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**Residents' Preferred Measures And
Willingness-To-Pay For Improving
Urban Air Quality In Hanoi City, Vietnam**



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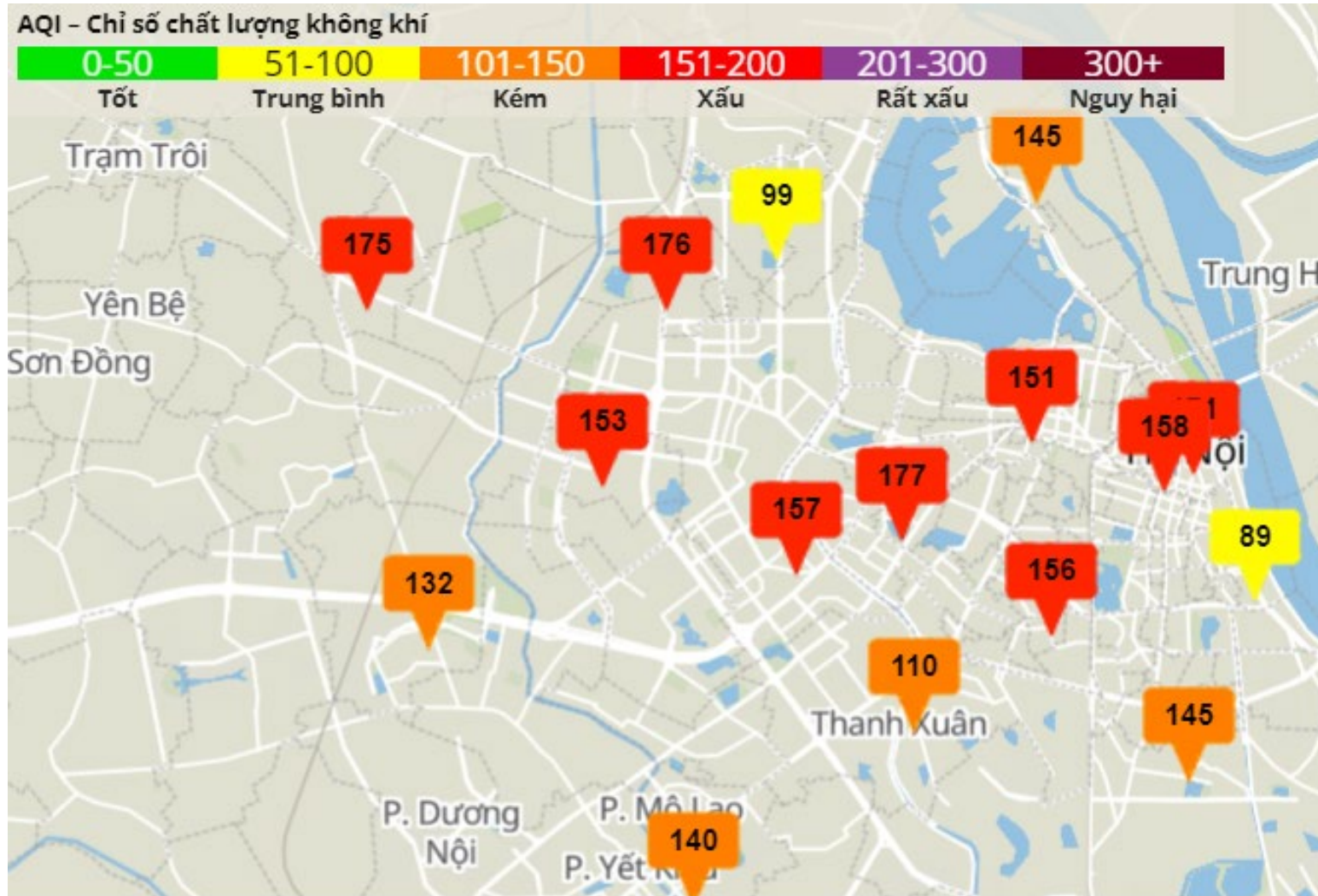
Introduction

- ▶ **Hanoi has experienced high level of air pollution.**
 - ▶ According to the National State of Environment Report on Air quality ([MONRE, 2014](#)), during the period 2010–2013, the proportion of days with Air Quality Index (AQI) at unhealthy levels of 101–200 ranged from 40% to 60% of total monitoring days.
 - ▶ The air quality data (monitored by the United States Embassy in Hanoi) showed that the average annual concentration of PM_{2.5}, in the period of 2015–2019, was 54 µg/m³, much higher than both the Vietnamese standard (25 µg/m³) and the WHO guideline limit (10 µg/m³) ([AirNow, 2019](#)).

Introduction

- ▶ Current air quality index (AQI) in Hanoi on 30 January 2023

Source: <https://moitruongthudo.vn/>



Introduction

- ▶ Air quality management plans for provinces are required in Article 13 of Law on environmental protection 2020 (in effects since January 2022)
- ▶ In recent years, Hanoi authorities have made efforts to improve air quality, such as installing more air monitoring stations, introducing the use of compressed natural gas (CNG) buses, and planting one million trees in the period of 2016–2020.
- ▶ The Hanoi People's Committee had the document no. 742/UBNDĐT dated March 15, 2021 on strengthening air quality management.

Introduction

- ▶ Air pollution is still a serious problem, and more effective solutions to improve air quality are demanded by residents of Hanoi City ([Vuong et al., 2021](#)). It is therefore important to understand the residents' desire for air quality improvements.
- ▶ Understanding residents' perspectives, especially those in the most adversely impacted areas, are important for the effective formulation and implementation of air quality policies ([Eden, 1996](#); [Zhang and Chen, 2018](#)).
- ▶ The aim of this presentation is to examine Hanoi residents' choices and their willingness-to-pay (WTP) for preferred measures that are expected to improve air quality of Hanoi city.

Survey implementation

- ▶ In June and July 2019, the main survey was administered in the form of face-to-face interviews with 1028 representatives of households living in different districts of Hanoi City
- ▶ [Carson and Groves \(2007\)](#) distinguish between inconsequential surveys (where respondents believe that there is a zero percent chance the survey results will influence the agency's decisions) and consequential surveys (where respondents perceive their responses will influence the agency's decisions up to some non-zero probability).
- ▶ [Vossler et al. \(2012\)](#) suggest that consequential choices encourage truthful preference revelation.
- ▶ Our survey was completed by 1028 respondents, but after removing 49 inconsequential responses, our analysis focused on responses of 979 respondents.

Residents' preferred choices of measures to improve air quality in Hanoi city

- ▶ The frequency of respondents' choice of measures is reported from high to low as follows:

1	Increase of green spaces	73%
2	Use of less polluting fuels	50%
3	Expansion of public transportation	43%
4	Application of strict emission standard for traffic vehicles	33%
5	Development of advanced monitoring system	30%
6	Application of traffic management strategies (e.g. speed control, congestion charges)	16%


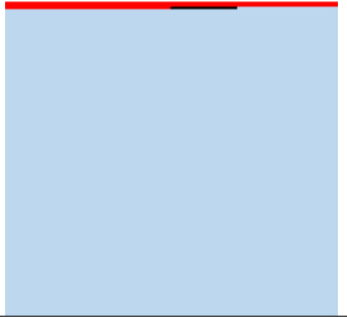
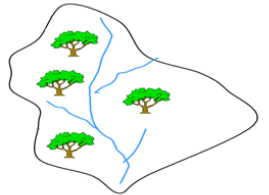
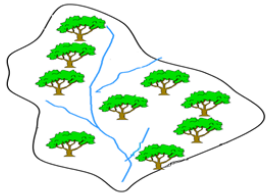


Willingness-To-Pay for improving air quality in Hanoi city

- ▶ Choice experiments (CEs) were applied to estimate WTP in our study
- ▶ In our CE survey, respondents were requested to state their most preferred alternatives over a sequence of six choice tasks.
- ▶ Each choice task includes two alternative options, which are described by different levels of attributes of the good or service that is being valued.

Attributes	Variables	Current levels	Improvement levels
Health risk related to air pollution:		Out of 100,000 people:	
People who get hospitalised due to air pollution-related diseases	Morbidity	350 people	350; 250; 150 people
People who die from air pollution-related diseases	Mortality	50 people	50; 35; 20 people
Urban tree cover area	Urban tree cover	8 m ² per capita	8; 13; 18 m ² per capita
Change to household electricity bill	Cost	No change	Increase of 15; 50; 85; 120 thousand VND/month = 180; 600; 1020; 1440 thousand VND/year

Willingness-To-Pay for improving air quality in Hanoi city

► An example of a choice task

	Program A	Program B
<p>HEALTH RISK related to air pollution</p> <p>Out of 100,000 people:</p> <ul style="list-style-type: none"> People who get hospitalised due to air pollution-related diseases People who die from air pollution-related diseases Remaining population 	<p>Out of 100,000 people:</p> <p>150 people get hospitalised (<i>200 fewer</i> cases than current situation)</p> <p>20 people die (<i>30 fewer</i> deaths than current situation)</p> 	<p>Out of 100,000 people:</p> <p>250 people get hospitalised (<i>100 fewer</i> cases than current situation)</p> <p>20 people die (<i>30 fewer</i> deaths than current situation)</p> 
<p>URBAN TREE cover area</p>	<p>8 m² per capita (<i>0m² larger</i> than current situation)</p> 	<p>18 m² per capita (<i>10m² larger</i> than current situation)</p> 
<p>Change to household electricity bill, starting in 2020</p>	<p>Increase of 50 thousand VND/month (= 600 thousand VND/year)</p> 	<p>Increase of 120 thousand VND/month (= 1,440 thousand VND/year)</p> 

Willingness-To-Pay for improving air quality in Hanoi city

- ▶ The total WTP was estimated for two improvement scenarios described as follows:
 - + Minimum improvement: number of people hospitalised 250/100,000, number of people died 35/100,000 and urban tree cover area of 13 m² per capita.
 - + Maximum improvement: number of people hospitalised 150/100,000, number of people died 20/100,000 and urban tree cover area of 18 m² per capita.
- ▶ **Total WTP estimates** by different logit models in thousand VND per month

Attribute	Conditional logit model	Mixed-logit model	Generalized multinomial logit model
Minimum improvement	34.528*** (2.030)	63.857*** (5.018)	56.618*** (4.915)
Maximum improvement	97.000*** (3.553)	91.580*** (6.378)	80.105*** (6.418)

Standard errors are in parentheses and are based on the Krinsky–Robb simulation using 10000 draws.
*** = Significance at 1% level. ** = Significance at 5% level. * = Significance at 10% level.

Willingness-To-Pay for improving air quality in Hanoi city

- ▶ The total WTP of a household for improvements in air quality of Hanoi City is about VND35,000 - 97,000 per month (~USD 1.5 – 4.2), which is about 0.16 – 0.44% of mean household income in our sample.
- ▶ **Our results appear to be within the lower range of the available values reported in the literature.**
 - ▶ Reviews of China's air quality CV studies by [Wang and Zhang \(2009\)](#) and [Sun et al. \(2016\)](#) show that the ratio of WTP estimates to income ranges **from 0.4% to 4.1%**.
 - ▶ Results of a CV survey in Cameroon, Africa suggest that on average households are willing to pay **0.2% of their household income** to improve air quality ([Donfouet et al., 2014](#)).
 - ▶ Another CV study undertaken by [Akhtar et al. \(2017\)](#) in Pakistan indicates that the WTP value for improved air quality is about **1.27% of respondents' income**..
 - ▶ A recent CE study in China indicates that each household is willing to pay **about 2.0% of household income** to improve air quality in Xi'an City ([Yao et al., 2019](#)).

Willingness-To-Pay for improving air quality in Hanoi city

- ▶ Mean marginal WTP estimates by different logit models in thousand VND per month

Attribute	Conditional logit model	Mixed-logit model	Generalized multinomial logit model
Morbidity reduction	0.201*** (0.018)	0.090*** (0.013)	0.079*** (0.015)
Mortality reduction	1.591*** (0.134)	0.599*** (0.092)	0.490*** (0.096)
Urban tree cover area	3.692*** (0.361)	1.927*** (0.293)	1.637** (0.307)

Standard errors are in parentheses and are based on the Krinsky–Robb simulation using 10000 draws.

*** = Significance at 1% level.

** = Significance at 5% level.

* = Significance at 10% level.

Willingness-To-Pay for improving air quality in Hanoi city

How the WTP estimates can be applied in a policy setting

- ▶ Using the marginal WTP for boosting urban tree cover, aggregate WTP estimates for Hanoi population are about VND 430–2874 billion (~USD 18.6–124 million) per year to achieve the tree cover of 18 m² per capita.
- ▶ In 2014, the Government of Hanoi issued the Plan for developing the system of urban trees, parks, and lakes in Hanoi City until 2030. The total cost for implementing this Plan in the years 2015–2030 was estimated at about VND51,181 billion, of which 46% would source from the government budget and 54% would be mobilized from other non-governmental sources.
- ▶ The estimates of WTP from households to boost urban tree cover in our study would account for 13%–84% of the cost for implementing the plan of Hanoi authorities.

Further readings

1. Thanh, N.C., Nguyen, H.D., Le, H.T., Kaneko, S. 2022. Residents' Preferred Measures and Willingness-To-Pay for Improving Urban Air Quality: A case study of Hanoi City, Vietnam. *Journal of Economics and Development*.
2. Thanh, N.C., Le, H.T., Nguyen, H.D., Le, T.H., Nguyen, H.Q., 2021. Estimating economic benefits associated with air quality improvements in Hanoi City: An application of a choice experiment. *Economic Analysis and Policy* 71 (9/2021), 420-433.

Thank you for your attention!

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