# What is the Level of Satisfaction with Environmental Factors During COVID-19?

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**ABSTRACT:**

**Introduction:** In response to climate change and infectious disease prevention, the importance of the environment and health has increased, as human health and wellbeing has been devastating from the Covid-19 crisis. Satisfaction is a key factor of the quality of life. In order to provide policy priorities combating climate change and Covid-19, providing the satisfaction among environmental factors and key factors affecting the willingness to pay for the environmental health might be crucial.

**Objectives:** The purpose of this study is to identify satisfaction of residents with environmental factors and examine determinants of influencing their willingness to pay for the environment health.

**Methods:** An importance-performance analysis was used to explore the level of satisfaction regarding environmental factors during Covid-19. This is based on a survey data of 332 residents in Chungnam province, South Korea. Logistic regression analysis was implemented to find out the factors influencing the willingness to pay (WTP) for environmental health.

**Results:** The findings revealed that climate change, waste, energy, air, environmental health were key attributes required the highest priority for improvement. Logistic regression analysis examined that satisfaction of environmental health was a main factor associated with the residents' WTP for environmental health.

**Conclusions:** The attributes which are low satisfaction and high perception on the importance are needed to be improved. The outbreak of Covid-19pandemic might be relevant to decrease in the satisfaction of environmental health. This suggests that the improving the services of environmental health might be important for post- pandemic period. These finding could contribute to improving environmental factors and the sustainability of environmental planning.

## 1. Introduction

Unprecedented Corionavirus outbreak has been devastating impact on human wellbeing and life [1,2]. The importance of the environment and health has increased as Covid-19 crisis lead to have an influence on people' physical and mental health [3, 4].

Satisfaction with environmental factors is a key factor of the quality of life and a psychological factor with daily experiences [5, 6]. Previous researches have considered the level of satisfaction among environmental factors such as air and energy [7-10]. This implied that the satisfaction of residents might vary significantly from spatial and socio-political inequality [11]. In addition, many studies have

investigated the estimated WTP for environmental quality improvement [12-14]. Several studies have provided the concept of climate mitigation policy for achieving sustainability and willingness to pay for climate change mitigation [15-20] associated with energy and air pollution [17, 21]. However, due to increases on the importance of environmental factors and health concerns during Covid-19 outbreak, little is known about the satisfaction of residents among environmental factors, in particular, in Asia and South Korea.

Chungnam Province is one of the eight provinces of South Korea and is so called urban-rural complex areas with a 2012 GDP per capita of $56,133 (Chungnam

province, 2021). Chungnam Province is divided into 8 cities (si) and 7 counties (gun) which is located in the southwest of the Korean Peninsula. The total area of South Chungcheong Province is 8,247.2 km$^2$ as of early 2023, accounting for 8.2% of the total area of the country (100,431km$^2$). It has excellent ecological natural resources, and internationally important biological habitats such as uninhabited islands, marine ecology near the west coast. The water resource uses the Geumgang River, which is one of the major river in South Korea, following the Han River and Nakdong river. Geumgang River is used as a major source of water for living, industrial, and agricultural purposes in the areas. The water resources is rich in endemic fish species and the water quality varies from upstream and downstream. There are concerns about environmental health damage to residents that have been continuously raised due to coal, steel complexes, asbestos, the residents may be sensitive to environmental health. In addition, the proportion of the population aged 65 or older is 18.6% (as of 2020), which might continue to be higher than the national rate and may increase the social burden due to the increase in the health vulnerable population.

Moreover, during and after COVID-19 pandemic, a lot of researches have emphasized the importance of ecosystem services such as natural ecosystem services and marine ecology [22-25]. A lot of existing studies have shown the determinants of willingness to pay for improved water supply and quality, climate change, air pollution [26-30]. Several studies have investigated association between life satisfaction and environmental health under the impact of pandemic [26-30]. However, few studies have focused on satisfaction with and key attributes among environmental factors during Covid-19 and investigated important factors influencing willingness to pay of the environmental health. Therefore, in order to provide policy priorities combating climate change, it has becoming important to find out the satisfaction with the environmental factors among residents and to find out key attributes related with health and environment.

## 2. Objectives

The purpose of this study is to evaluate key attributes among environmental factors during Covid-19 outbreak as provided the satisfaction and importance level using an importance- performance- analysis (IPA). Additionally, this aims to provide main determinants influencing the WTP for environmental health using logistic regression with a case study of Chung Nam in South Korea.

## 3. Methods

The total sample size was 332 as a face-to-face survey was implemented in Chungnam province, South Korea, Prior to the main survey, a pilot survey tested to have the clarity of each question of the questionnaire. The questionnaire was classified into three parts. In the first part, series of questions were asked about the level of satisfaction and importance with environmental factors The questions are asked about the satisfaction with a choice answer on a 5-scale Likert questionnaire. The 10 attributes about environmental factors were air, soil, climate change, waste, energy, environmental health, marine ecology, natural ecosystem, water, noise and vibration were selected. In the second part, this section included the WTP questions for improving environment health. Finally, in the third part of the questionnaire, socio-economic status was included such as age, residential years and household income.

Importance-performance matrix called the Cartesian diagram is shown as a grid which is consisted of four quadrants graphically (see Fig. 1). IPA was implemented to identify the most important factors for environmental health. With values given the satisfaction among environmental factors on the X-axis and the importance on the Y-axis, the curve intersection was shown as the average value in the four quadrants [31]. IPA uses a group of attributes associated with specific services to be evaluated based on the level of satisfaction according to each attribute and how the attributes of environmental factors are perceived.

Logistic regression is a statistical method to examine how dependent variables affect independent variables which are bivariate variables [32]. This is used to measure the relationship between the dependent such as a dichotomous outcome and variable either continuous or categorical variables. Based on the findings of earlier studies, our study hypothesized that socio-economic variables plays an important role on the decision of WTP [33-34]. Age of residents are expected to be an influencing factor as older people are more interested in their environmental health. Income is expected to have

a positive influence on the WTP. This is because higher income is more likely to be affordable to pay. The period of residence is expected to have a positive influence on the decision of WTP. The higher residential period, the higher the probability that residents living longer may have more the WTP. The satisfaction of environmental health is hypothesized to be negatively associated with residents' choice on the WTP due to higher risk of their health.

## 4. Results and Discussion

Table 1 shows the mean values of importance and satisfaction level. Among environmental factors, climate change showed the highest importance with 4 points, and air, soil, waste, energy, and environmental health all showed high importance with 3.9 points or more each. On the other hand, in terms of satisfaction, noise vibration and natural ecology showed the highest level of satisfaction with 3.4 points, followed by soil and water satisfaction with 3.1 points. The finding indicates that attributes with low environmental satisfaction were found to have high importance. This might imply that as satisfaction decreases, its importance becomes greater.

**Table 1.** Mean of satisfaction and importance level

| Attribute | Importance | Satisfaction |
|---|---|---|
| Air | 3.982 | 3.097 |
| Soil | 3.934 | 3.145 |
| Climate change | 4.000 | 2.955 |
| Waste | 3.970 | 2.686 |
| Energy | 3.934 | 2.903 |
| Environmental health | 3.918 | 2.746 |
| Marine ecology | 3.789 | 2.988 |
| Natural ecosystem | 3.807 | 3.414 |
| Water | 3.767 | 3.193 |
| Noise and vibration | 3.749 | 3.468 |

The IPA is plotted for each attribute in Figure 1. The result of IPA showed that key attributes among environmental factors were climate change, waste,

energy, air, environmental health. For the attributes, improvements are required due to low satisfaction and high importance of residents.
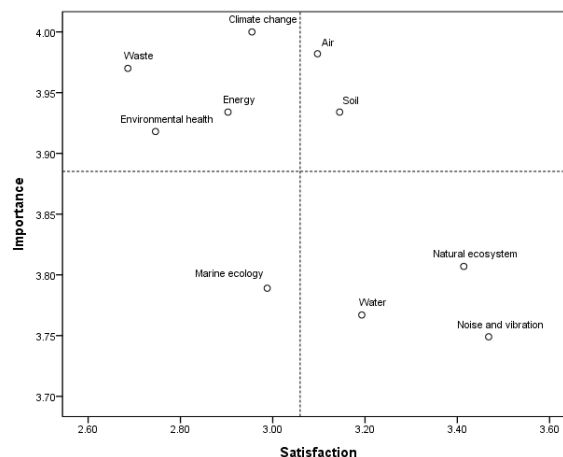


**Figure 1.** The result of IPA

This is in line with the findings implied at residents have importance on climate change, waste, energy, environmental health [19-21]. The quality of the environment is related with the satisfaction of the environmental factors. This is in line with the results imply that a link between the occurrence of new infection and their health. The emergency of Covid-19 pandemic can lead to threating of the health and environment from climate change and energy use [1, 35-36]. Residents' perceptions about environment and health has been increased from the pandemic [37]. During the pandemic, the attitudes of households towards food consumption was changed as an increased packed food consumption and the use of food delivery services lead to an increase in waste generation, in particular, in South Korea [38-39]. This can give more attention in people to waste management. This can be relevant to the results from the existing studies showing that impact of the outbreaks on food consumption in households at home and eating out [40-41].

The results of socio-economic characteristics show in Table 2. In terms of age, respondents in their 60s or older were the highest at 37.35%, followed by those in their 50s at 28.0% and those in their 40s at 20.48%. With respect to income group, the 21-30 group had the highest income at 23.19%, followed by the 31-41 group at 20.18%. The average number of years of residence

was 38.77. As the surveyed age was higher, the average number of years of residence was somewhat higher.

**Table 2.** Descriptive statistics of characteristics

| Variables | Description | Total(N: 332) | |
|---|---|---|---|
| | Category | N | % |
| Age (years) | 20s | 13 | 3.92 |
| | 30s | 34 | 10.24 |
| | 40s | 68 | 20.48 |
| | 50s | 93 | 28.0 |
| | > 60s | 124 | 37.35 |
| Income[a] | < 10 | 34 | 10.24 |
| (million KRW) | 10-20 | 57 | 17.17 |
| | 21-30 | 77 | 23.19 |
| | 31-40 | 67 | 20.18 |
| | 41-50 | 57 | 17.17 |
| | > 51 | 40 | 12.05 |
| Variables | Mean | Std. dev. | |
| Residence years | 38.77 | 18.67 | |

[a] Unit US$ 1.00 = KRW 1,334 (2024.2).

In addition, Table 3 provides the logistic regression model for WTP for environmental health. The results showed that the variable satisfaction of environmental health was found to be a key factor influencing the WTP for the environment health.

**Table 3.** Logistic regression model for the WTP of environment

| Variables | Coef. | Std.Err. |
|---|---|---|
| Satisfaction of environmental health | -0.327*** | 0.137 |
| Age | 0.028 | 0.131 |
| Income | -0.070 | 0.100 |
| Residential years | -0.047 | 0.225 |
| constant | 0.748 | 0.839 |

*Number of obs. = 332; LR chi2(4) = 7.34;*
*Prob > chi² = 0.12; Log likelihood = -222.67539;*
*Pseudo R² = 0.0162*

In the logistic regression analysis, our finding was inconsistent with the existing studies on WTP estimation showing the socio-economic variables were key factors. There. Our result in conformity with previous research investigating the satisfaction can potentially affect the decision on the WTP [42-43] and might be an association with the emergence of COVID-19 [44-45].

## 5. Summary and Conclusion

The aim of this study is to identify satisfaction of residents with environmental factors and examine determinants influencing their willingness to pay for the environment health using a case study of Chungnam Province in South Korea. The result of IPA regarding the key priority including 10 environmental attributes showed that the key attributes which have low satisfaction and high perception on the importance were the environment associated with climate change, waste, energy, air, environmental health. In the logistic regression analysis, the results showed that the variable satisfaction of environmental health was found to be a key factor influencing the WTP for social cost of the environment health. Our finding was inconsistent with the existing studies on WTP estimation showing the socio-economic variables were key factors.

Our analysis shows key findings. First, less performance attributes indicates climate change, waste, energy, air, environmental health. The 5 attributes which are low satisfaction and high perception on the importance are needed to be improved. Second, as environmental factors can affect interactive effects on the occurrence of COVID-19, the pandemic has affected an increase in residents' awareness about their environment and COVID-19 incidence can be relevant to decrease in the satisfaction of environmental health. This suggests that the improving the services of environmental health might be important to increase the satisfaction of residents.

Despite the practical implications, this study some limitations. First, the scope of this study and targeted population are within ChungNam province, South Korea. Second, this cross-sectional survey data can not understand causal effects between variables. Third, residents during Covid-19 might be health risk-taking. This can lead to the differences of satisfaction with environmental factors during and after pandemic.

Future research needs to extend study areas across several geographical regions and compare the findings of this research before and after the pandemic. Further studies could be explained using previous perspectives reflecting pro-environmental behaviours after the outbreaks. In addition, future studies could be relevant to policy response beyond heuristic hypothesises in the post-pandemic. Future investigations can be suggested that the findings showing how Covid-19 has reshaped the life of rural residents in developed and developing countries and differences with various conditions of public infrastructures and services during the Covid-19 pandemic in rural areas. This study could provide basic information to help policy decision in post-pandemic environment and in the pursuit of sustainability.

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**References:**

1. Siddique, A., Shahzad, A., Lawler, J., Mahmoud, K.A., Lee, D.S., Ali, N., Bilal, M. and Rasool, K., 2021. Unprecedented environmental and energy impacts and challenges of COVID-19 pandemic. Environmental Research, 193, 110443.

2. Arthi, V. and Parman, J., 2021. Disease, downturns, and wellbeing: Economic history and the long-run impacts of COVID-19. Explorations in Economic History, 79, 101381..

3. Murakami, M., Takebayashi, Y., Ono, K., Kubota, A. and Tsubokura, M., 2020. The decision to return home and wellbeing after the Fukushima disaster. International Journal of Disaster Risk Reduction, 47, 101538.

4. Park, J.Y., Hight, S.K., Bufquin, D., de Souza Meira, J.V. and Back, R.M., 2021. An examination of restaurant employees' work-life outlook: The influence of support systems during COVID-19. International Journal of Hospitality Management, 97, 102992.

5. Zhou, K., Tan, J. and Watanabe, K., 2021. How does perceived residential environment quality influence life satisfaction? Evidence from urban China. Journal of Community Psychology, 49(7), 2454-2471.

6. Ward Thompson, C. and Aspinall, P.A., 2011. Natural environments and their impact on activity, health, and quality of life. Applied Psychology: Health and Well-Being, 3(3), 230-260.

7. Xu, H., Huang, Q. and Zhang, Q., 2018. A study and application of the degree of satisfaction with indoor environmental quality involving a building space factor. Building and Environment, 143, 227-239.

8. Liao, P.S., Shaw, D. and Lin, Y.M., 2015. Environmental quality and life satisfaction: Subjective versus objective measures of air quality. Social Indicators Research, 124, 599-616.

9. Vogel, J., Steinberger, J.K., O'Neill, D.W., Lamb, W.F. and Krishnakumar, J., 2021. Socio-economic conditions for satisfying human needs at low energy use: An international analysis of social provisioning. Global Environmental Change, 69, 102287.

10. Azam, M., Liu, L. and Ahmad, N., 2021. Impact of institutional quality on environment and energy consumption: evidence from developing world. Environment, Development and Sustainability, 23, 1646-1667.

11. Han, S., 2022. Spatial stratification and socio-spatial inequalities: the case of Seoul and Busan in South Korea. Humanities and Social Sciences Communications, 9(1), 1-14.

12. Paudel, U., Adhikari, S.R. and Pant, K.P., 2023. Willingness to Pay for Environmental Quality Improvement Programs and Its Determinants: Empirical Analysis in Western Nepal. Sustainability, 15(3), 2176.

13. Polyzou, E., Jones, N., Evangelinos, K.I. and Halvadakis, C.P., 2011. Willingness to pay for drinking water quality improvement and the influence of social capital. The Journal of Socio-Economics, 40(1), 74-80.

14. Nwofoke, C., Onyenekwe, S.C. and Agbo, F.U., 2017. Willingness to pay (WTP) for an improved

environmental quality in Ebonyi State, Nigeria. Journal of Environmental Protection, 8(02), 131.

15. Streimikiene, D., Balezentis, T., Alisauskaite-Seskiene, I., Stankuniene, G. and Simanaviciene, Z., 2019. A review of willingness to pay studies for climate change mitigation in the energy sector. Energies, 12(8), 1481.

16. Falk, A., Becker, A., Dohmen, T.J., Huffman, D. and Sunde, U., 2016. The preference survey module: A validated instrument for measuring risk, time, and social preferences.

17. Khosla, R., Dukkipati, S., Dubash, N.K., Sreenivas, A. and Cohen, B., 2015. Towards methodologies for multiple objective-based energy and climate policy. Economic and Political Weekly, 49-59.

18. Alberini, A., Bigano, A., Ščasný, M. and Zvěřinová, I., 2018. Preferences for energy efficiency vs. renewables: what is the willingness to pay to reduce CO2 emissions?. Ecological Economics, 144, 171-185.

19. Haque, M.S., Uddin, S., Sayem, S.M. and Mohib, K.M., 2021. Coronavirus disease 2019 (COVID-19) induced waste scenario: A short overview. Journal of Environmental Chemical Engineering, 9(1), 104660.

20. Algahtani, F.D., Hassan, S.U.N., Alsaif, B. and Zrieq, R., 2021. Assessment of the quality of life during COVID-19 pandemic: a cross-sectional survey from the Kingdom of Saudi Arabia. International journal of environmental research and public health, 18(3), 847.

21. Tantiwat, W., Gan, C. and Yang, W., 2021. The estimation of the willingness to pay for air-quality improvement in Thailand. Sustainability, 13(21), 12313.

22. Weiskopf, S.R., Rubenstein, M.A., Crozier, L.G., Gaichas, S., Griffis, R., Halofsky, J.E., Hyde, K.J., Morelli, T.L., Morisette, J.T., Muñoz, R.C. and Pershing, A.J., 2020. Climate change effects on biodiversity, ecosystems, ecosystem services, and natural resource management in the United States. Science of the Total Environment, 733, 137782.

23. McNeely, J.A., 2021. Nature and COVID-19: The pandemic, the environment, and the way ahead. Ambio, 50(4), 767-781.

24. Grima, N., Corcoran, W., Hill-James, C., Langton, B., Sommer, H. and Fisher, B., 2020. The importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. Plos one, 15(12), e0243344.

25. Noszczyk, T., Gorzelany, J., Kukulska-Kozieł, A. and Hernik, J., 2022. The impact of the COVID-19 pandemic on the importance of urban green spaces to the public. Land Use Policy, 113, 105925.

26. Adepoju, A.A. and Omonona, B.T., 2009. Determinants of willingness to pay for improved water supply in Osogbo Metropolis, Osun State, Nigeria. Research Journal of Social Sciences, 4(1), 1-6.

27. Lee, S., Kim, H.N., Nguyen, T.T., Koellner, T. and Shin, H.J., 2018. Farmers' and Consumers' Preferences for Drinking Water Quality Improvement through Land Management Practices: The Case Study of the Soyang Watershed in South Korea. Sustainability, 10(5), 1419.

28. Lee, S., Nguyen, T.T., Kim, H.N., Koellner, T. and Shin, H.J., 2017. Do consumers of environmentally friendly farming products in downstream areas have a WTP for water quality protection in upstream areas?. Water, 9(7), 511.

29. Malik, S., Arshad, M.Z., Amjad, Z. and Bokhari, A., 2022. An empirical estimation of determining factors influencing public willingness to pay for better air quality. Journal of Cleaner Production, 372, 133574.

30. Osiolo, H.H., 2017. Willingness to pay for improved energy: Evidence from Kenya. Renewable energy, 112, 104-112.

31. Azzopardi, E. and Nash, R., 2013. A critical evaluation of importance–performance analysis. Tourism management, 35, 222-233.

32. Weisburd, D. and Britt, C., 2007. Logistic regression. Statistics in criminal justice, 526-578.

33. Lazaridou, D., Michailidis, A. and Trigkas, M., 2019. Socio-economic factors influencing farmers' willingness to undertake environmental responsibility. Environmental Science and Pollution Research, 26, 14732-14741.

34. Nielsen, J.B., Gyrd-Hansen, D., Kristiansen, I.S. and Nexøe, J., 2003. Impact of socio-demographic factors on willingness to pay for the reduction of a

future health risk. Journal of Environmental Planning and Management, 46(1), 39-47.

35. Usman, M., Husnain, M., Riaz, A., Riaz, A. and Ali, Y., 2021. Climate change during the COVID-19 outbreak: scoping future perspectives. Environmental Science and Pollution Research, 28(35), 49302-49313.

36. Rume, T. and Islam, S.D.U., 2020. Environmental effects of COVID-19 pandemic and potential strategies of sustainability. Heliyon, 6(9).

37. Garrido-Cumbrera, M., Foley, R., Braçe, O., Correa-Fernández, J., López-Lara, E., Guzman, V., Marín, A.G. and Hewlett, D., 2021. Perceptions of Change in the Natural Environment produced by the First Wave of the COVID-19 Pandemic across Three European countries. Results from the GreenCOVID study. Urban Forestry & Urban Greening, 64, 127260.

38. Sharma, R., Dhir, A., Talwar, S. and Kaur, P., 2021. Over-ordering and food waste: The use of food delivery apps during a pandemic. International Journal of Hospitality Management, 96, 102977.

39. Liu, C., Shang, J., Liu, C., Wang, H. and Wang, S., 2023. Policy Recommendations for Reducing Food Waste: An Analysis Based on a Survey of Urban and Rural Household Food Waste in Harbin, China. Sustainability, 15(14), 11122.

40. Filimonau, V., Kadum, H., Mohammed, N.K., Algboory, H., Qasem, J.M., Ermolaev, V.A. and Muhialdin, B.J., 2022. Religiosity and food waste behavior at home and away. Journal of Hospitality Marketing & Management, 31(7), 797-818.

41. Özbük, R.M.Y., Coşkun, A. and Filimonau, V., 2022. The impact of COVID-19 on food management in households of an emerging economy. Socio-Economic planning sciences, 82, 101094.

42. Demirgüneş, B.K., 2015. Relative importance of perceived value, satisfaction and perceived risk on willingness to pay more. International Review of Management and Marketing, 5(4), 211-220.

43. Rafique, M.Z., Sun, J., Larik, A.R. and Li, Y., 2022. Assessment of Willingness to Pay for Pollution Prevention, Health and Happiness: A Case Study of Punjab, Pakistan. Frontiers in Public Health, 10, 825387.

44. Hynes, S., Armstrong, C.W., Xuan, B.B., Ankamah-Yeboah, I., Simpson, K., Tinch, R. and Ressurreição, A., 2021. Have environmental preferences and willingness to pay remained stable before and during the global Covid-19 shock?. Ecological Economics, 189, 107142.

45. Jiang, N., Ao, C., Long, Y., Wei, Y., Xu, L., Lei, B. and Mao, B., 2024. Exploring the change in the heterogeneity of public preferences for air quality improvement policies before and after the COVID-19 pandemic: comparative results from latent class model analysis. Environment, Development and Sustainability, 1-25.