

Sustainability of Agriculture and Urban Quality of Life in Japan : Economic Efficiency, Sociality and Environment Protection

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Abstract

Urban agriculture in Japan has the problems such as reduction in farmland, aging of farmers, expansion of abandoned cultivated land and environmental pollution by stock raising waste or agricultural chemicals. Similarly, urban side has various social and environmental problems as well, for instance, the problems of garbage, river management, food safety, natural environment, etc.

Function of urban agriculture is not only to supply agricultural goods but also to create landscapes, to ensure land conservation and sustainable management of renewable natural resources and to provide environmental benefits such as conservation of biodiversity. Therefore, urban agriculture can contribute to improve urban quality of life through supplying local public goods.

Sustainability of urban agriculture is composed of three elements, i.e.: economic efficiency, sociality and environment protection. The relative importance of three elements changes along with regions and times, and the balance among them is always called for. The contribution of agriculture to the urban quality of life links to the sustainability of urban agriculture.

Therefore, the sustainability of urban agriculture can be realized by building cooperative and bidirectional relations between the urban residents who highly concern about agriculture, food safety and environmental issues and the farmers who concern about sociality and environment protection.

JEL classification: I31, Q15, Q56, R14

Keywords: Sustainability, Quality of Life, Urban Agriculture, Multifunctionality

1. Introduction

Urban agriculture in Japan is facing various problems such as decreasing farmlands, aging of the farming population, increasing abandonment of cultivation of farmlands and environmental pollution by livestock waste and agrichemicals. Similarly, urban municipalities have various social and environmental issues including waste, river management, food safety and natural environmental issues. Since it is difficult to achieve cost-effective and large-scale agriculture management in urban areas, in terms of economical efficiency, the level of sustainability of urban agriculture is not high. Nevertheless, it is not impossible to increase economic efficiency of urban agriculture if its excellent accessibility to consumers is

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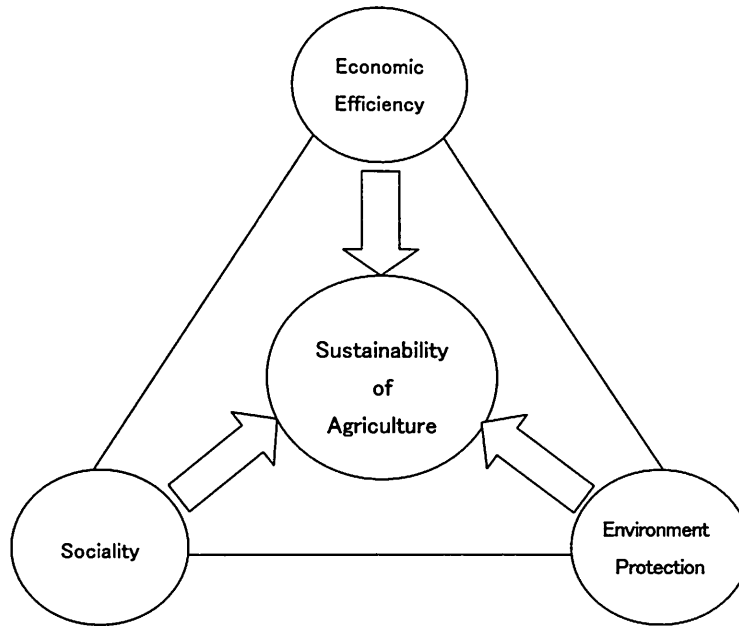


Figure 1. Factors of sustainable agriculture

properly utilized and the needs of urban consumers are correctly understood. The improvement of economic efficiency is not the only means to improve sustainability of urban agriculture. Sustainability of agriculture is composed of three aspects: economic efficiency, sociality and environmental protection (see Figure 1). The relative importance of each of these three aspects varies depending on the place and time but a balance between these three aspects is always required. On the other hand, a large number of urban residents are highly interested in agriculture, foods and environment. It enables urban residents to change their relationship with farmers who generally value sociality and environmental protection, from hostile and one-sided one to more cooperative and interactive one.

These three aspects have close relationships with multifunctional characteristics of agriculture and farmlands. And many of these multiple functions have characteristics of local public goods. Therefore, in this research, multifunctionality of urban agriculture and farmlands will be examined from economics perspectives, urban residents' concerns about urban agriculture and farmlands will be surveyed and measures to be taken for the promotion of urban agriculture and preservation of urban farmlands will be considered.

2. Multifunctionality of agriculture and farmlands in urban areas

From a viewpoint of regional economics and urban planning, agriculture and farmlands were previously considered as something that conflicted with urbanization. However, in recent years, importance of existence of agriculture and farmlands in urban areas has been advocated, both in developed and developing countries, through various projects including UNDP [6] and APO [1]. One of the reasons for such development is that multifunctionality of agriculture and farmlands has started to attract attention. According to OECD [2, 3],

multifunctionality of agriculture and farmlands refers to their functions not only to supply agricultural goods but also to create landscapes, to ensure land conservation and sustainable management of renewable natural resources and to provide environmental benefits such as conservation of biodiversity. Contents of such multifunctionality are broad and they are summarized as stated in Table 1. In the light of its multifunctionality, agriculture supplies not only agricultural goods but also local public goods and farmland can be seen not only as a space to support agriculture but also as a space that has many other functions. Through perspectives explained above, a contact point between researches on the quality of life including those conducted by Rosen [5] and Roback [4] and those on urban agriculture becomes visible.

In analyzing quality of urban life, the utility of urban residents U is considered to be determined by composite commodity C , housing services N , pure amenities (such as weather) A and public services G as follows:

$$U = U(C, N, A, G) \quad (1)$$

However, if urban agriculture and urban farmlands supply local public goods GA , the utility is determined by the following formula:

$$U = U(C, N, A, G, GA) \quad (2)$$

The total urban area S is calculated from the residential area SR and agricultural area

Table 1. Multi-functionality of agriculture and farmland in urban areas

Agriculture	Contents
Production of agricultural goods	Basic functions such as production of foods, etc.
Communication	Enjoyment of culture and creation of communication through exchange between citizens and between citizens and farmers
Welfare	Prevention of aging through agricultural work, healing effects of plants, gardening therapy
Education	Emotional and environmental education through nature and agriculture and learning agriculture and forestry
Recycling	Organically grown vegetables by turning kitchen garbage into organic fertilizer
Farmlands	
Environmental protection	Preservation of biological resources and natural environment
Creation of landscapes	Creation of pleasant landscapes, scenery of Japanese fields and scenery through which people can enjoy changes of the seasons
Disaster prevention	Functions to provide disaster evacuation sites and routes, to create green spaces for disaster prevention, to arrest the spread of fire, to provide spaces for temporary housing
History and culture	Preservation of groves of village shrines and continuation of harvest festivals
Support for building residential lands	Promotion of building residential lands, provision of gardens and vegetable gardens that support good rural living
Withholding or controlling of urbanization	Temporary withholding or controlling urbanization for a certain period of time

SA as $S = SR + SA$. Housing services N is a function of residential area SR . A decrease in farmlands brings increases in residential land, supply of housing services and utility of residents. Agriculture supplies local public goods GA as well as agricultural goods and GA is a function of SA . However, this GA changes depending on the agricultural management method and technologies used for the agriculture and hence supply of local public goods also changes. For example, organic agriculture and allotment gardens are ways to use farmland that create an excellent supply of local public goods.

In accordance with the above framework, demands for local public goods in urban areas supplied by agriculture and farmlands will depend on the degree of urbanization, preferences of consumers and supply conditions of public goods. In order to supply local public goods properly, it is necessary to resolve any issues regarding market failure and externality as well as to introduce urban agriculture policies in urban planning.

3. Subjects and methods of survey

3.1 Characteristics of Japanese urban areas

One of the characteristics of Japanese urban areas is the presence of many farm lands. After the late 1950s, in Japan, as the urbanization progressed, green areas in built-up urban areas disappeared and urban areas expanded at outskirts, destroying agricultural and forest lands. Unorganized progress of turning lands into housing lands from the urban core to outskirts without sufficient urban infrastructure resulted in a so-called "sprawl phenomenon". Farmlands were not brought into urban areas according to a plan. On the contrary, they were brought into urban areas in an expectation of turning them into housing lands in the future. However, although most farmlands were gradually turned into housing lands, urban planning did not require farmlands to be turned into housing lands. As a result, urban areas are now dotted with farmlands. These remaining farmlands in urban areas are lands suitable for agriculture and in many cases farmers have excellent agricultural management abilities. In addition, these remaining farmlands are functioning as green spaces in place of urban parks.

3.2 Land use classification under "The Agriculture Promotion Areas Act" and "The City Planning Act"

In Japan, for a systematic improvement of urban areas, City Planning Areas are designated and they are classified into urbanization promotion areas (UPAs) and urbanization control areas (UCAs). UPAs include existing residential areas and areas that would be developed within a decade. Farmlands located in UPAs can be used for non-agricultural purpose without the need for permission, by simply submitting a notice to the government. However, in the case of UCAs, land use was strictly regulated and permission for land conversion was required (APO [1]). Nowadays, lands in the UPAs in three major metropolitan areas are classified into Productive Green Lands (farmlands to be preserved) and Residential Farmlands (farmlands to be turned into housing lands) (see Figure 2). Productive Green Lands refer to farmlands that are designated as "lands with functions to prevent pollution or disaster and to provide good living environment such as preserving urban environment that are agriculture and fishing friendly and lands that are suitable for building

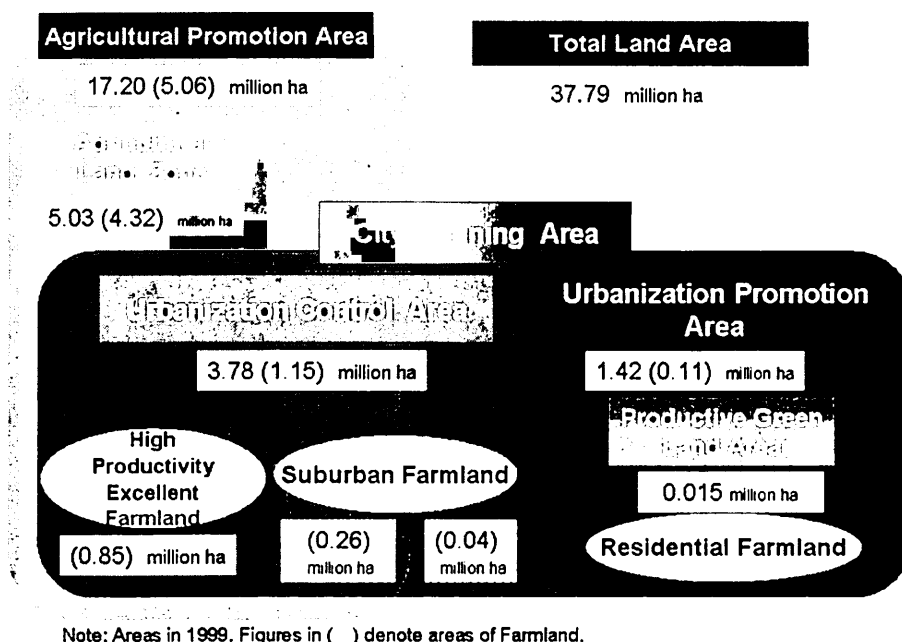


Figure 2. Land Use Classification under "The Agriculture Promotion Areas Act" and "The City Planning Act"

public facilities". If a land is designated as a Productive Green Land, the designation cannot be cancelled for a period of thirty years and the land is required to be used for agriculture. The property tax rate for such lands is the same as that for farmlands and deferred payment of inheritance tax applies to such lands. On the contrary, the property tax rate for Residential Farmlands is the same as that of residential lands but much higher than that of normal farmlands, and the deferred payment for inheritance tax is not accepted.

3.3 Characteristics of surveyed area

The survey area selected for this research is Tokyo. Needless to say, Tokyo is the most urbanized area in Japan. However, agriculture still exists in Tokyo. In Tokyo, 174,386 ha is designated as City Planning Areas. Of these areas, 107,623 ha (61.7%) is designated as Urbanization Promotion Areas (2003). The population of residents in Tokyo is 11,996,460 and the number of households is 5,692,903. Among them, only 14,390 are farm households. Of total employed population of 5,982,578, the population engaged in agriculture is 17,800. Of the total area of 2,102 km², farmlands occupy 85.5 km². In other words, the position of agriculture in Tokyo is weak. However, in terms of green spaces, farmlands occupy approximately 10% of the total green spaces in Tokyo. These spaces are providing valuable green spaces for Tokyo. Besides, Park area per person is 6.0 m² in Tokyo and 2.9 m² in Tokyo Special Ward. These numbers show a significantly low level of park spaces compared to urban cities in developed countries (2004).

3.4 Survey methods

The survey was conducted by Macromill, Inc. by using an internet survey method. Questionnaires contained questions regarding a profile of the respondent, relationship with agriculture, assessment on the area of residence, assessment on the role of agriculture and urban agricultural policies. Respondents were residents of Tokyo over twenty years of age. We collected 206 respondents in order to ensure the minimum number of 200 people from five different age groups: 20s, 30s, 40s, 50s and over 60. In the analysis, only respondents without

Table 2. Profiles of respondents

Unit : %

Age	20s	30s	40s	50s	Over 60
	19.6	20.2	20.4	19.5	20.1
Sex	Male	Female			
	57.0	43.0			
Marriage	Unmarried	Married			
	33.1	66.9			
Children	None	Some			
	45.6	54.4			
Occupation	Public Service Employees	Business executive	Company employee	Self-employed worker	Free-lance professional
	2.8	3.5	35.2	10.6	4.2
	Housewife	Part-time worker	Student	Others	
	16.1	10.8	5.1	11.6	
Annual household income	Less than 3mil. Yen	3 mil.~5 mil. Yen	5 mil.~10 mil. Yen	10 mil.~15 mil. Yen	Over 15 mil. Yen
	13.9	25.6	41.2	13.9	5.4
Area of Residence	Ward	Others			
	67.8	32.2			
Degree of Urbanization	1	2	3	4	
	10.8	37.3	22.3	29.7	
Type of Residence	Owned house	Owned apartment	Rental house	Rental apartment	Others
	37.3	21.0	2.8	33.0	5.8
Living year in Tokyo	Less than 1 year	1~5 years	5~10 years	10~20 years	Over 20 years
	1.5	11.1	10.0	13.4	64.0

Note: The degree of urbanization is determined based on the answer to the question, "How many farmlands exist in your area of residence?" 1 was for the answer for "lots" of farmlands exist in the area of residence, 2 was for "a little", 3 was for "not too many" and 4 was for "not at all".

non answer were used. Farmers and residents of islands were excluded. The survey was initiated at 8:00PM on March 11, 2005 and ended at the time the number of responses from each age group reached the expected number. Profiles of respondents are summarized in Table 2.

4. Analytical results

4.1 Urbanization and living environment

First, how urban residents assess their own living environment is clarified. Table 3 shows the assessment of good points of living environment by urban residents. This shows a relation of urbanization to external economy and supply of local public goods. The item that obtained the highest assessment among aspects of living environment was the development of transportation network. Other items with relatively high assessment were accumulation of commerce and natural and green environment. On the one hand, in relation to the degree of urbanization, the urbanization has improved residents' living environment in aspects of: transportation network; accumulation of commerce; medical and welfare services; recreational services; the level of arts and culture; and information. On the other hand, urbanization has caused a decrease in the level of natural and green environment.

Table 4 shows the assessment of bad points of living environment by urban residents. This shows a relation of urbanization to external diseconomy and shortage of local public goods. The most serious problem in the living environment is escalating prices of commodities and lands. In addition, problems with relative seriousness included air pollution, excessive concentration of population and noises. In relation to the degree of urbanization, it is evident that urbanization has resulted in the worsening of the above problems and deterioration of natural and green environment. On the contrary, approximately 40% of the residents in the least urbanized area responded that they did not feel any problems with their

Table 3. Good points of the area of residence

Unit: %

	Total	Degree of urbanization			
		1	2	3	4
Good transportation network	70.2	37.4	58.9	77.8	90.5
Abundance of goods and stores	49.5	33.6	41.6	55.7	60.7
Lively and exciting	21.6	7.5	15.1	25.3	31.9
Many places for education and lifelong learning	19.2	14.0	20.8	18.1	20.0
Lots of greens and nature	40.0	86.9	58.1	20.4	14.9
Good medical and welfare systems	23.0	19.6	21.9	18.1	29.2
Good sports and leisure facilities	15.7	9.3	13.8	15.4	20.7
Many opportunities to enjoy arts and culture	18.4	7.5	15.7	17.6	26.4
Abundance of information	26.2	6.5	20.3	31.2	36.9
Nothing particular	8.7	5.6	10.3	11.3	5.8

Table 4. Bad points of the area of residence

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Too many cars and people	33.8	9.3	27.8	38.9	46.4
High prices for commodities and lands	40.8	22.4	37.6	42.1	50.5
Poor security	19.5	15.9	19.5	20.8	20.0
Not enough greens and nature	23.0	2.8	10.8	29.4	40.7
Bad housing conditions	17.9	12.1	13.0	25.3	20.7
Feel uneasy with air pollution	33.6	12.1	28.6	39.4	43.4
Feel uneasy with noises	25.0	10.3	23.0	28.1	30.5
Lack of human relationships	21.7	15.9	21.1	22.6	23.7
Nothing particular	17.9	40.2	19.5	13.1	11.5

Table 5. Interests in agriculture

Unit : %

		Interests in agriculture			
		Very interested	A little bit interested	Not so interested	Not interested at all
Total		9.5	48.2	32.7	9.6
Age	20s	9.7	41.5	39.5	9.2
	30s	8.0	47.3	29.9	14.9
	40s	6.4	46.3	36.5	10.8
	50s	8.2	54.1	28.4	9.3
	Over 60	15.0	52.0	29.5	3.5
Sex	Male	12.4	51.9	28.3	7.4
	Female	5.6	43.3	38.6	12.4
Degree of urbanization	1	12.1	55.1	25.2	7.5
	2	9.5	52.4	30.8	7.3
	3	8.1	45.7	34.8	11.3
	4	9.5	42.4	36.3	11.9

living environment.

4.2 Involvement of urban residents in agriculture

Next, how urban residents are involved in agriculture is clarified below.

To the question concerning urban residents' interest in agriculture, although more than half of respondents responded "Interested in agriculture", elder residents and residents in the

Table 6. Experience in agricultural work

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Doing agricultural work as a hobby	6.9	11.2	7.6	6.8	4.7
Done before	25.3	17.8	29.7	28.5	20.0
Never done before	67.8	71.0	62.7	64.7	75.3

Table 7. Willingness to use allotted gardens

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Currently using	2.0	6.5	2.2	2.3	0.0
Wish to use in the future	3.8	3.7	5.1	3.6	2.4
Wish to use if close	24.3	19.6	24.1	25.3	25.4
Wish to use if inexpensive	16.0	21.5	18.1	16.7	10.8
Wish to use if there is an instructor	13.3	15.0	12.4	13.6	13.6
Do not wish to use	40.6	33.6	38.1	38.5	47.8

Table 8. Purchase of vegetables grown in Tokyo

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Always purchase	8.3	26.2	9.7	3.2	3.7
Purchased before	43.6	57.0	50.0	38.0	34.9
Never purchased before	5.6	1.9	4.6	8.1	6.4
Do not know	42.5	15.0	35.7	50.7	54.9

areas with less advanced urbanization have higher interest in agriculture (see Table 5). As to the question whether urban residents have any experience in agriculture or agricultural work, more than two-third of respondents answered "no experience at all" (see Table 6). On the other hand, there is a relatively large number of people who responded "doing agricultural work as a hobby". When the result is looked at by regions, the less advanced urbanization in the region is, the higher the number of residents with agricultural experience is.

As to the use of allotment gardens, although the number of residents who responded "currently using" is low (only for 2.0%), approximately 60% of the respondents wish to use them if possible (see Table 7). In relation to urbanization, the less advanced urbanization in the region is, the higher the number of residents with willingness to use allotment gardens is.

Although some of the respondents in the most urbanized area responded “wish to use if close”, many of them responded “do not wish to use”.

To the question regarding a purchase of vegetables grown in Tokyo, respondents who have purchased such vegetables exceeded 50%. Those who are not sure if they have purchased such vegetables amount to over 40%, indicating that many people do not even pay any attention to the origin of such vegetables (see Table 8). In relation to urbanization, from the aspect of consumption of agricultural goods, again, the less advanced urbanization in the region is, the higher interest in agriculture of the residents in the area is.

4.3 Assessment of agriculture and farmland by urban residents

Table 9 outlines how urban residents assess the role of urban agriculture and farm land. A function of agriculture and farm land that obtained the highest ranking from urban residents is the ability “to supply fresh and safe agricultural products” followed by functions “to supply affluent and healthy environment”, “to supply a place for agricultural experience and education” and “to preserve living environment”. Overall, the less urbanized the area is, the higher the assessment of the role of urban agriculture is. Although a function “to supply fresh and safe vegetables” acquired the highest assessment, effects on amenities also obtained a relatively high assessment. Unlike other effects, the more advanced the urbanization in the area is, the higher the assessment of their effects on education and interaction is. A majority of respondents in the most urbanized area chose functions “to supply a place for agricultural experience and education” and “to allow recycle of resources such as use of kitchen garbage as fertilizer” over a function “to supply fresh and safe vegetables”. Table 10 summarizes issues concerning urban agriculture. A relatively small number of issues are pointed out. Among them are the generation of insects and spraying of agricultural chemicals.

Table 9. Role of urban agriculture

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
To supply fresh and safe vegetables	81.4	126.2	78.9	77.4	71.2
To provide affluent and healthy environment	75.8	80.4	86.5	70.6	64.7
To prevent disaster	44.4	56.1	53.8	42.1	30.2
To preserve living environment	62.6	88.8	83.0	51.6	35.9
To provide opportunities to experience and learn about agriculture	64.8	51.4	52.4	70.1	81.0
To increase living matters and improve ecosystem	61.9	67.3	61.4	66.1	57.6
To allow recycling of resources such as turning kitchen garbage into fertilizer	53.0	34.6	38.9	59.3	72.5

Note: Points were calculated based on “Strongly agree”=2 points; “Agree”=1 point, “Disagree”= -1 point, “Strongly disagree”= -2 points, “Do not know”=0 point, multiplied by the response rate (%).

Table 10. Issues concerning urban agriculture

Unit: %

	Total	Degree of urbanization			
		1	2	3	4
Deterioration of landscapes	-131.0	-157.0	-138.9	-124.4	-116.6
Bad smell	-44.5	-66.4	-51.4	-40.7	-30.8
Noisy	-146.9	-156.1	-148.4	-139.8	-147.1
Dispersal of agricultural chemicals	18.7	9.3	12.7	23.5	26.1
Generation of insects	27.8	-10.3	5.4	36.7	63.1
Creation of dust	-19.3	20.6	-18.6	-27.1	-28.8
Illegal waste disposal	-37.2	-42.1	-49.5	-29.9	-25.4
Deterioration of security	-138.1	-145.8	-141.1	-133.9	-134.6

Note: Points were calculated based on "Strongly agree" = 2 points; "Agree" = 1 point, "Disagree" = -1 point, "Strongly disagree" = -2 points, "Do not know" = 0 point, multiplied by the response rate (%).

Table 11. Opinions on the existence of farmlands in the area of residence

Unit: %

	Total	Degree of urbanization			
		1	2	3	4
Better to exist	58.8	84.1	74.9	50.2	35.9
Better not to exist	5.0	1.9	2.2	4.5	10.2
Cannot say.	36.2	14.0	23.0	45.2	53.9

4.4 Perspectives of urban residents concerning urban agricultural policies

The last issue to be examined is perspectives of residents concerning agriculture and farm land in urban areas in the future.

As shown in Table 11, approximately 60% of urban residents are in favor of preserving urban farmlands. Only 5% of those are against the idea. However, assessment of residents on the preservation of urban farmlands significantly differs depending on the degree of urbanization. In other words, residents in the areas where urbanization is not advanced tend to prefer preservation of farmlands and those in the areas where urbanization is advanced tend to be less favorable to the preservation of farmlands. It was expected that residents in more urbanized areas would have higher demand for farmlands as green spaces due to a lack of green spaces. But the result was opposite. It can be assumed that this result is due to different preferences of residents depending on the area. In other words, residents in more urbanized areas have a weak preference for green spaces and residents in less urbanized areas have a strong preference for green spaces. However, this can be partly explained by Table 12 which indicates that residents in more urbanized areas have strong characteristics

Table 12. Characteristics of residents in urbanized areas

Unit : %

		Total	Degree of urbanization			
			1	2	3	4
Marriage	Unmarried	33.1	20.6	30.0	38.9	37.3
	Married	66.9	79.4	70.0	61.1	62.7
Children	None	45.6	32.7	41.4	49.8	52.5
	Some	54.4	67.3	58.6	50.2	47.5

Table 13. Methods to utilize urban farmlands in the future

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Actively produce agricultural goods	29.2	45.8	33.5	22.6	22.7
Keep them and utilize them as green lands, allotment gardens, etc.	53.5	42.1	55.4	56.6	52.9
Utilize them as resident lands, etc	4.1	1.9	2.7	4.5	6.4
Do not know	13.2	10.3	8.4	16.3	18.0

of unmarried and with no children. In any event, it is worth paying attention to the fact that over 30% of the residents in the most urbanized area prefer the preservation of farmlands. Table 13 outlines residents' perspectives on methods of utilization of urban farmlands. Regarding the utilization of urban farmlands, 53.5% of respondents selected "keep them and utilize them as green lands, allotment gardens, etc." and 29.2 % of respondents selected "keep them and use them as farmlands to actively produce agricultural goods". Those who support to "utilize farmland as residential lands, etc." amount only to 4.1%. What is sought by urban residents in urban lands is its function to provide green environment, rather than to produce agricultural goods. It is also evident that perspectives on the way to utilize farmlands are changing with the advancement of urbanization. Those in the least urbanized areas strongly support to "keep them and use them as farmlands to actively produce agricultural goods" and, as the urbanization advances, more people think it is better to "keep them and utilize them as green lands, allotment gardens, etc."

Table 14 shows urban residents' concerns on the policies of preserving agriculture and farmlands in urban areas. "Improvement of direct sales stores of agricultural goods and labeling producers' information, etc." and "use of local vegetables for school-provided lunch" were selected more than the other choices. In relation to urbanization, those in the area with less urbanization highly emphasize policies that support the production of agricultural goods. In contrast, those in highly urbanized areas emphasize policies toward the opening of farmlands. They expect policies to be those "to support participation of citizens in agriculture", "to increase opportunities to participate in events, morning markets, lectures, etc." and

Table 14. Measures necessary to maintain and keep urban agriculture and farmlands (multiple choices allowed)

Unit : %

	Total	Degree of urbanization			
		1	2	3	4
Use of local vegetables for school-provided lunch	41.3	52.3	43.2	41.2	34.9
Creation of face to face relationship between producers and consumers	35.5	33.6	43.2	33.0	28.5
Improvement of direct sales stores for agricultural goods and labeling producers' information, etc.	48.6	60.7	55.7	46.6	36.9
Measures to revitalize unutilized farmlands	33.0	34.6	33.5	31.2	33.2
Improvement of places for agricultural experience and nature observation	20.8	20.6	18.1	27.1	19.7
Support of participation of citizens in agriculture	19.7	15.0	19.5	17.2	23.7
Increase of opportunities to participate in events, morning markets, lectures, etc.	19.6	15.9	17.0	22.2	22.4
Provision of information regarding urban agriculture	14.1	13.1	14.6	10.0	16.9
Tax incentives and subsidies for farmers	13.5	15.9	13.8	14.5	11.5
No need for such measures	1.9	1.9	1.4	0.9	3.4
Do not know	8.6	3.7	5.9	10.0	12.5

“to provide information regarding urban agriculture”.

Quantification method type 3 (principal component analysis for categorical data) is then conducted in order to clarify how the assessment of the agriculture and farmland by local residents was formed. Table 15 compiles the results of the analysis. The 1st axis is construed to show “Residents' Evaluations on the Multifunctionality of Agriculture and Farmland (Positive-Negative)”. The 2nd axis is construed to show “Residents' Evaluations on Diseconomy of Externality of Agriculture and Farmland (Positive-Negative)”. Therefore, it is considered that the consciousness of local residents on the function of agriculture and farmland is formed by their evaluations on the multifunctionality of agriculture and farmland on one side, and diseconomy of externality of agriculture and farmland on the other.

Furthermore, quantification method type 2 (discrimination analysis for categorical data) is conducted to clarify how residents' attitudes toward preservation of urban agriculture and farmlands were influenced by their different awareness on the agriculture and farmland. Table 16 compiles the results of the analysis. Firstly, it is clarified that the degree of urbanization where residents are living is the most effective factor among the attributes of individuals. This is to say that residents who are in less urbanized area are more positive to the preservation of urban agriculture and farmland than those are in more urbanized area. Secondly, male and elderly residents shown in the table are more positive than female and younger one. Thirdly, residents who highly evaluate multifunctionality of agriculture and farmland but less concern about diseconomy of externality of agriculture are positive to the

Table 15. Quantification method type 3 on "Assessment of the agriculture and farmland by local residents"

	1 st axis	2 nd axis
Supply of fresh and safe vegetables: YES	-0.703	-0.009
Supply of fresh and safe vegetables: NO	2.205	0.027
Preserving living environment: YES	-0.946	0.216
Preserving living environment: NO	2.114	-0.484
Providing affluent and healthy environment: YES	-0.924	0.080
Providing affluent and healthy environment: NO	2.747	-0.239
Prevention of disaster: YES	-0.887	-0.027
Prevention of disaster: NO	1.443	0.044
Providing opportunities for interaction between people: YES	-1.193	-0.039
Providing opportunities for interaction between people: NO	1.984	0.064
Providing opportunities to experience and learn about agriculture: YES	-0.916	-0.183
Providing opportunities to experience and learn about agriculture: NO	2.331	0.467
Increasing living matters and improving ecosystem: YES	-0.914	0.052
Increasing living matters and improving ecosystem: NO	2.034	-0.116
Recycling of resources: YES	-1.041	-0.140
Recycling of resources: NO	1.922	0.258
Deterioration of landscapes: YES	0.911	-4.396
Deterioration of landscapes: NO	-0.081	0.390
Bad smell: YES	0.391	-2.241
Bad smell: NO	-0.212	1.215
Noisy: YES	-0.498	-5.885
Noisy: NO	0.020	0.241
Dispersal of agricultural chemicals: YES	-0.188	-1.230
Dispersal of agricultural chemicals: NO	0.247	1.610
Generation of insects: YES	-0.030	-1.281
Generation of insects: NO	0.044	1.852
Creation of dust: YES	-0.038	-1.624
Creation of dust: NO	0.028	1.200
Illegal waste disposal: YES	-0.310	-1.955
Illegal waste disposal: NO	0.163	1.027
Deterioration of security: YES	0.206	-5.518
Deterioration of security: NO	-0.011	0.286
Accumulated contribution ratio	20.13%	35.91%

Table 16. Quantification method type 2 on "residents' attitude toward preservation of urban agriculture and farmlands"

	Item	Category	Score	Range	
Face	Sex	male	0.073	0.170	
		female	−0.097		
	Age	20s	−0.053	0.131	
		30s	−0.022		
		40s	−0.017		
		50s	0.013		
		Over 60	0.078		
	Degree of Urbanization	1	0.374	0.663	
2		0.207			
3		−0.142			
4		−0.289			
Multi-functionality of agriculture and farmlands	Supply of fresh and safe vegetables	YES	0.008	0.034	
		NO	−0.026		
	Preserving living environment	YES	0.065	0.209	
		NO	−0.144		
	Providing affluent and healthy environment	YES	0.060	0.239	
		NO	−0.179		
	Prevention of disaster	YES	0.046	0.122	
		NO	−0.076		
External diseconomy of agriculture and farmlands	Providing opportunities for interaction between people	YES	0.039	0.103	
		NO	−0.064		
	Providing opportunities to experience and learn about agriculture	YES	0.022	0.078	
		NO	−0.056		
	Increasing living matters and improve ecosystem	YES	0.050	0.162	
		NO	−0.112		
	External diseconomy of agriculture and farmlands	Deterioration of landscapes	YES	−0.182	0.198
			NO	0.016	
Bad smell		YES	−0.090	0.138	
		NO	0.049		
Generation of insects		YES	−0.055	0.135	
	NO	0.080			
External diseconomy of agriculture and farmlands	Creation of dust	YES	−0.047	0.082	
		NO	0.035		
	Illegal waste disposal	YES	−0.007	0.011	
		NO	0.004		
Discrimination ratio			75.13%		

Note: Responses of "Positive" or "Negative" and "Cannot say" to the question of "Do you think if it is better to preserve agriculture and farmlands in your residential area?" are discriminated.

preservation of urban agriculture.

5. Concluding remarks

Urban agriculture in Japan is on a downward trend. On the other hand, cases that demonstrate sustainability of urban agriculture are emerging by creating new systems¹.

It is considered that sustainable urban agriculture can be achieved, in terms of economic efficiency, by growing high quality and high price agricultural goods that can compensate their high costs, in terms of sociality, by contributing to the society through production and other activities, and in terms of environment protection, by decreasing environmental burdens and contributing to the resolution of urban environmental problems.

What urban residents expect from urban agriculture is changing from its function to produce agricultural goods to other functions. It is true that parks function better as green spaces than farmlands. However, in the light of difficulty of procuring lands and maintaining such parks, a policy of maintaining urban agriculture in order to maintain green spaces with no associated cost is an important alternative. In order to realize that end, the agriculture side should be closely connected with urban residents and the agriculture should become essential for urban life. Farmlands should also be open as green spaces for urban areas.

Multi-functionality of agriculture and farmlands plays an important role to the quality of life not only in rural areas but also in urban areas. It will give great influence on urban planning as well. Therefore, it is necessarily to introduce the issue of multi-functionality of agriculture and farmlands into the existing urban economics and urban planning. However an indirect analysis was given in this research based on the evaluation of residents to the urban agriculture, and empirical analyses from public economics based on utility functions will be our future task.

¹ In 1995, "Kumagaya Organic Recycling Research Group" was established in Kumagaya-city in Saitama Prefecture by those in the livestock industry with support of other farmers, agricultural cooperatives, supermarkets, river administrators, machine manufacturers and local residents in order to implement a system to recycle organic waste within the community.

Also in 1995, Kokubunji-city in Tokyo implemented "Agriculture Volunteer System". Under this system, urban residents who completed one year training on agriculture are registered as "agriculture volunteers". Currently the number of agriculture volunteers exceeds 300. Coordination of works, schedules and assigned farmers for agriculture volunteers is undertaken by, among others, local agricultural cooperatives.

In 2000, four farmers and eighteen urban residents in Sagami-hara-city in Kanagawa Prefecture invested money to establish an agricultural production corporation "*Aozora Noen* [Blue Sky Farm Limited Company]". Under this system, abandoned rice paddies are leased in order to preserve farmlands.

Furthermore, in recent years, it is becoming increasingly important to teach children preciousness of food, agriculture and life in the field of education. Currently 174 farms nation wide and 29 in the metropolitan areas are certified by the Japan Dairy Council as dairy education farms.

On the other hand, in the southern part of Saitama Prefecture, there is a 1,250 ha wide area called "*Minuma Tanbo* [Minuma Paddy]". In this area, conversion of farmlands is strictly restricted in order to prevent a flood in the lower reaches of the river. However, it has become apparent that many people are no longer able to keep their farmlands due to retirement, etc. Under such circumstance, Saitama Prefecture and Saitama-city and Kawaguchi-city created a fund with approximately 14 billion yen, which has been turning such lands into public lands through purchase or lease of such lands.

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