

## **Exploring the Environmental Awareness of the Residents in Pearl River Delta of China**

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### **Abstract**

Environmental pollution and ecological damage caused huge economic losses and harmed the health of the people so as to affect the stability of society. Industries emit a large amount of untreated waste water, gas, slag and other hazardous wastes, which will seriously disturb the ecological balance of agriculture and natural resources and cause great harm; the spread of environmental pollution and public hazards directly endangers the health of the people. Along with the development of China, the problem of environmental degradation has become increasingly prominent, 78% of rivers that are close to industrialized townships cannot be sources of drinking water. This study intends to explore the environmental awareness of the residents in the Pearl River Delta of China, one of the most developed areas in China. The results of the survey indicated that 31.8% of participants believe that only the government is effective in environmental protection, people can then be active in participation of environmental protection.

**Keywords:** Environmental awareness, Pearl River Delta, China, environmental protection, Pollution.

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## **1. Introduction**

Since China's reform and opening in the 1980s, the social economy has developed rapidly, and the standard of living of the people has also been continuously improved. However, the problem of environmental degradation has become increasingly prominent (Chao, 2006). The water pollution has deteriorated the quality of daily life water usage, among the 1200 rivers in China, 850 of them have been polluted to certain level, and situations were continuously worsen. Moreover, among the top 7 river systems, 40% are not suitable for being sources of drinking water, and the percentage is raised to 78% for rivers that are close to the industrialized townships (Wu et al. 2000). If harmful substances are not handled properly, the environment will be polluted, resulting in destruction of industrial and agricultural production and people's health. After physical and chemical changes, environmental pollutants produce new substances. Many of them are harmful to people's health. These substances enter human bodies through different pipes (respiratory tracts, digestive tracts and skin). Some of them directly cause harm, and others have cumulative effects to seriously endanger human health. Different substances have different effects. For example, carbon dioxide, carbon disulfide, hydrogen sulfide, fluoride, nitrogen oxides, chlorine, hydrogen, carbon monoxide, sulfuric acid (fog), lead, mercury, barium chloride, exhaust gas such as smoke and dust pollute the air after their emission into the atmosphere. Wastewater discharge into rivers, lakes and oceans causes the water quality to deteriorate, destroys aquatic resources, and leads to negative effects on domestic and production water.

### **1.1 The impact of development on the ecological environment**

With the acceleration of industrialization and urbanization, environmental issues have already become the bottleneck of economic development in China, which are also global issues threatening the survival and development of the entire human race. Human survival and development cannot be separated from the ecological environment in which people live, and healthy ecological environment is conducive to economic and social development (Bohlem and Schlegelmilch, 1993). Ecosystem is a huge system covering all countries and regions. When people's survival and development are threatened, eventually it will trigger a series of ecological problems. In human activities, ecological and environmental issues are obvious in two aspects. One is ecological destruction, such as soil erosion, desertification, and lack of resources, climate change, and ecological imbalances. The other is environmental pollution. A lot of pollutants from human activities, such as wastewater, exhaust gas, solid waste and noise, are discharged into the environment, leading to a decline in environmental quality (Straughan, 1999), thereby affecting and endangering human health and destroying biological resources. These two aspects are mutually affected with a composite effect. If the ecological environment is damaged, it will hinder economic development so as to affect the speed and quality of economic development (Coe et al, 2008; Mahene, 2008).

### **1.2 The impact of development on climate and environment**

The impact of human activities on climate change has also been getting bigger and bigger (Scott and Willits, 1994). Air pollution is from exhaust gas, carbon black and dust from factories, power stations, and motor vehicles discharging into the air. Polluted air is harmful to the human body; besides, the exhaust gases in the air also form acid rain, which causes damage to trees, rivers, lakes and buildings. In addition, many exhaust gases seriously damage the ozone layer, leading to the addition of many harmful substances in the atmosphere. Water is an important resource for human survival. If the amount and type of substances contained in the water may cause harm to people, animals, plants and the environment, water will be polluted. Acid rain pollutes lakes and rivers. Untreated sewage directly into rivers or oceans produces toxic chemicals and waste, leading to water pollution, cloud rain and air pollution.

### **1.3 Overview of Pearl River Delta**

Pearl River Delta Economic Zone is established by Guangdong Provincial People's Government in 1994, subject to national policy. Here is the most active and developed region in the economic construction of southern China. The area is mainly adjacent to Hong Kong so that it is very conducive to the integration of local economic and information resources. Pearl River Delta is China's advanced manufacturing base and the gateway to the outside world. South China, Central China, and Southwest China are one of the three major urban agglomerations with the most concentrated population, the strongest innovation capability and the strongest comprehensive strength in China. It is known as the "Nanhai Pearl," located in the south-central part of Guangdong Province, China, Pearl River Estuary and the surroundings. Pearl River Delta is a geographical area and also an economic area. But the range is slightly different. In a narrow sense, Pearl River Delta Economic Zone includes Guangzhou, Shenzhen, Zhuhai, Zhongshan, Jiangmen, Dongguan, Huizhou (except Longmen), Foshan, and Zhaoqing (urban, Sihui). The Greater Pearl River Delta refers to the nine cities of the front Pearl River Delta. Hong Kong and Macau-two special administrative regions-are the busiest and most developed regions in China. The combination of railways, highways, waterways, civil aviation and other modes of transport has been initially formed to connect Hong Kong, Macau, all provinces and the country as a more comprehensive integrated transportation network. Since China's reform and opening, environmental damage is accompanied with rapid development of industrialization and urbanization. If strengthen management is not conducted, there will be irreversible consequences for the ecology.

### **1.4 The significance of resident survey in the region**

In the study, the environmental awareness of the residents in Pearl River Delta is analyzed with the sixteen dimensions to realize whether there are differences in the attitudes of the residents in Pearl River Delta in solving environmental problems, their awareness of contaminants, and their visions for nature, including their

awareness of the pollution level in the Pearl River Delta region, resolving attitudes, endorsing opinions with nature, etc. under various education standards, occupations and industries. Furthermore, it is attempted to realize if there is connection between responsibility awareness/cost consciousness and environmental protection behavior. The respondents of this paper are the corporate employees located in the Pearl River Delta and residents living in the neighborhood. In the use of questionnaire method, their perception and sensitivity to the surrounding environment, attitude of respecting the natural environment, concern about the impact of human beings on nature, etc. are explored. Based on the analyzed data, the policies and recommendations for the environment are proposed, expecting to provide a new theoretical basis for environmental protection of local companies, strengthen local government's environmental protection efforts, improve residents' awareness of environmental protection, and achieve the purpose of harmonious coexistence between man and the natural environment.

### **1.5 Investigation methods and data processing**

This study mainly uses the questionnaire survey method to conduct investigation and research on environmental awareness of the residents in nine cities and towns of the Pearl River Delta. There are a total of 20 questions, including 12 multi-choice questions and 8 multi-select questions, in which 1-4 items are basic personal data. The number of questionnaires issued was 500, with 422 recovery questionnaires; the recovery rate is 84.4%. The questionnaire data is analyzed with the SPSS software.

## **2. Literature Review**

With the development of society, people's awareness of environmental protection has gradually increased. The term environmental awareness has also gradually appeared in the public's field of vision. Alsmadi (2007) first attempted to define environmental awareness as people's strong sense of responsibility in the face of environmental issues in their daily lives. At this stage, environmental awareness can only be measured in the daily actions of the relevant actors.

Until the 1970s, the understanding of the relationship between people and the environment in Western society was a traditional sociological paradigm based on anthropocentrism. VanLier and Dunlap (1978) suggested the traditional sociological paradigm has become difficult to adapt to the needs of society, causing traditional theories to highlight their own improvement strategy. They considered the initial paradigm would lead people to cause excessive burden on the environment and there is a mistake in the point of view that the increased human needs would increase the environmental load indefinitely. They proposed a new paradigm which is essentially contrary to the traditional sociological paradigm, known as the New Environment Paradigm scale (NEP).

The new environmental paradigm scale has 12 independent options with no relevance. These independent options reflect people's understanding and awareness

for the harmony between humans and nature. During the research of VanLier and Dunlap, they adopted the new environment paradigm to make the questionnaire survey for two subjects. They considered the questionnaire has excellent predictive accuracy and structural reliability. Until 2000, some elements of the new environment paradigm had been not able to meet the development of the information age. Therefore, VanLier and Dunlap upgraded it into the new ecological paradigm (NEP2). In the new paradigm, the data indicators analyzed increased to 15. Based on the new environmental paradigm, Kuhn and Jackson developed 21 assessment tools for variables, dividing 21 variables into four levels through analytic hierarchy analysis, namely environmental damage, harmony between persons and nature, the relationship between quality of life and environmental awareness, and the limited load of the ecosystem, in the process of scientific and technological progress and economic development. Lieflander and Bogner (2014) conducted detailed analysis in ecological attitude and values of age and sex to compare the differences between the traditional paradigm and the new paradigm. Five categories were proposed, namely the environmentally conscious ceiling caused from economic growth, changes in social concepts, the need for future generations to grow, natural values, the orderly and game-like development of ideas. Franzen (2013) analyzed the development of environmental concern using the environmental modules of the International Social Survey Program. Abun (2018) explored that the environmental problems are caused by human attitude toward environment and such attitude affects environmental behavior. Izadpanahi and Tucker (2018) developed a new instrument for measuring children's environmental attitudes.

Environmental awareness started relatively late in China. Its development status lacks a specific operating mechanism. Relatively speaking, the current research scale is rough with inadequate applicability, which cannot meet most of the actual assessment needs. Hong is the first one to introduce NEP into China and he revised its practical applicability according to China's current situation. After relevant research and evaluation of ecological environment in some cities in China in 2003, the Chinese version of the new ecological paradigm was considered to have acceptable reliability and effectiveness, but there were some shortcomings that couldn't be overcome temporarily. Therefore, some scholars modified and extended the NEP model and conducted its applicability assessment for the actual situation of rural areas in western China at the same time. However, it was found in the actual application process that the extended version led to some questions such as blurred key factors, poor structural integrity, and poor system consistency. If the nine elements were removed in the new NEP, the remaining six elements for evaluation of the rural areas of western China would improve the consistency of the system, reliability, and feasibility. Others use the revised NEP model to conduct interviews for the citizens of China's ten major cities. Statistical analysis shows the scale has good accuracy.

### **3. Descriptive Statistics of Respondents**

Among the 422 respondents in this study, those under 20 account for 47%, those at the age 21-35 account for 25.4%, those at the age 36-60 account for 21.4%, and those over 60 account for 6.2%. The ages under 20 are the most and those over 60 are the least. Females account for 51.5% and males account for 48.5%. On gender distribution, there are more women. The primary school education standards accounts for 9.2%, the junior high school education standards accounts for 30.7%, the senior high school or senior middle school education standards accounts for 44.5%, and the junior college or undergraduate education standards accounts for 6.6%. On academic distribution, the most are the senior high school or senior middle school education standards and the least are graduate students and above. As for occupation distribution, students account for 43.5%, workers account for 18.8%, farmers account for 10.4%, science and technology workers account for 7.7%, and other types of workers account for 19.6%. Students have the largest proportion and science and technology workers have the least proportion. Among the investigators, those who know about environmental information through TV account for 25.1%, those through newspapers account for 15.2%, those through the Internet account for 54.4%, and those through friends and relatives account for 5.3%. As for respondents' pipelines of understanding the environmental knowledge, the network has the largest proportion 54.4%, followed by TV with the proportion 25.1%. Among the investigators, those aware of exhaust gases account for 27.7%, those who aware of wastewater account for 26.1%, those who aware of waste residues account for 15.5%, those who aware of waste paper account for 5.8%, those who aware of waste liquid account for 11.7%, and those who aware of white exhaust gases account for 13.2%. As for respondents' perception of the three wastes, waste gases, water and residues account for the most. Among the investigators, 6.6% consider the current situation of urban pollution is very serious, 21.4% consider the current situation of urban pollution is relatively serious, 62.6% consider the current situation of urban pollution is not ideal, 5.6% consider there is no problem for the current situation of urban pollution, and 3.9% consider they do not understand the current situation of urban pollution. As for respondents' awareness of the severity of the fouling condition in their living cities, 61.1% consider it is not too serious and only 6.4% consider it is very serious; 9.8% consider the source of pollution mainly comes from the atmosphere, 21.4% consider the source of pollution mainly comes from factories, 27.1% consider the source of pollution mainly comes from life, 21.3% consider the source of pollution mainly comes from traffic, 7.6% consider the source of pollution mainly comes from agriculture, and 12.9% consider the source of pollution mainly comes from noise. The largest proportion in respondents' consideration of the main pollution in the environment lies in life, factory and traffic pollution. Among the respondents, 75.4% consider the environmental problems need to be solved urgently, 11.9% consider the environmental problems have no big deal, 7.9% consider the environmental problems are not urgent, 1.2% consider the environmental problems have no need to be resolved, and 3.6% consider the environmental problems have

no relation with them. As for respondents' thoughts about whether environmental issues need to be resolved urgently, 74.9% think it is imminent, 1.2% believe there is no need to solve it, 5.0% consider the government can do its duty to manage the environment, 51.1% consider the government's environmental governance attitude is general, 30.7% consider the government's efforts in this area are not enough, 7.2% consider the government does not have supervision, and 6.0% do not understand the government's attitude towards environment governance. As for the respondents' thoughts about the government's attitude towards the current state of pollution, 50.5% think it is normal and only 5% believe that they are doing their duty. Among the investigators, 31.8% consider the environment can get effective governance only through the government, 6.3% through lectures, 7.7% through media promotion, 37.7% through personal cultivation, and 16.5% through increased penalties. As for respondents' thoughts about effective methods of pollution prevention, the largest proportion is in strengthening self-cultivation and government participation in advocacy and supervision; 58.8% realize relevant environmental information for energy conservation and carbon reduction, 21.5% for cleaner production, 6.0% for total control, and 13.7% for environmental impact assessment; the highest proportion of the respondents who understand environmental information is energy saving and carbon reduction, accounting for 58.8%, followed by clean production. Among the investigators, 23.7% actively pay attention to environmental issues, 61.6% pay attention to environmental issues when they have time, and 7.6% do not care about environmental issues; as for whether the respondents are willing to pay attention to environmental information, 61% express they do so when they have time and 23.7% express they actively care about it. Among the investigators, 6.2% consider the reason of no governance is for the lack of funds, 12.3% for no preferential policy, 12.8% for no treatment technology, and 65.9% for insufficient degree of attention. As for respondents' consideration of the reasons why most companies today do not conduct centralized processing for pollutants, 65.9% think enterprises do not pay enough attention. Among the investigators, 16.1% are very willing to increase environmental protection costs, 32.2% are more willing to increase environmental protection costs, 24.6% have no subjective bias, 20.9% are not willing to raise environmental protection costs, and 5.2% are opposed to increase environmental protection costs. As for whether the respondents are willing to accept price increases to defend the environment, 32.2% are more willing, and 44.6% have no subjective bias and are not willing. 4.2% of the investigators may throw away the trash when they can't find the trash can, 6.7% may throw it away when no one looks at them, 5.4% may put it in an inconspicuous place, 54.7% may look for trash can to throw it away, and 29.0% may take it with them. 54.7% of the respondents will find the trash can to throw it and 29% will take it with them first. As for how to handle the noise from the casino near their home, 32.1% choose to endure it, 19.6% for door-to-door negotiations, 28.7% to find an environmental protection department to solve it, and 19.6% choose other ways; 32.1% of the respondents will endure it and 28.7% will ask for an environmental protection bureau to solve it. From their own

environmental protection awareness, 59.1% don't litter, 14.6% are willing to do publicity and environmental protection work, 17.6% can report illegal violations, 5.2% have no subjective bias, and 59.1% have other ideas. 59.1% of the respondents express they don't litter and 17.1% express they may report illegal violations. 59.7% think life and environment should be adapted to nature, 19.7% think life and environment should use nature, 8.3% think life and environment should conquer nature, and 11.8% have no clear opinions about life and the environment. As for respondents' views on nature, the most proportion is to be responsible for nature, accounting for 59.7%.

#### 4. Statistical Analysis of Environmental Awareness

In this section, the statistical analysis of the environmental awareness of residents in the Pearl River Delta is conducted. The statistical method is the chi-square test. The detailed results are explained below.

##### 4.1 Analysis of ages and attitudes towards environmental issues

In this section, whether there are differences between respondents' ages and their opinions of the urgency of treating pollutants, untreated contaminants, and protecting nature is analyzed, which are explain as follows:

###### 1. Age and the awareness of the urgency of treating pollutants.

In the Chi-Square test for age and the awareness of the urgency of treating pollutants, the significance is found to be 0.004 (as shown in Table 1), less than  $\alpha$  (0.05). Therefore, the null hypothesis is rejected, representing there are differences in the awareness of solving pollution urgency under different ages. Known by the crosstab, among the respondents under 20, 84.3% think it is imminent, which is far higher than other age groups.

**Table 1: Chi-Square test for age and awareness differences of urgency of treating pollutants**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	29.170	12	.004
Likelihood ratio	30.017	12	.003
Linearity versus linearity relevance	3.356	1	.067
The number of valid observations	418		



### 2. Age and no treating for pollutants.

In the Chi-Square test for age and no treating for pollutants, the significance is 0.006, less than 0.006. Therefore, the null hypothesis is rejected, representing there are differences in the awareness of no treating for pollutants under different ages, as shown in Table 2.

**Table 2: Chi-Square test for age and awareness differences of no treating for pollutants**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	23.179	9	.006
Likelihood ratio	19.030	9	.025
Linearity versus linearity relevance	6.638	1	.010
The number of valid observations	409		

### 3. Age and endorsing opinions with nature.

In the Chi-Square test for age and endorsing opinions with nature, the significance is 0.024, less than  $\alpha$  (0.05). Therefore, the null hypothesis is rejected, representing there are differences in endorsing opinions with nature under different ages, as shown in Table 3.

**Table 3: Chi-Square test for age and awareness differences of endorsing opinions with nature**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	19.132	9	.024
Likelihood ratio	21.729	9	.010
Linearity versus linearity relevance	.012	1	.913
The number of valid observations	419		

## 4.2 Education standards and awareness of environmental protection costs

In this section, respondents' education standards and their awareness for environmental protection costs are analyzed, including whether there are differences in the knowing of World Environment Day and their opinions of accepting raising environmental protection costs, which are explain as follows:

### 1. Education standards and the knowing of World Environment Day.

In the Chi-Square test for education standards and the knowing of World Environment Day, the significance is 0.005, less than 0.005. Therefore, the null

hypothesis is rejected, representing there are differences in the knowing of World Environment Day under different education standards, as shown in Table 4.

**Table 4: Chi-Square test for education standards and knowing differences of world environment day**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	14.820	4	.005
Likelihood ratio	14.837	4	.005
Linearity versus linearity relevance	2.742	1	.098
The number of valid observations	411		

2. Education standards and acceptance to improve environmental protection costs.

In the Chi-Square test for education standards and acceptance to improve environmental protection costs, the significance is 0.001, less than 0.05. Therefore, the null hypothesis is rejected, representing there are differences in acceptance to improve environmental protection costs under different education standards, as shown in Table 5.

**Table 5: Chi-Square test for education standards and acceptance differences to improve environmental protection costs**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	40.142	16	.001
Likelihood ratio	33.824	16	.006
Linearity versus linearity relevance	.408	1	.523
The number of valid observations	407		

### 4.3 Occupation and awareness of pollution degrees, resolving attitudes, and endorsing opinions with nature

In this section, whether there are differences in respondents' occupation and their awareness for pollution degrees, resolving attitudes, and endorsing opinions with nature are analyzed, which are explain as follows:

1. Occupation and their awareness for pollution degrees.

In the Chi-Square test for occupation and awareness for pollution degrees, the significance is 0.008, less than 0.005. Therefore, the null hypothesis is rejected, representing there are differences in their awareness for pollution degrees under different occupations, as shown in Table 6.

**Table 6: Chi-Square test for occupation and awareness differences for pollution degrees**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	32.904	16	.008
Likelihood ratio	33.837	16	.006
Linearity versus linearity relevance	.223	1	.637
The number of valid observations	405		

2. Occupation and attitude towards resolving necessarily.

In the Chi-Square test for occupation and attitude towards resolving necessarily, the significance is 0.000, less than 0.05. Therefore, the null hypothesis is rejected, representing there are differences in attitude towards resolving necessarily under different occupations, as shown in Table 7.

**Table 7: Chi-Square test for occupation and attitude differences towards resolving necessarily**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	77.860	16	.000
Likelihood ratio	76.354	16	.000
Linearity versus linearity relevance	22.334	1	.000
The number of valid observations	411		

3. Occupation and endorsing opinions with nature.

In the Chi-Square test for occupation and endorsing opinions with nature, the significance is 0.023, less than 0.05. Therefore, the null hypothesis is rejected, representing there are differences in endorsing opinions with nature under different occupations, as shown in Table 8.

**Table 8: Chi-Square test for occupation and endorsing opinion differences with nature**

	Numerical value	Degree of freedom	Significance (two-tailed)
Pearson Chi-Square	23.547	12	.023
Likelihood ratio	21.224	12	.047
Linearity versus linearity relevance	4.836	1	.028
The number of valid observations	412		

## 5. Conclusion

The environment and the economy are inseparable and affect each other, as a complement to each other. The richer people are, the higher their quality requirements for the environment will be and the easier they will take proactive measures to reduce the impact of environmental degradation problems. In addition to the economic impact, education is also an important factor affecting the development of environmental protection concepts. Therefore, the government should guide and demonstrate the public to raise public awareness of environmental protection. Starting from basic education, in the process of being educated, the government should pay attention to the development of environmental awareness and incorporate environmental protection into everyday life so as to gradually cultivate citizens who love society and environment. In recent years, most environmental disasters are closely related to activities of local businesses and the lack of public power of national decision-making bodies. In view of this, the government should focus on the establishment and improvement of relevant systems to safeguard citizens' equal participation rights. For example, the people should have the right to understand relevant issues, participate in the development of large projects and feasibility studies, control the implementation of large projects, etc. In the field of education, the government should pay attention to basic education work, raise residents' awareness of environmental protection, and increase their sense of participation. The government should play an innovative role in promoting environmental protection and introduce cross-border cooperation between relevant organizations in daily work to internalize public behavior from negative expectations to positive responses and mutual cooperation to reduce conflict and friction in policy implementation. The survey suggests 31.8% of participants believe that only the government is effective in environmental protection and this ratio is the highest. It can be seen that the people recognize the government is authoritative in environmental protection. Government policies can effectively promote people's active participation in environmental protection, e.g., to eliminate environmental damage through sanctions and criticism, and to support and promote the development of government incentives and sanctions mechanisms in environmental protection through appropriate behavior rewards.

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