance should be extended through subsidies, and legal status must be granted to street vendors to protect their rights. Street vendors should be recognized as a special component within urban development plans and included in the area's master plan. Establishing a social security fund for street vendors is crucial, ensuring they receive humanitarian aid during crises such as pandemics, disasters, and other emergencies.

5. CONCLUSION

This study seeks to explore the evolution, functional performance, challenges, and needs of bhaja sellers at a micro level, with the aim of developing effective strategies to protect their livelihoods and enhance their well-being. By focusing on this specific group, the research aims to provide a comprehensive understanding of their unique circumstances within the broader context of street vending.

Primary data for this study were gathered through in-depth interviews with the bhajan-sellers themselves, offering firsthand insights into their daily experiences and struggles. The findings reveal that bhaja selling is an occupation exclusively dominated by male vendors, with no female participation observed in this profession. This gender-specific trend underscores the cultural and social dynamics at play within this line of work.

Furthermore, the majority of respondents expressed that bhaja selling is more challenging than other forms of street vending. The difficulties faced by these vendors include not only the physical demands of their work but also the social and economic pressures that come with maintaining their livelihood in a competitive and often unpredictable market environment. These challenges highlight the need for targeted interventions that address the specific issues faced by bhajan-sellers, ensuring that they receive the necessary support to sustain and improve their economic status.

By understanding the intricacies of bhaja selling, this study aims to contribute to the formulation of policies and programs that can better support these vendors, ultimately leading to improved living conditions and greater economic security for those engaged in this occupation.

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Examining the socioeconomic determinants that impact Indian modes of transportation for Daily Commuting: An investigation of Moradabad City of India

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ABSTRACT

Objectives: The present study aims to analyze the factors which influence the selection of modes by commuters for daily travel to work .

Methodology: For accomplishment of this objective, a field survey has been conducted in Moradabad city among the commuters to collect the data by using a structured questionnaire in month of April-May, 2017 following the simple random sampling method. The data obtained through the survey has been analyzed by simple percent method. The public transport, private vehicles and non-motorized modes were taken as the dependent variable while the age, education, monthly income, household size, settlement status and distance were considered as the independent variables.

Results: The result clearly reveals that the selection of modes of transit varies with the variations in socio-economic conditions of commuters. It has also been found that the commuters living in better socio-economic condition in terms of education, monthly income, and size of household were likely more to commute by private modes of transportation than the commuters belonging to poor socio-economic condition who mostly rely on public and non-motorized vehicles.

Conclusion: The study suggests the base to better understand which attributes are more effective in selecting the means to travel for work Moreover, the commuting modes discussed in terms of public, private and non-motorized vehicles used by commuters according to their demographic, social and economic characteristics can help to formulate the effective and successful transportation policies.

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1. INTRODUCTION

Modes of commuting generally mean the modes of transportation which is used by commuters for their daily travel to work. Mode of transportation is a basic necessity for a commuter to accomplish its daily trip to work. Therefore, it is clear that without good accessibility and availability of transportation, the act of commuting can't be performed. Nevertheless, the choice of modes for daily journey to work by commuters is highly influenced by their socio-economic and demographic status. Therefore, the variations in modes of commuting are enough to show the disparity in socio-economic condition of commuters.

A mode of transportation is a key component of commuting. It has changed the volume, nature and pattern of commuting over time because the

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commuting involves the people who require the means of transportation at any given point of time and place to visit to place of work or return to home. Thus, commuting is not possible in absence of sufficient, punctual, fast and safe transportation. Besides, the mode of commuting is one of its basic components which greatly shapes the pattern of commuting existing in a particular region. In other words, the pattern of commuting in a particular place largely depends on the availability and accessibility of transportation of that particular area (Malokin et al. 2019; Rasca & Saeed, 2022; Sridhar & Nayka, 2022). The probability of long-distance commuting enhances with availability of rapid and punctual modes of transportation and decreases with the lack of efficient availability of transport mode (Zhou & Murphy, 2019).

Modes of commuting generally mean the modes of transportation which is used by commuters for their daily travel to work. The term “mode usage”, “mode choice”, or “modal split” are often used to describe the decisions people make regarding their travel means. Modal choice is the process of opting “persons trips" or “freight movements" by the mode of transport (Cracknel, 2001). Mode of transportation is a basic necessity for a commuter to accomplish its daily trip to work. Therefore, it is clear that without good accessibility and availability of transportation, the act of commuting can’t be performed. Nevertheless, the choice of modes for daily journey to work by commuters is highly influenced by their socio-economic and demographic status. It considers the factors that are important to people or companies when making the decision as to which mode to use. In fact, selection of mode of transport is a function of combination of factors such as demographic factors, physical determinants, economic factor, cultural factors (choice, taste, tradition, technological knowledge, social-status, advancement of civilization etc.) and governance factors (laws, regulations, etc.). Rasca and Saeed (2022) find that the young and adults commuters select the public means of transit. Commuters from oldest age group use public transport more than middle aged ones.

Gender differential in selection of commuting mode is also remarkable. The women being low wage earner prefer to commute by public modes of transportation. The financial prosperity of commuters influences selection of commuting transport considerably. Low and middle-income people travel more number of trips than high income people. The low groups usually prefer those modes, which have minimum cost rather than comfort, privacy and security. But most of the middle and higher groups prefer to use the modes that are more comfortable, safe and secure. In this context, an example can be cited, in Hanoi City of Vietnam, there are two settlements-old settlement and new settlement (Motte et al. 2016). The old settlement is inhibited by low income people and new settlements are occupied relatively by better off people. Residents of old settlement cover short distance simple by walking and for longer distance, they depend on bicycle but people of new settlement use motorbikes for both short and long distance movement (Hoai and Ann, 2010). One study reported that people do not necessarily minimize their travel time or always choose the most cost-efficient mode or route, even when they are making work trips (Anable and Gatersleben, 2005).

In the United States in urban areas (with a population of 2500 or more) 64 percent of the commuters went to work by car, while in Belgium only 14 percent used this transport mode (U.S. Census, 1962). A survey conducted during the fall of 1963 in the standard metropolitan statistical areas (exclusive of New York) found that of all journeys to work, 84 percent were made by car, 90 percent of the cars containing only one person. Contrary to it, in developing countries, at a time, hand pulled carts, bicycle, cycle rickshaw, intermediate public transport dominated the streets (Pain, 2004). However, with the advanced degree of urbanization and increase in city sizes, trips become longer. As a consequence, both cycling and walking reduce considerably. These reduce to about 1/2 of all trips in medium cities and 1/3 in large cities in India in between 1986 and 2005 (Chowdhury and Chowdhury, 2011). In another study, it has been claimed that the adoption of ridesharing services is influenced primarily by reliability, convenience of the booking system, comfort, and time savings (Tyrinopoulos et al., 2020). The findings of a research conducted by Nordfjærn et all (2019) showed that situational constraints were somewhat more important for mode use than psychological variables.

The commuting modes and their variable impacts on health have also been associated in considerable previous studies which clearly exhibits that the health of commuters is very much affected by the types of vehicles the commuter rely for daily commute. The past studies showed that travel by both public and private modes of transport can cause considerable stress (Tse et al., 2000; Wener et al., 2005; Bhat and Sardesai, 2006; Bayramzadeh & Fari, 2019; Mousavi et al, 2025) as well as poor quality of life (Costa et al., 1988). Insufficient capacity and crowding is a major cause of stress among commuters who use public transport. Stressors like traffic congestion, lack of reliable and punctual services of public transport can cause motivational deficiency, increasing absenteeism and low productivity among tired workers. Elevated stress levels can contribute to serious health problems such as cardiovascular disease and suppressed immune functioning (Wener et al., 2005).

In countries where the public transport system is not well-developed, daily experience of unreliable

transport, conflicting time schedules, congested roads and crowded trains contribute to commuters' physical and psychological stress (Cantwell et al., 2009). Various modes of transportation have been found affecting commuters' health well-being differently. Car driving in commuting has been found to elevate psychological markets of stress such as blood pressure and neuroendocrine hormone levels (e.g. Robinson 1991; Bellet et al., 1969; Simonson et al., 1968). Moreover, highway congestion increases blood pressure among car drivers (e.g., Stokols et al).
1978; Novaco et al., 1979; Schaeffer et al., 1988; Evans and Carrere 1991; White and Rotton, 1998). Public transportation commuting in especially crowded trains has been found to increase psychological stress (e.g., Singer et al., 1974; Cox et al., 2006). Unreliability and delays on commuter trains in London have been associated with low productivity and low efficiency in tired workers. This loss in productivity has been estimated to cost London city at least £230 million per annum (Cox et al., 2006).

The analysis of the determinants influencing the mode choice of commuters considered in terms of demographic and socio-economic characteristics of commuters and their place of origin as rural and urban is very important to understand the variations in their socio-economic status as well as variations in selection of different modes of transportation. The study will surely provide the base to better understand which attributes are more effective in selecting the means to travel for work.

The study has been organized into various sections. The first part of the study contains introduction. The rest of the study is organized as follows. Sect. II reviews of existing literature done so far; Sect. III presents the aims & objectives, research questions and research methodology used. The results and discussion portion are presented in Sect. 4. Last but not least, major findings, conclusions and policy implications are presented in Sect 5.

1.1. Review of Literature

A number of studies have examined the factors that influence choice of travel modes by daily commuters. For example, Palma and Rochat (2000) investigated the mode choice for trips to work in the city of Geneva using a nested logit approach. They observed that the car ownership decision was primarily related to the income level of the household and was also influenced by the number of working people in the household and location issues. The study highlighted the relative inadequacy of public transport to some commuters' needs, especially those who live in suburban areas across the border. This was attributed to the peculiar geographical location of the city of Geneva. Kingham et al. (2001) analyzed factors influencing commuting choice and the potential for drivers to change to more sustainable transport modes such as cycling and bus, using the journey to work surveys from two large companies in Hertfordshire, England. The findings show that people comprehend the issues relating to air pollution and traffic congestion arising from car use and are willing to change their mode of travel, given certain changes: living closer to the workplace, more efficient public transport services and reduced ticket prices.

Studying in the same context, Titheridge and Hall (2006) examined the relationships between patterns of commuting mode choice with socio-economic and land-use characteristics (residential and workplace) in South East England using regression models. They found that traveling to work by public transport, cycling and walking were promoted in dense, urban areas, with and shorter journey distances. Liu (2007) analyzed travelers' choice behavior using combined revealed preference/stated preference survey data on work-trip mode choice in Shanghai, China. Several versions of a multinomial choice model were specified and estimated in this study. For those at middle and high income levels, the study observed that in-vehicle time when traveling by bus and the money cost of choosing to travel by taxi were more important attributes, whereas for low incomes, money cost and in-vehicle time of choosing to travel by bus seemed to be more important. Nurdeen et al. (2007) modeled the transportation behavior for coercive measures for car driving in Kuala Lumpur. A binary logit model was developed for the three alternative modes: bus, train, and car. It was found that time of travel, cost of travel, gender, age, income level, and car ownership were significant factors in influencing car users' mode choice behavior. Reduction in total time of travel and cost of travel for the bus and train mode emerged as the most important element attracting car users toward public transport and away from car mode. Mahlawat et al. (2007) examined the travel behavior of students at Texas A & M University (College Station, TX). The mode choice model showed that time of travel, cost of travel, income, expenses, household type, number of hours in school, gender, and ethnicity were important factors in the student's choice of mode.

Using two comparable national travel surveys, Buehler (2011) empirically investigated the determinants of transport mode choice in Germany and the United States. The analysis revealed significant differences in travel behavior even between similar individuals in Germany and the United States. The use of car was found to be on two different levels in the two countries with significantly higher rates of travel by car for all groups of society in the United States. The Germans in households with more cars than drivers were found to make three times higher share of trips by foot, bike, and public transport compared with Americans in similar households. Chandrasekhar, et al (2020)

conducted a comprehensive study on the determinants of commuters' choice in context of rural and urban India. They used the data from Census of India 2011 covering 640 districts in order to understand what drives the commuting choice among non-agricultural workers. They found that urbanization level, population size and density along with education attainment and worker's sex ratio (gender ratio among workers), age (elderly) and land use mix play very important role in regional pattern in transport mode choice for commuting. Adriana, et al (2023) in their study on commute mode choice among the students explore that despite living in Jakarta, a motorcycle and car-dominated city, the students prefer to use sustainable transport. Public transport is the most common mode, followed by motorcycles, walking, cars, and ride-hailing. The analysis of a study done by Yong Hu et al (2023) revealed that only about half of the couples commute by their preferred travel mode, whereas the remaining couples were those where one or both partners were unable to use their preferred travel mode, mostly due to travel distance.

The review of previous studies related to mode choice analysis reveals that the choice of the mode varies significantly with socio-economic and demographic characteristics of the commuters. Most of the cities of developing countries have been reported depending on inefficient and unreliable means of transportation. In a country like India, where exclusive bus lanes are almost absent and with limited efforts for promoting the public transport, the attitudes and the preferences of travelers for selecting the modes are different. Moreover, majority of the cities in India are on the verge of taking major policy decisions for improving existing public transport system and also contemplating the need for introducing new systems of mass transport such as Bus Rapid Transit System, Metro rail. However, there is scanty research in developing countries on mode choice behavior of traveler to work. In this context, carrying out a study on behavior of commuters with regard to mode choice will be useful to the planners and decision makers to assess the shift to public transport, if the existing system is improved or a new system is introduced (Ashalatha et al, 2013).

1.2. Aims and Objectives

The aim of this research paper is to present the key determinants, factors, and motivators that affect the use, adoption or selection of transportation means for their daily commute.

- To examine the demographic factors affecting the decision of commuters of selection of means of transportation for daily commuting. To analyze and discuss the socio-economic factors which determine the selection of means of transportation for daily commuting.

1.3. Research Questions

The study contains followings research questions:

- Is there any impact of demographic characteristics on the choice of transport modes for daily commute to work in the city?
- Is the selection of the different means of commuting highly selective in terms of social and economic characteristics?
- Do the commuters belonging to rural and urban background areas have variations in their use of means of transportation for commuting?

2. METHODOLOGY

The present study is mainly based on primary sources of data that has been generated through the comprehensive field survey by using a well-structured questionnaire to the respondents pertaining the demographic and socio-economic aspects of commuters. The field survey has been conducted in Moradabad city during 2017. Since, some commuters are very difficult to be identified due to lack of fixed work place and hidden in nature; in the city, the working and transit palaces were visited before drawing the actual sample of commuters and the sample of 5% individual commuters was selected following the purposive random sampling method for the survey from the working and transit points, connecting roads and labour markets. The survey is consisted of total 2294 respondents in the Moradabad city whereas the total number of sampled commuter households was 2256 in which the sampled male commuter households consisted of 2093 and sampled female commuter household included 163. The total number of selected rural and urban commuters in the survey were comprised of 1672 and 622 respectively. For the collection of data, only those commuters have been taken into consideration who were identified visiting to Moradabad city by crossing the administrative boundary of Moradabad city either from nearby village, town, city, block, tehseel or across the other districts particularly for the purpose of work, and all those who had been travelling to city for recreation, excursion, shopping, health or other individual purposes were excluded from the survey. For the collection of primary data, the administrative boundary of Municipal Corporation of Moradabad city has been taken as the unit of study and the individual commuter as the unit of enquiry. Before filling the questionnaires, commuters were recognized on the basis of their places of origin; rural commuters and urban commuters, the separates individual slips having the attributes of rural and urban environment were used to ease the task of survey. Hence the commuters are always in hurry either to reach to their place or to return to their place of residence after performing their duty, that's why it

was very difficult to agree them to give the answers of the questionnaire. Mainly three times for the survey were selected, the first one was of early morning (7 am to 10 am) in the morning, second one was of noon (1pm to 3 pm) and last third was of evening (from 5 pm to 9 pm). These are peak the times of commuters' arrival or departure either to workplace or to return to place of residence. The data collected through the field survey using individual slips have been scrutinized and processed in tabular form according to the requirements of the various aspects of the study. Moreover, possible attention has been paid to maximize the accuracy and validity of the data after screening, sorting, excluding of invalid and incomplete questionnaires. The obtained data through the field work has been analyzed through the simple percentage, average and descriptive method. The map of Moradabad city has been drawn by using Arc GIS Programme.

2.1. Study Area

Moradabad city has been selected for the present study which lies in the western part of Uttar Pradesh. Moradabad has been servicing as an industrial, commerce, educational and administrative city since long of period for employment attraction as well as for the movement for various purposes. Above of all, it has immense popularity because of the locations of brass manufacturing industries all over the world and consequently widely known as Brass city or Peetal Nagari. The geographical location of city lies between the parallel of 28° 16' to 28° 21' north latitude and meridians of 78° 46' to 79° east longitude. It is situated at a distance of 167 km from the national capital New Delhi on the banks of the Rāmgangā River, a tributary of Ganga River passing to the north-east of the city. The city occupies an area of 75 sq. km. Administratively, Moradabad City has been given the status of class first town by qualifying all the criteria. With respect to its demographic characteristic, Moradabad city has a population of 887871 inhabitants in which male and female constitute 464580 and 423290 respectively. The total literacy rate is 68.75% whereas the male and female literacy is 72.22 percent and 64.95 percent respectively.

The Moradabad city is speedily growing into an industrialized city of western Uttar Pradesh which has attracted the attentions of majority of population living in its periphery or surrounding villages and small town characterized with low level of industrialization, lack of sufficient job opportunities, shrinking employment, declining work force and decreasing size of land holding resulted in minimizing the demand of human labor force, in search of suitable sources of their livelihood. Its significance further lies in its well connectivity of both road and railway not only with its surrounding towns and villages but also with major commercial, industrial cities of India as being a headquarter of northern railway it facilitated the exports and imports of raw as well processed material to the other cities. The good connectivity of road network even to small villages further motivated the workforce to commute to city and good availability of transportation facilitated them to return back to their home after having performed their regular jobs.

Having observed the prevailing condition in Moradabad City in terms of its geographical location, growing industrialization, fast development after being included in smart city plans in 2015, transport infrastructure, good connectivity and its attachment with its hinterland having the sufficient labor force, it can be concluded that the phenomenon of commuting may accelerate over the period of time with fast rate until the diffusions of industrialization on the same rate occurs in its nearly located town and villages.

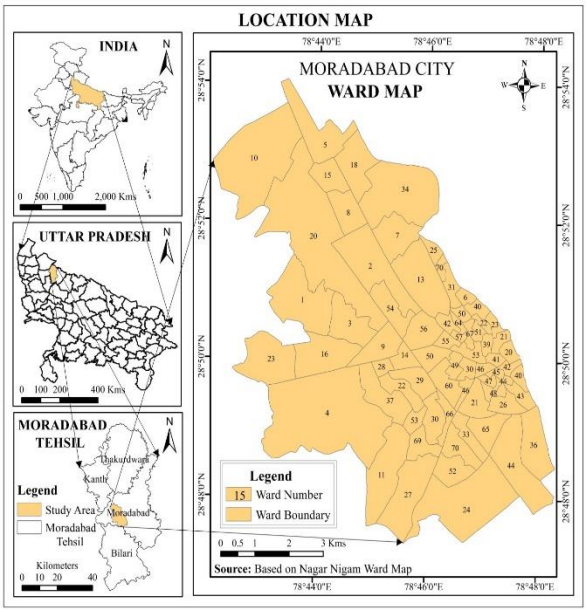

Fig 1. Map of the study area

3. RESULTS

3.1. Commuting Mode by Age and Sex-composition

The data on percentage distribution of modes of transportation of commuters based on their age and sex-composition has been depicted in table-1. It can be analyzed from the table that the younger (below 15) and older commuters (aged 60 and above) are more to commute by non-motorized vehicle and relatively less to commute by private and public transport than the commuters aged 15-59 years old. The similar condition has been observed among the females, while the reverse trend for both sexes male and females has been found among the adult commuters aged 15-59 years old where they use more the private vehicles than non-motorized modes as compared the those belonging to

juvenile (below 15 years) and senile age-groups (aged 60 and above).

Table 1. Percentage Distribution of Commuting Modes by Age and Sex Composition in Moradabad City, 2017

Age-Groups	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Below 15	Male	45.45	-	54.55	100.00
	Female	50.00	-	50.00	100.00
	Total	46.67	-	53.33	100.00
15-29	Male	70.39	11.18	18.42	100.00
	Female	91.67	4.17	4.17	100.00
	Total	71.95	10.67	17.38	100.00
30-44	Male	73.61	10.09	16.31	100.00
	Female	60.00	26.67	13.33	100.00
	Total	72.78	11.09	16.13	100.00
45-59	Male	67.11	9.21	23.68	100.00
	Female	88.89	3.70	7.41	100.00
	Total	69.41	8.63	21.96	100.00
60 and above	Male	50.00	8.70	41.30	100.00
	Female	71.43	-	28.57	100.00
	Total	52.83	7.55	39.62	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

A further examination of table-1 shows that in age-group below 15, the proportion of the commuters using the non-motorized modes (53.33) is more than the people using the public transport to travel (46.67 percent), while no commuter has been reported to commute by his own private vehicles. As the age of commuters increases, the use of public and private transport also increases but percent of non-motorized transport decreases. It is evident from the data that the commuters falling in age-group of 30-44 who travel to work by public transport are the highest in percentage by comprising 72.78 percent followed by those who lie in age-group of 15-29 where they share 71.95 percent. The non-motorized vehicles have recorded its highest position in age-group below 15 where it has constituted 53.33 percent of people aged below 15. The percentage of non-motorized vehicles further declined to 39.62 in age group of 60 and above, and further reduced to 21.96 percent in age-group of 45-59. The pattern has been witnessed opposite in case of private vehicles where these types of vehicles have secured the highest position in age-group of 30-44 (11-09 percent) followed by age-group 15-29 (10.67 percent), and age-group 45-59 (8.63 percent).

With respect of sex-wise analysis, the data exposes that the females aged below 15 are more to commute by public modes of transport but less to travel by cycle or walk than the males, the similar trend exists in age-group 15-29 where the ratio of males commuting by private and non-motorized transport exceed the females, but condition gets reversed in age-group 30-44 where the percentage share of females using the private modes of commuting is sufficiently more but remarkably less to travel by public modes of transportation than their counterpart males but the previous condition is repeated in age-groups of 45-59 and 60 and above where the females commuting by public modes of transit are higher than males but lower by using the private as well non-motorized vehicles than the males.

3.2. Modes of Commuting by Settlement Status

The data regarding the percentage distribution of modes of transportation based on settlement status has been given in table-2. An analysis of the data brings the fact into light that as a whole the percentage share of public modes of transport used by commuters to travel is the highest followed by non-motorized and private vehicles and their respective figures are 70.53 percent, 19.35 percent, 10.11 percent. But the variations are notable among the males and females travelling by different types of modes of transportation. It can be seen from the data that the males who have been commuting by non-motorized modes are more than females but trend gets opposite in use of public and private vehicles where the females exceed the males to commute by public and private modes of transportation. The females commuting by public modes of transportation, private vehicle and non-motorized means of commuting comprised 77.17 percent, 10.87 percent and 11.96 percent respectively whereas the corresponding figures for males have been noticed to be 69.95 percent, 10.05 percent and 20 percent respectively.

Table 2. Percentage Distribution of Modes of Commuting based on Settlement Status in Moradabad City, 2017

Settlement Status	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Rural	Male	69.81	9.03	21.16	100.00
	Female	77.05	6.56	16.39	100.00
	Total	70.33	8.85	20.81	100.00
Urban	Male	70.36	12.86	16.79	100.00
	Female	77.42	19.35	3.23	100.00
	Total	71.06	13.50	15.43	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

The further examination of the data regarding the distribution of commuters based on modes of transportation by settlement status exposes that the commuters from urban areas are more in percentage to travel by public modes of transportation and less likely to opt the non-motorized vehicles than those coming from rural areas who in number exceed their counterpart using the non-motorized transport. The overall use of non-motorized vehicles is the least in both rural and urban areas. This finding is pertinent to the past study which exhibits that with very high growth rates and increasing per capita level of income, the use of motorized transport modes (especially personal two and four wheeler vehicles) is on the rise (Schafer and Victor, 2000; Pucher et al., 2005) in rural and especially urban areas. The proportion of people commuting from the rural and urban areas using the public vehicles have been observed 70.33 percent and 71.06 percent respectively, whereas their corresponding figures for the private vehicles have been observed 8.85 percent, 13.50 percent respectively. The ratio of rural commuters (20.81 percent) traveling by non-motorized have been noted sufficiently higher than the urban commuters (15.43 percent). Moreover, the females commuting from the both rural and urban sectors are more than the males to commute by public modes of transportation but the share of females living in urban areas becomes higher than females from rural areas to access the private vehicles, while the dependency on non-motorized modes is more for rural females commuters than the women from urban area.

3.3. Modes of Commuting based on Household Size

The data pertaining the percentage distribution of modes of commuting based on household size has been presented in table-3. The size of household has been observed influencing the use of modes of transportation. It can be seen from the table that the commuters who are living in households with more than 12 members are more likely to commute by public and private modes of transportation and less likely to travel by non-motorized modes of transportation. On the hand, the commuters, living in households with less than 12 members are more to commute by public and non-motorized modes of transportation and less likely to commute by private vehicles. The reason behind this difference is that the household income of commuters living in joint family is higher than the commuters living in nuclear family and thus they are more to afford the private vehicles. The trend completely gets reversed among the female commuters where they are more in percentage than males to commute by private modes living in nuclear family with one exception which is in case of 10-12 household members.

Table 3. Percentage Distribution of Modes of Commuting by Household Size of Commuters in Moradabad City, 2017

Household Size	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Up to 3	Male	67.68	6.06	26.26	100.00
	Female	64.29	14.29	21.43	100.00
	Total	67.26	7.08	25.66	100.00
4 – 6	Male	71.43	9.23	19.34	100.00
	Female	78.00	12.00	10.00	100.00
	Total	71.96	9.46	18.59	100.00
7-9	Male	69.11	11.31	19.57	100.00
	Female	84.00	4.00	12.00	100.00
	Total	70.17	10.80	19.03	100.00
10-12	Male	67.44	13.95	18.60	100.00
	Female	66.67	33.33	-	100.00
	Total	67.39	15.22	17.39	100.00

Household Size	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
More than 12	Male	50.00	33.33	16.67	100.00
	Female	-	-	-	-
	Total	50.00	33.33	16.67	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

3.4. Modes of commuting by Educational Status

The data considering the percentage distribution of modes of commuting based on education has been arranged in table-4. The data discloses the fact that the commuters who are illiterate or educated to the level of high school are comparatively greater to commute by non-motorized vehicles and proportionally lower to travel to place of work by the private modes than the commuters with higher level of education. This condition is witnessed similar among the both genders; male and female.

Table 4. Percentage Distribution of Commuting Modes Categorized by Educational Status in Moradabad City, 2017

Educational Status	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Illiterate	Male	74.13	2.62	23.26	100.00
	Female	79.41	-	20.59	100.00
	Total	74.60	2.38	23.02	100.00
Primary	Male	72.54	5.04	22.42	100.00
	Female	84.62	-	15.38	100.00
	Total	72.93	4.88	22.20	100.00
High School	Male	72.36	8.13	19.51	100.00
	Female	75.00	-	25.00	100.00
	Total	72.52	7.63	19.85	100.00
Intermediate	Male	58.06	27.42	14.52	100.00
	Female	66.67	33.33	0.00	100.00
	Total	58.82	27.94	13.24	100.00
Graduation	Male	54.69	37.50	7.81	100.00
	Female	78.57	21.43	-	100.00
	Total	58.97	34.62	6.41	100.00
Post-Graduation	Male	56.86	41.18	1.96	100.00
	Female	63.64	36.36	-	100.00
	Total	58.06	40.32	1.61	100.00
Others	Male	42.86	35.71	21.43	100.00
	Female	83.33	16.67	-	100.00
	Total	55.00	30.00	15.00	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

The data given in table-4 discloses that the highest percentage (23.02 percent) of non-motorized vehicles has been traced among the illiterate commuters followed by the commuters educated up to primary level (22.20 percent), having the education of high school (19.85 percent), other diplomas holders (15.00 percent), intermediates (13.24 percent), and graduation (6.41 percent), while the lowest share of non-motorized modes has been recorded among the post-graduates commuters (1.61 percent). Moreover, the lowest percentage share of private vehicles has been registered among the illiterates, after that it has been seen continuously increasing with the increase in level of commuters' education and became highest among the post-graduate commuters in which it constitutes more than two-fifth of all modes. In addition to it, the public modes of transportation are mostly used by all categories of education but its maximum share has been witnessed among the illiterate commuters, after that it has been recorded constantly declining with increase in level of education with few exceptions. It clears positive relationship between the education and

income of commuters and consequently its effect on the selection of modes of commuting. The commuters getting higher income in terms of high level of education are more to afford the private vehicles than those who are earning lower income along with the low level of education.

A gender-wise analysis shows that the women who completed education up to high school are more likely to commute by the cycle or walk than the women who are illiterate or educated up to level of primary, after that no women has found commuting by non-motorized modes, while the highest dependency of women commuters on private vehicles to travel to workplace has been witnessed among the post-graduates, however, this ratio is comparatively lower than the males. In addition fluctuating trend of public modes of transportation has seen among the educational categories of educated female commuters.

3.5. Modes of Commuting based on Monthly Income

The data regarding the percent distribution of modes of transportation based on monthly income has been presented in table-5. The data exhibits that the public modes of transportation are mostly used by the commuters whether earning high or low income but the people who earn very low income per month prefer to commute by non-motorized vehicles and carry the higher percentage value while those who like to commute by public and private modes have the low percentage value. Moreover, the percentage of commuters earning handsome amount per month is comparatively higher to select private vehicles than the commuters earning low income who significantly depend on public modes of transportation.

The further analysis of data contained in table-5 depicts that little more than four-fifth of commuters who earn up to 1500 rupees per month have been found to commute by non-motorized vehicle, while less than one-fifth people have been recorded to travel by public modes of transportation. It is because, the people earning very low income can not afford their own privates modes and also the expense of public modes of transportation, therefore, in order to save the money, they mostly travel to work by cycle or by walk. Moreover, it has been seen that the ratio of people commuting by non-motorized vehicles begins to decline but tends to increase by public vehicles as their monthly income tends to rise. It is evident from the table that the commuters who earn 1500-3000 are the highest (50.00 percent) to commute by public modes of transportation followed by the commuters travelling by non-motorized (43.48 percent) and by private vehicles (6.52 percent).

Table 5. Percentage Distribution of Commuting Modes based on Monthly Income of Commuters in Moradabad City, 2017

Monthly Income (in rupees)		Types of Commuting Modes			Total
	M/F/T	Public	Private	Non-motorized	
Below 1500	Male	25.00	-	75.00	100.00
	Female	-	-	100.00	100.00
	Total	16.67	-	83.33	100.00
1500-3000	Male	37.04	7.41	55.56	100.00
	Female	68.42	5.26	26.32	100.00
	Total	50.00	6.52	43.48	100.00
3000-6000	Male	72.98	2.18	24.84	100.00
	Female	88.10	2.38	9.52	100.00
	Total	74.25	2.20	23.55	100.00
6000-9000	Male	73.12	10.02	16.86	100.00
	Female	92.31	7.69	-	100.00
	Total	73.67	9.96	16.37	100.00
9000-12000	Male	57.89	34.21	7.89	100.00
	Female	66.67	33.33	-	100.00
	Total	59.09	34.09	6.82	100.00
Above of 12000	Male	55.68	42.05	2.27	100.00
	Female	50.00	50.00	-	100.00
	Total	55.10	42.86	2.04	100.00
All	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on sample survey by author, 2017.

The percentage of the commuters using the non-motorized vehicles to commute has been found continuously decreasing with the increase of monthly income. It can be seen from the data that the people who earn 3000-6000 and 6000-9000 rupees per month constitute 74.25 percent and 73.67 percent respectively

to have the use of public modes of transportation whereas the commuters who use their own private modes for commuting account for 2.20 percent and 9.96 percent respectively, whereas, the corresponding figures for the commuters depending on non-motorized modes are 23.55 percent and 16.37 percent.

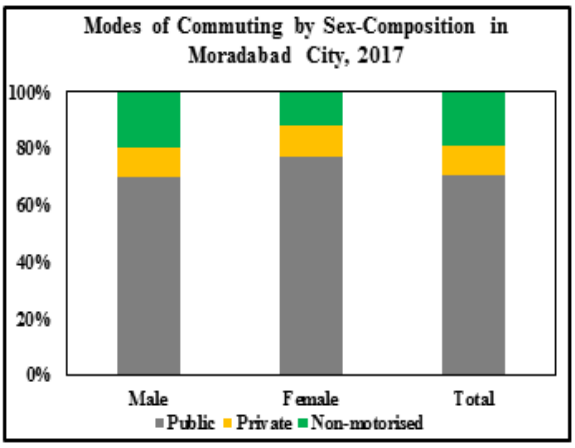

Fig.2

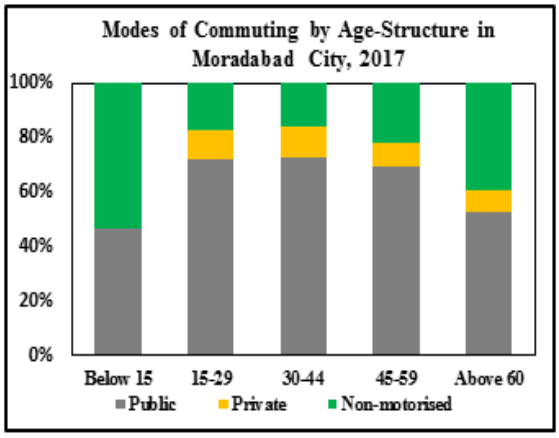

Fig.3

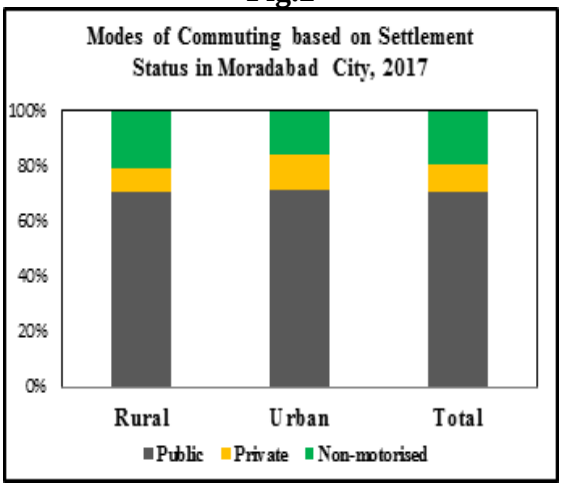

Fig.4

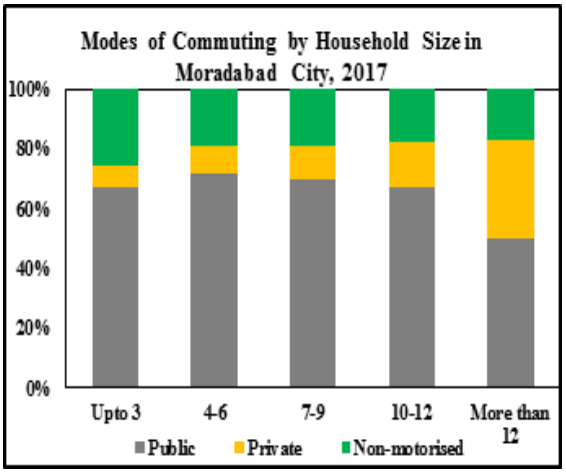

Fig.5

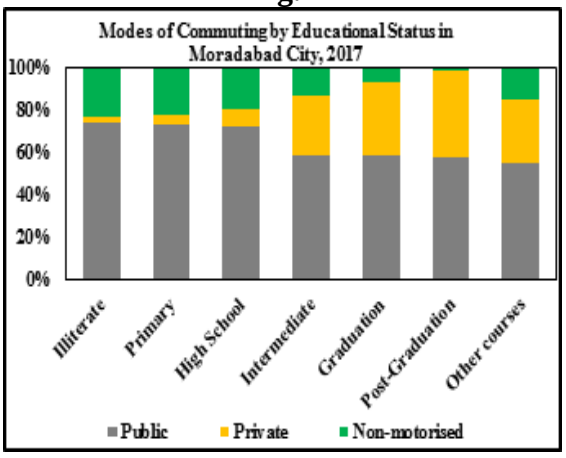

Fig.6

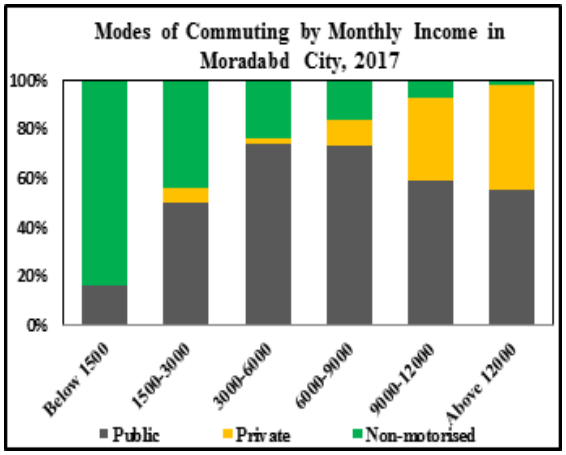

Fig. 7

Modes of Commuting based on Socio-Economic Characteristics in Moradabad City, 2017

It has been observed that the use of private vehicles rises with rise in monthly income. It is evident from the table, that percentage share of commuters who earn 9000-12000 and more than 12000 rupees per month and commute by the private vehicles becomes higher than commuters who were recorded having the monthly income less than 9000. However, the ratio of public modes transportation still exits highest, but percentage share of commuters using the non-motorized vehicles becomes the lowest in above categories of monthly income.

A further examination of the data reveals the fact that females earning upto 1500 are the highest to commute by non-motorized modes and their ratio is also higher

than the males commuting by the same modes of transportation. Likewise, the women who earn more 1500 rupees per month are more than males to use the private vehicles. It has been also found that women in categories of 1500-3000 and 9000-12000 rupees per month are more than the males to depend on public modes of transportation and relatively less to travel by both private as well non-motorized modes of commuting than their counterpart males.

4. DISCUSSION

- Place of origin of commuters has been seen an important factor determining the selection of commuters' mode of transportation as the commuters commuting form rural were more dependent on non-motorized vehicle than the urban commuters who were greater in amount to commute by public as well private vehicles because of their availability of public transportation and affordability of private vehicles. Another reasons is that the towns/cities as the place of residence of commuter were far located from Moradabad city, therefore, it was nearly impossible to commute by non-motorized vehicle.
- A sex-wise analysis reveals the striking finding that the females who were found using the private and public modes of transportation were likely more than the males whose share in commuting by both kind of transportation was lower than their counterpart. But the condition gets reversed in selection of non-motorized mode of commuters when the male exceed the female. This may be because the females due to perceived sense of security mostly rely on public transportation. Another reason can be associated with the fact that the highly educated women commuters were able to afford the private the vehicles mainly commuting form the urban areas.
- The age-wise assessment of commuters'mode choice makes it clears that the use of non-motorized vehicle was higher among the juvenile and senile age-group than the adult commuters who exceeded them in travelling to work by public and private modes of commuting.
- The relationship between household size and modes of commuting is also notable. It has been found that the commuting living in big sized household were higher to commute by public modes of transport than those living in small size of household who were more to travel by private modes of transportation.
- The commuters being comparatively highly educated were greater to commute by private vehicle rather than by public and non-motorized vehicles while opposite trend has been observed among the commuters having the low status of education who were largely using the public modes of transportation to commute..
- The major problems faced by commuters in Moradabad city were overcrowded modes, congestion on the road, old and polluted vehicles, occurrence of accidents, exposure to the pollution, mental and health stress, etc.
- The data exhibits that the public modes of transportation were mostly used by the commuters whether earning high or low income but the people who earned very low income per month were more likely to commute by non-motorized vehicles and less likely to commute by public and private modes while the percentage of people earning handsome amount per month was comparatively higher to use private vehicles than the commuters earning low income.

5. CONCLUSION

The overall results reveal that the modes of transporatation selected by commuters to travel vary according to their age, sex, education, income, household size, and distance between the place of work and place of residence and the suitability of modes of transportation. The females and elderly people are more to depend on public means of transit than the males and the adults. Commuters living in poor and low status household in terms of education and affordability are more likely to commute by public transport and non-motorized and less likely to commute by private vehicles than commuters with the high level of income and education who depend more on private vehicles for their daily journey to work. Thus the people due to their low level of income may have less options of transport modes and therby less likely to spare the time for social activities, education, health accessibility and more work opportunity which may affect their social well being and life chances in future. Overall, what the study finds is a strong linkages between educational attainment and income levels on one hand and the use of different kinds of modes of transport on the other. Thus it is clear that social as well as economic background has a great influence on selection of modes of commuting.

Investments in transport infrastructure are acknowledged to be transformative in nature since they facilitate increase in the mobility of individuals and workers, reduce transport costs and integrate various markets. These investments hasten structural changes in the economy by stimulating growth, facilitating social inclusion, and improving sustainability (Berg et al 2020). Moradabad city having good connectivity by both railways and roadways, and availability of modes of transportation experiences the increasing rate of commuting but the quality and quantity of

transportation required by the commuters according to thier demographic, social and economic status are not efficient. Therefore, there is an immediate need for proper development of transport infrastructure and understanding its various dimensions from socio-economic, demographic and spatial point of view to regulate the commuting in city for its social development and economic growth. There should be a continuous assessment of the changes in demand of modes and responses thereby to maintain the reliability of the system.

It is expected that the recommendations proposed in the research may provide better solution to the existing transportation system in Moradabad city and improve the options for commuters. The findings of this study will be of high importance to the government agencies responsible for urban planning such as the Ministry of Urban Planning who can take into consideration the results to add gravity to the effects of congestion, the National Transport Commission for formulating policies regarding transit and all authorities relevant to motor traffic and urban infrastructure. The Central Bank can use the findings to take into effect the economic impact when measuring econometrics of labour. It is expected that this research will be of some use in this regard.

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Factors Affecting Willingness to Pay for Improved Solid Waste Management in Quetta, Pakistan

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ABSTRACT

Background: Solid waste management is continuing to be a major challenge across the globe, especially in the developing world, with Pakistan not exempt.
Objectives: The aim of this study was to explore the factors affecting willingness to pay for improved solid waste management in Quetta Metropolitan City, Balochistan, Pakistan.
Methods: We employed multistage sampling for this cross-sectional study to select the households. The data was collected between November 2022 and December 2022 from 400 respondents through a questionnaire-based survey. We analyzed the data using both descriptive and inferential statistics.
Results: The findings revealed that 76.5% of the respondents were willing to pay for improved solid waste management (ISWM) in Quetta. The logistic regression analysis on households' willingness to pay for ISWM waste revealed that age, gender, educational attainment, type of family, monthly income, and education on waste disposal were positively associated with willingness to pay. The findings imply that people with higher incomes are more willing to pay for better waste management. Economic disparities among the respondents affect community involvement in waste management. Urgent action is needed to address environmental and health problems caused by poor waste disposal in Quetta.
Conclusion: As most Quetta residents are willing to pay for improved solid waste services, the study presents a key opportunity for municipal authorities to implement sustainable, community-supported reforms that could help alleviate budget constraints. These may include establishing a user fee system, a municipal waste fund, and a digital payment platform. The public-private partnerships (PPPs) and integration of informal collectors into formal systems can further enhance efficiency. Finally, mass awareness campaigns at the community level and in educational institutions can significantly improve waste management practices.

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1. INTRODUCTION

The procedure of producing, gathering, shipping, isolating and disposing of solid waste falls under solid waste management. Solid waste encompasses all items deemed undesirable and futile by society (Asim & Salam, 2016). Only when we discard an apparatus without any expectation of reuse, despite its intrinsic value, does it become waste (Khattak et al., 2009). This

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definition has been recognised in the term 'practices differ for developed and developing countries because of the effect of several factors such as economy, politics and culture (Miao, 2018). A material becomes waste when it is discarded without expecting to be compensated for its inherent value (Khattak et al., 2009).

Globally, the quantity of municipal waste is increasing more rapidly than the rate of urbanisation; in 2012 the cities of the world created around 1.3 billion tonnes of solid waste, amounting to 1.2 kg per day per person. Due to growth of population and urbanisation, municipal management of waste production is anticipated to be 2.2 billion tonnes by 2025 (Aoike, 2019; Shahzada et al., 2024). Currently, in sub-Saharan Africa, the annual production of municipal solid waste is approximately 62 million tonnes, which averages to 0.65 kg per person per day (Wilson et al., 2012). Globally, solid waste management remains a significant challenge, particularly in rising cities and urban areas of the developing world. Each year, about 1.3 billion tonnes of solid waste are generated by the world's urban areas, and this volume can be increased to 2.2 billion tonnes by 2025 (Afroz et al., 2009).

Municipal solid waste (MSW) could be explained as consisting of all non-hazardous wastes and domestic refuse, like institutional and commercial wastes, street sweepings, and construction garbage (Magutu & Onsongo, 2011). Municipal waste includes garbage collected by or on behalf of municipal management authorities or directly by the private sector, not municipalities, such as private non-profit institutions or businesses; it is actually generated by households, offices, and public institutions (Miao, 2018). In addition to waste generated by households, municipal solid waste also includes refuse from hotels, offices, shopping complexes, schools, shops, and institutions, as well as waste produced by municipal services such as the maintenance of recreational areas and street cleaning (Magutu & Onsongo, 2011).

According to McGranahan (1993), waste management in most developing countries seems to be a serious environmental problem in individual homes and around them (Rahji et al., 2009). The issue of solid waste in Dhaka, the capital of Bangladesh, is much more serious than that in other cities of developing countries (Afroz et al., 2009). In Nepal, solid waste management is a major problem for the national and provincial governments. The total budget that is spent on municipal waste management is around 10%, and about 63.2% of waste is collected by municipalities (Maskey & Singh, 2017). Rathai (2007) estimated that Mumbai produces approximately 6,256 tonnes of waste daily. In Mumbai, the Municipal Corporation of Greater Mumbai (MCGM) is responsible for waste management services (Khattak et al., 2013). According to Lijun Zhao (2009), in China, households generate 60% of MSW on a daily basis, which mostly consists of paper, organic matter, plastic, textiles, metals, and others (Miao, 2018).

In Nigeria, 21% to 81% of the collection rate of solid waste is mostly prohibited in high discernibility regions where people are willing to pay about the proper collection of solid waste (Akhtar et al., 2017). According to a study in Eskişehir Metropolitan, the municipality generally recognised that citizens' expectations were lower than municipal services. Satisfaction with waste assortment also impacts the WTP for solid waste management. Households who are more satisfied with collection will pay more than dissatisfied ones (Akgul & Sciences, 2012).

Annually Pakistan produces 48 million tonnes of solid waste. Overall, Pakistan has poor infrastructure for solid waste, which results in serious health and environmental issues (Mukherji, 2018a). In large population centres, like Karachi, solid waste management, horticulture, and parks are the most prominent issues (Asim & Salam, 2016). This poses negative effects on the environment and health of millions of citizens of Karachi. The Government of Pakistan estimates 77000 tonnes of solid waste are produced in the country each day; all of this material is produced in the metropolitan cities, including Karachi, which produces an average of 13000 tonnes of municipal solid waste each day (Mukherji, 2018a).

Solid waste management in Balochistan has been one of the challenges in urban services delivery (Ain et al., 2023; Muhammad et al., 2024). Research studies in Balochistan have reported that the rate of urbanisation and urban sprawl has accelerated in recent years, particularly in Quetta (Bazai & Panezai, 2020), highlighting the need to improve waste management services (Malik et al., 2022). Rehman et al. (2021) have described food loss and waste in the Quetta metropolitan area as compact awareness issues at the household level. There is an acute shortage of literature that has assessed the willingness to pay for improving solid waste management in Quetta city. Therefore, this study aimed

to analyse the factors influencing willingness to pay for improved solid waste management in Quetta Metropolitan City, Balochistan, Pakistan.

2. METHODOLOGY

2.1. Study Design

The case study research design was used for this study that involves the in-depth investigation of s specific case, individual, group, even or a topic under study.

2.2. Setting

Quetta is the largest and most populous city of the province Balochistan (Bazai & Panezai, 2020). The city is located at 30.17° North latitude and 66.97° East longitude, respectively (Khan et al., 2020). Quetta is the provincial capital of Balochistan, a province that lags behind in socio-economic indicators (Panezai, 2017; Panezai, 2012). The population of Quetta city constitutes 2,595,492 as per the census of 2023 (Pakistan Bureau of Statistics, 2023). Pashtoon, Baloch, Bravi, Sidhi, Punjabi, Hazara, and other minor ethnic groups inhabit the city (Ali & Panezai, 2021). Only Quetta city has been granted the status of a Metropolitan Corporation in the province. The management of solid waste has been one of the challenging issues of the city.

2.3. Conceptual Framework

The aim of the study is to evaluate willingness of households to pay about improved solid waste management (ISWM) services in Quetta city, Balochistan. For this purpose, the respondents were asked about their willingness to pay about better management of solid waste. We also asked them about the current waste management practices in their areas. We used binary logistic regression to explore the relationship between the independent variables (IVs) and the dependent variable (DV). The dependent variable is willingness to pay and will be measured by yes for willing and no for not willing (Balasubramanian, 2019; Mulat et al., 2019). The independent variables include age, gender, caste, marital status, ethnicity, family type, family size, monthly income, household ownership, satisfactions on current situation, amount willing to pay, environmental awareness (Balasubramanian, 2019; Ndau & Tilley, 2018; Song et al., 2016b; Tassie & Endalew, 2020; Wegedie et al., 2020). The willingness of respondents for improved solid waste management would help urban planning and management authorities, particularly the Metropolitan Corporation Quetta (MCQ) in better solid waste management in Quetta city. The findings of this study are also helpful to assess the progress of provincial and districts governments in achieving Sustainable Development Goals (SDGs), particularly the Goal-11 which is aimed to make the human settlements & cities safe, resilient, sustainable and inclusive across the globe.

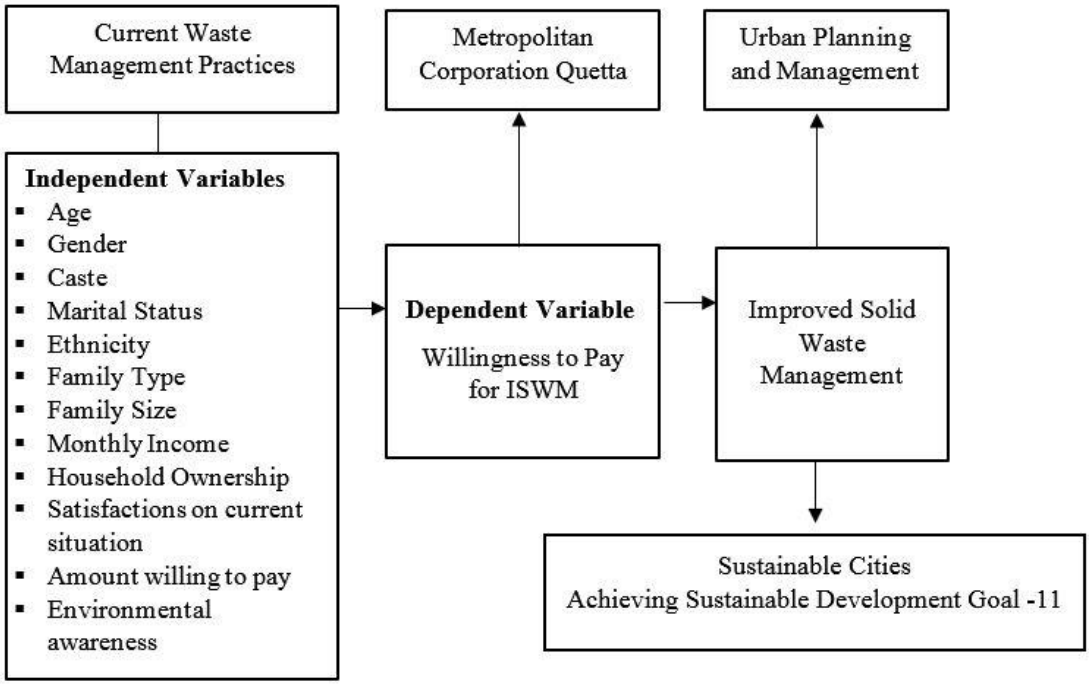

Fig 1. Conceptual Framework

2.4. Study Variables

The study involved both dependent variable (DV) and independent variables (IVs). The DV was willingness to pay whereas the IVs included the socio-demographics charateristcis of the respondents.

2.5. Data Sources and Data collection

The primary data, which were collected between November 2022 to December 2022 in Quetta city Balochistan. Tool for the data collection was Questionnaire, on improved solid waste management. A proper survey was managed for 400 questionnaires, in which 210 were collected from three different Universities like, the University of Balochistan (UoB), Quetta, the Sardar Bahadur Khan (SBK) Women University, Quetta and The Balochistan University of Information Technology, Engineering, and Management Sciences (BUITEMS) and the remaining 190 were collected from the business sector such as Thoghi Road, Sariab Road, Main AirPort Road, Circular Road, Main Nawan Killi Road, Fatima Jinnah Road and Sabzal Road.

2.6. Unit of Analysis

The shopkeepers and households in Quetta city are the units of analysis for this study.

2.7. Sample Design

This study employed multistage sampling for the selection of sample and data collection. The purposive and simple random sampling techniques were used for the current research. The purposive sample, also known as subjective sampling, is type of non-probability sampling in which the sample is selected subjectively keeping in view the requirements of the study. Moreover, simple random sampling was used for selection of the respondents. Details of the sampling stages are given below.

- **Stage 1**

In the first stage, Quetta City is selected purposively as a study area for current research. The reason for selection of Quetta is that it is the provincial capital of Balochistan province. It is the most urbanized city of Balochistan. Due to mass urbanization and poor urban planning, the solid waste management has been a challenging issue for the Metropolitan Corporation Quetta (MCQ).

- **Stage 2**

In In the second stage, we purposefully selected students from three public sector universities to serve as respondents for this research. The public sector universities include the UoB, SBK and BUITEMS which are located in Quetta city. We selected students from public sector universities based on the following criteria. Firstly, they represent the general public of Quetta city. Secondly, they represented all households of low, middle and high income which made the sample more representative.

Table 1. Description of Universities

S/N	Universities	Status
1.	University of Balochistan (UoB), Quetta	Public
2.	Sardar Bahadur Khan Women, University (SBK), Quetta	Public
3.	BUITEMS University, Quetta	Public

Source: Primary data, 2022

- **Stage 3**

In the stage 3, the simple random sampling was used for selection of the sampled respondents from the Bachelor of Science (BS), the Master of Science (MS), the Master of Philosophy (M.Phil.) and the Doctor of Philosophy (Ph.D.) programs.

2.8. Data analysis methods

Descriptive statistics was used for descriptive analysis of the data collected through a questionnaire survey from respondents.

2.9. Inferential statistics

2.9.1. Binary Logistic Regression

In this study, we employed a logistic regression model to analyze the willingness to pay for waste disposal among households. The model is expressed as follows:

$$P(\text{Willingness to Pay} = 1) = \frac{1}{1 + e^{\beta 0 + \beta 1 X1 + \beta 2 X2 + \cdots + \beta n Xn}} \ldots\ldots\ldots (1)$$

P (Willingness to Pay=1) is the probability of households expressing a willingness to pay for waste disposal. X1 ,X2,…,Xn represent the independent variables associated with the household characteristics and attitudes. β0,β1 ,…,βn are the estimated coefficients for the respective independent variables. e is the base of the natural logarithm. The logit function, the inverse of the logistic function, transforms the probability into log-odds:

$$\text{logit}(p)=\ln(1/1-pp)=\beta 0+\beta 1X1+\beta 2X2+\ldots+\beta nXn$$

These coefficients (β0,β1,…,βn) were estimated using maximum likelihood estimation, providing insights into the relationship between household characteristics and the probability of expressing a willingness to pay for waste disposal.

This study has used both descriptive and inferential analysis methods. The statistical methods used in this research consisted of descriptive statistics of frequency counts, percentage, mean, and standard deviation. For descriptive data analysis, mean and standard deviation were calculated. Whereas, for inferential analysis, the binary logistic regression model was used to explore the relationships between willingness to pay for improved solid waste management service and the socio-demographic characteristics.

3. RESULTS

3.1. Descriptive Statistics of Respondents

The findings in Table 2 showed the socio-demographic profile of the respondents in Quetta city. The majority of the respondents belong to the age group below 45 years old. Out of the total, 71.0% were male and 29.0% were female respondents. With regard to education, 6.0% were illiterate, 5.0% belonged to primary class, 10.0% to middle class, 12.5% to matric, 13.0% to inter, 42.3% to bachelor, and 11.3% to master. The family size of the respondent was <6 (16.0%), 11-16 (57.8%), between 12 and 17 (13.0%), and 18+ (13.3%). The family type of the respondent was single (39.8%), and 60.3% belonged to a joint family system. House type of the respondent: 75.0% owned their personal house, and the remaining 25% were living in rented houses. The average monthly income groups of the respondents were <40000 (12.3%), 40000–69999 (28.5%), 70000–99999 (36.5%), and 100000+ (22.8%), respectively. The majority (54.8%) of the respondents were found to be aware of solid waste, and 45.3% were not aware of solid waste. 54.3% of the respondents had public bins near their houses, while 45.8% of the respondents had no public bins near their houses. 55.3% of the respondents had no access to door-to-door solid waste collection services, while 44.8% had access to door-to-door solid waste collection services. Of the total, half (50.0%) of the respondents were paying no money for the solid waste collection services, and the remaining half (50.0%) were paying for the services of solid waste collection. The findings of this study showed that the majority of the respondents were found to be considering solid waste collection as very important (37.8%), slightly important (31.0%), extremely important (13.3%), not important at all (10.3%), and moderately important (7.8%), respectively. The majority of the respondents reported the current state of solid waste collection services as poor (48.5%), fair (23.3%), neutral (21.8%), excellent (8%), and good (5%), respectively. Moreover, out of the total, 36.5% of the respondents were satisfied by the MCQ waste management practices, 27.8% were neutral, 19.5% were very satisfied, 13.3% were dissatisfied, and 3.0% were very dissatisfied, respectively.

Table 2. Socio-demographic profile of the respondents

Socio-demographic profile	Frequency	Percent
Age of respondents		
< 25	189	47.3
25 - 34	86	21.5
35 - 44	114	28.5
45+	11	2.8
Gender		
Male	284	71.0
Female	116	29.0
Education level		
Illiterate	24	6.0
Primary	20	5.0
Middle	40	10.0
Matric	50	12.5
Inter	52	13.0
Bachelor	169	42.3
Master	45	11.3
Family Size		
< 6	64	16.0
6 - 11	231	57.8
12 - 17	52	13.0
18+	53	13.3

Socio-demographic profile	Frequency	Percent
Family type		
Single	159	39.8
Joint	241	60.3
House Type		
Personal	300	75.0
Rented	100	25.0
Average monthly income (in PKR)		
< 40000	49	12.3
40000 - 69999	114	28.5
70000 - 99999	146	36.5
100000+	91	22.8
Having awareness proper waste disposal		
No	181	45.3
Yes	219	54.8
Total	400	100.0
Having public bins near your house		
No	183	45.8
Yes	217	54.3
Having access to door to-door waste collection service		
No	221	55.3
Yes	179	44.8
Currently paying for waste collection services		
No	200	50.0
Yes	200	50.0
Important of solid waste disposal		
Not Important At All	41	10.3
Slightly Important	124	31.0
Moderately Important	31	7.8
Very Important	151	37.8
Extremely Important	53	13.3
Perception of current state of solid waste collection		
Poor	194	48.5
Fair	93	23.3
Neutral	87	21.8
Good	23	5.8
Excellent	3	.8
Satisfaction with MCQ's waste management practices		
Very Dissatisfied	12	3.0
Dissatisfied	53	13.3
Neutral	111	27.8
Satisfied	146	36.5
Very Satisfied	78	19.5
Total	400	100.0

Source: Field Survey, 2022

Note. PKR= Pakistan Rupee (The national Currency of Pakistan)

3.2. Disposal of collected waste

The results in Table 3 showed the disposal of collected waste in Quetta City. The highly reported disposal of collected waste was found in general public meetings with 50.3% responses. The second highly reported collected waste was found in an open space, with 21.5% attended by respondents. Moreover, in the itinerant waste van (8.5%), by the roads (5.8%), not applicable (4.0%), in a hole (3.0%), others (7.0%), and others.

Table 3. Disposal of collected waste (Multiple Responses)

Disposal of collected waste	Frequency	Percent
Not applicable	16	4.0
In the public bin	201	50.3
In the itinerant waste van	34	8.5

Disposal of collected waste	Frequency	Percent
By the road or street side	23	5.8
On an open space	86	21.5
In a hole/in own compound	12	3.0
Others	28	7.0
Total	400	100.0

Source: Field Survey, 2022

3.3 Willingness to pay for improved solid waste management

The findings in Table 4 reveal the willingness to pay for improved solid waste management in Quetta City. A little more than three-fourths (76.5%) of the respondents were willing to pay, whereas 23.5% were not willing to pay.

Table 4. Willingness to pay to ISWM

Willingness to pay to ISWM	Frequency	Percent
No	94	23.5
Yes	306	76.5

Source: Field Survey, 2022

3.4. Results of regression analysis

The logistic regression analysis on households' willingness to pay for improved solid waste management (ISWM) waste results are mentioned in Table 4.23. Age emerges as a significant determinant, with a clear trend of increasing willingness to pay with increasing age. Specifically, individuals aged 25–34, 35–44, and 45 and above are 3.77, 5.76, and 5.21 times more likely, respectively, to express a willingness to pay compared to those under 25. Gender plays a distinctive role, indicating that females are 5.72 times more likely than males to express a willingness to pay for water disposal, which is significant at p-value < 0.05. Educational attainment exhibits a compelling relationship with willingness to pay. Notably, individuals with educational levels beyond the baseline of being illiterate demonstrate a substantial increase in their likelihood to contribute their WTP. The coefficients for educational categories such as matric, inter, bachelor, and master are all statistically significant (p-values < 0.01), underlining the importance of education in shaping attitudes toward WTP for waste disposal. Family dynamics also play a crucial role. Households in joint family setups are 4.29 times less likely to express a willingness to pay compared to those in single-family structures. The type of housing is another factor of influence, as individuals living in rented houses are 2.42 times less likely to express willingness compared to those residing in their own homes. Monthly income levels demonstrate varying effects on willingness to pay. While the coefficients for income groups of 40,000–69,999 and 100,000 and above are not statistically significant, the group with an income range of 70,000–99,999 shows a noteworthy positive association, indicating a higher likelihood of expressing willingness to pay. Furthermore, the inclusion of education on waste disposal as a variable demonstrates its positive impact on willingness. Individuals with education on waste disposal are 2.61 times more likely to express a willingness to pay. The overall model fit is robust, supported by the highly significant Likelihood Ratio chi-square test (LR chi2), a high Pseudo R2 value (0.905), and a log likelihood of -20.527.

Table 5. Results of the regression analysis on willingness to pay for improved solid waste management

Variables	Coefficient	Std. err.	P-value	95% Conf. Interval	
Age (years)					
<25	Ref.				
25 – 34	3.77	1.72	0.028**	0.397	7.155
35 – 44	5.76	1.99	0.004***	1.855	9.667
45+	5.21	2.47	0.035**	0.357	10.071
Gender					
Male	Ref.				
Female	5.72	2.21	0.01**	1.378	10.076

Variables	Coefficient	Std. err.	P-value	95% Conf. Interval	
Education level					
Illiterate	Ref.				
Primary	-0.81	2.12	0.702	-4.988	3.360
Middle	-0.154	2.87	0.957	-5.784	5.474
Matric	5.833	2.15	0.007***	1.617	10.050
Inter	12.48	4.22	0.003***	4.203	20.767
Bachelor	11.42	3.05	0.000***	5.437	17.402
Master	10.825	3.374	0.001***	4.211	17.439
Family type					
Single	Ref.				
Joint	-4.29	1.96	0.028**	-8.144	-0.452
House type					
Own House	Ref.				
Rented	-2.42	1.421	0.088*	-5.211	0.359
Average monthly income (PKR)					
<40000					
40000 - 69999	3.76	2.510	0.134	-1.154	8.687
70000 - 99999	5.63	2.64	0.033**	0.446	10.822
100000+	5.59	2.94	0.058*	-0.189	11.371
Awarenss on waste disposal					
No	Ref.				
Yes	2.61	1.43	0.068*	-0.191	5.421
Having public bins near homes					
No	Ref.				
Yes	-0.90	1.24	0.466	-3.349	1.534
Dispose Household SW					
No	Ref.				
Yes	-0.60	1.44	0.677	-3.426	2.223
cons	**-8.90**	**3.13**	**0.005**	**-15.052**	**-2.757**
LR chi2(18)	**395.14**				
Prob > chi2	**0.000**				
Pseudo R^2	**0.905**				
Log likelihood	**-20.527**				

Source: Field Survey, 2022
*significant at 10%, **= significant at 5%, and ***=Significant at 1%.
Abbreviations. MSWM= Municipal Solid Waste Management

Table 6. Suggestions by respodents for improving solid waste management in Quetta

S. No	Suggestions	Frequency
1.	MCQ should make a proper solid waste management strategy covering each area	61
2.	Waste should be disposed off on daily basis by MCQ's human resource	23
3.	MCQ should prioritize the waste disposal in municipal services delivery	22
4.	MCQ staff needs to be trained for professionalism and honesty	20
5.	MCQ should devise and follow the clean city strategy	15
6.	Expansion of installing solid waste bins across the metropolitan area	13
7.	Establishment of recycling system for municipal solid waste	7
8.	MCQ should initiate awareness campaigns for safe solid waste disposal	5
9.	I do not know and have no idea	5
10.	Regular cleaning of public dustbin by MCQ	5
11.	MCQ needs to enhance its sewerage system to eradicate unpleasant smells.	2
12.	Workforce expansion needed at MCQ	2
13.	MCQ should enhance solid waste collection services.	2
14.	Establishment of waste segregation mechanism at source	2
15.	Government should provide financial and technical resources to MCQ	2
16.	MCQ should follow waste reduction strategy	2
17.	MCQ should adopt advanced waste collection practices.	1

S. No	Suggestions	Frequency
18.	The existence of solid waste on the street poses a significant hazard.	1
19.	MCQ should ensure employee amenities.	1
	Total	191

Source: Field Survey, 2022

3.5. Suggestions on improving the solid waste management

Table 6 presents suggestions from 191 respondents regarding solid waste management, revealing strong public concern about its health and environmental impacts. The most frequently cited issue, mentioned by 32 respondents, was the link between solid waste and disease, underscoring widespread awareness of public health risks. Closely following, 31 individuals pointed out broader environmental and health hazards associated with poor waste management, while 25 respondents emphasized the importance of proper collection for maintaining cleanliness. Recycling also emerged as a significant theme—24 respondents called for the adoption of recycling practices, and 14 recognized its potential to generate new products. A smaller number highlighted additional benefits of recycling, such as income generation and environmental protection. Other concerns included water pollution (5 responses), sewer blockage (3), and gas emissions (1). Notably, 9 respondents viewed solid waste as unimportant, and 3 admitted uncertainty. Overall, the responses reflect a strong consensus on the importance of effective waste management, with emphasis on health, environmental, and economic dimensions.

4. DISCUSSION

This study has assessed the households' willingness to pay for improved solid waste management in Quetta, Balochistan. The swift rise in the amount of solid waste is becoming a significant environmental issue in the developing countries (Khattak et al., 2009). destroying human health and stimulating ecological, financial, and natural harms due to poor management of solid waste in developing cities (Akhtar et al., 2017) Therefore, there is a pressing need for improved solid waste management because of its major environmental and public health implications.

Our findings showed the sociodemographic profile of the respondent in Quetta City, where the majority of the respondents were youth and quite mature, and most of them were male, and somehow females too, as the data has been collected from universities and the business sector. Similar findings are reported by Akhtar et al. (2017).

The majority of the respondents to this study were students of different universities in Quetta city, mostly bachelor's and master's degree students, and most of them were part of large families, as the people of Quetta city mostly live in joint family systems. The study of Macau University showed the interviewees were 38.96 years old, and just 33.33% of the respondents were male. Besides this, the average number of household members was 3.70, and the education status was high school (Song et al., 2016a).

The findings of this study revealed that the majority of the respondents are part of joint family systems, as most of the population of Quetta City lives in joint family systems as per their tradition, and a small number of these interviewees have single family systems. As Quetta city, where this study has been done, is a developing city where the majority of the population belongs to the middle class and somehow the upper class, the majority of these respondents who took part in this data belong to the middle class. The findings of our study are quite similar to Akhtar et al. (2017).

The findings of this study showed that the majority of the respondents were aware of solid waste management and its importance, and some number expressed their views that they were unaware of it, and the majority of them in this study found that they were thinking about this major issue regarding solid waste collection, which is very important, as it causes many problems. The same study showed that the majority of the respondents were concerned about the environmental problems in Macau, and most of the answers (80.8%) almost spent work on it (Song et al., 2016a).

Majority of the respondents of this current study found that, they are already paying money for the solid waste services, and expressed their concern about its environmental problems and wished to overcome it, and also wanted to play their role along the local government, whereas some respondents answered that, they are not concern about it, as this number of respondents showed that, the current state of solid

waste in this area is very poor and need to be boost up, but those who were paying money showed, its good even some showed its excellent, similar study revealed the findings, where the respondent were not happy as the waste management workforce is too small to active municipalities to attain their goals (Limon et al., 2020). Besides all these, a large number of the respondents of this study were pleased by the MCQ waste management practices, and some of them were neutral; the average respondent was very satisfied, and a small number of the respondents were dissatisfied (13.3%), and very few were dissatisfied, respectively, with solid waste management services, which need to be improved as soon as possible.

Our findings showed that highly reported disposal of collected waste was founded in general public bins, and a small amount of collected waste was found in open spaces such as roads, grounds, streets, and even in drains, about which everyone knows its negative effects and environmental disasters. Similar studies are reported. Everybody knows the negative effect of unlawful waste dumping, throwing it into disaster, the effect of burning waste, putting aside organic-inorganic waste, or permitting it to pile up in public places (Brotosusilo et al., 2022). Moreover, 8.5% were in the itinerant waste van, 5.8% were found on roads, 4.0% were not even applicable, 3.0% were found in a hole, and 7.0% were others. For waste disposal, 45% of respondents chose landfill and 12.5% chose burning (Akhtar et al., 2017). To establish an effective solid waste management system, it is crucial to immediately stop the practices of open disposal and open burning (Mukherji, 2018b).

Our findings revealed the willingness to pay for improved solid waste management in Quetta City, where the majority of our respondents were found willing to pay for solid waste services, while just a small number of respondents were not pleased to pay for the improved solid waste services. Some studies also reported that 63% of interviewers were willing to pay less than USD 48 for neighborhood cleaning, 18.5% refused to pay anything, 16% were willing to pay USD 4.8-9.7, and 2.5% were willing to pay over USD 9.54 (Akhtar et al., 2017). The study found that the majority of the interviewers expressed positive views on solid waste management, from the point they agreed with all the beliefs specified in the researcher-designed survey, resulting in an average rating of 1.08 (Limon et al., 2020).

4.1 Limitaion of the study

The current study has a few limitations. The majority of the respondents were university students representing households in the city with highly educated backgrounds. Although we tried to neutralize this effect of education by adding a little less than half of the respondents from the business sector, caution is needed in generalizing the findings of this study.

5. CONCLUSION

This research study on the willingness to pay for improved solid waste management services in Quetta, Balochistan, Pakistan, has produced important findings that have explored the current status of waste management and disposal services in the Quetta metropolitan city of Balochistan and also investigated households' willingness to pay for improved solid waste collection and associated factors in the Quetta metropolitan city.

The major findings of this study showed that the overall state of solid waste collection services in Quetta City is quite poor. This is due to lack of awareness about solid waste among masses, no proper education about solid waste collections, due to insufficient availability of dustbin at home, and due to poor management and strategy by MCQ. As there is no such public bins near houses, in case if there are public bins, then that is quite in distance, and these container are not getting empty properly by MCQ, and there is no sufficient public bins in metropolitan area to dispose solid waste safely, thus to sort out this major problems, MCQ should prioritize solid waste disposal, and adopt advanced waste collection services. Moreover, MCQ has to initiate proper campaign about solid waste disposal and should take well strategy about solid waste management. Similarly, the Government should take part to provide financial and technical resources to MCQ, and should provide sufficient and technical human resource to MCQ, above all these MCQ should follow waste reducing strategy.

The major findings of this study showed that, the problems that is caused by solid waste is air pollution, water pollution, smell and several health related problems and diseases, beside these problems, it also affect the environment, and there is a pronounced hazard on the street, just because of the presence of solid waste, and it caused harmful gases, because of rotting of solid waste, and these all happening, because there is no proper disposal strategy, no collection

services of solid waste on daily basis, no sufficient public bins for safely disposal, no social and public awareness campaign to educate people about the importance of solid waste collection, now to overcome these major problems. MCQ should start campaign to educate people through social media, through posters, through commercial advertizments, and making use of social platforms to aware people about solid waste collection, and MCQ should make strategy to reduce solid waste by implementing recycling mechanism, so that gain economic importance, because after recycling solid waste, new product could be produced to utilize for solid waste collection. Most importantly, MCQ should enhance solid waste collection services. Establishment of a waste segregation mechanism at the source will therefore sort out these said problems.

5.1. Policy implications

As the majority of the residents in Quetta City are willing to pay for ISWM services, this provides a great opportunity for municipal administration and policymakers to implement community-backed and sustainable reforms. These reforms could include the introduction of a use fee system, establishment of a municipal solid waste fund, and establishment of a mobile app for digital payments for improved solid waste management. Moreover, the introduction of public-private partnerships (PPPs) and the integration of informal waste collection with formal waste collection can surely improve the disposal of solid waste. Last but not least, mass awareness of safe waste disposal strategies and techniques at the community level, schools, colleges, and universities can surely result in improved solid waste management services.

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