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Air Pollution Governance and Residents' Happiness: Evidence of Blue Sky Defense in China

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Abstract: Enhancing people's happiness should be the standard of public policies. With the growing prominence of air pollution issues, governments and scholars have started to pay attention to happiness as it relates to air pollution. However, the relevant research has been limited in China, and the results are not clear, with little attention given to subjective perception related to air pollution. In recent years, China has strengthened its efforts in containing air pollution, striving to fulfill the people's longing for a blue sky. In this study, we aimed to investigate the impact of pollution governance on residents' happiness, considering both objective and subjective aspects. Using the Chinese General Social Survey and data on PM_{10}, our study was diachronic in nature, analyzing residents' happiness and the improvement in air quality as well as people's evaluation of governance concerning pollution. The statistical methods used primarily included *t*-tests and multiple linear regression. The results showed the following: (1) Residents' happiness showed a significant improvement from 2013 to 2021, accompanied by enhancements in both an objective improvement in air quality and subjective evaluation of pollution governance. (2) Both an objective improvement in air quality and the subjective evaluation of pollution governance showed positive effects on residents' happiness. This study not only enriches the theoretical understanding of the relationship between air pollution and happiness but also provides valuable insights for formulating policies that are more conducive to pollution governance and public happiness. To enhance happiness, the government needs to continue improving the air quality and guide residents in appropriately evaluating pollution governance.

Keywords: happiness; air pollution; PM_{10}; governance evaluation

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1. Introduction

Humans constantly seek happiness. So, what exactly is happiness? In short, happiness can both be expressed as yearning and joy. It impacts social development and economic progress. Countries with relatively high levels of happiness often have a more liberal, creative, and inspiring social environment. According to the World Happiness Report 2023 [1], China has a happiness index of 5.818, ranking it 64th out of nearly 140 countries and regions surveyed. The 14th National Five-Year Plan and 2035 Vision Goal emphasizes continuously enhancing people's happiness in China. A responsible government should ensure that its citizens enjoy the benefits brought by economic growth. China has achieved tremendous success in economic development, and the material living standards of the people have significantly improved. However, China has also paid a heavy price through environmental degradation. The ecological environment, as a living space, is naturally relied upon for safety and emotional support. The destruction of the living environment has caused everyone to face the cost of environmental pollution [2]. Air pollution is particularly severe compared to other forms of pollution and is more easily perceived by residents [3],

thus receiving widespread attention from all sectors of society. Given the close dependence between humans and the atmospheric environment, pollution governance is deemed highly urgent.

Since the 1950s, there has been an increasing discussion on the factors influencing the happiness of the residents. Scholars have used interdisciplinary research methods, including psychology, sociology, and economics, to study the determinants of residents' happiness. The existing research has shown that individual characteristics, family characteristics, and public policies can all affect the happiness of residents. In recent years, with the growing prominence of ecological environmental issues, the impact of environmental pollution, including pollution of the air, on residents' happiness has also attracted attention from scholars. The existing literature has made valuable contributions, but there are still some gaps in the research. (1) Some studies suggest that air pollution negatively affects the happiness of the residents through various mechanisms such as sensory stimulation, health risks, increased healthcare costs, and daily life inconveniences [4–8]. Air pollution is considered a key factor leading to differences in happiness levels among countries [9]. However, the existing research has mainly focused on developed countries. On the other hand, there are also studies indicating that air pollution can promote happiness through economic growth in developing countries. There is limited research on this topic, specifically in the context of China, and the findings are inconsistent [10,11]. (2) Different studies employ different methods to measure air pollution, including subjective evaluations and objective measurements. While most analyses focus on the impact of objectively measured air pollution on residents' happiness, the influence of their subjective perception of air pollution is often overlooked. Generally, when both subjective and objective measures of air pollution exposure are considered, subjective pollution has a more significant impact on happiness than objective pollution exposure itself [12–14]. Overall, there is a complex relationship when it comes to happiness and air pollution. Such pollution and pollution governance seem to be two sides of the same coin. In our previous research, we discussed the social impact of air pollution in China, primarily focusing on the relationship between pollution and residents' evaluation of the government [3]. In this paper, we will continue this topic and study the social benefits of pollution governance. China, which has experienced severe smog crises, is advancing the battle for a blue sky and strengthening air pollution governance. What impact does the blue sky defense have on people's sense of happiness?

In contrast to objective pollution and subjective pollution, this study selected an objective improvement in air quality and subjective evaluation of pollution governance as two aspects through which we measured air pollution governance. We drew on data from the Chinese General Social Survey (CGSS) and measured happiness and subjective evaluations of pollution governance by matching indicators of socioeconomic status with statistics on particulate matter (PM). We first analyzed the diachronic differences in public happiness and pollution governance, and then, the impact of objective improvements in air quality and subjective evaluations of pollution governance on the happiness of the residents. The findings of this study are as follows: (1) The happiness of the residents showed a significant improvement from 2013 to 2021, accompanied by enhancements in both an objective improvement in air quality and subjective evaluation of pollution governance. (2) Both objective improvements in air quality and subjective evaluations of pollution governance were found to have a significant positive impact on the happiness of residents.

There are three chief ways in which this study contributes to our current knowledge: (1) It expands on previous studies. Currently, most studies focus on areas where happiness and objectively polluted air are related. Given how complex the relationship is, research from developed countries may have limited applicability in developing countries. However, we examined the governance of polluted air as it relates to happiness, taking into account both objective improvements in air quality and subjective evaluations of pollution governance. Our perspective is relatively novel and comprehensive, and the connection

between the findings and public policy is more relevant. (2) This paper emphasizes the happiness brought by a blue sky and provides empirical evidence for the tremendous benefits of China's continuous improvement in air quality. As a country with severe air pollution in the world, China has made rapid progress in pollution governance in recent years and requires more academic attention. This study sheds light on the positive impact of air pollution governance on happiness in China. The findings of this study have important implications for air pollution governance and improving residents' happiness. (3) While air quality improvement falls under the domain of public affairs, residents' happiness is an individual experience. This study combines both aspects, bridging the gap between micro-level happiness and national governance, thereby facilitating collaboration between the micro- and macro-domains in the field of happiness research. This study falls at the intersection of environmental sociology and happiness economics. While there is ongoing debate among Chinese economists regarding the relationship between air pollution and happiness, this study approaches the issue from the perspective of pollution governance, providing insights into the local development of environmental sociology in China.

This study will be presented in the following sequence. First, a review of the literature on the impact of polluted air on residents' happiness leads to the research hypotheses. Next, the method section discusses the data collection and measurement methods using academic surveys and official statistics. The results section offers several observations derived from the data. The discussion and conclusion discuss the findings in relation to the results and provide conclusions and future prospects. The sub-objectives of this study included elucidating the changes in residents' happiness from 2013 to 2021, as well as the corresponding changes in subjective and objective indicators of air pollution governance. The sub-objectives also included analyzing the impact of pollution governance on residents' happiness. By proposing and testing hypotheses, we can answer the main research question on the nature of the relationship between objective improvements in air quality, subjective evaluations of pollution governance, and happiness.

2. Literature Review

Theoretical research on happiness primarily focuses on two levels of research areas. The first is the macro-level study of national happiness. The Gross National Happiness (GNH) index in Bhutan is a typical representative of this theory and practice. The GNH index is a social development concept that emphasizes the overall well-being of the nation, with a focus on balanced development in both material and spiritual aspects [15–17]. The second is the micro-level study of happiness, which is the main focus of this paper. It describes the happiness of residents based on the individual's subjective well-being and experiences. The research on happiness emerged in the US in the 1950s and has since been extensively studied by scholars from various disciplines [18,19]. For example, the combination of happiness and economics has formed the field of happiness economics. The factors influencing happiness have always been a focus of research in order to explore the ultimate secret to achieving happiness from a multidisciplinary perspective. There is a considerable amount of literature on happiness. Scholars, such as Alesina et al. [20], have divided the research on happiness into two aspects: individual characteristics and social characteristics. In terms of macro-social factors, economic conditions are considered an important aspect. Based on data analysis, American economist Easterlin [21] proposed that, from a cross-sectional study perspective, wealthier individuals are happier than poorer individuals; however, from a time series perspective, economic growth does not necessarily improve national happiness. This inconsistency between cross-sectional and time series conclusions is referred to as the "happiness paradox" or Easterlin paradox. Subsequently, many studies have attempted to explain this phenomenon from the perspective of omitted variables, among others [22–24].

Air pollution, as a major environmental risk, is gradually becoming a heated topic in international research. Numerous studies conducted by researchers such as Welsch [25], Luechinger [26], and Smyth et al. [27] have shown that air pollution significantly damages

the happiness of local residents. Therefore, many scholars believe that air pollution, as an important non-economic factor influencing individual happiness, can provide a good explanation for the Easterlin paradox [17]. The existing literature mainly comes from developed countries and has repeatedly confirmed the negative relationship between air pollution and residents' happiness [28]. However, research on the impact of air pollution on residents' happiness in China started relatively late, and there are relatively few research findings, and the findings are not consistent. Zhang et al. [29] used China Family Panel Studies (CFPS) data and found that after controlling for factors such as weather, air pollution significantly reduced residents' short-term hedonic happiness. Based on the CGSS2017 data, Liu et al. [30] found a significant negative influence of polluted air on the happiness of residents. The deterioration of air quality partly explained the existence of the Easterlin paradox in China. However, some scholars also argue that air pollution has brought about faster economic growth and has promoted the happiness of the residents through the transmission of the economy. Some studies have found a positive correlation between subjective happiness and haze pollution [31]. This may lead to confusing findings regarding the impact of air pollution on happiness.

Most previous studies did not distinguish between objective air pollution and subjective air pollution. Most scholars usually discuss the impact of objectively existing air pollution factors such as SO_2 and PM on the happiness of the residents but rarely analyze the influence of residents' perception of air pollution on their happiness. Subjective air pollution refers to the subjective judgment and evaluation of the existing air pollution made by individuals, which is a combination of objective air pollution and the psychological experiences of the residents [32]. In fact, compared to objective air pollution, the impact of subjective perception on happiness among residents may be more worthy of attention. As a result, some scholars have explored this line of thinking and obtained two significantly different conclusions. First, most studies believe that subjective pollution has a significant negative impact on the happiness of the residents and may even be more important than actual pollution levels. Mackerron et al. [33] found that both existing air pollution levels and subjectively perceived air pollution significantly reduce the happiness of the residents. Second, a minority of studies believe that subjective pollution has no impact on the happiness of residents [27].

Overall, although there is extensive research on polluted air's impact on residents' happiness, gaps remain for further investigation. Given China's polluted air context, data analyses, including experiences specific to China, are called for. How applicable are the research findings from developed countries to present-day China? In China, there is limited research on subjective air pollution. It would be of great practical significance to examine the influences of both subjective and objective air pollution levels on residents' happiness. Since the beginning of the 21st century, with the implementation of large-scale comprehensive social surveys, the academic community has started to focus on the relationship between macro-social factors and happiness. From these studies, we can observe that most macro-social factors are related to government public management, reflecting the increasing emphasis on public policy in happiness research. However, there is relatively limited research from an environmental governance perspective on the impact of pollution governance on happiness. Currently, the focus is mainly on environmental governance measures such as environmental taxes and carbon emission taxes [34,35]. Ambrey et al.'s study [36], which utilized the Household, Income, and Labour Dynamics in Australia (HILDA) survey and Geographic Information System (GIS) data, demonstrated that a comfortable environment significantly enhances residents' life satisfaction. Cunado et al. [37] also confirmed the positive influence of reducing air pollution on improving residents' happiness. In the past decade, the Chinese government has prioritized pollution governance and environmental protection as major projects for public welfare and people's livelihoods. In fact, it is urgently needed to clarify the inherent connection and logical relationship between pollution governance and the happiness of the residents. This will provide insights into the relationship between air pollution and happiness from another perspective and,

to some extent, address the limitations of the existing research. This also contributes to obtaining more robust empirical evidence regarding the effectiveness of China's pollution governance policies. Corresponding to objective pollution and subjective pollution, this study selected objective improvements in air quality and subjective evaluations of pollution governance as two aspects to measure pollution governance and investigate its impact on happiness. Our hypotheses were as follows:

Hypothesis 1. *Greater objective improvement means greater happiness.*

Hypothesis 2. *Better subjective evaluation of governance means greater happiness.*

This study also considered other factors. Bulent [38] pointed out that demographic factors, including gender, marital status, number of children, education level, and health status, significantly influence individuals' happiness. Other scholars have proposed that happiness is significantly positively correlated with physical health, and individuals who rate their health as poor tend to have lower levels of happiness [39]. Additionally, the issue of imbalanced and insufficient economic and social development in China is still prominent, leading to widespread differences among the population. Therefore, exploring the relationship between demographic characteristics, socioeconomic factors, and happiness can provide insights for the government to promote pollution governance and design policies to enhance the happiness of the residents in an orderly manner.

3. Materials and Methods

3.1. Sample

The data used in this study mainly come from CGSS (2013 and 2021). CGSS, which began in 2003, is already recognized as an authoritative data set for studying the happiness of residents and environmental behavior by Chinese scholars. The sampling procedures for CGSS2013 and CGSS2021 adopted multi-stage stratified sampling, and the survey mode was face-to-face interviews. The execution time corresponds to the years 2013 and 2021, respectively. The reason for choosing the data from 2013 and 2021 is that they include the environmental module. After we had processed it, the effective sample size in 2013 was 6783; for the 2021 data, it was 2741. For a small number of missing values in the samples, we mainly used a mean or median replacement.

This study also used data at the provincial level, specifically social-economic and air pollution indicators from 19 provinces in China. The China Statistical Yearbook supplied the data on socioeconomic status, while information on polluted air was gathered from provincial ecological environment bulletins. Lagged handling concerning macro-level indicators was conducted to further address endogeneity issues. The provincial-level socioeconomic data are from one year before the CGSS data. This study collected macro-level data at the provincial level, with a matching rate close to 100% for the CGSS sample. In some related studies, such as Levinson's study on US residents [40], only 52.3% of valid samples were retained. The high matching rate in this study ensures that the sample represents residents in various pollution levels, avoiding sample selection bias. Due to the need to protect the privacy of respondents in the CGSS, we only located respondents to their respective provinces instead of pinpointing them to specific districts or counties.

3.2. Assessments

3.2.1. Happiness

This study's dependent variable was happiness. Happiness can be measured using subjective or objective criteria, and this study focused on subjective happiness. Scholars often prefer to use a single-variable measurement and self-reporting method when studying happiness [41]. This method is adopted by many studies or surveys, such as the World Values Survey (WVS). Using the questionnaire CGSS2013, we specifically asked: "Overall, are you feeling happy with your life?" There was a total of 5 answer options: 1 represents

"deeply discontent", 2 represents "quite discontent", 3 represents "not content and not discontent", 4 represents "quite content", and 5 represents "thoroughly content". High scores indicate a greater contentment being reported by respondents. The CGSS2021 survey also included very similar questions. We treated ordinal variables as interval variables, and the results did not show significant differences. Tian et al. [42] also used this approach when analyzing the determinants of the happiness of the residents.

3.2.2. Objective Improvement in Air Quality

We chose the concentration index of PM_{10} and matched the change in the annual average concentration of PM_{10} in the province where the respondents were located to objectively indicate pollution governance. Selecting PM_{10} as the concentration indicator was based on careful consideration. Theoretically, PM_{10}, SO_2, etc., are major air pollutants. From the perspective of particle size, PM_{10} includes $PM_{2.5}$. Some scholars have found that air pollution is reflected in the accumulation of PM_{10}, which is easily perceived by the population, and previous research has also used PM_{10} as an independent variable for air pollution perception [43,44]. From a practical perspective, $PM_{2.5}$ was only included in the latest ambient air quality standards in early 2012, and the monitoring of $PM_{2.5}$ by environmental protection departments in 2012 only covered key cities nationwide. In contrast, China started monitoring PM_{10} earlier and has more mature detection work compared to that for $PM_{2.5}$. Therefore, this study used the annual average concentration index of PM_{10} in the province where the respondents were located in 2013, 2016, 2020, and 2021 and calculated the difference in PM_{10} as the objective indicator. The values for 2013 and 2021 were used for the diachronic analysis, while the values for 2016 and 2020 were used for the regression analysis. However, this study also collected the average concentration values of $PM_{2.5}$ in 2016 and 2020. Compared to 2016, the mean value of PM_{10} decreased by 27.000, and the mean value of $PM_{2.5}$ decreased by 17.413 in 2020. Objective improvements in air quality are reflected in PM improvements.

3.2.3. Subjective Evaluation of Pollution Governance

The subjective indicator of pollution governance examined pollution governance from the perspective of subjective perception. The government carries out environmental governance through environmental regulations, administrative orders, and economic penalties, making it difficult to quantify the subjective indicators of environmental governance. This study used residents' evaluations of local government environmental protection and governance through questionnaire responses as an alternative indicator of subjective perception of pollution governance. The specific question in the CGSS2013 survey was, "How do you think your local government has done in environmental protection work in the past five years?" There were 6 options: 1 represents "overemphasis of developing economic conditions, neglecting the environment"; 2 represents "lack of care and investment concerning protection of the environment"; 3 represents "efforts have been made—the results are not satisfactory"; 4 represents "great efforts have been made and some achievements have been made"; 5 represents "significant achievements have been made"; and 8 represents "unclear." The CGSS2021 survey also included a very similar question. Since it asks about the situation in the past five years, the subjective evaluations from CGSS2021 can correspond to the changes in PM_{10} from 2016 to 2020. The respondents could make independent choices based on their personal subjective perception of government environmental governance. The larger the assigned value (1–5), the better the subjective evaluation of pollution governance.

3.2.4. Control Variables

Referring to the abundant literature on happiness research, the selection of control variables considered the need to reduce endogeneity issues. Therefore, relevant variables were included in the model to alleviate estimation bias caused by omitted variables as much as possible.

The micro-level characteristics of residents include (1) individual demographic and social characteristics, mainly gender, age, education, income, health, survey location, political status, religion, marriage, and family size. Among them, gender, survey location, political status, religion, and marriage variables were dummy variables. The education variable measured the total number of years of formal schooling received by the respondents. The income data were logarithmically transformed. (2) Attitude mainly includes social trust, social fairness, and self-assessed class, representing residents' self-perception of society. Social trust and social fairness are regarded as indicators of social cohesion that can influence happiness [45]. Attitude variables also include environmental values (EVs). Scholars have found that individuals with EVs are more environmentally friendly and adapt their behaviors according to environmental changes [46].

The provincial macroeconomic variables were the per capita GDP (ten thousand CNY) of each province, the GDP growth rate of each province, and the region where each province is located, which was classified according to national policies (ranked from 1 to 3, with a higher number, indicating a greater regional advantage).

Table 1 shows the descriptive statistics for the regression analysis variables, which are derived from CGSS2021, socioeconomic markers from 2020, and PM improvements (2016–2020).

Table 1. Descriptive statistics.

Variable	Obs	Mean	SD	Level
Happiness (1–5)	2741	3.987	0.817	Individual
Subjective evaluation of pollution governance (1–5)	2741	3.653	0.964	Individual
Gender (male = 0)	2741	0.540	0.498	Individual
Age	2741	51.596	17.618	Individual
Year of education	2741	9.219	4.572	Individual
Income	2741	7.508	5.703	Individual
Health (1–5)	2741	3.511	1.105	Individual
Survey location (rural = 0)	2741	0.556	0.497	Individual
Political status (non-Communist Party = 0)	2741	0.124	0.330	Individual
Religion (no religious belief = 0)	2741	0.065	0.246	Individual
Marital status (not in marriage = 0)	2741	0.717	0.451	Individual
Family size	2741	3.439	1.905	Individual
Social trust (1–4)	2741	2.731	0.788	Individual
Social fairness (1–5)	2741	3.470	0.974	Individual
Self-assessed class (1–10)	2741	4.279	1.833	Individual
EVs	2741	28.827	4.674	Individual
GDP per capita	19	7.868	3.320	Province
GDP growth rate	19	0.025	0.024	Province
Region (1–3)	19	1.877	0.799	Province
PM_{10} improvement from 2016 to 2020	19	27.000	10.188	Province
$PM_{2.5}$ improvement from 2016 to 2020	19	17.413	7.001	Province

3.3. Methods

In this study, we used Stata, a powerful statistical software and the core product of Stata Corp. After several updates and iterations, Stata has evolved into one of the most commonly used statistical software products worldwide. For example, Li et al. [7] conducted an empirical study on the impact of environmental awareness and conditions on successful aging using Stata17.0. Using the Stata 17.0 software, this study first conducted a diachronic assessment of the happiness of the residents and their subjective evaluation of pollution governance at the provincial level based on the CGSS2013 and CGSS2021 surveys. The study also compared the differences between PM_{10} levels in 2013 and 2021 using *t*-tests. Then, through regression analysis, the study explored the factors influencing the happiness of the residents by considering individual micro-level characteristics, macroeconomic development, and air pollution levels in their respective provinces.

To validate the research hypotheses proposed earlier, this study referred to Levinson's [40] econometric model and constructed a happiness model consisting primarily of the happiness of the residents, an objective indicator of pollution governance, and a subjective indicator of pollution governance. The model aimed to examine the impact of pollution governance on the happiness of the residents. The formula is as follows:

$$happiness_{ij} = \alpha + \beta_1 objectivegovern_j + \beta_2 subjectivegovern_{ij} + \beta_3 X_{ij} + \beta_4 Y_j + \varepsilon_{ij} \quad (1)$$

where $happiness_{ij}$ represents the subjective perception of happiness for resident i in province j; $objectivegovern_j$ represents the objective indicator of air pollution governance in province j; $subjectivegovern_{ij}$ represents the subjective indicator of air pollution governance perceived by resident i in province j; X_{ij} represents the micro-level individual characteristic variables of resident i in province j; Y_j represents the macroeconomic variables of province j; and ε_{ij} represents the random disturbance term. The coefficients β_1 and β_2 measure the impact of the objective and subjective indicators of pollution governance on the happiness of the residents, with the sign indicating the direction of the effect.

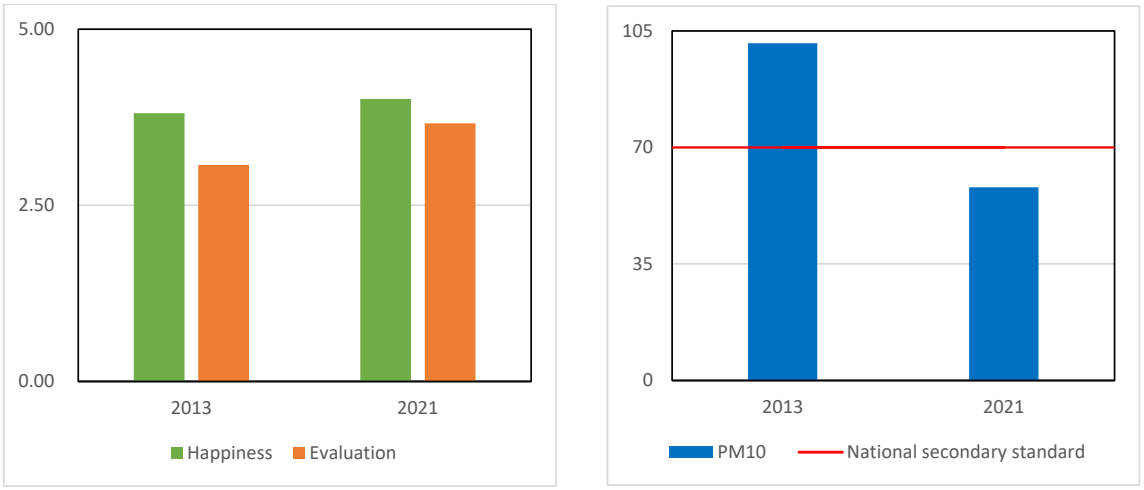
For our regression analysis, we first conducted a one-way analysis of variance with random effects, also known as the null model, which does not include any explanatory variables, either individually or regionally. The model is a preliminary analysis for the application of a multilevel model, which can provide information on the variation of results at both levels separately. It is worth noting that this model can derive intra-class coefficients of correlation (ICCs). Higher ICCs indicate a large between-group variation, while a low ICC suggests that the within-group variation explains a larger proportion of the total variance. By calculating the ICC and using Cohen's [47] empirical rule, which considers an ICC value greater than 0.059 as indicative of the appropriateness of a multilevel model, we preliminarily determined that a multilevel model was warranted. There were no significant differences in the average happiness scores among residents in different provinces, and thus, we proceeded with multiple linear regression modeling. This is one of the widely used models in the academic field for studying happiness. Although happiness is not a continuous variable, as pointed out by Mackerron et al. [33], linear regression models can provide results similar to ordered probit models. The advantage of linear regression is its simplicity and ease of interpretation.

4. Results

4.1. The Diachronic Analysis of Residents' Happiness

The changes in the average level of residents' happiness at the provincial level are as follows. At two time points, 2013 and 2021, the values were 3.809 and 4.009, respectively, indicating a significant ($p < 0.001$) improvement (Figure 1). Similar results have also been reported by other surveys conducted during a similar time period. According to The World Happiness Report (WHR) [48,49], from 2010 to 2012, the happiness score of Chinese residents was 4.978, ranking 93rd out of the 156 countries and regions worldwide. From 2019 to 2021, the happiness score of Chinese residents was 5.585, ranking 72nd among the 146 countries or regions surveyed. Both the score and ranking have significantly improved, indicating that the happiness of the Chinese population is increasing.

The changes in the provincial annual average concentration of PM_{10} are as follows. The national secondary standard for China is $\leq$70 $\mu g/m^3$. In 2013, the concentration was 101.290 $\mu g/m^3$. By 2021, it had decreased to 58 $\mu g/m^3$, with $p < 0.001$, showing a significant decline with turning points towards meeting the standard. As the regression analysis included the changes in PM_{10} from 2016 to 2020, this paper also provides the value of PM_{10} in 2016 as 87.211 $\mu g/m^3$ and the value of PM_{10} in 2020 as 60.474 $\mu g/m^3$. From the data on ecological environment monitoring, 2020 saw the average concentrations for six major pollutants, including PM_{10}, steadily meet the standards. In 2022, the Minister of Ecology and Environment of China stated that in the past decade, China has undergone historic changes in air quality and has become the country with the fastest improvement in air quality in the world.



(**a**) (**b**)

Figure 1. Province-level statistics for various years. (**a**) Residents' happiness and evaluation of pollution governance; (**b**) PM_{10} and national secondary standard (70 μg/m^3).

The changes in the subjective evaluation of pollution governance at the provincial level are as follows. The score was 3.073 in 2013 and 3.663 in 2021, showing a significant ($p < 0.001$) improvement. Recently, from the Policy Research Center for Environment and Economy (PRCEE), a Citizen Ecological Environment Behavior Survey Report (2022) was issued in China. The report showed that, in terms of perception of environmental conditions, the public recognizes the government's ecological environmental protection work and generally believes that the efforts of both the central and local governments in ecological, environmental protection are continuously increasing, with the proportions of those who believe in the increased efforts being 69.2% and 64.7%, respectively.

Table 2 shows the results of the *t*-test for the longitudinal values. From 2013 to 2021, the happiness of the residents and subjective evaluation of pollution governance both significantly increased over time. Both are subjective assessments made by the respondents, and we speculate that there may be a direct connection between the two. As for PM_{10}, there was also a significant decrease from 2013 to 2021, indicating the government's actual achievements in environmental protection and significant improvements in objective air quality. The specific impact of pollution governance needs further research.

Table 2. Changes at province level over time.

Factors	Time Span	Finite Difference		Variance	
		Mean	SD	*t*	*df*
Happiness	2021–2013	0.200 ***	0.153	5.698	18
PM_{10}	2021–2013	−43.289 ***	25.886	−7.289	18
Subjective evaluation of pollution governance	2021–2013	0.590 ***	0.309	8.320	18

Note: *** $p < 0.001$.

4.2. Factors Influencing the Happiness of the Residents

4.2.1. Baseline Regression Analysis

According to the research needs, this study analyzed the impact of pollution governance on the happiness of the residents through three regression models. Table 3 presents the model settings and regression results. Model 1 is a null model. Model 2 includes the objective indicator of pollution governance, micro-level individual characteristics of the residents, and macroeconomic variables at the provincial level. Model 3 adds the subjective indicator of pollution governance to Model 2 to comprehensively assess the various variables' influences on residents' happiness.

Model 1 is a null model. Since this study includes explanatory variables at both the individual and macro levels, it is theoretically preferable to use a multilevel model for the statistical analysis. However, we can see that the between-group standard deviation (SD) was 0.112, the within-group SD was 0.810, and the ICC was 0.019. According to the empirical rule (ICC value exceeds 0.059), we did not use a multilevel model and instead opted for multiple linear regression.

Model 2 showed that PM_{10} improvement ($\beta = 0.005$, $p < 0.001$), age ($\beta = 0.005$, $p < 0.001$), education ($\beta = 0.009$, $p < 0.05$), health ($\beta = 0.151$, $p < 0.001$), marital status ($\beta = 0.083$, $p < 0.05$), family size ($\beta = 0.030$, $p < 0.001$), social fairness ($\beta = 0.236$, $p < 0.001$), self-assessment of class ($\beta = 0.059$, $p < 0.001$), EVs ($\beta = 0.007$, $p < 0.05$), per capita GDP ($\beta = -0.013$, $p < 0.05$), and region ($\beta = -0.067$, $p < 0.01$) had significant effects on the happiness of the residents. Objective improvements in air quality had a significant positive relationship with happiness, with greater improvements in PM_{10} levels associated with higher levels of happiness. Thus, Hypothesis 1 is supported by our analysis. This finding is also consistent with the findings of Cunado and colleagues [37]. Many scholars, including Rehdanz et al. [50], have studied objective pollution and found that polluted air significantly reduces residents' happiness. Therefore, it can be inferred that objective improvements in air quality may enhance the happiness of residents. Therefore, the findings of this study are essentially similar to the results of Rehdanz and other scholars' research. In terms of individual characteristics, older people tended to have higher levels of happiness. Deaton et al. [51] explained this phenomenon using the Socio-emotional Selectivity Theory, which suggests that as people age and accumulate emotional wisdom, they choose to focus on events and friendships that bring them emotional satisfaction. Education has a significant positive impact on individual happiness. That is, greater education correlated with greater happiness. This finding is consistent with the results of Assari [52] and Nizeyumukiza et al. [53]. In labor economics, education can improve human capital and provide better employment opportunities [54]. Education also increases people's expectations for life and work, giving them a sense of confidence and respect, which, in turn, enhances life satisfaction [55]. There was a positive correlation between health and happiness, with healthier individuals having higher levels of happiness. Health is a necessary condition for a good life [56]. Larsson et al.'s research [57] found that individuals with chronic illnesses or severe pain had much lower levels of happiness compared to physically healthy individuals. Married individuals tended to have higher levels of happiness compared to those who were single. This may be because being together with a spouse allows for emotional satisfaction through communication, companionship, and support, making it easier to overcome life stresses. Larger family sizes were associated with higher levels of happiness. The sense of social fairness contributed to an enhanced sense of happiness among residents. Similar findings have been observed internationally, with Oishi et al. [58] suggesting that higher levels of average happiness are associated with less severe inequality. Unfair inequality caused by unequal opportunities, such as differences in social status and corruption, negatively impacts happiness [59]. A higher self-assessed social class was associated with a higher level of happiness. Social elites or successful individuals perceive themselves to be in the upper echelons of society, leading to a strong sense of superiority and happiness. Happiness was significantly affected, directly and positively, by personal EVs; individuals with raised EVs generally showed increased happiness. In terms of provincial macroeconomic variables, there was a significant negative correlation between the region's per capita GDP and happiness. In areas with higher economic levels, residents tended to have lower happiness, which is related to the greater work and economic pressures faced by residents in economically developed areas. A higher income seems to bring life satisfaction rather than emotional happiness. It can be said that the wealthier the region, the stricter the public's requirements for pollution governance and the more comprehensive the pursuit of happiness. Regions with greater locational advantages tended to have lower happiness, and this logic is consistent with the impact of per capita GDP on happiness.

Table 3. Factors influencing assessment of happiness.

Variable	Model (1)	Model (2)	Model (3)	Model (4)
Gender		0.038 (0.029)	0.038 (0.029)	0.039 (0.029)
Age		0.005 *** (0.001)	0.004 *** (0.001)	0.004 *** (0.001)
Year of education		0.009 * (0.004)	0.009 * (0.004)	0.009 * (0.004)
Income		0.001 (0.003)	0.000 (0.003)	−0.000 (0.003)
Health		0.151 *** (0.014)	0.148 *** (0.014)	0.149 *** (0.014)
Survey location		0.038 (0.032)	0.042 (0.032)	0.036 (0.032)
Political status		0.020 (0.046)	0.016 (0.046)	0.018 (0.046)
Religion		−0.056 (0.057)	−0.065 (0.057)	−0.051 (0.057)
Marital status		0.083 * (0.033)	0.084 * (0.033)	0.088 ** (0.033)
Family size		0.030 *** (0.008)	0.029 *** (0.008)	0.028 *** (0.008)
Social trust		0.022 (0.018)	0.019 (0.018)	0.017 (0.018)
Social fairness		0.236 *** (0.015)	0.229 *** (0.015)	0.228 *** (0.015)
Self-assessed class		0.059 *** (0.008)	0.057 *** (0.008)	0.057 *** (0.008)
EVs		0.007 * (0.003)	0.007 * (0.003)	0.007 * (0.003)
GDP per capita		−0.013 * (0.005)	−0.012 * (0.005)	−0.021 ** (0.006)
GDP growth rate		−0.395 (0.599)	−0.438 (0.598)	−0.480 (0.600)
Region		−0.067 ** (0.021)	−0.064 ** (0.021)	−0.082 *** (0.022)
PM_{10} improvement (2016–2020)		0.005 *** (0.001)	0.006 *** (0.001)	
Subjective evaluation of pollution governance			0.057 *** (0.015)	0.056 *** (0.015)
$PM_{2.5}$ improvement (2016–2020)				0.008 ** (0.002)
Constant	3.998 *** (0.031)	1.690 *** (0.172)	1.528 *** (0.177)	1.658 *** (0.173)
Provincial-level variance	0.112			
Individual-level variance	0.810			
N	2741	2741	2741	2741
R^2		0.206	0.210	0.208

Note: Numbers in parentheses are the standard error. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The regression results of Model 3 indicate that, after incorporating both the subjective and objective variables of pollution governance, the subjective evaluation of pollution governance ($\beta = 0.057$, $p < 0.001$) and PM_{10} improvement ($\beta = 0.006$, $p < 0.001$) had significant effects on the happiness of the residents. Specifically, the better the subjective evaluation of pollution governance perceived by the public, the higher their level of happiness was, supporting Hypothesis 2. Such a finding is supported by a majority of the relevant studies. Overall, both the subjective and objective indicators of pollution governance had positive and significant effects on the happiness of the residents. In terms of coefficients, the subjective evaluation of pollution governance was much more impactful than the objective improvement in air quality, indicating that subjective evaluations play a stronger role in enhancing the happiness of the residents compared to objective improvements. Additionally, comparing Model 3 with Model 2, we found that the influence of the control variables on the happiness of the residents did not change significantly.

4.2.2. Robust Analysis

Generally, robustness tests involve substituting core variables or using alternative statistical analysis methods. In this study, robustness tests were conducted using different statistical methods and alternative core variables.

First, we replaced the econometric methods. In the previous analysis, the Ordinary Least Squares (OLS) method was used for regression estimation. Since the measurement of happiness can be seen as an ordinal variable, the Ordered Logit Model (OLM) was used to compare the consistency in coefficient signs and the significance of the main explanatory variables in order to validate the robustness of the model. The results showed that objective improvement in air quality ($\beta = 0.018$, $p < 0.001$) and the subjective evaluation concerning pollution governance ($\beta = 0.184$, $p < 0.001$) significantly influenced the happiness of the residents. In terms of statistical significance, the regression results of both estimation methods were significant at the 1‰ level. The above analysis confirms that under commonly used econometric model specifications, the positive effects of pollution governance were consistently present, indicating a robust model.

Secondly, we substituted the variables. In recent years, $PM_{2.5}$ has become the primary factor affecting the proportion of good air quality days in China. $PM_{2.5}$ is not only the main air pollutant but also receives much attention in Chinese cities. In this study, $PM_{2.5}$ was used as a substitute for the PM_{10} index, and the linear regression models were employed for estimation and robustness testing. The Model 4 results in Table 3 represent the regression results. The $PM_{2.5}$ improvement ($\beta = 0.008$, $p < 0.01$) significantly promoted residents' happiness, i.e., a greater objective improvement led to increased happiness. A higher subjective evaluation of pollution governance ($\beta = 0.056$, $p < 0.001$) was also associated with a higher level of happiness. The two hypotheses were still supported by the data. Therefore, the robustness of the research findings is good.

5. Discussion

The Chinese government's promotion of Beautiful China construction is a concrete manifestation of the goal to improve people's happiness and the quality of their lives. Making the air fresher for the public to breathe will contribute to enhancing public satisfaction and happiness. Based on the quantitative analysis combining the CGSS2013 and CGSS2021 survey data with matched province-level socioeconomic markers along with PM information, we found that, firstly, between 2013 and 2021, there was a significant improvement in public happiness. This may be closely related to the objective improvement in air quality and the positive subjective evaluation of pollution governance. Secondly, this study proposed two hypotheses, which were supported by the data. Both the objective indicator of pollution governance and the subjective indicator were conducive to the improvement in happiness. After robustness tests, the conclusions of this study remained robust. The findings of this study are largely consistent with those of the majority of related research. For instance, Cunado et al. [37] suggested that environmental policies aimed at reducing

air pollution have a positive impact on individuals' happiness. However, there are also inconsistencies, such as Smyth et al. [27] finding that subjective air pollution perception had no significant effect on happiness. It is important to note that Smyth et al.'s study focused on subjective air pollution rather than the subjective evaluation of pollution governance. Additionally, their study utilized data from 30 Chinese cities in 2003; thus, their contrasting findings could be attributed to the relatively less severe environmental issues in China in 2003 and the weak environmental awareness among residents at that time. In contrast, this study found that subjective evaluation is even more important for happiness than objective indicators. Moreover, the sample data used in this study were more closely aligned with contemporary China in terms of time.

There are implications for policy, suggested by this study's results, for environmental measures aimed at improving public happiness. First, the happiness of the residents is both the primary objective and direct benefit of environmental governance. As early as 1776, the Declaration of Independence explicitly declared that every person has the right to pursue happiness. In June 2012, the resolution of the 66th United Nations General Assembly stated that the pursuit of happiness is a fundamental goal of human beings, and happiness and well-being are universal objectives and expectations in the lives of people worldwide. It has practical significance to recognize this in public policy goals. Happiness is not only an individual's life pursuit but also a cornerstone of social development. This issue is of great importance for countries in formulating public policies. Happiness indicators can both assess public policies and inform the design of public policies. The measurement of happiness and the enhancement of happiness have been increasingly valued by governments worldwide. The divergence between China's past economic growth and public happiness has validated the Easterlin paradox, which states that GDP does not equal happiness. Using GDP as the sole criterion for evaluating officials' performance does not meet the demands of people's livelihoods. Whether social development is harmonious should not only focus on overall economic growth but also consider the influence of a beautiful and clean ecological environment on public happiness. In the past decade, the Chinese government has made winning the blue sky defense a top priority. With significantly improved air quality as a rigid requirement, while China's GDP doubled, the average concentration of $PM_{2.5}$ decreased by 57%, and the number of heavily polluted days decreased by 93% from 2013 to 2022. This study showed that from 2013 to 2021, the happiness of residents was on the rise and was closely related to pollution governance. The government, enterprises, individuals, and society should align their goals and responsibilities and jointly address the challenges of environmental pollution. Efforts should continue to be made to govern environmental pollution and further enhance governance impacts on residents' contentment. Only by taking residents' happiness as the purpose of development and building a harmonious environment–economy–livelihood can China achieve the goal of happiness growth. The public is the ultimate beneficiary of the achievements in the blue sky defense, and their environmental interests should be given priority, effectively enhancing their happiness through environmental governance. On a global scale, air pollution governance, as a public good, is a value-based activity that serves the public interest and should aim to satisfy the public's sense of happiness. The ideal state of environmental governance is to provide the public with a comfortable ecological environment. Government policies on environmental governance should consider promoting happiness. Countries should strengthen their commitment to sustainable human development and work together to build the future that humanity aspires to while helping to promote GNH.

Secondly, it is important to focus on the effect of subjective evaluations of pollution governance on the happiness of the residents. The Chinese government has implemented numerous pollution governance policies [60]. Currently, a prominent issue in pollution governance is the need to move away from performance-oriented thinking. Local governments are particularly concerned about presenting objective data and trying to showcase their achievements in pollution control through air monitoring data. However, air pollution governance needs to return to the spirit of public service. Public participation is crucial

in environmental governance, and the subjective evaluation of pollution governance is also essential. The Aarhus Convention is an international treaty whose core principles are ensuring the transparency of information and public participation in environmental decision-making. Currently, many countries in Europe and Asia have signed and ratified this convention. In the practice of building a beautiful China, China should focus on public participation as an innovative aspect of environmental governance and develop an innovative environmental governance system. It is important to combine government-led environmental governance with channels that allow for broad public participation while guiding and relying on the public. For example, since 2019, PRCEE, with an official institutional background in China, has been conducting tracking surveys to assess citizens' ecological environmental behavior and regularly publishes annual survey reports. The report focuses on topics such as the public's evaluation of pollution prevention and governance policies. Currently, the general public has a strong willingness to participate in air pollution governance, but their actual actions are relatively weak. In fact, increasing public evaluation would be a good practical breakthrough. Improving residents' subjective evaluation of pollution governance contributes to enhancing a sense of happiness. The public has the most experience and the most say in effective governance concerning pollution. This emphasizes the importance of truly making people feel happy. We found that the residents' evaluation of governance concerning pollution matters greatly, directly affecting their happiness. In order to strengthen pollution governance more reasonably and effectively, the government should not only focus on improving objective air quality but also pay attention to the feelings of the public and consider the subjective needs of local residents in the pollution governance process. The research on the perception of air pollution originated in the US in the 1950s, and studies from developed countries preceded those from China and are more extensive in terms of findings. Chiarini et al. [61] used households from over 20 European countries as samples and proposed recommendations. It is recommended to combine subjective perceptions with objective indicators. In the era of the internet, we must also pay full attention to the social impact of the media. Social media data can reflect concerns about happiness caused by air pollution and provide real-time feedback to the government [62]. Governments and various sectors of society in all countries need to pay attention to and make efforts to enhance the subjective evaluation of pollution governance. This can improve the relationship between humans and nature, as well as the relationship between individuals and themselves, enabling the public to actively adapt to the development of nature, maintain a relaxed mindset in response to social changes, and ultimately satisfy their inner world. In this way, individuals can enjoy life, appreciate its beauty, and enhance their happiness.

6. Conclusions

Happiness serves as a mirror that reflects a nation's value choices and the level of governance. There is a strong public demand for a clean environment, and advancing environmental pollution governance is an effective key to unlocking national happiness. This study, from the perspective of public policy, explored residents' happiness as it relates to pollution governance by using both objective improvements and subjective evaluations as indicators. This study found that over the past decade, there was a positive trend in the happiness of Chinese residents, while the subjective and objective indicators of pollution governance also improved during the same period. The improvement in air quality and the evaluation of pollution governance both had a significant positive impact on happiness. This study provides valuable insights and reference data for China's efforts to defend the blue sky and improve public happiness. This study combined micro-level happiness with national environmental governance, making it an innovative interdisciplinary research. It deepens the research in environmental sociology and extends the field of happiness economics. However, it should be pointed out that this study has certain limitations, primarily in terms of the research data and statistical methods. As the study used cross-sectional panel data in the regression analysis, it is difficult to rigorously identify the

causal relationship between the subjective perception of pollution governance and the happiness of the residents. Future research could rely on large-sample longitudinal panel data and utilize more effective econometric models to explore the causal relationship between air pollution and happiness, which would further validate the findings of this study. Happiness is no longer a subject that can be thoroughly studied by a single discipline, as the factors influencing happiness involve economics, politics, culture, society, and the ecological environment. Therefore, research on happiness needs continuous integration and development across disciplines such as economics, biology, psychology, and sociology. Future studies also require strengthened interdisciplinary research.

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