

# Difficulties in Accessing Grocery Stores in Japan

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## 1. Introduction

According to the National Census of 2010, people aged over 65 account for 23.0% of the national population, which is the world's highest level of aging (Statistics Bureau, Ministry of Internal Affairs and Communications). Also, according to the National Institute of Population and Social Security Research, the population over 65 is predicted to increase by 25% in 20 years, from 29.48 million in 2010 to 36.85 million in 2030, raising the ratio up to 31.6%.

Meanwhile, the number of food stores continues to decline, with the number of retailers dealing in food and drink down by 26% in 10 years, from 526,000 in 1997 to 390,000 in 2007 (Current Survey of Commerce). Since the abolition of the Large-Scale Retail Store Law in 2000, this trend has been in acceleration.

Under the current climate of aging population and the decline of grocers, there is an emerging section of the population such as senior citizens who face inconvenience and laboriousness involved in shopping for food. For example, there are cases in urban areas where the opening of a large-scale commercial complex resulted in the closure of shops downtown, and consequently elderly residents in the area suffer inconvenience in food shopping; in rural areas, where aging population is progressing rapidly, the closure of Japan Agriculture-run shops made food shopping more difficult for the residents. More than 80% of the local authorities in Japan recognize the need, at least to a degree, for some measures to assist the populace with food-shopping difficulties, which we will describe later. The issue is, however, widely recognized throughout the country by local authorities irrespective of the size of their municipalities.

Given this situation, Ministry of Agriculture, Forestry and Fisheries, the *Annual Report on Food, Agriculture and Rural Areas in Japan FY2011* includes “Difficulties in access to food,” as one of the important policy agenda in the field of food, to address situations in which vulnerable people such as the elderly suffer inconvenience and laboriousness involved in shopping for food.

Implementation of measures for difficulties in accessing food is urgently needed, as the forecast increase in the aged population is directly related to an increase in the

number of the elderly with difficulties to access to shopping for food. However, Japan has not adequately accumulated research data on this issue. In the approach to this problem, the authors undertook the following three tasks: (a) to analyze residents' awareness of their direct involvement in the issue; (b) to conduct a quantitative analysis of spatial conditions between residents and stores; (c) to identify the level of awareness of the local authorities that have a role in developing and implementing measures.

## 2. Theme and Methodology

### (1) Difficulties in Accessing Grocery Stores

This paper refers to the situation in which shopping for food is carried out with certain difficulties as “Difficulties in Accessing Grocery Stores” for the purpose of analyses. This is because having difficulties in shopping for food is directly relevant to accessibility of food, which can be understood in close association with factors such as spatial conditions (e.g., distance to stores), car ownership, and personal conditions (e.g., age), as Sugita [4][5] points out.

### (2) Consumer cost in shopping

The difficulties in accessing food issues can be discussed in the context of the theory of commerce because issues regarding the retailing of foods are its major features. In this context, the distribution sector is seen as responsible for creating distribution services, and the decline of the service standard is construed to increase consumer costs in acquiring assets (Suzuki and Tamura.: [6] 54–58). The consumer cost in food shopping is considered to have increased if consumers begin to suffer more inconvenience and difficulties in shopping for food due, for example, to closure of nearby shops, which in turn lowers the level of distribution service provided by distributors.

Suzuki and Tamura suggest that consumer cost takes three forms: (a) monetary cost (transport fees, parking fees, etc.); (b) time spent for shopping (convertible into monetary cost as opportunity cost); and (c) psychological/physical cost (from crowded shopping environments, etc.). Difficulties in food shopping are considered to directly reflect these consumer costs.

### (3) Food security perspective

An increase of consumer cost for buying food gives rise to the issue of food security in household once it reaches a level that necessitates the restriction on food consumption. Although Japan's national food self-sufficiency is low, overall demand for food is met with sufficient supply. Under such conditions, however, constraint on food consumption may still arise for some households if accessibility of stores diminishes.<sup>1</sup> The 2010 ' Ministry of Agriculture, Forestry and Fisheries, *Basic Plan for Food*,

*Agriculture and Rural Areas* ' states that Japan “in response to the aging population, will strive to ensure ready food supply to consumers by sound development of diverse delivery services carried out by private companies” as part of “Policies for Securing Stable Food Supply”[9].

In the United Kingdom, where food deserts<sup>2</sup> have been recognized since the 1990s, the UK Department for Environment, Food and Rural Affairs (DEFRA) includes household access to food stores as one of the indicators employed in the assessment of household food security. Here, the desired outcome is that “All households, including those without cars, have adequate physical access to food stores, ” and the indicator is “the number and percentage of households within 15 and 30 minutes of a supermarket/food store by public transport/walking and by cycling” (DEFRA [16]: p.134). Similarly, the United States Department of Agriculture (USDA) investigated to assess the extent of areas with limited access to affordable and nutritious food, identify characteristics and causes of such areas, consider how limited access affects local populations, and outline recommendations to address the problem, in accordance with the Food, Conservation, and Energy Act of 2008 (ERS/USDA [17]).

#### (4) Theme and methodology of this paper

In order to consider measures to address this issue as part of developing policies for securing stable food supply in Japan, the following points must be clarified:

- (a) factors causing inconvenience and laboriousness involved in shopping for food,
- (b) the actual state of accessibility of food stores,
- (c) factors in the difficulties and desired solutions from the perspective of the population, and
- (d) recognition of the present state and preferred measures from the perspective of local authorities, who play a significant role in implementing such measures.

This paper aims to clarify the above in order to contribute to implementing measures for solving the difficulties in accessing food. Later, they will be discussed in this order.<sup>3</sup>

In order to undertake this task, we conducted an awareness survey with the local populace about the reality of shopping for food. It targeted individuals who do food shopping for their households. The respondents were asked whether they had difficulties or felt inconvenience and laboriousness involved in shopping for food, and to give descriptions of such difficulties and their opinions about what was needed to solve them. The following three points were observed in the preparation of the survey:

- (a) respondents' age groups cover all generations including youth in order to relatively elucidate the relationship between difficulties in accessing food and the aged population;
- (b) regional comparison is enabled between suburban residential complex, central provincial city and rural town, considering the complexity of the difficulties in accessing food; and
- (c) the implication of shop proximity to the difficulties in shopping is quantified by measuring the distances between houses and stores using a

geographical information system (GIS).

We also conducted an awareness survey targeting municipal governments in Japan. This survey asked if they were aware of the measures that needed implementing, whether there were any measures in place, about the measures they consider necessary for addressing the issues, and so on.

### 3. Factors causing inconvenience and laboriousness involved in shopping for food

#### (1) Target districts of the local populace awareness survey

The survey was conducted in three locations: a residential complex in western Tokyo to represent a suburban residential complex (“Residential Complex A” hereafter), the city center of a provincial city in southern Fukushima prefecture (“City B”), and an entire town in the southern part of Tottori prefecture (“Town C”) to represent a rural town. City B suffers from a collapsing food supply system in the old central district as mass retailers are established in the suburbs, and Town C is an archetypal rural town where the local population is aging rapidly. Table 1 outlines these locations.

Table 1. Outline of target regions

Region	Outline of the region	Research Info
Residential Complex A	<p>Location: West of Tokyo, about 2km south of a JR station on the Chuo line.</p> <p>Description: Rented accommodation complex provided by Urban Renaissance Agency. Local bus services run every 10 minutes between the complex and the railway station.</p> <p>Many slopes in the vicinity due to its hilly location. Car parking lots are situated on the peripheral green areas.</p> <p>Population etc.: About 2,300 out of 2,800 units are occupied. The estimated aging rate is 26%.</p> <p>Food stores: A medium-sized supermarket, fishmonger, bakery, noodle shop and social drink house are located in the center of the complex. Several general supermarkets are found in the vicinity of the complex and the railway station.</p>	<p>Survey conducted: Jul.-Aug. 2010</p> <p>Distributed to: 2,354</p> <p>Returned: 906</p> <p>Response rate: 38.5%</p>
City B	<p>Location: An old castle town in the southern part of Fukushima prefecture. The area designated for City Centers Revitalization Initiatives is targeted.</p> <p>Description: There are many GMSs along the national route in the outskirts, and the city center is in decline.</p> <p>City Centers Revitalization Initiatives are in operation.</p> <p>Population etc.: The area has a population of about 3,000, with an aging rate at 33.8%. Aging is more progressive than the overall aging rate for the entire city.</p> <p>Food stores: One Co-op store within the target area, and only a few privately-run stores.</p>	<p>Survey conducted: Sep.-Oct. 2010</p> <p>Distributed to: 2,002</p> <p>Returned: 886</p> <p>Response rate: 44.3%</p>
Town C	<p>Location: Located in the Chugoku Mountains, south of Tottori prefecture. The entire town is the target area.</p> <p>Description: 90% of the municipal area is green forests. It is situated about 40km by road from Yonago city.</p> <p>Population etc.: The population is about 5,500, with an aging rate at 48.0%. One of the most rapidly aging communities.</p> <p>Food stores: One food supermarket store and several private stores are found near town-hall.</p>	<p>Survey conducted: Oct.-Nov. 2010</p> <p>Distributed to: 2,313</p> <p>Returned: 1,200</p> <p>Response rate: 51.9%</p>

Source: Authors' original data

These locations are characterized by the difference in terms of the road distance to stores used most frequently and means of transport. Regarding the distance to stores, 250–500 m and 2–5 km were the most frequent answers at Residential Complex A. The former refers to a food supermarket stores in the complex, and the latter refers to general merchandise supermarket and department stores outside the complex. In contrast, City B yielded 1–2 km, and more than 10 km ranked the highest in Town C.

As to the means of transport to stores, more than 40% of the people in Residential Complex A answered “on foot,” followed by “by bus.” In City B, more than 60% of people under 65 years of age drove to stores, but less than 30% of people aged 65 years or over had access to cars to drive. In Town C, more than 80% of people under 65 years of age drove to stores, as did about 50% of people of 65 years or over. People aged 65 or over in Residential Complex A and Town C used bus as an alternative to driving themselves, whereas those in City B walked or rode bicycles to stores nearer to them for shopping.

(2) Proportion of answers to acknowledge experience of inconvenience and laboriousness involved in shopping for food

In the survey, individuals who answered that they experienced inconvenience and laboriousness involved in shopping for food accounted for 45.3% of the respondents in Residential Complex A, 40.2% in City B and 46.1% in Town C.<sup>4</sup> To compare the figures about the populace aged 65 or over across the three locations, it is 46.7% for Residential Complex A, 48.8% for City B, and 52.3% for Town C (Table 2).

Also, when analyzed by age brackets and household types, the percentage increased for older individuals in City B and Town C, with a significant difference between the groups “under 50” and “aged 65 or over.” Furthermore, the percentage is high among

Table 2. Percentage of answers acknowledging experience of inconvenience and laboriousness involved in shopping for food (%)

	Residential Complex A	City B	Town C
Total	45.3	40.2	46.1
Age Groups			
Under 50	48.1	24.8	35.4
50-64	40.9	35.7	36.8
65-74	46.3	47.1	46.1
75 or over	47.1	50.5	56.8
(65 or over)	46.7	48.8	52.3
Household Types			
Elderly single occupancy	46.3	49.5	56.0
Other single occupancy	37.5	31.4	42.2
Elderly married couple	47.2	42.1	51.2
Other 2-peopled household	45.9	43.9	45.5
Household of more than 2	46.5	36.6	38.4

Note: Responses without age/household-style data are excluded.

Source: Authors' original survey.

“elderly single-occupant households” with a large gap between them and “households of more than 2 persons.” However, regarding Residential Complex A, it is high among individuals “under 50,” and “households of more than 2 persons” also show high percentage. Most of the households with more than 2 persons at Residential Complex A are couples with children; the generation that is raising children. Therefore, this outcome suggests that this generation at Residential Complex A, as well as the aging generation, experience many difficulties in access to food.

### (3) Analysis of the factors causing inconvenience and laboriousness involved in shopping for food

In order to identify the factors causing difficulties in shopping and to quantify their impact, we employed the logit model, assigning a value of 1 to those who answered “experiencing inconvenience and laboriousness” and 0 to those who experience “no inconvenience and laboriousness” as dependent variables. The marginal effect is obtained from estimating coefficient values of various factors, and by calculating the change of the probability to answer “experiencing inconvenience and laboriousness,” the magnitude of the effect of these factors can be ascertained.

In this process, influential factors are categorized into supply and demand factors. The supply factors are independent of direct influences from aspects pertaining to individuals, including closure of stores or termination of public transport services. The demand factors include personal attributes of the populace such as access to cars, age, gender, family structure, income-level, health status and so on. Opening/closure of stores in the supply factors are associated with spatial conditions such as the distance and traveling time to stores.

We analyzed the data by three age clusters—all age groups, 65 years or over, and under 65—as well as by region-clusters of all regions and individual locations.

Independent variables include distance and traveling time to the most frequently used stores as factors indicative of the spatial conditions, and means of transport as an influential factor to the temporal aspect. Of these, distance belongs to the supply factors while the means of transport belong to both supply factors and demand factors. The time factor is a complex of these factors.<sup>5</sup> In addition, the following are included in the demand factors: age, gender, number of individuals in the household, family members living in close proximity, family members in need of long-term care, status of income earner, and participation in local activities. Also in the case of the age group of 65 years or over, we additionally used the Tokyo Metropolitan Institute of Gerontology (TMIG) Index of Competence<sup>6</sup>

Model I is based on the time required to reach stores as a variable. Model II is based on the road distance to stores and means of transport as variables instead of time.

Variables are dummy variables except the number of family members and TMIG Index

of Competence, which are numerical values. The standards for the dummy variables are as follows: “within 15 minutes” for time, “under 250 m” for road-distance, “on foot” for means of transport and “under 65” for age. The standard for the employment status of income-earners is set to “pensioner.” The income-levels of households vary greatly depending on the employment status of income-earners. Living costs of the self-employed (individual proprietors) and non-regular employees are significantly lower than those of pensioners (unemployed) according to the per-capita consumption expenses calculated from data such as household income surveys.

#### (4) Results

Table 3 shows the estimate variables and marginal effects from the data inclusive of all regions. In Model I, the variable of time to stores shows greater impact on difficulties in shopping for food than the other variables do. Time to stores is significant over the 15-minute mark, and over 30 minutes has a higher incidence of “experiencing difficulties” than the 15-30 minute bracket. A longer traveling time is considered to impact the aged population through an increased psychological and physical strain, while younger generations suffer an increased opportunity cost.

In Model II, the variables of distance to stores and availability of cars are greatly correlated with the higher incidence of “experiencing difficulties.” Close examination of the data from all age groups reveals that the distance factor becomes significant when it is over 1 km, and the difficulties in food shopping increases as the distance increases. Regarding the means of transport, the outcomes are significantly negative only when respondents have cars to drive themselves, and the incidence of “experiencing difficulties” is greatly lower than traveling on foot.

When we compare two age clusters, namely 65 years or over and under 65 years old, distance is found to have greater impact on the aged population, and thus they are vulnerable in terms of distance to stores. On the other hand, the difficulties are greatly reduced in both instances where respondents have cars to drive themselves.

Both Model I and Model II have positive values for the age group of 65 years or over, and the aged population is considered to suffer greater difficulties in terms of the all-region-based analysis.

Where there are family members living separately in the neighborhood, Model II shows a negative outcome, indicating that the difficulties are reduced if there are people nearby who can provide assistance for shopping, whereas the existence of someone in need of long-term care in the household significantly increases the inconvenience and difficulties in shopping, placing a great burden especially on younger generations.

In terms of the status of income earner, Model II shows a significant, positive coefficient for non-regular employees under 65 years old. It is considered that low income levels and insecurity of employment status of non-regular employees among

Table 3. Factors causing difficulties in shopping for food

Independent variables	Model I				Model II							
	All age groups		Under 65		All age groups		65 or over					
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect				
Constant variables	-0.413	-0.102 *	2.678	0.416 ***	-0.661	-0.161 **	-0.610	-0.151 *	2.100	0.379 ***	-0.621	-0.149
Traveling time to stores												
15-30 minutes	0.685	0.168 ***	0.812	0.200 ***	0.514	0.121 **	-	-	-	-	-	-
30 minutes or more	1.161	0.281 ***	1.103	0.264 ***	1.167	0.283 ***	-	-	-	-	-	-
Road-distance to stores												
250-499m	-	-	-	-	-	-	0.440	0.109	0.727	0.178 *	0.159	0.036
500m-1km	-	-	-	-	-	-	0.398	0.098	0.665	0.163	-0.083	-0.018
1-2km	-	-	-	-	-	-	1.049	0.256 ***	1.425	0.331 ***	0.504	0.117
2-5km	-	-	-	-	-	-	1.214	0.295 ***	1.350	0.320 ***	1.009	0.237 *
5-10km	-	-	-	-	-	-	1.414	0.334 ***	1.719	0.371 ***	0.748	0.179
10km or more	-	-	-	-	-	-	2.142	0.482 ***	2.309	0.493 ***	1.765	0.413 ***
Means of transport												
Bicycle	-	-	-	-	-	-	-0.186	-0.045	-0.179	-0.045	-0.151	-0.033
Driving (car or motorbike)	-	-	-	-	-	-	-1.101	-0.259 ***	-0.937	-0.227 ***	-0.895	-0.204 **
Car (driven by others)	-	-	-	-	-	-	-0.240	-0.057	-0.256	-0.063	-0.360	-0.076
Bus	-	-	-	-	-	-	0.143	0.035	0.130	0.033	0.102	0.023
Other	-	-	-	-	-	-	-0.768	-0.169 *	-0.937	-0.215	0.135	0.031
65 or over	0.405	0.098 ***	-	-	-	-	0.326	0.079 **	-	-	-	-
Male	-0.322	-0.078 ***	-0.760	-0.186 ***	0.086	0.020	-0.149	-0.036	-0.600	-0.148 ***	0.166	0.038
No. of people in a household (score)	-0.089	-0.022 *	-0.025	-0.006	-0.069	-0.016	-0.079	-0.019 *	-0.055	-0.014	-0.049	-0.011
Family members living nearby	-0.282	-0.068 **	-0.230	-0.057	-0.311	-0.070 *	-0.326	-0.079 ***	-0.320	-0.080 *	-0.289	-0.064 *
Family member(s) in need of long-term care	0.387	0.096 ***	0.241	0.060	0.535	0.127 **	0.485	0.120 ***	0.354	0.088 *	0.571	0.134 **
Status of income-earner												
Employed (full-time)	-0.033	-0.008	0.139	0.035	-0.072	-0.016	0.046	0.011	0.187	0.047	-0.019	-0.004
Employed (part-time)	0.322	0.080	-0.198	-0.049	0.390	0.092	0.445	0.110 *	0.107	0.027	0.483	0.113 *
Self-employed	0.222	0.055	0.267	0.067	0.254	0.059	0.220	0.054	0.128	0.032	0.260	0.060
Other	0.099	0.024	-0.363	-0.089	0.128	0.030	0.314	0.078	0.045	0.011	0.273	0.063
Participation in local communities/activities	-0.123	-0.030	0.183	0.046	-0.203	-0.046	-0.157	-0.038	0.111	0.028	-0.284	-0.064
TMIG Index of Competence (score)	-	-	-0.228	-0.057 ***	-	-	-	-	-0.214	-0.053 ***	-	-
Residential Complex A	-0.072	-0.017	-0.508	-0.125 **	0.391	0.091 *	-0.274	-0.066	-0.590	-0.145 **	0.068	0.015
Town C	-0.175	-0.043	-0.304	-0.076	-0.128	-0.029	-0.406	-0.098 *	-0.565	-0.140 *	-0.284	-0.063
Total of samples	2,433		1,169		1,131		2,346		1,134		1,077	
Dependent variable = 0	1,399		614		725		1,348		589		697	
Dependent variable = 1 (experience difficulties)	1,034		555		406		998		545		380	
Log likelihood	-1569.9		-746.0		-702.4		-1476.7		-713.2		-651.3	
Goodness of fit (%)	63.0		64.9		66.0		64.3		64.8		66.5	

Notes: 1. Significance at: \*, 5%; \*\*, 1%; and \*\*\*, 0.1%.  
 2. "-" indicates the variable is not applicable.  
 3. "stores" refer to those which respondents use most frequently.  
 Source: Estimates by authors



the younger generations contribute to increase the burden in shopping for food. Lastly, in the case of 65 years or over, high-level functional capacity (score of TMIG Index of Competence) has a significant influence on the reduction of the difficulties and inconvenience. This suggests that maintaining a high level of behavioral competence among the aged population is also important in an attempt to solve difficulties in accessing food.

The outcomes of estimates by regions (Table 4) indicate that, first of all, distance has little impact for respondents at Residential Complex A, which has nearby stores and public transport readily available. Of the demand factors, the age factor did not show significant difference between older and younger generations reflecting that the latter, who represent young families raising children, also experience difficulties. The younger generation also shows the tendency of reduced difficulties where they have family members living in close proximity, and of increased difficulties where someone in the family is in need of long-term care or the income-earner is in non-regular employment. To sum up the characteristics of Residential Complex A, the younger generations as well as the older generations experience difficulties in shopping and the younger generations are particularly susceptible to the demand factors.

In City B, where the city center suffers from decline due to the establishment of mass retailers in its suburban areas, older citizens who usually walk to shops tend to experience inconvenience when stores are more than 1km away, while the level is reduced for people under 65 if they use cars. In terms of the demand factors, the difficulties increase for the older generations, people with family members in need of long-term care, and self-employed income earners aged 65 years or over. As stated above, the population in City B experiences difficulties in shopping influenced by both supply and demand factors.

Finally, in Town C, where the distance to stores is far greater, the aged populace

Table 4. Characteristic specifics of inconvenience and laboriousness classified by regions

	Residential Complex A (suburban residential complex)		City B (central provincial city)		Town C (rural town)	
	65 or over	Under 65	65 or over	Under 65	65 or over	Under 65
Supply factors			1km or more (+)		1km or more (+) 10km or more (+)	
	(no significant difference between generations)		65 or over (+)		(no significant difference between generations)	
Demand factors	Use of cars (-)	Nearby family members (-)	Family member(s) in need of LT care (+)	Self-employed (+)	Use of cars (-)	Nearby family members (-)
	Competence (-)	Family member(s) need LT care (+)	Part-time employee (+)		Family member(s) need LT care (+)	Self-employed: farmers (-)
						Competence (-)

Note: (+) and (-) indicate factors that significantly increase/decrease difficulties in shopping.

Source: Authors' original data

experiences difficulties in shopping when the stores are located at 1km or more, whereas the younger generations only experience difficulties when the distance is 10 km or more. However, the use of cars did not appear to reduce the difficulties for them. This is possibly because the distance to stores is so long that driving made no difference. Also, age does not appear to reflect the incidence of experiencing difficulties; the younger generations indicated the level of difficulties similar to that of the older generations. Unlike Residential Complex A and City B, however, the existence of family members in need of long-term care did not appear to be a contributory factor. On the other hand, the factors that contribute to reducing the difficulties included family members living in close proximity and good health of aged individuals. Furthermore, households engaging in farming are considered to experience lesser degree of difficulties in shopping as they produce part of their food supply themselves. The results from Town C indicate that, while the supply factor, namely the distance to stores, strongly influences the difficulties in shopping, demand factors such as family members living nearby, behavioral competence and status of income earner are found to contribute in reducing the difficulties.

An observation by regions thus illuminates that the influences of supply factors and demand factors differ from region to region.

#### 4. The Reality Regarding the Distance to Stores

##### (1) The populace likely to experience difficulties in shopping

In this section, we take the results from the above analyses, that factors of distance, use of cars, and age had great impact on the difficulties in shopping, and create a standard that defines the populace that experiences difficulties in shopping. We then apply it to elucidate the reality of accessibility of stores for the population.

First, the distance that provides easy access to stores is set to 500 m on a straight line. It is based on the following rationale: road distance of 1km or more yielded significant difficulties for car users, as described in Section 3. above; 500 m is adopted in a past case study [1]; and a public opinion poll of July 2009 [8], conducted by the Cabinet Office of the Japanese government, found that 37.3% of people, the largest proportion of the overall surveyed population, considered the walkable distance in everyday situations to be between 501 and 1,000 m.

We identified availability of cars to be one of the important indexes, as the analyses indicated that the difficulties in shopping were largely reduced by driving to stores.

Finally, as older individuals are generally found to experience more difficulties and are vulnerable in terms of the distance to stores, estimation is conducted separately for the populace aged 65 years or over and for those under 65.

According to the above, we postulate the populace that experiences difficulties in shopping to the greatest degree to be aged 65 years or over without cars, whose nearest

shops are located at 500 m or farther. We will refer to a set of these indexes as “access conditions.”

In the following, we estimate the population by the access conditions based on the half-grid square data for population and the number of stores. In this case, we calculated the probability of the distance to stores being greater than a certain value on an assumption that population and stores are distributed with uniformity within the grids. The outcomes are regarded as population ratio (see Appendix for details). Then, we calculated the population distribution by generating estimated ratios based on several threshold distances.

We used the Current Survey of Commerce 2007 for the data on the number of stores, and the half-grid square data from national censuses of 2010 and 2005.<sup>7</sup>

The reality of accessibility is possibly different in urban and rural areas. Therefore, we employ a different regional classification: DID (densely inhabited district)<sup>8</sup> for urban areas and non-DID for rural areas. Regarding store types, we created a category “fresh food stores” that includes providers of fresh food indispensable for everyday diet (meat and poultry stores, fresh fish stores, vegetable and fruit stores, department stores, general merchandise supermarkets and food supermarket stores as defined in the Current Survey of Commerce) and “food supermarket stores” (department stores, general merchandise supermarkets and food supermarket stores) that provide a wide range of goods. The latter is created because many people who experience difficulties in food shopping identified the poor selection of products in their nearby stores as problematic, of which we will describe later.

## (2) Population distributions by access conditions

Table 5. Population by access conditions (2010 population data)

		(million people, %)										
Region	Age	Overall	Change rate	Fresh Food Stores				Food Supermarket Stores				
				500m or more	Change rate	Without cars	Change rate	500m or more	Change rate	Without cars	Change rate	
Nationwide	Overall	128.06 (100.0)	0.2	46.32 (36.2)	-0.9	8.54 (6.7)	-0.1	71.76 (56.0)	-0.7	15.07 (11.8)	0.3	
	65 or over	29.25 (100.0)	13.9	11.37 (38.9)	11.9	3.82 (13.1)	14.2	17.28 (59.1)	12.4	6.44 (22.0)	14.4	
DID	Overall	92.13 (100.0)	2.0	20.15 (21.9)	3.7	4.73 (5.1)	3.7	40.10 (43.5)	2.3	10.43 (11.3)	2.5	
	65 or over	19.35 (100.0)	17.9	4.08 (21.1)	24.3	1.81 (9.3)	24.7	8.45 (43.7)	19.6	3.99 (20.6)	19.9	
Non-DID	Overall	35.93 (100.0)	-4.0	26.17 (72.8)	-4.3	3.82 (10.6)	-4.5	31.66 (88.1)	-4.2	4.64 (12.9)	-4.5	
	65 or over	9.89 (100.0)	6.8	7.30 (73.8)	6.0	2.02 (20.4)	6.2	8.83 (89.2)	6.3	2.45 (24.8)	6.5	

Notes: 1. The FY2007 Current Survey of Commerce and the 2010 National Census were used to estimate the number of stores and population respectively. Change rates indicate the difference between 2005 and 2010.

2. Figures in ( ) are percentages against Overall.

Source: Estimates by authors

Table 5 shows the estimated population classified by access conditions.

Based on the data from the 2010 census, an estimated 46.32 million people in Japan live 500 m or more away from their grocer (36.2% of the total population). There is a slight decrease in this number from 2005 because of a population increase in urban areas, where distances to stores are shorter. Here, non-DID represents a far greater proportion. This is because the DID population accounts for approximately 70% of the overall population, yet only 21.9% of them fall in the “farther than 500m” category. Conversely, 72.8% of the population in non-DID fall in this category.

Further, it is estimated that 8.54 million people (6.7% of the total population) among those whose stores are farther than 500 m have no access to cars. Here, the population without a car is greater in DID. It is supposed that, although distance to stores tends to be longer in non-DID, a high rate of car ownership is creating the situation in which driving renders support to shopping activities.

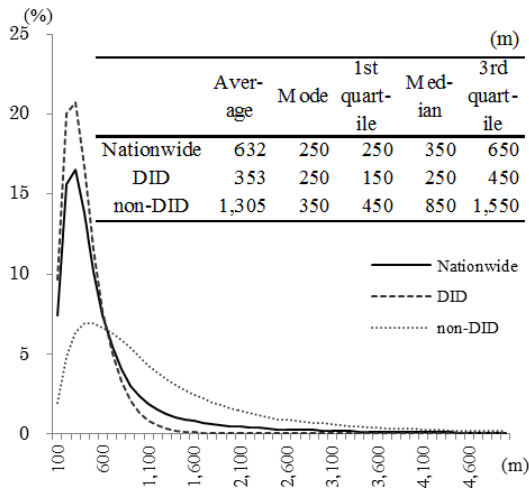
There are 3.82 million people aged 65 years or over without cars, living at the distance of 500 m or more to stores, the populace that is considered to be most susceptible to difficulties in shopping (13.1% of the total 65+ population). Within this population, 2.02 million people are found in non DID, accounting for a high 20.4% of the population aged 65 years or over in non DID. This indicates that for many elderly people in the rural areas, where people drive to stores more often, use of cars is not possible. However, the change rate in 5 years shows a considerable increase of 24.7% for the aged population in DID, reflecting the recent progressive aging of population in urban areas.

Regarding the figures in terms of the food supermarket stores category, the number of people who fall into the 500 m+ bracket is 71.76 million nationwide (56.0% of the total population), in which there are more people in DID, unlike the case in the fresh food stores category. The possible explanation for this is that many stores in this category are located outside city centers, operating in wider trading zones on the assumption that their clientele is likely to drive to the stores.

Of this population, 6.44 million are 65 years or over without cars, 60% of which is found within DID. Thus, the populace with poor access conditions largely consists of people in DID in terms of the food supermarket stores case.

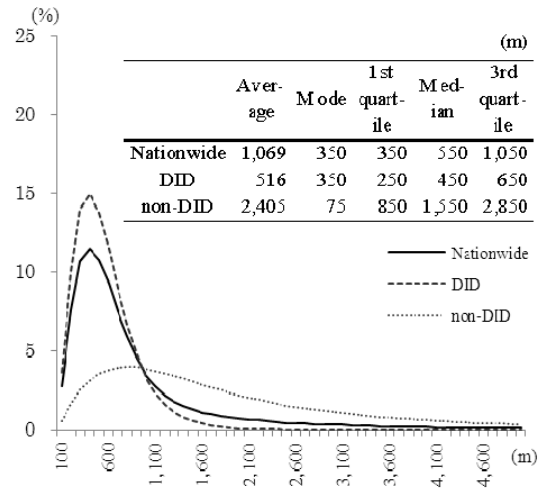
### (3) Population distributions by distance to stores

While the population ratio in terms of the 500m threshold can indicate the state of accessibility of stores, it does not reflect actual distances, which must be taken into account particularly where the percentage is high. It is especially important in the case of rural areas, where driving to shops is commonplace. Therefore, we include the population ratio analysis by distance to stores in the following. Figure 1 indicates the population distribution by distance to “fresh food stores” in Japan.



**Figure 1. Population distribution classified by distance to Fresh Food Stores**

Source: Estimated by authors



**Figure 2. Population distribution classified by distance to Food Supermarket Stores**

Source: Estimates by authors

The national average is 632m, but it is extremely biased toward left and lingers low and widely toward right, which represents greater distance. The median of 50% (median value  $\pm 25\%$ ) is between 250 and 650m, indicating longer distance than that of the mode.

Also, this distribution of the national population is similar to that of DID. This is due to the fact that DID accounts for a larger proportion. Regarding non DID, the average distance is 1,305 m, much greater than that of DID. The median of 50% is considerably wide, spreading between 450 and 1,550 m.

The average distance to food supermarket stores is 1,069 m for the national population, while it is 2,405m for non DID population (Figure 2). In this case, the 50%-median of non DID is between 850 and 2,850 m, even more widely spread, which indicates that the accessibility of stores becomes extremely poor when range of products is an issue in rural areas.

#### (4) Average distance to stores by access conditions

Table 6 shows the average distances to stores reorganized in terms of access conditions.

It is notable that, in terms of fresh food stores in DID, the population over 65 years old lives closer to stores than those under 65. The possible explanation is that the progress rate of population aging is high in older city centers of provincial cities and that long-standing grocers are often located within such city centers. In contrast, there is no significant difference between generations in terms of food supermarket stores. On the other hand, the aged population in non-DID tends to live farther from stores.

The average distance for the populace aged 65 years or over without cars, whose nearest shops are located farther than 500 m, is 1,398 m—well over 1km. It increases to 1,768 m in terms of food supermarket stores. The average distances for the non-DID

Table 6. Average distance to stores classified by access conditions

		(m)					
Region	Age	Fresh Food Stores			Food Supermarket Stores		
		Overall	500m or more	Without cars	Overall	500m or more	Without cars
	Under 65	602	1,220	1,051	1,001	1,561	1,231
	65 or over	750	1,508	1,398	1,341	2,042	1,768
DID	Overall	353	727	712	516	805	774
	Under 65	355	727	712	517	805	769
	65 or over	342	724	714	516	809	785
Non-DID	Overall	1,305	1,678	1,727	2,405	2,682	2,811
	Under 65	1,250	1,610	1,553	2,274	2,544	2,469
	65 or over	1,474	1,881	1,919	2,804	3,092	3,190

Note: The FY2007 Current Survey of Commerce and the 2005 National Census were used to estimate the number of stores and population respectively.

Source: Estimates by authors

population that falls in this bracket are 1,919m in terms of fresh food stores and 3,190 m in terms of food supermarket stores. Here, again, the problem of accessibility of stores in rural areas is highlighted. These residents experience a greater degree of difficulties in shopping, exacerbated by the three factors of remoteness, lack of a car and being of advanced age.

## 5. Descriptions of Difficulties and Residents' Opinions about Measures for Improvement

### (1) Analytical methodology

In this part, we will identify individuals' perception of issues and opinions about desirable solutions from the local populace awareness survey, classified by region as well as by age group.

It must be noted that considerations for future measures to be taken must seek solutions that are strongly relevant to people's problems, and opt for realistic measures based on this understanding. Bearing this in mind, we employ the mathematical quantification theory class III in addition to a region-specific analysis, in order to illuminate the relationship between the conditions in which the populace finds themselves, contents of their difficulties, and their opinions about desired improvement measures. In doing so, we distinguish the population based on the results presented in Section 3., according to the following three indicators: the distance to stores is 1 km or more; they drive cars to stores; and age threshold of 65 years.

### (2) Descriptions of difficulties in shopping for food

The awareness survey with the local populace asked the individuals who answered they experienced inconvenience and laboriousness involved in shopping for food to identify the nature of their difficulties. The responses are shown in Table 7 in

Table 7. Descriptions of inconvenience and laboriousness involved in shopping for food

	(individuals, %)						Relationship between regions			
	Residential Complex A		City B		Town C					
	under 65	65+	under 65	65+	under 65	65+	under 65	65+		
No. of samples (excluding responses without answers)	146	235	133	192	162	334				
Overall	100.0	100.0	100.0	100.0	100.0	100.0				
1. Long distance to stores	24.7	18.7	54.9	50.5	61.7	51.2	*	B,C>A B,C>A		
2. Slopes on the way to stores	24.7	29.8	4.5	6.8	1.9	2.4		A>B,C A>B>C		
3. Steps/gaps on the way to stores	12.3	11.5	1.5	3.1	0.0	3.0	*	A>B,C A>B,C		
4. Having to use buses	21.2	25.5	3.8	3.1	8.6	17.1	*	A>B,C A>C>B		
5. Having to use taxis	0.7	1.3	2.3	5.7	0.6	4.5	*	C>A		
6. Infrequent bus services	2.7	2.6	6.0	3.6	12.3	32.0	***	C>A C>A,B		
7. Long distance to bus stops	2.7	8.9	*	2.3	2.6	3.1	8.1	*	A,C>B	
8. Poor range of products at nearby stores	63.0	59.6	40.6	33.9	49.4	18.6	***	A>B,C A>B>C		
9. Physical difficulties in walking	11.6	35.7	***	5.3	26.0	***	4.3	20.7	***	A>C A>B,C
10. Physical difficulties in carrying things	34.9	38.7	16.5	26.6	*	7.4	15.6	*	A>B>C A>B>C	
11. No one is available to assist shopping	7.5	8.1	6.0	8.3	2.5	4.2				

Note: 1. Multiple answer; based on responses of those who answered either "experience difficulties" or "sometimes experience difficulties."

2. Significant difference between under-65 and 65-and-over at:- \*: 5%; \*\*: 1%; and \*\*\*: 0.1%

3. The relationship between regions is based on multiple comparisons; A>B means the value of Residential Complex A is significantly higher than that of City B (at 5% significance), while A,B indicates there is no significant difference between the two.

percentages. More than 50% of residents in City B and Town C, irrespective of their age bracket, identified "long distance to stores," making it rank at the top. This suggests that the distance is a significant issue in provincial cities and rural towns. In Residential Complex A, on the other hand, about 60% regarded the product range at nearby stores insufficient, denoting a higher percentage for that than for the distance issue. The product-range issue also has a high response rate among individuals under 65 in City B and Town C, after the distance issue, suggesting that merely providing stores closer to residents does not alleviate difficulties in shopping.

Now, we compare these response rates between age brackets, and between regions. While we conducted differential analysis of the response rates in an ordinary manner for cross-age-bracket comparison, we employed Ryan's method to obtain comparison between the three regions.

From the comparison of response rates between different age-bracket groups, "physical difficulties in walking" is a significant problem among the aged population across the regions. In Town C, many items have significantly higher response rates among people aged 65 years or over than under-65s. There is a particularly large gap between the groups regarding the item "infrequent bus services." This points to the difficulty pertaining to the fact that many elderly citizens who do not own or drive cars have no choice but to rely on bus services while most residents under 65 years old use cars for shopping. In contrast, people under 65 in Town C take issue with the product range more than their elderly counterparts.

Let us now turn to cross-regional comparison. In Residential Complex A, where most people go shopping on foot, the issue in relation to the condition of roads to stores such

as slopes, steps and gaps, has more significance than in other regions. Also, they perceive the issue of product range at nearby stores more problematic than their counterparts do. While “having to use buses” has a significantly higher response rate than other regions, this is considered to be associated with the issue of product range at nearby stores. However, these people do not seem to consider the frequency of bus services problematic any more than people elsewhere. Therefore, they criticize the necessity to use buses but the services provided are not causing difficulties to them. Further, the response of “physical difficulties in walking” is significantly high among residents aged 65 years or over in Residential Complex A. This is also reflected in the high response rate for “physical difficulties in carrying things,” experienced when they carry their shopping home.

Regarding City B, distance to stores features as a significant issue, like it does in Town C. “Physical difficulties in carrying things” is a more serious issue than it is in Town C. Residents in Town C, the majority of whom drive to remote stores for shopping, identify the issues of distance to stores and public transport such as poor bus services.

### (3) Measures to resolve inconvenience and laboriousness involved in shopping for food

We now move on to consider what the residents in these regions regard as important to resolve their difficulties in shopping for food. In all regions, many people identified “establishment of new stores nearby” and “encouraging and supporting local stores” as important (Table 8). For other items, “improvement of delivery services for purchased

Table 8. Desired measures to resolve inconvenience and laboriousness involved in shopping for food

	(individuals, %)						Relationship between regions	
	Residential Complex A		City B		Town C			
	under 65	65+	under 65	65+	under 65	65+	under 65	65+
No. of samples (excluding responses without answers)	145	220	130	194	156	315	under 65	65+
Overall	100.0	100.0	100.0	100.0	100.0	100.0		
1. New stores nearby	43.4	36.8	73.8	74.2	51.3	41.3	*	B>A,C B>A,C
2. Encouraging/supporting local stores	59.3	49.1	54.6	49.0	39.1	31.1		A,B>C A,B>C
3. Improvement of bus services	12.4	14.5	9.2	7.7	17.9	24.4		C>A>B
4. Subsidies for bus/taxi use	7.6	9.5	4.6	6.7	6.4	5.4		
5. Free transfer services	10.3	17.7	9.2	14.9	10.3	17.1	*	
6. Volunteers to do shopping for you	3.4	2.7	2.3	2.6	3.2	1.9		
7. Volunteers to accompany shopping	4.1	2.3	0.8	2.1	3.8	2.9		
8. Mobile grocery stores	9.7	8.2	4.6	6.2	18.6	36.8	***	C>A,B C>A,B
9. Home-shopping/delivery systems	15.9	7.3	**	7.7	7.7	21.2	9.2	*** C>B
10. Delivery services for purchased goods	33.1	35.9	17.7	10.3	*	8.3	10.2	A>B>C A>B,C
11. Meal delivery services	4.8	7.3	4.6	3.1	6.4	6.3		
12. Improvement of take-outs	2.1	4.5	6.2	2.1	*	1.9	0.6	A>C
13. Improvement of roads to stores	8.3	7.3	10.0	7.7	8.3	2.2	**	A,B>C

Note: 1. Multiple answer; based on responses of those who answered either "experience difficulties" or "sometimes experience difficulties."

2. Significant difference between under-65 and 65-and-over at: \* 5%; \*\* 1%; and \*\*\* 0.1%

3. Relationship between regions is based on multiple comparisons; A>B means the value of Residential Complex A is significantly higher than that of City B (at 5% significance), while A,B indicates there is no significant difference between the two.



goods” had a high response rate in Residential Complex A. In comparison, individuals aged 65 years or over in City B regard "improvement of free transfer services to stores" as important. This reflects the reality in City B that, while only a small proportion of elderly citizens use cars, the aged populace, like younger citizens with cars, has a desire to utilize newly opened shopping establishments in suburbs but the means of transport are limited. In the results from Town C, “launch/enhancement of mobile grocery stores” and “new bus routes and improvement of existing bus services” rank high among the responses by the populace aged 65 years or over. In contrast, improvement of delivery service ranks high for the residents under 65.

When these responses are analyzed by age groups, the result shows that it is the younger generations that regard the improvement of delivery as important, identified by a significantly high proportion of under-65s in Residential Complex A and Town C. In Town C, mobile grocery stores and free transfer services are regarded as important by the aged populace, showing a divide between them and their younger counterparts under 65 years old in their perceptions of necessary measures against the major issue of long distance to stores.

In the cross-regional comparison, a significantly high response on “improvement of delivery services for purchased goods” is found in Residential Complex A, suggesting a close association with the high number of residents who walk to stores and who have difficulties in walking and/or carrying things. Also, people aged 65 years or over responded more frequently than under-65s to identify "improvement of take-outs" and “improvements of roads to stores” although the response rates are not high.

People in City B have a higher expectation for new stores to be opened than in other regions.

The responses by people in Town C are characterized as improvement of bus services for the residents aged 65 years or over, improvement of delivery services for the generations under 65; the launch/enhancement of mobile grocery stores is desired equally by both groups.

#### (4) Relationship between specifics of difficulties and desired improvement measures

The analyses above imply that specific elements of difficulties depend on the circumstances in which individuals find themselves (distance to stores, accessibility of cars and age), and that desired improvement measures are closely related to specific experiences of difficulties.

We analyze this relationship here using the mathematical quantification theory class III. We employ the 0/1 variable applied to 6 variables for conditions of individuals (remote stores/no cars/advanced age; remote stores/no cars/young age; remote stores/with cars/advanced age; remote stores/with cars/young age; nearby stores/advanced age; nearby stores/young age), 11 variables for specifics of difficulties, 13 for desired improvement measures and 3 for regions. We analyze an aggregated

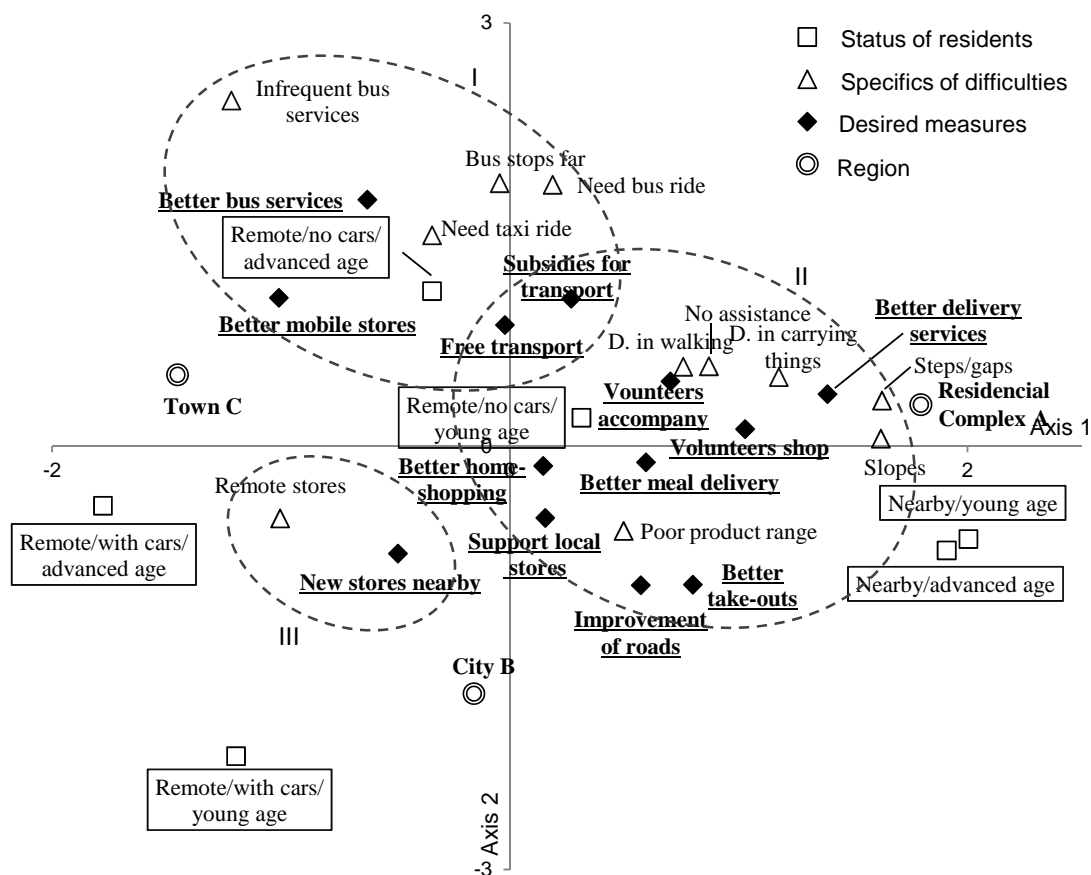


Figure 3 Results of Quantification Theory III Analysis

Note: Resident attributes are as follows: "remote stores" means more than 1km to stores, "nearby" is under 1km (in road distance); "with cars" signifies shoppers driving or riding themselves to stores, "no cars" means otherwise; "advanced age" includes people aged 65 years or above, and "young age" signifies people under 65.

data set that includes data from the three regions. The three regional variables are also useful to identify to which region particular outcomes apply most.

The mathematical quantification theory class III is a method, dealing with qualitative data with 0/1 variables assigned, to apply numerical values to variables and respondents so that the correlation coefficient denotes the highest value. To create a distribution map from the values thus assigned to variables, variables of similar responses are displayed closely to one another. The mathematical quantification theory class III is equivalent to the correspondence analysis in mathematics.

Figure 3 illustrates the results of the quantification theory III. The cumulative contribution ratio is 17.3% at the second axis, which is not very high, but correlation coefficients are sufficiently high, with 0.637 for axis 1 and 0.569 for axis 2.

On two-dimensional distribution with axes 1 and 2, three broad groups are identified in terms of specifics of difficulties.

Group I represents necessity to use public transport and inconvenience in using it. Individuals who identify these as problematic consider it important to improve bus services, increase the number of mobile grocery stores, provide boarding assistance to vehicles such as buses, and improve mobility environments such as free transfer

services and mobile traders. The conditions of residents indicated to be closely related to these are that they live far away from stores, do not drive cars, and particularly, are of advanced age.

Group II represents those who mainly go shopping on foot, who find problems in road conditions, physical difficulties in walking and carrying, lack of assistance, and so on. In other words, this group represents people who have stores close to their residences. These individuals consider that improvement of home delivery services, support given by volunteer groups, free transfer, and subsidies for transport fees are important to resolve their difficulties. Also, they indicate the need for new measures such as improvement of courier, meal delivery, and take-out services, although these feature somehow distant on the map. This is also closely related to individuals under 65 whose stores are remotely located, and who do not drive. The desired measure displayed nearby is improvement of courier services.

Group III represents the individuals who consider the distance to stores as problematic, and want new stores opened closer to them. There is a suggested relationship with groups of individuals whose attributes are remote stores and with cars.

In terms of the matches between the above outcomes and regions, Residential Complex A approximately corresponds to group II, City B applies to groups II and III, and Town C is close to groups I and III.

## 6. Awareness and Attitude of Local Authorities Regarding Difficulties in Accessing Food

### (1) Difficulties in accessing food from the viewpoint of local authorities

Finally, we consider the awareness of the issues and measures put in place by local authorities, which are supposed to play an important role in addressing difficulties in accessing food.

In preparation, we conducted an awareness survey using a questionnaire to 1,750 local authorities throughout the country including Tokyo special wards (the current number as of March 2010), between July and August 2010. We obtained 1,118 responses, with 64% response rate.

The results indicate that just under 30% of the local authorities that responded consider that they “definitely” need specific measures for residents who experience inconvenience and laboriousness involved in shopping for food. If we include the response “required to a degree,” approximately 80% of local authorities assert the need for measures. This clearly suggests that they recognize difficulties in accessing food to be an important policy agenda at the municipal level.

On the other hand, only about 20% of the respondents actually undertake or implement some measures to directly address the issues. The figure remains about 30% even if we include responses to indicate “possible measures under consideration,”

Table 9. Factors that cause difficulties for the local populace  
(multiple responses)

	(%)
1. Decline of city centers/existing shopping districts	39.5
2. Closure of local stores	69.7
3. Downsizing services provided by local cooperative societies	6.1
4. Opening large GMSs in suburbs	24.9
5. Pullout of GMSs	4.9
6. Aging local population	92.0
7. Increasing single-occupant households	36.4
8. Termination of public transport services	34.4
9. Decline of retailers' services such as home delivery	10.9
10. Decline of local support systems	17.0
11. Delay in road construction/maintenance	2.6
12. Decline of administrative services due to financial struggles	1.3
13. Other	2.8

Source: Authors' original survey.

suggesting the reality that, while they are becoming more aware of the issues, they are considerably slow in responding to them. Higher rates for awareness and direct measures in place are found with the authorities in provincial and rural districts, highlighting their serious attitude toward difficulties in accessing food.

## (2) Causing factors of the issues

Table 9 shows the local authorities' opinions regarding what is causing the difficulties in accessing food. They point out the major factor to be "aging local population," as 90% of them agree. It is followed by such supply factors as "closure of local stores" and "decline of city centers/existing shopping districts." They also point to "increasing single-occupant households" and "termination of public transport services," which indicates the possibility of impoverished conditions of transportation that links supply and demand being one of the causes as well as supply and demand factors themselves. A few local authorities also suggest "decline of local reciprocal support systems," "decline of retailers' services such as home delivery," and "downsizing services provided by local cooperative societies.." These opinions are voiced mainly by local authorities situated in remote districts, which suggests a possible consequence of closure/merger of local post offices and JA branches.

From these responses, it is supposed that causes of difficulties in accessing food comprise of a complex combination of shared problems such as aging population and closure of local retailers, on the one hand, and region-specific circumstances such as declining local systems of various assistance, on the other. It is also supposed that these causing factors and events are not necessarily independent from each other. It is possible that several factors are related in a close and complex way; for example, an opening of a general merchandise store (GMS) in a suburb causes the local small retailers in the city center to decline.

Table 10. Measures in place or considered necessary in the future regarding people with shopping difficulties

	(%)	
	Implemented	Consider in future
<Community development/Transport>		
1. City-center initiatives/support	38.0	24.1
2. Discussion/inclusion into general developmental plans/ Developmental Planning Master Plan	35.8	9.1
3. Measures against general merchandise stores and suburban mass retailers	14.7	4.6
4. Operation/support of route buses	74.9	66.2
<Support for businesses/Retailers regulations>		
5. Measures against (support for) unoccupied stores	36.0	23.4
6. Subsidies for local stores	65.4	43.7
7. Launch/manage co-operative/satellite stores	16.8	12.3
8. Open/manage farmers' markets	53.3	20.1
9. Introduce/manage/support mobile grocery stores	2.7	28.3
<Community development/Initiative support>		
10. Referral to local support groups/support their activities	46.1	23.2
11. Subsidize local activities for community development/support such activities	83.2	18.1
12. Support establishing protocols on community look-out programs to protect aged citizens	42.1	29.0
<Administrative services>		
13. Support to enhance people's mobility such as bus tickets, transfer services*	33.4	24.5
14. Support home delivery/courier services	6.9	42.6
15. Referral to shopping-assisting volunteers, agents/support their activities	14.2	41.0
16. Operate meal delivery services/support such services	45.4	25.0

Note: Excluding services designated for people disabilities or under long-term care insurance.  
Source: Authors' original survey.

### (3) Measures in place or considered necessary in the future

Table 10 shows response rates about the measures either in place for people experiencing difficulties in shopping or considered necessary to be implemented in the future. The measure that is implemented in most places is “encouragement and support for community development/local initiatives” followed by “operation/support of route buses,” “subsidies for local stores,” “opening/management of farmers’ markets,” accounting for more than 50% of all local authorities. It has to be noted that these measures are implemented as initiatives to support local public transport or improve local communities, and not for better convenience of shopping for local residents.

Measures that would have direct impact of improvement to difficulties in accessing food such as “introducing mobile grocery stores” and “measures against general merchandise stores and suburban mass retailers” are not undertaken by many local authorities. These measures have hurdles to clear before implementation: introduction of mobile grocery stores is problematic from financial as well as public interest perspectives, concerning subsidizing private corporations; regulations on GMSs and other mass retailers are outside the jurisdiction of local authorities.

Table 10 also shows that “operation/support of route buses” and “subsidies for local stores” among others are measures considered necessary in the future. These are also found among the measures actually being implemented, indicating strong support given to these options. There are, on the other hand, measures that are regarded as important but not implemented, including “introducing mobile grocery stores,” “support for home delivery and courier services” and “referral services to shopping-assisting volunteers and agents.”

#### (4) Characteristics of local authorities and Difficulties in Accessing Foods

We now turn to consider the circumstances under which difficulties in accessing food

Table 11. Comparison of responses by local authorities classified by population ratio of residents living at 500m or more away from stores

		(people, %)			
		a. <40%	b. 40-75%	c. 75%<	Direction
Conditions	Population*	223,465	49,551	10,972	a>b>c
	Aging rate*	19.2	25.0	30.1	a<b<c
	Percentage of single-occupant households*	28.2	22.8	22.0	a>b,c
	Percentage of car owners*	112.9	152.9	160.5	a<b<c
Recognition of issues	Need for measures (integrated data)*	70.9	83.5	81.7	a<b,c
Measures in place	Direct measures in place (integrated data)*	18.8	25.1	28.3	a<c
Causing factors	1. Decline of city center/shopping district*	48.6	40.7	26.2	a,b>c
	2. Closure of local shops	72.9	70.5	64.2	
	3. Downsizing cooperative association services*	1.2	6.9	9.6	a<b,c
	4. New GMSs in suburbs*	26.7	27.8	15.3	a,b>c
	5. GMSs pullout*	7.5	5.3	0.9	a,b>c
	6. Aging local population	89.0	92.8	93.4	
	7. Increase of single-occupant households	39.2	35.1	36.7	
	8. Termination of public transport services*	26.7	36.9	36.7	a<b
	9. Decline of retail services	10.2	11.4	10.5	
	10. Decline of local support systems*	24.3	17.1	8.7	a>b>c
	11. Delay of road maintenance	1.6	2.1	4.8	
	12. Administrative services	1.6	1.0	1.7	
Important measures	1. City centers*	29.6	25.5	14.5	a,b>c
	2. Development planning/master plans	10.8	9.7	5.7	
	3. GMSs/suburban mass retailers*	6.8	4.8	1.8	a>b,c
	4. Route buses etc.*	55.6	70.1	68.0	a<b,c
	5. Vacant stores*	34.8	22.0	14.5	a>b,c
	6. Local stores*	58.8	41.9	32.0	a>b>c
	7. Co-operative/satellite stores	15.2	12.0	10.1	
	8. Farmers' markets	19.6	19.6	22.4	
	9. Mobile grocery stores	22.8	29.6	31.1	
	10. Local support groups*	34.8	44.6	46.1	a<b,c
	11. Community development initiatives*	28.4	23.4	17.1	a>c
	12. Protocols on look-out community programs to protect aged citizens	21.6	16.3	18.9	
	13. Bus tickets, mobility, transfer	28.8	28.3	30.7	
	14. home delivery/courier services*	14.4	26.2	30.7	a<b,c
	15. Assisting volunteers/agents*	35.6	41.1	46.9	a<c
	16. Mead delivery services	25.6	24.3	25.9	

Source: Estimates by authors

Note 1: "Causing factors" refer to Table 9, while "Important measures" refer to Table 10.

Note 2: "\*" indicates significant factors by Kruskal Wallis test (5% level).

Note 3: Differences between groups are based on Bonferroni Correction.

Note 4: In the Direction column, a>b,c is an abbreviation of a>b and a>c. The same principle applies to other patterns.

arise, and see how they relate to the local authorities' awareness of the issues, causing factors or specific measures. Once these relationships are clarified, it is possible to categorize types of difficulties in accessing food and make considerable contributions in assisting local efforts to address them.

With the spatial relationship between populace and stores, namely the population ratio of people living more than 500 m away from stores, as a baseline, we conducted cross-group evaluation of variables assigned to awareness of issues and state of implementation of direct measures, recognition of causing factors, and necessary future measures, with population size, level of aging, single-occupant households, and car ownership as conditions. Because considerable biases are predicted in the variable distribution, we adopted Kruskal–Wallis test, a type of non parametric test, followed by application of Bonferroni correction, to confirm the inter-groups relationships in terms of size. The following is an attempt to categorize difficulties in accessing food by population ratio according to the distance to stores.

Table 11 shows the test results. The local authorities that have less than 40% of local population living more than 500 m away from stores are in urban areas such as major cities, as they are characterized by the size of population, high percentage of single-occupant households and low rate of aging. In these municipalities, “decline of city centers/shopping districts,” “opening large GMSs in suburbs” and “decline of local support systems” as causing factors are significantly higher than in other regions, although the level of local authorities' awareness of the issues and degree of implementation are relatively low. On the other hand, they support the ideas of “local stores,” “unoccupied stores” and “city center” as measures necessary in the future in relation to difficulties in accessing food.

The local authorities with 40–75% population ratio have an average of just under 50,000 population, and the highest rate for the awareness of the difficulties in accessing food. The causing factor notable in the responses of these local authorities is “decline of city centers/shopping districts,” resembling the characteristics of urban areas such as “opening large GMSs in suburbs.” They also named “termination of public transport,” which is a causing factor unique to rural areas. This suggests that the local authorities in this group are diverse, partly due to the municipality mergers in recent years which created some local authorities that cover a broad administrative area. Regarding necessary future measures, they have high expectations for “city center” and “route bus services” that correspond to the causing factors, and also for “local support systems” and “home delivery/courier services.”

The local authorities with a population ratio of more than 75%, that is, municipalities where people feel more inconvenienced to go shopping in relative terms, have a high aging rate while the population is small. These are mainly remote areas. The figures indicate that they have a high level of awareness of issues and are implementing many improvement measures. “Downsizing services of cooperative societies” in the causing

factor category has a significantly high response rate, and high expectation is held for “route bus services,” “shopping-assisting volunteers/agents,” “local support systems” and “home delivery/courier services” as important future measures.

There was no significant variance confirmed of some variables which many municipalities identified as causing factors, namely “aging population,” “closure of local retailers” and “increasing single-occupant households”; these are found to be equally problematic in terms of difficulties in accessing food irrespective of the population ratio.

## 7. Conclusions

This paper explicated current situations of difficulties in accessing food in Japan through analyzing awareness of local populations and local authorities, and conducting further statistical analyses.

First, it identified influential factors relevant to the difficulties in food shopping based on local populace surveys conducted in a suburban residential complex, a central provincial city and a rural town. The factors that have most impact on the difficulties in food shopping are spatial conditions such as traveling time and distance to stores, and means of transport. These factors influence the difficulties significantly when a journey to stores takes longer than 15 minutes, or involves more than 1km of road distance for pedestrian shoppers. Also, the distance issue affects the population of advanced age more seriously than it does younger generations. Means of transport, on the other hand, can considerably reduce the difficulties in cases where shoppers have cars to drive themselves. We also confirmed that people aged 65 years or over have significantly more difficulties in shopping than those who are under 65. However, we found that underlying circumstances are diverse from region to region.

Based on the analysis outcomes, we investigated the accessibility of the local populace to stores, with a focus on comparisons between urban and rural areas. We formulated a standard to postulate the populace that experience difficulties in shopping more than others that is, individuals aged 65 years or over without cars, whose nearest shops are located farther than 500m. The estimated population fitting this description was about 3.8 million based on the “fresh food stores” criterion, and approximately 6.4 million based on the “food supermarket stores” criterion. Under the “fresh food stores” criteria, this population had a bias toward rural areas (non-DID) while a larger proportion was found in urban areas (DID) when analyzed under “food supermarket stores.” The average distance to stores in rural areas was 2.7 times of that in urban areas in terms of the “fresh food stores,” and the difference increases to 4.1 times in terms of the “food supermarket stores,” suggesting that people in rural areas suffer greater disadvantages in order to benefit from shops with an adequate range of products.

We further analyzed the local populace’s opinions about specifics of the inconvenience



and laboriousness involved in shopping for food and necessary measures for improvements. The respondents unanimously highlighted launch of new stores as desired improvement measures. However, in order for this study to serve as insights for future initiatives, the relationship between the opinions with high response rates and the specifics of difficulties must be also taken into account rather than such opinions alone. Conclusions obtained from the cases included in this paper are as follows: (a) senior citizens in rural or remote towns who live away from stores and do not drive cars desire improvement of public transport services and mobile grocery stores more than a launch of new stores nearby; (b) residents of central provincial cities consider launch of new stores important; and (c) shopping-assisting services such as improvement of delivery services for purchased goods are desired by people irrespective of their age who live in a suburban residential complex, who mainly walk to nearby stores for shopping.

Finally, approximately 80% of all local authorities in Japan recognized a need for measures in relation to difficulties in accessing food, but just under 30% had some direct measures in place. The causing factors they pointed out included problems shared across the local authorities such as rapidly aging population and closure of local retailers, and region-specific factors such as declining local systems of various assistance. In terms of the relationship between causing factors and measures considered necessary in the future, we found that many local authorities chose such measures as to employ or strengthen resources and systems found in local communities. In places with urban characteristics, local authorities regard measures for local shops and unoccupied stores to combat decline of shopping districts, while in municipalities without such characteristics, and where stores are located remotely, they consider it important to boost local support systems. In the municipalities characterized somewhere between these two types, they are faced with termination of public transport and consider route bus services of more value.

Difficulties in accessing food addressed in this paper are part of wider, national-level issues such as a rapidly aging society and falling national population. At the same time, they are local issues reflecting individual circumstances of local districts. In this sense, they are not merely problems concerning shopping convenience, but relevant to a range of everyday-life issues such as healthcare and education. This implies a strong possibility that difficulties in accessing food develop beyond impoverishing daily-life conditions of residents into endangering sustainability of their local communities. From considerations upon these points, solving difficulties in accessing food requires liaison with relevant administrative offices as well as diverse agents across various fields to carry out long-term, comprehensive initiatives.

## Appendix: Method of calculating population ratio in terms of the distance to stores being greater than a certain length

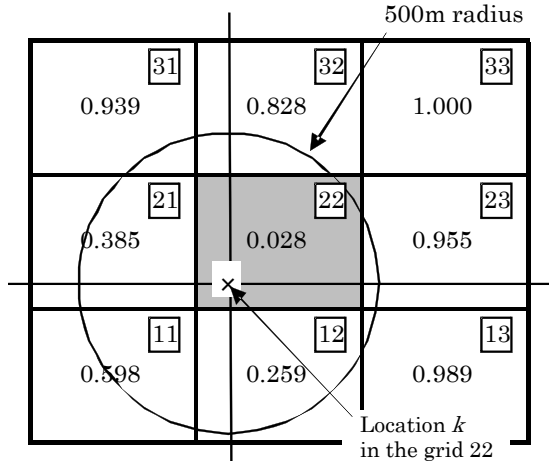


Figure 4. Probability of distance to stores in each grid to be 500m or more

Source: Created by Authors

Take the case of the distance being 500 m or more. Grid 22 in Figure 4 represents an area of residence. Supposing that stores are distributed with uniformity in any grid, probability  $q_{ki}$  of the distance between residents living at point  $k$  and their closest store in a given adjacent grid  $i$  ( $i=11-33$ ) being 500 m or more corresponds to the ratio of the area within the grid outside the circle of 500 m radius centered on  $k$  against the whole area of the grid in question. On the premise that  $c_i$  is the number of stores within grid  $i$

and locations of the stores within the grid are independent, the probability that all stores in grid  $i$  are 500 m or more away from the residents at  $k$  is  $(q_{ki})^{c_i}$ . Furthermore, the probability of the distance between the residents at  $k$  and stores being 500m or more means the probability in the same sense in all grids, hence

$$P_k = \prod_i (q_{ki})^{c_i} \quad \dots (1)$$

Then, supposing that residents are also equally distributed within the grid and that, provided that grid 22 is divided into  $n \times n$  ( $k=1, 2, \dots, n^2$ ),  $k$  represents one of the segments, expectation of probability that the distance between residents in grid 22 and their closest stores is 500m or more is a mean value of a number of  $P_k$  where the number is  $n^2$ . That is,

$$\frac{1}{n^2} \sum_k P_k = \frac{1}{n^2} \sum_k \left[ \prod_i (q_{ki})^{c_i} \right] \quad \dots (2)$$

This expectation is the population ratio of residents whose nearest store is at 500 m or farther.

The above method is based on the premise that, where a multiple number of stores are in one grid, their locations are mutually independent. However, these locations are in reality more likely to reciprocally influence. Given the above, it is highly probable that the result of the above formula is underestimated in a context of urban areas, where numbers of stores gather in some places in the grid. Considering this, we ran a

calculation, apart from the above-stated case of absolute locational independence, in an absolutely collective location scenario, and extracted median values between them.

An absolutely collective location would mean an extreme case in which, where a number of stores exist in one grid, all of them are found at one and the same location. For calculation in this scenario, formula (2) will have  $c_i = 1$  when a given grid contains more than one store.

For more details regarding the above, refer to Yakushiji and Takahashi [12].

#### Notes:

- 1 See Iwama et al. [1], [2] for more on the relationship between accessibility of stores and food intake.
- 2 “Food Deserts” is a notion that the UK government officially adopted, referring to the problem of malnutrition among economically-challenged people living in inner cities. Deregulation led giant GMSs roll out into suburbs, and many grocery stores in the inner cities suffered closure. The low-income population had no choice but to purchase food from remaining corner shops, where only a limited range of fresh food was available [1]. Thus, food deserts are an important urban problem. Compared to previous works, this study covers broader issues related to difficulties in accessing grocery stores in both urban and rural areas.
- 3 Regarding the themes discussed in Section 3, 4, 5 and 6 in this paper, refer to the authors’ papers [13], [14], [15] and [7] respectively. Also, refer to [11].
- 4 In this paper, the data presented as “experiencing difficulties” represents those whose responses were they either “experience difficulties” or “sometimes experience difficulties” in food shopping, while “no difficulty” include responses of “minor difficulties” and “no difficulty at all.”
- 5 In terms of means of transport, use of private cars is considered a demand factor while use of public transport is a component of supply factors.
- 6 It is appropriate to interpret health indexes of aged population using the behavioral competence in activities of daily living (Kumagai [3]). Independent lifestyle in local communities requires competence in the following “higher-level functional capacity”: (a) instrumental self-competence, (b) intellectual activity, and (c) performing social roles. Abilities in these activities can be quantified using the TMIG Index of Competence, which is a measure of higher-level functional capacity. It contains five questions for instrumental self-competence, four questions for intellectual activity, and four questions for performance of social roles, and positive answers to them form the score, out of the total 13.
- 7 Half-grid squares are a block of 22.5 seconds longitudinally, and 15 seconds latitudinally, forming a square of approximately 500 m.
- 8 A densely inhabited district is defined using the notion of a standard unit block

employed in the National Census; more than two adjacent unit blocks have population density of 4,000 or more individuals per km<sup>2</sup> each and the total population of such blocks exceeds 5,000.

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