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PERCEPTION ABOUT WILLINGNESS TO PAY TO PREVENT INDUSTRIAL POLLUTION: A CASE STUDY OF UTTARAKHAND

Sukhwinder Singh*

Abstract

Industrialization has brought economic growth and development to many regions across the globe, including the Indian Himalayan Region (IHR). However, it has also resulted in an increase in environmental pollution, posing serious threats to the delicate ecosystems of the Himalayas. Understanding public perception regarding willingness to pay (WTP) to mitigate industrial pollution is crucial for sustainable development and effective policy implementation. The purpose of this study is to determine the WTP for a pollution-free environment in the Indian hill state of Uttarakhand using the Contingent Valuation (CV) approach. Data for this study was collected through structured questionnaire and results reveals that 71.2 % of respondents were prepared to pay for improved environmental standards. 21.3 % were not willing to pay, as they consider it as a responsibility of either the government or industrialists to manage the industrial pollution. As a result, this paper will offer guidelines for creating an effective policy framework and raise awareness among all stakeholders on how to manage industrial pollution in Rudrapur. According to the study, effective outreach programmes for industrial pollution management could be offered by social institutions, financial institutions, non-governmental organisations (NGOs), and the government as a part of their social responsibility.

Keywords: *Willingness to Pay, Pollution, Health, Industries, Waste Management*

* *National Institute of Technology, Hamirpur, Email: sukhwinder.0310@gmail.com*

Introduction

The Indian Himalayan Region (IHR), which spans several northern Indian states, has a distinctive and ecologically significant environment. The IHR, which is distinguished by its stunning mountains, extensive cultural legacy, and rich biodiversity, is crucial in sustaining the livelihoods of millions of people and the ecological balance of the subcontinent. Industrialization, on the other hand, poses an increasing threat to this delicate ecology, which has far-reaching effects on both local populations and the environment at large (Mani, 2021). It is worth mentioning that Himalayas which are generally considered as the one having a plethora of clean air and water are slowly and gradually turning into the polluting zones. This statement is further strengthened with the inclusion of several cities from IHR into the category of severe and critically polluted areas by Central Pollution Control Board (CPCB) of India. Udham Singh Nagar (Rudrapur) from the hilly state of Uttarakhand is one such prime example of it. The extent of industrial pollution in this region is already elaborated in the report of Comprehensive Environmental Pollution Index (CEPI) by CPCB (CPCB, 2013). Mining, manufacturing, and energy production are just a few of the industries that have exploded due to industrialization and urbanisation in the IHR. These businesses produce a lot of jobs and contribute significantly to economic growth, but they also release a variety of pollutants into the environment.

The pristine air, water, and land that were previously associated with the IHR have been degraded by rising pollution levels, which has a negative impact on the ecosystems of the area and the wellbeing of its residents. There is a rising understanding of the need to address this issue promptly as industrial pollution threatens the region's biodiversity, water supplies, and agricultural production. As concerns about the harmful effects of industrial pollution increase, it is crucial to comprehend people's perceptions of their Willingness to Pay (WTP) to prevent such pollution in order to create effective environmental conservation and sustainable development policies.

Ciriacy-Wantrup (1947) initially theorised contingent valuation surveys as a technique for extracting market valuation of a non-market good. Numerous other methods and strategies were adopted at that time with

regards to contingent valuation and it is presented in various studies such as by (Beardsley, 1971; Hadker et al., 1997; Price, 1989). The term "Willingness to Pay" (WTP) describes a person's willingness to make a financial contribution or take particular activities to address environmental problems and safeguard natural resources. In the context of industrial pollution in the IHR, understanding people's perceptions of WTP is crucial since it can reveal how much local communities are aware of and concerned about environmental deterioration (Guo et al., 2020). Additionally, evaluating WTP might help in identifying possible cash resources that can be tapped for projects related to sustainable development and pollution reduction(Verbič & Slabe-Erker, 2009).Despite the detrimental effects of poor air quality on the local population, research conducted so far in industrialised nations have generally indicated low marginal WTP for reducing such environmental harms(Field et al., 2015).
The fundamental idea behind the contingent valuation approach is to simulate people's answers based on how they would react in hypothetical situations. Questions about the highest amount that people are willing to pay for a change (improvement or purchase) at the level of environmental goods are asked in the ex-ante analysis for environmental evaluation (Ann et al., 1987).WTP perception is influenced by a wide range of variables that go beyond purely economic factors. An individual's attitude towards environmental conservation and willingness to take part in measures to reduce pollution can be greatly influenced by socio-cultural, demographic, and environmental factors. To design targeted interventions and remove obstacles that obstruct environmental protection, it is also critical to comprehend the elements that discourage people from supporting WTP activities.

Without conducting an effect assessment study, the industrial industrial estates in Rudrapur were constructed. Due to this and following a reconnaissance assessment, it seems that the project will have both good and negative socioeconomic effects on the neighbouring populations. Thus, the study's main goal is to investigate and analyse people's perceptions of their Willingness to Pay (WTP) to prevent industrial pollution in the Indian Himalayan Region (IHR). The study seeks: to assess how much people in the IHR are aware of and concerned about industrial pollution, its effects on the environment, and its effects on human health;

to determine the socio-demographic, economic, and environmental elements that affect people's WTP for pollution mitigation activities; to investigate potential obstacles that prevent people from taking part in WTP projects and making a contribution to environmental preservation; to offer recommendations for policy to encourage sustainable development and reduce industrial pollution in the IHR based on research findings.

While several studies have investigated environmental perceptions and WTP in various contexts, research focusing specifically on the IHR is limited. The region's unique socio-cultural context and ecological significance necessitate a dedicated examination of how individuals in the IHR perceive industrial pollution and their willingness to financially contribute towards its avoidance. This research article aims to fill this gap in the literature by providing a comprehensive analysis of the perception of individuals in the IHR regarding their WTP to avoid industrial pollution.

Literature Review:

The CV approach has been used extensively in empirical studies to estimate the public's WTP for non-market commodities. Shono et al. (2014)carried out a CV survey to assess Indonesian public WTP for healthcare services. Zalejska-Jonsson (2014) used a CV survey to evaluate the WTP for green flats in Sweden. El-Fadel & Massoud (2000)utilised the CV approach to conduct a health-based economic assessment, while Y. Wang et al. (2017) used it to analyse the Chinese public's willingness to pay to avoid living near nuclear power plants. The majority of them(Sun, Yuan, & Yao, 2016)(Ouyang et al., 2019)try to estimate people's WTP and investigate how variables like age, income, and family size affect the amount of WTP.

To estimate WTP, numerous statistical methods are used. For instance, logit regression model (Woo et al., 2014)and probit regression models(H. Wang & Mullahy, 2006)(X. J. Wang et al., 2006)are frequently used to analyse binary response data and are frequently used to estimate probability when there are latent variables in the regression.The two models differ significantly in these two ways: The logit model can be

applied to numerous regressions, although the probit model is more frequently employed in regressions with a single dependant variable. The first is that the probit model has a normal distribution whereas the logit model has a logistic distribution.

WTP questions can be asked in a variety of ways in a CV survey. To determine people's willingness to pay (WTP) for carbon offsets from train travel, (Lim & Yoo, 2014) used the double-bound dichotomous choice (DBDC) format CV approach. (Chien et al., 2005) created a generic model to calculate the health benefits of better air quality under an investigation using the CV technique and dichotomous choice (DC) methodology. (H. Wang & Mullahy, 2006) conducted a study to elicit willingness to pay using payment card method. Additionally, numerous research have shown that OE format CV surveys yield more accurate estimates of respondents' WTP than other survey formats (X. J. Wang et al., 2006) (Kedia et al., 2020).It is simple to determine intervals in a payment card survey and bidding values in a DC survey since research in India that concentrate on the calculation of WTP for reducing pollution are few and far between. As a result, this study's payment card strategy is finally used.

Material and Methodology:

Study Area

The State Infrastructure and Industrial Development Corporation of Uttarakhand Limited (SIIDCUL) operates numerous industries in Rudrapur, a city in Uttarakhand that is rising and developing quickly. Diverse industries of all sizes and sorts have been built in this region by the State Industrial Development Corporation of Uttarakhand Limited (SIDCUL), Dehradun. In the Tarai region of the Himalaya, the IIE Rudrapur is home to more than 450 industries, many of which are related to food production, electroplating, automobiles, and other products (Goyal & Gupta, 2016). This industrial area experiences seasonal climate fluctuations all throughout the year, including hot summer temperatures (March to June), torrential monsoon rains (July to September), and bitter cold (October to February).

Rudrapur's rapid industrialization has had a significant impact on the area's suitability for human habitation. Municipal wastewater from Rudrapur city and industrial effluent from another industrial park, Pantnagar, when discharged directly into the nearby surface water, have the potential to deteriorate the water quality and wipe out the local biodiversity. Population growth, economic pressures, and development processes are the causes of these issues. Rapid urbanisation has an impact on the environment, and discussions about political and economic issues now frequently include remedies to alleged environmental issues. The population living near the industrial units is facing several problems in terms of health, scarcity of water, poor sewage and other infrastructural issues. The majority of slums and manufacturing facilities, including those that process corn, phosphate, ply wood and electroplate in the Rudrapur and Chattarpur region, are situated close to the SIDCUL drain. Therefore, an effort has been made to quantify the cost of these issues from the perspective of residents with the help of Contingent Valuation approach.

Methodology

Contingent Valuation Methods (CVM) has been used to estimate the WTP by households for pollution free environment. Hadker et al. (1997) explains CVM, as a survey approach, in which respondents are asked how much they would be ready to pay for the use or conservation of natural goods, and their preferences are predicated on the availability of substitute items in a fictitious market. This methodology is suitable for assessing environmental commodities that don't have market data or their substitutes but have an impact on respondents' welfare (Hoevenagel, 1994).Since CV is independent of the real market or observable conduct, it can be used in a variety of valuation circumstances(Grossman, 2011; Liu, 2020; Sun, Yuan, & Xu, 2016). Multiple layouts, including "open-ended, dichotomous choice, double bounded dichotomous choices, iterative bidding, and payment cards," are used in CVM based research (Yoo & Yang, 2001). By assessing families' WTP for better services and environmental conditions through direct and indirect methods, CVM draws attention to a number of concerns relating to health, the environment, and atmosphere (Sánchez et al., 2018)(Bateman et al., 2006).

This study employed the Payment Card Approach under CVM, which is a widely accepted method for estimating the economic worth of non-market items such resources, wildlife, and environmental quality (Yang et al., 2013). This technique is widely used in industrialised countries to calculate the benefits of non-market environmental commodities that are openly included in costs and benefits calculations (Fonta et al., 2010). A list of payment amounts was displayed on the payment card, and households select the amount that best reflects their maximum WTP (Champ & Bishop, 2006).

The payment card was created with a 10-cell response scale, which is compatible with the notion that measurement inaccuracy rises as WTP values do.

The primary data to achieve the objective of this study was collected from the IIE-Rudrapur with the help of structured questionnaire. In 2023, the survey was carried out between January and February. Applying Cochran statistics, the intended sample size for this investigation was 384. However, an additional 10% of this size was taken into account to rule out any prejudice (Woolson et al., 1986). A total of 396 fully completed questionnaires were received out of 424 total respondents. Through the use of cluster random selection, households were selected.

Face-to-face interviews were used to distribute and collect the questionnaires. The socio-demographic characteristics of the households are listed in the questionnaire's section A, including the respondents' gender, age, household size, level of education, and income.

Information on residents' perspectives and attitudes towards environmental pollution is provided in Section B. The CVM questions in Section C ask for households' projected WTP for a industrial pollution management programme. In order to reduce bias, respondents were urged not to alter their responses while selecting the WTP values, as stated on the payment form. Respondents were explicitly informed that they would have to pay extra money to the relevant authorities if they believed that the planned industrial pollution management programme would be beneficial. Keeping in mind that this additional expense may cause them to spend less on other vital expenses like food, clothing, and savings.

The respondents were given a payment card and asked to check the chosen figure that would represent their WTP for the suggested industrial pollution management system if they agreed to pay the fee to the Uttarakhand government.

Model of the Study

For an industrial pollution management programme in Rudrapur, a regression model was created and tested using the SPSS 28 software to determine the variables that affect families' WTP. The two alternatives for respondents' WTP for improving the environment in Rudrapur were either 1 or 0. The response "1" indicates their willingness to pay (WTP) for better environmental conditions, whereas the response "0" indicates that they are not willing to pay (WTP) for better pollution control measures. WTP was the dependent variable in this study, and the independent variables were demographic traits, socioeconomic variables, environmental factors, health issues, and economic factors. Researchers can choose between logistic regression and probit regression since the dependent variable might take on a 0–1 form. The method of evaluation in this study was logistic regression (Duffield & Patterson, 1991). The probability model can be written as:

$$WTP\ (yi= 1) = a+b1x1\ldots\ldots\ldots bnxn$$

The logistic regression equation for the log-odds to estimate WTP can be calculated using the set of predictors as follows:

$$Log[p1\ /\ 1\text{-}p1] = b0+b1x1$$

Coefficientb1demonstrates how the odds of deciding to pay for better industrial pollution management choices have changed. It was anticipated that a number of variables, including respondents' gender, level of education, and income, would influence their WTP. The results are also in line with the other studies (Nosratnejad et al., 2016; Ouyang et al., 2019; Taale & Kyeremeh, 2016). These elements served as independent variables in the model. The list of independent variables is mentioned in Table 1.

Table 1 Variables Considered for this Study

Indicators	Description	Category	Codes
Gender	Gender of the respondent	Male	1
		Female	2
Age	Age of the respondent	15–30	1
		31–45	2
		46–60	3
		60 and above	4
Education	Educational Qualification of the respondent	Illiterate	1
		High School	2
		Senior Secondary	3
		Undergraduate	4
		Postgraduate	5
		Others	6
Income	Monthly Income of the respondent from all sources	Less than 10,000	1
		10,001–25,000	2
		25,001–50,000	3
		50,001–100,000	4
		100,001–above	5
Willingness to Pay	Household's willingness to pay for industrial pollution management		1 = Willing to Pay
			0 = Not Willing to Pay
Perception about Industrial Pollution	Industrial pollution has a negative impact on the habitat		1=strongly disagree 2=disagree 3=neutral 4=agree 5=strongly agree
	Industrial firms are taking pollution control measures		
	Value of land/property has decreased in last 5 years due to the presence of industrial clusters/industrial pollution		
	Shelf life of perishable commodities has decreased during the last 5 years due to industrial pollution		

	Industrial pollution has caused difficulty in breathing	
	Bad health has impacted the ability to do work as before	
	Household demand for organic products has risen with the rising industrial pollution levels.	

Results and Discussions

Demographic Indicators

Demographic profile indicating socio-economic characteristics of the respondents is presented in Table 2. It is important to understand these characteristics as they can play a significant role in any model (Eagle et al., 1998)(Rashid, 2020).A total of 396 respondents were covered in this study from Rudrapur area, around 64% of them were men and 36% of whom were women. Ages 15 to 30 make up the majority of responses (59.09%), followed by ages 31 to 45 (21.97%). Around 33.84% of the respondents were undergraduate while only 4.55% were illiterate in this sample. According to the survey's demographic profile, the income bracket of INR10,001 to 25,000 has the biggest percentage of respondents (45.96%), followed by INR25,001to 50,000 (28.28%).

Table 2 Demographic Profile of the Respondents

Demographic Indicators		Frequency	Percentage
Gender	Male	252	63.64
	Female	144	36.36
Age	15–30	234	59.09
	31–45	87	21.97
	46–60	62	15.66
	60 and above	13	3.28
Education	Illiterate	18	4.55
	High School	67	16.92
	Senior Secondary	93	23.48
	Undergraduate	134	33.84
	Postgraduate	78	19.70

	Others	6	1.52
Income	Less than 10,000 INR	45	11.36
	10,001–25,000 INR	182	45.96
	25,001–50,000 INR	112	28.28
	50,001–100,000 INR	56	14.14
	100,001–above INR	1	0.25
	Total	**396**	**100**

Perception of Household on Industrial Pollution

Table 3 presents the perception indicators of the respondents to certain statements asked during the survey through a structured questionnaire. Results indicate that 92.17% of respondents agreed that industrial pollution has a bad effect on the environment. While 64.49% of respondents believe industrial enterprises should employ all available pollution control measures and have identified this as a significant contributor to environmental degradation. In addition, the majority of respondents felt that industrial pollution had a negative influence on health, which also affects their productivity at work. 76.17% believed that perishable goods' shelf lives have decreased, and 71.22% thought that domestic demand for organic food products has increased with the rise in industrial pollution levels.

Table 3 Perception Indicators of the Respondents

Perception Indicators	Agree (in%)
▪ Industrial pollution has a negative impact on the habitat	92.17 %
▪ Industrial firms are taking pollution control measures	64.49 %
▪ Value of land/property has decreased in last 5 years due to the presence of industrial clusters/industrial pollution	85.85 %
▪ Shelf life of perishable commodities has decreased during the last 5 years due to industrial pollution	76.17 %
▪ Industrial pollution has caused difficulty in breathing	93.28 %

▪ Bad health has impacted the ability to do work as before	89.74 %
▪ Household demand for organic products has risen with the rising industrial pollution levels.	71.22 %

Sources of Industrial Pollution

During the data collection, when respondents were questioned about their knowledge about the main sources of industrial pollution in the Rudrapur region. Figure 1reveals that 55.7% of respondents identified relase of toxics by the industries as the main source of environmental contamination, whereas 34.8% of respondents believed that movement of heavy vehicles dumping was also one of the significant causes of the industrial pollution. 69.9% of respondents opined that dumping of garbage by the industries is main cause of contamination by the industries. 17.8% of respondents think that construction activities by industrial units are also responsible for pollution, whereas 31.5% were of the opinion that incomplete burning of fossil fuels is also causal agent for rising pollution levels by the industries.

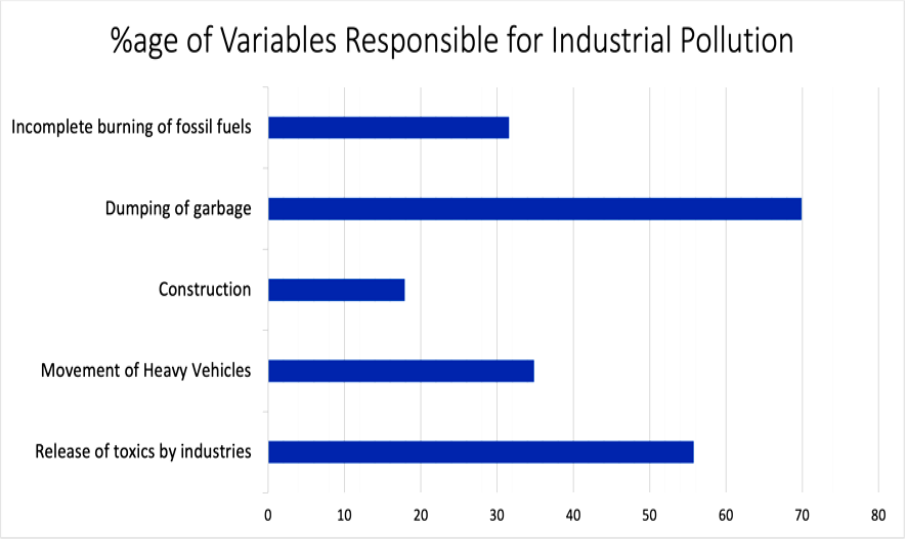

Figure:1 Variables Responsible for Industrial Pollution

Willingness to Pay

The study's primary goal is to determine each household's WTP in order to manage Rudrapur's environmental pollution level. People were

questioned about their willingness to pay in order to enhance the system for managing industrial pollution. 76.2% of respondents said they would be prepared to pay to improve Rudrapur's industrial pollution management system, while 21.3% disagreed and 2.5 % were unable to answer the same. 31.2% of those surveyed believe that the government should do more to improve the management of industrial pollution in Rudrapur. They don't feel the need to pay more for this because they are already paying heavy taxes and other bills to the government. Around 63.4% of the respondents are willing to pay more money than their stated amount to manage pollution by industrial cluster of Rudrapur region. They believe that the primary cause of the illnesses that lower their ability to do work is industrial pollution. However, some people refused to spend money on new facilities. They believe that the government should make investments to raise environmental standards of this region. People who are willing to pay were most probably suffering from several health issues which has impacted their earnings as well.In order to get rid of the problems related to health, infrastructure and improve basic amenities in the region, they welcomed this method, if it can provide them with the concrete solution.

Table 4 Willingness to Pay – Distribution (Payment card used in the Study)

Willingness to Pay Amount (in INR)	*Frequency*	*Percentage*
0	83	21.50
10	24	6.22
20	12	3.11
50	19	4.92
100	60	15.54
200	45	11.66
400	39	10.10
800	33	8.55
1500	42	10.88
3000	29	7.51

Results from Table 4reveals that 15.5% of respondents are willing to pay INR100 and 10.88% are willing to pay INR 1500 for industrial pollution management in Rudrapur. 21.5% of the respondents prefer not to opt for this method to avoid industrial pollution as they either don't want to own this problem or they do not have enough savings/income to pay for such kind of services. The findings indicate that INR608 and INR 150, respectively, represent the mean and median values of WTP for an effective industrial pollution management programme.

The regression model takes into account socio-demographic factors, households' perception, and attitudinal variables as independent variables while WTP was the endogenous variable to assess the impact of socio-demographic factors, such as gender, age, education, income, and households' perception, on households' WTP for improved industrial pollution management in Rudrapur. With a statistically significant value of 56.72 at the 1% level, the likelihood ratio test shows that the estimated logistic regression model had a good fit, demonstrating a strong link between explanatory variables and WTP. R2 value of 0.87 also indicates that model has a good prediction accuracy (Cameron & Windmeijer, 1997; Mbachu et al., 2012)

Table 5 Descriptive Statistics of Willingness to Pay

Descriptive Statistics	Mean	608
	Median	150
	Standard Deviation	966.4574486
	Kurtosis	4.153675989
	Skewness	2.058520316
	Minimum	0
	Maximum	3000

Households with a high level of education and income are more likely to pay for an improved pollution management programme, according to the positive coefficients of education (α= 0.520, p 0.001) and income (α = 0.370, p = 0.001). These findings are consistent with the idea that WTP rises with household income and level of education. However, the research discovered a weak, non-significant correlation between WTP and

age of the respondent ($\alpha = 0.079$, $p > 0.05$) and size of the household ($\alpha = -0.045$, $p > 0.05$).

The results also showed that the households' perception of industrial pollution has a negative impact on habitat ($\alpha = 0.389$; p value 0.001), industrial pollution has caused difficulty in breathing($\alpha = 0.251$; p value 0.001), industrial pollution has impacted the ability to do work ($\alpha = 0.375$; p value 0.001), shelf life of perishable commodities has deteriorated ($\alpha = 0.274$; p value 0.001), and value of land prices has decreased due to industrial pollution ($\alpha = 0.320$; p value 0.001). The WTP for better industrial pollution management in Rudrapur was significantly influenced by all of the aforementioned factors.

Policy Implications

Diverse dynamics in the industrialisation are causing changes that are limiting sustainable growth in the IHR. The Uttarakhand State Industrial Policy of 2003 introduces a strategy for attracting manufacturing plants that are resource-efficient and should provide local employment. However, this lead to the creation of industrial hubs at the border areas of Uttarakhand, thus giving a setback to the actual agenda of this industrial policy. As the Industrial Policy was introduced to change the layout of Uttarakhand by raising the livelihood of people living in the far-flung areas. But in actual, Industrial zones were limited to border areas of Uttarakhand only which had better infrastructural quality than the rest of the state. While eliciting WTP, respondents were of the opinion that they are ready to contribute for a better industrial pollution management system only if government officials effectively execute policies. This study recommended that, while keeping in mind the broader interests of society, appropriate strategies be used before implementing any such projects. It is also recommended that urban development and planning should be prioritised. Marginalised communities should have access to affordable housing options, especially migratory slum residents.

It is important to take the right actions to reduce industrial pollution and upgrade Rudrapur's drainage infrastructure. The administration ought to be devoid of corruption. Heavy metal exposure to fresh water, air, and

land should be prevented or well managed, and industries should maintain a functional drainage system and recycle the water for numerous uses. Planned industrial waste excretion to avoid water channels, safe and clean usage of water bodies, and government awareness are significant considerations. The sewage system in Rudrapur is outdated and not working efficiently, therefore urban local bodies should improve the sewage and drainage system. People should also be guided about using environmental resources effectively, such as by rainwater harvesting, making them aware about sanitation water contamination. Lastly, government should ask for help from other interested parties, including urban residents and NGOs, if it is unable to improve its system for managing industrial pollution. Overall, regulating industrial pollution and implementing policies need the development of an efficient monitoring system.

Limitations

Although this study addresses the key features of the problem associated with industrial pollution in the Rudrapur, there are certain limitations that should be considered. First, due to time and financial limitations, this study was unable to cover the entirety of City. Future research must assess the entire city in order to recommend a suitable legal framework for the control of industrial pollution. Second, and this is a crucial point for future research, this study was unable to interview the current authroities of State Pollution Control Board of Uttarakhand.

Conclusion

This study aims to make a substantial contribution to understand people's attitudes and WTP towards preventing industrial pollution in the Indian Himalayan Region. The study intends to teach policymakers, environmental organisations, and other stakeholders on the crucial role of public engagement in pollution mitigation efforts by illuminating the factors influencing WTP and highlighting potential hurdles. Using payment card approach, residents of critically polluted Rudrapur (Uttarakhand) area, were asked to elicit WTP for better environment and management of industrial pollution. While 21.3% of respondents disagreed and 2.5% were unable to comment, 76.2% of respondents said

they would be willing to pay to improve Rudrapur's industrial pollution management system. According to 31.2% of respondents, more needs to be done by the government to improve Rudrapur's industrial pollution management. 11.6% of respondents said they would be willing to pay INR 200, 10% for INR 400, and 7.5% INR 3000, which was the maximum amount listed on the payment card.

The socioeconomic determinants impacted WTP for the reduction of industrial pollution, but education and income were two of the most important ones. With a particular emphasis on involvement of public, industrialist and government, this research could significantly aid in the provision of important insights that may significantly contribute to preventive actions against industrial pollution. In the end, the research hopes to open up opportunities for environmentally responsible growth and preservation in this ecologically fragile area, preserving the natural wonders of the Indian Himalayan Region for future generations.

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