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Research Article

Accounting of Air Pollution on Tourism Economic Loss in Fuzhou Based on Big Data Analysis

Hong Zhu

Fuzhou Technology and Business University, Fuzhou, Fujian 350001, China

Correspondence should be addressed to Hong Zhu; lhk@fafu.edu.cn

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When measuring the overall image of a city, air quality is one of the main indicators which is closely related to the quality of life. For a city, it is also a concrete manifestation of the tourist attraction ability. Air pollution in urban areas has already had an important impact on the daily lives of residents. It not only has a direct impact on human health but also affects human emotions, travel consumption, outdoor activities, and other aspects, thereby affecting economic vitality. Since air quality is a core indicator to measure the comprehensive image of a city, in order to effectively increase people's sense of experience and enhance the local tourist attraction ability, this paper studies the air pollution impact on tourist cities. When exploring the impact of Fuzhou's scenic spots and tourism frequency on air pollution, the number of scenic spots and reviews published on the Meituan software from 2018 to 2019 is selected as the research object. In the actual analysis, tourist attractions are divided into tourist attractions selected by people outside of Fuzhou and tourist attractions selected by residents. The empirical results show that the frequency of local travel will be reduced by 0.090 percentage points for every one percentage point increase in the air quality index. It can be calculated that the annual local travel due to the increase in the air quality index will reduce the number of tourist attractions in Fuzhou by approximately 2.4511 million. Every time the air index rises by 0.164 percentage points, the corresponding annual reduction in tourists is 11.733 million. Through the analysis of these 6 scenic spots, it can be concluded that whether it is scenic spots suitable for local people's tourism or scenic spots for tourists from all over the world, air pollution will reduce the frequency of scenic spots travel, which will cause urban tourism economic losses. Through the research of related theoretical data, it can be found that haze weather and air pollution have a negative impact on Fuzhou's scenic spot income and tourism growth rate. At the same time, air pollution will also affect the comfort of the city and then have a negative impact on the city's investment environment and the living environment, which will affect the city's economic development and other aspects of construction.

1. Introduction

With the continuous deepening of reform and opening, the economic development in China has also made considerable progress. Industrialization and urbanization have become more and more perfect. With rapid development, environmental pollution problems have gradually emerged, especially air pollution [1, 2]. Air pollution is one of the highlights of environmental pollution. Because people need to be exposed to the air all the time; once the air is polluted, people's health will be threatened [3]. This paper mainly studies and analyzes the particulate matter (PM) that causes haze in environmental pollution. When haze weather occurs, visibility and air quality will be reduced to a certain extent [4].

In recent years, a large part of the PM index in the air of cities, such as PM2.5 and PM10 have exceeded the normal qualified level, and the long-term haze weather has also made tourists who come to travel have a very poor travel experience [5, 6].

At present, domestic cities with relatively developed economies such as Beijing-Tianjin-Hebei and the Yangtze River Delta are suffering from relatively serious air pollution. At the same time, the development of their tourism industry is also at the leading level across the country [7, 8]. When people choose tourist destinations, they first need to consider important factors such as weather. Especially in today's rapid economic development, a variety of air pollution, mainly haze, occurs

frequently in major regions of the country, and the coverage area is increasing.

In this case, the major media and the public in China have begun to focus on the problem of air pollution [9]. In the previous research on air quality, the main research focus was on the impact and harm caused by air pollution to the human body. Long-term exposure to air pollution may increase the possibility of human respiratory diseases or other diseases [10]. In addition, the long-term or short-term exposure of people in a polluted air environment also has two effects on human health. One is an acute effect, and the other is a chronic effect [11].

For urban tourists, this impact caused by air pollution can also be regarded as an acute impact. In the process of traveling, tourists mainly face health risks. If tourists realize that they may face health risks when choosing a tourist destination, their emotions will be negatively affected and eventually they will cause tourists to refuse to carry out tourism activities in this city [12]. Based on this, it can be clearly seen that if tourists realize that the city they are going to may have environmental pollution such as haze, they will definitely think twice in the final decision. Moreover, as mentioned in the previous article, the haze will not only affect people's health to a certain extent but also affect air quality and visibility. It is not difficult to see that air pollution such as haze will directly have a serious adverse effect on the local tourism industry [13].

This paper conducts in-depth exploration and research on air pollution in major cities across the country and related tourism industry data indicators. At the same time, it focuses on the impact of air pollution on people's tourism decision-making and whether the urban tourism industry and popularity will be affected. The impact of air quality is discussed and analyzed. In addition, the improvement of air quality is used to analyze how the improvement of air quality can promote the urban economy, etc., in order to help the local tourism industry to obtain a more rapid and accurate development direction. In the development process of the tourism industry, air quality is likely to become another important factor in addition to cultural heritage, cultural environment, brand influence, and other aspects.

2. Materials and Methods

2.1. Overview of Tourism Development. In recent years, countries around the world have vigorously developed tourism. China has unique geographical and natural conditions. China is one of the countries with abundant tourism resources in the world, and it is also one of the most competitive countries in the tourism market. With the continuous development of the nationalized market in China, the number of tourists from abroad is increasing. The total number of tourists is in a leading position in the world, and tourism revenue ranks second in the global ranking [14].

Tourism demand is booming year by year, and the tourism industry has gradually become one of the main driving forces of the GDP increase in China. According to data in 2019, the total number of inbound and outbound tourists in China was 90 million and 130 million, respectively, and the number of outbound tourists ranked first in the world [15]. Under the background of the vigorous development of tourism in China, the total domestic tourism revenue has continuously exceeded more than 80% of the total revenue of the tourism industry in China, and it is showing a rising trend. In the same year, the total number of domestic tourist trips exceeded 5 billion, an increase of 12% compared to last year.

The total domestic tourism revenue is as high as 5.73 trillion yuan, an increase of 13% compared to last year. According to the statistics released by China's tourism industry, as shown in Figures 1 and 2, the vast majority of the total tourism revenue in China are all derived from domestic tourism and belong to the main force of the entire tourism industry. The tourism industry's role in promoting GDP in China is also increasing. In 2019, it has reached 6.53%, and its overall contribution to the employment and national economy is higher than 10%.

2.2. The Air Quality Index in the Study Area. Analyzing the AQI (Air Quality Index) of Fuzhou in 2018 and 2019, we can see that 150 days belong to the first class, 312 days belong to the second class, 165 days belong to the third class, 68 days belong to the fourth class, 25 days belong to the fifth class, and 10 days belong to the sixth level. Air quality level 1 and level 2 are fine weather, and level 3 to level 6 indicate environmental pollution. Analyzing Figure 3, we can find that in 2018 and 2019, 63.3% of the weather in Fuzhou City was fine weather and 36.7% of the weather was polluted.

Although the air quality and the number of polluted days have improved compared with before, the problem of air pollution is still prominent, especially the frequent occurrence of haze weather, which seriously affects the health of residents and the overall image of the city. However, the environmental protection goal determined during the "13th Five-Year Plan" period is that by 2022, more than 80% of the weather should reach a good level, so the problem of air pollution still needs to be solved. At this stage, air quality issues are still attracting attention, and the road to pollution control is still long.

2.3. The Impact of Air Quality in the Study Area on Tourism Activities. As the domestic environmental pollution has become more and more serious, since 1973, China has established an environmental protection plan every five years to restrain and control the air pollution problem. China reregulated the air quality measurement standards in 2012 and uniformly stipulated the restriction requirements for various types of atmospheric environments, focusing on ozone, NO_2, CO, SO_2, and PM2.5, and the concentration of PM10 to be limited [16].

From the perspective of tourists, the problem of air pollution will affect the people's decision-making and cognition of tourism. Air pollution will threaten the health, reduce the comfort of travel, and affect travel. First, the human body is forced to inhale pollutants such as particulate matter, SO_2, and optical smog to cause disease, then pollutants in the air directly contact the skin, thereby

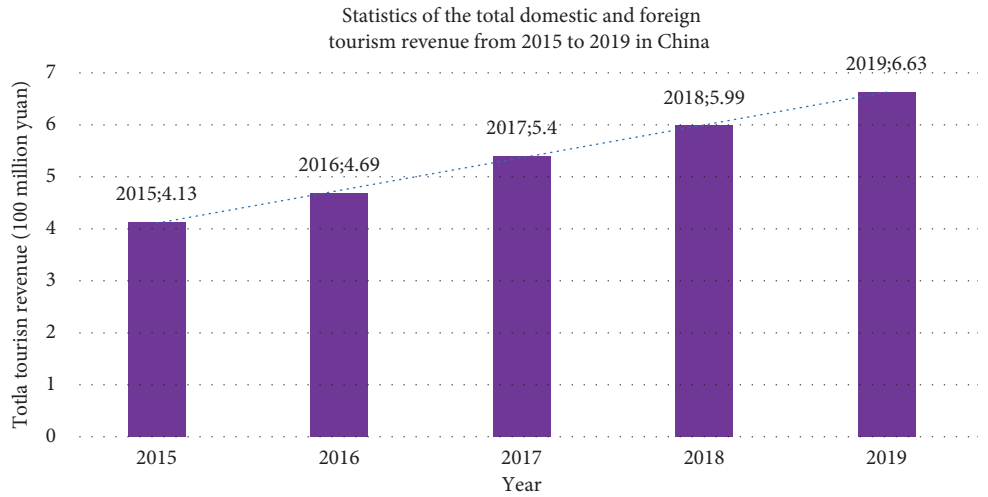

Figure 1: Statistics of the total domestic and foreign tourism revenue from 2015 to 2019 in China.

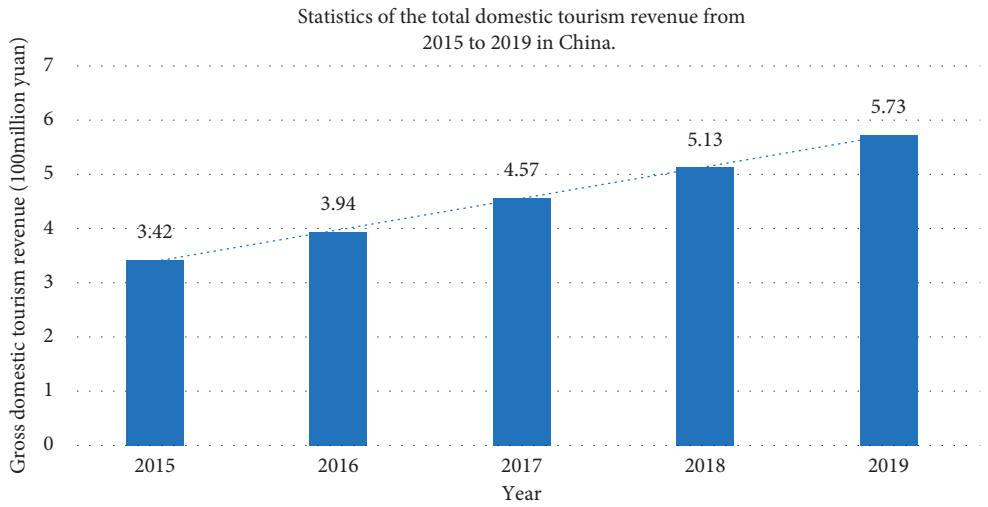

Figure 2: Statistics of the total domestic tourism revenue from 2015 to 2019 in China.

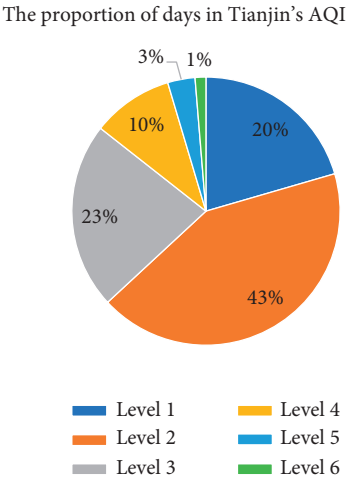

Figure 3: The proportion of days in Fuzhou's AQI series.

threatening people's health, finally, the pollutants have an impact on the water or food consumed by residents, thereby inducing diseases.

From the perspective of city image and scenic spot resources, air pollution will affect scenic spot resources, which will affect the process of residents' selection of tourist spots. Moreover, after the atmosphere is polluted, there may be some acid rain, which threatens a large number of plants and destroys various tourism resources, which in turn reduces the value of humanities and natural landscapes. People will also give lower scores when evaluating scenic spots. The correlation between the number of tourist attractions and the number of days that the air quality is polluted can be observed from Figure 4.

3. Results and Analysis

3.1. Variable Selection and Data Description. In this paper, Fuzhou City is used as an example to analyze the impact of air pollution on people's satisfaction and travel frequency. Therefore, two contents are needed: tourist-related data and air pollution-related data. Therefore, it is decided that the daily pollution situation is represented by the AQI, and the number of tourists is represented by the total number of comments on the tourist attractions on the Meituan website. There are two groups of data selected when analyzing the total number of reviews of tourist attractions: 18,112 from the local people after completing the tour and 3,564 from people all over the world.

3.1.1. Independent Variable. When evaluating air pollution in Fuzhou, the AQI is selected as the core indicator. When evaluating the air quality and change patterns of a certain city on the day, the detection data is used as the basis. The data from 2018 to 2019 is selected. The main reason for choosing AQI includes CO, SO_2, ozone, NO_2, PM2.5, and PM10.

3.1.2. Control Variables. Local tourist attractions have chosen West Lake Park, Luoyuan Bay Ocean World, and Shizhu Mountain. Locals like to go to these three scenic spots. We summarize the total number of daily reviews in the three scenic spots and find the logarithm to explain the daily tourist volume of the scenic spots. Tourist attractions for out-of-towners have chosen Fuzhou Gushan Scenic Area, Fuzhou National Forest Park, and Sanfang Qixiang. Most of these attractions are visitors from all over the country, and the number of tourists is representative.

Rain, snow, wind, and the daily average temperature will all affect travel, so this factor should be taken into consideration in the research process.

3.2. Model Construction. From a statistical point of view, the panel data model can be divided into three categories, including fixed effects, random effects, and mixed effects. These three types of models must be tested and selected [17–19]. In addition, the collinearity problem of each variable must be analyzed in the research process to ensure that there is no prominent collinearity phenomenon in each variable.

Based on the question that needs to be studied this time, whether air pollution will affect people's satisfaction with tourism and the frequency of tourism can be analyzed by the following model:

Model 1. The frequency model of Fuzhou locals' travel and tourism can be described as follows:

$$LnLOCAL_t = \beta_0 + \beta_1 \mathrm{In\,AQI}_t + \beta_2 X_t + \beta_3 HOLIDAY_t + T_t + \gamma_t + \delta_t + \theta_t. \quad (1)$$

Model 2. The frequency model of out-of-towners' travel to Fuzhou can be described as follows:

$$LnEVERY_t = \beta_0 + \beta_1 \mathrm{In\,AQI}_t + \beta_2 X_t + \beta_3 HOLIDAY_t + T_t + \gamma_t + \delta_t + \theta_t. \quad (2)$$

Model 3. The frequency model of all tourists to Fuzhou can be described as follows:

$$LnRAT_t = \alpha_0 + \alpha_1 \mathrm{In\,AQI}_t + \alpha_2 X_t + \alpha_3 HOLIDAY_t + T_t + \gamma_t + \delta_t + \theta_t. \quad (3)$$

In formulas (1)–(3), $\mathrm{LnLOCAL}_t$ means the total number of reviews in Japan selected by Fuzhou locals on Meituan.com for travel in Fuzhou for t days; $\mathrm{LnEVERY}_t$ is all reviews in Japan for the attractions selected by people from all over the Meituan.com visiting there for t days; LnRAT_t represents the total number of reviews on the scenic spots selected

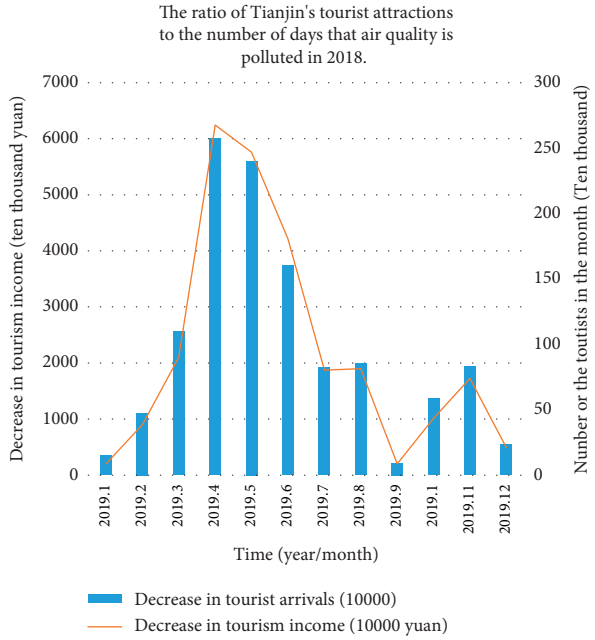

Figure 4: The ratio of Fuzhou's tourist attractions to the number of days that air quality is polluted in 2018.

by Meituan online travel in Japan for t days; In AQI_t represents the air pollution index of Fuzhou City issued by the Ministry of Environmental Protection in Japan; X_t controls a series of weather variables; such as daily average temperature, rain, and snow factors; $HOLIDAY_t$ represents dumb Meta variable; T_t is the number of travel days; γ_t represents weekly fixed response; δ_t represents monthly fixed response; θ_t represents random error.

Normally, the model of panel data contains three types. Failure to select the appropriate model will make the result quite different, so the model checking work must be completed [20, 21]. First, we choose the F test method to test, and if the result shows that the null hypothesis is rejected, the model can be selected.

Observing the test results in Table 1, we can see that the data value is at a significant level at 1%, rejecting the null hypothesis, so the mixed effects model is not used, and the fixed effects model is selected.

3.3. Regression Results and Data Analysis. The article analyzes scenic spots in Fuzhou as an example to quantitatively identify the impact of air pollution on scenic tourism. There are three core data. The first is the total number of tourists in the scenic spot, which is represented by the total number of daily comments on Meituan.com. The second is tourism satisfaction, which is represented by the scores of tourists on the Meituan website. The third is air pollution-related data, which is represented by the AQI of each day announced by the relevant departments, which completes variables such as weather variables, holidays, and average temperature. The final regression model results are shown in Table 2.

Analyzing the data shown in Table 2 can find that there is a negative correlation between air pollution and the travel

Table 1: F test results.

Model	F	P
Model 1	23.12***	0.000
Model 2	28.06***	0.000
Model 3	18.98***	0.000

Note. "***," "**," and "*"represent significant at the levels of 1%, 5%, and 10%, respectively.

frequency of local people, which validates Model One, that is, air pollution will reduce the travel frequency of local people. When only considering the time trend, the result is the part shown in Model 1, and the final result is the part shown in Model 2 when the weekly fixed effects and time trends are considered. After considering the monthly and weekly fixed effects and time trends, the final result is the part shown in Model 3. After adding all the control variables, it can be found that air pollution can significantly affect the travel frequency of local people. The difference between the comments on each day is more than 70%, indicating that this model has good explanatory capabilities. After adding all the control variables, the coefficient is equal to −0.090, and it can be concluded that every 1% increase in AQI will reduce the travel frequency by 0.090%.

In 2019, the number of the local people who traveled to Fuzhou was 13.46 million times. In 2019, the locals spent a total of 3.5652 million yuan on tourism in Fuzhou. In 2019, the per capita tourism consumption of local people was 28.06 yuan. Each time the air quality index decreased by 1%, the real number of local tourists decreased due to the decrease in air quality is 2.4511 million times (Table 3).

Analyzing the regression results in Table 4, it can be found that for every 1% increase in AQI, the frequency of travel to Fuzhou from various places decreased by 0.164%, air pollution reduced the number of tourists by 11.733 million, and the annual income loss was as high as 26.621 million yuan. The average value of the monthly income loss was 22.184 million yuan, and the average daily income loss was 739,500 yuan.

Because the air quality varies from month to month, the economic loss of revenue from scenic spots varies from month to month. Figure 5 reflects the impact of air pollution on monthly income and visits to scenic spots when considering the monthly AQI.

From Figure 5, it can be seen that the monthly economic losses of Fuzhou scenic spots due to air pollution reduction and the number of people is also different, and the impact in the second quarter is relatively large. The annual loss of income of foreign tourists due to air pollution in the Fuzhou area is 8.044 million yuan. From the previous analysis, it can be found that whether it is a scenic spot that local residents like to visit or a scenic spot that residents in other regions like to visit, the number of tourists will be reduced due to air pollution, which will cause a certain loss. As a result, this article's estimate is confirmed that air pollution will affect people's tourism perception and will have an impact on the image of scenic spots and tourism traffic, thereby reducing the total number of tourists to urban scenic spots.

Table 2: Regression results of the model for the influence of air pollution on the frequency of local residents traveling in Fuzhou.

Variants	$LnLOCAL_t$		
	Model 1	Model 2	Model 3
LnAQI	−0.159*** (−5.814)	−0.178*** (−6.533)	−0.090*** (−1.905)
HOLIDAY	0.455*** (8.546)	0.438*** (8.097)	0.426*** (9.172)
TEMP	0.024*** (18.001)	0.024*** (18.286)	0.006*** (0.704)
WINDPOWER	−0.016 (−1.150)	−0.021 (−1.302)	−0.005 (−1.068)
RAINSNOW	−0.198** (−2.099)	−0.198** (−2.151)	−0.139*** (−1.931)
Time trend	Yes	Yes	Yes
Weekly fixed response	No	Yes	Yes
Monthly fixed response	No	No	Yes
Constant	3.137*** (22.910)	3.130*** (23.079)	2.642*** (26.814)
Number of samples	800	800	800
P	0.000	0.000	0.000

Note. Same as Table 1. The number in brackets is the T test value.

Table 3: Statistics of local tourism data and air quality in Fuzhou in 2019.

Number of local tourists in Fuzhou in 2019 (ten thousand times)	Total tourism consumption of locals in Fuzhou in 2019 (ten thousand yuan)	Per capita consumption of local tourists in 2019 (ten thousand yuan)	2019 annual average air quality index
13046	354652	28.06	105

Table 4: Regression results of the model for the influence of air pollution on the frequency of people traveling to Fuzhou.

Variants	$LnLOCAL_t$		
	Model 1	Model 2	Model 3
LnAQI	−0.146*** (−4.512)	−0.151*** (−4.466)	−0.164*** (−4.801)
HOLIDAY	0.155** (2.311)	0.158** (2.522)	0.194*** (3.130)
TEMP	0.033*** (20.084)	0.033*** (20.451)	0.016*** (2.810)
WINDPOWER	−0.071*** (−2.945)	−0.072*** (−3.042)	−0.045** (−1.993)
RAINSNOW	0.127 (1.552)	0.120 (1.515)	0.041 (1.903)
Time trend	Yes	Yes	Yes
Weekly fixed response	No	Yes	Yes
Monthly fixed response	No	No	Yes
Constant	4.231*** (25.689)	4.211*** (25.465)	3.896*** (7.461)
Number of samples	400	400	400
P	0.000	0.000	0.000

Note. Same as Table 1. The number in brackets is the T test value.

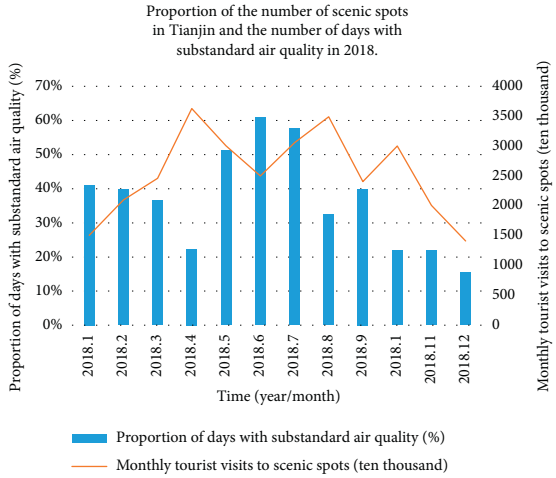

Figure 5: Fuzhou scenic spots in 2019 reduced visits and economic losses due to air pollution.

4. Conclusion

(1) The empirical research results show that after controlling for other influencing factors, the coefficient of air pollution on the number of Fuzhou people traveling there is −0.090, and it can be found that every 1% increase in AQI will reduce by 0.090% of the frequency of residents traveling in Fuzhou. The increase in the AQI of local residents each year could reduce the income of attractions in Fuzhou by 65,0621 million yuan. In addition, holidays will significantly increase the tourist volume of scenic spots and will be less affected by air pollution.

(2) From the perspective of out-of-town tourists, when the local air quality index rises by 1%, the travel frequency of the population in other areas of Fuzhou will drop by 0.164%. Every year due to air pollution, the number of people at scenic spots will drop by 11.733 million, the annual income loss is equal to

RMB 26,621,900, and the average value of monthly income loss is equal to RMB 22,184,900. The average value of daily income loss is equal to RMB 739,500. Because local people have been in Fuzhou for a long time, they have reasonable expectations and psychological tolerance for poor air quality and have relatively little impact on local people's daily tourism and entertainment activities, while air pollution has a more serious impact on people from all over the world.

(3) With the help of quantitative research methods, this study can not only obtain the people's willingness to avoid air pollution problems but also accurately judge the impact of pollution reduction or increase on the people and social activities. It can be seen from research that air pollution will affect the evaluation of scenic spots and people's tourism conditions, as well as the local economic development. From another perspective, the greater the control of air pollution, the more obvious the effect, and the local benefits will also be elevated.

Data Availability

The figures and tables used to support the findings of this study are included in the article.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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