Urban Agriculture as a Tool for Adapting Future Cities

Keidai Kishimoto and Wanglin Yan

Abstract Urbanization, industrialization, and improvements in transportation have meant that most produce (fruits and vegetables) no longer needs to be produced within the cities where they are consumed. It can be more efficient to grow food intensively and on a large scale in rural areas. The separation of agriculture and cities raises issues about energy consumption for transport and massive use of pesticides and fertilizers in rural areas while the loss of farmland reduced food security in overcrowding cities. The benefits of urban agriculture have been attracting more attention in recent years, especially since the COVID-19 pandemic in 2020. While the capacity of urban agriculture is limited yet, it can indeed provide beneficial ecosystem services such as supplying healthy and fresh vegetables to urban dwellers, mitigating heat island and climate change, offering recreational opportunities, and alleviating disaster risks, etc. Japan's Basic Act on the Promotion of Urban Agriculture, enacted in 2015, recognized the importance of urban agriculture. This chapter will first review the trends and related policies of urban agriculture in Japan, and then introduces the services and functions of urban agriculture in Tokyo from the urban planning perspective.

Keywords Urban agriculture · Land use change · Ecosystem services

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1 Policies and Trends of Urban Agriculture in Tokyo

1.1 Basic Act on the Promotion of Urban Agriculture

Under Japan's Basic Act on the Promotion of Urban Agriculture, enacted in 2015, central and local governments are mandated to take concrete measures for conserving and promoting urban agriculture. In the past six decades, city planning in Japan was based on the assumption that agricultural land in cities should be converted to residential land uses. However, the Basic Act shifted the paradigm (Ishihara 2019), to the view that urban agriculture is a valid land use, and that agriculture does belong in cities (Ministry of Agriculture, Forestry and Fisheries and Ministry of Land, Infrastructure, Transport and Tourism 2016). The Basic Act conveys the messages that (1) urban agriculture should be conserved in order to deliver various ecosystem functions, (2) city planning should aim to make a better environment through coordination of built-up land uses and agricultural land uses via the multifaceted functions of urban agriculture, and (3) cities should promote urban agriculture in ways that are compatible with local conditions (Ministry of Agriculture, Forestry and Fisheries and Ministry of Land, Infrastructure, Transport and Tourism 2016).

Accompanying the Basic Act, the Basic Plan on the Promotion of Urban Agriculture listed six functions of urban agriculture: (1) supplying agricultural production, (2) preparing for disasters, (3) forming favorable landscapes, (4) maintaining the national land and environment, (5) providing opportunities for farming experience, learning, and communication, and (6) enhancing understanding of agriculture (Table 1). Some functions are unique to Japan (Sect. "Services of Urban Agriculture in Tokyo"), but most functions have been demonstrated by researchers around the world who have studied urban agriculture (e.g., Lovell 2010; Peng et al. 2015; Shinji 1995; Azuma 1995).

Accordingly, local governments have reacted with ten measures as listed below.

Table 1 Expected benefits of urban agriculture in Japan. (Source: Ministry of Agriculture, Forestry and Fisheries and Ministry of Land, Infrastructure, Transport and Tourism (2016))

Benefits	Examples
Agriproducts	Fresh local produce
Disaster	Fire prevention, shelters, temporary housing sites
Scenery	Relaxation
Environment	Rainwater infiltration, groundwater recharge, biodiversity conservation
Society	Experiencing and learning about agriculture, exchanges between producers and residents
Understanding	Fostering understanding of agriculture and agricultural policy

1.1.1 Improving the Supply of Agricultural Products and Attracting/Fostering Farmers

Governments support the matching of farmland lessors and lessees and the entry into agriculture by social services and education. Some farmers employ persons with disabilities in an effort to support agricultural management and encourage their participation in society, while they also gain a sense of purpose and confidence by engaging in agriculture. Governments also support the introduction of screens, greenhouses, hedges, and appropriate waste disposal to prevent pesticide spraying, odors, noise, and dust from affecting surrounding nearby residential areas. For example, Tokyo Metropolitan Governments supported 63, 56, and 39 farm households in 2013, 2014, and 2015, respectively, to introduce facilities (Tokyo Metropolitan Government (a) (n.d.), (b) (n.d.), (c) (n.d.)). Some agricultural products have brand names unique to the region, as branding can help spotlight and preserve the local culture.

1.1.2 Promoting Disaster Prevention, Landscape Enhancement, Land/Environmental Conservation

Governments conclude agreements with related organizations and including farmland as part of regional disaster prevention plans. Farmland can play a role in fire prevention and as temporary evacuation sites.

Governments also promote agriculture-related landscapes (e.g., traditional groves around farmhouses, irrigation watercourses, etc.) in landscape plans, special green space preservation areas, and green master plans.

1.1.3 Developing Accurate Land Use Plans

Governments incorporate farmland (large areas, long-term use) into Urbanization Control Areas. They also include farmland into the site optimization plans and master plans to control future land use. In 2018, “Countryside Residential Districts” is introduced in Japanese zoning system, which previously consists of 12 categories to regulate the types of land use in urban areas. In Countryside Residential Districts, developments are prohibited without governmental permission to control the balance between agriculture and living environment. This is expected to support managing urban agriculture (Akashi 2018).

1.1.4 Tax Measures

Farmers let their farmland registered inside Urbanization Promotion Area as Productive Green Space for reaping favorable tax, if they intend to keep farming for

30 years. When farmland was not so designated, farmers would pay taxes equivalent taxes on residential land. The Act on Productive Green Space was enacted in 1991 and revised for the first time in 2018. The government has relaxed the conditions for registration and allowed the construction of farmer restaurants and farmer's market inside Productive Green Space.

1.1.5 Promoting Local Consumption

Governments support the expansion of sales channels, including fresh produce stands and restaurants. They also promote the use of local products in school lunches and social services facilities. For example, in Tachikawa City, vegetables grown in the local account for 16.8% of the total amount of vegetables purchased for school lunches in 2020 (Tachikawa City (n.d.)).

1.1.6 Developing Programs/Conditions for Agricultural Experience

Governments dispatch experts to create programs, and provide supports for maintenance of allotment gardens and experience farms. From the 1960s to the 1980s, today's allotment gardens began to develop in Japan by utilizing vacant farmland, and in 1990 various acts were enacted to manage allotment gardens for improving urban environment (Kudo 2009). The 432 allotment gardens were provided in the end of March 2018 by local governments (84.8%), farmers (10.7%), etc. (Tokyo Metropolitan Government (e) (n.d.)). Efforts to expose urban residents to urban agriculture provide opportunities for them to experience and learn about farming.

1.1.7 Enhancing Opportunities for Agricultural Experience in School Education

Some local governments incorporate year-round agricultural experience into curricula and extracurricular activities and develop teaching materials and manuals. (In Japan, agricultural experience in school education is limited to planting and harvesting; there is room to improve the effectiveness of learning opportunities).

1.1.8 Promoting Public Understanding and Interest

Governments advertise urban agriculture through the media and events and provide opportunities for urban residents to experience agriculture and agricultural products through agricultural festivals and farmers' markets.

1.1.9 Promoting Agricultural Learning and Skills Development for Urban Residents

Governments promote initiatives to allow urban residents to participate in urban agriculture as volunteer farmers, attracting urban residents who would like to be involved in agriculture due to a growing interest in farming and health promotion.

1.1.10 Promoting Research

Governments promote the development of basic data and statistics on urban agriculture, as well as empirical evaluation of the effects of measures and model cases.

1.2 A Look at Tokyo and Municipalities

Plans for urban agriculture promotion are formulated in each prefecture and municipality. In Tokyo, because urban agriculture includes not only allotment gardens and educational farmlands, but also many professional farming operations, professional farmers play an important role in determining whether or not urban agriculture is conserved and promoted.

The Tokyo Metropolitan Government encouraged urban agriculture and promoted the concept to the national government even before the adoption of the Basic Act on the Promotion of Urban Agriculture. The Tokyo Metropolitan Government aims to have urban agriculture coexist with cities and contribute to the lives of a large urban population (Tokyo Metropolitan Government 2017). It has basic guidelines that promote (1) fostering new farmers and developing strong management styles, (2) preserving farmland and fulfilling its multifunctional roles, (3) promoting sustainable agricultural production and local production for local consumption, and (4) promoting agriculture that takes advantage of regional characteristics (Tokyo Metropolitan Government 2017).

Each municipality positions its agricultural promotion plan in response to national and Tokyo Metropolitan Government plans, higher-level plans such as urban master plans, and related plans such as green master plans and basic plans for industrial promotion. In Tokyo, 27 out of 49 cities had agricultural promotion plans or similar plans as of January 2020. Most of these plans are to be reviewed every 5 years and revised every 10 years. Some municipalities that do not have a plan specifically for agriculture do have an equivalent plan (such as a detailed policy for the agricultural sector as part of an industrial development plan).

Comparing the plans of some municipalities in Tokyo on the promotion of urban agriculture, we found that the major cities emphasized the relationship between agriculture and urban/community development, while the suburban municipalities emphasized support for agriculture as an industry, such as local consumption and

agricultural management support (Arakawa and Akita 2021). Urban areas with large populations and fragmented farmlands of small area tended to focus on the significance of agriculture for their citizens, while suburban areas tended to focus on developing the agricultural industry. In basic policies as well, urban areas tended to focus on the general public, while suburban areas tended to focus on agriculture as an industry. In addition, while value-adding through branding is more prevalent in large cities, value-adding in suburban areas is promoted through the integrated promotion of the growing, processing, and consumption of produce (referred to as "sixth industry").

1.3 Evolution of Urban Agriculture Policy in Japan

In Sects. "Basic Act on the Promotion of Urban Agriculture" and "A Look at Tokyo and Municipalities", we confirmed that the Basic Act on the Promotion of Urban Agriculture established a policy for promoting urban agriculture and related policies. There was a paradigm shift in the policy approach toward urban agriculture in Japan, replacing the perspective that farmland in urban areas should be converted to residential uses with the current perspective that farmland should belongs in the urban environment. Historically, urban agriculture was actively excluded and converted to residential areas, but the past attitudes were gradually relaxed, and today, urban agriculture is being conserved and promoted. These processes resulted in the current landscape of urban agriculture in Tokyo. It is necessary to understand this as the background for future developments. This section outlines the historical evolution of urban agriculture policy in Japan.

During the period of high economic growth after World War II, Tokyo Metropolitan Area had concentrated industries and populations extensively, leading to a proliferation of sprawling development. Due to a serious shortage of housing in urban areas, farmland was being converted to residential land. Satoyama (traditional Japanese rural landscape with a mosaic type of land uses including semi-natural ecosystems) (Ichikawa et al. 2006; Takeuchi et al. 2003) were also being modified to accommodate new towns and housing complexes all over Tokyo. In 1968, the City Planning Act introduced a zoning system to limit urbanization. This zoning system divided urban areas into Urbanization Promotion Areas and Urbanization Control Areas, encouraged the conversion of Urbanization Promotion Areas to residential land within 10 years, and encouraged the conversion of agricultural land.

However, with rapid urbanization, the cities were getting overcrowded, and green space sharply declined in the 1970s and 1980s, and living environment worsened. Furthermore, the so-called bubble economy (asset inflation) encouraged the development of suburban areas and dramatically raised land prices. Based on the increasing demand for land, the attention of land use policy has shifted to the interests for better living environment. The Act on Production Green Space enacted in 1991 set the scene for a new urban agriculture scheme by dividing urban agriculture into (1) what should be converted to residential land, and (2) what should be conserved as

Productive Green Space. In order to take advantage of the new system, many farmlands were designated as Productive Green Space (PGS) in 1992. Those contractors of PGS are now facing either to renew or release to residential market because of land succession.

After the collapse of the bubble economy, the Tokyo Metropolitan Area faced a new phase. Urbanization process has being shifted to re-urbanization (Kanda et al. 2020; Ushijima 2012) as described by Klaassen's model (Klaassen et al. 1981). In these shrinking urbanization stages, society came to expect urban agriculture multiple functions rather than paved built-up areas. As a precursor, the Food, Agriculture, and Rural Areas Basic Act in 1999 indicated that the government should implement the necessary measures to promote agriculture to meet urban demand by taking advantage of proximity between farmland and the areas where farm output would be consumed.

2 Agricultural Land Use Patterns in Tokyo

As described above, along with social maturity, the approach toward urban agriculture in Japan has gradually changed from viewing farmland as something that should be converted into residential land, to viewing farmland as belonging in cities. However, the evolution of attitudes toward land in cities has produced a fragmented distribution of small-scale farmland, and weak urban agriculture. The distribution pattern of farmland has changed dramatically in accordance with individual circumstances, social conditions, and government policies toward urban agriculture. To get fruitful services from urban agriculture, it is important to protect existing farmland. In this section, we will examine the situation of existing farmland, the significant decrease of farmland in the past, and current distribution patterns.

2.1 Farmland Loss and Conversion

The area of agricultural land in Tokyo has decreased by about half over the past 40 years (Fig. 1). In particular, the area of rice paddy has decreased significantly, from 7360 ha in 1975 to just 249 ha in 2015, and the area of field has decreased from 13,200 ha in 1975 to 6470 ha in 2015. In the meantime, despite several policies changed as mentioned above, the loss has continued steadily. Figure 2 shows that the area of field designated as Production Green Space decreased by about 20% over the 20 years from 1995 to 2015, while two-thirds of the field not designated as Productive Green Space was converted to residential land. In other words, farmland loss continues even after the amendment of the Act on Productive Green Space, however, the more significant decrease is attributed to non-registered farmland as Productive Green Space (Ishihara 2014).

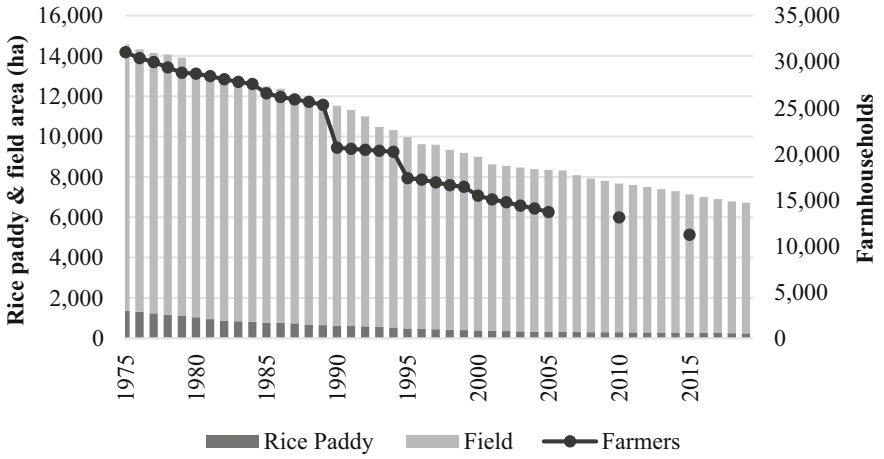

Fig. 1 Changes in rice paddy area, field area, and farm households in Area in Tokyo Metropolitan Government (1975–2019) (data source: Kanto Regional Agricultural Administration Office (n.d.))

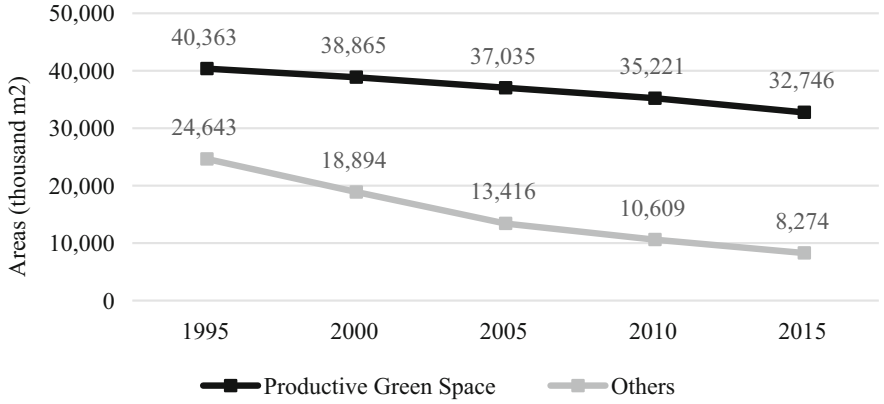

Fig. 2 Changes in Productive Green Space and other farmland inside urbanization promotion area in Tokyo (1975–2015) (data source: Tokyo Metropolitan Government (f) (n.d.), (g) (n.d.))

The factors behind farmland loss are probably related to competition with other land uses based on economic rationality, and the decreasing number of farmers due to aging and a lack of successors. In terms of competition with other land uses, there is high pressure to develop land into residential and commercial facilities, especially around railway stations. As a result, farmlands with high land prices and small parcel area are sold and converted mainly to housing (Nakahara and Hoshino 2006) as shown in Fig. 3. In Nerima City, a Tokyo suburb, agricultural land was being converted for infrastructure development in the 1960s, condominium development in the 1980s, and transitional land uses such as parking lots and storage lots, as well as supermarkets and convenience stores since the 1990s (Takatori 2000). In recent

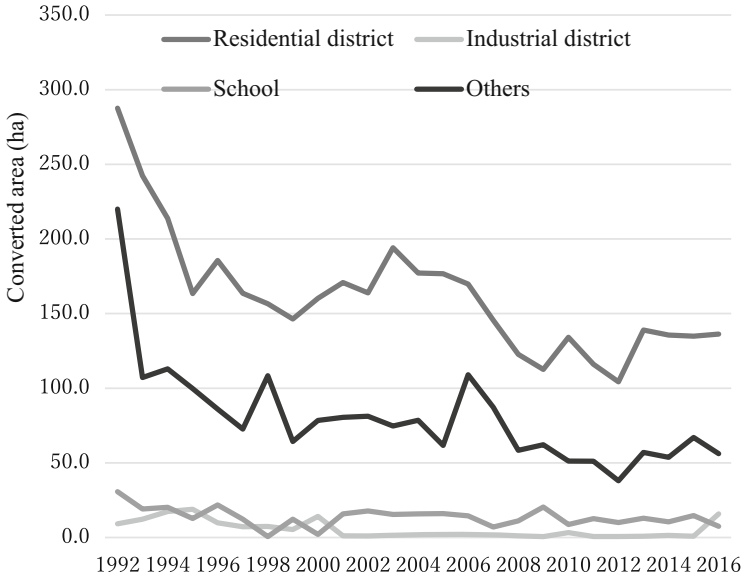

Fig. 3 Land use converted from farmland (1992–2016) (data source: Tokyo Metropolitan Government (h) (n.d.))

years, some land has been converted to parks and welfare facilities, reflecting the demand for green space and facilities to meet the societal needs of an aging population (Satake and Saio 2018).

As shown in Fig. 1, the number of farming households decreased by about one-third over 40 years to 2015. Looking at the age composition of the farming population, the percentage of farmers aged 65 and above increased from 48% to 54% between 1995 and 2015, while the percentage of farmers under 30 years old was steady at only 2% (Fig. 4). Furthermore, there are many reports of farmers giving up their farmland due to this aging of the farming population. In some cases, individual farmers leave their farmlands due to physical problems or injuries, and in other cases, entire families give up their farmland when farmers die. As for inheritance, "mini-development" (subdividing land to liquidate the property or settle inheritances) often occurred around cities, leading to fragmentation into smaller parcels, and loss of farmland (Nakahara and Hoshino 2006).

In 2022, many farmland parcels that were registered in 1992 as PGS will be exit from the 30-year obligation to cultivate and the benefit of tax incentives. There are concerns that many farmers will not want to re-designate their farmlands as PGS and will seek to convert them to residential uses. Various measures have been implemented, such as easing the conditions for the designation of PGS and approving of farmer-run restaurants, but it is likely that the effectiveness of these measures will not be immediately evident.

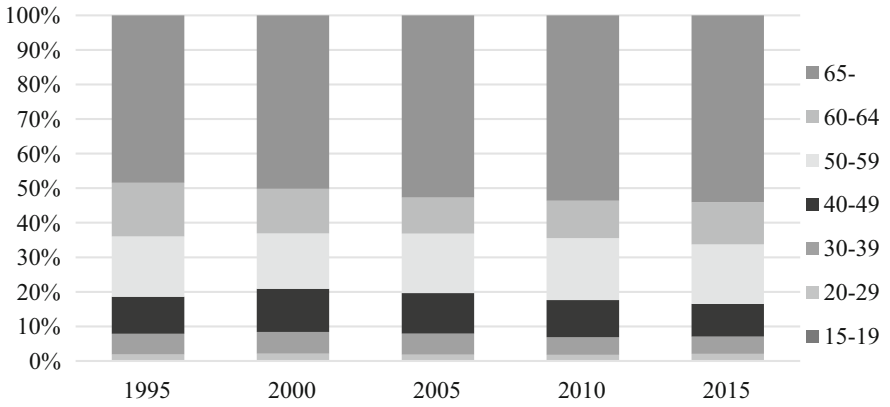

Fig. 4 Demographics of farmers (1995–2015) (data source: Tokyo Metropolitan Government (i) (n.d.), (j) (n.d.), (k) (n.d.), (l) (n.d.), (m) (n.d.))

2.2 Distribution of Farmland

In Tokyo, the Japan Railway (JR) Yamanote Line is an elongated circular line that connects the central areas and sub-centers of Otemachi, Shinjuku, Ikebukuro, and Shibuya, a number of railways radiate out from the JR Yamanote Line toward the suburbs. Commuters walk or bus to suburban stations, and take trains to central areas. Therefore, by looking at the distribution of agricultural land in Tokyo in terms of distance from the JR Yamanote Line and distance from the nearest railroad station, one can begin to grasp the relationships between land uses in the urban structure.

Within 10 km outside the JR Yamanote Line, urbanization is significant except for the coastal areas and rivers, while farmland only exists far from stations. In this zone, agricultural land has been fragmented into small farmland parcels due to high urbanization pressures due to proximity to the city center. Meanwhile urban agriculture provides cities with leafy vegetables, flowers, and many varieties of plants, benefiting from proximity to the city center. Figure 5a shows a typical farmland landscape in this zone. Mini-developments have often resulted in the conversion of agricultural land to housing, parking lots and supermarkets (Nagae 2007; Takatori 2000), but many farm parcels are still located in this zone.

Within about 20 km of the JR Yamanote Line, there are densely populated areas around the railroad lines and in some surrounding areas. As shown in Fig. 5b, urban agriculture produces not only leafy vegetables but also trees and plants that might be more typical in suburban areas.

Within a 30 km radius of the JR Yamanote Line, urbanization is progressing in the vicinity of railroad stations, and factories and distribution centers are located in the suburbs. Although this area is in competition with urbanization and development, the mix of agricultural products from here is somewhat different from areas within the 10 km or 20 km radius because of the relatively large parcels and the

Fig. 5 The faces of urban agriculture in Tokyo. Changes in landscapes from city center to the suburban areas are depicted from photos (**a**–**f**). Aerial photos are from Geospatial Information Authority of Japan and cropped by the authors

distance from city center. Depending on the region, root crops, fruit trees, and flowers are cultivated. However, as shown in the example of Kiyose City in Fig. 5c, agricultural land is being converted to other uses due to inheritance issues and urbanization encroaching from the city center.

Within a 40 km radius of the JR Yamanote Line, urbanization is advancing around railroad stations, while large parks, military bases, and factories are located in the surrounding areas. The surrounding flatland and hilly areas are densely populated. In the northern part of the region, farmlands are located on the flatlands to keep separate from factories and bases. In the western region of Tokyo, in the

southern part of the Tama Hills, rice production is done in small valleys while vegetable cultivation, mainly tomatoes and eggplants, is done mainly in the northern part of Machida City (Fig. 5d). Urban agriculture in this region varies significantly based on regional factors and topographical features such as hills and river valleys, and large-scale developments such as a military base and Tama New Town.

The area within 50 km includes foothills and the western edge of the Musashino Plateau. Urbanization has taken place along the JR Ome Line and around Hachioji City, and farmland is distributed on flat and extensive hills and terraces that skirt cities and mountains. In Akiruno City, shown in Fig. 5e, farmland is distributed on terraces and hills along the Akigawa River, and tomatoes, sweet corn, and chestnuts are the major crops. In these areas, leafy vegetables account for less of the farm produce by weight than in other distance zones, while the cultivation of fruit vegetables and potatoes is large.

Outside the 50 km radius, the area is predominantly mountainous and has low population density. Farming is conducted on mountain slopes and terraces, but most of it is outside of built-up areas, so it is not considered to be urban agriculture (Fig. 5f).

As described above, an examination of urban agriculture in Tokyo based on distance from the city center reveals differences in the farming environment depending on the degree of urbanization. Within a 20 km radius, farmland appears fragmented into small parcels due to high demand for land, while within a 30 km and 40 km radius, relatively large parcels remain, although those areas are facing challenges in finding farming successors and gradual urbanization. Within a 50 km radius, large parcels of farmland remain, with landscape features of suburban farming.

3 Services of Urban Agriculture in Tokyo

We have confirmed that urban agriculture, which has been regarded as belonging in cities, is shrinking due to internal and external pressures such as competition for land use and a decrease in the number of farmers. Therefore, to ensure that urban agriculture survives in cities, it is important to evaluate the various services that urban agriculture provides, articulate its significance to society, and take concrete actions such as urban planning and individual projects.

3.1 Production and Resource Use by Urban Agriculture in Tokyo

In Tokyo, 78,895 tons of vegetables were produced in 2019, yielding an agricultural output value of 18.9 billion yen. The population of Tokyo is about 14 million, so

vegetable output per capita works out to 5.6 kg. Since the average daily consumption of vegetables per Japanese person is 269.8 g (Ministry of Health, Labour and Welfare, 2020), vegetables produced in Tokyo are equivalent to 20.9 days of vegetable consumption. The national health promotion policy Health Japan 21 set a target daily vegetable consumption of 350 g; in that context, Tokyo produced enough vegetables for the equivalent of 16 days.

Next, we compare the production of vegetables by category (Fig. 6). The following 14 vegetables are commonly consumed in Japan: barley, carrot, cabbage, Chinese cabbage, cucumber, eggplant, leek, lettuce, onion, radish, spinach, sweet pepper, taro, and tomato. Tokyo produces many of the common vegetables such as cabbage, eggplant, radish, and tomato, but does not widely produce bell pepper, lettuce, onion, and taro.

Meanwhile, leafy vegetables such as komatsuna (sometimes referred to as Japanese mustard spinach), udo (sometimes referred to as Japanese spikenard or mountain asparagus), and wasabi (sometimes referred as Japanese horseradish) are specialty products in Tokyo. Areas surrounding the urban area of the Edo period (1603 to 1867) consumed large amounts of vegetables, and to this day, the areas surrounding the JR Yamanote Line still cultivate komatsuna, spinach, and garnishes, for which freshness is important (Adachi City 2011). In fact, komatsuna originated from Edo and spread throughout Japan, and although present-day Tokyo is gradually ceding production to other prefectures (Ishihara 2015), komatsuna is still one of Tokyo's most important agricultural products. Udo is a vegetable native to Japan, mostly cultivated in holes in the ground where sunlight does not reach (Koito et al. 2018). In Tokyo, udo is mainly cultivated in Tachikawa City and is branded as Tokyo udo (Koito et al. 2018). Although udo is not a common vegetable, it is known as an ingredient in Japanese cuisine. In Tokyo, Okutama Town is famous for wasabi production. Wasabi is a crop used as a condiment for soba noodles and sushi. The cultivation of wasabi requires a very specific environment including clear water, so the number of suitable growing areas is limited even in Japan. Many of these Tokyo specialty vegetables have been produced since the Edo period and are branded as Edo-Tokyo vegetables.

It is important to note, however, that these vegetables consume a large amount of water and energy in their life cycle. The total amount of energy and water used for fertilizers, pesticides, and cultivation facilities amounts to 835.1 terajoule (TJ) and 18.9 megaliter (ML), respectively, or in terms of farmland, 19.1 MJ/m^2 and 0.434 L/m^2, respectively (Kishimoto and Yan 2021). Water- and energy-intensive agriculture is often located close to urban centers, putting a strain on the environment (Kishimoto and Yan 2021). This research is still in its infancy, so it will be important to further investigate and quantify these aspects of urban agriculture in the future.

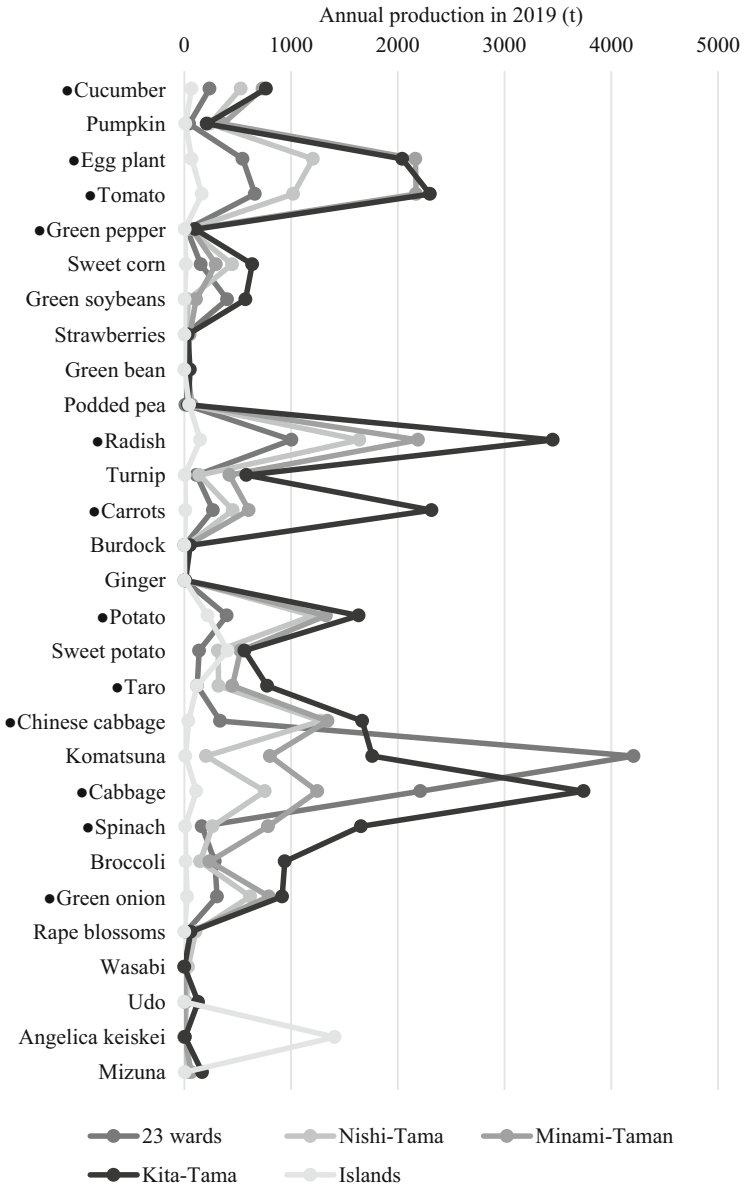

Fig. 6 Vegetable production in each selected areas in 2019. Commonly consumed 14 vegetables are with ●. (data source: Tokyo Metropolitan Government (n) (n.d.))

3.2 *Fresh Produce Stands for Supplying Local Vegetables and Enhancing Understanding of Farming*

Agricultural products produced in Tokyo are consumed via direct sales, in school lunches at elementary and junior high schools, through distribution at produce markets, and through contract shipments to mass merchandisers. Tokyo has a large number of fresh produce stands that sell locally-produced vegetables. Fresh produce stands are operated by a variety of entities, and farmers themselves account for 26% of total flows of vegetables, and Japan Agricultural Cooperatives (JA) and municipalities 20% (Tokyo Metropolitan Government 2017). About 70% of citizens reportedly want to buy local vegetables (Tokyo Metropolitan Government (d) (n. d.)). Fresh produce stands operated directly by farmers often use vending machines or are unmanned stands with payments done on an honor system (Fig. 7). Farmers and residents interact either directly or indirectly in the processes of packaging, pricing, and selling vegetables. Meanwhile, fresh produce stands operated by JA and

Fig. 7 Fresh produce sales in Tokyo (unmanned stand, vending machine)

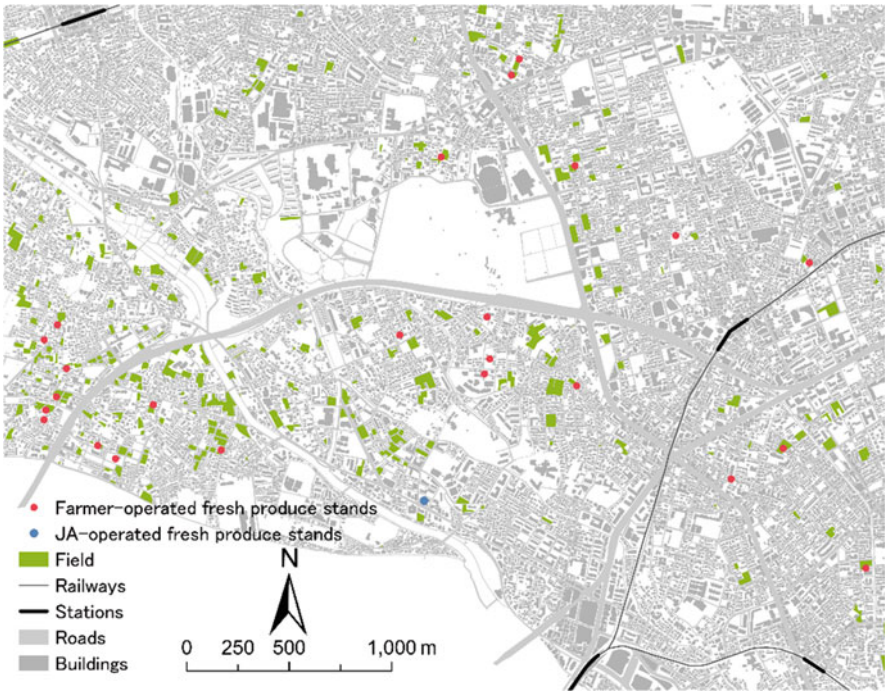

Fig. 8 Distribution of fresh produce stands in southern Setagaya area (source: Authors created using land-use data from Setagaya City)

municipalities have large shop areas where people can enjoy a variety of local vegetables.

Fresh produce stands are clearly an important nexus connecting citizens and urban agriculture. They enhance awareness and understanding of urban agriculture and local vegetables. In many cases in Japan, the location of fresh produce stands is published on local government websites or in official booklets. Figure 8 shows the distribution of fresh produce stands in the southwestern part of Setagaya City. This area is located about 15 km from Tokyo's major sub-center of Shibuya, or about 15 min by train, which is very convenient for access. Even though the area is highly urbanized, we identified about ten fresh produce stands within only a few kilometers of stations. Each farmer sets up a simple store or vending machine on farmland or attached to the house, to sell harvested vegetables. Individual farmers typically have different production schedules, harvest different vegetables, and use their own techniques to make vegetables tasty. JA operates two fresh produce stands in Setagaya City, which sell locally-produced vegetables, sandwiches and jams, thereby promoting primary, secondary, and tertiary industries (so-called sixth industry).

3.3 Farmland Based Disaster Risk Reduction

Urban agriculture can also play a role in coping with disaster risks, since the farmland itself is valuable open space in the midst of cities and agricultural facilities can be utilized in emergencies. Farmland can be utilized as sites for temporary evacuation or temporary housing. Urban farmland can provide quickly accessible areas where people can escape to safety in the event of an earthquake or a fire. As of the end of March 2015, 56 municipalities in Japan's three major metropolitan areas (Nagoya, Osaka, Tokyo), including 29 in Tokyo, had signed agreements with farmers on cooperation in the event of a disaster (Ministry of Agriculture, Forestry and Fisheries 2015). A study in Sakai City in Osaka reported that the city has the capacity to temporarily accommodate all residents who live within a 400-m radius of farmland (Hara et al. 2016).

Groundwater wells on farmland can also provide a valuable source of water in times of disaster. The so-called disaster cooperation wells are part of an initiative to make wells accessible to local residents free of charge in the event of a disaster. For example, Yokohama City has 2529 and Chiba City 151 disaster cooperation wells (Endo et al. 2020), some of which are probably originally for agricultural use.

Because Japan has experienced so many natural disasters throughout its history, the disaster response function has been integrated into urban agriculture.

4 Discussion and Conclusion

This chapter introduced Tokyo's approach of urban agriculture to resilient and adaptive cities, which is based on the idea that agriculture does indeed belong in cities. We described the evolution of policies and society in terms of urban agriculture, the actual situation of farmland distribution and status of farmers, and services provided by urban agriculture. Here we discuss three key aspects of how urban agriculture will need to adapt to social, economic, and ecological change in the future.

The first issue is the need to adapt to social change in terms of population decline and aging. For centuries, the Tokyo Metropolitan Area has attracted a growing population, but is projected to enter a phase of population decline in 2035 (National Institute of Population and Social Security Research 2018). Meanwhile, the ratio of seniors (aged 65 and older) is projected to increase from 22.7% in 2015 to 30.7% in 2045 (National Institute of Population and Social Security Research 2018). These changes will lead to a shortage of successors for farmers. Previous urban planning to address demographic change included optimization of land uses and compact cities as a part of land use plans, with a focus on housing and city centers. Previous schemes were not able to conserve farmland effectively, so city planning from now on requires more discussion about issues such as land use and successors of farming.

Second, urban agricultural land is increasingly being recognized as multiple-use public space for local communities rather than mainly being for economic activities by farmers (Miyachi 2006). Currently, farmers own the land and do the farming, but urban residents also benefit from urban agriculture and wish to preserve it. There may be insufficient linkages between the supply and demand sides of these services. As it stands today, the conservation of farmland depends on the will of farmers, but if farmland is to be used more broadly as a "public space" for the improvement of the urban environment, systems of cooperation and support will be necessary to encourage farmers to continue farming, combined with policies and initiatives by local governments to conserve farmland. For example, Multifunctional Payment Systems is an initiative to support activities to maintain farmland providing multiple functions and improve the quality of local resources (Ministry of Agriculture, Forestry, and Fisheries, 2022). It includes mowing the slopes of farmland, mucking up waterways, repairing cracks in waterways, and planting trees. There may also be ways to combine the activities of the private sector and non-profit and community organizations rather than relying solely on local governments. In response to public demand in recent years from people who want to enjoy farming accessibly, an increasing number of private allotment gardens has appeared, where prices may be high but extensive guidance and support is also provided.

Third, the situation surrounding urban agriculture has been changing since the beginning of the COVID-19 pandemic. Some newspapers have reported that more and more people have been visiting produce stands to obtain fresh and inexpensive vegetables. Some people have moved out of the crowded Tokyo central area to suburban and rural areas where they can work remotely from home while also enjoying more comfortable living environments. As a result of these changes of perspective and behavior, many people have been benefitting from urban agriculture. Further research is needed to clarify what role urban agriculture has played in responses to the COVID-19 pandemic, but it is likely that urban agriculture will attract more attention as an adaptive strategy for the "new normal" in Tokyo.

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