

# Analysis on Residents' Satisfaction and Its Influencing Factors with Water Environment Management: Based on the Data from Xiaoqing River

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## Abstract

Xiaoqing River is one of the key rivers in the Yellow River Basin, and its management satisfaction is the content that the government should consider when formulating policies. This paper concentrates on residents' satisfaction of water environment management in Jinan section of Xiaoqing River, using questionnaires to find out the problems and effects of Xiaoqing River management. Based on the correlation analysis of the questionnaire data, the results show that five factors including the impact of water pollution, understanding of Xiaoqing River governance, willingness to participate in Xiaoqing River governance, policy publicity, and government regulation have a positive impact on the satisfaction of Xiaoqing River water environment governance. Finally, the paper puts forward some countermeasures and suggestions to increase residents' satisfaction from five aspects, such as increasing publicity efforts, paying attention to the cultivation of public participation consciousness, etc.

## Keywords

Water Environment Management, Satisfaction Survey, Correlation Analysis

## 1. Introduction

People are the main beneficiaries of water environment governance, and their satisfaction is the content that the government should consider when formulating policies. At present, there are many research methods and perspectives on the satisfaction of water environmental governance in China. Lv Tianyu *et al.* [1]

carried out an effective measurement of the performance of rural water environment governance through the survey of farmers' satisfaction, and quantitatively analyzed the influencing factors of the performance of rural water environment governance from the two dimensions of "process" and "result". Li Qian *et al.* [2] conducted a survey on the satisfaction of farmers after the implementation of "participatory" small watershed management and soil and water conservation measures, and analyzed the effect of "participatory" small watershed management and the benefit evaluation after management. The above studies are all about the satisfaction of water environment governance in specific areas.

Xiaoqing River is one of the key rivers in the Yellow River Basin, and its water quality problems seriously affect the ecological environment protection of the Yellow River Basin. The deterioration of water quality will have a negative impact on the cities along the coast and the Yellow River Basin, so the water environment treatment of Xiaoqing River is imminent. In recent years, under the guidance of Xi Jinping's thought of ecological civilization, the steps of water environment management of Xiaoqing River have begun to accelerate. In 2019, the Xiaoqing River achieved a historic breakthrough in upgrading three water quality categories in one year. In 2022, it was further upgraded to the second category, becoming a typical demonstration case of national and provincial environmental protection supervision and rectification, and promoting the governance experience throughout the province.

In recent years, the management of Xiaoqing River has attracted wide attention from all walks of life, and the number of studies on the Xiaoqing River has increased. Yang Qing [3], Dai Xuejing [4] and Teng Shaoxiang [5] analyzed the effect of Xiaoqing River treatment from the perspective of pollutants through the detection data of pollutants; Geng Xiangyan [6] and Li Caihong [7] studied the treatment policy of Xiaoqing River from the perspective of system design. Wang Chunlei *et al.* [8] studied the influence of the National People's Congress on the regulation of Xiaoqing River from the perspective of supervision. The above studies are mostly from the perspective of the government, and less consideration is given to the participation of the public.

This study takes the residents along the banks as the object, and carries out a satisfaction survey on the governance effect of water environment in Jinan section of Xiaoqing River. Through cross-analysis and correlation analysis combined with semi-structured interviews, it aims to find out the shortcomings of water environment governance in Xiaoqing River Basin and put forward suggestions for modification. It provides a reference for the government to take the next step, so as to further improve the governance of Xiaoqing River, and maximize the satisfaction of residents and the effect of government governance.

## **2. Data Sources and Research Methods**

### **2.1. Overview of the Study Area**

Xiaoqing River is a river of the Bohai Sea system in the middle of Shandong

Province in the Yellow River basin. It originates from Mulizhuang in Jinan City, flows through 5 cities such as Jinan, Binzhou, Zibo, Dongying and Weifang, finally flows into the Laizhou Bay Bohai Sea in Weifang. With the total length of 260.7 kilometers and the basin area of 103.36 square kilometers, Xiaoqing River is the largest inland river in the province (**Figure 1**).

It is a comprehensive utilization river for flood control, irrigation and shipping. The Xiaoqing River used to be clear to the bottom, but with the development of industrialization and urbanization, the discharge of industrial sewage on both sides of the Xiaoqing River has increased and the population has risen sharply, the river has gradually turned black and smelly, and the water quality has deteriorated seriously, which has become a sewage river in Jinan urban area.

Before the comprehensive treatment of the water environment in 2015, there was no section of Class III or better than Class III in the upper reaches of Xiaoqing River, and there were 11 sections inferior to Class V, accounting for 73.3%. In April 2015, the State Council issued the Action Plan for Water Pollution Prevention and Control (referred to as the “Water Ten Articles”), and Shandong Province took this opportunity to accelerate the comprehensive management of the water environment. Since the central environmental protection supervision in 2017, the water pollution control in Jinan section of Xiaoqing River has made a historic breakthrough, the water body function has been gradually restored, and the water quality of Xiaoqing River has achieved “three consecutive rises”, which is manifested by the increase in the number of sections reaching Class III or better than Class III, and the disappearance of inferior Class V sections. In 2021, there are 13 sections reaching Class III or better than Class III standards, accounting for 90%, which is 90% higher than that before the treatment; inferior Class V sections disappear, which is 73.3% lower than that before the treatment. From the point of view of reaching the standard, the rate of reaching the standard of water quality increased from 20.0% to 100%, an increase of 80 percentage points. From the perspective of over-standard items and over-standard



**Figure 1.** The map of Xiaoqing River.

multiples, within five years, the over-standard items have been reduced year by year, the over-standard multiples have been reduced as a whole, and the chemical oxygen demand and petroleum that exceeded the standard in the early stage have achieved stable standards. In addition, Xiaoqing River has successively built 3211 kilometers of municipal sewage pipelines and 3117 kilometers of rainwater pipelines, effectively improving the collection and treatment capacity of urban domestic sewage, and achieving remarkable results in water pollution control, which has been rated as a typical demonstration case of national environmental protection supervision and rectification.

## 2.2. Data Collection

The study adopts the typical survey method to collect questionnaires. In the regulation of Xiaoqing River, Jinan section is the upstream area of Xiaoqing River and a typical demonstration case of regulation. Therefore, in July 2022, the researchers went to Jinan City, Shandong Province to conduct field research, and finally selected four sites, including Mulizhuang Village, the source of Xiaoqing River in Huaiyin District, Wujiabao Street in the upper reaches and Xianggongzhuang Village and Fujiacun Village in the lower reaches of Jinan Section of Xiaoqing River in Zhangqiu District, covering villages in the upper and lower reaches, demonstration sections and non-demonstration sections. A total of 300 questionnaires were distributed and 272 valid questionnaires were recovered, with an effective rate of 90.6%.

Questionnaires and semi-structured interviews were used in the survey. First of all, the structural interview method was selected to investigate the four sites along the Xiaoqing River. The questionnaire consists of three parts: the first is to investigate the “basic information” to understand the gender, age, educational level and political outlook of the respondents. The second is “the satisfaction of Xiaoqing River water environment management”, which measures the residents’ perception of the effect of Xiaoqing River management. The third is to investigate “various possible factors affecting the satisfaction of Xiaoqing River governance.” The impact of water pollution on the Xiaoqing River and the satisfaction of governance were investigated through the Likert five-level scale. The respondents were mainly residents living near Xiaoqing River for a long time, and other respondents included government staff and village cadres who participated in the governance of Xiaoqing River. After getting the score of residents’ satisfaction, they also interviewed residents and village cadres to understand the reasons behind their dissatisfaction.

## 2.3. Research Hypothesis

Hypothesis 1: The impact of Xiaoqing River water pollution on the satisfaction of Xiaoqing River governance is positive. In this study, the impact degree of Xiaoqing River water pollution was used as an observation index to measure the change of Xiaoqing River governance perceived by residents.

Hypothesis 2: Xiaoqing River government regulation efforts and Xiaoqing River policy propaganda efforts have a positive impact on the satisfaction of Xiaoqing River regulation. The government and village-level organizations are the main participants in environmental governance, and their policy formulation, that is, the institutional environment, affects the satisfaction of the people [9]. At the same time, the organization and mobilization of grass-roots units to farmers may also affect farmers' evaluation of the governance effect [10]. In the study, we set Xiaoqing River government regulation efforts and Xiaoqing River policy propaganda efforts as explained variables to measure the institutional environment and mobilization of Xiaoqing River regulation.

Hypothesis 3: There is a difference between the understanding of Xiaoqing River governance and the satisfaction of Xiaoqing River governance, and the understanding of Xiaoqing river governance and the willingness to participate in Xiaoqing river governance have a positive impact on the satisfaction of Xiaoqing River governance. Public participation is one of the important ways of environmental governance [11]. Yue Qinglei measured public participation through public participation willingness and other dimensions, and concluded that public participation positively affected the satisfaction of environmental governance [12]. The research of Zhou Chong *et al.* found that villagers' familiarity with governance is also positively correlated with satisfaction [13]. In this study, the public participation of Xiaoqing River is measured by the understanding of Xiaoqing River governance and the willingness to participate in Xiaoqing River governance.

The comparison of the three hypotheses is shown in **Table 1** below.

### 3. Empirical Analysis

When investigating the residents along the Xiaoqing River, the ratio of male to female interviewees is about 2:1, the age is concentrated above 40 years old, and most of the education level is a primary school. In addition to the above survey of personal basic situation, the questionnaire also investigates the understanding of Xiaoqing River governance, the impact of Xiaoqing River water pollution, participation willingness and governance satisfaction. Specific Percentage analysis results are shown in **Table 2**.

**Table 1.** The comparison of the three hypotheses.

Assumptions	Layers	Indicators	Impact
Hypothesis 1	Importance	Xiaoqing River water pollution impact degree.	Positive impact
Hypothesis 2	Government	Xiaoqing River remediation efforts, Xiaoqing River policy publicity efforts.	Positive impact
Hypothesis 3	The populace	Understanding of Xiaoqing River governance and willingness to participate in Xiaoqing River governance.	Positive impact

**Table 2.** Percentage of influencing factors of Xiaoqing River governance.

Name	Options	Percentage (%)
Understanding of Xiaoqing River Regulation	Understand	53.64
	I don't understand	46.32
Impact degree of water pollution in Xiaoqing River	It's serious	2.94
	Serious	8.82
	General	25.53
	There is basically no impact	55.88
	Don't know	8.82
Willingness to participate	Unwilling to participate	8.80
	Willing to participate	91.2
Governance satisfaction	Very dissatisfied	5.88
	Not satisfied	5.88
	General	8.82
	Quite satisfied	52.94
	Very satisfied	26.47
Total		100

Data sources my own questionnaire survey results.

From **Table 2**, we can see that 53.64% of the people know about the governance of Xiaoqing River, more than 46.32% do not know, which shows that the government's propaganda efforts still have a lot of room for improvement. Through interviews with staff of the upstream management office of Xiaoqing River, we can know that the government attaches great importance to the regulation of Xiaoqing River and will carry out strict assessment of the regulation of Xiaoqing River. The government has done a lot of work, such as third-party companies testing the upstream water quality every day, sending special personnel to regularly clean up the garbage in the water, building roads on both sides of the river, and building drainage facilities. Although the government has made a lot of efforts, due to less publicity, there are still some residents who do not understand the government's governance of Xiaoqing River and the measures taken, which will be the next direction for the government to improve its work.

Secondly, only 2.94% and 8.82% of the residents chose "very serious" or "serious" about the impact of Xiaoqing River water pollution, 55.88% of the residents chose basically no impact, and about 34% of the remaining residents felt that the impact was general or unclear. The above results show that the water pollution of Xiaoqing River has little or no impact on most residents. It is understood that the Xiaoqing River has built a "national standard station + micro-station" global monitoring system, which can use 81 water quality monitoring "sentinels" to monitor the urban water environment quality in real time. In

addition to implementing the inspection system of river length system, the local government has also established a mechanism of encrypted inspection by environmental protection grid members and investigation on foot along the river, forming a closed-loop of rapid response of online monitoring, tracing and immediate rectification. These powerful water pollution control measures have improved the huge impact of the pollution of Xiaoqing River on the residents along the river to a certain extent.

In addition, the data results show that the public's willingness to participate in the governance of Xiaoqing River is high, 91.2% of the residents choose to participate, only 8.8% of the residents are unwilling to participate, indicating that the public's awareness of water environmental protection is strong, most of the people are willing to contribute to the governance of water environment, which provides a good foundation for the government to govern Xiaoqing River.

What's more, from the data, we can see that the overall satisfaction of Xiaoqing River governance is 52.94%, more than half of the residents are satisfied, and the proportion of very satisfied has reached a quarter, which proves that the overall satisfaction of residents is at a high level. However, about 10% of the residents still choose to be very dissatisfied and relatively dissatisfied. Through interviews with these residents, the main reasons for dissatisfaction include: First, farmers are not satisfied with the economic compensation for the widening project of Xiaoqing River. Second, after the construction of the project, the ecological restoration of the river is not in place. During the construction of Xiaoqing River, farmers' farmland was expropriated. At that time, the compensation standard for land expropriation was formulated by the government, which did not compensate for the cash crops that had been produced on the farmland. Farmers lost their economic sources, but the government's economic compensation was not enough to maintain their livelihood, resulting in huge losses for farmers. In addition, after the completion of the construction of Xiaoqing River, some sections of the road have not done a good job of road greening and ecological restoration on both sides of the river, and the road is uneven. After complaints, the construction has been carried out again, but the construction effect is unsatisfactory, which still affects the travel of residents.

It can be seen from **Table 3** that the average overall satisfaction of Xiaoqing River sewage treatment with a full score of 5 is 3.882, which proves that residents are satisfied with the overall treatment of Xiaoqing River water pollution. According to the data of specific improvement indicators, people are also satisfied with the performance of water odor reduction, water clearer, floating debris reduction and river greening improvement since the Xiaoqing River regulation, among which the highest average satisfaction is the improvement of water quality, with an average satisfaction of 0.765, followed by the improvement of river greening, with an average satisfaction of 0.676; The average satisfaction of water odor reduction and floating debris reduction was 0.647. From this, we can see that the residents agree with the effect of Xiaoqing River treatment, and think that the sewage situation of Xiaoqing River has been improved in all aspects

**Table 3.** Average satisfaction of Xiaoqing River as a whole and each index.

Name	Average value	Standard deviation	Minimum value	Maximum value
Satisfaction of sewage treatment in Xiaoqing River	3.882	1.066	1	5
The water is clearer	0.765	0.426	0	1
The floating objects are reduced	0.647	0.480	0	1
Improvement of river greening	0.676	0.470	0	1
Other	0.118	0.323	0	1

Data sources my own questionnaire survey results.

**Table 4.** Chi-square analysis results of understanding the satisfaction of Xiaoqing River sewage treatment.

Topic	Name	Understanding of Xiaoqing River Regulation		Total	$\chi^2$	p
		Understand	I don't understand			
	Very dissatisfied	2	14	16		
Xiaoqing River governance satisfaction	Not satisfied	0	16	16	71.918	0.000**
	General	16	8	24		
	Quite satisfied	74	80	144		
	Very satisfied	74	8	72		
	Total	146	126	272		

\*p < 0.05; \*\*p < 0.01. Data sources my own questionnaire survey results.

after the treatment.

In order to explore the difference of the satisfaction of Xiaoqing River treatment, this study uses the chi-square test to analyze the difference between the understanding of Xiaoqing River treatment and the satisfaction of Xiaoqing River sewage treatment. The specific results are shown in **Table 4**. It can be seen from the results in **Table 4** that the understanding of Xiaoqing River regulation is significant at 0.01 level (Chi = 71.918, p = 0.00 < 0.01), which means that the understanding of Xiaoqing River regulation is different from the satisfaction of Xiaoqing River regulation. Through the percentage comparison, it can be seen that the number of very dissatisfied and relatively dissatisfied people who do not know the choice of Xiaoqing River regulation work is 14, which is higher than 2 people who know the choice of Xiaoqing River regulation work. 74 people were very satisfied with the choice of knowing the Xiaoqing River regulation work, which was significantly higher than who did not know the Xiaoqing River regulation work, which proved that knowing the situation of Xiaoqing River regulation had a certain impact on the choice of Xiaoqing River regulation satisfaction.

In order to further explore the impact of Xiaoqing River water pollution, the



government's regulation efforts, policy publicity efforts, the understanding of Xiaoqing River governance, and the correlation between residents' participation in Xiaoqing River governance and satisfaction with Xiaoqing River governance, Spearman correlation analysis is carried out below, and the specific analysis results are shown in **Table 5**.

It can be seen from the results in the above table that there is a positive correlation between the explained variables Xiaoqing River water pollution impact degree, government regulation efforts, policy publicity efforts, Xiaoqing River governance understanding, Xiaoqing River governance residents' participation and the satisfaction of Xiaoqing river governance, and the p values are less than 0.05. Hypothesis 1, Hypothesis 2 and Hypothesis 3 are proved. Among them, the correlation values between government regulation efforts, policy propaganda efforts, understanding of Xiaoqing River regulation and satisfaction are 0.339, 0.512 and 0.425, showing a significant level of 0.01, which indicates that there is a significant positive correlation between satisfaction of Xiaoqing River regulation and government regulation efforts, policy propaganda efforts and understanding of Xiaoqing River regulation. And its correlation value is far greater than 0, which shows that the satisfaction of Xiaoqing River regulation is closely related to the government's regulation efforts, policy publicity efforts and the understanding of Xiaoqing River regulation. In addition, the correlation coefficients between the satisfaction of Xiaoqing River governance and the impact of Xiaoqing River water pollution and the willingness of residents to participate in Xiaoqing River governance are 0.209 and 0.185, showing a significant level of 0.05, which indicates that there is a significant positive correlation between the satisfaction of Xiaoqing river governance and the impact of Xiaoqing River water pollution and the willingness of residents to participate in Xiaoqing River governance.

**Table 5.** Spearman analysis results of factors affecting the satisfaction of Xiaoqing river governance.

<b>Satisfaction of Xiaoqing River Regulation</b>		
Impact degree of water pollution in Xiaoqing River	Correlation Coefficient	0.209
	<i>P-value</i>	0.015*
Government Regulation of Xiaoqing River	Correlation Coefficient	0.339
	<i>P-value</i>	0.000**
Propaganda of Xiaoqing River Policy	Correlation Coefficient	0.512
	<i>P-value</i>	0.000**
Understand the situation of Xiaoqing River regulation	Correlation Coefficient	0.425
	<i>P-value</i>	0.000**
Willingness to Participate in Xiaoqing River Management	Correlation Coefficient	0.185
	<i>P-value</i>	0.031*

\*p < 0.05, \*\*p < 0.01. Data sources my own questionnaire survey results.

#### 4. Conclusions and Recommendations

The above study shows that after the comprehensive regulation of Xiaoqing River by the government, the public is generally satisfied with the environmental management of Xiaoqing River, 79.43% of them are satisfied and very satisfied, and only 11.76% of them are dissatisfied and very dissatisfied. After the regulation, the water quality of Xiaoqing River has improved, the odor has disappeared, the floating debris has decreased, and the greening has improved; The influencing factors of Xiaoqing River governance satisfaction include the influence degree of Xiaoqing River water pollution, government regulation efforts, policy publicity efforts, the understanding of the Xiaoqing River governance, and the participation of residents in Xiaoqing river governance. These five factors have a significant positive impact on Xiaoqing river governance satisfaction. At the same time, the study found that the government's policy propaganda is not enough, farmers are not satisfied with the economic compensation measures of Xiaoqing River widening project, and the ecological restoration of the river is not in place after the construction of the project.

Based on the above research conclusions, in order to improve the satisfaction of Xiaoqing River regulation, this paper puts forward the following suggestions:

First, the government needs to increase policy publicity. Understanding of Xiaoqing River regulation has a significant positive impact on the satisfaction of Xiaoqing River regulation. Therefore, the government can carry out policy propaganda in coastal communities or villages, so that residents can understand the relevant policies of Xiaoqing River governance, and experience the improvement brought by Xiaoqing River governance. Make full use of the landscape belt along the Xiaoqing River, promote the organic integration of the Xiaoqing River's "transportation corridor, ecological corridor, cultural corridor and landscape corridor", and take the comprehensive regulation and development and utilization of the Xiaoqing River as one of the key tasks of "making every effort to build" five Jinan "and speeding up the construction of the central city of the Yellow River Basin".

Second, we should attach importance to the cultivation of people's awareness of participation. There is a positive correlation between satisfaction of Xiaoqing River governance and Xiaoqing River governance. Therefore, the government can improve the residents' willingness to participate in the governance of Xiaoqing River through education and publicity, and at the same time, strengthen the implementation of incentive policies, broaden the channels for people to participate in the governance of Xiaoqing River, and encourage and guide social forces to participate in Xiaoqing River governance. Establish a Xiaoqing River supervision and maintenance system involving various forces, clearly implement the participation of government departments, social organizations and coastal beneficiaries in supervision, so that people's willingness to participate and public satisfaction increase synchronously.

Third, we should pay attention to safeguarding the vital interests of the pe-

sants at the bottom. When harnessing the Xiaoqing River, the project planning should be carried out reasonably according to the different layout and scale characteristics of farmland and water conservancy in different places, and the land should not be requisitioned compulsorily. By improving the economic compensation standards and mechanisms, we can protect the economic interests of the bottom farmers, ensure their long-term livelihood, and improve their support and satisfaction for Xiaoqing River governance.

Fourth, do a good job in the follow-up ecological restoration of the project. During the construction of Xiaoqing River Project, long-term planning should be given priority to, the restoration of coastal roads and embankments should be paid attention to, and the roads occupied after construction should be restored to their original state, so as to create a convenient and beneficial Xiaoqing River governance. In addition, due to the special geographical location of Xiaoqing River, attention should be paid to strengthening the restoration of water ecological environment, delimiting the red line of ecological control for spring protection, forming a water resources allocation pattern of “six horizontal and eight vertical, one net and five water moistening spring city”, maintaining a complete spring ecosystem, effectively improving the urban water environment, restoring the urban water ecology, and promoting the ecological protection and high quality development of the Yellow River Basin.

Fifth, the government should intensify its efforts to rectify the situation. Therefore, the government should continue to attach importance to the ecological environment management of Xiaoqing River, firmly and effectively implement the relevant policies of Xiaoqing River water pollution, make use of effective management systems such as river length system, supervise the implementation of policies, and effectively reduce the impact of water pollution. Improve the governance performance of the government and the governance satisfaction of the residents along the Xiaoqing River.

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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