Study on the Role of Taxi Subsidy Scheme for the Mobility of Elderly in Rural Areas

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Abstract

With the development of society, transportation has become an indispensable part of our life. To find out more innovative, creative and comfortable transport tool to meet the unpredictable behavior of outings is vital. Especially, elderly mobility in rural areas with distinctive characteristics need more attention.

In Japan, the number of elderly is expected to increase in the future and increasing number of people are living well past 80 while maintaining active lives. Thus, it is necessary to understand their mobility needs and travel behaviors. In addition, in recent years, traffic accidents caused by the elderly have become a serious issue requiring close attention. Moreover, owing to the promotion of returning the driver's licenses of elderly people, there is often a need to secure alternative transportation means (e.g., private cars) for these groups.

As for the characteristics of the mobility of rural areas, population is dispersed distributed, the service demand is low and infrequent. Because of these reasons, after the deregulation policy in 2002, some mass transit companies left from bus services in local areas, this caused inconvenience on the mobility of elderly especially for the people who have struggles with driving because of age or physical disability. To secure the mobility of these groups, huge financial support to cover the operation cost and available human resources for drivers form the big two challenges.

To tackle the mobility problems, the implementation of community bus service has conventionally been focused on urban areas. This approach, however, could only a limited number of people in rural areas. To meet the increasing needs of special groups such as the elderly and disabled people in rural areas, flexible transport services have been introduced, including on-demand ride sharing taxis and private paid passenger transportation system, called "Jikayou Yushou(自家用有償)" in Japanese; these require reservations, but allow for flexible route and schedule settings, so as to support the mobility

of elderly in the service area. Owing to such services, mobility support for the elderly is expanding (in certain areas).

Among these solutions, a taxi subsidy scheme (TSS) has been widely introduced by many rural authorities. TSS subsidizes the taxi fare by distributing tickets to a limited target group according to certain conditions such as age, driving license, disability, and socio-demographic background. The local government subsidizes part of the taxi fare by issuing a certain number of tickets to target persons annually, and users can pay part of their taxi fees with this ticket. As a welfare policy, the original target of the system, i.e., people with disabilities, has been expanded to include the elderly and poor.

However, during the implementation, many issues relating to this policy, such as subsidy amount, usage time and number of distributed tickets, settings for target persons, and target area have been encountered. Based on this fact, in this paper, we examined TSS from three perspectives: the local government that supports the policy with subsidy; small- and medium-sized taxi operators whose business management is influenced by TSS; and the elderly people with their outing status and TSS usage status. Furthermore, based on the trends of national policies, we examined the effective utilization of TSS as a public mobility service for the elderly in rural areas. As a result, for local governments, the TSS was found to be widely known as a support for vulnerable groups and for those who have returned their licenses, and the burden on residents is often not a large expense. From the viewpoint of taxi operators, TSS has considerably contributed to business management. Additionally, many business operators want to increase the usage time and number of people eligible for subsidies. The elderly survey showed that TSS users use taxi for various purposes and are less likely to be influenced by high prices compared with non-TSS users. In other words, it is suggested that the TSS should be the “ideal public transportation” by narrowing down the target users and improving the service.

Chapter 1 Introduction

Transportation, as being one of the basic and fundamental factor for the development of society, plays a vital role for the sustainable and harmonious development of a nation. Transport can be a symbolized aspect to measure and define the country's economy and people's living standard. In a big city, different types of fast and convenient transit modes became an indispensable part of people's daily life. However, with this increasing trend of usage and ownership of private and public transportation, series of economic, social and environmental issues have been occurring. In order to find out more comfort, environmentally friendly and convenient especially low costed transportation, a lot of research have been conducted. In this thesis, we mainly focus on the undeniable problem that the special socially disadvantaged group of people (older adults, young and disabled) strongly need transport services for social inclusion in rural and remote mountainous areas.

1.1 Mobility situation in rural areas

Out of these series of economic, social, and environmental issues caused by frequent usage of transportation, a group of socially disadvantaged people (e.g. elderly, young and disabled people) in remotely located rural areas have difficulties for outgoings, such as shopping, visiting the doctor regularly etc. in the global level, after deregulation policy and the aging society with rapidly growing speed, the need for transport services for those special groups is becoming undeniable.

Even though, in most urban areas, people are seeking and enjoying a range of transport modes for their different trip expectation ranging from basic low cost fixed scheduled and routed public transit to flexible and comfortable private door-to-door services, on the contrary, the situation in rural areas is quite challenging. In Japan also after the deregulation in 2002, most of the transit company left from bus services in local areas. This causes problem for

people who have difficulties of having physical weakness and fare to drive by themselves because of old age. Generally, like this rural areas where population density is low, demand for transportation is not so high are provided with low frequency transportation service for most of the day.

1.2 Elderly mobility and related supporting policies

With an increasingly aging population and the deregulation of policies concerning public transportation, securing the mobility of elderly people, especially those living in rural areas, has become a serious problem. Even thought, outing frequency of elderly is relatively low compared to other active adult groups who commute everyday for work, but the basic fundamental travel patterns for regular hospital visiting, shopping for daily necessities and social activities cannot be ignored, which are essential for keeping the active life in their late ages. On the other hand, convenient transport tool is considered as one of the basic requirements in the assessment of peoples` quality of life.

As supporting policies, in remote rural areas, to provide mobility assistance to residents with disabilities or significant mobility restrictions preventing them from using public and community transport, non-profit organization corporations are using volunteer driving services with the aid of local residents. The users only pay a small amount of reasonable money, i.e., not for business profit. Generally, however, this scheme is only introduced in areas where there is no taxi service. Considering the characteristics of the demands of aged people in rural areas, individual service remains necessary, and the usage of existing taxi services may represent one of the operational solutions.

However, because of the individual usage, the sharing ratio may be excessively low and inefficient. As such, in areas where there is little demand for public transportation, instead of establishing shared types of services, attention is being paid to using individual types of transportation services such as taxis, which can respond to the individual demands and achieve door-to-door service.

So, TSS that subsidizes on the taxi fare is being carried out widely by local authorities in Japan to support the special groups' transport needs. TSS supports the transport costs for limited groups who have difficulties on utilizing public transport service because of their physical weakness. This types of service affords community members with general social inclusion and participation of social activities.

The taxi subsidy scheme which is currently running in Japan is also classified into the following three types:

1. Elderly type--- this type refers to the condition of people who is at the age of 70 or over.

2. Welfare type---this type refers to the condition of people with disability regardless of age.

3. Integrated type--- this type refers to a type that integrates both elderly and welfare type.

On demand-ride sharing taxi is another type of support policy for elderly mobility which combines the features of both taxi service and local bus service like providing door-to-door service while sharing together with other passengers with fixed fare. However, people`s attitudes, especially older adults towards the sharing type is not so desirable considering from the conventional thinking way for safety.

1.3 Structure of the thesis

This research thesis is divided into six main chapters which describe the situation of mobility in rural areas and statement of current problem especially for the special groups. Alongside this, relevant research conducted in different countries are demonstrated with its advantages and disadvantages. The first chapter is the introduction of research topic which contains the background information for the mobility of elderly in rural areas and mobility challenges relating to age and physical weakness.

In chapter two, the literature review is contained. Because the real situation

of transport in each country is different, so the various research conducted in the worldwide have the unique effectiveness to their local region. We will pick up some examples and summary their features and business model in order to get some useful conclusions for finding the better solution to the current problems. In each business model running in different regions, they are providing alternative service option for customers to meet the need of unexpected trip behaviors, however, just like everything has its two sides, along with their advantages, some challenges like having funding constrains for local authorities, drivers shortage for companies still exist to cause the service discontinued. So, in this chapter, we will review these various examples to learn from their lessons.

Chapter three is about the analysis for business condition of small and medium-sized taxi operators in local areas of Japan, especially the situation under the Covid-19 crisis also the role of TSS in taxi industry. In this chapter, a questionnaire survey was sent to small and medium sized taxi operators in August 2020, when it was a time of recovery situation after emergency status was lifted in Japan. According to the list from National hire taxi companies' directory 2018 version, among 5886 taxi companies, 2993 companies were chosen as target companies with 1 to 20 vehicles, which locates towns or cities except Ordinance-designated cities in Japan.

Chapter four mainly analyzes the roles of taxi service and taxi subsidy scheme (TSS) for the mobility of elderly people living in depopulated areas. In this chapter, the actual situation of elderly mobility and usage status of TSS is analyzed by using a web questionnaire survey with 300 people over 65 years old. The target people of this survey are divided into three groups: people with private cars, people without a private car and with no TSS, and people supported by a TSS. The results show that the TSS has a certain effect on ensuring mobility for the elderly in depopulated areas. People without the ability to use public or private transportation freely showed a strong desire to increase the subsidy rate and number of usage instances. In view of this, the

utilization of a "shared taxi" reservation type is suggested for improving the subsidy rate.

Chapter five is about the two way surveys of website survey and questionnaire survey to the local authorities in Japan with introduction status of TSS. Based on the data obtained from two surveys to the 817 municipalities, which is designated as depopulated areas, 211 municipalities have introduced TSS. The different condition of subsidy rate, subsidy amount and number of subsidy tickets are analyzed according to their different local condition.

The final chapter is the conclusion of whole thesis. In this chapter, we summarize the roles of TSS on all three sides such as the taxi operators who provide the service, local municipalities who support the service with financial aid, and taxi users who experiences the service with their real life activities. Advantages and challenges will be demonstrated comprehensively and thoroughly.

Chapter 2 Literature review

The number of elderly people as a proportion of the world's population is growing significantly. Special attention to the accessibility and mobility requirements of this group is needed. In order to find better solution for conquer the challenges for both rural and urban areas, lots of research and scheme have been implemented all around the world. In this chapter, we depict the various elements which are found in academic research. Following an initial review of key topics covered by the literature, elderly sustainable transport accessibility studies were classified into four key categories: social and transport, infrastructure improvement, accessibility index and mode choice (**Fig.2.1**). Previous literature [1] and key words were used to inform this classification. The first category, social and transport, represents the social living style of the elderly, travel destination, travel pattern and mode preference related studies. The infrastructure improvement category includes previous studies investigating infrastructure solutions for elderly mobility. The accessibility index category includes previous public transport and walking accessibility index studies, further classified into distance-based and time-based methodologies. The last category, mode choice, includes previous studies related to mode choice modeling using various mathematical models.

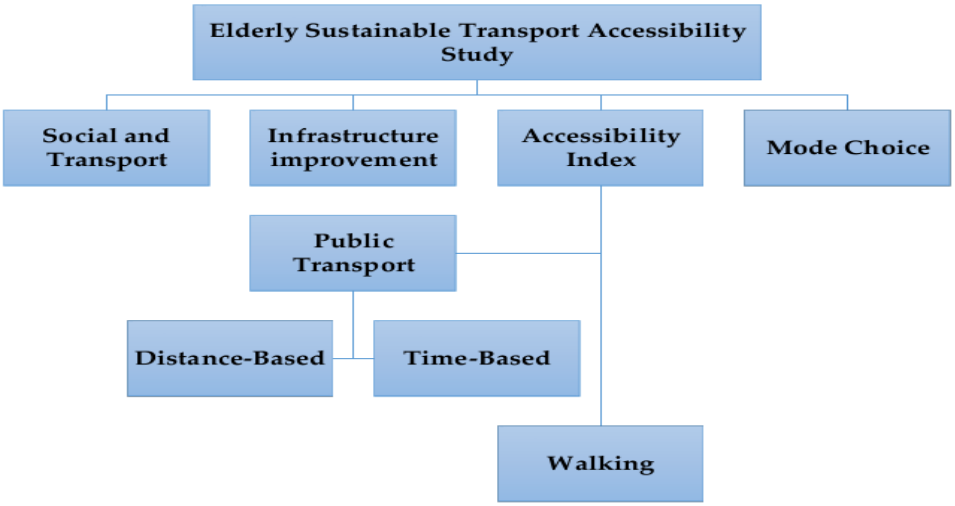


Fig.2.1 Elderly sustainable transport accessibility study classifications

2.1 Mobility challenges for rural areas worldwide

Several studies can be found on transportation services for depopulated areas. Case studies are important to analyze the trip pattern of the elderly because the traveling purpose, time and cost for a single trip, and availability of public transport in their local area have a significant influence on their traveling behavior [2]. Zhao and Yu [3] found a rapidly increasing trend in aging of population in rural areas caused by migration of the younger generation for employment opportunities, which should be managed by policy developers by encouraging and attracting more migrant residents to ensure regional revitalization. McDonagh [4] found that poor accessibility of transportation not only has a negative influence on social and economic development of rural areas but also contributes to social exclusion and isolation of the elderly. Mulley et al. [5] found the impact of a properly designed MaaS (Mobility as a Service) on the mobility of the elderly to be positive.

A survey by Harris and Tapsas [6] shows that most of the elderly prefer using taxi. On the contrary, only a tiny fraction uses public transport for their daily life activities. Although high prices result in taxis being affordable only for short trips, most of the respondents still think taxi is convenient public transport tool [5]. In Barkeley City, a taxi scrip program has been established with the cooperation of transportation network companies (TNCs) for two purposes: increase the number of registered taxis and reduce waiting time. According to the survey conducted on the users of this program, most users were found to use it for medical visits and grocery shopping. However, smartphone-based booking has become a challenge because only 40% are smartphone users [7]. Incorporating TNCs with taxi service addresses the difficulty in hailing a taxi, which can be analyzed by the “matching degree of supply and demand for taxi resources” model created by the relationship between the subsidy ratio and satisfaction level [8].

According to the statement done by John D. Nelson, Steve Wrighta Nelson

[9], Finland and Belgium adopted DRT into their mainstream public transport system for its citizens who are over 65. From these experiences, both countries found that it is very important for government to consider about the quality of life of its elderly citizens and the ability to live independently.

A report submitted by the Department of Transport and Main Roads [10] in the Queensland government of Australia provided a series of information regarding the background of their TSS, the sustainability of the service, reviews for eligibility, entitlements, and duplication of Government benefits and assistance through other systems, and funding for the TSS program. A TSS was introduced in Queensland in 1987 to provide an affordable and accessible transport option for people with disabilities who experienced profound difficulties when using other modes of public passenger transport. The state government subsidy funded 50% of the taxi fare for each trip, up to a maximum subsidy of $25. Membership was not means-tested, and the number of taxi trips able to be undertaken and number of subsidies paid per member were unlimited. Members were issued with an electronic membership smartcard and were also entitled to a maximum of 20 interstate travel vouchers each 12-month period, for use with any taxi service in other jurisdictions. After consideration of all of the information made available and the views put forward by the Panel members, the Panel made recommendations such as undertaking research to identify more detailed demographics and usage patterns. i.e., to better understand the availability of access to members and transportation network.

Rural transport receives less concern from government in infrastructure and service provision, consequently rural people face many problems related to poor accessibility and mobility. Until now, provision of rural public transport (RPT) service has not been firmly regulated by government. There has no specific regulation that control RPT operation and service like in urban area. Such condition let RPT operation has no strong foundation [11].

Challenges in public transport provision for rural areas are similar across countries, it is difficult for conventional public transport to meet different

accessibility needs of different user groups. Demand- responsive transport is seen as one of the key options to meet public transport challenges in rural areas. There is a clear case for maintaining qualitative regulation in the taxi industry, including vehicle standards, requirements for driver training, safety and minimum service standards. These qualitative regulations should, however, be designed carefully to enable development of innovative services and market structures that benefit from reforms [12].

It was found that taxis, as one of the public transport modes used by the elderly in Hongkong, cannot meet their needs because of high price, long waiting time, and preference for walking to available area. Therefore, a step-wise taxi fare subsidy scheme for improving the mobility of the elderly was suggested [13].

2.2 Mobility challenges for rural areas in Japan

In Japan, ensuring the mobility of elderly people living in depopulated areas with poor transport access has become a serious issue in today's society. Looking at the socio-economic situation nationwide, the population and birth rate are declining, but the aging rate is increasing. By 2050, the total population will be 100 million or less, and the aging rate (the ratio of 65 years or older to the population) is estimated to be about 38% in Japan. With regard to local public transportation, approximately 74% of regional railway companies and 65% of regional route bus transportation operators face negative balance of payments; it is thus assumed that the condition of local public transportation will become even more severe under rapid population decline in the future. Currently, transportation companies in rural areas are struggling to keep their business sustainable [14].

In Japan, with the revision of the Road Transport Law in 2006, "Private Passenger Transport System" was established. Through this policy, municipalities and non-profit organization corporations provide inexpensive transport service in areas without public transport through private cars.

However, this system is only limited to areas with no taxi operators, and its sustainability became an issue owing to shortage of operators. In addition, although the number of demand-type shared taxis, either introduced directly by local governments or outsourced to bus and taxi companies, is increasing, the utilization efficiency tends to be low. Therefore, Sorensen et al. [15] proposed that the role of demand responsive transport (DRT) on achieving the accessibility and utilization efficiency of public service and reducing car ownership should be investigated.

For the taxi industry, the situation in rural areas is different from urban areas. Even though taxis are now providing the area with mobility service, low demand for service, high operational costs, and rejuvenation needs of drivers presents difficulties in maintaining the business adequately. Even though in some areas demand-responsible type shared taxis are being implemented, the sharing ratio is still low because of individual usage and the system is inefficient [16].

For rural areas, the transportation service demand is low due to deficiency of regular travelers; therefore, it is more sustainable to respond to individual demands achieving flexible door-to-door service rather than focusing on the establishment of public transportation according to the features of rural areas. Therefore, in Japan, many municipalities have introduced taxi subsidy scheme (TSS), which subsidizes a part of the taxi fee for certain groups of people limited by conditions, such as age, possession of a driving license, and disability. The local government subsidizes part of the taxi fare by issuing a certain number of tickets to the target persons annually. As a welfare policy, the original target of the system, i.e., people with disabilities, has been expanded to include the elderly and poor.

Based on the subsidy amount and number of distributed tickets, the programs in the available areas can differ according to the local authorities' conditions. The range of subsidy tickets distributed annually varies from 20 to 100. The subsidy rate can be divided into several cases, e.g., a fixed amount of subsidy

per ticket or a variable subsidy amount depending on conditions. With the growing trend of depopulation, decentralized living, and increasing number of single-person households, such individual mobility support service is considered to be a major support measure for last-mile travel that can even be combined with innovations such as autonomous driving and ride sharing in the future.

2.3 Existing studies relating to elderly mobility in Japan

Moriyama [17] analyzed the transport activities of demand-type shared taxi and the association of residents in mountainous areas and showed that although the operation method is thought to be economical, this service does not meet the expected cost- effectiveness in many cases due to issues such as reservation difficulties for the elderly and long waiting time for drivers.

Yoshida [18] investigated the possibility of increasing the frequency of taxi usage by introducing a flat-rate service for “Mina Taku” in Minamisoma City, Fukushima Prefecture. In this study, it was concluded that among the flat-rate services, the system that allows users to choose between flexible destinations is preferred over that where a fixed amount is set between two points. This also has a positive impact on increasing the usage of taxi. However, even with flat-rate service, the expected usage is approximately 2 times/month. Hence, it is difficult for taxi-business operators to autonomously provide the flat-rate service in rural areas.

Ishio et al. [19] conducted interviews with local governments that introduced TSS and public awareness survey and found that local governments see TSS as cheaper than new transport services like on-demand ride-sharing taxi. Based on a public awareness survey, it was found that there is no opposition to TSS, and many people with poor mobility believe that mobility should be ensured.
Aini et al. [20] described the role of TSS and analyzed the improvement measures from the perspective of local governments, taxi operators, and target users. By analyzing the operational costs and the subsidy burden on local

governments, it was found that when the population density is low, covering areas with TSS is more cost effective than demand-type shared taxis.

In response to the introduction of “Revitalization” of the taxi business as local public transportation by the Revision of Taxi Appropriate Law in 2014, Kato and Sugiura [21] found that by improving the vehicle allocation/reservation system and vehicle diversification by utilizing information and communication technologies with TSS improves usage efficiency of vehicles, which can promote more commercial businesses, such as the elderly support system (Mimamori in Japanese). Additionally, securing the drivers is a national issue. Nishi [22] found that cooperation with residents is indispensable for drivers for establishing and continuing operation of paid transportation in depopulated areas, the financial cost is the greatest challenge to the sustainability of the operation.

A research by Hayakawa [23] in 2004 compared FTS systems and showed that demand type taxi is the mainstream for region with a population of over 6,000. But for population under 6000, and additional situation if there is no taxi operator, a kind of private car service without taxi license, called "jikayo_yusho" in Japanese provided by local residents is welcomed. However, if taxi operators exist, they consider the implementation of taxi service with subsidy for users. For example, Bicchu town of Okayama prefecture (population approximately 2000) introduced paid transportation by private cars as "welfare transfer service", and Nega village of Nagano prefecture (population approximately 900) adopts the demand ride sharing taxi service.

According to other Hayakawa’s [24] research, Tatebayashi city of Gunma prefecture (population approximately 78.000) and Omachi city of Nagano prefecture (population 29.000) also introduced taxi subsidy scheme to the elderly with the elimination of the bus service. In these two cities, elderly people were supported by distributing taxi tickets, but the pressure on municipality and users increased. This revealed a fact that bus service is more efficient than taxi subsidy system, which caused the restart of bus service in

these regions. However, Hayakawa said that taxi subsidy system makes a certain sense because some elderly people have the difficulty to access to the bus stop.

Chapter 3

Investigation to small and medium-sized taxi operators -Situation under Covid-19 crisis and role of taxi subsidy scheme-

3.1 Overview

In this chapter, current situation of small and medium sized taxi operators, and the impact of TSS to their business management is analyzed. Whether the Taxi Subsidy Scheme has a positive influence on using taxi service need to be considered. As for survey method, a questionnaire survey was sent to 2993 of small and medium sized taxi operators in August 2020, when it was a time of recovery situation after emergency status was lifted in Japan. Total response of 803 companies were analyzed.

3.2 Relevant Literature Review

A taxi is a public transportation tool for providing "door-to-door" individual transport service, whereas other public transportation modes such as buses or railways are considered as mass transit. As taxis respond to individual needs or small demand, they are also praised as an environmentally responsible alternative to private car use [25]. Taxi industry all around the world are facing similar challenges, which consequently accelerates the promotion of self-regulation and better taxi service in order to stand firmly in this intensive competition. Local authorities have disseminated initiatives to support the taxi industry to boost their competitiveness. Several types of measures are being employed to bring benefits to both sides of taxi operators and taxi users, such as Taxi Subsidy Scheme (TSS), on-demand ride-sharing taxi or private paid passenger transportation system, as a service for local areas and complement of mass or medium transportation modes. TSS subsidizes the taxi fare by distributing tickets to a limited target group according to certain conditions such as age, driving license, disability, and socio-demographic background. The TSS is a solution that has been widely introduced by local authorities. The

local government subsidizes part of the taxi fare by issuing a certain number of tickets to target persons annually, and users can pay part of their taxi fees with this ticket. As a welfare policy, the original target of the system, i.e., people with disabilities, has been expanded to include the elderly and poor.

According to the subsidy amount and number of distributed tickets, the programs in the available areas can differ, according to the local authorities and their own conditions. The range of subsidy tickets distributed annually varies from 20 to 100 sheets. The subsidy rate can be divided into several cases, e.g., a fixed amount of subsidy per ticket, or a changeable subsidy amount depending on conditions. This paper focus on the business condition of small and medium sized taxi operators, especially the situation under the COVID-19 pandemic, as well as the role and effect of the TSS on the taxi business.

With the revised Road Transport Act of 2002, demand adjustment restrictions on taxi business were mitigated, in large cities, the competition among business operators was promoted by reductions in fares and increases in the number of vehicles. However, the declining trend of users in the long-term did not change, and as a result, the driver's working environment deteriorated, working hours increased, wages decreased, and accidents increased. For this reason, the "Special Measures Act on the Optimization and Revitalization of General Passenger Vehicle Transportation Business in Specific Areas" was enacted in 2009, also some solutions to "optimize" the business have been made, such as reductions in company numbers and increase in fares.

Furthermore, in the "Act on Revitalization and Rehabilitation of Local Public Transportation Systems" revised in 2019, local governments are obliged to make efforts to create a "local public transportation plan" which respond to the local transportation needs by fully utilization of local buses, taxis and private transportation.

Looking at the socio-economic situation nationwide, the population and birthrate are declining, but the aging rate is increasing. By 2050, the total population will be 100 million or less, and the aging rate (the ratio of 65 years

or older to the population) is estimated to be about 38%. All these factors put pressures on business condition that approximately 74% of regional railway companies and 65% of regional route bus transportation operators are in deficit; it is thus assumed that the condition of local public transportation will become even more severe under rapid population decline in the future. In this way, transportation companies in local areas are in a difficult situation for keeping business sustainable.

Even though taxis are now providing the area with mobility service, low demand for service, high operation cost, needs for rejuvenation on drivers cause difficulties for maintaining the business properly. Even though, some areas are implementing the demand-responsible type shared taxi, because of the individual usage, the sharing ratio is still low and inefficient.

Recently, many studies have pointed that for this type of low and dispersed service demand, it is better to investigate the individual type of transportation service by taxi which can respond to the individual demand by achieving flexible door-to-door service rather than focusing on the establishment of public transportation according to the characteristic of rural areas. Along with taxi service, Taxi Subsidy Scheme is implemented by considerable number of local governments in order to provide these special groups with proper support by enabling them use taxi more often for their daily life activities so that bring convenience to their daily life. Whether the Taxi Subsidy Scheme has a positive influence on using taxi service need to be considered.

3.3 Existing Research

Rural transport receives less concern from government in infrastructure and service provision, consequently rural people face many problems related to poor accessibility and mobility. Until now, provision of rural public transport (RPT) service has not been firmly regulated by government. There has no specific regulation that control RPT operation and service like in urban area. Such condition let RPT operation has no strong foundation.

Challenges in public transport provision for rural areas are similar across countries, it is difficult for conventional public transport to meet different accessibility needs of different user groups. Demand-responsive transport is seen as one of the key options to meet public transport challenges in rural areas. There is a clear case for maintaining qualitative regulation in the taxi industry, including vehicle standards, requirements for driver training, safety and minimum service standards. These qualitative regulations should, however, be designed carefully to enable development of innovative services and market structures that benefit from reforms.

Lots of efforts have been made to maintain the taxi industry for securing the mobility of rural area in Japan. In order to improve the service effectiveness, it is advocated to diagnose the real situation. Lots of private bus operators have with-drawn from public services due to the deficit. However, in areas where bus demand was originally low, the number of passengers was small, and due to the low population density, fare revenue could not cover operation costs, it is fairly difficult for operators to continue the business, also sharing type of business is still inefficient. The need for revitalizing and rehabilitating the regional public transportation system have been giving pressure on local government, various situations in different regions require unique and proper policy, to which the problem cannot be solved in a uniform manner.

According to both of our research on the private paid passenger transportation system (Jikayou Yusho transport system), and our research on small and medium sized taxi operators, showed that rejuvenation on drivers is the major problem for maintaining the business.

Regarding the Taxi Subsidy Scheme, research by Hayakawa shows that Tatebayashi City, Gunma Prefecture and Omachi City, Nagano Prefecture are examining whether the taxi subsidy ticket that replace the abolition of fixed-route buses can secure the mobility of need of residents. Research done by Suzuki11) in Akita City show that outgoing behavior of elderly will change by the discount rate of taxi fare, supporting the elderly over 70 years old with 50%

discount rate is recommended. In addition, Kobayashi focused on corporate subsidies and user subsidies as maintenance measures for public transportation, a proposed model of a subsidy system that com-bines both of them is examined as a measure for maintaining the social sustainability of public services in depopulated areas. Furthermore, Yoshida focusing on the introduction of a unlimited ride taxi service in small sized local cities, he describes the case study at Minamisoma City, Fukushima Prefecture introducing the unlimited ride taxi service by using the vehicle allocation data of “Minataku” to increase the possibility for frequency of taxi utilization. It has been shown that compared to the case where the fixed distance is set only between two predetermined points, an unlimited ride service with fixed monthly fee that allows the user to flexibly select their destination leads to higher taxi demand to some degree.

3.4 Research method

3.4.1 Aim of research

The aim of this study is first to examine the business condition for small and medium sized taxi companies in Japan under the disaster of COVID-19. And this study also focuses on the role of Taxi Subsidy Scheme (TSS) as a remedy for the situation. TSS is introduced in many local governments as a support policy to the mobility vulnerable group with certain amount of distributed ticket as a part of taxi fee.

By the analysis of questionnaire survey of taxi companies, existing problems and their perspectives for future business management, also the situation during COVID-19 pandemic are explained, by the comparison on the role of TSS between different sized companies, effects of TSS on business sale were examined.

3.4.2 Content of questionnaire survey

In this study, we design the questionnaire survey with seven main sections, as it is shown in **Table 3. 1**. The first section is organized with basic in-

formation for the structure of company (number of vehicles, staff and changes during the pandemic). The second section is about drivers, this includes age construction, changes on drivers` number and problems about securing drivers number and rejuvenation. The third section is about corona influence on business management. Forth section is corona prevention measures. Fifth section is about taxi subsidy scheme. The sixth and seventh sections are the expectation about future business management and expectation from local government towards taxi business.

Table 3.1 Content of Questionnaire Survey

Q	Question type	
1	Basic information	
	1	Post code
	2	Staff number
	3	Owned vehicles number
	4	Changes on the number of vehicles from last year
2	About drivers	
	1	Age structure
	2	Changes on the number of drivers from last year
	3	Problems about drivers
3	Corona influence on business management	
	1	Business profit comparison ratio from last year
	2	Business sale per car
	3	Business prospect
	4	Corona supporting policy
	5	Future business prospect
4	Corona prevention measures	
5	Taxi subsidy scheme (TSS)	
	1	Introduction status of TSS
	2	Target users
	3	TSS usage ratio
	4	Expectation about TSS
6	Expectation about future business management	
7	Expectation from local authorities toward taxi business	

3.4.3 Questionnaire survey result

A questionnaire survey was sent to small and medium sized taxi operators in August 2020, when it was a time of recovery situation after emergency status was lifted in Japan. According to the list from National hire taxi companies' directory 2018 version, among 5886 taxi companies, 2993 companies were chosen as target companies with 1 to 20 vehicles, which locates towns or cities except Ordinance-designated cities in Japan.

We mailed the questionnaire to the address listed in directory, as a result, 644 responses were received by mail, 159 responses were received by filling out the online Google form, total responses from 803 companies were obtained, the response rate is 26.8%. Among them, the valid response of 786 companies were analyzed.

3.4.4 Company types by owned vehicles

From this collected data, these companies are divided into three types according to the number of owned vehicles for the competitive analysis on the situation and opinions, that is, type A company with 1~5 vehicles which accounts for 262 samples with 33.3% of respond, type B company with 6~10 vehicles which is 248 samples about 31.6%, and type C company with over 11 vehicles which is 276 samples representing 35.1%.

3.5 The Situation of taxi business under the impact of Covid-19

3.5.1 Changes on the structure of company

During the impact of pandemic, a lot of business industries are faced to close down or narrow the business scale, so we make a comparison about the basic structure of company with last year before the pandemic. As shown in **Fig.3.1** on number of vehicles and **Fig.3.2** on number of drivers, type A company shows stable trend compared to others, like 89% and 84% response respectively with no change.

About drivers situation, type B and C company both shows that it is difficult

to increase the number of drivers with more than 55% response, as shown in **Fig.3.3**. As for the age construction shown in **Fig.3.4**, 60 to 70 years old drivers account for large portion, that is 68%, however, 86% of respond is for difficulty of drivers rejuvenation, the ratio of driver shortages and aging is lower in small companies than in medium-sized companies.

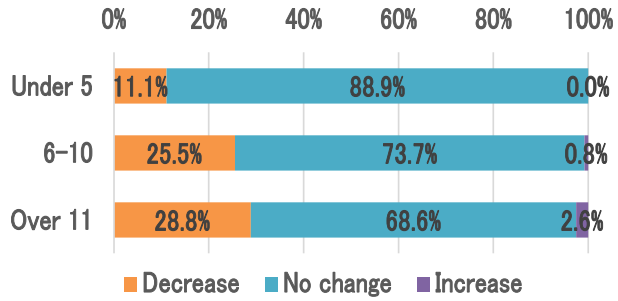


Fig.3.1 Comparison on number of vehicles before Covid-19

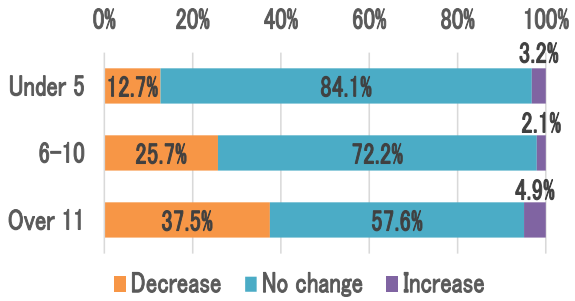


Fig.3.2 Comparison on the number of drivers before Covid-19

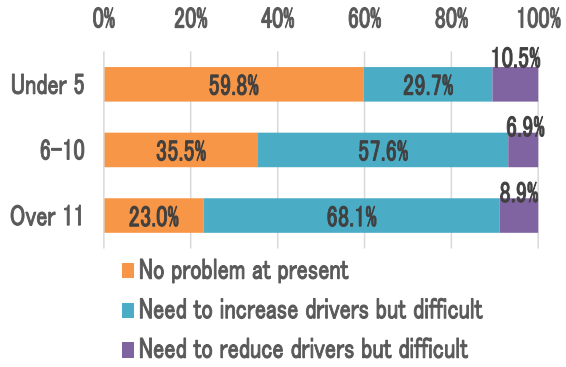


Fig.3.3 Situation of drivers

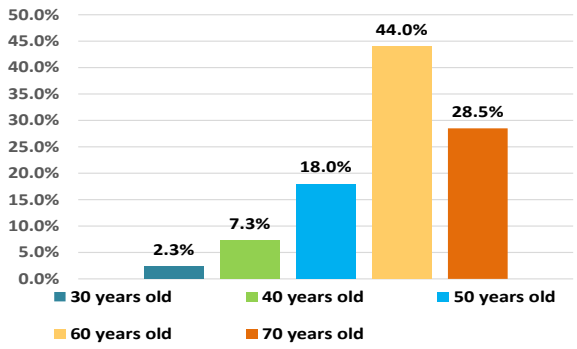


Fig.3.4 Drivers age construction

3.5.2 Impact on business sale with Covid-19

With the outbreak of corona virus, not only business industry, but all carriers in different fields have been impacted severely by the decreased outing behavior, taxi industry is not an exception. We collected the data about the daily business sale per car before COVID-19 as shown in **Fig.3.5**, and from this data, the average business sale is estimated to be 15,567 JPY for companies

with under 5 vehicles, 19,802 JPY for companies with 6~10, as well as 22,562 JPY for companies over 11.

For all types of company, business sale was dropped severely about 60-80% from last year for more than 60% companies, as it is shown in the **Fig.3.6**. If situation goes like this, for all three type of companies, about 40-50% said the business may not be continued shown in **Fig.3.7**. Nearly 50% of respondents are concerned about the continuity of management. For this reason, many business operators are applying for various subsidies support system shown in **Fig.3.8**.

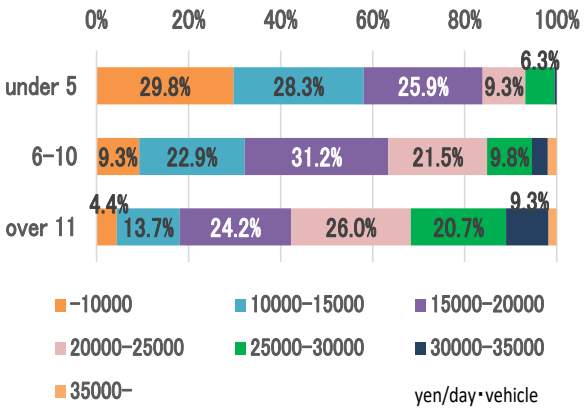


Fig.3.5 Daily business sale per car before Covid-19

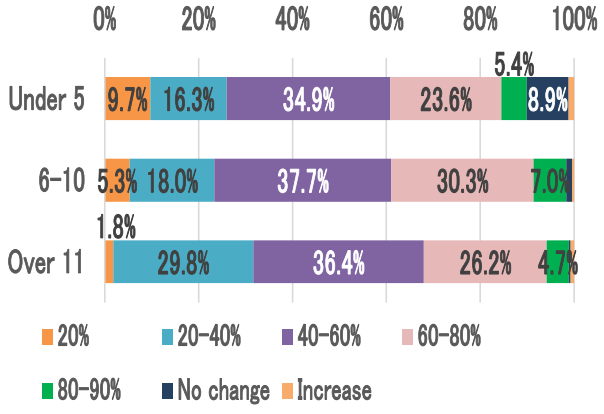


Fig.3.6 Drops on business sale after Covid-19

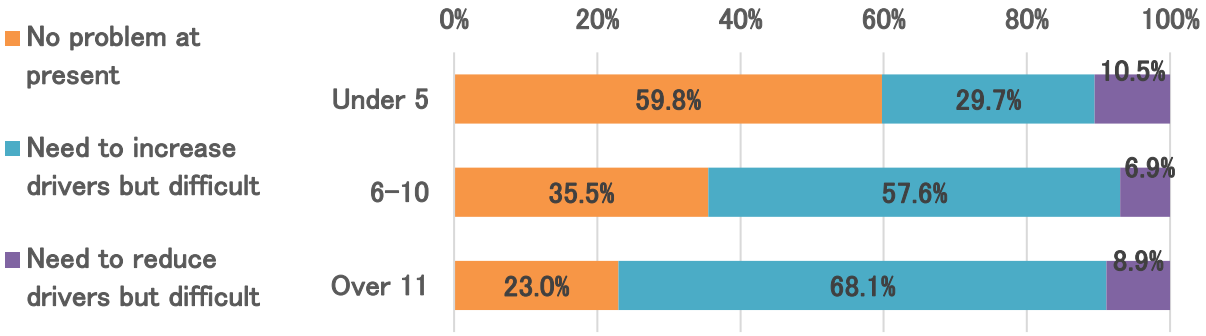


Fig.3.7 Perspectives about future business continuity

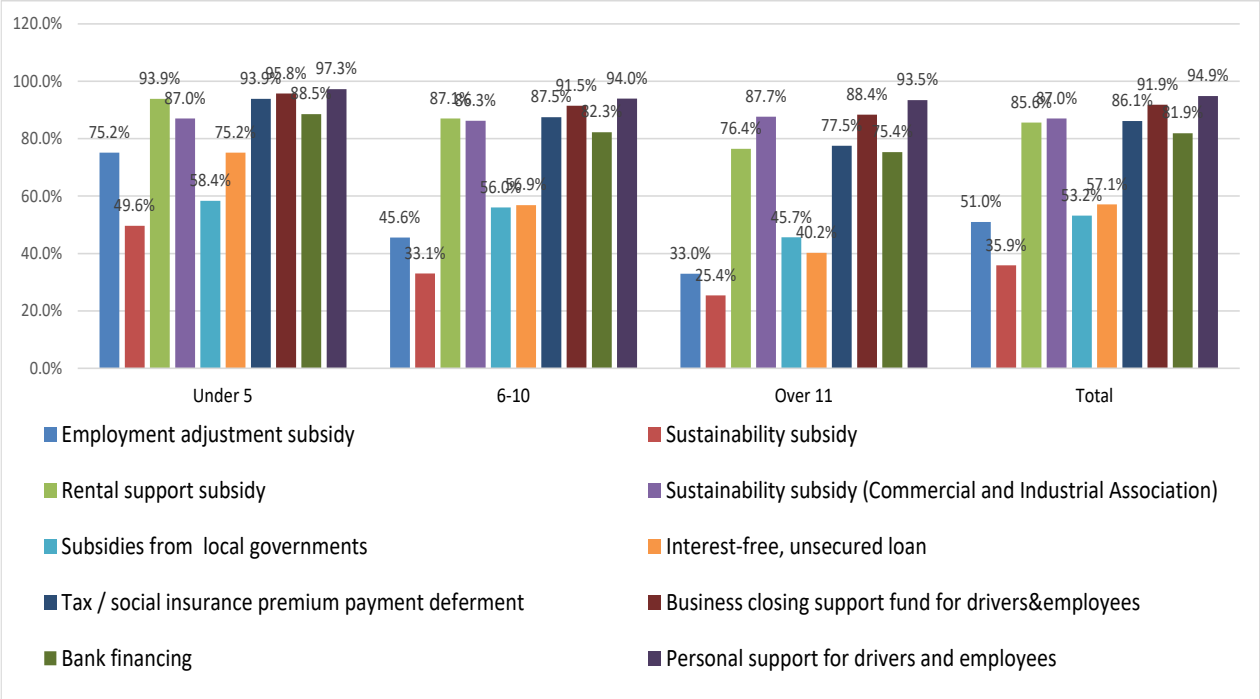


Fig.3.8 Application level of government support with the impact of Covid-19

3.5.3 Infection prevention infrastructure

When asked about the infection prevention measures, whatever the small or medium sized taxi operators, they all almost well implemented all required measurements for preventing the spread of corona virus.

3.6 Analysis on the role of taxi subsidy scheme (TSS)

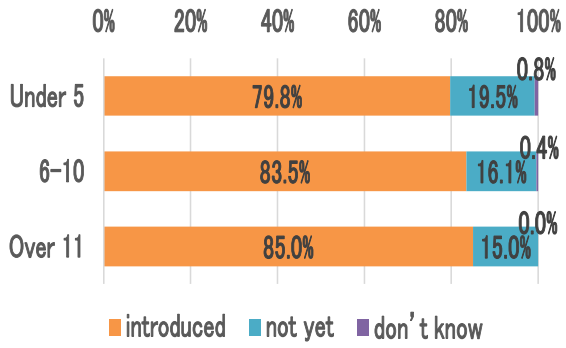
3.6.1 Introduction of taxi subsidy scheme (TSS)

As for the introduction of TSS, 82% of companies said TSS is introduced in their area shown in **Fig.3.9**. when asked about the willingness for the introduction of TSS from the part that have not introduced yet, they show high willingness about 72%. Disabled people form the big portion of target users for this policy, elderly stands second.

3.6.2 Contribution of taxi subsidy scheme (TSS)

About the usage of TSS before pandemic situation, from the valid response of 803 company, we squeezed the 645 company who introduced the

TSS policy, there is a daily user with high response, 55% shown in **Fig.3.10**. Regarding to the contribution of TSS on business before pandemic situation, for all types of company, it has certain amount of contribution with 48% shown in **Fig. 3.11**. However, the usage ratio of TSS decreased 35% because of the pandemic.



F.3.9 Introduction of TSS

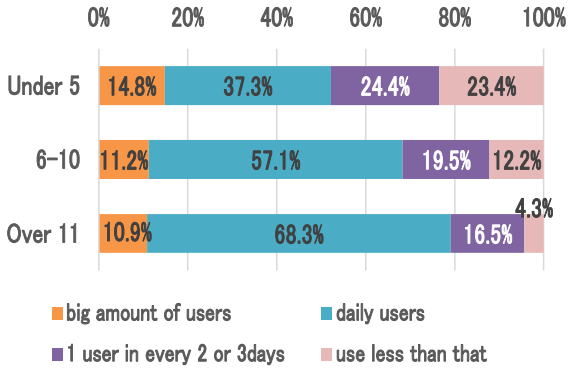


Fig.3.10 Usage portion of TSS

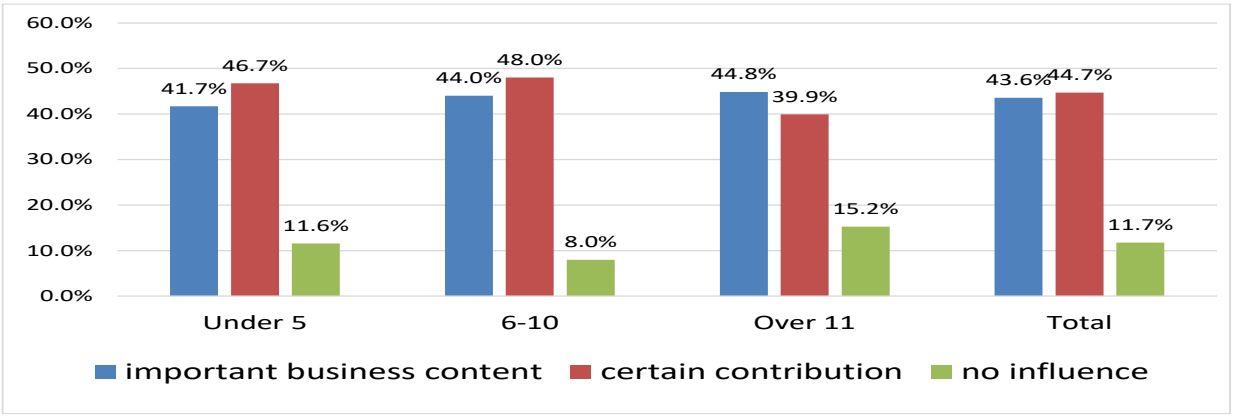


Fig.3.11 Contribution of TSS on business

3.6.3 Quantitative analysis on taxi business with TSS

Considering from the position of taxi operators, increasing the profit may be referred as a priority. In each business sector, there will be several different factors contributes to business sale in a different level. To find out what kind of factors in which level have influence on increasing the profit, a stepwise regression model by using SPSS ver25, is conducted in this research.

In statistics, stepwise regression is a method of fitting regression models in which the choice of predictive variables is carried out by an automatic procedure. In each step, a variable is considered for addition to or subtraction from the set of explanatory variables based on the prespecified criterion. In this study the p-value of F-statistics is used criterion and threshold of variable addition (PIN) is 0.05 and subtraction (POUT) is 0.10 as the default setting of SPSS. **Table 3.2** shows the variables added in each step. After the step-by-step iterative construction of a regression model select the independent variables to be used in a final model. The formula for stepwise regression model is as following:

$$Y_i=\beta_0+\beta_1 x_{i1}+\beta_2 x_{i2}+\ldots+\beta_p x_i+\varepsilon \quad (1)$$

Where, for i is the number of observations (taxi companies), Y_i is dependent variable, x_i is explanatory variable, β_0 is Y-intercept, β_p is slope coefficients for each variable, and ε is the model`s error term.

Variables for this model are chosen as shown in **Table 3.2**. In this research, data was collected from taxi companies with 1~20 vehicles from whole Japan. As a factor which can influence the business sale as dependent variables of this model, area scale, population density, aging ratio, number of taxi company in each town or city where the responded company locates, number of vehicles and drivers working in the company, and intro-duction of TSS were chosen as explanatory variables. **Table 3.2** shows the correlation value of explanatory variables with the dependent variable (sale) as well, which shows significant relationship. Area scale, population density and aging ratio were obtained from 2015 Census (Statistics Bureau, Ministry of Internal Affairs and Communications). Business sale, number of drivers and number of vehicles is obtained through this survey (2). We choose 654 companies according to the valid answer for the column of business sale as sample. Because there is no specific data of number of taxi company for whole region of Japan according to their geographical position, so the number of taxi company in each area which is corresponding to respondent is made by searching the administrative

code one by one. As we got to know the status of introduction of Taxi Subsidy Scheme through this survey, the influence of TSS on business operators is also considered as one of the factors whether to promote it if this policy has beneficial effect on both sides, taxi business operators and mobility vulnerable group.

To examine the relationship between business sale and each explanatory variable, stepwise regression model is implemented. The result confirmed that the model variables were selected correctly, this allows to estimate the coefficients of each parameters in the model. In this result, the associated p-value by F-test of ANOVA (Analysis of Variance) for the model is < 0. 000***. It means the hypothesis that all of parameters of this model might be zero is significantly rejected. R and R square value, however, are not sufficient so that the model explains only 30% of variance of sale. **Table 3.2** and **Table 3.3** show the adding variables on each step and the value of VIF (variance inflation factor) in order to check multicollinearity. As all of VIF values show less than 10.0, there would be little concern about multicollinearity.

Each estimated parameter shows the influence level by each explanatory variables, area scale and number of vehicle are automatically deleted.

In this research, we mainly examine the influence of Taxi Subsidy Scheme to business opera-tors whether to promote it as a policy of sup-porting mobility vulnerable group if it has positive influence on taxi operators. As we selected companies with 1~20 vehicles, considering it may have different result according to different size of business scale, stepwise regression model selected the significant business scale. As a result of this model, population density, aging ratio, number of taxi company, number of staff as well as the Taxi Subsidy Scheme (TSS) for companies with 6 to 10 vehicles turned out to be significant, as it is shown in **Table 3.3**. It seems that companies with under 5 vehicles almost all introduced TSS, so it is difficult to find out the differences.

Table 3.2 Variables list of regression model and results

Variables (unit)		Explanation (data source)	Correla-tion with sale/ sig.	Step-wise	VIF (last step)
D	Business sale (yen/vehicle・day)	Daily sales/vehicle dependent variable (Survey)	-	Depen dent	
1	N of drivers (n)	Number of drivers in the company (Survey)	0.494**	in 1	
2	N of vehicles (n)	Number of vehicles in the company (Survey)	0.434**		3.97
3	Area Scale (square km)	Area size of town or city where the company locates (Census)	-0.155**		1.08
4	Population density (/square km)	Population density of town or city where the company locates (Census)	0.313**	in 2	
5	Aging ratio (%)	Population ratio of over 65 years old of town or city where the company locates (Census)	-0.300**	in 4	
6	N of taxi company (n)	No. of taxi company in the same town or city where the company locates (Taxi directory)	-0.287**	in 3	
7	Aged population (n)	Aged (65-) population (Census)	0.085*		4.3
8	Aged population per company (n)	Aged (65-) population / N of taxi company in the town or city (Census, Taxi directory)	0.198**		1.38
9	TSS (under 5 vehicles)	Dummy variable of company with TSS introduction status for each type. (Survey)	0.312**		1.84
10	TSS (6~10 vehicles)		0.287**	in 5	
11	TSS (over 11 vehicles)		-0.305**		1.95
12	TSS (under 10 vehicles)		0.312**		2.31
Survey: Survey of taxi companies Census: Census 2015 statistics Taxi directory: Taxi directory in 2018 VIF: Variance Inflation Factor to check Multicollinearity			sig.: siginificant level ** <0.01 *<0.05 stepwise: in or out and step no.		

Table 3.3 Coefficients for each parameter in stepwise regression model

Step	Valid variables	Estimate parameter	p-value (t-test)	VIF
	Intercept	21185.200	0.000	-
1	N of drivers	403.284	0.000	1.237
2	Population density	0.970	0.000	1.296
3	N of taxi company	-50.001	0.000	1.139
4	Aging ratio	-207.940	0.000	1.450
5	TSS (6~10 vehicles)	1838.050	0.006	1.027
	R / R square	0.548	0.295	
	ANOVA F value / p-value	55.366	0.000	
p-value : siginificant level of parameter value by t-test				
VIF: Variance Inflation Factor to check Multicollinearity				

So, the formula of the multiple regression model can be written as followings:

$$Y_i=\beta_0+\beta_1 PD_i-\beta_2 AR_i-\beta_3 TC_i+\beta_4 ND_i+\beta_5 TSS_i \quad (2)$$

Where:

Y_i :business daily sale per vehicle (yen/day･vehicle)

β_0: intercept is 21185 (yen/day･vehicle)

$\beta_1 PD$: 0.970 * population density (person/km^2)

$\beta_2 AR$: -207.938 * aging ratio (%)

$\beta_3 TC$: -50.001 * number of taxi company

$\beta_4 ND$: 403.284 * number of drivers

$\beta_5 TSS$: 1838.054 * dummy variable of introduction of TSS （company with 6 to 10 vehicles）

Population density, aging ratio, number of taxi company in each area and number of drivers, and Taxi Subsidy Scheme (TSS) turned out to be statistically significant. For one unit increase in population density, there will be 0.97 increase in business sale, which, to some degree, explain the situation of low population density areas that maintaining the taxi business sustainability is

much more challenging in depopulated area. Surprisingly, although taxi is considered as a transport mode for elderly people, for one unit increase in aging ratio result in 207.9 decrease in business sale, which shows that the higher the aging ratio in rural areas is, the lower the usage of taxi becomes. Low frequency or short trip of outing behavior of elderly mobility and expensive fare of taxi may cause this result. As we know the current taxi industry is facing a lot of challenges after the deregulation policy, increasing on the number of taxi companies is the direct result of this policy. The model shows that one unit increase on the number of taxi company will result 50.001 decrease on business sale, which may increase the competition severely. From this survey result, while a lot of companies complaining about the difficulty of increasing the number of drivers, the model shows that one unit increase on the number of drivers will increase the business sale 403.284 unit, lack of drivers and staff may be considered as another hindrance for improving the business sale. As one of the main purpose to be examined, this time, the relationship between taxi business sale and introduction of TSS is also examined, however in stepwise regression model, TSS introduction for companies with 6 to 10 vehicles turned out to be significant, TSS influence on business sale is about 10%, in case of company with 6-10 vehicles. On the other hand, few distributed taxi subsidy ticket and high price for taxi ride may limit the elderly from using taxi, which is turned out to be true in the above result, aging ratio. It means the higher the aging ratio, the fewer the usage of taxi. So, expansion of Taxi Subsidy Scheme on most needed target group with the aim of effective usage is advocated while it is beneficial to both users and operators sides.

3.7 Opinions and expectations for taxi business

3.7.1 Expectation for improving the policy of taxi subsidy scheme (TSS)

When asked about the expectation for TSS by several items like expansion

on targeted people, distributed ticket, service available area, and the discount rate supported by local government, and also reducing the burden of paperwork, simplification for confirmation of user authority, among them the expansion on targeted people and dis-tributed ticket accounted for large portion with 35% and 44% respectively shown in **Fig.3.12**. This result to some degree explains the situation that considering it from business operator side, the subsidy amount for this policy is allocated from government side, so taxi companies want more TSS users.

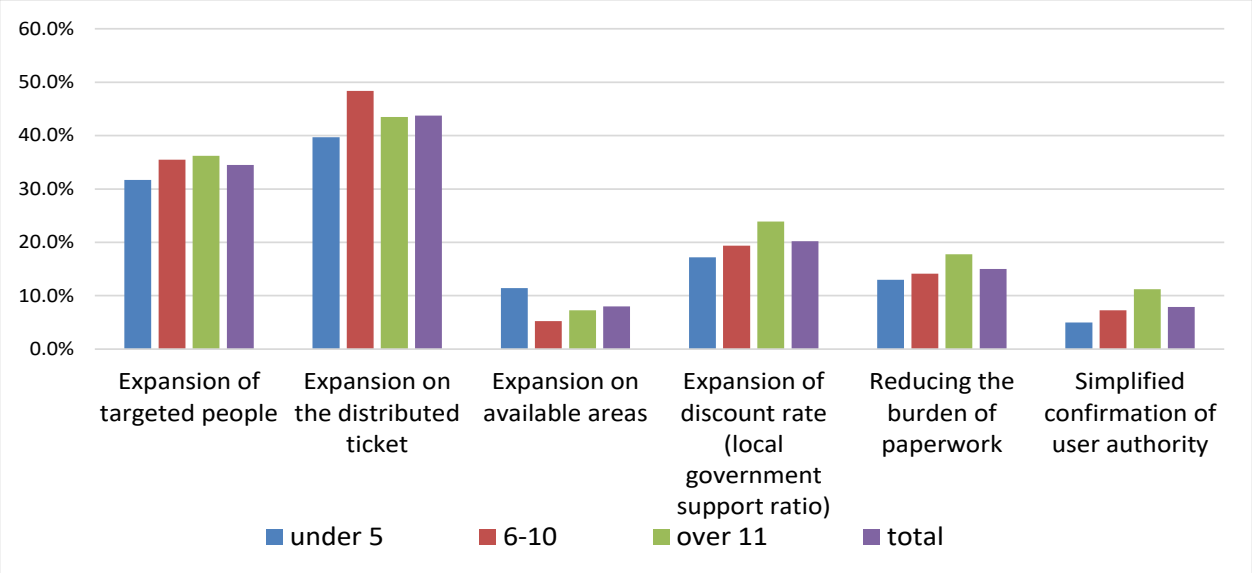


Fig.3.12 Expectation for improving of TSS

3.7.2 Opinions about future management

Based on the current situation of taxi industry, perspectives, expectation, and opinions on improving of taxi business for future development were also examined. For future improvement measures, we got almost half of the opposite response for introduction of fixed fare policy, private paid passenger system in transport vacant area, nursing care taxi business, welfare taxi business, outsourcing of reservation and dispatch and IT based dispatching, which are considered to not necessary for future business. on the contrary, they show higher desire for items like fuel-efficient vehicles for reducing operation cost, vehicles with safety support system, enhancing work style and benefit for

attracting drivers as it is shown in **Fig.3.13**.

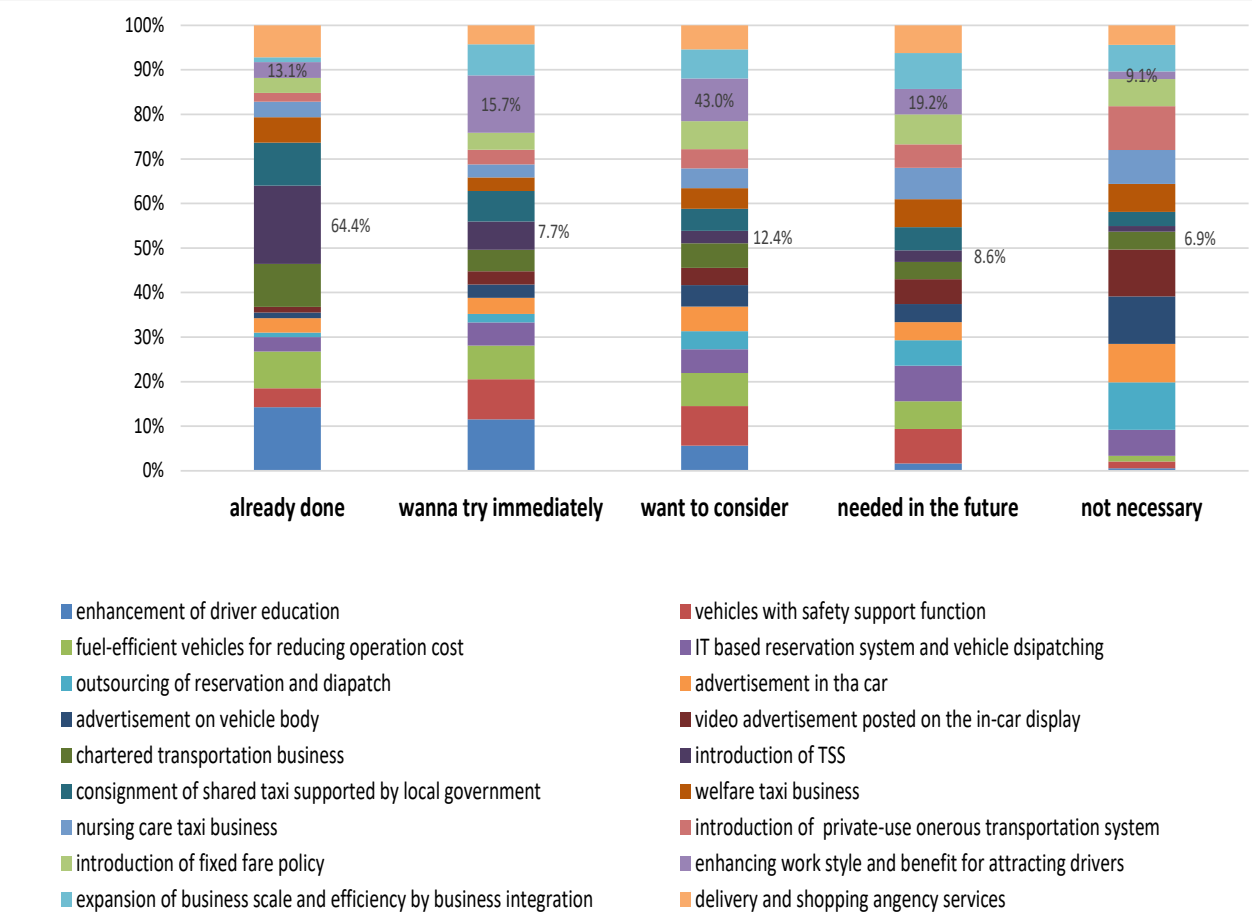


Fig. 3.13 About the future improvement measures

3.7.3 Expectations from local government towards taxi industry

As an expectation from local government to-wards taxi industry, we provide several items like guidance and support for expansion of management integration; implementation of private paid passenger transportation; deregulation on operation area; introduction of new fare system like unlimited ride shared taxi; introduction and expansion of TSS; in-car display for emergency broadcasting; supports on IT facilities for outsourcing reservation & allocation; subsidy for purchasing safety support and fuel-efficient vehicles; financial subsidy for dealing with covid infection. Certainly, urgent need for financial support for dealing with corona impact got highest response with 52%, and surprisingly, they show higher desire,45%, for introduction and expansion

of TSS, and subsidy for purchasing safety support and fuel-efficient vehicles, introduction of reservation type shared taxi accounts for second and third high portion, which is shown in **Fig.3.14**. Desire for fuel-efficient vehicles for reducing operation cost and vehicles with safety support system is double confirmed in this section.

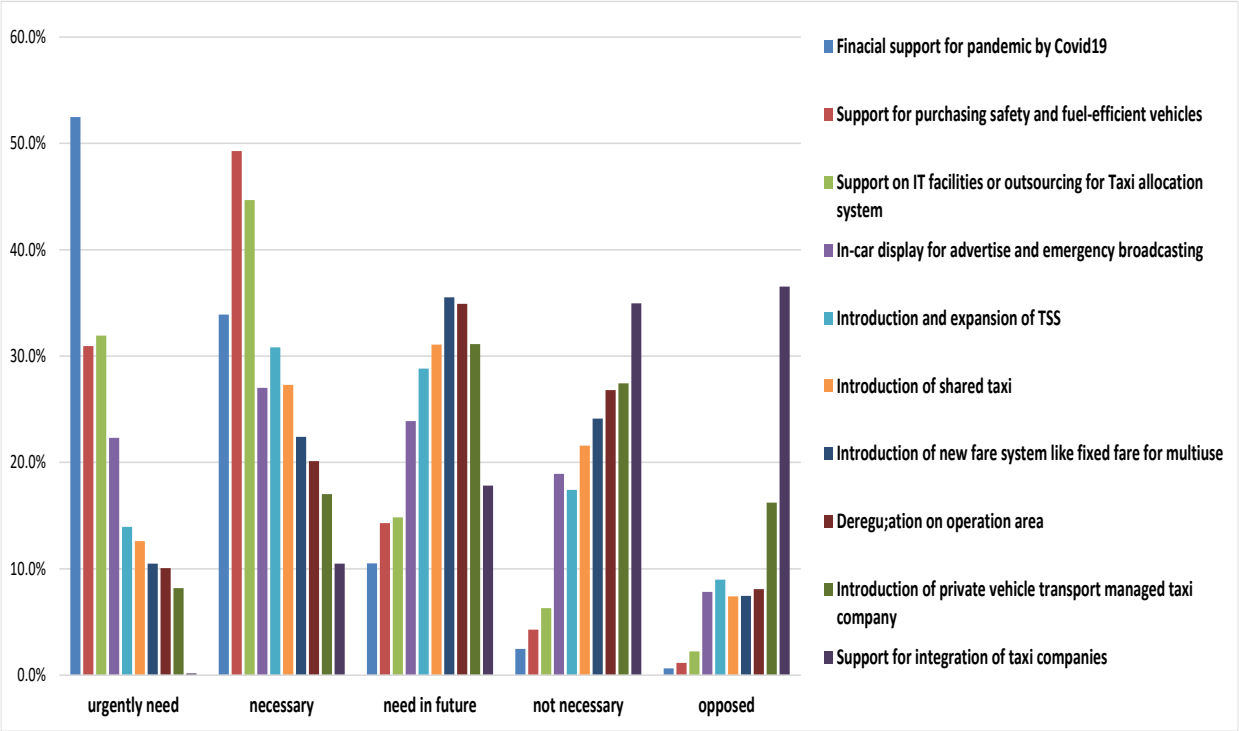


Fig.3.14 Expectation from local government towards taxi industry

3.8 Conclusion

Results of COVID-19 impaction analyzed in this paper showed that small or medium sized taxi companies with under 20 vehicles tend a decreasing trend about the changes on number of vehicles and drivers.

In addition, when the scale of company gets bigger, the burden of management gets severe. More than 50% of all sorts of company are facing the 60% drop on business sale compared to last year because of the COVID-19 pandemic, but they all are committing their effort for preventing the spread of COVID-19 to keep the business continuous and applying for various financial support system.

About the role of Taxi Subsidy Scheme (TSS), more than 80% companies respond that they have introduced TSS policy, and about half of them said they have daily TSS users, which can be seen as an important service content for taxi industry especially with small sized companies.

By employing of regression model on business sale, TSS with 6 to 10 vehicles turned out to be statistically significant. From population density and aging ratio, it seems that compared to relatively populated area, business sustainability faces more challenges in the area with low and dispersed population. Growth on the number of taxi company and declining on the number of drivers which is the consequence of the deregulation policy in taxi industry shows the negative impact on business.

So, raising on frequency for usage of taxi and securing the mobility of elderly at the same time by popularization of Taxi Subsidy Scheme (TSS) to most needed target group is recommended.

In addition, considering the national policy for the mobility of elderly persons, the Act on Revitalization and Regeneration of Local Public Transport (Transportation Rehabilitation Law) revised in 2020, which point out the obligation for local public organization to create a “Regional Public Transport Plan”. The position of taxis as public transportation has been clarified, calls for securing mobility by integrating various means are popularized but the awareness and efforts for cooperation with taxi operators are delayed. General taxi transportation still has many regulatory barriers, and it is important to properly divide roles with shared transportation.

In order to increase the continuity of the taxi business in local areas, it is important to improve vehicle utilization effectively not only from transport passengers, but also for responding to various needs by creating other service such as shopping agency, hospital transport, food distribution service.

For this purpose, there may be a direction to establish a business of “transportation service vehicle dispatch center” that centrally accepts and dispatches such transportation needs. Furthermore, as a new system to balance

the burden and benefits, the factor of intergenerational cost burden such as transportation insurance is also considered important. In that respect, as a policy to support taxi users, it is important for Taxi Subsidy Scheme (TSS) not to expand the number of people covered, but to properly identify people with traffic difficulties and enhance the subsidy for ensuring the mobility of those people.

As mentioned above, in this study, it is clarified that the business condition for small and medium-sized taxi operators has deteriorated due to the corona disaster. And from the revealed result of TSS contribution on taxi operators, the direction of improvement on TSS was organized. These measures are not only limited to the situation of corona disaster, but also it is necessary to be considered as one of the important factors in maintaining the management of small and medium-sized taxi operators in local areas in the future.

Chapter 4

Analysis of Roles of Taxi Service and Taxi Subsidy Scheme for Mobility of Elderly People Living in Depopulated Areas

4.1 Outline for the chapter

For securing the mobility of elderly people living in rural areas, lots of measures are being employed. In this chapter, we conducted a web questionnaire survey for 300 people living in depopulated areas. By dividing the focus group to private car owners, TSS users and non-TSS users, their outing behaviors were analyzed.

The results show that the TSS has a certain effect on ensuring mobility for the elderly in depopulated areas. In view of this, the utilization of a "shared taxi" reservation type is suggested for improving the subsidy rate.

4.2 Overview of elderly mobility in rural areas

Mobility in depopulated area, especially for the special groups like elderly and disabled people is facing various challenges, which have direct influence on improving of people`s quality of life in their late ages. For securing the mobility of elderly people living in rural areas, lots of measures are being employed.

With the revision of the Road Transport Law in 2002, entry and withdrawal into the bus business was deregulated, and in the revision plan in February 2006, the requirements for regular operation with route settings were eliminated. Owing to depopulation and motorization in rural areas as well as such deregulation policies, the withdrawals of route buses in rural areas have increased. In this context, the characteristics of rural areas, including their dispersed population density, low de-mand for service, and needs for financial support, cause problems for covering the area with transportation services. Most rural areas have difficulties in maintaining the continuous operation of a public transit service.

In Japan, the number of elderly people is expected to increase in the future and increasing numbers of people are living well past 80 while maintaining active lives. Thus, it is necessary to understand their mobility needs and travel behaviors. In addition, in recent years, traffic accidents caused by the elderly have become a serious issue requiring close attention. Moreover, owing to the promotion of returning the driver's licenses of elderly people, there is often a need to secure alternative transportation means (e.g., private cars) for these groups. Therefore, in place of route buses, there is an increasing demand for-door to-door service. As such, we need to take a close look at the growing trend of urgently requiring such individual services.

To tackle the mobility problems, the implementation of community bus service has been conventionally focused on urban areas. This approach, however, could only a limited number of people in rural areas. To meet the increasing needs of special groups such as the elderly and disabled people in rural areas, flexible transport services have been introduced, including on-demand ride sharing taxis and private paid passenger transportation system, called "Jikayou Yushou(自家用有償)" in Japanese; these require reservations, but allow for flexible route and schedule settings, so as to support the mobility of elderly in the service area. Owing to such services, mobility support for the elderly is expanding (in certain areas).

In contrast, people living in area where there are no on demand-ride sharing taxis or that are out of the operating service cannot receive these ser-vices. Even in the operating area, because of the individual use, the sharing ratio may be excessively low and inefficient. As such, in areas where there is little demand for public transportation, instead of establishing shared types of services, attention is being paid to using individual types of transportation services such as taxis, which can respond to the individual demands and achieve door-to-door service.

In remote rural areas, to provide mobility assistance to residents with disabilities or significant mobility restrictions preventing them from using

public and community transport, non-profit organization corporations are using volunteer driving services with the aid of local residents. The users only pay a small amount of reasonable money, i.e., not for business profit. Generally, however, this scheme is only introduced in areas where there is no taxi service. Considering the characteristics of the demands of aged people in rural areas, individual service remains necessary, and the usage of existing taxi services may represent one of the operational solutions.

A taxi subsidy scheme (TSS) subsidizes the taxi fare by distributing tickets to a limited target group according to certain conditions such as age, driving license, disability, and socio-demographic background. The TSS is a solution that has been widely introduced by rural local authorities. The local government subsidizes part of the taxi fare by issuing a certain number of tickets to target persons annually, and users can pay part of their taxi fees with this ticket. As a welfare policy, the original target of the system, i.e., people with disabilities, has been expanded to include the elderly and poor.

According to the subsidy amount and number of distributed tickets, the programs in the available areas can differ, according to the local authorities and their own conditions. The range of subsidy tickets distributed annually varies from 20 to 100 sheets. The subsidy rate can be divided into several cases, e.g., a fixed amount of subsidy per ticket, or a changeable subsidy amount depending on conditions.

Therefore, several issues are considered herein, such as the actual situation for the mobility of the elderly in rural areas, the role(s) taxis play in elderly mobility, and the roles of TSS policy and people`s attitudes toward it.

4.3 Existing Research and Purpose of this Study

There are existing research studies on the role of taxi services in a depopulated area. Kato provides an overview of recent changes in the legal system related to taxis and discusses the direction for taxi projects aiming to contribute to regional public transport services and to play an indispensable

role. In addition to the contributions of on-demand ride sharing taxis, there may be various contributions in the form of original taxi businesses for transporting passengers individually by deactivating the taxi meter. In the future, with the diversification of travel needs and the aging and population decline in regional and suburban areas, taxis are expected to expand into securing public transport services by complementing or replacing public bus transportation modes.

According to the research on on-demand shared taxi schemes, Hayakawa showed that, in an area where the conventional public transport has been abolished, focusing on demand-type shared taxis (representing cooperation by taxi companies and private paid passenger transportation) is vital. Moreover, it is important to introduce the proper type of scheme according to the local situation, i.e., it is not always necessary or appropriate to copy a solution thoroughly (similar to cases of introducing IT technologies to small business in the same manner as in advanced cases). A study by Kato estimated the cost-saving effect of local public transportation in Toyota City, Aichi Prefecture. The results showed that taxis could be used as a local public transportation option where the density of the transportation demand is low and would be expected to reduce 20–70% of the operation costs for public transportation. It also suggested that according to regional characteristics, areas with inefficient bus routes with large detour ratios are suitable for the replacement of community buses by taxi services with a mileage fare system. Meguro focused on the introduction of group taxis and revealed that there were limitations in the current public transport system insofar as covering the mobility needs of the elderly and disabled people. They also noted that the introduction of group taxis could contribute to improvements in socializing by participants.

However, according to another research study by Moriyama, demand-based ride-sharing taxi services may not be economical, owing to the costs for the reservation procedures. In fact, sometimes it is necessary for the driver to wait for customers, which is costly. In addition to this, the procedures for making

reservation procedure can also form barriers for older people. As such, a proper introduction, especially regarding the policies including taxi utilization, can be vital when considering the local conditions in depopulated areas. According to Hayakawa's research, Tatebayashi city of Gunma prefecture (population approximately 78,000) and Omachi city of Nagano prefecture (population 29,000) introduced a TSS to the elderly along with the elimination of bus service. In these two cities, elderly people were supported by distributing taxi tickets, but the pressure on the municipality increased. In this case, it revealed that bus service is more efficient than a TSS, and ultimately led to a restart of bus services in these regions. However, Hayakawa said that the TSS makes a certain amount of sense, because some elderly people have difficulty accessing bus stops. Another study by Ishio evaluated the characteristics of TSSs as policy for supporting the movement of the vulnerable groups in remote areas. The feasibility of a TSS depended on the environment in which it was implemented. In addition, it was found to be implemented at a low cost relative to other demand-based transport services. In this article, the TSS was examined from the perspective of public awareness. Based on the results of a questionnaire, it was found that citizens did not oppose taxi assistance in principle; in particular, they indicated that those requiring support should be provided with appropriate assistance.

A report submitted by the Department of Transport and Main Roads in the Queensland government of Australia provided a series of in-formation regarding the background of their TSS, the sustainability of the service, reviews for eligibility, entitlements, and duplication of Government benefits and assistance through other systems, and funding for the TSS program. A TSS was introduced in Queensland in 1987 to provide an affordable and accessible transport option for people with disabilities who experienced profound difficulties when using other modes of public passenger transport. The state government subsidy funded 50% of the taxi fare for each trip, up to a maximum subsidy of $25. Membership was not means-tested, and the number of taxi trips

able to be undertaken and number of subsidies paid per member were unlimited. Members were issued with an electronic membership smartcard and were also entitled to a maximum of 20 interstate travel vouchers each 12-month period, for use with any taxi service in other jurisdictions. After consideration of all of the information made available and the views put forward by the Panel members, the Panel made recommendations such as undertaking research to identify more detailed demographics and usage patterns. i.e., to better understand the availability of access to members and transportation network.
Considering the above research, this study aims to clarify the actual conditions and issues concerning elderly mobility in depopulated areas. A comprehensive analysis is conducted to identify the roles of the taxi service and TSS in securing the mobility of elderly, along with the level at which they influence the movement behaviors of the elderly for their daily life activities.

4.4 Research method

4.4.1 Outline of questionnaire survey

We conducted a web questionnaire survey on Rakuten Insight in July 2019, aiming to obtain an understanding of the current actual situation regarding the use of taxis with a TSS by the elderly.

In this research, the questionnaire survey was conducted with elderly people living in depopulated areas. The depopulated areas were defined as local governments and included 817 municipalities designated according to the Act on Special Measures for Promotion of Independence in Depopulated Areas (revised in April 2017).

In a screening question of the Web survey, we requested the postal code of the corresponding living area of the respondent; then, the target person was extracted after checking his/her postal code to the list of 817 municipalities. The web survey required the respondent to answer 20 short questions, and was intended to last for 15 minutes. The contents of the questions asked in the questionnaire are shown in **Table 4.1**.

Table 4.1 Questionnaire survey content, including on taxi subsidy scheme (TSS)

Q	Question	
1	Occupation	
2	Transportation that can be used freely	
3	Frequency of outing by purpose	
4	The most common one-way traveling time	
5	Usage of transportation	
6	Dissatisfaction with the use of buses and railways	
7	Purpose of using taxi	
8	Reasons for using taxi	
9	Difficulties for using taxi	
10	Status of introduction of taxi subsidy scheme	
	1	TSS has been introduced and receiving the distributed ticket
	2	Targeted person but has not registered and did not receive distributed ticket
	3	TSS has been introduced but not aimed as target person
	4	TSS has not been introduced but being aware of subsidy system
	5	Knows nothing about the subsidy scheme
11	1	Annual number of taxi tickets distributed (upper limit)
	2	Annual number of taxi tickets used (number of uses)
12	Discount rate by taxi subsidy scheme	
13	Self-pay per vist	
14	Request for improvement of taxi subsidy scheme	
15	The frequency of outing with the increasing number of distributed tickets and discount rate	
16	Possible increase on the usage of taxi by 50% fare discount and no limitation on using number	
17	Suggestion for supporting the mobility in depopulated arae	
	1	Expansion on amount of subsidy to limited targeted person
	2	Expansion on the scope of targeted person with inconvenient transportation
	3	Expansion on the scope of targeted person, subsidy rate and number of times
	4	Substantial public transportation except the taxi
	5	Support for the mobility of family members
18	Opinions about ride sharing taxi	
19	Role of taxi in the region	
	1	Mobility for daily life
	2	Transport tool for emergency
	3	Support for the mobility vulnerable residents
	4	Transportation availability for visitors
	5	Door-to-door high quality transportation service
20	Pros and cons of taxi business maintenance measures in depopulated areas	
	1	Maintain local taxis with public support
	2	Public support through policy mitigation for improving taxi management
	3	Policy mitigation on using private car for supporting mobility
	4	Introduction and development of self-driving taxis
	5	Policy mitigation for running taxi business as second career for migrants

4.4.2 Sampling and focus group

A total of 300 people over 65 years old living in depopulated areas were chosen as the sampling group, as this ground was considered as being able to provide a better understanding regarding the actual situations of their daily life experiences. The sampling group was divided into three groups using screening questions. Group S1 could freely go out with a car, motorcycle, or moped by themselves. Group S2 did not have driving licenses and could not use a motorcycle or moped. Finally, group S3 comprised persons without a driving license, motorcycle, or moped, and who answered the question by listening to the explanation of families. The sample collection for the focus group was designed with 100 samples for each group; however, from the results of the confirmation question, two people were found to belong to another group.

For further analysis, sampling groups S2 and S3 with the same feature (unable to use car or moped freely) were subdivided according to the status of receiving a TSS so as to provide three focus groups, i.e., focus groups A, B, and C.

Table 4.2 shows the definitions and sizes of the sampling groups (S1, S2, S3) and focus groups (A, B, C), as well as the age (mean and standard deviation) and gender ratio of each group. Regarding occupation, unemployed, housewife, and company employees accounted for the largest three proportions, from highest to lowest at 32.7%, 25%, and 24.7%, respectively.

Table 4.2 Structure of sampling and focus groups

Sampling groups by screening question \ Focus groups		A: With PC/ No TSS	B: No PC/ No TSS	C: No PC/ With TSS	Total	Age : Mean (STD) Female ratio
S1	People over 65 years who can freely go out with car, motorcycle,or moped by themselves	98	0	0	98	68.9 (3.45) 49.0%
S2	People over 65 years who can go out by themselves, but has no driving license, or cannot use motorcycle or moped	0	94	8	102	69.8 (3.63) 51.0%
S3	Over 65 years who don`t have driving license, motorcycle or moped, answering the question by listening to the explanation of families	0	93	7	100	43.2 (10.3) 50.0%
Total		98	187	15	300	
S1 + S2	Age : Mean (STD) Female ratio	68.9 (3.45) 49.0%	69.6 (3.49) 50.0%	71.6 (4.96) 62.5%	69.4 (3.56) 50.0%	

PC : Private Car Owner, TSS: Taxi Subsidy Scheme User

4.5 Summary of survey results

4.5.1 Situation of mobility for focus groups

Fig.4.1 shows the available mobility modes for the three focus groups. A one-way analysis of variance is used to determine whether there are any statistically significant differences between the means of the three groups. In this figure, significantly different ($p < 0.05$) pairs of groups are shown as arrows, based on the results of a multiple comparison according to Tukey's method. Bicycle is the most commonly used mode of transportation, with approximately 40% of the usage rate relative to the other transportation modes. A significantly large portion of TSS users appear to have no available mobility mode. For scooters, TSS users also show high significance relative to the other two groups.

Going out for daily life activities is an indispensable part of daily life. **Fig.4.2** shows a comparison of the annual frequencies of going out between the focus groups. In total, the frequencies of TSS users' outings for all purposes seem lower than those in other groups. However, TSS users without a private

car have a significant higher frequency of traveling for hospital visits.

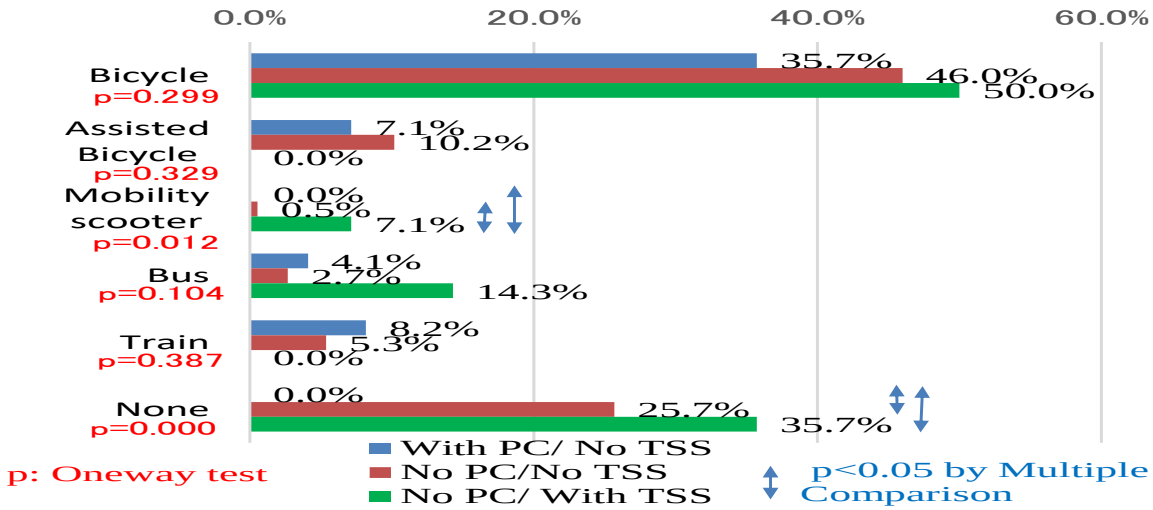


Fig.4.1 Available mobility modes

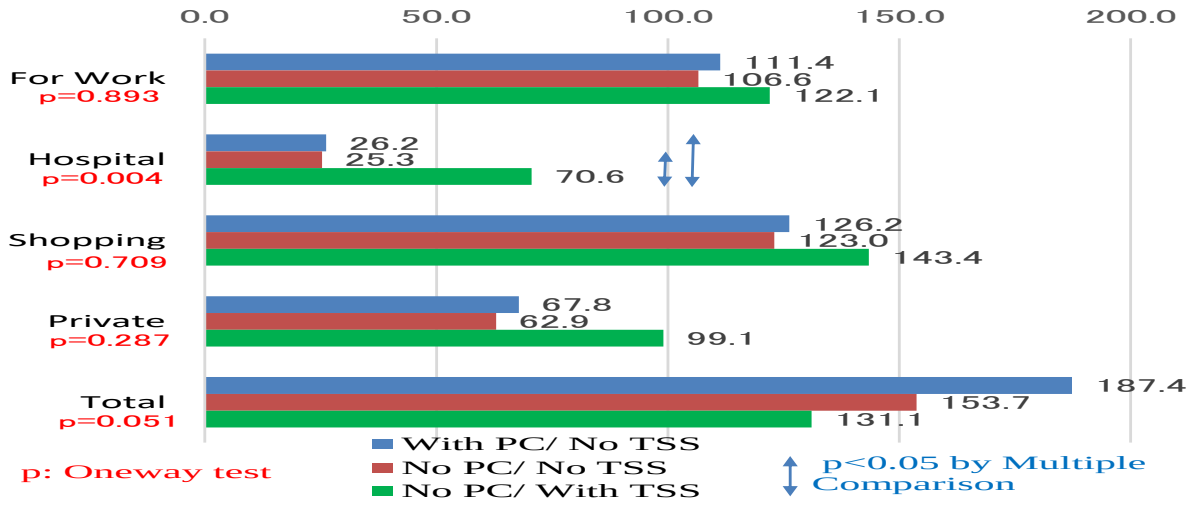


Fig.4.2 Annual frequency of going out by purpose

Fig.4.3 shows the frequency of outing by transportation mode, except for private car or motor-cycle. When focusing on outings for TSS users and non-TSS users without private cars, they show a higher frequency of outing compared to the group with private car as transportation mode. Insofar as the taxi mode, despite the significance level being weak, the TSS users show a higher frequency than the others.

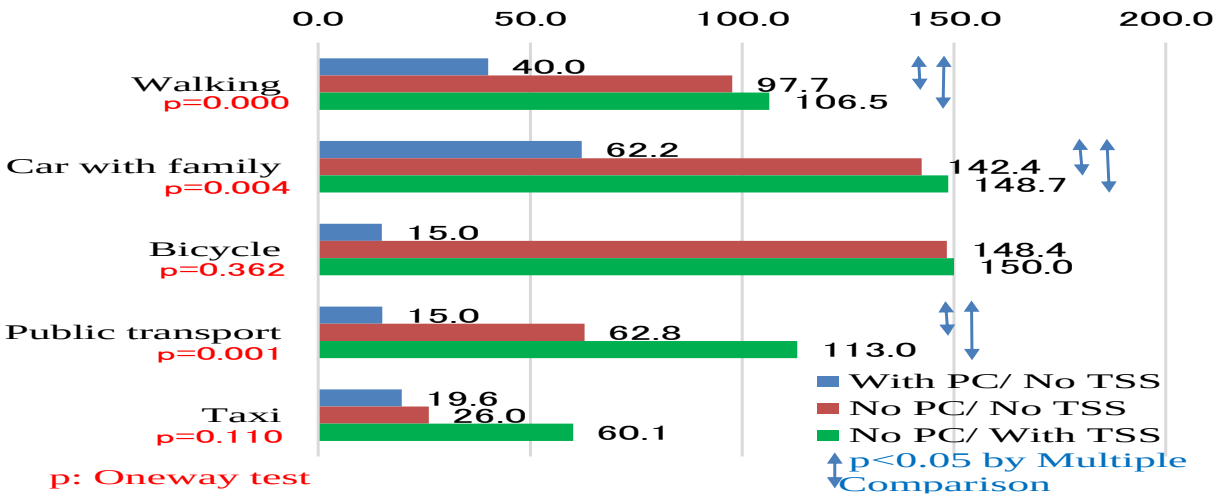


Fig.4.3 Annual frequency of going out by modes

4.5.2 Role of taxi service relating to taxi subsidy scheme (TSS)

When examining and measuring the roles of taxis in securing mobility for elderly, the purposes and reasons for using taxis, difficulty in using taxis, and influences of TSSs on taxi usage are analyzed according to the different groups. As shown in **Fig.4.4**, the purpose for using the taxi differs according to the state of owning a private car and receiving a TSS. TSS users are using taxis for various purposes in their daily life activities more than the other two groups; the Fisher's exact test shows significant independence, with p = 0.000.

To analyze the relationship between a TSS and taxi usage, a simple linear regression is conducted. The linear regression equation evaluates the percentage of usage of taxi services (dependent variable) from the existence of a TSS (dummy variable). The model indicates a positive coefficient for the relationship between the existence of the TSS and taxi usage, and the coefficient is significant according to the t-test, as shown in **Table 4.3**.

Fig.4.5 shows the reasons for using taxis, including safety, comfortableness, time flexibility, speediness, drinking parties, and the subsidy. TSS users have significantly higher proportions than the other two groups, especially for items like comfortableness, time flexibility, and the subsidy. In contrast, TSS users do not show any interest for using taxis to go to drinking parties.

After asking about the advantages of using taxis, the counterpoints concerning their difficulties were identified based on several items in the questionnaire, including those concerning the expensive fare, its state of being a luxury, a lack of availability ("no taxi company coming home"), difficulty in obtaining taxi services when calling ("hard to get taxi when calling"), and worrying about the service by taxi drivers. Among them, the expensive fare and "luxury" are the main reasons for the present state, and there are no large differences between groups regardless of receiving the TSS subsidy or not, as shown in **Fig.4.6**.

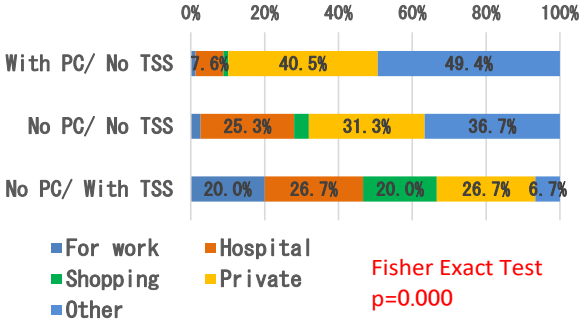


Fig.4.4 Purpose for using taxi

	Estimated parameter	Std.Error	t-value	Pr(>|t|)
Intercept	0.0433	0.0089	4.8740	0.0000
TSS(dummy)	0.1477	0.0397	3.7170	0.0002

Table 4.3 Result for regression model of taxi usage

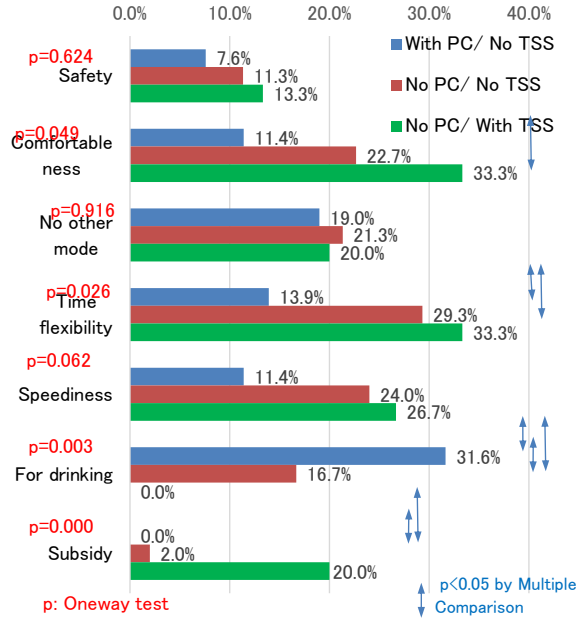


Fig.4.5 Reasons for using taxi

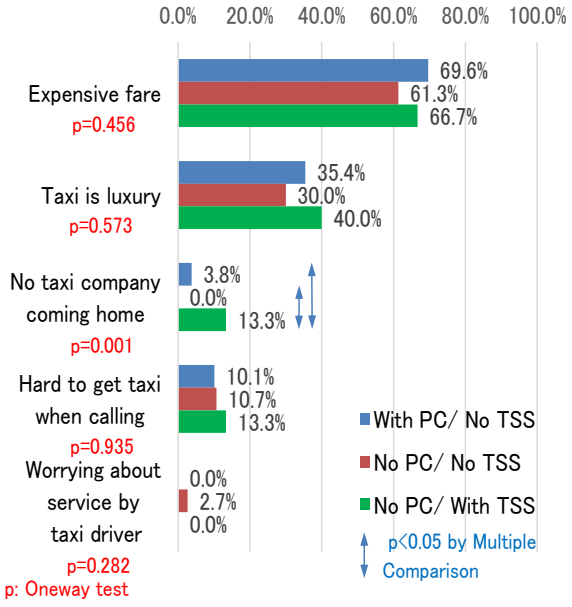


Fig.4.6 Reasons for difficulties in using taxi

4.5.3 Improvement for taxi service with TSS

Fig.4.7 shows the opinions of the focus groups concerning the best improvement policy for TSSs. No significant independency appears among the focus groups. Over 60% of people, and particularly over 70% of TSS users, believe in either expanding the subsidy ratio for the people for whom it is necessary, or targeting additional users for TSSs. Expanding the subsidy seems to have larger approval than expanding the number of users.

As a means of securing mobility for the group(s) that most need it, proposals including increasing the annual usage of taxis by assuming that taxi fares are halved by the subsidy system and making the number of usages or time unlimited are being discussed.

Fig.4.8 shows the intentions for growing the annual frequency of taxi usage times in the case of this scheme. TSS users show significantly a higher intention compared to other two groups, with average increases of 14 times, eight times, and five times, respectively.

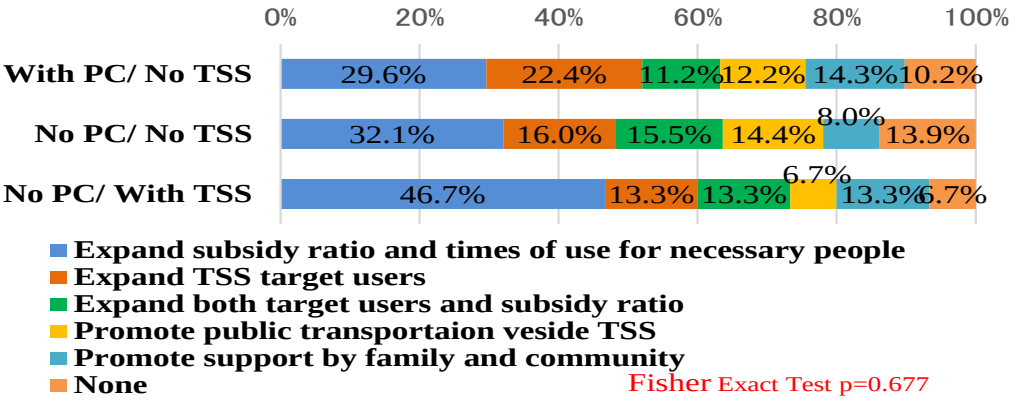


Fig.4.7 Best improvement policy for taxi subsidy scheme (TSS)

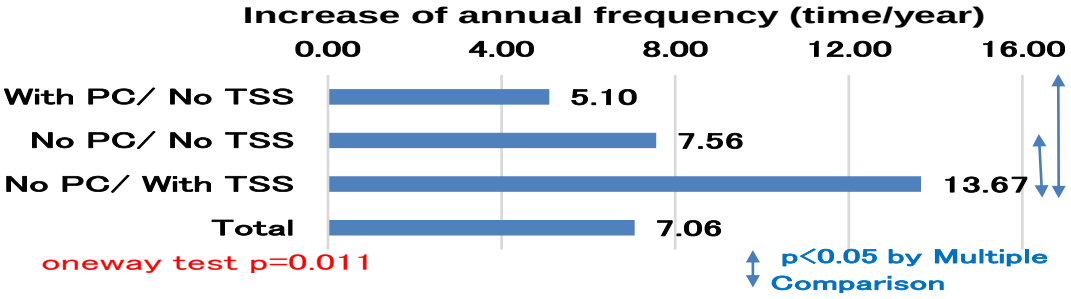


Fig.4.8 Intention for increasing the annual frequency of taxi usage in case of 50% fare subsidy without limit

The role of taxi service according to the types of trips for different groups is also analyzed, as shown in **Fig. 4.9**. There are no significant differences between focus groups, as they all put strong value on emphasizing the roles of taxis for daily mobility, as an emergency safety net, and for supporting disabled people. TSS users are more likely to emphasize the r daily mobility role.

When asked about their opinions regarding improvement measures for local taxi businesses as shown in **Fig.4.10**, again, no significant differences are found between the focus groups. Higher approval and expectations are reached regarding measures such as maintaining the local taxi businesses with public support, lifting the ban on mobility services as a second business for migrants and retirees, and deregulation for business management or improvement. The only significant difference among the focus groups appears in the introduction of self-driving taxi businesses. The approval ratio for this item by non-TSS users without private cars is significantly lower than by other groups, and this item gets the lowest votes relative to the other suggestions overall.

As another method of reducing the operation costs of taxi services, reservation type ride-sharing taxis are being widely discussed. **Fig.4.11** shows the acceptance level of reservation-type shared taxis. Specifically, 50% of people said they will use reservation type shared taxis if the price is cheaper, and the willingness to make reservations is relatively higher compared to the unwillingness to make reservations and/or to share with other people. In particular, for TSS users, there are no significant differences, owing to both sides opinions' for preference and rejection.

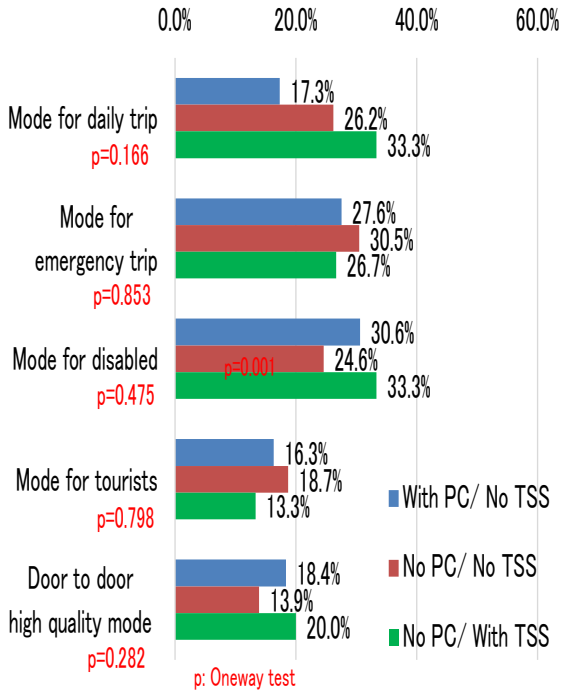


Fig.4.9 Expected role of local taxi

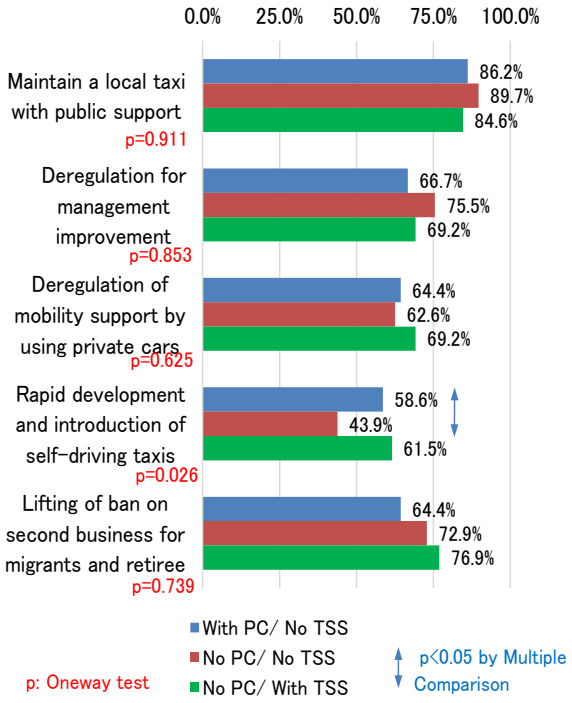


Fig.4.10 Opinions on improvement measures for local taxi

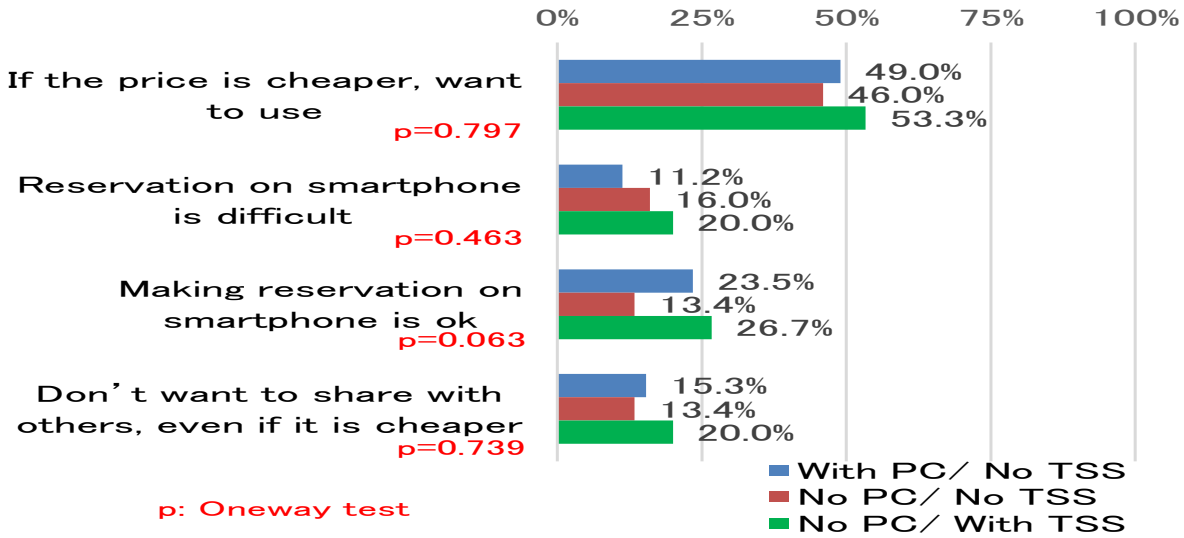


Fig.4.11 Intention for using reservation-type shared taxi

4.6 Conclusion

The following points were clarified from the comparison of the three focus groups. Overall, the frequency of going out annually for all purposes by TSS users is less than in the other two groups, but their use of taxis for going to the

hospital is significantly higher. This means that TSS users are mainly using taxis for securing the basic movements fundamental to the daily life experience.

The movement by taxi usage revealed another fact, i.e., that TSS users are using taxis for more diverse purposes compared to the other two groups, and with the aid of TSSs, the elderly tends to use taxis more frequently.

Even though TSS users place significant value on comfort and time flexibility when using taxis, and despite the fact that some amount of the taxi fee is subsidized, the reasons for avoiding the use of taxis (expensive fares and a feeling of unnecessary luxury) rate as high as in the other two groups. These are assumed to be the reasons for the low subsidy rates and limited number of usages.

In each group, more than 60% of respondents said that it is necessary to increase the TSS subsidy rate or expand the number target users. Nevertheless, from this research, it is found that under the appropriate level of public burden, an effective selection method for target persons, with the same amount of subsidy to the people needing the most, is more favorable. As we know that the frequency of the elderly going out for various purposes is relatively low compared to other members of society, simply securing fundamental outing purposes by providing additional ticket application procedures for the persons needing them the most is recommended.

Assuming that measures can be expand the subsidy through reducing the taxi fee by half and eliminate the upper limit on the number of usages, TSS users answered they will increase their annual taxi usage by approximately 14 times on average.

For taxi service in rural areas, regardless of the group type, all groups emphasize the roles of taxis in daily transportation, emergency transport, and mobility for disabled people. For maintaining the taxi service in rural areas, support from local government is strongly desired. As a measure for expansion of mobility support, it is conceivable to use the reservation-type shared taxi. Regardless of the group, nearly 50% of people say they will use this method

(depending on the subsidy rate).

As described above, it was clarified that TSSs have a certain effect on ensuring mobility for the elderly in depopulated areas. However, there is a strong desire to increase the subsidy rate and number of usages for those who are either unable to use private transport, or who are out of the circle of public transportation service. To improve the effectiveness of the subsidy ratio, it is possible to use a sharing method.

This study analyzed taxi services and TSSs from the user side, but it is necessary to analyze the opinions from taxi operators, and to understand the intentions of the local governments providing the subsidies.

Chapter 5
Examination of taxi subsidy scheme in depopulated areas based on local government survey

5.1 Overview

With the continues growth on the number of aging population in Japan, securing the mobility need for elderly living in depopulated areas has become a serious issue in our society. For this issue, various types of transport policies such as demand-type shared taxis and community buses are implementing and examining. Therefore, local governments in depopulated areas with the characteristics of little demand for public transportation and dispersed population place attention on individual transportation services with taxi for achieving door-to-door individual service. Taxi subsidy scheme is one of the solutions. The purpose of this study is to analyze the actual condition and issues about taxi subsidy scheme through questionnaire survey conducted to depopulated local governments in order to examine its sustainability.

In this Chapter, to analyze the current situation of TSS as a support policy for the mobility of elderly, we conducted two ways of survey to local governments like Website survey and Questionnaire survey. Based on the data acquired from these two surveys, TSS introduction status, annually distributed tickets and subsidy amount, as well as the problems were analyzed by population size and aging rate. Changes on subsidy amount and users before and after the corona pandemic is also analyzed.

5.2 Research background

Securing the mobility of elderly has been a top issue in recent 20 years since the deregulation policy on transportation is carried out and growth on aging population keeps increasing trend in Japan. Due to factors such as rapid declining on birthrate and increasing number on elderly also have negative impact on securing the number of drivers which is considered as one of the main issues in keeping the transport service sustainable in mountainous local

areas. there are businesses that have no choices but to abolish routes or reduce rides due to constant shortage on drivers.

High car-dependency are spreading globally recently. Looking at the car ownership in Japan, according to the survey in 2019 [28] it was 8.5% in urban areas and 16.9% in rural areas, that private car ownership in rural areas is higher than urban areas. at the same time, the number of fatal traffic accidents caused by drivers aged 75 or over rose by 13 from the previous year to 346 in 2021 by the statistics showed from National police agency. Moreover, because of the promotion of driving cessation of elderly people by returning their driving license voluntarily, there is still a strong need for public transportation to keep active life for elderly. Creating convenient, healthy and active living environment by environmentally friendly transportation with fully covering the needs of its citizens become a prior issue at present.

To build up such a harmonious and developed community, the related parties such as business provider, service user, government administration and local municipalities, etc. play a different vital roles. Among them, local municipalities play a central role in considering the ideal form of local public transportation which is suitable according to their own geographical, social and economic condition. It also plays collaboration role with related parties and demonstrating leadership. In particular, since it is necessary to improve the effective usage of regional public transport system, the local government will be requested to support the expenses required for efforts such as dissemination of information about public transportation service in order to make better collaboration between parties.

Just like it is well known that transportation has become an indispensable part of our daily life, a well-organized transport system not only means a “transportation tool”, but it also plays a huge role of motivating regional revitalization by reconnecting people and regions. For this reason, many municipalities are introducing different types of transportation policies into their region such as demand-ride sharing taxi, community buses, private paid

passenger transport system, and taxi subsidy scheme, etc.

5.3 Literature review and purpose of study

5.3.1 Existing research

In big cities, people usually rely on public transportation for daily outings. And various public transport tools such as bus, trains, and taxi are available to choose. However, in depopulated areas, for someone who doesn't have private transport tool to use freely, it is difficult for them to use these public transport tools, either. When traveling by train, it is necessary to travel to the station by bus, and the number of available bus is also few. A taxi is a convenient way to travel without private car, but the fare will be higher depending on the destination, which will become financial burden for elderly living in mountainous area. Traveling by family driving seems economical compared to other tools, but it makes you to request families spending time to transfer you. According to the study from Masao [29], which is conducted in Tomi village as one of the local governments with highest aging ratio in Okayama prefecture, there was only one round trip per day between each areas inside the village. Usually the elderly in this village uses mobile supermarket to buy the daily necessities, or their children visit them once a week for bringing them daily necessities. Elderly people usually have a need for regular hospital visiting, due to fewer welfare facilities just like having only internist clinic and dentist clinic, they must go outside of village for other treatments, which is considered that the living environment for elderly is not good enough.

Another research done by Chen [30] showed a proposal for improving traffic function for Onjuku town. Onjuku town was selected from the top 10 municipalities in Chiba prefecture with high aging rate. There is only one bus in every three hours, and there are few routes in the town, which is seen as inconvenient public transportation for daily life activities. According to the analyze of the survey report, sharing economy was seen as only solution due to insufficient public transportation system.

As for supporting measures for elderly living in rural areas, another study [31] by Akifumi conducted in Kameoka city in Kyoto prefecture shows that private paid transportation service organized by local governments and local non-profit organizations(NPOs) is permitted in mountainous public transport vacant areas as one of the mobility supporting measures. On the other hand, even in rural areas near cities, the daily movement depends on private cars, and if private cars are not available, the situation will be similar to mountainous areas like without public transportation. And this situation is thought to be linked to the reason that local governments may not be allowed to operate transportation service for fee.

5.3.2 Purpose of study

Achieving of securing the mobility need of elderly and keeping the service sustainable is often expected by local governments. However, in depopulated local areas, it is not always easy to achieve because of lots of challenges like burden on financial cost, shortage on drivers. In this study, taxi subsidy scheme (TSS) is being examined from depopulated local governments side.

As we know, taxi, which is an individual transportation service that can achieve door-to-door service, is expected to support the individual traveling patterns and last mile movement.

In this study, a website survey and questionnaire survey are conducted to depopulated local governments to investigate the implementation status and issues about TSS, as well as the impact of corona virus on TSS.

5.4 Survey method

In this study, two types of survey were conducted. They are government website survey and government questionnaire survey.

5.4.1 Government website survey

In this website survey, 817 local governments which is designated as

depopulated areas according to the list of depopulating areas, cities, towns, and villages by Ministry of Internal Affairs and Communications [32] were set as target sample.

The survey method was to search the following words on the homepages of depopulated local governments and extract the relevant data. The key words as followings: "Taxi Subsidy", "Taxi Assistance", "Taxi Ticket", "Taxi Elderly", "Welfare taxi", "Taxi Corona", "Taxi Vaccine".

The related data extracted by the website survey is as follows.

● Data on the conditions of the target person

1. Target age
2. Whether having driving license
3. Presence or absence of private car
4. Household tax status
5. Household structure

● Data on the number of tickets

6. Number of tickets distributed annually
7. Number of tickets distributed from the approved month to the end of the fiscal year

● Data on the amount of grant

8. Amount to be subsidized annually
9. Subsidy amount per ticket
10. Discount rate subsidized per ticket
11. Price when one ticket is equivalent to the basic charge

● Data about restriction

12. Only for use from home to the nearest facility, etc.
13. Limitation on usage area
14. Limitation about on/off boarding place
15. Limited taxi companies
16. The on/off boarding place is limited to inside the municipality
17. Limited destination or boarding area

5.4.2 Questionnaire survey to depopulated local governments

In this survey, a questionnaire survey was sent to the depopulated local governments (817 local governments conducted the website survey)in December 2021.

The purpose of study is to understand the intentions of local governments regarding taxi business and mobility support policy by TSS provided to elderly from its current status and examination status. In addition, we will investigate the impact and issues caused by the Corona disaster on TSS. The questionnaire content is divided into three big sections like questions to the government without introduction and with introduction and to all, which is shown in **Table 5.1.**

Table 5.1 Questionnaire survey content

Questions to local government without introduction of TSS	
Q1	Consideration for introduction of TSS
Q2	Possible issues for introducing the subsidy scheme
Questions to local government with introduction of TSS	
Q1	Achievements of TSS
Q2	Requests from users and parliaments to improve TSS
Q3	Examined items for system improving
Q4	Concerns/Issues
Q5	Expected improvements because of corona
Q6	Purpose when setting the target person for taxi subsidy
Q7	Contents considered when setting the maximum number of usage time and the subsidy amount
Questions for all local governments	
Q1	Opinion about TSS
Q2	Measures implemented as mobility support for the elderly during the corona disaster
Q3	About subsidizing taxi operators
1	Supporting policy in purchasing vehicles that are easy for the elderly to use
2	Supporting policy for improving convenience by IT reservation / dispatch system
3	Support for the introduction of fixed fare for areas and unlimited ride fare
4	Support for providing inexpensive transportation services by introducing private paid passenger transportation with the participation of taxi operators
5	Supporting guidance for management stabilization such as management integration of taxi operators
Q4	Opinions about taxi subsidy scheme and mobility support
1	A system (insurance, etc.) should be introduced to support the mobility of the elderly at the expense of the younger generation.
2	Taxi operators should diversify their businesses such as home delivery, food delivery, caring, and shopping.
3	Introduce transportation by private car / resident driving (Uber method, etc.)
4	Introduce a method to reduce taxi fare with public grant under the local public transportation plan
5	The development of self-driving cars is the key to solving mobility support.

5.5 Summary and analyze for the results

5.5.1 Results about TSS policy

(1)Comparison on introduction status

We searched the website of 817 municipalities designated as depopulated areas and confirmed the introduction status of TSS. As a result, it was confirmed in 161 of municipalities (19.7%).

Again, a questionnaire survey was sent to 817 municipalities nationwide designated as depopulated areas, and got response from 325 municipalities, the response rate was 39.8%. Among them, 211 municipalities have introduced the taxi subsidy scheme. According to the results of questionnaire survey, TSS implementing cases increased from 191 to 250 cases, number of implementing governments increased from 161 to 211, an increase of 50 governments was confirmed.

From the response, the TSS introduced municipalities were divided into three categories according to the population size and the proportion of elderly people aged 65 and over, which is shown in **Fig.5.1** and **Fig.5.2** respectively. It can be seen from the figures that the higher the population dispersion and aging ratio, the more the introduction of TSS is.

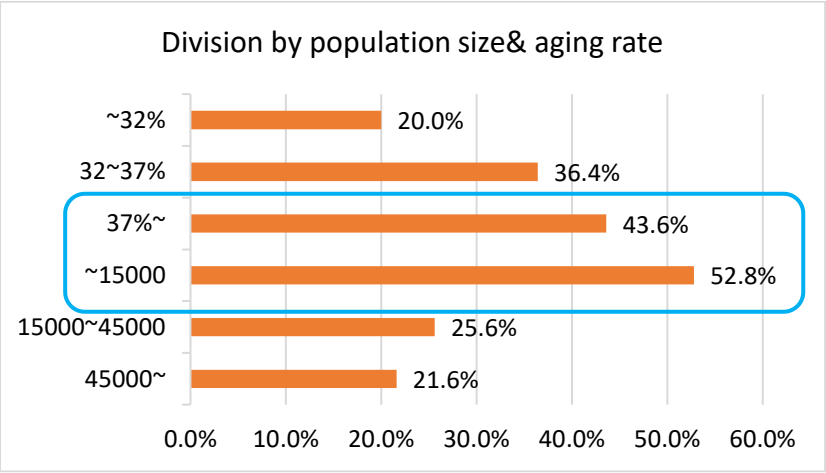


Fig.5.1 Division by population size

(2) Comparison on age limitation from two surveys

Fig.5.2 shows the target age limitation for TSS by population size and aging

ratio. In all categories, over 65 or over 75 years are the two main standards. In municipalities with a large population or higher aging ratio, the percentage of target ages being 75 years or older was high.

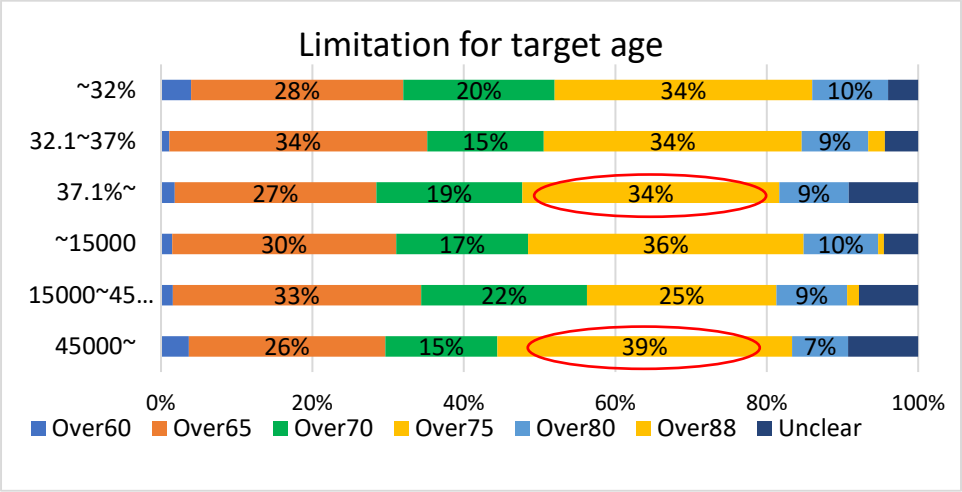


Fig.5.2 Limitation for target age

(3) Number of distributed ticket/subsidy amount

Through questionnaire survey, with investigation for number of distributed tickets and subsidy rate, we are able to get the unknown items which were occurred in website survey. Looking at the number of distributed ticket by population size and aging ratio, for municipalities with large population or small aging ratio, 24-30 tickets have the highest percentage. But for other groups, 32-50 tickets were the highest portion, which is shown in **Fig.5.3**.

Subsidy rate is different according to local municipalities, it was divided into several cases, such as fixed amount of subsidy per ticket, variable subsidy amount depending on conditions, subsidizing by usage fee ratio, and subsidy based on the user's burden. The system with subsidy amount of 50 to 300 Yen is the most common pattern, shown in **Fig.5.4**. From the relationship of these two mutual linked items, If the subsidy amount per ticket is high, the number of distributions tends to be small. On the contrary, if the subsidy amount is low, the number of distributions tends to be large.

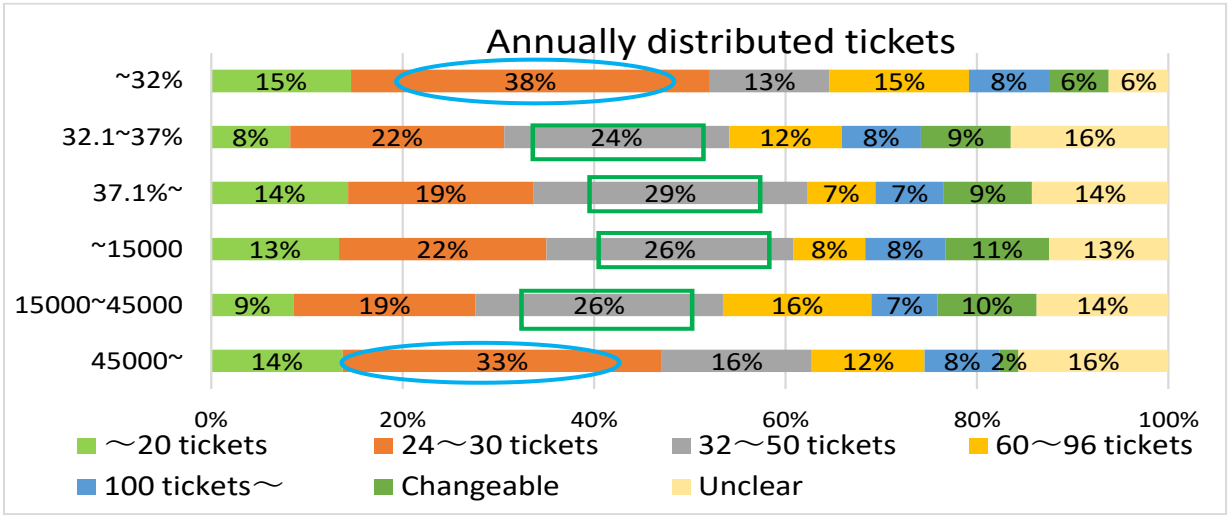


Fig.5.3 Annually distributed tickets

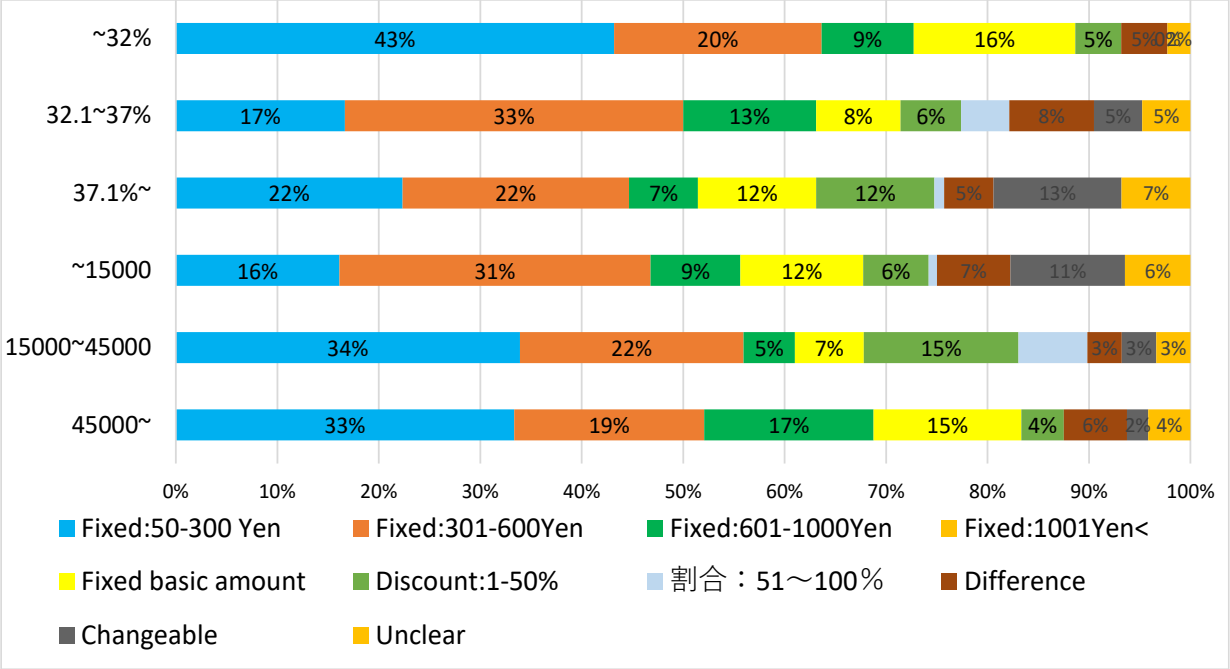


Fig.5.4 Distribution of subsidy amount

5.5.2 Opinions, problems about TSS and taxi operators

(1)Local municipalities` attitudes about taxi operators

As for supporting measures towards taxi operators shown in **Fig.5.5** , answers of “necessary in the future” and “no need” were the high ranked answers that almost accounted half and half.

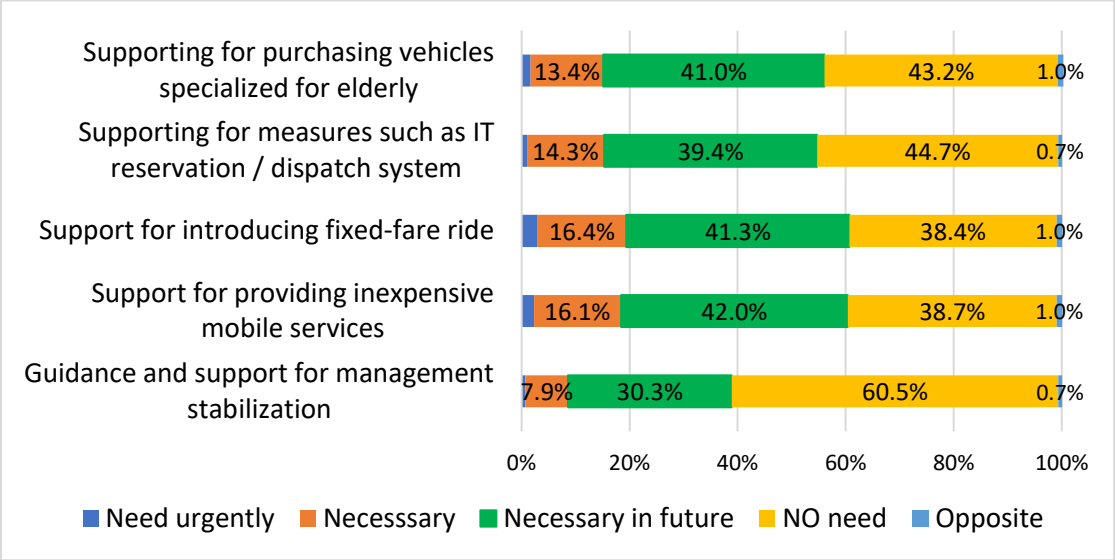


Fig.5.5 Local municipalities attitudes about taxi operators

(2) Problems on implementation of TSS

Securing the financial resources is the main problem for all municipalities with or without introduction of TSS. As another reason for municipalities not to introduce TSS is that they are supporting other types of services such as community buses, private paid passengers service, shared taxis and demand buses. On the other hand, in municipalities with small population, there were no taxi operators that they have no choice to implement this policy.

(3) Improvement plans under consideration

Surprisingly, most of the municipalities think current system is the best that about 60% of response was given to “not consider” whatever by population size or aging ratio.

5.5.3 Impact of corona crisis on TSS

(1) Changes on the number of users

Fig.5.6 shows the average number of people targeted in 2019 and 2020. The average number of users increased in all categories.

(2) Changes on total amount of subsidy before and after the corona disaster

Fig.5.7 shows the average amount of subsidy to TSS by 2019 and 2020. Since the average number of users was increasing, the subsidy amount was also expected to increase, but it only increased in the municipalities with large population. It seems even if the number of user is increased, the average amount of subsidy was decreased in order to collaborate with the refrain of going out policy.

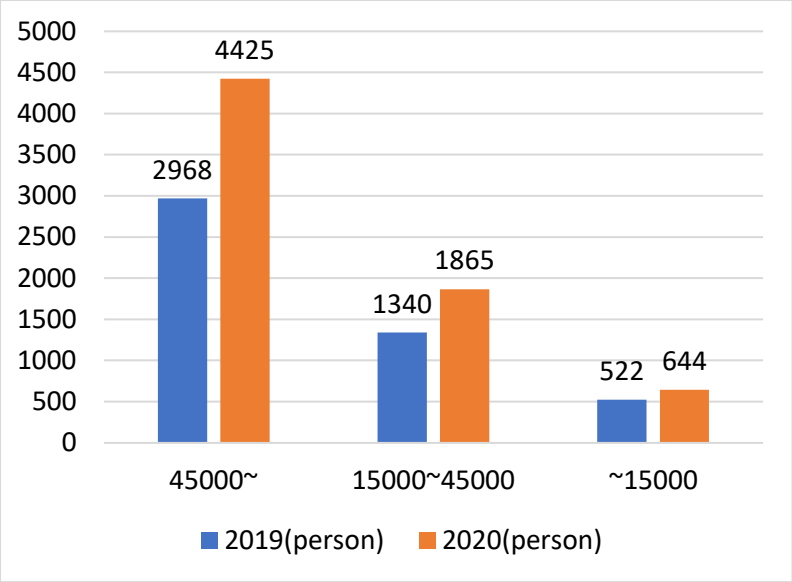


Fig.5.6 Average number of TSS users

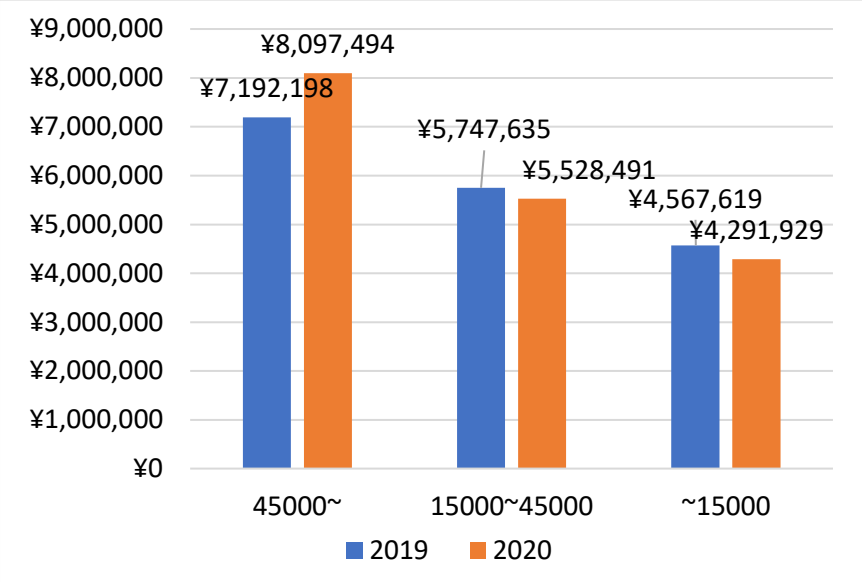


Fig.5.7 Average amount of subsidy

5.6 Conclusion

Purpose of this study is to clarify, through website survey and questionnaire survey, the actual situation and issues of depopulated local governments and taxi subsidy scheme as for the mobility of elderly.

5.6.1 Overall summary for the surveys

● Perspectives about taxi operators from local government

With the high response to the items like “Support for the introduction of flat-rate fare for areas and unlimited ride service” and “support for providing inexpensive mobility service”, it is not difficult to find out that local governments recognize taxi fares are high.

● Opinions on taxi subsidy scheme and mobility support

More than 65% of municipalities think that taxis are public transportation. In addition, more than 90% of municipalities think that "sustaining taxi operators is important" and "supporting the movement of elderly people is important as a welfare measure". On the other hand, a slightly higher percentage of response is given to the item that a system (insurance, etc.) should be introduced to support the mobility of the elderly at the expense of the younger generation, from which it is necessary to consider about the implementation of this idea.

5.6.2 Local governments with introduction of TSS

◆ As for the scheme contents, it includes those issued at the time of application for those who meet the conditions and those issued at the time of license return.

◆ From the most common request that local governments get from users like “increase the maximum number of usage time” and “increase on the target users”, it is clear that municipalities with small population want to increase

maximum usage time, contrary, municipalities with large population want to increase the number of target users.

However, after corona disaster, in municipalities with large population, request for increasing the maximum number of usage time is decreased, oppositely request for expansion on available area is increased. This trend is predicted by the influence of corona that people might want to go to the area by taxi where they previously used to go by public transportation.

◆ As for concerning issue, “securing budget by increasing users” was cited most often. To achieve the growth on taxi demand, local governments are required to provide flexible response. So, it is necessary to balance the demand and response by improving the policy system. As another reason, “low utilization ratio” is also pointed.

Since the data about taxi subsidy scheme from website survey is more than the questionnaire survey, it is considered that even the TSS is introduced on the website of the municipalities, but the residents awareness in real life is not sufficient. We believe that it is possible to increase the number of users and the utilization rate by focusing on disseminating the taxi subsidy scheme and responding to the demands of users. In addition, some local governments think that it is effective in increasing taxi demand due to business diversification, so such flexible measures will be necessary in the future.

Before the outbreak of coronavirus, there were many local governments with large population and low aging rate who have an increase in the number of people eligible for the subsidy system. However, more than half of the governments reported decrease on the total amount of subsidy and usage time after corona, so it is considered due to the influence of self-restraint for outing.

5.6.3 Local governments without introduction of TSS

Among them, about 40% of municipalities hold positive attitude towards taxi subsidy scheme. For municipalities with large population and higher aging rate,

the main concerns for this system were “difficulties in securing financial resources” and “difficulty in setting appropriate subsidy amount and subsidy rate”. On the other hand, for municipalities with small population and lower aging rate, “no available taxi operators” was the main difficulty.

It is necessary to improve the system not only by the local governments but also with the cooperation of national and prefectural governments with the aid of securing the financial resources as the support for the mobility of elderly.

In this study, we conducted a questionnaire survey to local governments about the situation of before and after the outbreak of coronavirus, we believe that further research is needed to meet the demand after the end of corona. It is also necessary to examine the usefulness of taxi business diversification and transportation insurance. Furthermore, we believe that conducting a survey of municipalities that implement taxi subsidies for non-elderly people will lead to the examination of future sustainability.

Chapter 6 Conclusion

In this chapter, we make conclusions about TSS policy through surveys done by three sides; taxi companies, elderly and local governments.

6.1 Results from Survey to Taxi Companies

According to the results of the survey of small and medium-sized taxi operators in depopulated areas based on the management situation and issues and expectations and requests for the taxi subsidy scheme, TSS has contributed considerably to business management. Additionally, many business operators wish to increase the number of usage time and people eligible for subsidies. The demand for expansion of TSS is the second highest after the COVID-19 preventive safety measures.

6.2 Results from Survey to Elderly

We analyzed the contribution of TSS to mobility of the elderly living in depopulated areas and investigated their intention to use carpooling, flat-rate taxi, and vehicle dispatch services through a web survey. It was found that TSS users use taxi for various purposes and are less likely to be influenced by high price compared with non-TSS users. There are high demands for increasing the maximum number of usage times and increasing discounts. In other words, it is suggested that the taxi subsidy system should be the "last public transportation" by narrowing down the target users and improving the service. For flat-rate service, if the price per service is reduced to 300 Yen, the purchase intention will increase considerably. The reservation-type carpooling system will be used by less than 50% of the people if it is cheap or without reservation. By flexibly setting the financial cost on the user according to their needs, combined usage of shared taxi service with TSS and an upgraded vehicle allocation system is suggested.

6.3 Results from Survey to Local Governments

TSS is widespread as a support for traffic vulnerable group and those who have returned their licenses, and the burden on residents is often not a large expense. There is a high demand for increasing the number of usage time, but the increase in the burden on public funds upon increasing the number of target users is a concern. Therefore, a balance between the budget and demand of users must be considered by developing a method for selecting the target persons and the appropriate subsidy amount (upper limit of the number of usage time) within the appropriate level of the burden on public funds. Even requests for increasing the usage time and number of target users are common among both business operators and taxi users. However, as is evident from the results of our survey, arbitrarily increasing the number of users is inefficient as it will only increase the financial burden on the government. Boosting usage efficiency by supporting the people really in need of transport is important because in certain areas with different sociodemographic background, some target users have a higher demand for outings, while some do not go out very often. Instead of increasing the usage time, setting an additional application procedure for tickets after the completion of distributed tickets is a better strategy.

6.4 Recommendations and Future Task

As mentioned above, the utilization of taxi subsidy tickets has certain advantages for all three stakeholders: the local government, taxi operators, and the elderly users. Promoting the expansion of TSS to those who need to be secured by an effectively designated selection system of target users is recommended as an improvement measure. Furthermore, individual transportation services have considerable costs; thus, it is impossible to provide services uniformly with subsidies, and acquiring social consensus is difficult as well. Therefore, it is essential to consider using it in combination with a shared system to reduce costs. Considering the provisions of Road

Transport Law, utilization for permission of sharing transport has a higher flexibility as it may be easier to position as a public transportation measure.

Furthermore, as a system to balance the burden and benefits, the direction of intergenerational cost burden such as “transportation insurance” is also considered an important policy. “Transportation insurance” means paying transportation insurance from a young age to secure mobility when at old age. In many local governments, the financial burden of public transportation is mostly within the range of several hundred yen to several thousand yen per capita per year. If the transportation insurance is done per day, the total amount will be several yen to several tens of yen, which can be acceptable as a slight burden. We would like to study the intention and feasibility of such measures as a future issue.

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