Assessment of Transit Oriented Development Potential in Newly Emerging Cities - A Case of Sindhulimadhi

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Abstract

Transit-oriented development (TOD) today is recognized as a development type that forms communities, stresses the importance of human interaction, and the importance of proximity for that connection. It is an effective urban planning technique that addresses the present-day concerns of sustainability which relies on integrating land use and transport network systems. TOD aims at developing harmoniously a transit network and the land it deserves both at the local and at the regional scale. TOD is more than fighting land consumption; it aims at revitalizing regions as well as promoting new lifestyles. The incorporation of Transit-Oriented Design in a city supports it in every phase - social, economic and overall development. TOD also often requires existing transit to be considered a proper TOD, an assumption that this research challenges proposing other important characteristics for this development type and the concept of bringing in transit through TOD rather than only executing it around existing transit. Sindhulimadhi is taken as study area to model a new pattern of sustainable urban developmental planning, which supports land use, transportation planning, environment and all fields of growth management. Sindhulimadhi is one of the emerging city in Nepal. However, due to rapid urbanization, they are facing haphazard and uncontrollable development problems and problems related to unplanned development resulting in the growth of unorganized transportation planning. Moreover, this study is an applied research which lies under pragmatic paradigm. Thus, this research deals with the ideology of assessing TOD potentials in Sindhulimadi into the development of a regional city and measure its efficiency in different urban contexts, in order to provide better and feasible planning strategies for the proposed future development.

Keywords

Transit Oriented Development, Urban Development Scenario, Transportation planning, Emerging cities, Sindhulimadhi, City planning

1. Introduction

Transit oriented developments are an increasingly utilized method of spatial planning and land use management that encourages growth to occur around transportation corridors and nodes. Transit oriented development as a planing tool integrates the land use and transport system, thereby creating lively, sustainable, pedestrian and cycling friendly areas and neighborhoods, while encouraging people to choose transit over cars for their long commutes [1]. A more widely agreed description of TOD is an urban environment with high densities, mixed and diverse land uses, located within as easy walk able area around a transit stop [2]. But TOD planning is not and should not only be about creating development that is oriented towards transit use. It should also mean bringing transit to those locations, where the development already possesses the physical characteristics of that of a typical TOD, but without having transit connectivity at that place. This actually signifies a two sided planning approach that ensures that necessary planning interventions are made to either make the urban development more transit oriented or to bring transit to places where the development is already transit oriented. TOD is the concept of planning dense, walk able neighborhoods around existing or future transit lines, usually within a half-mile radius, or ten-minute walk from the station.

Urban area is the engine of the national economy. The population living in urban areas is increasing in Nepal, and cities grow accordingly. They often grow by spreading outside their limits and thus consuming Sindhulimadhi, is a municipality of rural areas. Sindhuli District, and the population is growing very enormously. After the construction B.P. Koirala Highway, the economic and tourism sector of Sindhulimadhi has boomed drastically. With the rapid development in Sindhulimadhi, policy makers are faced with the challenges involved in planning strategies for providing transportation systems to keep pace with development. Now, it is a pressuring issue for policy makers in Sindhulimadhi to develop appropriate urban transportation systems to ensure that the cities will be able to develop sustainably. Because of all these development projects, emerging cities can only enjoy a few more years of booming times because of unsustainable transportation systems. There is a growing concern in Sindhulimadi about increase in population, uncontrolled urban sprawl, unorganized services distribution, traffic problems, congestion, open space depletion, parking, and various other problems that have been attributed to many circumstances. So, the research focuses on how to deal with all difficult situations in Sindhulimadhi to reach significant strategies that stand on the trend of Transit Oriented Development, which can improve all physical, social and environmental circumstances. The overall objective of the research is to assess the potential strategy of TOD for achieving sustainable urban development.



Figure 1: Map of Nepal showing Sindhuli district

Figure 2: Linkage of Sindhuli with Kathmandu and Janakpur

2. Transit Oriented Development

Transit Oriented Development has gained popularity as a mean of redressing number of urban problems, including traffic congestion, affordable housing shortages, air pollution, and incessant sprawl. Several factors have heightened the public interest in TOD. One is a receptive policy environment, marked by recent legislation and grant funding-at all levels of government committed to promoting livable communities and Smart Growth. TOD has attracted interest as a tool for promoting smart growth, leveraging economic development, and catering to shifting market demands and lifestyle preferences [3] There are four main terms, density, diversity, distance and design, so called 4Ds [4]

- Density: raising density around transit stations.
- Diversity: mixed land use, extensive choices of housing and commutating.
- Design: pedestrian or friendly oriented design.
- Distance: distance from the station

Transit oriented development improves the livability of communities and environment, and it increases accessibility and transportation options, with being successfully integrated into the economic pattern of the area. It creates places for community life, be a key force in the revitalization of neighborhoods, helps to create new businesses and improves access to job opportunities, and helps to make communities safer, in part by making them more comfortable and attractive. The hallmarks of transit oriented development are enhanced mobility and environment, pedestrian friendliness, alternative suburban living and working environments, neighborhood revitalization, public safety, and public celebration.

Definitions of TOD success often focus on the physical characteristics of its built form. A list of six performance criteria is prepared to be used in evaluating project outcomes, with relative importance of the criteria to be based on the major goals the TOD sets out to accomplish. While physical characteristics are necessary elements, focusing instead on project outcomes as a benchmark of success allows a framework for trade offs that most projects must make. [5] [6] These six criteria are summarized below:

• Travel Behavior and Location Efficiency - A location efficient TOD plan is designed to optimize travel behavior. In essence, location

efficiency gives people mobility choices, reduces congestion, enhances time savings through shorter commutes, improves pedestrian access, and makes driving an automobile optional instead of being necessary.

- Local Income and Financial Return The economic indicators focus on the range and success of investment for both public and private investors, the amount, affordability, and tenure of housing, property values, taxes, and percent of income spent on housing and transportation.
- The Natural Environment An ideal TOD includes compact development and mixed land uses while still provided green and natural space.
- The Built Environment Successful TOD seeks to reach the typical built environment through improving public health and safety
- The Social Environment TOD should provide people with platonic meanings that can raise the quality of life
- Efficient Regional Land Use Patterns and Redevelopment through the Policy Context -This criterion involves channeling growth to where it can best be handled. Results of efficient regional land use include less loss of farmland and open space, a better balance between jobs and housing, shorter commutes, less congestion and pollution, and more efficient delivery of essential community services.

3. Study Area

Sindhulimadi of Sindhuli is chosen to be the study area to assess potentials of transit oriented development. Sindhulimadi is the former name of Kamalamai municipality. It is an inner terai city which connects Kathmandu with Terai region. Sindhulimadhi is the main business and trading center hub of the municipality. Moreover, the bazaar is a low to mid rise high density settlement which acts as a break a bulk point, where cargo is shifted from one form of transport to another coming from India or Terai region. Current situation of urban structure and land use Sindhulimadi includes many land uses with size variation from time to time. Also,the population growth is increasing dramatically and this leads to the creation of other land uses related to the needs of the population. The research is limited to a physical area of Sindhulimadi. An area with a radius of 500 meters around the bus park, ward 5 and 6 is chosen as study area. The distribution of population is not even throughout Sindhulimadi. Ward no 6 have highest population with 8976 followed by ward no 5 with 6709 (Source: Sindhuli Local level profile, 2074). Moreover, this research is limited to studying urban design principles of Transit oriented development on the local neighborhood scale.



Figure 3: Images showing the land use and urban growth change of project area (Sindhulimadi)

4. Methodology

This study is an applied research, which lies under pragmatic paradigm. For this survey, mixed method was used as a research of this nature entails both quantitative as well as qualitative data. The land use and street characteristics were observed on site and were summarized as well as inventoried which included the number of lanes, bus stations, building typology, traffic characteristics, parking etc. Sample surveys were used directly on site through personal interviews and direct observations. The survey was done at random and different age groups for both genders. The data collection was done through the KOBO toolbox and later analyzed using SPSS. Eighty-five questionnaires were collected from different sample survey from local residents, students, shopkeepers, office staffs etc. For the qualitative method, photographs and maps were studied and compared with existing situation to understand the change over time. The variety in these questions aims first to meet the research objectives, and to collect all the necessary data that can support the criteria, decisions, results and recommendations in the research. The sections in the questionnaire verify the

objectives in this research related to building a sustainable and smart pattern, which based on the term TOD as the following: trips and transportation; walk and use of public transportation; transportation network, services and land use.

5. Data and Results

A sample size of 85 representatives was surveyed. 46.7 percent female and 50.7 percent male were included as per the data. Age groups of children, adult and elderly were included in the survey along with the category of major ethnic groups and all possible occupations. The education level of people varied largely from under SLC to master and above level. According to the community opinions, which are indicated and shown through the results of the questionnaire, the criteria that have to be followed during proposing the building of smart and sustainable urban model that based on TOD are known.

5.1 Road Networks

Functioning transportation networks is a key element for cities and towns, and precondition for economic activity and social participation. Roads of Sindhulimadi can be classified as follows:

- Regional roads: The main assess highway of Kamalamai Municipality is BP highway which connects eastern terai with city Kathmandu. Similarly, ongoing Hetauda- Chatara road (newly named as Madan Bhandari Inner Terai highway) joins eastern and western Chure bhavar region of Nepal. Along with them, many district and rural road has facilitated the other part of district to municipality. (e.g.: Dharan-Chatara-Hetauda road, BP highway)
- Main roads: They fork from BP Highway to serve the cities and communities that are located on both sides of the highway. (e.g. : Hospital road, Dhungrebass road)
- Design: Collective roads: They are used to collect and distribute traffic to from local streets, and to ensure free accesses to the main roads.
- Local roads: These roads connect residential neighborhoods and the local services with the collective roads. (e.g. Stall bazaar, Madhutar)



Figure 4: Hierarchy of Road networks)

Among the questionnaire survey, the majority of transportation mean that people mainly depend on to do their daily trips are public transportation means (45.3%) so public transportation is very important element on the roads and have to be supported and enhanced physically and economically. The performance and efficiency of the current transportation network and the public transport is between acceptable and weak (58.7% - 21.3%) so it needs to make significant improvements on this factor. (86.7%) of people are agreeing with the establishment of pedestrians' and bicyclists' lanes within streets so the idea of implementing pedestrianism and bicycling corridors is agreed and can enhance the approach. (84.0%) of people think that idea of encouraging the walking and using the public transport can improve the social relationships between the citizens of the neighborhood so this approach can enhance the social relations and it is very harmonious with sustainable aspects. (72.9%) are agreeing with the idea of depending on the public transportation means after Thus, Public develop it and reduce costs. transportation must to be the focal point of planning and designing the model and they must integrate with pedestrianism. Administrative and economic support have to be implemented on this aspect.



Figure 5: High density core area



Figure 6: Road Standards not very clear in vehicular as well as pedestrian



Figure 7: Safari tempo causing congestion



Figure 8: Poor level of service (LOS) of pedestrian space

5.2 Market and Public service centers

Sindhulimadhi and Dhurabazar is the main business and trading center hub of the municipality. It is located in ward 6 of the municipality. The market centers has various facilities like banking and cooperatives, electricity, telephone/mobile, health and education services. This market provides various services to its neighboring local bodies viz; trade, market and also for transportation too. Moreover, Sindhulimadi bazaar acts as a break a bulk point, where cargo is shifted from one form of transport to another. All the goods carrying trucks from India or Terai stops in Sindhulimadhi and the cargo is transferred from the one form of transportation(big trucks) to the smaller vehicles. From Sindhulimadhi the goods are transported mainly to cities like Ramechhap, Dolakha, Charikot, Okhaldungha, Solukhumbu, Salleri and all the districts in higher altitude. Likewise the people of adjoining rural areas of Teenpatan rural municipality, Golanjhor rural municipality and Dudhauli Municipality usually visit here for trade and business purposes. Because of this, break of bulk points often became centers of urbanization.

5.3 Urban Growth Trend

Urban growth is a process of population concentration, structural change and socio-cultural change affecting both people and place. Progressive concentration of people and their activities towards towns and cities are key dimension of urban growth. The percent of increase of urban population, urban centers show a high pace of urbanization in core area of Sindhulimadi. The urban growth trend of the municipality shows concentrated more towards core area of Sindhulimadhi and Dhurabazar area. Space for building is limited in this area where land selling and buying is shifted towards agricultural land. Proportion of urban population to the total population of a region determines the level of urbanization reflects the development of a region. Huge disparity in the level of urbanization signifies that the urbanization process has not operated in a balanced way.



Figure 9: Built up changing trend from 2013 to 2018

5.4 Evaluation tool and measuring success of TOD

From the literature and site study, strategies to systematically evaluate the potential success of TOD were studied. Transit Oriented Development TOD as a sustainable and smart approach seeks to create an urban environment, which maximizes economic development and social equity, whilst minimizing negative externalities upon the natural environment. This section offers a strategy to systematically evaluate the potential success of TOD. The tool identifies and evaluates various indicators of the impacts of TOD, provides the results of a survey TOD indicators, and identifies evaluation model as a tool that can be used to systematically monitor and measure impacts. The proposed strategy of evaluation is erected on six categories about performance criteria and TOD outcomes. Each category includes number of characters that can describe the situation. All answers are analysed and summarized as the following:

A. Travel behaviour and location efficiency

Transit Access The study area is immediately adjacent to the transit stop served by local and major accessibility.

Everyday Destination The study area is near everyday destinations that are readily accessible to pedestrians and bicyclists.

Street Connectivity All streets are designed for vehicle speeds of 40km/h or less, and every street is designed to accommodate pedestrians. Many streets do not include bicycle facilities or traffic calming measures that would facilitate use by pedestrians and bicyclists.

Pedestrian and Bicycle Realm Few or no sidewalks and no bicycle facilities are provided. Access to Parks and Open Space The project area is adjacent to tundikhel (park) and has developed areas on three sides

Street Frontages Building frontages are visually monotonous. The facades of buildings with long street frontages are broken into smaller modules. Transparent window and door openings are provided at street level. Some ground-floor frontages are designed to allow for outdoor seating for shops, restaurants and cafes.

Vehicle and Bicycle Parking On-street vehicle parking or bike lane creates a buffer between pedestrians and vehicle traffic. Limited on-street bicycle parking is available. Due to the parking, traffic congestion occurs.

B. Local Income and Financial Return

Employment Potentiality TOD project would

stabilize and maintain existing community employment opportunities and/or provide planned and funded job relocation.

C. The Natural Environment Natural Features Some existing natural features including most mature trees and some open space areas are preserved and highlighted as public amenities.

D. The Built Environment

Project Density The study area is located in an area that is developed at a high density including at least 50density found in the community.

Consistent Street Edge Buildings and their main entrances are oriented toward the street and maintain or define setback/build-to lines that are close to or adjacent to the sidewalk. Since the buildings step back from the build-to line, attractive landscaping can be provided. All vehicle entrances are located behind or on the sides of buildings.

E. The Social Environment

Housing Diversity The study area is in an area with various types of housing.

Historic Features Some existing usable buildings have been rehabilitated and reused.

Universal Access If the area can be developed as an TOD, it meets the requirements of mobility over a local and minimum scale of urban fabric or provides access to people with disabilities

6. Findings and Discussion

Communities are looking for ways to get the most out of new development and to maximize their return from social, economic and environmental activities. Communities expect to create new neighbourhoods and maintain existing ones to be more attractive, convenient, safe, and healthy. The main goal of the approach is to assess the potential set of comprehensive and methodological framework for upraising the quality of life in the city within modelling a new pattern of sustainable and smart urban developmental planning, which based on transit oriented development.

Sindhulimadi as TODThe indicators to decide any place urban area are its Physical infrastructures, land use, Services, Economy, Social characteristics, Technology, Management scenario and its urban formation. Upon comparative analysis, Sindulimadhi, Dhura bazar and Dhungrebas area are the potential area towards urbanization. The main reason is the BP Highway which has come as a boon to people of Sindhuli. Moreover, Sindhulimadi bazaar acts as a break a bulk point. In addition, the success of mixed land use pattern can be judged by the increase in density and congestion on Madi bazaar, Stall bazaar and Dhura bazaar. Major market areas, all are developed as mixed land use having shops on ground floor and residences on upper floors. In this regard the Sindhulimadi has witnessed, lived and grown with the concept of mixed land-use on major roads like Madi bazaar, Stall bazaar and Dhura bazaar.

- Density As the plot sizes were small and were developed organically in mixed land use, the density was more on center bazaar areas. On outer side as the development was new, land cost was less. The development that took place was having openness and less density.
- Road Widths and Transportation Networks-Due to the lack of transportation facilities during that period and narrow road widths and poorly constructed roads people didn't prefer traveling to those areas and hence the development was confined to one particular area.
- Mindset of People- The residents of always wanted to live close to their workplace (shops) and they were always skeptical about the distances. Whereas, immigrants from the other cities had no such mental barrier of distance.

The urban structure of Sindhulimadi is characterized by many troubles that can be summed up within; population growth, lack of services, deficit in infrastructures, environmental pollution, traffic congestion especially in core area, and lack of recreational areas. Bringing the attention to focus on Sindhulimadi, it is a city that efficiently masters the mixed land-use patterns in its urbanscape and is surrounded by the greenery at the periphery of the city. In modern Urban Planning practices, mixed land use on circulation arteries on high densities are termed as Transit Oriented Development (TOD). So to say, the concept of TOD is not new for Sindhulimadi. Likewise, being the commercial hub of Sindhuli district, Sindhulimadi has tremendous potential to develop a successful Transit-Oriented Development design. However, the evolution of urban growth with

a multitude of relations and dependencies requires not only new forms of transport, but also new methods of spatial planning.

7. Conclusion

This study helped in putting the development plans portrayed by the cities into perspective. It provides a synthesis of the major steps that are needed to create a more efficient community through the organization of transportation and circulation. Also, it provides tools for analysis, design and evaluation. This is done through methodological framework. Conclusions, applied outputs and recommendations are achieved through all research up-growth.

In conclusion, Sindhulimadi has shown great characteristics for TOD development. This concept and the study results show that enacting transit-oriented development techniques do not need to be focused on areas that have the strongest cases of transit but can be used to improve existing conditions and revitalize areas that have potential for improving their communities with or without transit. This not only helps in maintaining the uniqueness of the place but also improves sense of belonging. The aim of this study was to look at regional cities through TOD perspective. These are developing cities and a lot can be achieved through efficient and conscious planning. Regional cities have potential to restrict the urban sprawl and generate higher densities than suburbia. This potential can be utilised efficiently through TOD. The analysis of the cities brought out their shortcomings as well as the strengths, a further study will help in programming a better development plan. Moreover, this study can be considered as a starting point for such detailed studies and actual plans towards urban developmental and growth control in Sindhulimadi.

8. Recommendations

The questionnaire showed that most people do not see the public transportation as an ideal mean to transit with; also, most of them are agree with the idea of depending on these public means after making some essential improvements. These results represent a strong platform to establish such developmental approach. According to the results about the transportation means that people mainly depend on, it is seen that it is essential to provide a variety of transportation choices. Then, three modes of travel means are proposed to satisfy the trends of community, with compatibility with the approach. Public transportation is a very efficient system, which include buses and tempos. The system needs to be supported and enhanced physically by the government in order to save time and effort of travel, especially in peak hours and also to minimize the prices of travel. Private transportation is a critical transportation mean, which needs a very caution treatment. It is not supported economically, in order to reduce the dependency on it and to make it as auxiliary transportation mean. Pedestrianism and Bicycling is a very important idea, which needs a lot of strengthening and enhancing. A pleasant pedestrian environment and corridors are promoted to attract this trend by lightening, furnishing and safety. All destinations are close all origins and to each other, to encourage the idea.

Moreover, there are three types of stations to be proposed to serve the complement model. These stations are allocated and determined their areas according to many criteria. The three types of proposed stations.

• Neighbourhood' stations (Local stations): can

be considered as local stations that serve at the scale of neighbourhoods and can make a streetscape development.

- Districts' stations (Major stations): can be considered as major stations that serve at the scale of all district and can make a significant development for infill sites in the district.
- Regional stations (Bus Park)): can be considered as global stations that direct the future development of Sindhulimadi throughout the outskirts of the city.

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