IMPACT OF METRO STATION ON SURROUNDING LAND USE

A case study of Bangalore Metro Rail Corridor

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Abstract: *A two-way relationship is possessed by urban transportation and its surrounding land use. A transportation infrastructure is developed as soon as any land is put to a certain use because of travel demand to that specific land. As the transportation facilities increases there is also an upliftment in land value. Improved accessibility causes both direct and indirect impact on its neighborhood. There are various other factors also which influences the change in land use like land value, population density, vacant land availability and average footfall. This paper examines the land use pattern over a period of time along the metro station's influence zone in Bangalore city. The result shows that the distance to the central business, residential and commercial districts have a significant impact on land use. Likewise, better transport options and improved accessibility have led to an increase in the demand for both residential and commercial spaces. Therefore, planning of these transit corridors are necessary to prevent any future haphazard development.*

Keywords: *Land use, Density, Metro Station, Transit system, Influence Zone*

1. INTRODUCTION

Transportation systems play an important role in the urban function of any city. The mass transit system has helped cities move a large group of people from one destination to another, reducing urban problems. Many large cities in recent years have promoted, planned, and implemented mass transit systems to overcome problems such as traffic jams, accidents, and urban deterioration and sprawl. In this context, it becomes essential to understand the impact of metro rail corridor on its surrounding and the way development takes place.

The aim of the study is to determine the impact of the Metro Station on surrounding land use. The objective is to assess land use changes along the transit station at different points of time. The study will cover land use-based parameters which influences the development pattern surrounding the metro stations. Study will be based on secondary sources of information like master plan, zonal development plan etc. The study will be limited to 1000m buffer zone of metro station.

2. LITERATURE REVIEW

(Pol, 2002) defines the influence area around the stations into "Three Spheres" and identifies the three spheres on the basis of vitality. First one with very strong, second with strong and third one with marginal effect.

(Hurst, 2011) finds that the effect of distance to LRT stations on land use change had a different radius and magnitude depending on existing land use. The change is low-density housing to denser uses was observed only up to 90 feet from the station due to the transit corridor. Vacant and industrial land were the most likely

to experience land use change and Industrial properties within 1-mile distance were 10% more likely to experience land use change.

(Robert Cervero, 2011) finds that Transit system alone is itself insufficient factor in increasing land values and intensifying land-use development surrounding the station.

(A. Roukouni, 2012) notices that "Before" and "After" Land use recording along the operating metro line will help in understanding how the metro station affects the land use and the analysis should be taken out through combination of these recordings.

According to (National Transit Oriented Development (TOD) Policy, 2017) Government of India, the area in the immediate vicinity of the transit station, i.e., within a walking distance, having high density compact development with mixed land use to support all basic needs of the residents is called the influence zone of a transit station / corridor. Influence zone is either established at a transit station or along the transit corridors. It is generally up to a radius of nearly 500-800m of the transit station. Where the distance between the transit stations is less than 1 km and there is overlap in the influence area, it can be identified as a delineated zone (around 500m) on either side of the transit corridor within 10 - 12 minutes walking distance.

3. BANGALORE: CITY CONTEXT

Bangalore city has experienced an incredible sprawl within the city area. town size has grown from 160 sq.km. (1991) to 741 sq.km (2011). With over 8.4 million inhabitants and 11,876 people/ sq. km., Bangalore comprises one among the world's densest urbanized areas within the world. (Census, 2011)

The city may be a key contributor to the state economy. The annual growth is about: 3% for the population; 6% for employment; and 9% for the income. Vehicle ownership has grown from 58 to 503 per 1000 population from 1981 to 2013. The WPR has changed from 45% (25.5 Lakhs) in 2001 to 43.7% (36.3 Lakhs) in 2011.
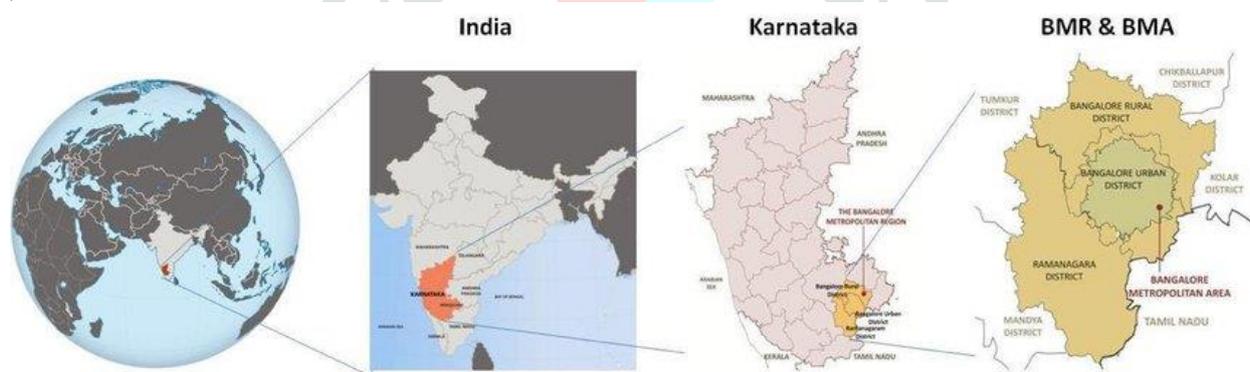

Figure 1: Karnataka-Bangalore Location Map (R.Hemashree, 2021)

4. STUDY AREA DELINEATION

Namma Metro is a Mass Rapid Transit System (MRTS) serving largest city Bengaluru, Karnataka's capital with 2 lines and 51 stations in the city. (Corporation, 2011)

The East-West route (Purple Line) starts from Kengeri to Baiyappanahalli with total stations of 22 with a travel length of 25.72 km and the North-South route (Green Line) starts from Nagasandra to Silk institute with 29 stations covering a length of 30.37 km. All of these proposed route's color-coded and are divided into phases, where Phase 1 and 2A includes Green, purple, yellow and red corridor and phase 2A includes blue corridor.
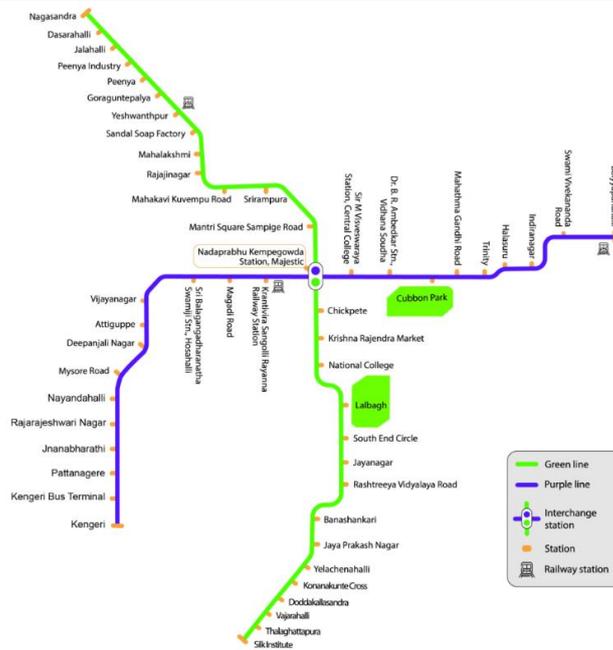
Figure 2: Bangalore Metro Rail Network (Corporation, 2011)

Out of 51 metro stations, only 3 stations are considered for study along purple corridor namely MG Road, Halasuru and Swami Vivekanand Road in line with the objective of measuring changes in land use due to its impact in surrounding influence zone.

5. METHODOLOGY

The influence zone in divided in 4 parts surrounding the metro station i.e., zone 1 (0 to 150 meters), zone 2 (150 to 250 meters), zone 3 (250 to 500 meters), zone 4 (500 to 1000 meters). The Land use is taken into consideration from Bangalore revised master plan 2015, master development plan 2031, existing situation analysis from RMP 2031 report.
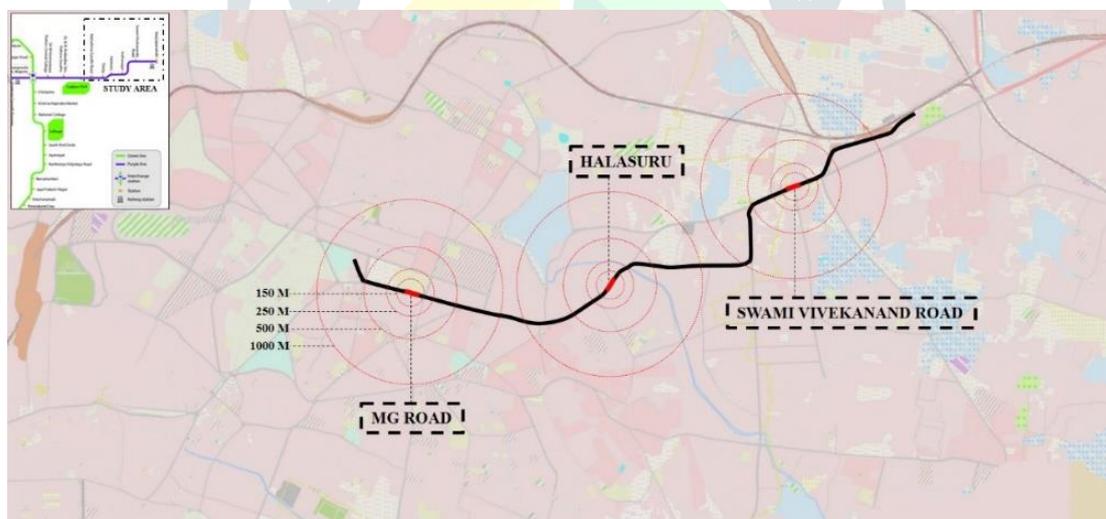
Figure 3: Study Area Delineation

The project cycle of Namma Metro is taken into account for analyzing its impact and land use taken into consideration for the year is finalized through following stages:

1) Project Inception (1998 – 2002)   : Land use (2001)
2) Project formulation (2003 – 2007)   : Land use (2006)
3) Project Construction (2007 – 2014)   : Land use (2011)
4) Post completion (2014 – 2021)   : Land use (2021)

Table 1: Identified characteristics of selected Metro Station areas

S. No.	Station Name	Urban Zones	Multimodal Integration	Predominant Land Use	Ecological Network
1.	Mahatma Gandhi Road (MG Road)	Core Urban	Intra city	Commercial	Green
2.	Halasuru	Urban High	Intra city	Residential	Blue
3.	Swami Vivekanand Road	Urban High	Intra city	Public/semi - public	-

(Kumar, 2021)

6. DATA ANALYSIS

6.1. MG Road Metro Station

It is the shopping and entertainment hub of the city and is situated within the core urban zone. Predominant land use around the station is commercial (retail, shopping complexes and restaurant) followed by public/ semi-public and residential land use. Private land available for development around the station is 55% of the area and rest 45% belongs to the central and state government.
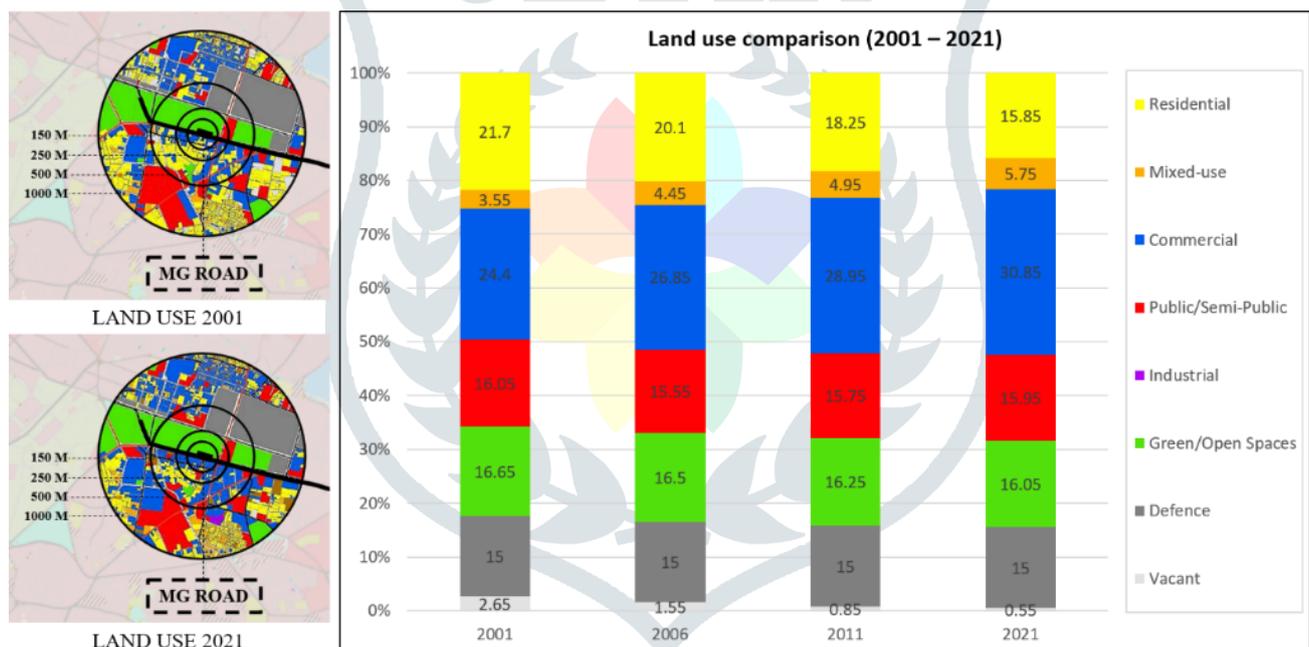

Figure 4: MG Road Metro Station - Land use Comparison between 2001 and 2021

Change in residential land use is been observed from 21.7% to 15.85% with a decrease of 5.85% while commercial land use changed from 24.4% to 30.85% with an increase of 6.45%. Mixed-use increased by 2.2% as the residential underwent conversion due to increased accessibility and increasing demand for commercial retail and office spaces.

6.2. Halasuru Metro Station

It is one of the oldest neighborhoods in Bangalore city. Predominant land use around the station is residential followed by public/ semi-public and commercial land use. It is known for its market and lots of temples.
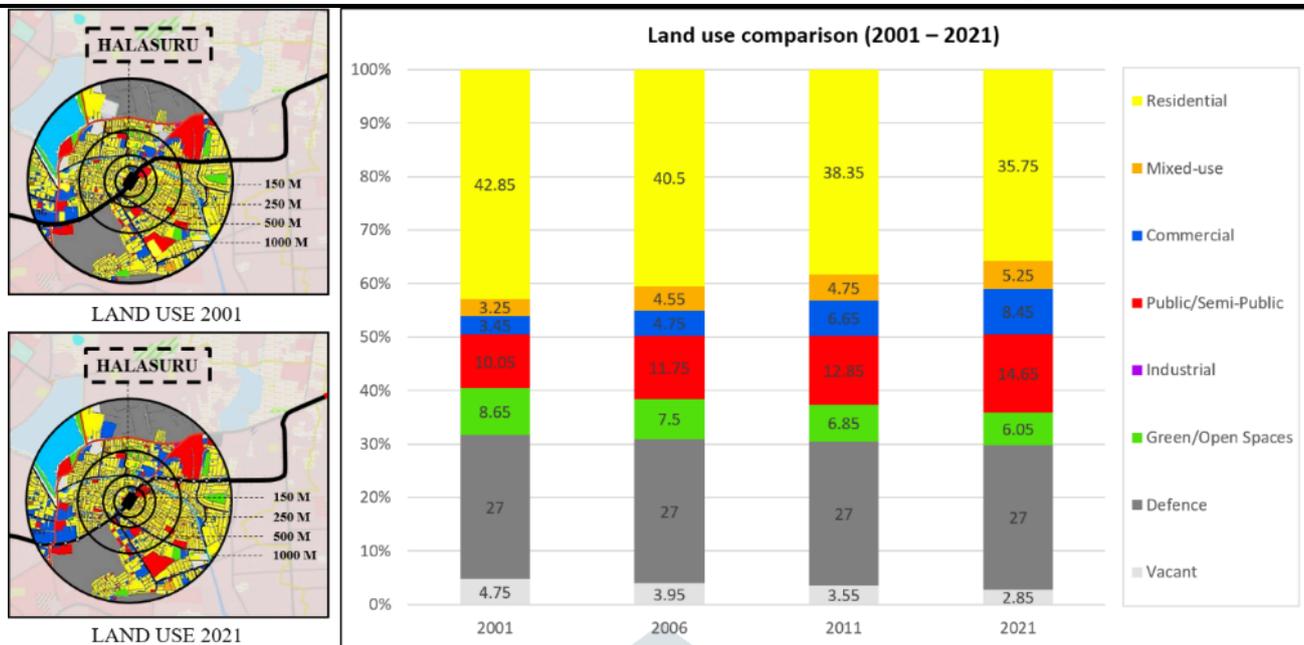
Figure 5: Halasuru Metro Station - Land use Comparison between 2001 and 2021

Change in residential land use is been observed from 42.85% to 35.75% with a decrease of 7.1% while commercial land use changed from 3.45% to 8.45% with an increase of 5%. Mixed-use increased by 2% as the residential underwent conversion due to increased accessibility and increasing demand for commercial retail and office spaces.

6.3. Swami Vivekanand Road Metro Station

It is situated within the urban high zone. Predominant land use around the station is public/semi-public and defense followed by residential land use.
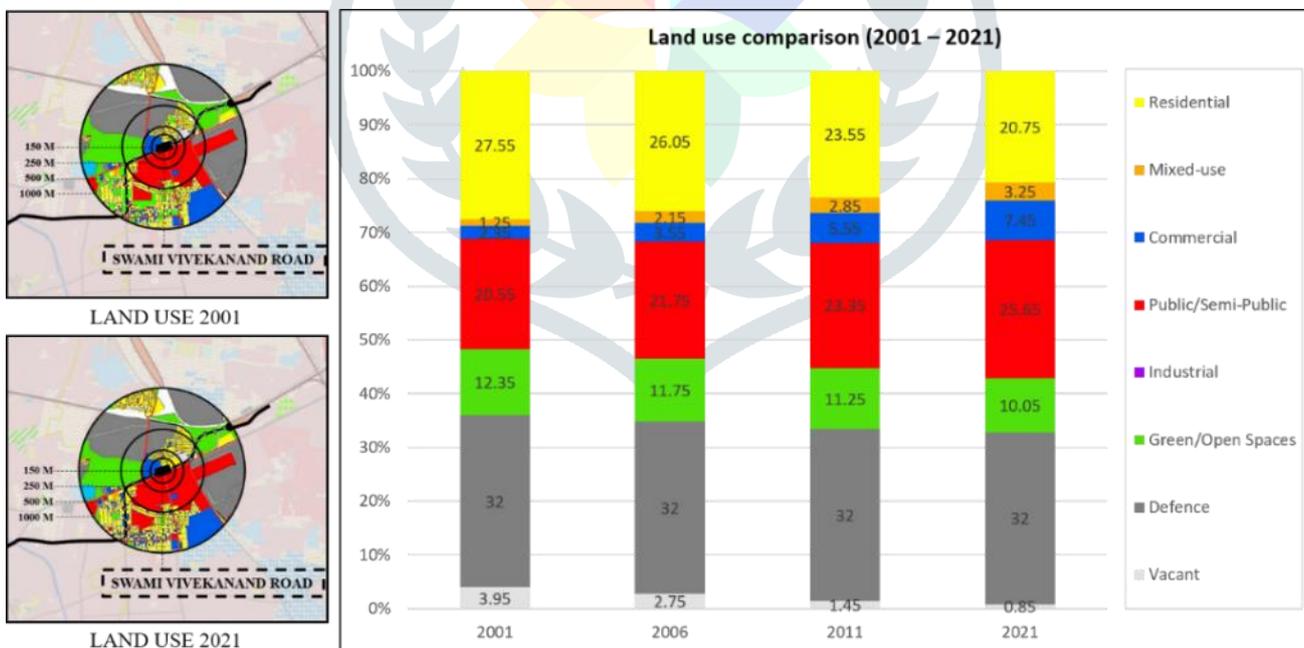

Figure 6: Swami Vivekanand Road Metro Station - Land use Comparison between 2001 and 2021

Change in residential land use is been observed from 27.55% to 20.75% with a decrease of 6.8% while commercial land use changed from 2.35% to 7.45% with an increase of 5.1%. Mixed-use and public/semi-public land use increased by 2% and 5.1% respectively as the residential underwent conversion due to increased accessibility and increasing demand for commercial retail and office spaces.

6.4. Comparative analysis of all 3 metro stations

The change in land use percentage within the identified influence zone is calculated in the table below.

Table 2: Percentage change in land use

Metro Station	Residential	Mixed-use	Commercial	Public/ Semi-Public
MG Road	-5.85	2.2	6.45	-0.1
Halasuru	-7.1	2	5	4.6
Swami Vivekanand Road	-6.8	2	5.1	5.1

7. CONCLUSION

Therefore, it can be observed that from the construction period (2007-2010) that the area had a higher demand for commercial and residential uses. The residential land use was converted to commercial and mixed uses, and a few of the smaller plots were amalgamated to maximize the FAR for the construction of a high structure that could accommodate a large population. As the need for commercial retail and office space grows, residential and commercial land use plots are being transformed to mixed-use developments with more commercial floor space. The presence of a metro station causes a decrease in residential land use and an increase in commercial land use in all of the station influence zones. Within the buffer zone, residential and commercial land use are found to be inversely proportional. The level of interaction between the transit station and land use determines the extent of this inverse proportionality. This study will also help in accessing other important parameters which impacts development around the Metro Station like –

a) Land value

b) Accessibility

c) Population Density

d) Transport Network

e) Central Business District location

f) Availability of vacant land

g) Social Infrastructure facilities

8. RECOMMENDATIONS

For effective Transit Oriented Development along the Metro corridor following strategies can be adopted in development plans –

a) Bye laws regarding the kind of development and density.

b) Development controls for high rise development.

c) Mixed-use development provisions.

d) Considerations of public open areas and plazas.

e) Improved accessibility infrastructure facilities.

f) Parking management and NMT.

g) Redevelopment schemes provision considering the future development.

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