

# RESEARCH ON SELECTION OF MODE OF TRANSPORTATION IN WINTER AROUND LOCAL CORE CITIES OF HOKKAIDO

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## 1. Introduction

Hokkaido, located in the northern most part in Japan, is exposed to difficult winter weather conditions for one third of the year. Chronic traffic congestion and traffic accidents, the lowering level of traffic service, and various other winter road problems have developed.

With the restrictions on the activities of people who live in Hokkaido that arise from these winter transportation problems, hindering the functions of the city supporting daily life and inflicting social and economic losses, a solution to the problem is demanded.

This research was carried out with questionnaires to the people in local core city areas and local center city areas in Hokkaido who use a transportation system for commuting to work, school, or for shopping, in order to understand changes in people's choice of mode of transportation from autumn to winter and the required travel time. In addition we analyzed and compared these results with surveys done in Hokkaido's capital Sapporo, the results of which will be introduced.

From the results of the analysis, we examined how to develop a comprehensive winter transportation system, including public transportation, for the future.

## 2. Overview of City Areas

### 2.1 Profile of each city area

The Hakodate area (Hakodate City, Kamiiso Town, Ohno Town and Nanae Town) is situated at the southern end of Hokkaido and has a population of about 360,000. This area has been developed from early times as an important point of transportation. This is also a tourist city area with its international culture and a history as an international city. As public transportation, buses, streetcars and trains are in service.

The Kushiro area (Kushiro City, Kushiro Town and Shiranuka Town) is situated in the eastern part of Hokkaido and has a population of about 230,000. This area, which includes the Kushiro port, is the center of transportation in eastern Hokkaido. Embraced by Kushiro Shitsugen (Marshland) National Park, this city area coexists with nature. For public transportation, buses and trains are in service.

The Muroran area (Muroran City, Noboribetsu City and Date City) is situated in the southern part of central Hokkaido and has a population of about 200,000. With its naturally formed good port, this area contributes to the industrial development of Hokkaido as a base for distribution and the special steel industry. Also, this is a tourist city with one of the most famous hot spring resorts in Japan in it. For public transportation, buses and trains are in service.

Central Hokkaido area (Sapporo City, Otaru City, Ebetsu City, Chitose City, Eniwa City, Kitahiroshima City, Ishikari City, Tobetsu Town, Naganuma Town and Nanporo Town) is situated in the southwestern part of Hokkaido and has a population of about 2.4 million. In particular, Sapporo City is the capital of Hokkaido and is developing as the center of politics and economy for Hokkaido. For public transportation, buses, streetcars, subways and trains are in service.

## 2.2 Present state of each city area

As evidenced by the fact that the population of the Hakodate area decreased by 4% from 1986 to 1999, that of the Kushiro area decreased by 6% from 1987 to 1999 and that of Muroran decreased by 5% from 1990 to 1999, the overall population has been decreasing. At the same time, the decline in the birth rate and the graying of the population is accelerating. On the other hand, urbanization of suburban areas and construction of large-scale commercial facilities in the outskirts are furthering decline and hollowing out the central city district. Although the trends of low birth rate and aging population are observed in the central Hokkaido area, too, its population is increasing by absorbing the population of other areas in Hokkaido.

## 2.3 Climate of each city area

Sapporo easily tops other snowy cities in the world both in terms of population and accumulated snowfall. Among other three city areas, the Hakodate area has the largest amount of accumulated snowfall.

Temperature generally goes down below zero during 3 months in winter in all areas. The Kushiro area, in particular, has an extremely cold climate.

As for precipitation, Sapporo has a small amount of rainfall in spring while other areas have much precipitation in summer and less precipitation in winter.

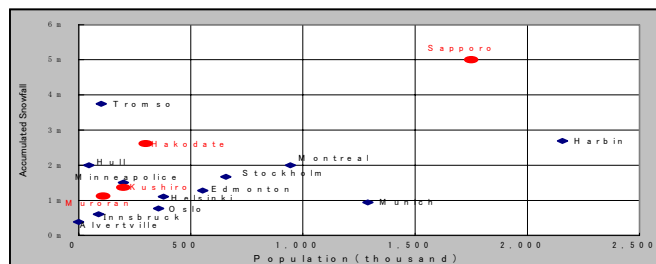


Fig.1: Comparison among Snowy Cities in the World

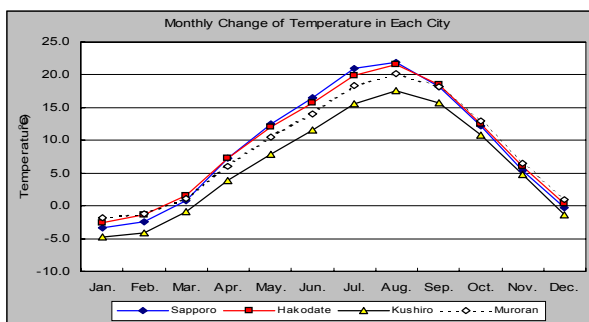


Fig.2: Monthly Change of Temperature(°C)

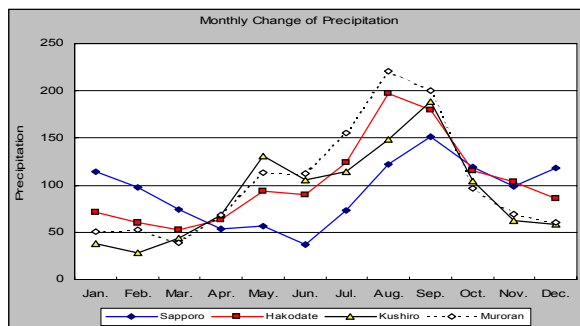


Fig.3: Monthly Change of Precipitation(mm)

### 3. Urban transportation in recent years

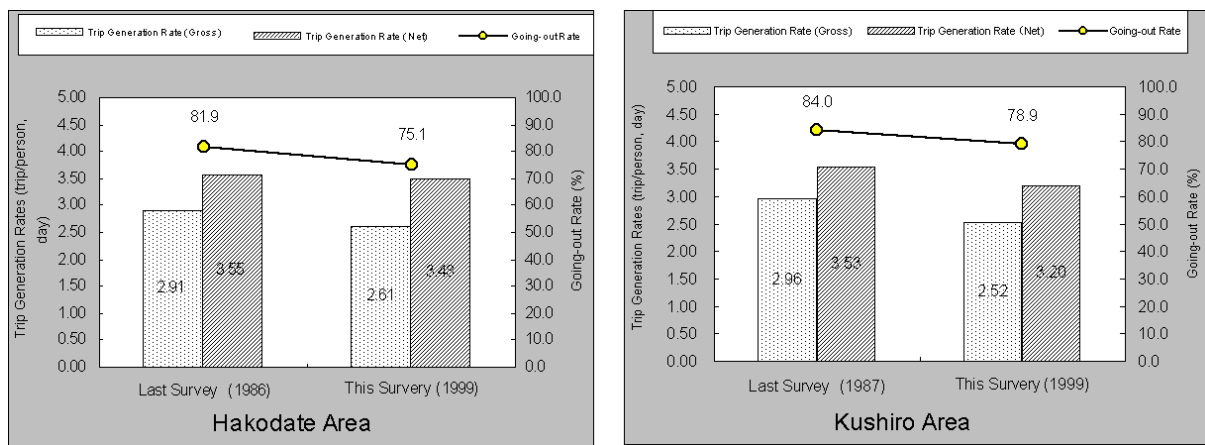
#### 3.1 Actual situation survey in 1999

Among the 3 city areas in which we conducted a questionnaire by home visit, we will report on the analysis results of the situation in the Hakodate and Kushiro areas. The Muroran area was omitted because it is impossible to compare the result of the survey this time with the last one conducted only about the automobile.

This survey was conducted for the purpose of knowing the daily behavior of people living in each area. Questions were asked about the kind of people (sex, age, occupation, etc.) who make trips, places of departure and arrival, the purpose of the trips (going to work or school, shopping, on business, etc.), means of transportation (train, streetcar, bus, automobile, bike+motorbike, on foot, etc.) and the time they traveled. This survey enables us to comprehend various traffic phenomena in city areas and provides us with basic data for future planning of urban transportation.

#### ○ Change in trip generation rates (average number of trips) and going-out rate

Trips generated per day decreased from the last time survey both in terms of gross rate (trips per person including those who did not go out) and net rate (trips per person who went out). The going-out rate also declined. It means that the frequency of each person's going out is decreasing, showing that the people's mobility in all city areas is declining as the population of each city area is on the decline.

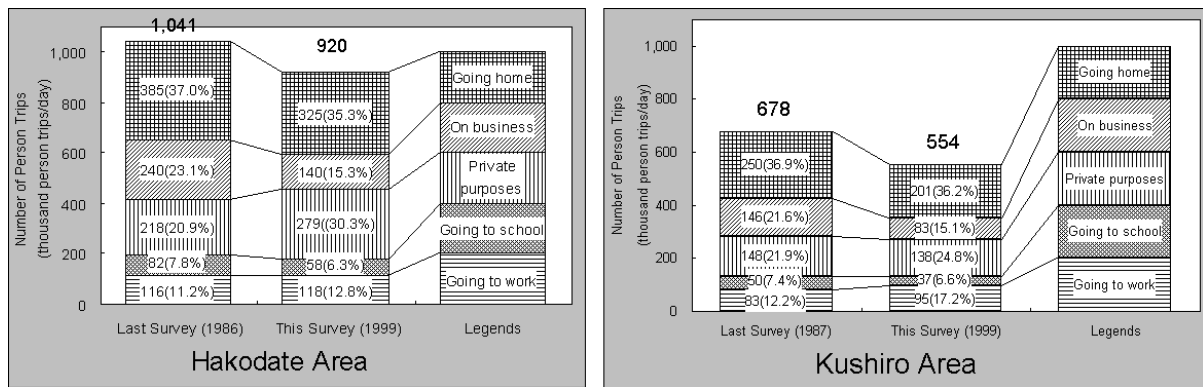


**Fig.4: Changes in Trip Generation Rates and Going-out Rate**

#### ○ Change in number of trips by purpose

The percentage of trips for going to work or school and going home remains almost unchanged, while the percentage of trips for private purposes increased and that for business purposes decreased substantially.

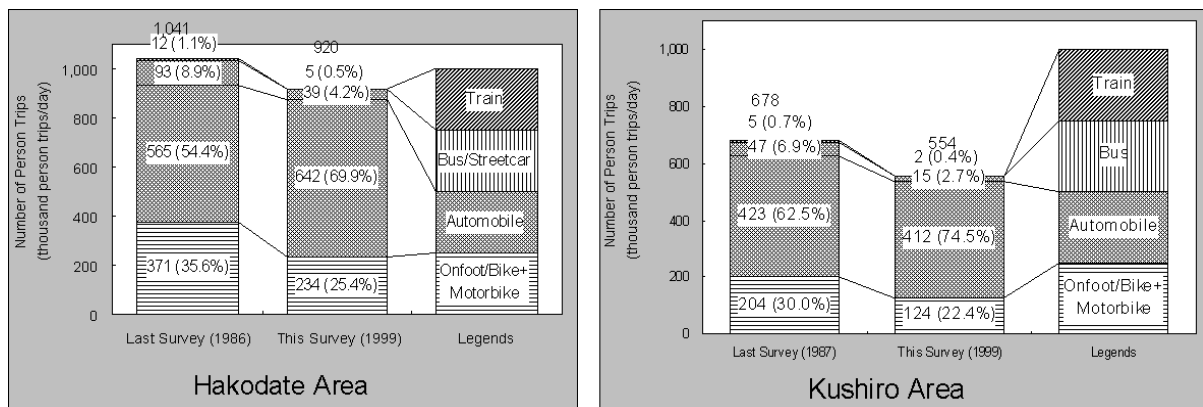
The increase of trips for private purposes is supposed to be the result of increased leisure time and activated mobility of elderly people. The decrease of trips for business purposes may be attributable to advancement of information technology and changes in retailing methods.



**Fig.5: Change in Number of Trips by Purpose**

○ Change in number of trips by means of transportation

The percentage of trips by automobile increased while that of trips by public transportation (bus, streetcar and train) decreased substantially. The fact that the percentage of trips by automobile increased in spite of the decline in people's mobility in all city areas evidences people's reliance on automobile as a means of transportation.



**Fig.6: Change in Number of Trips by Means of Transportation**

#### 4. State of Transportation in Autumn and Winter

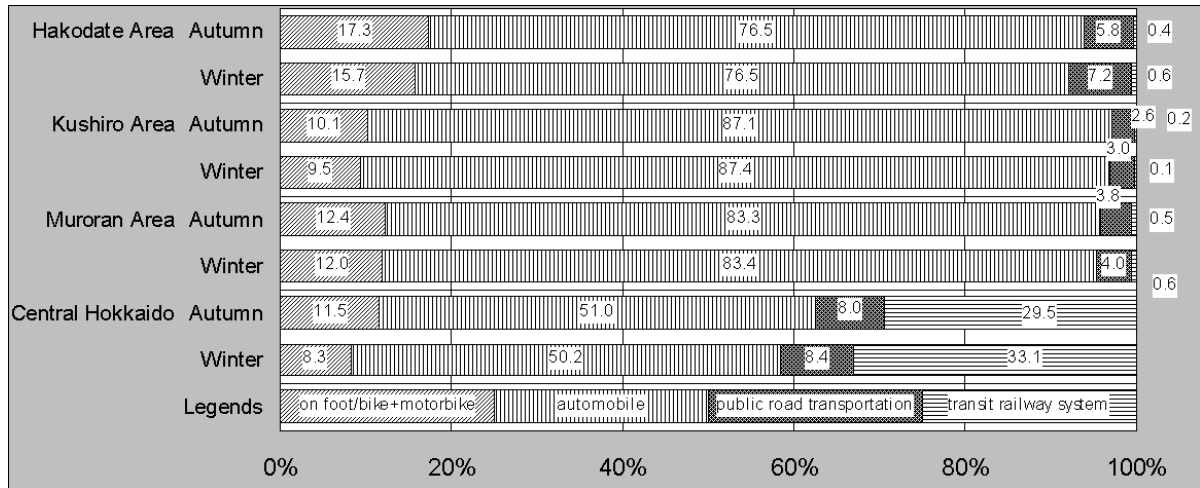
##### 4.1 Result of winter transportation survey in 1999

We will conduct a comparative analysis using the result of the survey conducted in the 3 city areas (Hakodate, Kushiro and Muroran areas) in 1999 and the result of the survey on winter transportation (only for commuting purpose) in the central Hokkaido area in 1994.

For the 3 city areas, we set the items concerning people's behavior in autumn and winter related to trips for commuting, going to school and shopping in the questionnaire we conducted by home visit. For the central Hokkaido area, we selected those who commute among the respondents of the questionnaire conducted by home visit in autumn, and later sent out questionnaires to them concerning their trips in winter.

○ Change in the choice of means of transportation (share by facilities) (for commuting purpose)

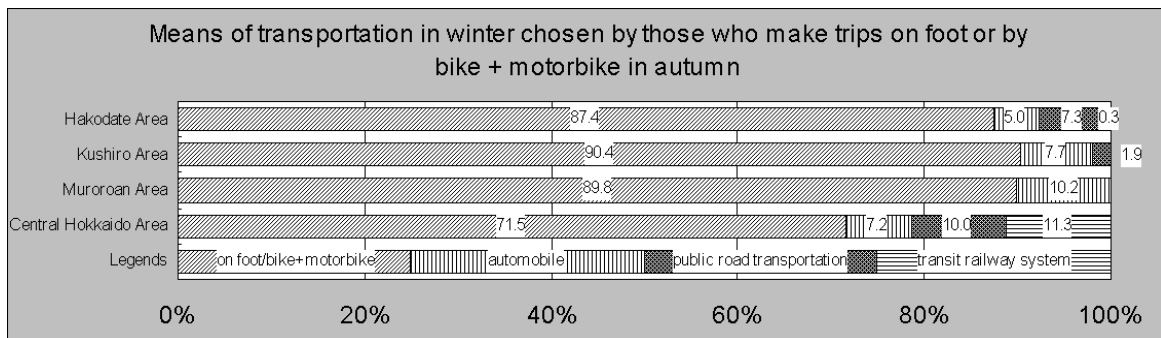
Shares of transportation facilities show little difference between autumn and winter. In each city area, the percentage of trips on foot and by bike + motorbike decreases in winter and that of trips by public transportation increases. This switch of means of transportation occurs at a higher rate especially in the central Hokkaido and Hakodate areas where public transportation other than buses are in service. There is little change in the percentage of trips by automobile in every area. The railway service in the central Hokkaido areas includes subways.

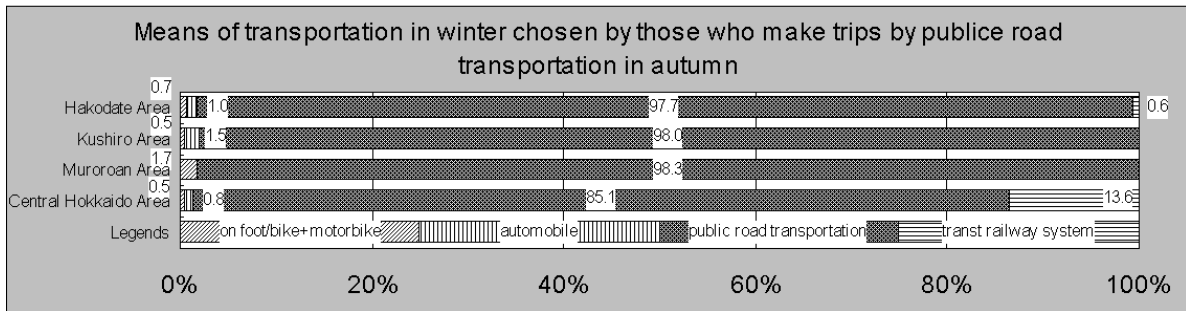
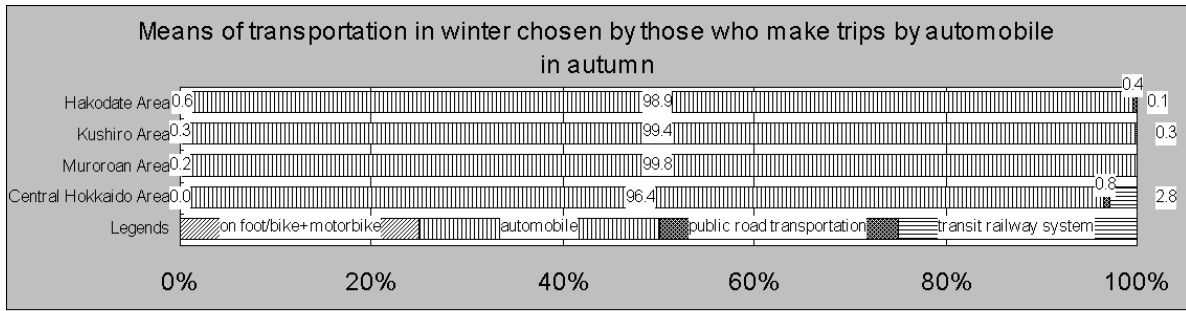


**Fig.7: Change in Shares of Transportation Facilities**

○ Changeover of means of transportation (for commuting purpose)

More people who make trips on foot or by bike + motorbike in autumn switch to public transportation in the central Hokkaido and Hakodate areas than other areas, while more such people switch to automobile in the Kushiro and Muroran areas. Those using automobiles and public transportation (bus and streetcar) in autumn rarely switch to other means of transportation, although some switch to the railways in the central Hokkaido area.

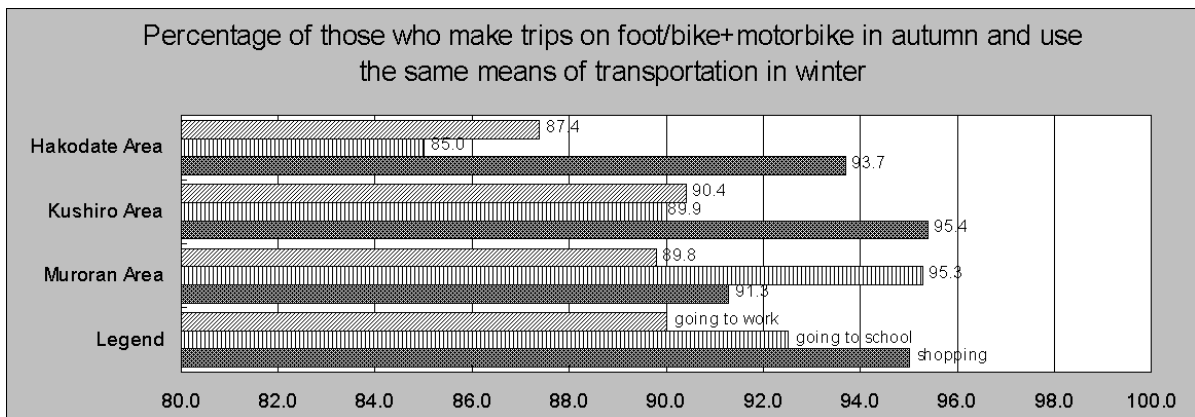


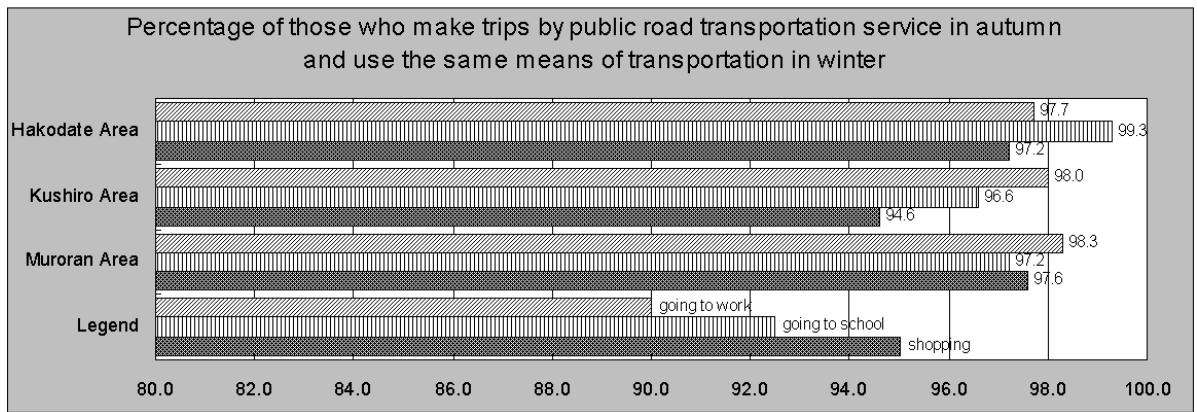
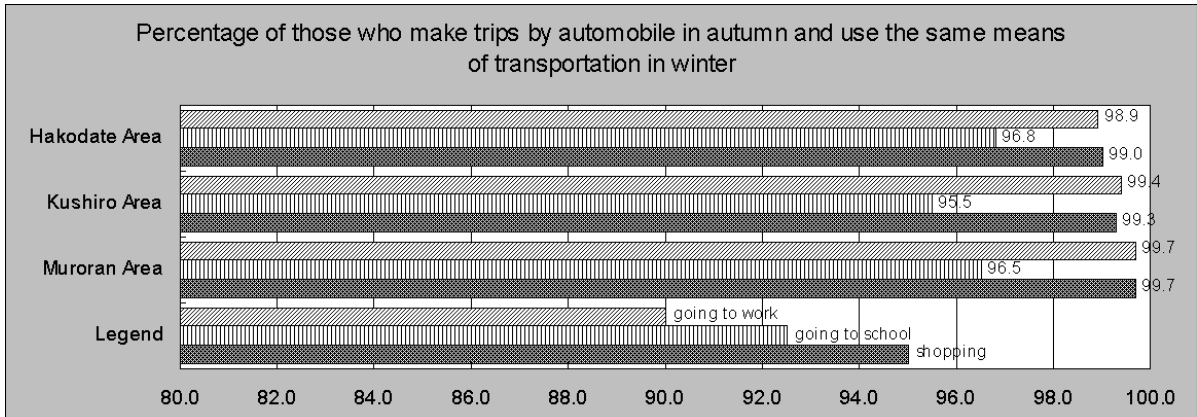


**Fig.8: Means of Transportation in Winter Chosen by Users of Each Means in Autumn**

○ Changeover of means of transportation by purpose (commuting, going to school and shopping)

Those who go shopping on foot or by bike + motorbike in autumn rarely switch to other means of transportation in winter in the Hakodate and Kushiro areas where the changeover rate for the purpose of going school is the highest. On the other hand, in the Muroran area, changeover of means of transportation rarely occurs in trips for going to school whereas a larger number of people switch to other means for the purpose of shopping. With respect to trips by automobile, changeover of means of transportation occurs in trips for going to school at the highest rate and rarely occurs for shopping purposes in the 3 city areas. As for trips by public road transportation, the rate of changeover of means of transportation for going to school in the Hakodate area is notably low and that for shopping purposes is notably high in the Kushiro area.



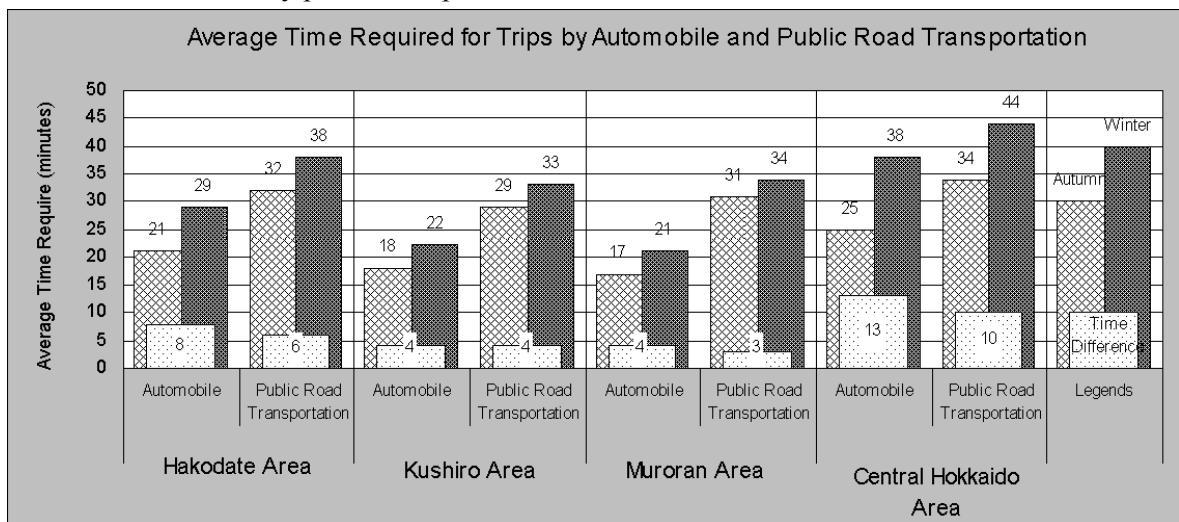


**Fig.9: Changeover of Means of Transportation by Means and Purpose**

○ Change in the average time required for trips by means of transportation (for commuting purpose)

In all areas, more time is required for trips by automobile and public road transportation in winter.

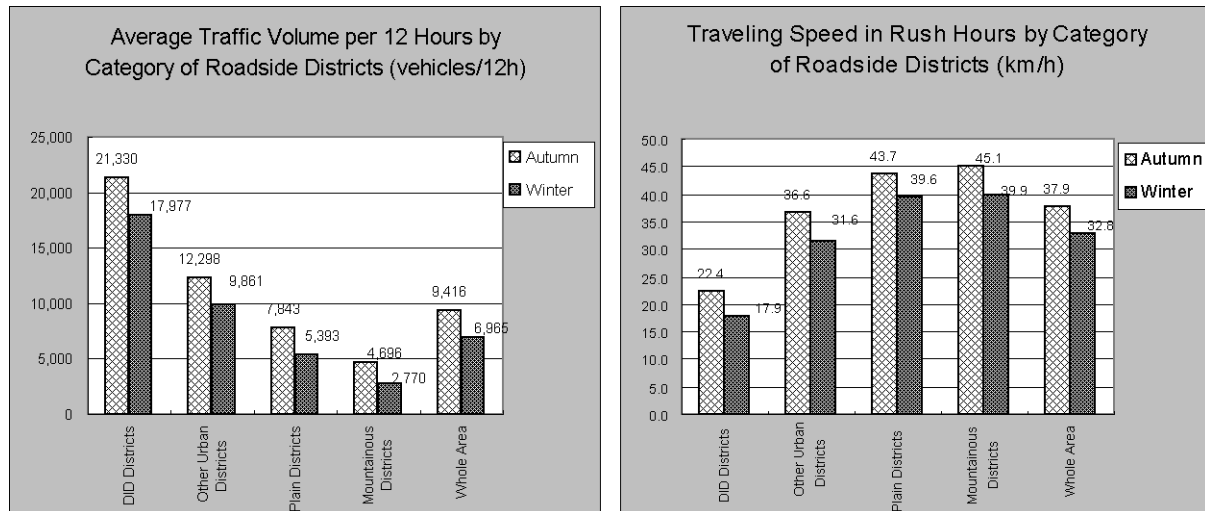
The difference between autumn and winter in the average time required for trips in the Kushiro and Muroran areas is within 5 minutes both for trips by automobile and public road transportation. In the Hakodate area, it takes almost 10 minutes longer in winter and more than 10 minutes longer in the central Hokkaido area. The delay in trips by automobile in winter is 2-3 minutes more than that by public transportation.



**Fig.10: Average Time Require for Trips**

○ Change in the volume of automobile traffic

According to the survey on the volume of automobile traffic in Hokkaido in 1999, the volume of traffic decreases in winter by 16% in DID (densely inhabited districts) and by 26% in the entire of Hokkaido. The average traveling speed in rush hours falls in winter by 20% in DID and by 13% in entire Hokkaido. For all the efforts to improve road traffic service in winter, winter road conditions in Hokkaido are never the same as in autumn, as indicated by the decline in the volume of traffic and traveling speed. It is obvious that great restrictions are placed on the range of trip and other elements by the increase of the time required for each trip and other factors.



**Fig.11: Change in Volume of Automobile Traffic and Traveling Speed**

#### 4.2 Summary of changeover of means of transportation in autumn and winter

In the Kushiro and Muroran areas, changeover of the means of transportation from the one used in autumn to another in winter does not happen so much. This is because there is little difference between autumn and winter in terms of time required for trips both in the trips by automobile and public road transportation, resulting in the lack of motivation for changeover.

In the Hakodate area, a small number of people switch from trips on foot, by bike + motorbike or by automobile in autumn to trips by public road transportation in winter. In the central Hokkaido area, the same kind of changeover occurs in a larger number of cases. This is because the delay in public road transportation is less than the transportation by automobile. Another point common to these 2 areas is that both areas have other urban transport systems than buses and trains.

### 5. City planning considering transportation in winter

#### 5.1 Present state of local cities

In all city areas, with the increase of automobiles owned by citizens and the number of citizens who have driver's licenses, the automobile has the largest share as the means of transportation. As a result, chronic traffic congestion in winter when snow falls has become a source of concern. On the contrary, passengers of public transportation are decreasing, especially in the case of bus service



whose passengers decreased by half in these 10 years, putting in question whether public transportation services can continue to be operated.

In local cities in Hokkaido, except for Hakodate which has a streetcar, buses play the central role in public transportation. Entering into and withdrawal from bus business will be liberalized in 2002 when the demand-supply adjustment regulation (licensing system for starting business and fare approval system) concerning buses on regular routes is scheduled to be abolished. Free competition may lead to improvement of convenience and efficiency of the service. On the other hand, there is a fear that streamlining of bus routes might be promoted.

Although passengers of public transportation are decreasing, there still exist children and elderly people who have no alternative for public transportation. For these people, buses on regular routes are an indispensable means of transportation. After the withdrawal of private bus companies as a result of deregulation, local governments are expected to take responsibility for securing public transportation.

City planning in the past, which aimed at developing inexpensive and good residential areas in suburbs in order to meet the demand for housing increased with the growth in population, resulted in urban sprawling. In local cities today, the central district becomes exhausted and urban districts in suburbs are also sparsely populated. For the future, further decline in population is expected.

If the central district of a city that decides the first impression of the city is depressed, the city would lose its core and even its existence would be endangered. A city with low population density is inefficient in improving and maintaining its urban facilities. This is one factor causing financial difficulties of local governments.

## **5.2 City planning for the future**

The result of the survey this time shows that there is little difference between autumn and winter in people's choice of means of transportation. However, considering that trips in winter takes longer time than in autumn, it does not mean that people are satisfied with the means of transportation they chose in winter.

If more people switch their mean of transportation from automobile in autumn to public transportation in winter, the volume of automobile traffic would decrease, thus traffic congestion would be eased and traveling speed would increase. Consequently, smoother bus service could be provided and the standard of transportation service in winter would be improved. However, in the present circumstances, there is little difference between automobile and public transportation in terms of increase in the traveling time in winter and there is no merit of switching means of transportation. We suppose this is the reason why changeover of means of transportation does not occur so much.

Based on the survey, we suppose that if each city area has a transit railway system like the central Hokkaido area, changeover of means of transportation in winter would be promoted. However, given that it is difficult for a city area with a population of less than 500,000 to maintain transit railway system, the practical way of maintaining public transportation is to improve the efficiency of bus service to the level comparable with transit railway system.

One example is to designate one lane on arterial roads as the exclusive bus lane and to systematically control the operation of bus service by special traffic lights for bus. If these drastic measures are taken, smooth urban transportation in winter with little loss of time will be realized.

Especially in snowy and cold regions like Hokkaido, traffic congestion in winter caused by frozen road condition called “mirror bahn” is a serious problem. Punctual transportation can be a strong weapon for facilitating changeover of means of transportation. In addition, by encouraging people to live in the districts along the lines of urban transportation service through land use planning, a highly-efficient city will be realized.

In winter, due to low temperature and snow fall, the distance that people are willing to walk without feeling any difficulty is shortened and the use of the bike + motorbike is impossible. Therefore, how to secure walking space in cold and snowy regions is an important issue to be considered in city planning. Underground shopping centers and underpasses in Sapporo and snow flowing gutters in Asahikawa are effective for this purpose. However, it is difficult for all cities to construct such facilities. In the central district of a local city, it would be effective to build arcades and install road-heating systems in order to secure space for pedestrians in winter while encouraging elderly citizens to live in the central district.

Faced with a decline in the birthrate and a graying society, now is the time to proceed city planning placing emphasis on public transportation services, though the situation varies depending on the size of the city area. Especially in Hokkaido where a lot of expenses are required for securing urban transportation in winter, cost-effective city planning should be promoted from this stage in order to maintain public transportation services. It is expected that each local government will take the initiative in presenting a clear picture of the basic public transportation system of the city and promoting land use in line with it for the ultimate purpose of redeveloping the city into a well-organized and compact city.

### **5.3 Conclusion**

In this survey conducted in the areas with less snowfall than other areas in Hokkaido, there was no distinctive difference between autumn and winter in people’s choice of means of transportation. If the same survey were conducted in the northern Hokkaido area where they have extremely cold winter and much snowfall, the result might be quite different. For the future, we will continue our research on urban transportation and city planning that can benefit people’s life in cold and snowy regions through surveys and analysis of city areas of different climate and population.