

Transit Oriented Development (TOD) in Dhaka: Opportunities and Challenges for (Re)development around Stations

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Abstract: Land (re)development is an integral part of TOD planning especially in the areas that are already built. Dhaka the capital city of Bangladesh is a densely populated spontaneous city with narrow roads, inadequate pedestrian facilities, unplanned structures, inappropriate land use mix and weak policy enforcing environment. TOD planning here is more difficult than other cities of the developed world. This study has considered an empirical case station, analyzing the spatial attributes that theoretically defines TOD and available policy documents to identify the opportunities and challenges of (re)development for TOD planning in Dhaka. Study has recognized land readjustment for the under developed parts of the study area as the best suitable land redevelopment tool in the context of Dhaka to integrate land use with proposed transit stations after evaluating the existing physical form of the city, relevant policies and TOD practices of different cities.

Keywords: Transit Oriented Development (TOD), redevelopment, land readjustment.

1. INTRODUCTION

Transit Oriented Development (TOD) is an influential planning theory, which has been inspiring transit developments around the world (Calthorpe, 1993). TOD is not an 'one size fit all' tool rather more context specific approach (Kamruzzaman, Baker, Washington, & Turrell, 2014; Suzuki, Cervero, & Iuchi, 2013) still nearly all have a number of similar components: medium to high density within approximately 800m or 10 minutes walking distance, land use diversity and pedestrian friendly design for better connectivity to the stations (Calthorpe, 1993; Cervero & Kockelman, 1997; Curtis, Renne, & Bertolini, 2009; Dittmar & Ohland, 2004). Much of the TOD research has focused on the developed world. The challenges for such policies in the developing world have not been revealed yet. In the developing world where cities are growing rapidly TOD provides an opportunity to design a transit oriented urban form (Gilat & Sussman, 2003; Ratner & Goetz, 2013). The recent development of metro lines in Dhaka brings a prospect to integrate transport and land use through promoting TOD (RAJUK, 2016). The first mass transit project of Dhaka city MRT line 6 is now in construction. It will connect the northern periphery to the CBD through 16 stations (RSTP, 2015) along the 20.1 km corridor. Another two-mass transit corridor MRT line 1 (19 stations) and MRT line 5 (14 stations) is going to integrate with the network shortly (DTCA, 2018a, 2018b). However, current planning strategies propose TOD (RAJUK, 2016) but there is no detail planning about how to make it happen. Dhaka is facing crisis of mobility, environment and inequality since long back (RAJUK, 2016). TOD may slow down motorization (Sung & Oh, 2011), serve the low income by cheap high capacity transit, and have better access (Sun, Zacharias, Ma, & Oreskovic, 2016; Vale, 2015) to job and other functional areas. Opportunities

for TOD planning include station area development or redevelopment, real-estate development along the transit corridor and policy of building new affordable housing within walking distance from the transit station (Gilat & Sussman, 2003). TOD planning on a virgin land is not that complex like on an existing built up area, especially in a developing city where land use is not well integrated with transport planning (STP, 2005); low capacity of roads, high density of people, weak policy enforcement capacity imposes too many challenges to bring TOD in real.

TOD is the formation of denser, mixed use activity node which is connected by high quality transportation, integrate both transport and land use (Suzuki et al., 2013). Transit influence the land use development by improving accessibility which depends on availability of land and characteristics of local built up form (Atkinson-Palombo & Kuby, 2011; Cervero & Kockelman, 1997; Singh, Lukman, He, Flacke, & Zuidgeest, 2015). Hess and Lombardi (2004) on the other hand argue about the role of policy for successful implementation of TOD. Successful policy always acknowledges for bringing the transit-land use synergy (Dittmar & Ohland, 2004; Dunphy et al., 2004; Giuliano, 2004). Policy is the element that bind the transit with land use around station area and thus contribute to shape it (Dunphy et al., 2004). Therefore analyzing built or spatial form and policy helps to understand and control of development or redevelopment according to the pre-defined principle of TOD (Bertolini, Curtis, & Renne, 2012).

Focusing these two major aspects in mind this study has tried to identify the opportunities and challenges for redevelopment near transit stations considering the spatial context and policy environment of Dhaka. Two basic research questions have been figured out to reach into the study purpose. First research question, what are the spatial and policy opportunities and challenges to (re)develop around MRT stations of Dhaka? - to identify the potential and challenges for TOD planning in Dhaka which implies the urgent need of land redevelopment through analyzing the spatial attributes of case station and available policy. Second research question Which redevelopment tool will be best suited to Dhaka's context for successful TOD? - demands to verify the appropriate land redevelopment tool for Dhaka based on the identified opportunities and challenges.

2. TOD AND LAND (RE)DEVELOPMENT

TOD as a planning tool integrates the land use and transit system, thus creates lively, sustainable, pedestrian and cycling friendly neighborhoods with high densities, mixed and diverse land uses (Calgary, 2004). The first and foremost formal definition of TOD comes from Peter Calthorpe (1993) as a mix use community within an average 2000 ft or 10 minutes walking distance of a transit stop and core commercial area. The next definition comes from Cervero who identified three most important variables associated with TOD, all of which were features of the built environment, included density, diversity and pedestrian-friendly design (Cervero & Kockelman, 1997). The 3D's definition further expanded to 5D's with the addition of distance to transit and destination accessibility (Ewing & Cervero, 2010). Most of the TOD definitions focus on built form although Dittmar and Ohland (2004) also argue that TOD cannot be defined by only physical form; it must need a functional integration of transit and surrounding development. Transit agencies throughout the world are working to promote TOD in station areas and gives credit for policies to encourage transit-supportive development or redevelopment. Cervero (1998) argue about three particular division of public sector: transit agencies, redevelopment agencies and local governments for successful TOD. Numerous studies have discussed TOD planning strategies for station areas (Curtis, 2012;

Curtis et al., 2009; Lin & Gau, 2006). However, any single measure like transit base housing, employment or walkable design is not influential enough to make TOD successful rather mix of land use and supportive policies can make it more effective (Hess & Lombardi, 2004).

Concept of transport infrastructure and level of accessibility influence the development and redevelopment of urban land can be traced back to German School of location theory (White, Weber, & Friedrich, 1909). Transportation impact influence location choices of firms and households (Suzuki, Murakami, Hong, & Tamayose, 2015) and the basic concept underlying this hypothesis is accessibility. Transit investment powerfully shape the cities by changing accessibility (Hansen, 1959; Ratner & Goetz, 2013; TRB, 1996). "With the concept of land use intensification and sustainable development based on urban smart growth that attempt to balance growth while fulfilling economic, social, and environmental needs, a large amount of urban stock land has been redeveloped" (Zhou, Zhao, & Zhou, 2017). TOD which considered as an approach of smart growth closely related to land development or redevelopment. However, despite the theoretical simplicity empirical verification has proven it as complex because of different reasons: the impact of transport is not immediately apparent and depends upon many physical, social, economic factors and policy environments (Still, 1995). The real picture of transport and urban spatial structures in developing countries is scary because of socio-economic issues, overcrowded urban cores, poorly designed road networks, spatial mismatch among location of functions and weak institutional setup for planning and control (Cervero, 2013; Suzuki et al., 2013). Transport land use relationship is not only key factor to understand the nature and evolution of urban form but also has important policy implication (Giuliano, 1989). Green and James (1993) argue about the influence of rail transit on existing station area development. They compared station and non-station areas in Washington along rail corridor and find that the station area experienced a higher rate of population and employment growth than the non-station areas. Another similar study by (Cervero, 1995) concludes that Bay Area Rapid Transit underpin a huge increase of office space at downtown San Francisco which added around 80,000 jobs since 1970. Porter (1997) looked at the challenges and opportunities for 18 North American TOD and found that the commitment to making TOD work is strong in cities where transit agencies and local government work together to coordinate supportive policies for TOD. Meck (2002) indicate about studies like land use and market condition, encouraging mixed uses, pedestrian circulation and density for supportive policy guideline on necessary components of a TOD plan.

Research found different criteria that implies need for redevelopment approach for planning TOD, physical characteristics of the area are most important among them (Nippon Koei Co., 2006). In the developing cities, most transit investment take place in already urbanized area as an urgency to address existing unmet traffic demand and reduce congestion (Suzuki et al., 2013). Retrofitting these areas in response to new development opportunities offered by transit accessibility is difficult than TOD planning in greenfield areas (Nippon Koei Co., 2006). Land ownership is the one reason that poses the difficulties; private business and household own the majority of TOD precinct where government usually has little control. The other difficulty is redevelop built up areas whether they are public or private owned, requires demolition means social and economic implications or substantial cost (Suzuki et al., 2013).

3. DATA AND METHOD

This study implies both qualitative and quantitative approach. To answer the first research question, several literatures have been reviewed. The spatial attributes that theoretically

defines TOD or 3D's (density, land use diversity and pedestrian friendly design) of TOD (Cervero & Kockelman, 1997) has been considered to evaluate the existing spatial form of the case station. Further, (re)development potential has been identified by using spatial analysis tool of GIS considering relevant spatial criteria like average plot size, building height and volume, availability of vacant land, presence of tin shade (temporary materials for structure) houses etc. Criteria for this has been drawn from international case studies, like the physical form, economic or social characteristics which drive a geographical area to be developed again. For details analysis and justification in Dhaka's context, the availability of data has been considered further along with existing relevant policies for land development (Dhaka Structure Plan 2016-2035, Density Zoning Study 2018 under Detailed Area Plan and Building Construction Act, 2008). GIS database of Detailed Area Plan (DAP) of Dhaka, vector data from Dhaka North City Corporation and data collected through field observation has been used for spatial analysis. For the second research question that quest to verify the appropriate land development approach for study area, the best land redevelopment approach has been justified through different case study example. Internationally land redevelopment approaches have been carried out in different countries due to several reasons like rehabilitation after war, post disaster recovery, vacant land designing etc. Considering international experiences and based on the findings from the first research question the second analytical part has been developed.

4. OPPORTUNITIES AND CHALLENGES FOR TRANSIT ORIENTED (RE)DEVELOPMENT: EMPIRICAL CASE

For developing high-density neighbourhood with diverse land use and good pedestrian friendly urban design, major redevelopment take place in already urbanized area (Rayle, 2015). TOD around existing transit stations is quite complicated because it implies certain type of development in qualitatively different form of structure it replace (Rayle, 2015). Hence, serve to designate areas for investment and coordinate policies to create compact development. Mirpur 11 no station along MRT line 6 has taken as empirical case, shows in figure 1 for this study, which is already built-up and predominantly residential in characteristics. Considering the 10 minutes walking distance which theoretically defines TOD (Calthorpe, 1993), 800m radius area has been selected as TOD precinct.

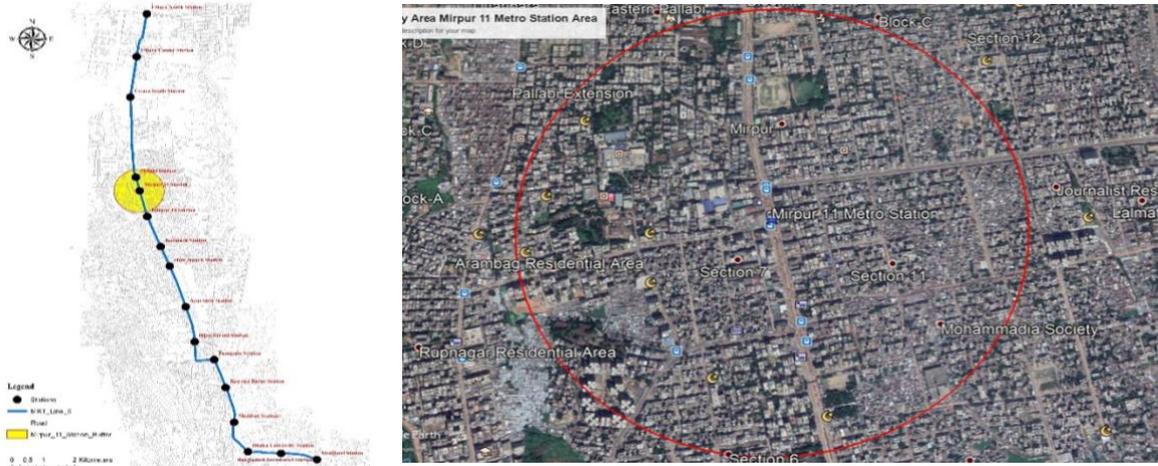


Figure 1: Location of case station (Mirpur 11) along the corridor of MRT line 6
 Source: Author, adopted from DAP database and satellite image

Result from spatial analysis indicates that, the diversity of land use is quite good although the density represents opportunity of development in the study area, shows in table 1. Most of the areas within the TOD precinct are above the lower cut off in terms of density, have the threshold for supporting transit facilities. Landuse diversity which ranges from 0 to 1, high value of entropy means high level of diversity and higher potential for TOD.

Table 1: Spatial features of the case station (800m precinct)

Criteria	Indicator	Description	Calculation	Average value
Density	Residential density	High residential densities are supportive for more efficient public transport	Number of dwelling units per sq. km residential area	41601.11
Diversity	Land use diversity	High level of diversity creates more balanced and consistence passenger flow, reduce vehicle trips, enhances the liveliness of the place	Defined as $1 - \sum \left(\frac{a}{A}\right)^2$ Where, a is the total area of specific landuse and A is the total area.	0.69
Design	Walkable/ Cycle able path	More walkable path means high level of accessibility to the transit stations	Road length in km	58.36

Note:

1. Residential density was calculated in km²respectively based on total residential area and rounded to two decimal places.
2. Landuse diversity was calculated through entropy method.
3. Walkable/ cycle able path was calculated excluding the arterial road from the network.

Though the road hierarchy is not maintained in accordance with land use planning, the connectivity, both internal and external, is well for now. However, there is huge chance of accessibility problem in future when the new transit will upsurge the development. The area is residential land use dominant as 5493 number of plots (around 47.36% of total area) is serving residential purpose where other purposes as commercial, industrial, healthcare, educational and mixed use are being served through 609 numbers of plots. 70,455 dwelling units exist in 812808 square meter area, which refers the residential density of 0.087 dwelling unit per square meter. As Among 12536 structures of the area, 7610 structures are only one storied, 1962 structures are 2-3 storied, 2622 structures are 4-6 storied and only 342 structures are above 6 storied, shows in figure 2 (a). Average building height (number of floors) is 2.31. Very high residential density allied with low building height specify the possibility of slum or shanty type development. This could be a deterrent for TOD. This high residential density and low-rise development results in lack of other facilities even roads. About 58.36km long road network exists in this study area with average width of 7m ranges from 3m to 15m.

Previously “Dhaka Metropolitan Building Construction Rules 2008” superseded the earlier set of building construction rules issued in 1996 for the Dhaka metro and provide more authority to RAJUK. However, currently, Draft Density Zoning Plan 2018 is the latest regulatory documents for providing guidelines to control the density and manage the growth of the city. It provides rules on building coverage area, allowable floor space in relation to the building height, i.e. floor area ratio (FAR), road width and plot size. Following Dhaka Structure Plan 2016-2035, Draft Density Zoning Plan 2018 has been prepared, which aims at reducing population pressure in Dhaka to make the capital livable. Presently Building

Construction Rules (2008) is being used to control the development activities in Dhaka but current practice of FAR is not so effective to control the population density in residential area (RAJUK, 2018). According to draft Density Zoning Plan 2018, following reasons are responsible which direct to switch attention from FAR towards building height for development approaches of Dhaka city:

- There is no fixed or standard size of residential apartment in Dhaka; number of dwelling units varies according to plot size and FAR.
- Current FAR value is flat, at times higher than required and used equally within the city, which does not consider local character, existing potentials and scenarios
- FAR does not have any direct role to control the population density maintaining its environment properly in residential area.

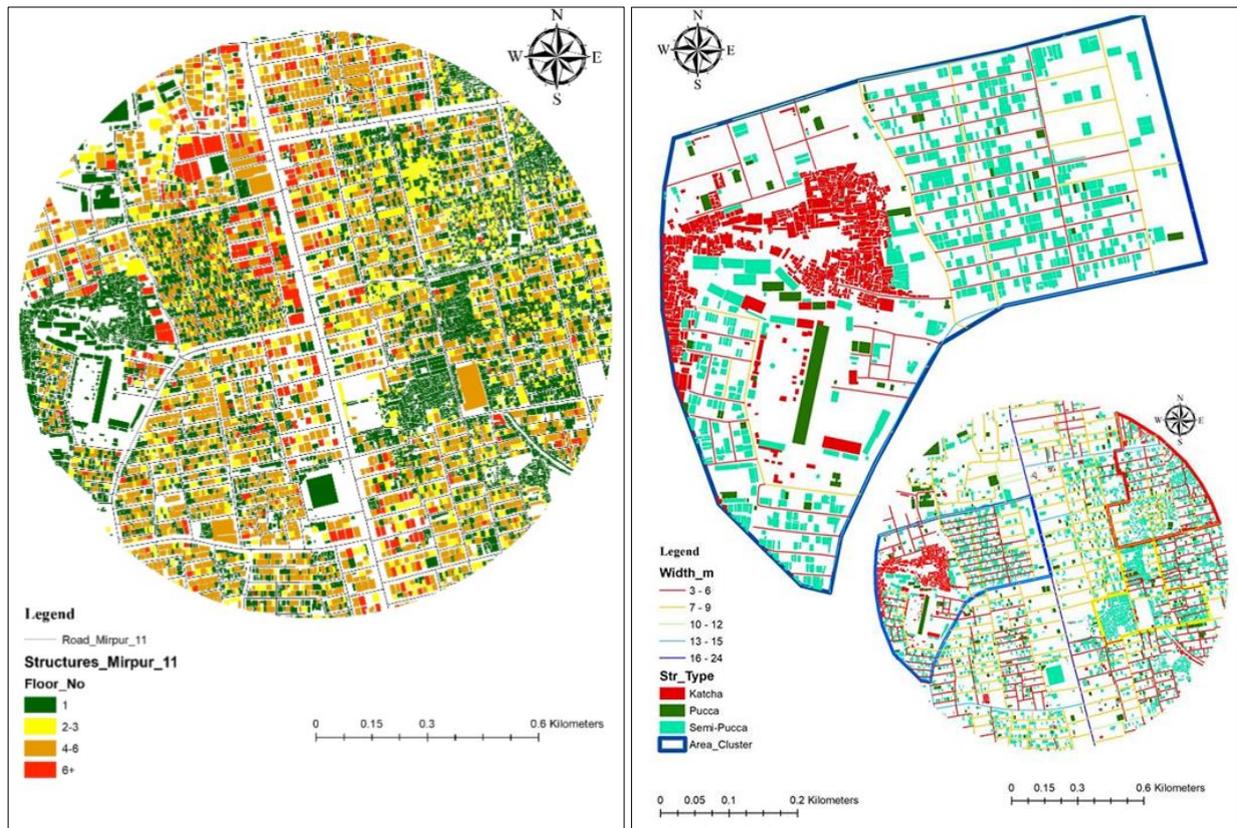


Figure 2. (a) Spatial distribution of building height and (b) (re)development potential of the case station

Spatial analysis found study area has huge potential for redevelopment. About 60.71% structures can be categorized for redevelopment because of its building material (temporary building construction material as tin) and for being only one storied, shows in figure 2 (b). Current policy has provision that allowed 12 stories for housing in TOD precinct (RAJUK, 2018). Since average number of floors in study area is 2.31 and policy guideline shows direction for increasing building height, redevelopment in this case study area is admissible immediate redevelopment could be possible through collective initiatives from land owners, developers and development authorities. A close visualization from one of the (re)developable cluster, shows in figure 2 (b) illustrates the probable augmentation of case study area. The cluster consists of 19190-meter length road where the average road width is 4.85 meter. Based on the potential (re)developable criteria as building material, construction type (fully

permanent material used as semi pucca or totally temporary materials based as kutchra), among 2555 structures from the marked area, 1775 structures are potential for immediate (re)development.

5. LAND REDEVELOPMENT FOR TOD PLANNING IN DHAKA

For a developing city like Dhaka where majority of population belongs to middle income, lower middle income and lower income category, very high-rise developments has been discouraged considering the social and economic viability (RAJUK, 2018). Density zoning study also suggests that, density of Dhaka city must be distributed in accordance with traffic and infrastructural capacity, community facilities and amenities (soft infrastructure) as well as existing development intensity, maximizing the intensity of people and jobs close to high capacity transport systems (particularly rail); within acceptable environmental limits. Dhaka Structure Plan (2016-2035) projected 26 million people by 2035. By maintaining current level of average urban density in Dhaka Metropolitan Region area (245pph), the city would need additional 35,512 hectares of urban land to accommodate future population and most of which have to be converted from current agricultural lands. If the use of agricultural lands to be avoided it will need more 16,057 hectares of new urban land to meet the preferred density level 300pph (RAJUK, 2016). So, for improving and redeveloping existing central region by maintain no additional density, within the regional urban centers in the peripheral locations, RAJUK has suggested to initiate participatory land development techniques such as land readjustment (LR), guided land development (GLD) and other participatory land development techniques. MRT stations are focal points of development because of the immediate direct access, they provide to a high-quality transportation system that is able to move large volumes of people, in a dependable and predictable manner, and at a reasonable cost. So the areas surrounding the stations are prime locations for development in general and high density development in particular (RAJUK, 2016). According to the guidelines of Dhaka Structure Plan, mass transit-related land development policies should work towards creating communities that are compact, mixed use activity areas centered on a station that by design encourages residents, workers, and shoppers to use the metro system. The prescribed land development policies have suggested encouraging the use of public transportation services. The surrounding areas of the metro station can be the centerpiece that connects the residents and workers to its outer regions as well as the civic and public spaces that surround it (RAJUK, 2016). Spatial analysis evident that the potential (re)developable plots are under private ownership and even not have adequate access roads and other facilities. Only increasing building height may not be a good solution to accommodate future development. This could be results in chaotic development rather than meet TOD goal.

According to Wang, Li, and Wu (2011) in the context of urban land redevelopment, prime locations need to be updated and replaced quickly. Transport facilities in the redeveloped land are one of the most essential aspects for the new expansion and development survival. So, it's essential to create a balance for "supplying enough traffic facilities to satisfy the redevelopment" and "restrict the re-developed land type and intensity" (Wang et al., 2011). For a residential land use prevailed area of Mirpur 11 metro station, where among 12536 structures, 10355 (82.60% of total number of structures) are using for residential purpose, it is very clear that a more coordinated infrastructure along with road allocation can bring a more systematic distribution through land redevelopment. Since Metro Rail Construction corridor that connect the CBD and old Dhaka to the northern periphery (RSTP, 2015), includes numerous typologies of land use around the different stations, and policy also recommends

redevelopment, the TOD station nearby areas are in need of redevelopment for balancing transport supply with existing and projected growth of population (RAJUK, 2016).

There are many terms of this tool such as land readjustment– land pooling – land consolidation – land re-dividing - land plot boundary modification which are practiced internationally. Many countries use land expropriation tool for developing old areas, but this tool causes high financial burden on the government for buying land plots and developing them, furthermore the population refuse to leave their property which led to the difficulty in implementation the process of expropriation besides it takes a long time to negotiate with the population and owners (Elkawy, 2018). According to Louwsma et al. (2017) “land consolidation and land readjustment are two powerful instruments that facilitate the rearrangement of land rights in accordance with the desired land use development. The exchange of land rights is the main underlying principle of land consolidation and land readjustment, whereby land consolidation generally focuses on rural areas and land readjustment on urban areas.” Japan could be a best example for land readjustment in planning TOD (Suzuki et al., 2015). Land readjustment is harder to carry out in built-up areas and need very strong incentive mechanism.

Dhaka Structure plan 2016-2035 suggested that, the development of Dhaka must follow innovative techniques for major development attributes for future development. In this regard, RAJUK is aiming to follow development approaches like land readjustment, land sharing and land consolidation for as long-term urban development policy (RAJUK, 2016). As the case station is already built-up, TOD implementation will be hard as it requires land acquisition for the redevelopment. Land readjustment could be the way to solve this problem without acquisition of land (Olajide, 2015) which is also convenient considering the private land ownership context of Dhaka. The underdeveloped structures with good accessibility could be considered for urgent phase development plan. However, for the long run, introducing land readjustment will be a good tool for redevelopment. Through land readjustment the private land parcel as well as public (road, open space, etc.) can be consolidated and thus help to shape the urban form. Only allowing development may results in chaotic growth as the existing road are not designed considering the high level of development that transit will induce in near future.

According to Louwsma et al. 2017, land readjustment can achieve five policy goals, if it is implemented carefully: First, it can assemble land for urban expansion and revitalization with minimal displacement. Second, land readjustment can help recover a portion of the project cost. Third, it can promote maximization and intensification of land use, thereby enhancing land value for landowners and expanding the property tax base for the municipality. Fourth, land readjustment can distribute land redevelopment costs and benefits equitably among landowners and other stakeholders such as the municipality, private developers, and the community, especially the urban poor and landless. Fifth, land readjustment can encourage public participation in policy decision-making. Land readjustment has been used in many countries as a tool to promote more inclusive and efficient urban development. It refers to a participatory process that also fosters trust and collective actions, because landowners are empowered to make decisions on planning, servicing and redevelopment.

6. CONCLUSION

Integration of transport and land use need to be trigger in developing cities before it's too late (Chorus & Bertolini, 2011). As the cities of developing countries are rapidly growing, opportunities for linking land development and transport infrastructure should not be ignored

(Harumain & Morimoto, 2013). A large share of future urban growth is projected for medium to large cities in the developing world (Habitat, 2011). Discourse of literature argue that many developing cities have the kind of prerequisite if mass transit investments are to trigger meaningful land use change, including rapid growth, rising real income, enhance congestion level (Suzuki et al., 2013). From the empirical case, along with the present spatial form of the study area, recommendation of Dhaka Structure Plan 2016-2035, Density Zoning Plan 2018 has been considered and land readjustment approach has been identified as the best redevelopment tool. This of course assume that there is supportive planning, density control, zoning, public sector leveraging, a commitment to travel demand management, control of private vehicle ownership and the capacity to control the land use are put into motion by transport infrastructure investment (Cervero, 2013). As Dhaka is spontaneous city with already existing higher population density and unplanned spatial growth (B. Ahmed, Hasan, & Maniruzzaman, 2014; S. Ahmed & Bramley, 2015; Kabir & Parolin, 2012; Khan & Siddiqua, 2015; Mowla, 2012), TOD implementation in this context is more challenging than other cities. Moreover, there is no previous TOD not even mass transit experience before. Therefore, the context specific forces need to be crafted very carefully to explore the best suitable typology and development recommendations.

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