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### Title

Post-Occupancy Evaluation Affected by Seasons: A Case Study of Waterfront Green Belt Along Yitong River in Changchun City

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## **Post-Occupancy Evaluation Affected by Seasons: A Case Study of Waterfront Green Belt Along Yitong River in Changchun City**

### **Abstract**

The vitality and user experience of outdoor public places in high latitudes often change drastically with the change of seasons. This survey carried out Post-Occupancy Evaluation for different seasons on the green belt along the Yitong River in Changchun City since the current one is for summer. Through a field and online survey, documented the special behavior of users in winter, the influence of the season on users of different ages, living distances, and limitations of the current infrastructure. Finally, the analysis drew the following conclusions, the season will affect the travel frequency of residents, especially those who live far away and relatively young. Seasons will also affect residents' evaluation of riverside infrastructure. There is a lack of pedestrian bridges. At present, there are more users in the southern section of Changchun on the Yitong River than in the northern section.

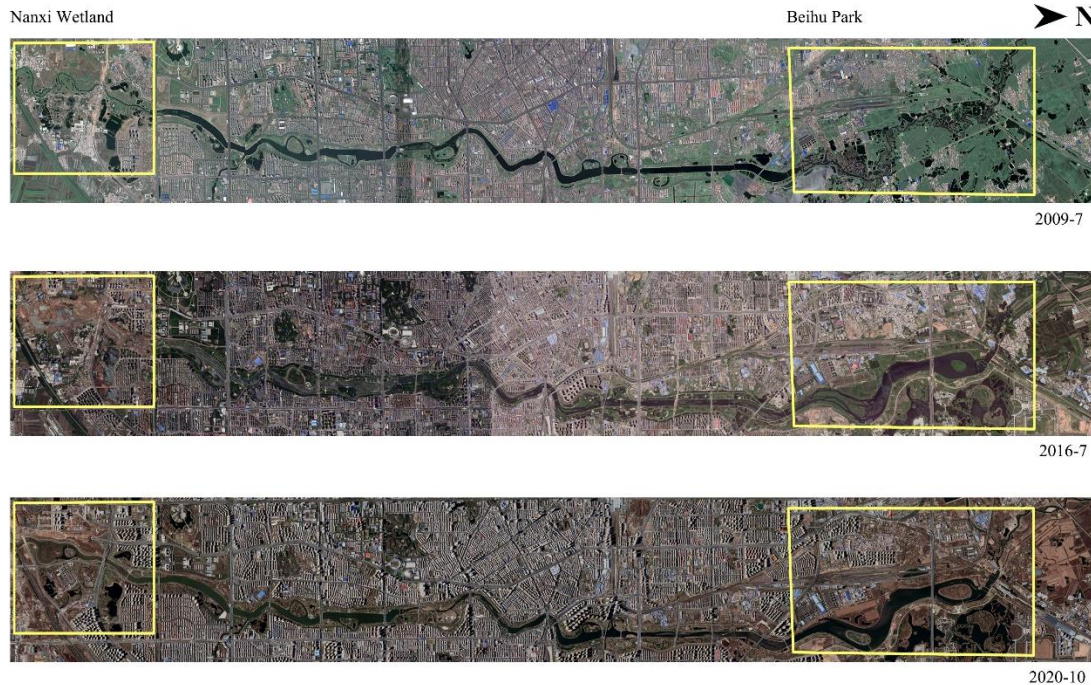
**Key Words:** Post-Occupancy Evaluation, Changchun, Yitong River, Seasons.

## **1. Introduction**

### **1.1 Yitong River background information**

Changchun (43°05'N~45°15'N, 124°18'E~127°05'E) is the capital city of Jilin Province in the northeast of China (Changchun Municipal People's Government, 2020). Yitong River is a secondary tributary of Songhua River and the largest river flowing through Changchun City (Baidu Encyclopedia). According to "Manchuria Geography", in 1868, the width of the middle section of the Yitong River was up to 327 meters, with dense forests along the banks. The water was limpid, and there were a lot of fish (Japanese General Staff Department, 1944). With the influx of people and rapid development, the river was polluted and the surrounding land was denuded of vegetation. The "Changchun County Records" of 1928 recorded that there was no forest left in Changchun and only a small number of trees in and around the city planted by the upper class for landscaping. (Yitongbang, 2019).

Since 1986, the Changchun Municipal Government has been committed to the ecological restoration and management of the Yitong River and its surroundings through the passing of bills and governance planning. In 2016, the Changchun Municipal Government started the Yitong River comprehensive treatment project, which is the largest scale, and the most thorough treatment project with the most investment in Changchun history. The overall treatment project was completed by the end of 2020. (Baidu Encyclopedia; Xinhua Net, 2018). Among them, Changchun Beihu Park was completed in 2014, and Nanxi Wetland was completed in 2017.



**Figure 1.** Historical comparison of satellite imagery of Yitong River in Changchun.<sup>1</sup>

### **1.2 Post-occupancy evaluation**

Post-occupancy evaluation (POE) is a systematic test of the effectiveness of the built environment after being occupied from the perspective of human users (Zimring, 1980). The scope includes a built environment that can accommodate people including urban designs, landscape designs, architectural designs, etc. Previous research on POE on the green belt along Yitong River mainly focused on the infrastructure during the summer period (Pan, 2017).

### **1.3 The impact of climate on cities in cold regions**

Cities in cold regions including Changchun are a special group of cities distributed in the northern hemisphere. Temperature, especially the severe cold in winter, will have an adverse effect on these cities (Liu, 1998). In such cities, the severe winter weather conditions will have a huge

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<sup>1</sup> Image source: Google Earth satellite imagery

impact on urban construction, which is also a challenge for designers. In many cities in cold regions of China, plans and designs currently do not fully consider the influence of the seasons, resulting in a large reduction in the use experience comparing with expectations of open public spaces during the long winter (Yuan & Guo, 2007). River is a typical example of how high latitudes and seasonal changes will impact the way people use the site and their experience (Xing, 2019; Wen, 2019). For example, a river is a natural obstruction to lateral passage in summer, but will become a natural linking corridor after the river is completely frozen in winter. Since reducing the difference in the utilization rate of open space in winter and summer while enhancing the vitality of open space in winter is an important issue for such cities (Yuan & Guo, 2007), the current study focuses on the how people use and evaluation of the green belt along the Yitong River in summer can't compare the difference between different seasons.

## **2. Methods**

### **2.1 Research process**

On the basis of reviewing relevant documents pertaining to river management in Changchun, other articles pertaining to the design of public spaces in the Yitong River or cold regions, and POE studies, this experiment mainly collected information from field and online questionnaires (The questionnaire is attached in appendices), then organized, summarized, and analyzed to get the final results and conclusions.

#### **2.1.1 Field questionnaires**

Fifty questionnaires were randomly released on-site, 17 respondents completed the questionnaire

between South Ring Road and South Fourth Ring Road Overpass, while 16 of them were between Jilin Road and Gongping Bridge, and 17 of them were between Changxin Bridge-Donghuancheng Road.

### 2.1.2 Online questionnaires

The author published the online questionnaire through the Questionnaire Star, and received a total of 405 valid questionnaires before the questionnaire was closed.

## 3. Results

### 3.1 Respondents' age distribution

The age distribution of the respondents was mainly 26-75 years old. Among them, 36-45-year-old respondents were the most.

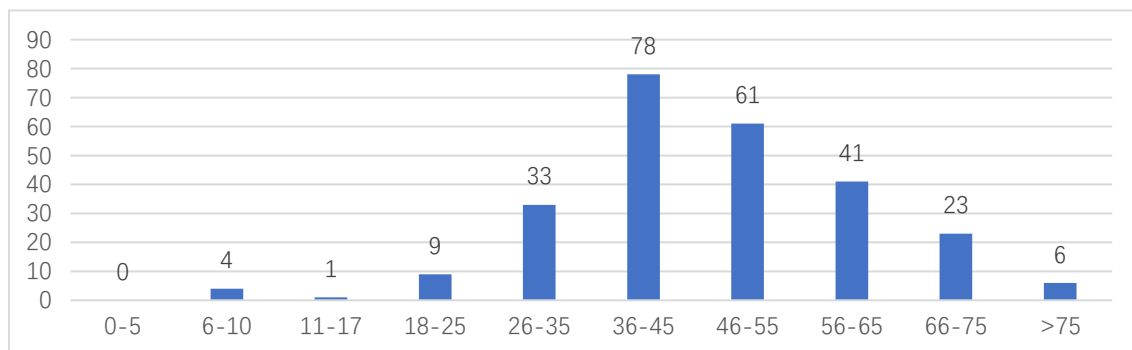
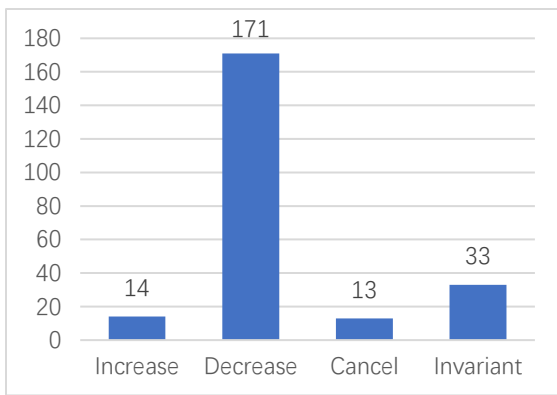


Figure 2. Age distribution of respondents.

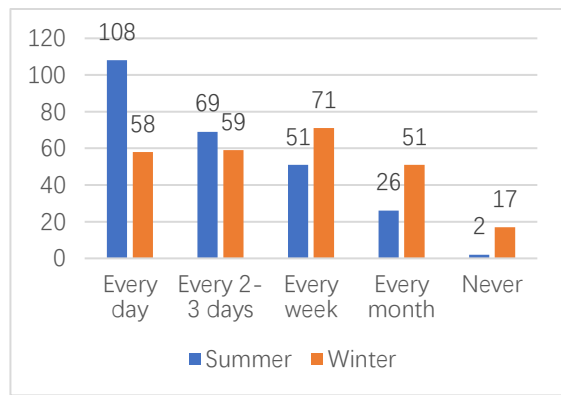
### 3.2 Frequency of trips to the green belt along Yitong River

Based on the questionnaire, the travel frequency of most respondents will decrease in winter (Figure 3). Compared with the frequency of people traveling in summer and winter, the number of people traveling every day has decreased the most, about half, and the number of people

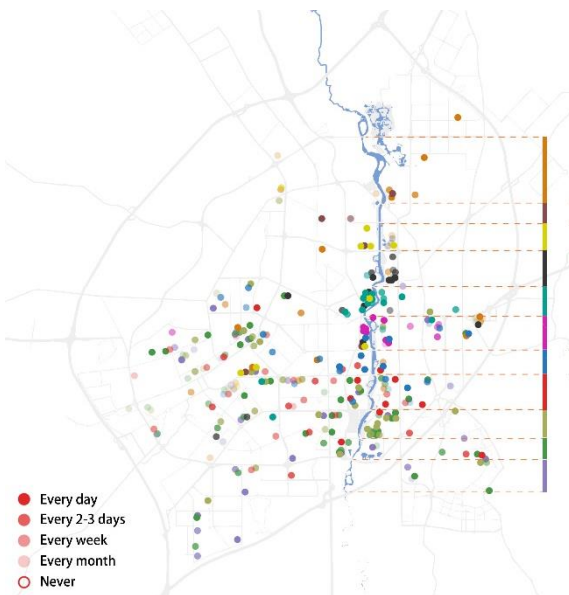
traveling monthly has doubled which was the one that increased the most (Figure 4). In Figure 5 and Figure 6, the position of the circle represents the address of the respondent, the color represents the river section that is frequently visited, and the shade of color represents the frequency of trips. Finally, we can find that respondents' residences were more distributed in the south of Changchun than in the north, and the travel frequency of people living farther away was more affected by the season.



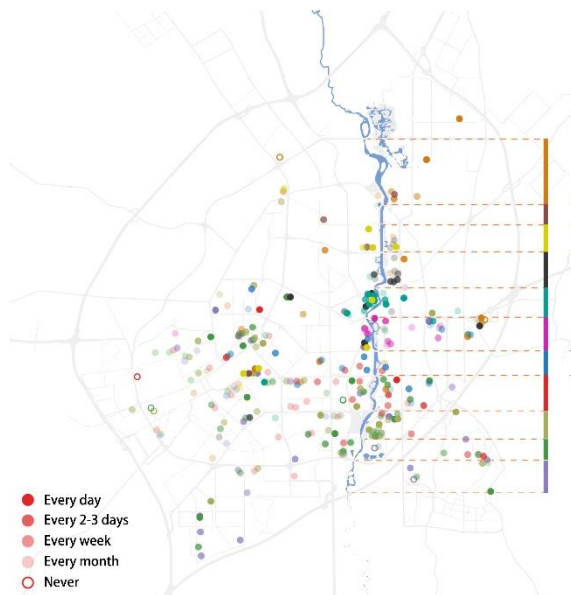
**Figure 3.** Changes in the frequency of respondents' travel in winter.



**Figure 4.** Frequency of respondents going to the green belt around Yitong River.



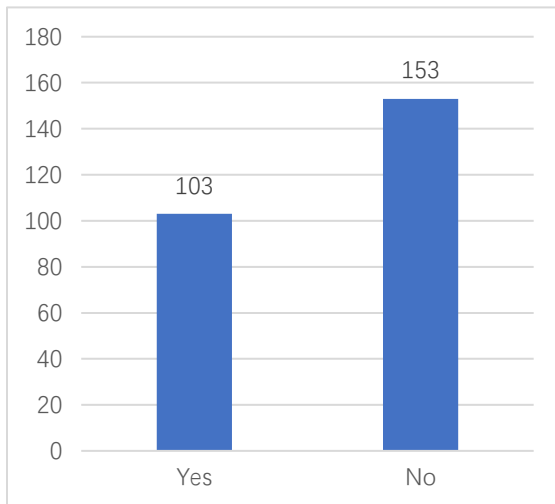
**Figure 5.** The distribution of respondents' residences and river sections they visit in summer.



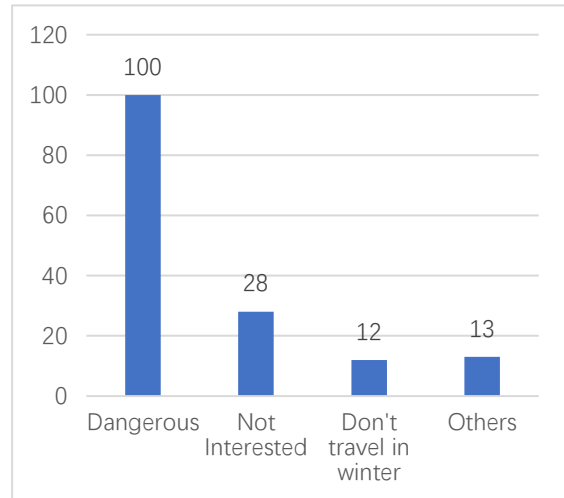
**Figure 6.** The distribution of respondents' residences and river sections they visit in winter.

### 3.3 Usage and evaluation in winter

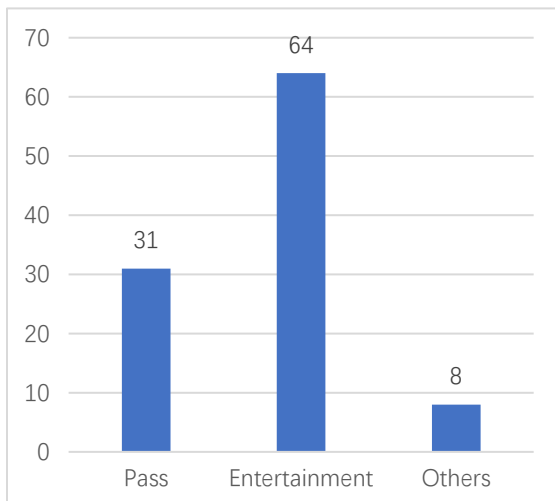
More than half of respondents indicated that they do not want to go on the frozen surface of the river in winter for safety concerns. For those who indicated that they are willing to walk to the river in winter, their activities are mainly entertainment and transportation. At the same time, most people believed that there is a lack of pedestrian bridges for pedestrians.



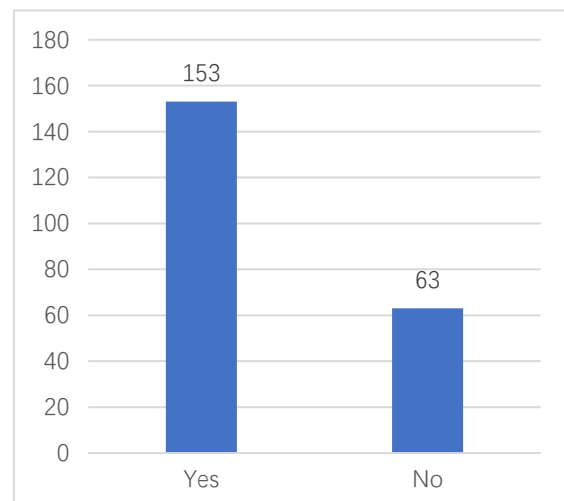
**Figure 7.** If the respondents will go on the surface of Yitong River in winter.



**Figure 8.** Respondents' reasons for not going to the surface of Yitong River in winter.



**Figure 9.** Activities that respondents would do on the surface of Yitong River in winter.



**Figure 10.** Respondents' thought about if there is a lack of pedestrian bridges.



Based on the result of the questionnaire distributed in the field and online, there were significant differences according to different seasons in the evaluation of different aspects below of the infrastructure along the Yitong River by users at the level of  $p < 0.01$ .

	Road smoothness & safety	Ease of walking	Comfortableness of walking across the river	Fitness facilities use comfort	Comfortableness of seats and other rest facilities	Comfortableness of barrier-free facilities	Ornamental Value of plants	Sanitation condition
Summer	7.7	7.7	6.92	6.76	6.64	6.67	7.36	7.06
Winter	7.21**	7.03**	6.67**	6.35**	6.42**	6.47**	6.27**	6.82**

\*  $p < 0.05$ , \*\*  $p < 0.01$

**Table 1.** Users' evaluation of infrastructure in the green belt along Yitong River.

## 4 Discussion

### 4.1 Respondents' age distribution

The age of the respondents is mainly middle-aged group, followed by the elderly group. The behavior patterns and experiences of different groups often change because of their physical functions and living arrangements. Therefore, to get more accurate and detailed analysis and conclusions, we need to have a certain survey coverage of different age groups and a cross-comparative analysis.

### 4.2 Frequency of trips to the green belt along Yitong River

As a city in a cold area, cold temperature in winter is still one of the important factors affecting people's travel in Changchun. According to the statistics of respondents' residential address and travel frequency in summer and winter (Figure 5 & 6), respondents who were living by the river have a relatively small decrease in travel frequency in winter, and the respondents' who were living far away were more affected by the seasons. Except for Beihu Park and Nanxi Wetland,

most of the respondents tend to go to the river section closest to their homes. Therefore, enhancing the attractiveness of the green belt along the Yitong River in winter can start with these two parks.

### **4.3 Usage and evaluation in winter**

From spring to autumn, when the water of the Yitong River melts, it becomes a natural barrier for passage. Although the river freezes in winter, it is actually not as free for people to walk as expected. Because river water is more dynamic than lakes, in the southern section of Changchun, part of the ice surface has melted due to man-made drainage. However, the surface of the melted river is frozen again due to the low temperature, which brings people an undetectable danger, and it is consistent with many people's perception - going to the surface of the river in winter is dangerous (Figure 11). The current bridges are basically vehicle bridges, which make it very uncomfortable for people to cross the bridges on foot even if there is a pedestrian passage next to it - people need to walk to the high bridge through many steps, and then go down to the plane through many steps after passing the bridge. Therefore, setting up pedestrian bridges in some places with high pedestrian demand can not only help meet people's walking demand throughout the whole year , but also avoid risks that people may face in winter.

In addition to knowing people's walking needs through questionnaires and other methods, a potential method is to judge the number of footprints across the river left on the river area in winter. But this can only be used as a dimensional reference, because it is difficult for us to judge the cause of the footprints. For example, even if there are a large number of footprints, they may

be left by the same person (Figure 12).



**Figure 11.** The surface of the river melted in winter.



**Figure 12.** Footprints on the surface of the river in winter.

## 5 Conclusions

- 1) Seasons will affect residents' travel frequency. Overall travel frequency in winter is lower than in summer.
- 2) Seasons have relatively stronger impact on the travel frequency of residents living farther away and younger residents.
- 3) Seasons will affect residents' evaluation of the riverside infrastructure. Overall, the evaluation in winter is significantly lower than in summer.
- 4) There is a lack of pedestrian bridges.
- 5) At present, there are more users in the southern section of Changchun on the Yitong River than in the northern section.

## 6 Insufficient and future work

There is a lack of statistical cross-analysis for some data. For example, the influence of seasons,

age and distance on residents' travel frequency, which may cause the results may lack certain accuracy in some aspects. Therefore, more data analysis is needed in the future.

The analysis of distance to residents' frequency to travel only considers the residential address of the residents, but does not consider other aspects of the activity circle, such as work address.

Therefore, to draw more accurate conclusions, we need to have a more detailed survey of the scope of the respondents' activities.

For the footprints across the river in winter, the records are not complete due to the multiple effects of snowfall on the original footprints and the melting of the river. In the future, it's possible to document more detailed records to determine potential locations that require more cross-river pedestrian bridges.

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## 8 Appendices

### 8.1 Field & Online Questionnaire

**1. What is your age?**

- A. 0-5 B. 6-10 C. 11-17 D. 18-25 E. 26-35 F. 36-45 G. 46-55 H. 56-65  
I. 66-75 J. >75

**2. Would you go to the park and the green belt along the Yitong River? (Single choice)**

- A. Yes (Go to question 4) B. No (Go to question 3)

**3. What is your reason for not going to the green belt Yitong River? (End)**

- A. Lack of time B. Too far C. Bad environmental and facilities D. Other \_\_\_\_\_

**4. Does your travel frequency change according to the seasons? (Single choice)**

- A. Yes (Go to question 3) B. No (Go to question 6)

**5. How will your frequency of travel change in winter? (Single choice)**

- A. Increase B. Decrease C. Cancel D. Constant

**6. How often do you travel in winter? (Single choice)**

- A. Everyday B. Every 2-3 days C. Every week D. Every month E. Never

**7. How often do you travel in summer? (Single choice)**

- A. Everyday B. Every 2-3 days C. Every week D. Every month E. Never

**8. What are the factors that affect the frequency of travel for you or your family?**

\_\_\_\_\_ (Fill in the blank)

**9. What is your working status? (Single choice)**

- A. Preschool B. Primary school C. Middle & high school D. University

E. Working      F. Unemployed      G. Retired

**10. Where is the river section you often go to? (Multiple choice)**

- A. Between Changchun Ring Expressway and South Fourth Ring Road
- B. Between South Ring Road and South Fourth Ring Road Overpass
- C. Between Weixing Road and South Ring Road
- E. Between Fanrong East Road and Satellite Road
- F. Between Nanhu Road and Fanrong East Road
- G. Between Ziyou Road and Nanhu Road
- H. Between Gongpin Bridge and Ziyou Bridge
- I. Between Jilin Road and Gongping Bridge
- J. Between Jilin Road (Changchun Bridge) and Rongguang Bridge
- K. Between Rongguang Bridge and Dongda Bridge
- L. Between Dongda Bridge and Yongning Bridge
- M. Between Yongning Bridge and Dongrong Bridge
- N. Between Dongrong Bridge and Changfa Bridge
- O. Between Changfa Bridge and Changxin Bridge
- P. Between Changxin Bridge-Donghuancheng Road
- Q. Between Sihua Bridge and Beihu Bridge

**11. When do you often go? (Multiple choice)**

- A. 1:00-3:00    B. 3:00-5:00    C. 5:00-7:00    D. 7:00-9:00    E. 9:00-11:00    F. 11:00-13:00
- G. 13:00-15:00    H. 15:00-17:00    I. 17:00-19:00    J. 19:00-21:00    K. 21:00-1:00



**12. The name of the community that you are living in currently?**

\_\_\_\_\_ (Fill in the blank)

**13. How do you go to the river in general? (Multiple choice)**

A. On foot    B. By bike    C. By Car    D. By Bus    E. Other \_\_\_\_\_

**14. Will you go to activities on the ice of the Yitong River in winter? (Single choice)**

A. Yes (Go to question 13)      B. No (Go to question 14)

**15. What activities do you do on the ice in winter? (Single choice) (Go to question 15)**

A. Pass by    B. Entertainment    C. Other \_\_\_\_\_

**16. What is your reason for not going to the ice in winter? (Single choice)**

A. Dangerous    B. Not interested    C. Other \_\_\_\_\_

**17. Do you usually need to walk across the river? (Single choice)**

A. Yes      B. No

**18. Do you think there is a lack of pedestrian bridges? (Single choice)**

A. Yes      B. No

**19. Please rate the following aspects during summer from 0-10 (uncomfortable-comfortable)**

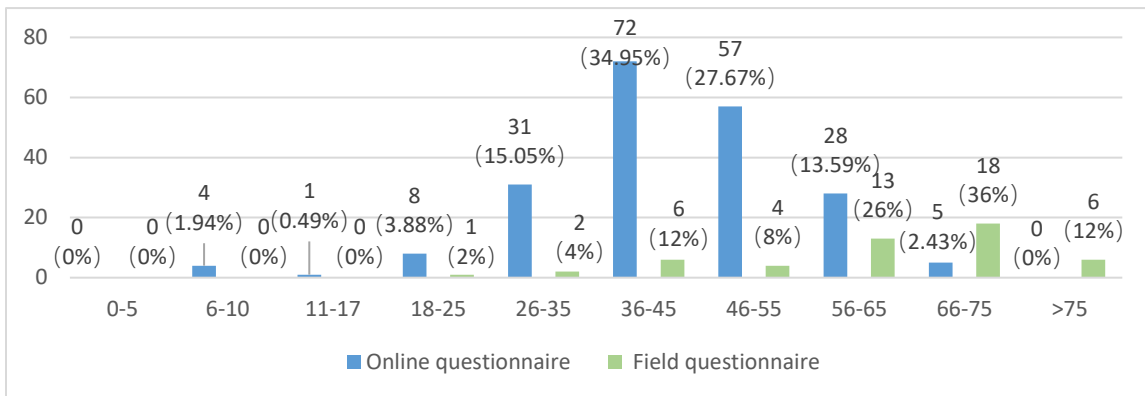
Road smoothness & safety	Ease of walking	Comfortableness of walking across the river	Fitness facilities use comfort	Comfortableness of seats and other rest facilities	Comfortableness of barrier-free facilities	Ornamental Value of plants	Sanitation condition

**20. Please rate the following aspects during winter from 0-10 (uncomfortable-comfortable)**

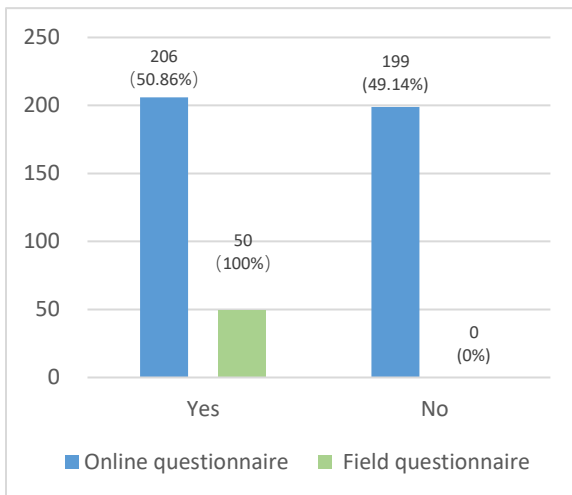
Road smoothness & safety	Ease of walking	Comfortableness of walking across the river	Fitness facilities use comfort	Comfortableness of seats and other rest facilities	Comfortableness of barrier-free facilities	Ornamental Value of plants	Sanitation condition

**(End)**

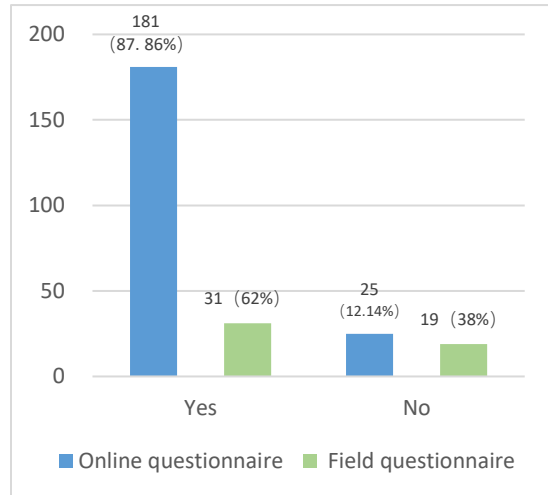
## 8.2 Other result figures from the questionnaire



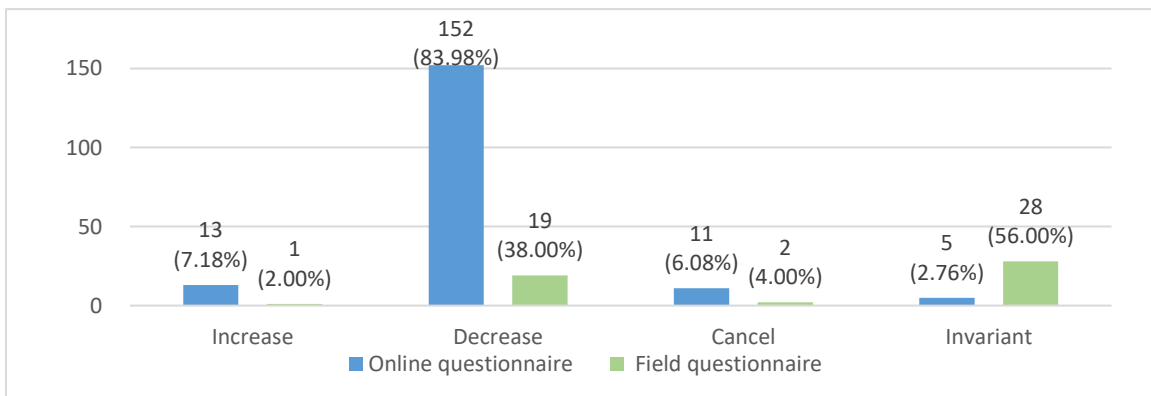
**Figure 13.** Age distribution of respondents.



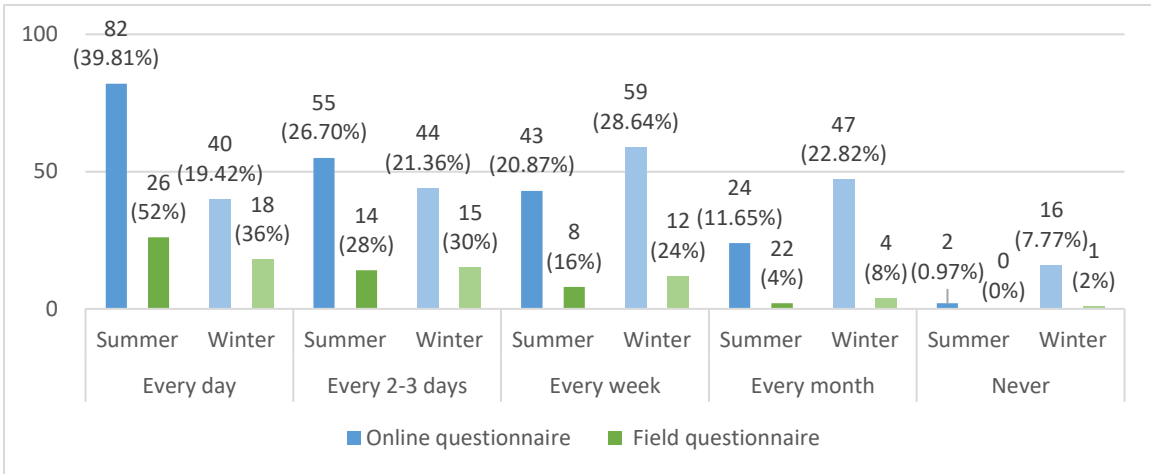
**Figure 14.** If the respondents will go to the green belt along the Yitong River.



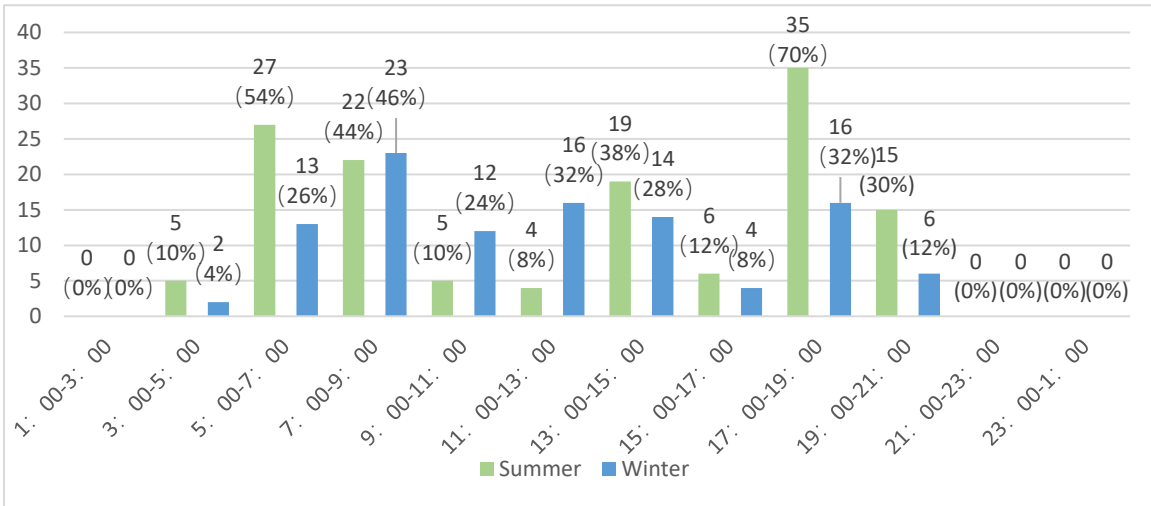
**Figure 15.** If the travel frequency will change according to different seasons.



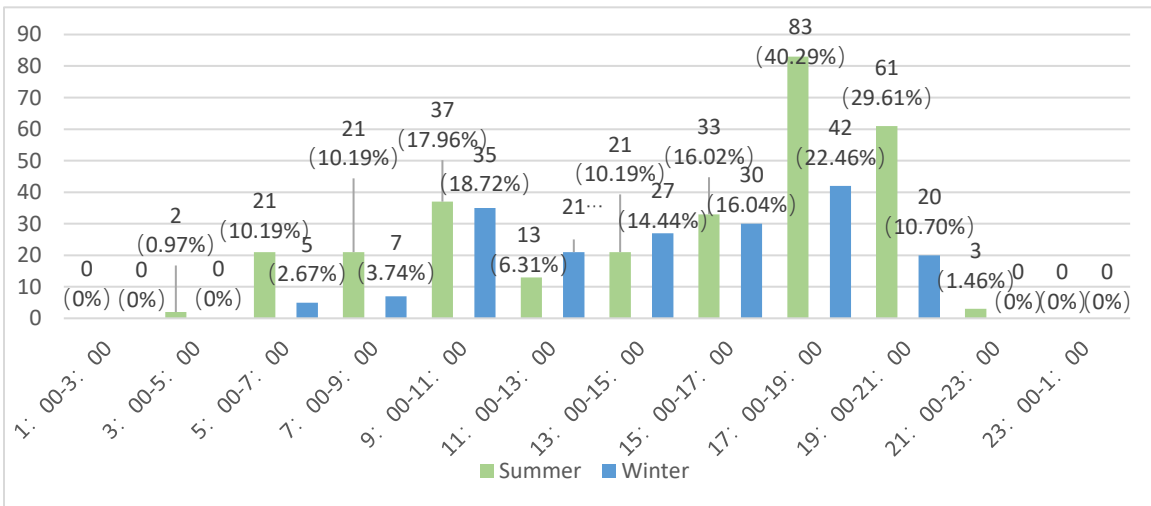
**Figure 16.** Changes in the frequency of respondents' travel in winter.



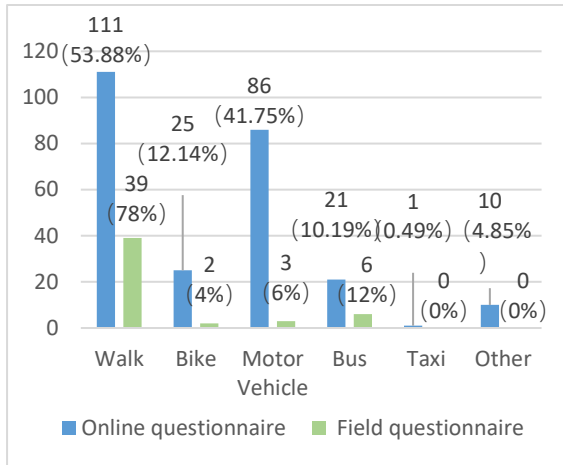
**Figure 17.** Frequency of respondents going to the green belt around Yitong River.



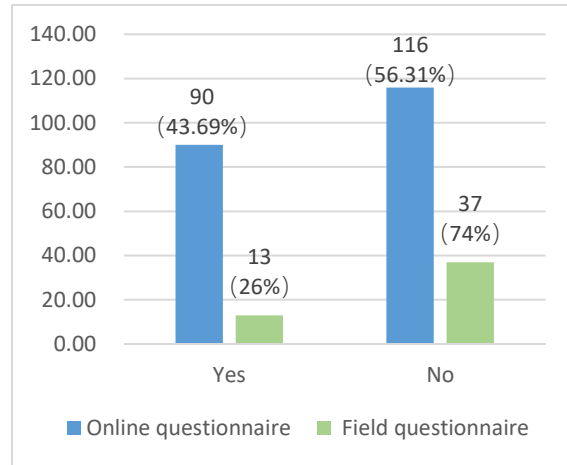
**Figure 18.** Traveling time of respondents based on the on-site questionnaires.



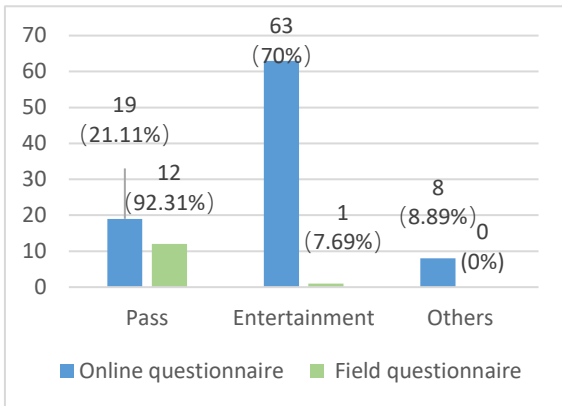
**Figure 19.** Traveling time of respondents based on the online questionnaires.



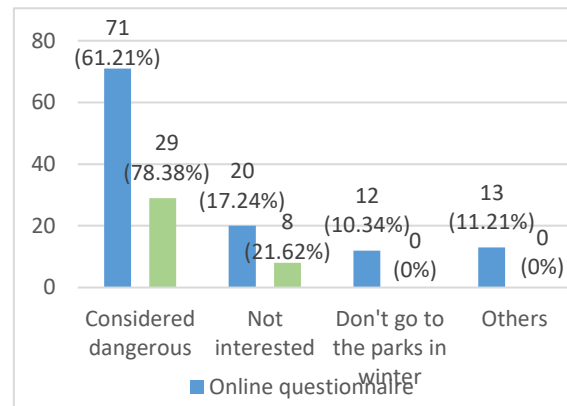
**Figure 20.** Respondents' travel mode to the green belt along Yitong River.



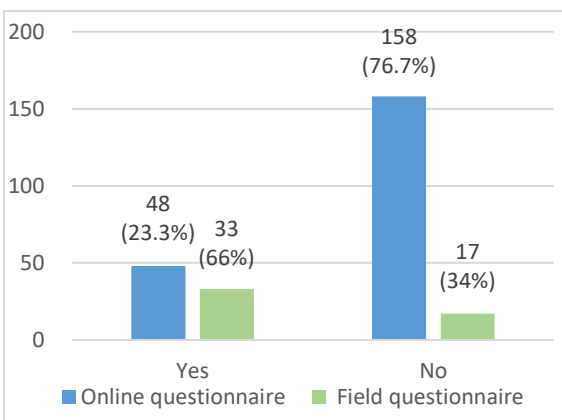
**Figure 21.** If the respondents will go on the surface of Yitong River in winter.



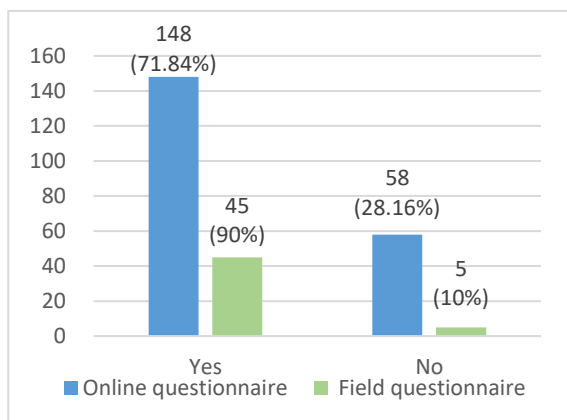
**Figure 22.** Activities that respondents would do on the surface of Yitong River in winter.



**Figure 23.** Respondents' reasons for not going to the surface of Yitong River in winter.



**Figure 24.** Respondents' needs of going across Yitong River on foot.



**Figure 25.** Respondents' thought about if there is a lack of pedestrian bridges.