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Risk Perception on Haze Pollution and Willingness to Pay for Self-Protection and Haze Management in Chiang Mai Province, Northern Thailand

Sukanya Sereenonchai [1,*], Noppol Arunrat [1] and Duangporn Kamnoonwatana [2]

[1] Faculty of Environment and Resource Studies, Mahidol University, Salaya, Nakhon Pathom 73170, Thailand; noppol.aru@mahidol.ac.th

[2] Research Institute for Languages and Culture of Asia, Mahidol University, Salaya, Nakhon Pathom 73170, Thailand; lcdkn@hotmail.com

* Correspondence: sukanya.ser@mahidol.ac.th or sukanya.ser@mahidol.edu

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Abstract: Air pollution is an important environmental health risk that affects people worldwide, including those in the Chiang Mai Province, Northern Thailand. A questionnaire survey based on accidental sampling to explore risk perception and willingness to pay (WTP) for self-protection and haze management was conducted via face-to-face interview of 250 households, in one urban and four rural areas (covering one rural plain and three different levels of highland areas). Data were analyzed using the contingent valuation method, a one-way ANOVA, correlation, and stepwise multiple linear regression. Key findings on risk perception found that urban respondents living in the lowest areas were more familiar with and experienced more effects from serious haze, while having the least trust in the local authority's management to cope with the situation. Influential factors determining familiarity and effect for people in most areas were their harm and severe haze experiences. Comparing WTP for a mask, an air purifier, and local authorities support, respondents in all areas were mainly willing to pay for a mask; this was influenced by various factors. The highest average price of willingness to pay was found in the urban area. The important significant factors that increased WTP for self-protection of urban respondents was severe haze experience, while rural respondents who had a longer stay duration, including married farmers in highland areas with less education, tended to have less WTP for self-protection but more WTP for haze management. Avoiding crop residue burning is the first strategy that should be used to deal with haze pollution. Early burning schedules of the highland people should be formally announced, and prompt risk communication should be implemented by local and central authorities and media practitioners.

Keywords: risk perception; haze pollution; willingness to pay; self-protection; haze management; Thailand

1. Introduction

Outdoor air pollution is a major environmental health risk that affects people in most parts of the world, especially those in low-income countries. Exposure to air pollution can cause health impacts, such as respiratory and cardiovascular morbidity [1]. Public risk perception of air pollution plays a major and continuous role in the public response to exposure, involvement in mitigating risks [2], and acceptance of mitigation policies [3]; perception is also influenced by both individual and contextual factors [4].

The public's willingness to pay (WTP) should be considered by air pollution management policymakers (for example, for tax policies to support air pollution control), and they should launch appropriate measures based on public acceptance to private sector [3]. The public's WTP should be taken into account by the private sector involved in the manufacture and sale of products related to self-protection from air pollution, such as masks and air purifiers. A WTP study can uncover reliable evidence that will help guide policymakers in reaching the national smog mitigation targets [5]. Although there are some previous studies regarding WTP for air pollution management or improving air quality, only a few studies regarding spatial differences have been explored; these have been mainly in China [3,6]. However, to the best of our knowledge, studies focusing on one big area, such as one province with different topographies and ways of life, are rare, especially for Thailand. Meanwhile, people in the big area, especially those in the lowest areas, can have more exposure to air pollution than those in higher areas.

People in the northern part of Thailand, particularly the Chiang Mai Province, have faced continuous haze pollution since 2007 [7]. The severity of the problem is generally evident during the dry season (around January to April of every year) in which conditions are dry, causing dust to be suspended in the atmosphere for a long time. Chiang Mai was ranked as having the worst air quality index (AQI) score in the world during March 2019 [8]. $PM_{2.5}$ concentration in the area increased due to drought, leading to an increase in forest fires. At the same time, most farmers burned agricultural waste to prepare land for farming during the rainy season. Additionally, the province has some of the most famous tourist attractions in Thailand and contends with urban growth, which causes more air pollution from transportation and human activities [9]. These have resulted in a significant increase in the level of haze and $PM_{2.5}$ concentration, affecting people's health—especially the elderly, young children, and patients with respiratory illnesses—and lifestyles, including tourism and service businesses [10].

Previous related studies have been conducted regarding public awareness and WTP for tackling smog pollution [11], and exposure, perception, and acceptable levels of $PM_{2.5}$ in China [6]. These studies highlight the need for study of smog prevention from a public participation perspective, public acceptable risk levels, and the State Council's Action Plan. Meanwhile, a few previous studies on WTP for air pollution management in industrial areas in Rayong Province [12] and Chon Buri Province [13] in Thailand were explored, but these lack a connection between risk perception and WTP. Another research gap is the lack of comparative study within one province for different areas of topography (urban–rural plain–rural highland), which is also an important factor that causes different densities of haze pollution.

Therefore, it is important to investigate risk perception and WTP for self-protection and haze management of people in urban, rural, and highland areas inside one province. This paper aims to (1) examine people's perceptions about tackling haze pollution and WTP for self-protection and authorities support; and (2) identify factors influencing perception, awareness, and WTP. The results could contribute to practical management and communication guidelines for haze pollution.

2. Literature Review on Factors Influencing Public Risk Perception and WTP

2.1. Factors Influencing Public Risk Perception

Public perception of air pollution affected by various factors such as age [14], educational level [15], income [6], marriage [15,16], and harm experienced due to haze [6]. Women are likely to express higher levels of risk concerns towards technology and the environment than men. Age showed positive relationship with risk perception [14,17]. Kim et al. [16] have indicated that young people are more sensitive to air pollution risks, while Egondi et al. [15] drew the inconsistent conclusion that elderly respondents with longer stay duration are unlikely to consider air quality as severe since they likely experienced worse environmental harms in past years. People with higher education level and income trend to be more informed and more concerned about air pollution, which might lead to a higher risk perception [15,16].

2.2. Factors Influencing WTP for Haze Management

According to the literature review, the respondents' WTP for air pollution management is influenced by various factors. The main influencing factors consist of occupation as businessman, government workers, and local workers [11], health condition [5], and exposure to severe haze and harm experiences [6]. Moreover, Dong and Zeng [5], Sun [18], Yang et al. [19] also suggested similar factors of age, education, income, risk perception, and attitudes toward government.

3. Methodology

3.1. Study Areas

Chiang Mai Province was selected as the study area where is located in the northern part of Thailand, about 700 km from Bangkok. The topography of this province is mainly comprised of mountains surrounding a valley landscape, in which haze from various sources collects more easily and for longer. Chiang Mai has faced haze pollution for more than a decade, especially during the dry season of February to April [20,21].

3.2. Sampling Design and Data Collection

Primary data were collected via questionnaire survey of 250 households from different topographies. There were five areas (as shown in Figure 1) consisting of urban and rural areas: (1) an urban area—two subdistricts of Suthep (urbanS, 357 m above mean sea level or a.m.s.l.) and Chang Khlan (urbanCK, 334 m a.m.s.l.) in Mueang District (39 respondents); (2) a rural plain area—Khee Lhek Subdistrict (48 respondents, 359 m a.m.s.l.); (3) a rural highland600 m a.m.s.l. (rural highland600)—Chaeng Keng Subdistrict in Mae Chaem District (67 respondents); (4) a rural highland 700 m a.m.s.l. (rural highland700)—Baan Tub Subdistrict in Mae Chaem District (37 respondents); and (5) a rural highland 1000 m a.m.s.l. (rural highland1000)—Pang Hin Fon Subdistrict in Mae Chaem District (59 respondents). The participants in each area were selected based on accidental sampling up to their available time, readiness and willing to participate in answering the questionnaire. All respondents were interviewed face-to-face by the researchers in order for greater participant convenience, and to ensure all questions and answers were clear and provided accurate meaning.

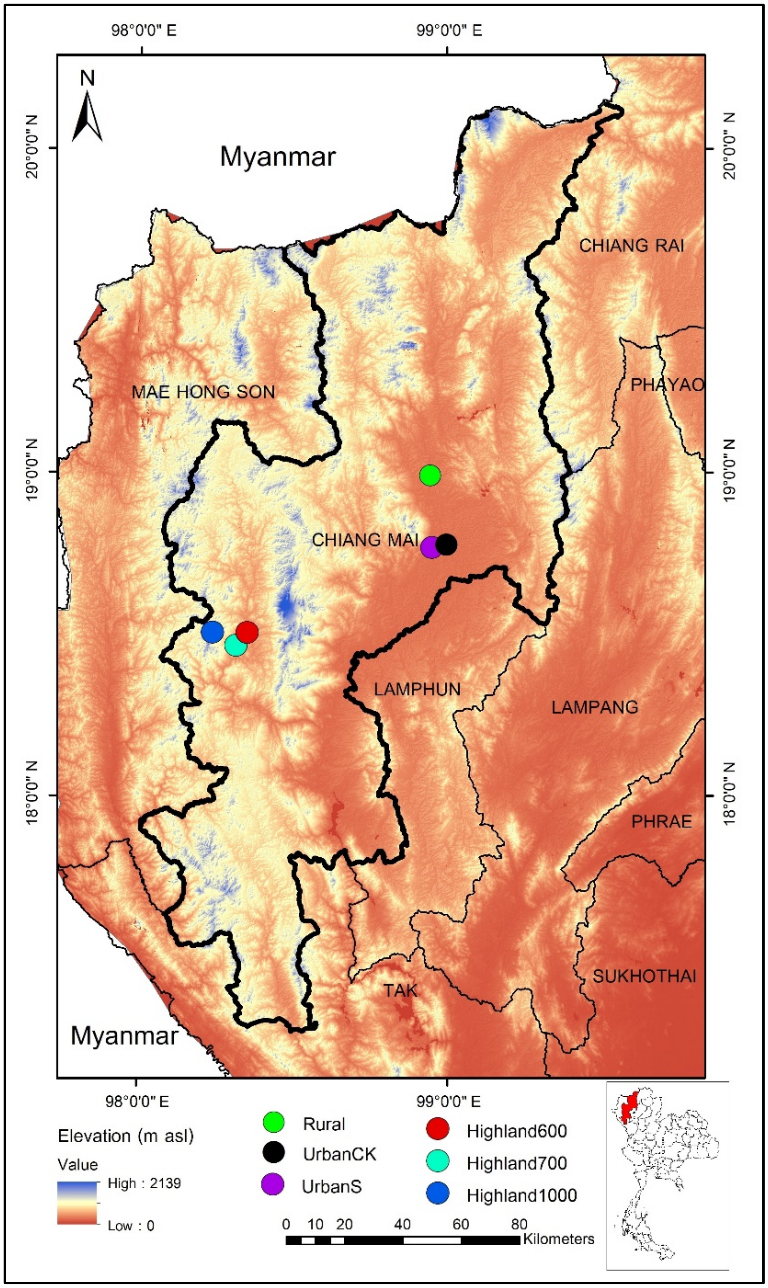

Figure 1. Study areas.

The questionnaire was designed based on the theories of public risk perception and WTP. There were five main parts (Table 1): (1) demographic information covering gender, age, body weight, marital status, schooling, occupation, monthly income, stay duration, smoking, and respiratory disease; (2) Public risk perception, including three aspects: familiarity, effect, and trust; (3) severe haze experience and harm experience; (4) Access to information channels about haze pollution; (5) general daily activities (hourly explanation); (6) WTP for self-protection and haze management, consisting of WTP for a mask, WTP for an air purifier, and WTP for authorities support to deal with air pollution; and (7) Methods to cope with air pollution. A five-point Likert scale was to record responses to the questions in part 2, where 1 = minimum and 5 = maximum, while other parts were mainly recorded using a checklist and an open form for related details. In addition, reliability of the questions in public risk perception was tested, Cronbach's Alpha was shown as 0.894. Therefore, the questions were reliable and fit for the purposes of this study.

Table 1. The questions in the questionnaire used to ask the respondents.

Part	Questions
(1) Demographic information (a check list and an open form)	1.1 Gender (1. male, 2. female) 1.2 Age (indicating the years) 1.3 Body weight (indicating the number) 1.4 Marital status (1. single, 2. married) 1.5 Schooling (indicating the years) 1.6 Occupation (1. farmer, 2. official staff, 3. private sector, 4. university student) 1.7 Monthly income (Baht) 1.8 Stay duration (indicating the years) 1.9 Smoking (1. smoke, 2. non-smoke) 1.10 Respiratory disease (1. yes, 2. no)
(2) Public risk perception (a five-point Likert scale answer: 5 = most, 4 = more, 3 = moderate, 2 = low, 1 = very low)	2.1 Familiarity: (1) Can you easily notice when the haze occurred? (2) Are you closed to health risks caused by haze? 2.2 Effect: (3) Do you think the health risks caused by haze common or unusual? (4) Do the impacts of the risk caused by haze affects you immediately? (5) How severe is the haze surrounding your area? (6) How severe do you think the haze will impact on your health? (7) How severe do you think the haze will impact on your family health? (8) Do you think the health risks caused by haze could continuously have a fatal effect on you? 2.3 Trust: (9) Do you think the local authorities use appropriate emergency measures in response to serious haze? (10) Do you think the local authorities need to develop methods for managing haze pollution? (11) At what level do you trust local authorities to control air pollution? (12) How strict is the air pollution standard in your area?
(3) Severe haze experience and harm experience due to haze (a five-point Likert scale answer: 5 = most, 4 = more, 3 = moderate, 2 = low, 1 = very low)	3.1 How much did you experience severe haze in the past few years? 3.2 How much did you affect due to the severe haze in the past few years?
(4) Access to information channels about haze pollution (a checklist)	1. TV, 2. radio, 3. local broadcasting tower, 4. word of mouth, 5. mobile, 6. website, 7. Line, 8. Facebook, 9. newspaper
(5) General daily activities (hourly explanation)	Stay at home, ride/travel by a motorcycle, ride/travel by a car, travel by a public bus (with air-conditioner), travel by a public bus (without air-conditioner), walk/work outdoor, stay/work/study inside a building, shopping/buying things inside a closed shop, shopping/buying things in a fresh/open market, other activities
(6) Willingness to pay (WTP) for self-protection and haze management (a check list and an open form)	6.1 WTP for a mask (1. Yes, type of mask, amount of money that willing to pay 2. No) 6.2 WTP for an air purifier (1. Yes, Amount of money that willing to pay 2. No) 6.3 WTP for authorities support to deal with air pollution (1. Yes, Amount of money that willing to pay 2. No)
(7) Methods to cope with air pollution (a check list and an open form)	(1) Use public transportation instead of private car (2) Information exposure regarding air pollution (3) Work from home/online class

Part	Questions
	(4) Open-burning scientifically (5) Reduce/avoid burning crop residues (6) Employing technology to deal with crop residues (7) Organize burning periods for farmers who need to burn (8) Policy support from local authorities (please identify)# (9) Policy support from Thai government (please identify)# (10) Others (please identify)

3.3. Data Analysis

3.3.1. Public Risk Perception of Air Pollution

Public risk perception in this study employed from Huang et al. [6] comprising of three aspects: familiarity, effect, and trust. Familiarity means that people can clearly notice the haze pollution and feel health risks caused by haze. Effect means that people perception of the health effects of air pollution to themselves and their family. Trust means that people believe in and accept their local authorities' management of and ability to respond to serious haze pollution appropriately and in good time. Public perception factors were calculated using the average value of all questions in each set of risk perception elements.

3.3.2. Daily $PM_{2.5}$ Exposure (DPE)

Daily $PM_{2.5}$ exposure of the respondents was calculated based on information from the US Environmental Protection Agency (EPA) [22] as shown in Equation (1):

$$\text{DPE } (\mu g/kg)\# \ (C \times IR \times EF/24)/BW \qquad (1)$$

where C is average $PM_{2.5}$ concentration ($\mu g/m^3$) for each outdoor activity time; IR is the respiratory rate of the subject partaking in the outdoor activity (m^3/day); EF is the outdoor exposure time (h); and BW is the body weight of the subject (kg).

To calculate DPE, three main sources of data were collected. Firstly, average $PM_{2.5}$ concentration of each area (C) was collected from two air quality report websites based in Thailand: (1) Air4Thai—Thai air quality and situation reports from the Pollution Control Department (PCD) [23]; and (2) CMAQHI—Chiang Mai Air Quality Health Index, which is a collaboration between Chiang Mai University, Rajamangala University of Technology Lanna, and Chiang Mai Provincial Office [7]. The average $PM_{2.5}$ concentrations from February to April 2019 in study areas are shown in Table 2. The limitation was that the $PM_{2.5}$ concentration was based on the secondary data measured by Air4Thai and CMAQHI, which having no full daily record in three study areas (N/A). Therefore, the monthly average $PM_{2.5}$ concentration values from February to April 2019 of each area were employed as this period usually having the serious haze in Chiang Mai. Secondly, the respiratory rates of outdoor activity (IR) for males and females were 15.8 m^3/day and 14.1 m^3/day [24]. Thirdly, the outdoor exposure times (EF) and body weight (BW) of respondents were collected from the questionnaire survey.

Table 2. The average $PM_{2.5}$ concentrations ($\mu g/m^3$,during February to April 2019 in study areas.

Duration	UrbanS	UrbanCK	Rural Plain	Rural Highland600	Rural Highland700	Rural Highland1000
February 2019	49.57	39	N/A	56.5	N/A	N/A
March 2019	82.27	100	159	82.61	N/A	N/A
April 2019	81.43	144	82	97.4	45	45
average per month	71.09	94.33	120.5	78.84	45	45
Source of information	Air4Thai	CMAQHI	CMAQ HI	Air4Thai	no record, apply from the nearest station	CMAQHI

N/A, not available.

3.3.3. WTP for Self-Protection and Air Pollution Management

The contingent valuation method (CVM) is a survey-based approach used to estimate WTP values for products or services that are not traded in a conventional market. The CVM approach covers bidding games, open-ended questions, and dichotomous choice [25]. Employing CVM with open-ended questions is one of the most widely and reliable methods used to study the WTP of citizens regarding environmental policy and economic evaluation analyses [18]. As mentioned, there are some previous studies by Pu et al. [3], Wang and Zhang [26], and Wang and Mullahy [27], which focus on people's WTP regarding air pollution mitigation and air quality improvement.

In this study, WTP for self-protection covers people's WTP for a mask and an air purifier to protect themselves from haze pollution. There are four types of mask (Figure S1); these consist of disposable ear-loop 3-ply (around 5 Baht/piece), carbon (around 10–12 Baht/piece), cloth (around 30–40 Baht/piece), and N95 (around 40–70 Baht/piece) face masks. WTP for haze management means people are willing to pay for their local authorities' support to cope with haze.

3.3.4. Statistical Analysis

In order to explore the factors influencing public risk perception, the dependent variables are public risk perception factors, while independent variables consist of demographic information covering gender, age, marriage, schooling, occupation, monthly income, stay duration, smoking, respiratory disease, severe haze experience and harm experience due to haze. The normal distribution test, Test of Homogeneity of Variances, ANOVA test, Robust Tests of Equality of Means (Brown-Forsythe) and Post Hoc Multiple Comparisons using Dunnett's T3 test were analyzed. The significance of public risk perception among each element of risk perception (familiarity, effect and trust) comparing between each area were analyzed by one-way ANOVA analysis, while the WTPs were compared by the average price, respectively. Stepwise multiple linear regression was used to explore and compare factors influencing public risk perception and the WTPs of respondents in each area. All mentioned factors were input into and analyzed using SPSS Version 22.0.

4. Results and Discussions

4.1. Demographic Information

Most of the respondents in highland areas were male (around 76% of the highland respondents). The average age and stay duration of respondents in urban area were the lowest (32 and 15 years, respectively), while their years of schooling was the highest (15 years) when compared with those in rural plain (9 years) and rural highland (8–12 years) areas. Most of the urban respondents were single, in contrast with those in rural plain and rural highland areas, which most of them were married. Respondents in all highland areas worked as farmers with an average monthly income (around 8365–8605 Baht) lower than those in urban (around 20,975 Baht) and rural plain (around 11,744 Baht) areas. Most of the respondents in all areas were non-smoking (around 81%) and had no respiratory diseases (around 97%). Demographic information of the respondents is presented in Table S1.

4.2. Risk Perception of Air Pollution

Public risk perception about air pollution can be evaluated via familiarity, effect, and trust [6]. In this study, the differences in public risk perception between five areas were investigated, as presented in Figure 2. The respondents in urban areas perceived the highest familiarity and effect and the least trust, compared with all areas. In other words, the respondents in rural highland areas had less familiarity and effect than those in urban area, and had more trust in their local authorities to manage the haze.

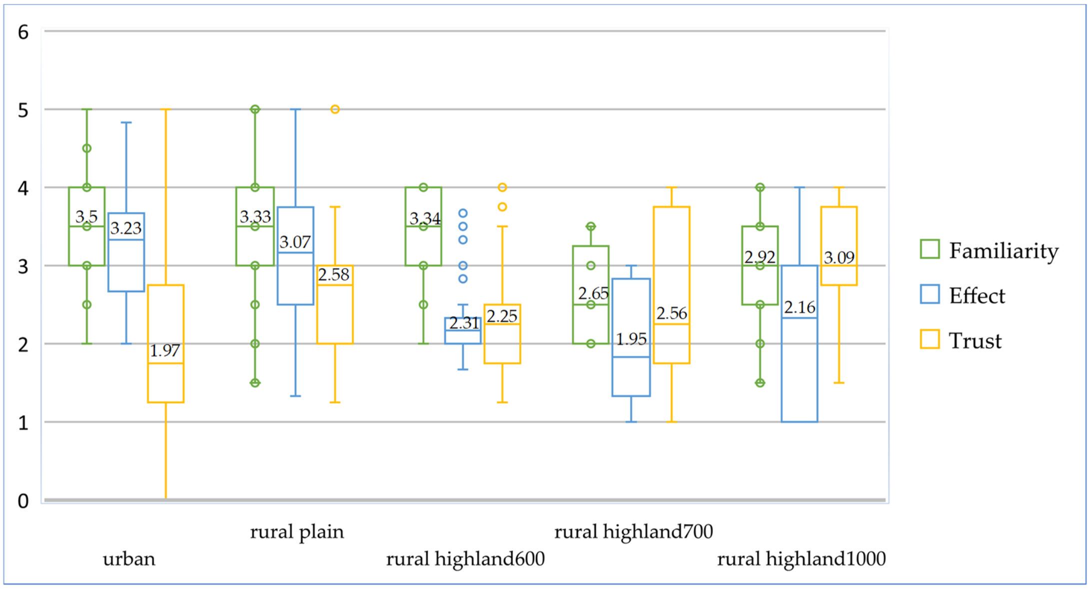

Figure 2. Mean values of risk perception factors.

In order to explore the differences of risk perception of air pollution, the data was firstly assessed the normal distribution by employing Skewness and Kurtosis method. According to Ghasemi and Zahediasl [28] and Kim [29], the absolute z-scores results of beyond the range of ±1.96 ($\alpha = 0.05$) reflect not significantly different from a normal distribution. The absolute z-scores for either skewness or kurtosis in this study were found as familiarity (−1.854, −1.524), effect (0.887, −1.387), and trust (0.233, −0.397), respectively. Therefore, the data was normal distribution.

The result of Test of Homogeneity of Variances showed *p*-value @0.000, which were less than α = 0.05, meaning that the variances of the three elements of risk perception (familiarity, effect, and trust) were different or Equal Variances not Assumed. ANOVA test to explore mean of each risk perception element was found difference as *p*-value (0.000) was less than α (0.05). Consequently, Robust Tests of Equality of Means employing Brown-Forsythe was tested, and p-value of 0.000 was found for all three elements meaning that different areas caused different risk perception ($p = 0.05$). This meant that at least one pair of the samples of each element was different, so Post Hoc Multiple Comparisons using Dunnett's T3 was then tested.

There were significant differences between the public perception factor of familiarity with haze in urban with rural highland700 and rural highland1000 areas (Table 3). The results mean that people in the lowest area could observe haze occurring in a timely manner and were more familiar with the health risks associated with haze than those in the two highest areas, while rural plain area was found significant difference with rural highland700 area only.

Table 3. Differences of risk perception of air pollution via familiarity, effect, and trust.

Area	Familiarity	Effect	Trust
urban (a)	0.851 *(d) 0.585 *(e)	0.919 *(c) 1.274 *(d) 1.064 *(e)	−0.609 *(b) −1.115 *(e)
rural plain (b)	0.685 *(d)	0.763 *(c) 1.119 *(d) 0.908 *(e)	0.609 *(a) −0.506 *(e)
rural highland600 (c)	0.695 *(d) 0.428 *(e)	−0.919 *(a) −0.763 *(b)	−0.843 *(e)
rural highland700 (d)	−0.851 *(a) −0.685 *(b) −0.695 *(c)	−1.274 *(a) −1.119 *(b)	−0.528 *(e)
rural highland1000 (e)	−0.585 *(a) −0.428 *(c)	−1.064 *(a) −0.908 *(b)	1.115 *(a) 0.506 *(b) 0.843 *(c) 0.528 *(d)

* The mean difference is significant at the 0.05 level. (a)–(e) shows the area of significant difference; (a) urban; (b) rural plain; (c) rural highland600; (d) rural highland700; (e) rural highland1000.

Almost similar to the public perception factor of haze effect on people's health, it was found that the effect of people in the lower lands (urban and rural plain areas), showed significantly positive differences compared with the higher areas (Table 3). This reflects that people in the lower areas feel that they face health risks caused by haze and severe impacts to their health.

Meanwhile, trust of the highest area was found significantly positive differences with all lower areas (Table 3). Moreover, the trust of urban respondents was significantly negatively different compared with those in rural plain and highest areas. This means that people in the urban area have less trust in the local authorities' response to serious haze, control of air pollution, and implementation of the national air pollution standard, especially when comparing with the highest area (rural highland1000).

4.3. Factors Influencing Risk Perception

Factors influencing risk perception was analyzed by stepwise multiple linear regression models (Table S3.1). The results clearly show that familiarity in most areas was significantly influenced by harm experiences (urban, $t = 5.815$, $p = 0.000$; rural plain, $t = 4.134$, $p = 0.000$; rural highland600, $t = 2.228$, $p = 0.025$; and rural highland1000, $t = 3.394$, $p = 0.001$). This proves that the respondents experiencing haze pollution may be more familiar with air pollution, which is in line with the finding of Beijing citizens as explained by Huang et al. [6]. Moreover, stay duration was found as one of the influenced factors for respondents in rural highland600 ($t = 2.623$, $p = 0.011$), indicating that the longer the stay duration, the closer they would feel to the air pollution. Together with harm experiences, the respondents in rural highland1000 were also dominant by severe haze experience ($t = 3.870$, $p = 0.000$) and schooling ($t = 5.118$, $p = 0.000$). This indicates that the more schooling respondents have, more severe the haze that surrounds their area with the more harm experienced, the more familiarity increases. The education factor is in line with Egondi et al. [15] and Kim et al. [16], indicating that well-educated people are likely to be more informed about the impacts of air pollution, which may be linked to a higher risk perception. Meanwhile, familiarity of people in rural highland700 area was significantly influenced by income ($t = 4.325$, $p = 0.000$) and smoking ($t = 3.628$, $p = 0.001$), which suggests that the respondents who gain higher income referring to their occupation as official staff, and smokers were farmer trended to be more familiar with haze pollution.

Effect of air pollution on most people in urban, rural plain, rural highland600, and rural highland1000 areas was highly influenced by harm experience ($t = 9.793$, $p = 0.000$; $t = 11.727$, $p = 0.000$; $t = 5.966$, $p = 0.000$, $t = 8.003$, $p = 0.000$, respectively), followed by severe haze experience ($t = 4.620$, $p = 0.000$; $t = 3.898$, $p = 0.000$; $t = 2.893$, $p = 0.005$, $t = 7.426$, $p = 0.000$, respectively) (Table S3.2). This suggests that people who experience haze pollution and are impacted by severe haze might be more sensitive to its effects. The effects for people in urban and rural plain areas were also influenced by age (t = 2.314, p = 0.027; t = 2.125, p = 0.039, respectively), this suggests that the more elderly may be more sensitive to effect, which is similar to the findings of Seo and Barrett [14] and Van et al. [17] indicating positive correlation between age and risk perception.

Meanwhile, the factors that influence trust varied quite a bit across the five areas (Table S3.3). Age was the main influencing factor in urban area (t = 4.070, p = 0.000), suggesting that the more elderly may be more trustful of the local authorities. Severe haze experience significantly influenced to trust of the rural plain and rural highland600 respondents (t = 2.577, p = 0.013; t = 2.348, p = 0.022, respectively), which indicates that people who experienced severe haze pollution may be less trustful of the local authorities. Stay duration, schooling and smoking influenced the trust of people in rural highland700 area (t = 5.912, p = 0.000; t = 4.368, p = 0.000; t = 2.358, p = 0.024, respectively), suggesting that people who are more highly educated may have more trust in their local authorities.

4.4. Willingness to Pay for Self-Protection and Air Pollution Management

To understand the WTP of the respondents, this study divides WTP into three types based on current and possible activities for self-protection from haze pollution: WTP for a mask, WTP for an air purifier, and WTP for local authority support (Table 4).

Table 4. WTP for self-protection and air pollution management.

Area	WTP for a Mask (% of Respondents)	Average Price (Baht/Piece)	WTP for an Air Purifier (% of Respondents)	Average Price (Baht/Machine)	WTP for Support Local Authorities (% of Respondents)	Average Price (Baht/ Household/ Year)
urban	58.97	82.74	10.26	7000	0	0
rural plain	64.58	55.68	10.42	12,500	2.08	25
rural highland600	7.14	20	2.99	3,700	0	0
rural highland700	45.76	16.3	0	0	8.47	20
rural highland1000	27.03	25	0	0	13.51	20

The highest percentage of WTP of the respondents was WTP for a mask, which was found in all areas. This might be because a mask can be brought with them anywhere and anytime that they would like to protect themselves from pollution, and the price per unit is not too expensive, especially when compared with an air purifier. The average price that the respondents in urban areas were willing to pay for a N95 face mask was the highest at 82.74 Baht/piece, followed by rural plain areas at 55.68 Baht/piece (Table 4). This might be because they faced the most serious haze pollution compared with those in the highland areas; hence, they would be more likely to pay more for self-protection. The results are in line with Carlsson and Johansson-Stenman [30] and Wang et al. [11] who found that people living in big cities or urban areas were more willing to pay than others to improve air quality in Sweden and for self-protection and smog treatment in China.

Meanwhile, WTP for an air purifier was found to be the highest in rural plain areas with 10.42% of respondents willing to pay for an average price of 12,500 Baht/machine; this was followed by the urban area (10.26%; 7000 Baht/machine). Regarding WTP to support the local authorities to deal with haze pollution, just a few percent of respondents in only three areas were willing to pay for their local authorities' support. The highest price was found in the rural plain area (25 Baht/household/year), following by rural highland700 and rural highland1000 (20 Baht/household/year).

4.5. Factors Influencing WTP for Air Pollution Management

WTP for air pollution management can be studied in two ways: (1) influence of demographic and socioeconomic variables; and (2) influence of risk perception factors [3]. Severe haze was found to be a crucially positive factor influencing WTP for a mask (Table S4.1) by urban respondents (t = 2.043, p = 0.048), which was similar to the findings of Huang et al. [6], indicating that severe haze experience was the main factor determining willingness to respond to haze. Stay duration was found to be a crucially negative factor influencing WTP for a mask in rural plain and rural highland1000 areas ($t = -4.106$, $p = 0.000$; $t = -2.144$, $p = 0.037$, respectively), while marriage was a negatively influential factor for rural highland600 area ($t = -2.479$, $p = 0.016$). Moreover, rural highland700 respondents were also negatively influenced by schooling ($t = -9.358$, $p = 0.000$), income ($t = -6.130$, $p = 0.000$) and occupation ($t = -5.659$, $p = 0.000$) and positively influenced by trust ($t = 33.752$, $p = 0.000$), effect ($t = 6.898$, $p = 0.000$) and familiarity ($t = 8.851$, $p = 0.000$), while trust ($t = 4.565$, $p = 0.000$) and income ($t = 4.109$, $p = 0.000$) also positively affected rural highland1000 respondents. Results for trust were also in line with the study of Dong and Zeng [5] and Yang et al. [19] who discuss the positive attitude toward the government related to more WTP for smog and CO_2 mitigation in China. In addition, income was also in accordance with the finding of Wang et al. [11] indicating that higher income leads to more WTP for self-protection.

Regarding WTP for an air purifier (Table S4.2), rural plain respondents were mainly positively affected by schooling ($t = 3.499$, $p = 0.001$) and negatively affected by trust ($t = -2.087$, $p = 0.043$), while rural highland600 respondents were negatively and positively influenced by stay duration ($t = -3.226$, $p = 0.002$) and marriage ($t = 2.027$, $p = 0.047$), respectively. The education factor was also similar to the findings of Wei and Wu [31]. However, no WTP was proposed for the rural highland700 and rural highland1000 respondents, which might be because the air purifier price was quite high so they prefer wearing a mask for self-protection.

WTP for support local authorities of rural highland700 and rural highland1000 respondents were negative influence by effect ($t = -3.694$, $p = 0.001$; $t = -4.686$, $p = 0.000$, respectively), while familiarity was positive influence on rural highland1000 respondents ($t = 3.555$, $p = 0.001$) (Table S4.3). Based on the questionnaire survey, only five respondents in both areas were willing to pay for support local authorities 20 Baht/household/year, while their average familiarity and effect were less than those in other areas (as shown in Figure 2). From the interview during asking the questionnaire, they explained the reason of this support that they would like to help for haze management but they have quite low income. However, no WTP was proposed for the urban and rural highland600 respondents, while only one rural plain respondent was willing to pay, which is because most of the respondents thought that the local authorities should take their role and responsibility in haze management and assist their citizens to survive during the severe haze. In other word, most of the respondents were willing to pay for self-protection, especially buying a mask, instead of support their local authorities in haze management, which was also in accordance with the finding of Wang et al. [11].

4.6. Correlation Analysis between Risk Perception and Daily $PM_{2.5}$ Exposure (DPE)

In order to explore the relationship between public risk perception and DPE in different areas, Pearson's correlation analysis was employed to calculate the relationships in each area (Table 5). In the rural highland600 and rural highland700 areas, trust was found significant negative correlation with DPE (−0.496, −0.593; $p < 0.01$), reflecting that the respondents with less exposure to $PM_{2.5}$, their trust to the local authority's management was high. Moreover, in the rural highland700 area, familiarity revealed a negative correlation with DPE (−0.545; $p < 0.01$) providing that the respondents with higher DPE trended to have less familiarity. This might be due to their longer stay duration leading to the feeling of familiarity with the haze pollution. In the rural highland1000 area, familiarity and effect were found to be negatively correlated with DPE (−0.413, −0.546; $p < 0.01$), reflecting that the respondents with higher DPE felt less familiarity and gain less effects due to haze. Consequently, the central and local authorities should launch measures to improve air quality and implement prompt risk communication to citizens.

Table 5. Pearson's correlation analysis among perception factors and Daily $PM_{2.5}$ Exposure (DPE).

DPE	Average DPE	S.D.	Familiarity	Effect	Trust
urban	2.112	1.729			
rural plain	9.719	5.102			
rural highland600	5.954	2.868	0.289 *		−0.496 **
rural highland700	3.454	1.603	−0.545 **		−0.593 **
rural highland1000	3.788	1.596	−0.413 **	−0.546 **	

* = significant at the 0.05 level; ** = significant at the 0.01 level

4.7. Methods to Cope with Haze Pollution

The respondents made suggestions for methods that should be used to cope with air pollution; these are shown in Table 6. The first priority raised by the respondents living in urban, rural plain, and rural highland areas is to reduce or avoid burning crop residues, which accounts for 40.98%, 60%, and 40.49%, respectively. Meanwhile, there were differences in the second priority, which may reflect attitudes regarding the main causes of air pollution, educational background, and occupation. The urban respondents suggested the second priority is both information exposure regarding air pollution and employing technology to deal with crop residues (both 13.11%), but they gave lesser scores for organizing burning periods for farmers who need to burn and scientific open burning. However, these are important issues for most farmers, especially those in the highland areas; therefore, the farmers recommended these two methods as the second and third priorities, accounting for 27.46% and 22.18%, respectively. Information exposure regarding air pollution was given as the second priority by the respondents in the rural plain area (21.67%), followed by organizing burning periods for farmers and scientific open burning (both 3.33%). This is because most non-farmers rural plain respondents also suggested information exposure to enable people to become literate about the existing situation.

Table 6. Methods to cope with haze pollution.

No.	Urban Area		Rural Plain Area		Rural Highland Areas	
	Methods	%	Methods	%	Methods	%
1	Reduce/avoid burning crop residues	40.98	Reduce/avoid burning crop residues	60	Reduce/avoid burning crop residues	40.49
2	Information exposure regarding air pollution	13.11	Information exposure regarding air pollution	21.67	Organize burning periods for farmers who need to burn	27.46
3	Employing technology to deal with crop residues	13.11	Open-burning scientifically;	3.33	Open-burning scientifically	22.18
4	Use public transportation instead of private car	8.2	Organize burning periods for farmers who need to burn	3.33	Information exposure regarding air pollution	7.04

5. Conclusions and Recommendations

Risk perception of urban and rural respondents staying in lower areas demonstrated greater familiarity with and more effects of health risks from haze pollution. However, urban respondents had the least trust in local authorities' roles to deal with the serious haze; therefore, local authorities should take more effective actions in response to serious haze pollution.

Key factors influencing people's familiarity with and effects in both urban and rural plain areas were their harm experiences, severe haze, and age. Therefore, effective methods to reduce severe haze, which can cause harm to people, especially older people, should be a first priority in urban and rural authorities' plans and actions. Moreover, harm experience was also a main factor that determined both familiarity and effects for highland people. Meanwhile, people's trust in different areas was positive affected by diversified factors, such as age (urban area), severe haze (rural plain and rural highland600 areas), stay duration (rural highland700 and rural highland1000 areas).

Based on the CVM method and comparing three types of WTP, the respondents were mainly willing to pay for a mask; the highest average price was suggested by urban respondents. Regarding air purifiers, highland respondents thought that this was an unimportant and overly expensive machine for them. This contrasts with those in urban and rural plain areas where one-tenth of respondents were willing to pay for an air purifier. Regarding WTP for support local authorities in managing haze pollution, a higher percentage of positive respondents were found in highland areas, while no positive responses were found in urban and rural highland600 areas.

Crucial factors determining WTP for a mask varied by area. Severe haze was the outstanding positive influencing factor, while stay duration were influential with negative influence for rural respondents. In highland areas, risk perception was positive influencing factor, while schooling, occupation, stay duration and harm experience were negative significant factors. Regarding WTP for an air purifier, schooling was a key factor with positive influencing the decision of rural plain residents, while stay duration was negatively influence for the rural highland600 residents. Regarding WTP for local authorities support, effects from haze for rural highland700 and rural highland1000 residents were found to be the main negative factor.

The main recommendation suggested by most respondents in all areas to deal with haze pollution is to first reduce or avoid crop residue burning. However, in cases where technology to avoid burning is unavailable, an early burning schedule for all highland areas should be formally broadcast via all channels of communication, such as local and central media, including social media, so that urban and rural plain residents are well informed and can prepare for their self-protection. At present, if the highland communities want to plan early burning, they need to organize a community meeting with all the village leaders and the local authority (subdistrict administrative office) in their area in order to carefully plan the most appropriate date, time, and duration for each village's burning. Then, they draw up their subdistrict early burning schedule and propose it to the district administrative office for consideration. Before starting any burning, they need permission from the head of the district administrative office; therefore, this kind of information should be communicated to urban and rural plain residents as well. Moreover, $PM_{2.5}$ concentrations in each area should be broadcast or disseminated more via the most accessible channels for many people such as mobile phones, television, social media, and local broadcasting towers to promote risk perception and awareness, together with understanding about haze pollution. Another possible channel to inform people about $PM_{2.5}$ concentration is during the daily weather forecast, which is announced every day on all television channels, so that most people can be kept frequently up to date.

Supplementary Materials: The following are available online at www.mdpi.com/2073-4433/11/6/600/s1, Figure S1: Disposable ear-loop 3 ply (a), carbon (b), cloth (c) and N95 (d) face masks, Table S1: Reliability Test; Table S2: The details of demographic information of the respondents, Table S3.1. Factors influencing risk perception: Familiarity; Table S3.2. Factors influencing risk perception: Effect; Table S3.3. Factors influencing risk perception: Trust; Table S4.1. Factors influencing WTP for a mask; Table S4.2. Factors influencing WTP for an air purifier; Table S4.3. Factors influencing WTP for support local authorities.

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