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Lessons for Sustainable TOD by Japanese Private Railways: A Case Study of Tama Den-en-Toshi

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Abstract

This paper examines the sustainability challenges of the transit-oriented development (TOD) in suburban Tokyo, focusing on Tokyu Corporation's Tama Den-en-Toshi area. By tracing the historical evolution and urban planning theories that shaped this area, particularly the "Green Peas" structure, the paper highlights the balance between urban expansion and green-space preservation. Tama Plaza, a key district within this development, is explored as a case study to illustrate successes and ongoing challenges faced by the suburban TOD.

The paper also addresses the significant impact of the COVID-19 pandemic on urban living and commuting patterns in the Tokyo Metropolitan Area. As the shift toward remote work continues, it is crucial to reassess the role of suburban TODs, when the demand for local infrastructure, community spaces, and digital-technology integration is increasing. This changing dynamic offers both opportunities and challenges for areas like Tama Plaza, which must adapt to serve both residential life and evolving workspaces.

Finally, the paper offers policy recommendations for sustainable development in suburban areas by addressing aging populations, declining community cohesion, and economic pressures. The conclusions emphasize the importance of integrating digital technologies and revising land-use policies to ensure that TOD remains resilient and responsive to current and future residents' needs.

1. Introduction

1.1 Backgrounds and Objective

As one of the most important issues in the sustainable development of cities, Transit-Oriented Development, (TOD) has garnered interest in many developing countries in Asia. TOD has advantages, such as its ability to create a compact urban structure even in growing urban areas with increasing populations and to efficiently operate public transport without relying on private cars. Furthermore, TOD can also create an environmentally-friendly and sustainable urban structure. Furthermore, TOD can also create an environmentally-friendly and sustainable urban structure, as it is a form of urban development that integrates the urban transport and contributes to the future..

From this perspective, the Tokyo metropolitan area, which is considered to be a leading region for TOD in Asia, can provide much useful information. This is based upon the railway network for people who use public transport services at the highest priority for their daily mobility and for town developments or managements around stations. While this structure is partly underpinned by the historical background of railway networks being mostly completed before rising car ownership, it is worth examining if the TOD model can be exported or not to other places. In particular, the concept of sustainable TOD—the way of proceeding with projects through partnerships with private sector businesses—and the Stakeholders Associated TOD, which is based on the diverse stakeholders in the region, can be regarded as important examples.

The Japanese Transit-Oriented Development (TOD) model has achieved success, particularly through the integration of railways and with the association of private railway companies for urban development.. Studies show that new town developments in suburban Tokyo are planned around rail networks, contributing to community autonomy and promoting sustainable transportation (Sung & Eom, 2024). Tokyo's TOD, while relying on past transportation policies, also functions as a countermeasure to suburban urban sprawl, though further land-use policies are needed (Liu et al., 2022). Historically, private railway companies have linked real estate development with rail operations, creating communities dependent on rail transit (Yudi et al., 2023) This integration has facilitated high-density, pedestrian-friendly urban structures, increasing rail usage and fostering commercial development (Calimente, 2012). Additionally, Japanese TOD is characterized by a gradual and natural development known as “induced type TOD,” which is adapted to long-term land-use changes (Takayama et al., 2020). Moreover, urban compactness has contributed to the revitalization of commercial activities, which is a crucial element in the success of suburban TOD (Park et al., 2011). Overall, these studies illustrate that Japan's TOD serves as a significant global model for sustainable urban development.

These studies reveal several research gaps. Although historical analyses are abundant, research on how digital transformation (DX) and emerging technologies will impact TOD in the future remains scarce (Liu et al., 2024). There is also a shortage of empirical data on how current TOD models

will address issues such as aging populations and population decline, particularly in suburban areas (Sung and Eom, 2024). Furthermore, studies evaluating the social impacts of TOD in terms of economic inequality and social inclusion are lacking, with limited research on how TOD affects low-income communities (Calimente, 2012). These gaps highlight the need for more comprehensive and forward-looking analyses in the context of global TOD practices.

In this context, this paper focuses on the Tama Den-en-toshi area, which is a notable example of sustainable TOD in the Tokyo metropolitan area. The research objectives are: 1) to clarify the factors and methods that enabled diverse stakeholders to cooperate in the development of Tama Den-en-toshi as a whole, and 2) to present the mechanisms for collaboration among stakeholders in the operation stage of maturing and renewing the town after development through a case study of Tama Plaza. Further, we will review the environment surrounding TOD, which has changed significantly because of the recent spread of COVID-19 in Tokyo, and present our outlook for the future.

1.2 Structure of this paper

The study mainly focuses on cases of “Tama Den-en-toshi”, developed by Tokyu Corporation around a railway line, Den-en-toshi Line, in the south-western suburbs in Tokyo, from the 1960s.

The paper consists of five sections. After this introduction section, the concept and development history of Tama Den-en-toshi is described. The sustainable Den-en-toshi TOD (SDT) model is based on Den-en-toshi Line as a railway and an axis of TOD from Shibuya to Tama Den-en-toshi. The characteristics and conceptual background of SDT are also discussed in the next section. This is followed by a case study which focuses on the area around Tama Plaza station, one of the nuclei of Tama Den-en-toshi. It has a growth history as a main hub of local commerce and transport. The section also explores challenges and related projects in the area in the history of town development and management for fifty years with the aim of achieving a matured society and economy. Meanwhile, throughout decades towards a “matured” society/economy, various challenging issues and related projects of the area are explored with half a century history of town development/management and communities. The fourth chapter discusses post-COVID- vision for TOD. Experiences of individuals during the “COVID crisis” when they were forced to stay at home for working led to the understanding that they did not need to commute every day in the morning. It transformed railways from “commuting” to “communication,” and floorspace usage at suburban nuclei would be more mixed. However, DX is expected to play a vital role to promote sustainability. (Different phases of TOD—from 1.0 to 5.0—will be explained in section 2).ⁱ Finally, as concluding remarks, implications of the study for public policies and corporate strategies are discussed.

2. Concept and Development History of Tama Den-en-toshi

2.1 Historical Background : from Garden City to Tama Den-en-toshi

“Den-en-toshi” is a transformed concept of “Garden City” which was proposed by Ebenezer Howard in the late 19th century. Then, he proposed the idea of moving out to newly-created satellite towns in order to solve the serious problem of a low-quality living environment caused by congestion in the high dense central London. Realizing the Garden City at Letchworth, 50 miles north of London, this concept was later applied to the public policy of new towns.

Eiichi Shibusawa, an influential businessperson in the history of Japanese modernization, sympathized with Howard’s idea and tried to import it, translating as “Den-en-toshi”. In this period, Ichizo Kobayashi, the founder of Hankyu at Ikeda-Minoo area in Osaka Metropolitan Area, had already implemented developments like “Garden City.” However, the model was different from that of Howard who tried to build self-contained towns for living and working together; the Japanese “Den-en-toshi” was an area for living and not for working. Railway services were provided for those who worked in the center to commute every day (TOD 1.0). With the help of Kobayashi, Shibusawa’s friends developed Tamagawadai area into current Den-en-chofu, where the town around the station consisted of radial and orbital roads like “etoile” of Paris, which is centered around the symbolic station building.

The new towns were developed mainly under the initiative of the national government in order to accommodate the rapidly-increasing population in the suburbs after the war. Among these towns, Tama Den-en-toshi was planned and developed by Tokyu Corporation, a private railway/TOD firm located in about five thousand ha. This was triggered by a report of Keita Goto, the founder of Tokyu, “Prospectus for Development of the South-West of Tokyo” dated in 1953. In this report, a large-scale development of property for residential use and an axis of railway (or expressway) was proposed). Tokyu launched the project by organizing communication platforms with individual landlords. The development was not done by buying the whole land but by making partnership with the landlords under the scheme of land readjustment. Although the sites were reduced for public spaces like roads, schools, parks and the “reserve” for construction costs, the value increased by the transformation of the land from green fields and agricultural/forestry uses to built-up residential areas and the railway for the Den-en-toshi Line. As a result of the communication, 58 development corporations were organized for a 3,213 ha area. This first stage of the development commenced in the 1960s and the development reached its peak in the 1970s, and was almost finished in the 1990s. The total area is divided into four blocks from inner to outer: Kawasaki; Yokohama Aoba east of Tsurumi River; Yokohama Aoba west of Tsurumi River; the others (Yokohama Midori, Machida and Yamato). Each block has a core nucleus at a railway station: Saginuma; Tama Plaza; Aobadai; – Minamimachida, respectively. A distinctive characteristic of Tama Den-en-toshi is that areas around these nuclei, such as Tama Plaza Terrace and Minamimachida Grandberry Park with symbolic stations, have been developed mainly for commercial uses(Fig 2). In addition, Futakotamagawa Rise, located between Shibuya and Tama Den-en-toshi is another example of TOD and is characterized by its mixed

use with offices. The area is clearly different from areas where large-scale property developments were undertaken in such a way that public transports could not access them. This vision and strategy for the second stage of the TOD development resulted in the higher extent of public transport usage of Tokyu “Ensen”— the linear area around railway lines—compared with others (Fig 3).

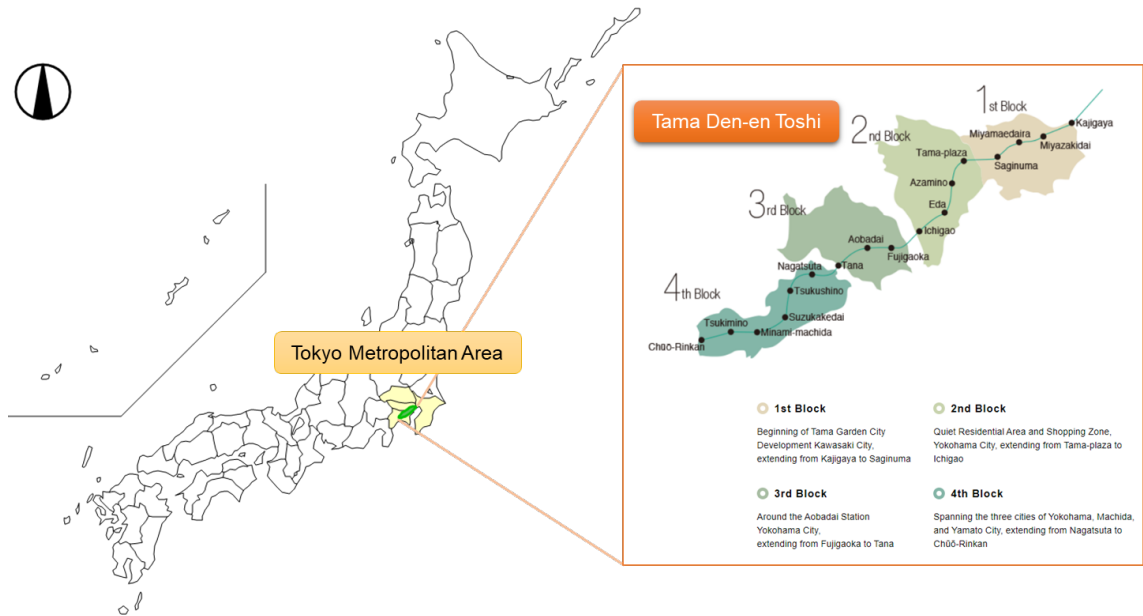


Fig 1 Location of Tama Den-en Toshi



Fig 2 Tama-Plaza station

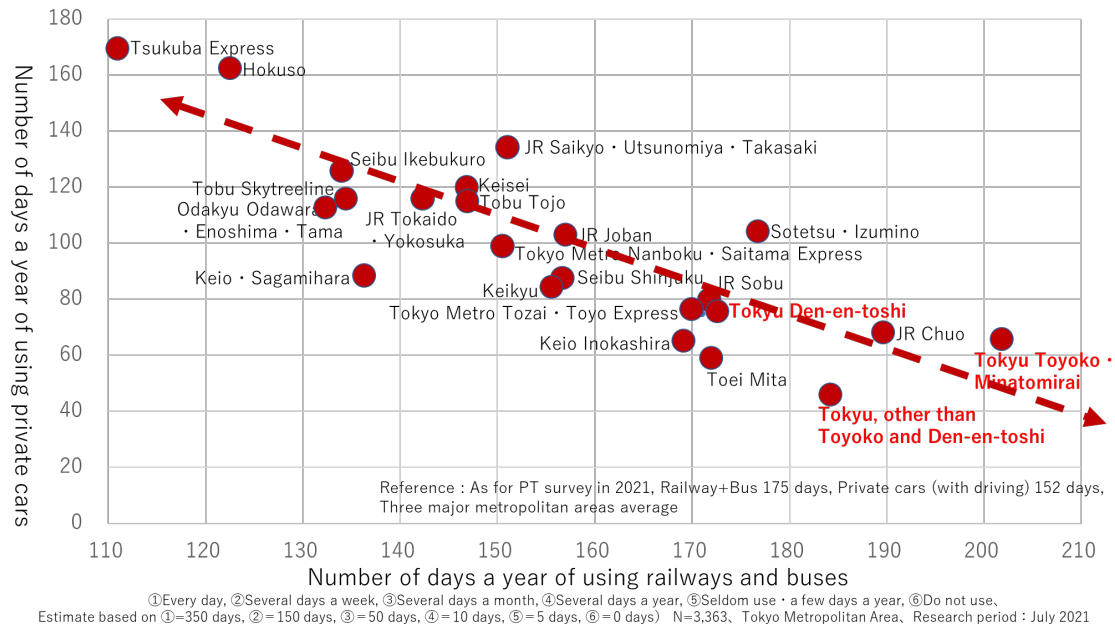


Fig 3 The extent of TOD by “Ensen”

2.2 Features and Evolution of TOD in Tama Den-en-Toshi

This study assumes that TOD has evolved in the following five stages:

- TOD 1.0 (- 1980) : In “Garden City” proposed by Ebenezer Howard in Britain and the Japanese “Den-en-toshi,” people started living in suburbs and working in the center..
- TOD 2.0 (- 2000) : Commercial nuclei appeared in suburbs providing various life services in addition to various life services.
- TOD 3.0 (- 2020) : Branding of “Ensen” is acknowledged as an important issue to compete with other areas and attract people to live, work, and visit, based on partnership with surrounding communities and area managements around stations.

The year of 2020 was the turning point of TOD, because the COVID -19 resulted in insisted changing lifestyle changes, especially in the way of working. It is accompanied with the widespread of DX as communication tools . Subsequent TOD 4.0 and 5.0 are as follows.

- TOD 4.0 (2020 -) : It is based on the “new normal” of post-COVID-19. Lifestyle changes bring about the change in the city structure. However, it should be recognized that minds for “sustainability” are rising. Throughout the transformation of the structure from “Green Peas” to “Natto” described later, sustainability and civic pride are promoted. Originally commerce-oriented suburban nuclei were reorganized. As for the center, various measures like urban design are significant for sustaining or promoting the status of a world city under harsh competitions among those in Asia.
- TOD 5.0 (2020 -) : Regarding the utilization of DX (or GX), creating networks and connectivity

like “Ensen” without close physical proximity among related parties and towns is not difficult. This implies the potentiality of increasing relationships or interactions in the population for regional revitalization and more sustainable behavior.

2.3 Concept and Vision

The characteristic of private railways in Japan is that income percentage from transport is abysmally low at about 20 – 30% (Fig 4). The others come from those related businesses like real estate, retail, hotel and entertainment. This means that Japanese railway firms are characterized as TOD firms, organized as conglomerates at each local “Ensen” base by various life-related industries and have the potentiality of taking initiative for making areas more sustainable. In fact, all the major TOD firms promise contribution to the sustainable development of regions in materialities expressed by integrated reports.

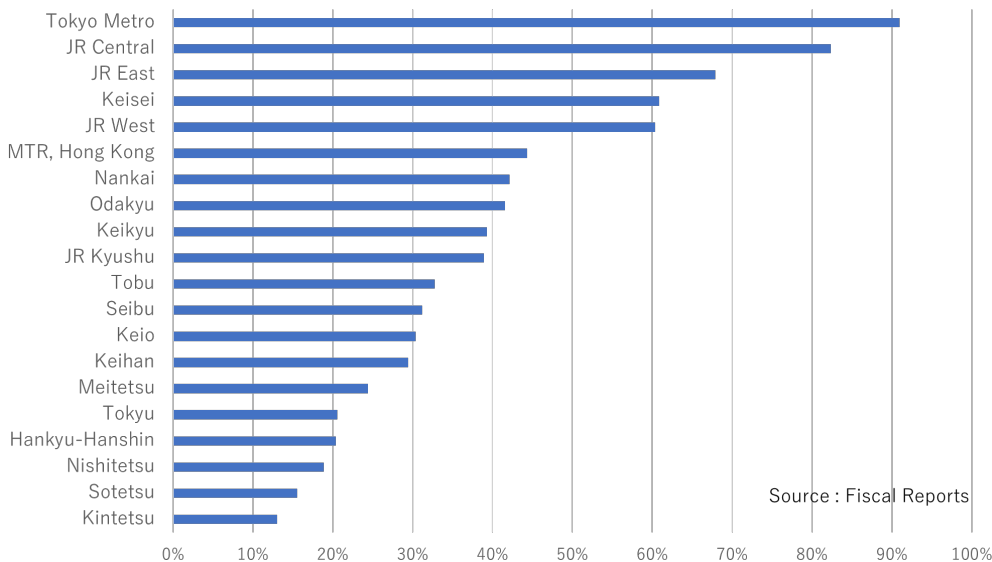


Fig 4 Proportion of transport business, 2023FY

By the way, what is “sustainable” ? Although the term can be defined to convey various concepts, here, it is used for something that meets the following five criteria.

1. Resilient community with minimizing environmental load

Carbon neutrality, disaster or pandemic readiness, circular economy, and local production or consumption

2. Guarantee of moderate “Sokosoko” Quality of Life, QoL

Safety, security, health, income, diversity and inclusion, and solving social issues

3. Feel moderate “Sokosoko” economic growth

Innovation, entrepreneurship, social enterprise, creative work, mutual aid, sharing

4. Effective utilization of the first-end technology

Society 5.0, ICT, DX, Big data utilization, Smart city, Mobility, MaaS, Caas

5. Respect for history and culture

Area management of axes and bases, Liberal arts, Walkable urban space

“Sokosoko” is a key phrase which means “to know one has enough.” Used by Philosopher Lao-tse about 2,500 years ago in China, economy works in the shape of a doughnut with two concentric circles in which one ring represents individuals’ meeting their essentials whereas the other represents their activities without crossing ecological boundaries. used by Kate Raworth. In order to effectively promote sustainability, a linear “Ensen” structure has been hypothesized for TOD. The SDT (Sustainable Den-en-toshi TOD) model, proposed for Shibuya to Tama Den-en-toshi in the south-west of Tokyo, takes the initiative based on the following features.

1. From Shibuya, nuclei; i.e. Sangenjawa, Futakotamagawa, Mizonokuchi, Saginuma, Tama-plaza, Aobadai, Minamimachida GBP, are located on the axis.
2. people can effectively move by Den-en-toshi railway line Stations are integrally developed with a symbolic design and surrounding premises/infrastructure, including various urban functions at centers.
3. Schemes of the “area management” are built to internalize external impacts around centers.
4. Various people who are exchanged to “places” in the “Ensen” area produce innovations which enable the rich QoL.
5. Total coordination between urban functions and mobility leads to carbon neutrality.
6. Progress towards the local production or consumption of energy and foods is achieved.
7. Progress towards design-oriented town development or management which respects history and culture is achieved.
8. Schemes of CSV, e.g. creating a shared value, encourage partnership between local communities and companies to create value.

It has been recognized that these features are realized in every “Ensen,” if the model is transferred.

The fundamental structure of TOD 3.0 is “Green Peas” which is a metaphor composed of peas and a pod (Fig 5). Peas are towns around stations that extend along railway lines and are surrounded by a pod, or an “Ensen” area with unique identity. This “Green Peas” concept was included in the medium-term management plan of Tokyu Corporation for 2005 – 2007 as strategy for the corporate growth and sustainability of areas. It was emphasized that area branding based on a partnership with various parties like local communities, governments, and other stakeholders led to a high value addition, attracting people to live, work, and visit under harsh competitions with other “Ensens.”

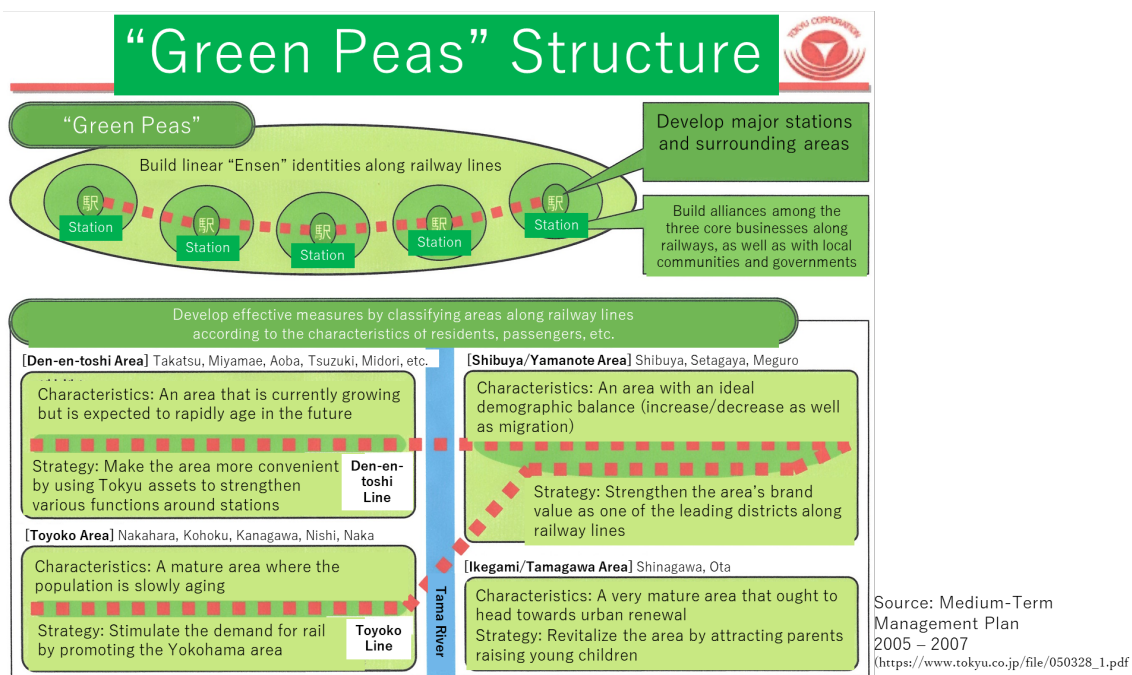


Fig 5 “Green Peas” Structure

Almost two decades have passed since the announcement of the “Green Peas” strategy. Business environment of TOD firms has significantly changed owing to COVID-19 and the rising awareness of sustainability. Suburbs, where people just live in the phase of TOD 1.0 – 3.0, start performing further functions, especially working. Railways, which previously focused on handling the commuting demand, are characterized as services for communication among areas on lines. Furthermore, in order to transform areas according to a more sustainable TOD, it is essential to bridge differences among “Ensens” to expand their linear activities to wider areas. The vision is realized by creating a network structure, in which nuclei are organized between lines and axes like mobility or green infrastructure (Fig 6). As this network structure looks like sticky fermented soy-beans, “Natto”, “NATTO-work” has become the basic concept for TOD 4.0 in the post-COVID era.

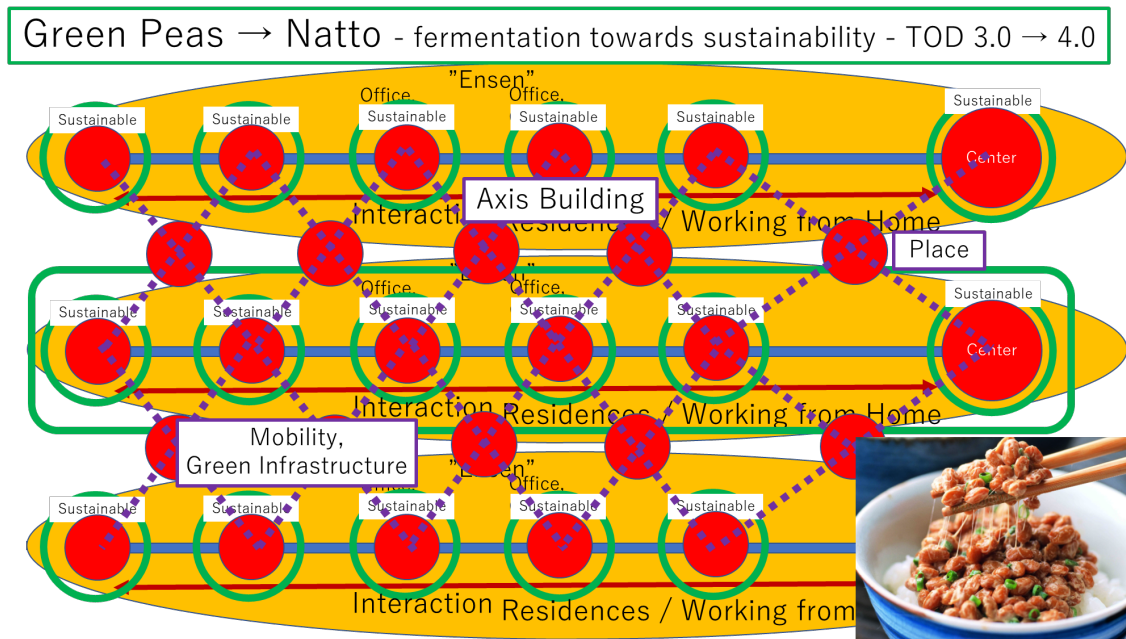


Fig 6 From “Green Peas” to “Natto”

In addition, the “NATTO-work” can be further expanded to remote areas, such as local cities and overseas countries, where TOD firms operate their business like hotels. From the perspective of Tokyu, “Ensen” of Hokuriku Shinkansen has great potentiality with various business resources areas, such as Ueda, Nagano, Toyama and Kanazawa, especially Aoki-mura where the founder, Keita Goto, was born.

3. TOD in Suburban Tokyo: A Case Study of Tama Plaza

TOD has played a critical role in shaping suburban areas in Japan, particularly in the Tokyo metropolitan region. This section focuses on Tama Plaza, the prime example of suburban development driven by TOD principles. Tama Plaza, located along the Den-en-toshi Line operated by Tokyu Corporation, offers valuable insights into the formation of suburban residential areas, the challenges they face, and the potential of TOD in a post-COVID, "new normal" era.

3.1 Background: The Role of Private Railway Companies in Japan’s Suburbanization

The post-war rapid economic growth in Japan led to severe housing shortages in urban centers, particularly in Tokyo. In response, large-scale housing developments were planned in suburban areas for the transformation of the vacant agricultural land into residential zones. Private railway companies, including Tokyu Corporation, played a central role in this suburbanization process. These companies developed not only railways but also residential areas along their lines, creating

self-sustaining suburban communities following TOD 1.0 outlined above. This method of urban development is distinctive in Japan, where private railway companies often act as urban developers, integrating transportation networks into the land-use planning.

Tokyu Corporation's Den-en-toshi Line, which connects suburban areas like Tama Plaza to central Tokyo, is a key example of this approach. The development of Tama Plaza, initiated in the 1960s, is a hallmark of this collaboration between transportation and urban development. The name "Den-en Toshi" translates as "Garden City," which is borrowed from Ebenezer Howard's Garden City concept. However, while Howard's vision emphasized self-contained cities, Japan's suburban developments, including those of Tama Plaza, maintain a strong commuting connection to Tokyo, relying on rail networks to link residential areas with the urban core.

3.2 Historical Overview of Tama Plaza

Tama Plaza, which had no housing in the 1960s, was transformed into a thriving suburban center by the 1970s as explained in TOD 2.0. The development of Tama Plaza was part of a greater national effort to decentralize the population and industries concentrated in central Tokyo. The population in Tokyo's 23 wards began to stagnate in the 1970s as people moved to newly-developed suburban areas like Tama Plaza. These suburban areas were designed to offer better living environments, including lower-density housing, green spaces, and comprehensive community facilities.

In the 1980s, suburban residential areas became focal points for community activities, particularly among women involved in child-rearing. By the 1990s, the aging population led to an increasing demand for care services, signaling the beginning of new challenges for suburban areas like Tama Plaza.

3.3 Current Challenges in Suburban Areas

Despite its initial success, Tama Plaza and similar focal areas for suburban developments are now facing significant challenges. The aging population is a major concern, as suburban areas have originally been designed for younger families. The area is also seeing a rise in vacant houses, as fewer young people are moving to suburbs, preferring rental housing in central Tokyo. The topography of the area, with its many hills, presents additional difficulties for elderly residents, who struggle with mobility and access to services.

Furthermore, suburban areas are experiencing a decline in community cohesion. Many original residents who purchased houses in these areas have lived there for decades, leading to an aging, static population. There is little generational turnover, and younger generations are getting increasingly disinterested in suburban living, finding suburban areas as less attractive than urban

centers. This has led to a decline in community interaction and a lack of communication between old and new residents.

Economically, the suburban model in which people once relied on commuting to the city is under pressure. As more people begin to work remotely in the "new normal," post-COVID-19 era, there is a growing demand for suburban areas to support both residential life and workspaces. This shift presents an opportunity for suburban areas like Tama Plaza to reinvent themselves, though it also poses challenges in terms of infrastructure and community planning.

3.4 TOD and Future Development in Tama Plaza

TOD has been at the core of Tama Plaza's development, with Tokyu Corporation playing a pivotal role in shaping the area's urban structure. The development is characterized by a mixed-use design, with commercial areas, residential zones, and transportation hubs integrated into a cohesive urban fabric. The proximity to the Den-en-toshi Line ensures that residents have easy access to central Tokyo, while local amenities provide for people's everyday needs.

In the recent redevelopment of Tama Plaza, the renewal of commercial areas and improvement in the living environment have been focused. Tokyu Corporation has worked with the Yokohama City government and local residents to develop new facilities, including the Tama Plaza Terrace, a shopping center designed to meet people's 21st-century needs. Additionally, new housing developments, such as the founding of a child-centered housing complex near the station, have been introduced to attract younger families.

The concept of the "Living Lab," a community hub located 10 minutes from the station, represents an innovative approach to fostering community engagement not only for areas around the station but also for those along the railway line to create "Green Peas" structure and addressing challenges faced by an aging population. This space allows residents to participate in shaping the future of their community and encouraging multigenerational interaction and collaboration between the public, private, and local sectors. This is an advanced case outlined in TOD 3.0 above.

4. New Normal Suburbs: Vision for the Future

As suburban areas like Tama Plaza look to the future, the concept of the "new normal" suburb is gaining attention. The COVID-19 pandemic has accelerated changes in how people live and work, with more emphasis on remote work, green spaces, and local economies. In this context, Tama Den-en-toshi has the potential to become a model for sustainable suburban living in the post-pandemic era, expanding the *ensen* according to network of structure of "NATTO" in TOD 4.0.

Key features of the new normal suburb include the integration of digital technologies, such as Digital Twin and Agile urban planning, which facilitate a more flexible and responsive urban development. Automated driving and other technological advancements are expected to transform transportation patterns, reducing the need for long commutes and increasing the importance of local mobility solutions.

In this future vision, suburban areas like Tama Plaza will need to adapt to new economic activities, with more people working and raising families in suburbs rather than commuting to the city. The focus will be on creating livable, low-density environments that balance residential life with economic opportunities. The development of green, outdoor spaces will be crucial in promoting people's health and well-being, while changes in commerce, such as the rise of e-commerce and the decline of traditional shopping centers, will reshape the suburban economy.

4.1 Importance of Walkable Neighborhoods in the Post-Pandemic Era

The COVID-19 pandemic significantly altered many aspects of our daily lives, leading to a new understanding of urban living and spaces we inhabit. Nearly two years since the pandemic first disrupted life as we knew it, some changes have persisted, while others have gradually reverted to pre-pandemic norms. Among the most significant lessons of the pandemic is the importance of walkable neighborhoods and their role in shaping a sustainable and resilient urban future.

One of the most immediate and widespread changes during the pandemic was the restriction of movement and social distancing. Face-to-face interactions were minimized, and virtual communication surged as people adopted remote working and online socializing. Teleworking, which had existed in the pre-pandemic era despite being relatively niche, quickly became the mainstream. In many ways, the pandemic has acted as a catalyst for the adoption of telework, expediting the use of technology that had not been not fully utilized, despite its long-time availability.

As telework has become an entrenched part of the work culture, particularly in major cities, it is expected to persist in the post-pandemic era. A survey by the Tokyo Metropolitan Government in 2023 found that hybrid teleworking, where employees combine working from the office with what they do at home, has become more prevalent than full-time remote work. This pattern is likely to remain as a flexible solution for many companies and employees moving forward. Interestingly, the ratio of teleworkers is higher in Tokyo than in other global cities like New York and London, highlighting the widespread acceptance of this new mode of work in Japan.

As people began spending more time at home, the importance of their immediate living environment grew. With less need for daily commutes, residents found themselves spending more time in their neighborhoods. This shift has increased the value of walkable areas—neighborhoods where daily necessities, such as groceries, parks, and recreational spaces, are accessible on foot. Walkability, once seen as a secondary benefit, has now become a primary factor in evaluating the livability of a neighborhood.

Moreover, there has been a growing preference for suburban and rural living, where more space, greener environments, and larger homes are available. This contrasts with the previous trend of living in dense urban centers, which was driven largely by proximity to workplaces. Now, as the reliance on commuting diminishes, suburban and rural areas are gaining popularity for their ability to provide a more balanced, health-conscious lifestyle.

4.2 Changing Demographics and Migration Trends

The shift to telework has profoundly affected the demographic landscape, particularly in the Tokyo metropolitan area. As the need for commuting decreased, many residents began reconsidering their living arrangements. During the pandemic, there was a notable migration from the central wards of Tokyo to suburban municipalities, such as those in Kanagawa Prefecture. Although the overall population of the Tokyo metropolitan area remained relatively stable, this internal migration marked a significant shift in living preferences.

The real estate market reflected these changes, with office vacancy rates in central business districts rising sharply in the early stages of the pandemic. As companies reduced their need for physical office space owing to teleworking, rents in business districts like Chiyoda, Chuo, and Shibuya fluctuated. While office rents eventually stabilized as the pandemic subsided, the trend toward living in suburban areas and away from central office spaces has had lasting implications.

4.3 Toward a New Vision for Sustainable suburb

As of fall 2023, the pandemic has largely subsided, and we are now transitioning into a post-pandemic world. This period presents an opportunity to rethink urban planning and the development of sustainable cities, particularly in suburban and rural areas. The current trends echo the early 20th-century ideas of Ebenezer Howard's Garden City, which promoted migration from congested urban centers to healthier, more spacious environments.

In the post-pandemic era, reimagining rural cities as not only places of residence but as self-sufficient, walkable communities that integrate modern work-life dynamics is essential. As telework has been embedded in our work culture, suburbs areas must be designed to accommodate

both living and working, providing residents with access to amenities, technology, and green spaces, all within a walkable distance. The next generation of rural and suburban cities should prioritize walkability, sustainability, and community, ensuring that they are not simply bedroom communities but vibrant, functional spaces that cater to modern needs.

The pandemic has left a lasting impact on how we view our living environments, highlighting the importance of walkable neighborhoods and sustainable suburban and rural living. As we move into the post-pandemic era, the shift toward more flexible work arrangements and the growing preference for suburban living present new challenges and opportunities for urban planners. Developing sustainable, walkable communities will be key to creating cities that are resilient and livable and are equipped to meet the future demands.

5. Conclusion

Tama Plaza serves as a valuable case study for understanding the past, present, and future of suburban development in Japan. As a TOD-based suburban community, it is essential to highlight both successes and challenges of the TOD model. While the aging population, vacant housing, and declining community engagement present significant obstacles, the collaborative efforts of local residents, the government, and private companies like Tokyu Corporation offer a roadmap for the future. In the new normal era, suburbs like Tama Plaza must continue to evolve, leveraging new technologies and executing sustainable urban planning to remain vibrant and livable communities.

Furthermore, a workshop by “activist” of town management held by Tokyu Research Institute on 16 February 2022 made clear potentiality to expand the activities around Tama Plaza station to Shin-yurigaoka on Odakyu “Ensen” in Kawasaki City, which means advancement from “Green Peas” to “Natto” model. DX accelerates the Natto structure for remote places, possibly those in overseas countries.

- 1) Overall, it is clear that transition of TOD from “Green Peas = TOD 3.0” to “Natto = TOD 4.0” is indispensable to create “sustainable” urban structure. Furthermore, TOD 5.0, utilizing DX and GX, is assumed to be effective to more balanced development at a nationwide and worldwide scale. Referring the case of Tama Plaza and study about changing behavior of post-COVID, mentioned in this paper, it is implied that the following three issues are essential to be explored. Hardware : If railways and property developments are carried out independently, it results in inefficient structure from a point of view of TOD. These should be integrated under a plan which has been made consensus by stakeholders, in addition to investment on infrastructure with public-private partnership (Fig). Some stations should be strategically designated as hubs where passengers can transfer to the secondly transports to access wider areas. High

density and well-designed nuclei/axes developments are effective to increase the ridership and promote civic pride.

- 2) Software : It should be pointed out that historical background of Japan that car ownership was low in the railway development period enabled people to naturally use public transport in their daily life. In case applying the “SDT” model, to cities where culture of using private cars is widely spread, soft measures of encouraging them to change life style should be implemented, such as stimulating “sustainable” mind of using more energy efficient = environmentally friendly mode and fashionable life style of exchanging diverse parties in the middle of town centers.
- 3) Management : “Green Peas” and “Natto” is sustained by approaches of area management. Originally, this is to internalize external impacts; i.e. accept “Trickled Down” values. However, in order to make areas more “sustainable”, it should be transformed to promote “Fountain Effects”; i.e. create original value from local small but strong parties’ innovations. This is based on communication and exchange between communities and private TOD firms, supported by public sectors, as sometimes they are beyond municipal boundaries especially on “Natto” structure.

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