

1 **PUBLIC AWARENESS, BEHAVIOR AND PREVENTIVE PRACTICES OF THE RURAL**  
2 **PEOPLE IN THE ADAPTATION TO SMOG EPISODES**

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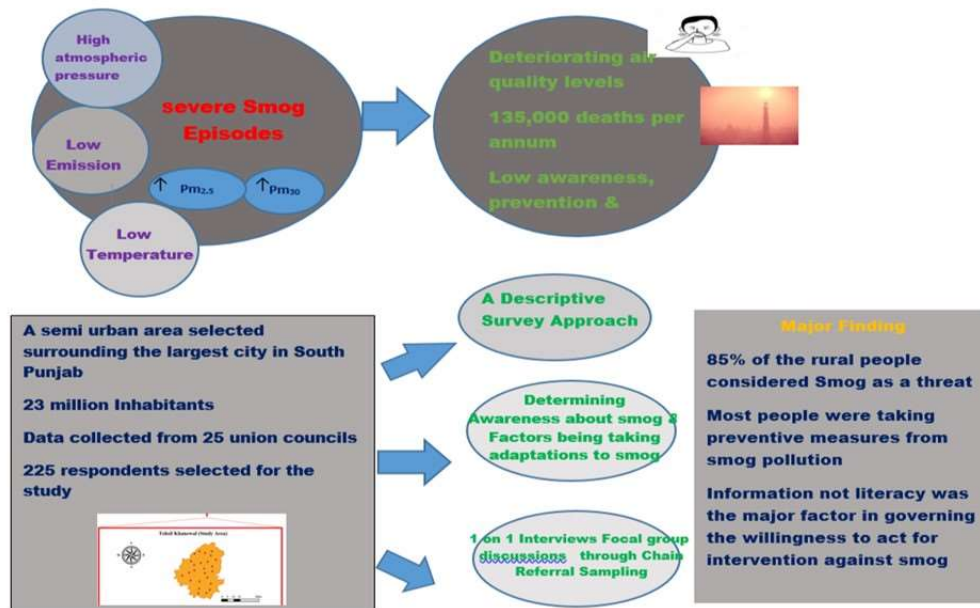
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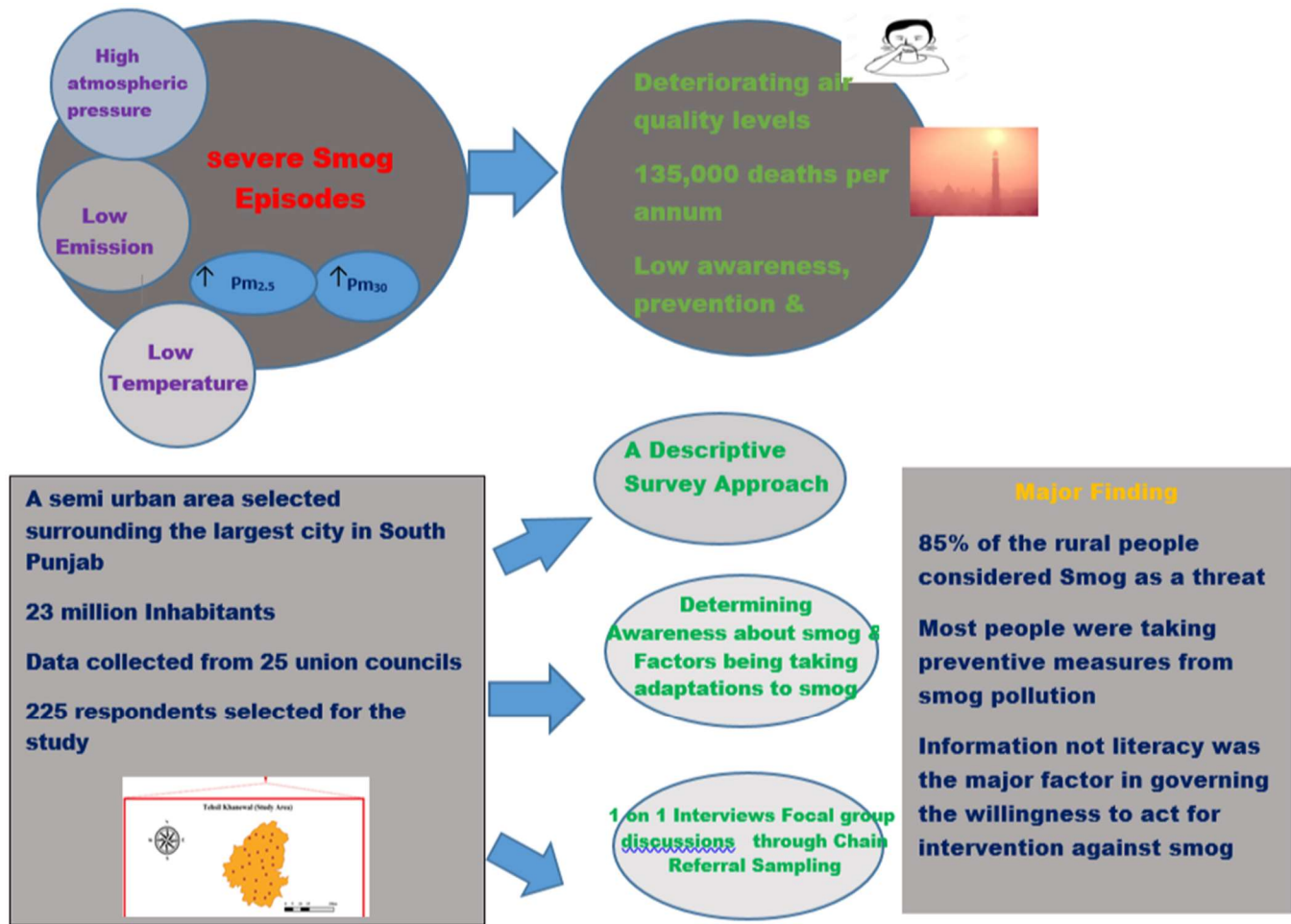


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20 **ABSTRACT**

21 Smog has emerged as one of the biggest issues facing Pakistan and many other nations in recent decades.  
 22 However, this crucial environmental issue has received less attentions of measuring public perception and  
 23 awareness of air pollution and the connections between it and smog prevention in a Pakistani context  
 24 especially with respect to rural areas. A questionnaire based study was designed to evaluate the rural people  
 25 perception, awareness and preventive practices to cope with severe episodes of smog in district Kahnewal,  
 26 South Punjab, to fill this gap. The results indicated that majority of the respondents comes from working in  
 27 the city accounting for 36.44% of the total income. About 85% of the people in the villages have moderate  
 28 to a good level of understanding regarding smog pollution. Moreover, around 84% of the people in the  
 29 villages were considering smog to be a moderate to very severe problem. Television news and weather  
 30 forecasts (34%) were found to be the most often used source of information on smog. About 44% of  
 31 respondents were using facemasks while 32% of the participants had reduced their outdoor activities as  
 32 potential protection measures against smog. The findings of this study can help to improve the  
 33 understanding of public awareness of smog pollution in rural people of Pakistan, thereby encouraging  
 34 greater public involvement in smog prevention and management, contributing significantly to the broader  
 35 goal of sustainable development.

36 **Keywords:** Air pollution; health consequences; smog control policies; government performance



38

39 **1. Introduction**

40 Among various global environmental challenges, smog is at the forefront of causing air pollution and  
 41 deteriorating the air quality of various mega cities worldwide (Saleem et al, 2019). Air quality levels of  
 42 various cities today are much worse as compared to previous decades (Ghauri et al 2013). For example, in  
 43 India alone, the PM<sub>2.5</sub> levels rose to 890 ( $\mu\text{g}/\text{m}^3$ ) in 2020 from 450 ( $\mu\text{g}/\text{m}^3$ ) in 2010 (Arif et al 2016). While  
 44 in Shanghai, the number of days with good air quality was just a mere 275 days in 2018, with an air quality  
 45 index good rate of 75.3% (Mukhtar, 2017). Rising levels of population, industrialization, unplanned cities  
 46 expansion, and increasing numbers of vehicles have enhanced the profile of pollutants. They are affecting  
 47 the cities and deteriorating the environment of the villages (Khan et al 2011; Sharif et al 2016; Azam et al  
 48 2016). Smog levels in the big cities and villages surrounding them are now frequent and much pronounced

49 every coming year (Azam et al 2016; Ghauri and Zafar 2016). Smoggy periods are getting so common that  
50 smog is now being perceived as the fifth season in most parts of the world (Sadiq, 2016 Omer, 2018). Smog  
51 pollution is now one of the most pressing environmental and public health issues of the world (Omer, 2018;  
52 Sarfraz, 2020). As smog levels have hit record levels thus currently globally, most parts of the world are  
53 observing the most serious air pollution of the current period (Sarfraz, 2020; Dimitriades, 1972).  
54 Smog is responsible for about 135,000 deaths per annum (Mulwijk et al 2016; Wilson, 1972). Heavy metals  
55 in the atmosphere are the leading cause of life-taking diseases such as Asthma, Bronchitis/emphysema, and  
56 Cardiac problems (Tao et al 2015). A study in Bangladesh depicted that smog is taking lives and potentially  
57 costing around 6% of the country's GDP (Imran, 2020). Studies have shown smog to affect the economic  
58 activities of various megacities (Khan, et al 2019; Wasif 2016; Iqbal, 2019). Thus, providing financial losses  
59 to major businesses around the world (Elsom, 2014; Zhang and Samet, 2015). Smog also imparts loss in  
60 terms of productivity (Ashraf et al 2019; Ali et al 2019). According to the World Bank and Health Metrics  
61 and Evaluation institute, the worldwide price for air pollution has accounted for 5.2 trillion dollars, about  
62 7.1% of the yearly GDP (Ali et al 2019; Newell, 2017). As per lancet, the cost of decreased efficiency and  
63 productivity because of smog-linked diseases has risen from 0.61 to 0.82% (Newell, 2017).  
64 In Pakistan, small periods of smog have been recorded for many years now (Qin et al 2018; Yasin et al  
65 2024). But the more pronounced, intensive, and frequent spells of smog had specifically blown two  
66 provinces of the country, i.e., Punjab and KPK. It started in 2012 and has spread on an area ranging from  
67 155000 to 35400 km<sup>2</sup> Calbi et al 2017). In most recent times, the largest metropolitan city of Punjab, i.e.,  
68 Lahore, became the 2<sup>nd</sup> most polluted city in the entire world (Wei et al 2017; Yasin et al 2021). This led  
69 Pakistan's smog season to be most detrimental for exposed people, especially children (Qin et al 2018).  
70 Levels of particulate matter in the megacities and their surroundings are rapidly increasing, reportedly  
71 having an annual particulate matter 2.5 average of 74 µg/m<sup>3</sup> (Shaw et al 2004; Hussain et al 2018).  
72 According to claims of some experts, smog in Pakistan has been linked with the coal refining industry in  
73 the country and crop burning activities by the farmers from the Indian Punjab (Jiang et al 2016). On the

74 contrary, both countries are experiencing the same issue, and they must cooperate in this regard to have a  
75 smog-free atmosphere (Amann et al 2017; Karambelas et al 2018).

76 Amid increasing smog episodes, it is important that not only the communities are fully aware and have  
77 sufficient knowledge regarding smog. But also, decision-making processes regarding preventive behavior  
78 are understood in order to generate behavioral responses (Mei et al 2014; Yasin et al 2023). Thus the  
79 necessity of this research becomes far more important and pivotal, as it would help to shape the design and  
80 implementation of effective and efficient adaptive policies both in urban and rural areas. Further, this study  
81 will help to depict perception and aid understanding of the levels of exposure to smog in a specific  
82 community. This research makes it easier to infer driving factors underlying various behavioral responses.  
83 A few limited studies in Pakistan have tried to depict awareness levels of smog among urban populations  
84 (Qin et al 2018; Jiang et al 2016; Ahmed et al 2019; Ranabhat et al 2015, Zhu and Yao, 2018). All of these  
85 studies have concluded that due to abrupt, frequent, and long smog events, people in the cities perceive  
86 smog as a harmful environmental condition (Jiang et al 2016; Ahmed et al 2019; Vogel and Rose 2017). A  
87 few of the studies in the country also displayed that residents actively participate in preventive and  
88 mitigating activities to curb smog (Jiang et al 2016; Bacev-Giles and Haji, 2017). Although there are many  
89 research on smog in urban settings, there are essentially none in the current literature on smog perception  
90 and the factors that contribute to it in rural Pakistan. Few things are known about the variables influencing  
91 how individuals in rural areas often perceive and respond to pollution, as well as how these factors affect  
92 individual behavior changes in these situations. (Oanh et al 2018; Yasin et al 2019).

93 The present study constitutes survey-based research applying a questionnaire that was distributed among  
94 the residents of villages in southern Punjab. This study is one of its kind to determine awareness regarding  
95 smog and factors behind taking adaptations to smog in rural areas of Pakistan. The next section will provide  
96 a methodology for conducting the survey at the study site. After that, several characteristics of awareness  
97 levels among the public are presented and discussed The aim is to understand what smog means to them,

98 the severity of the problem, the primary cause of smog, and potential mitigation activities. Finally, the  
99 conclusion and policy implication is presented.

## 100 **2. Materials and Methods**

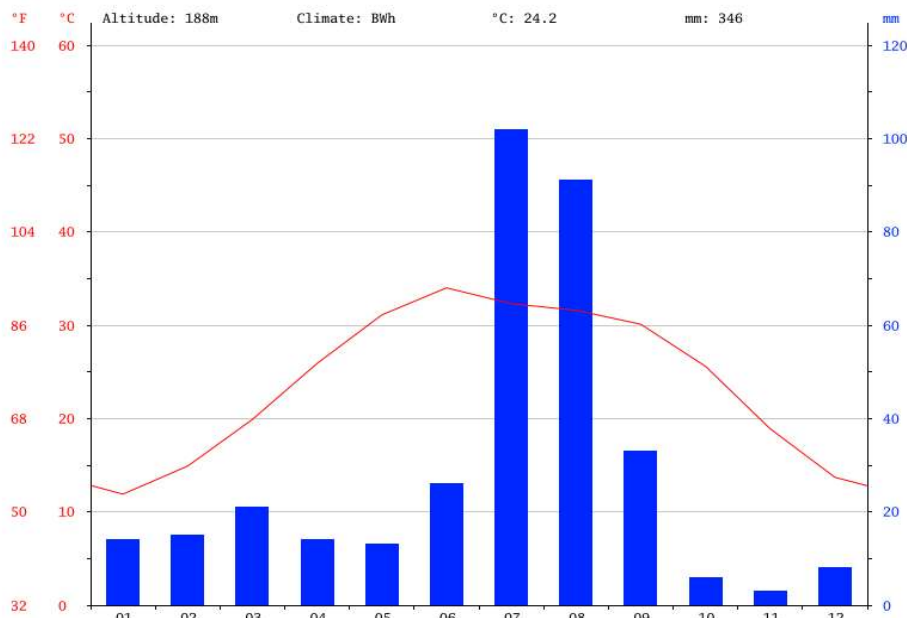
### 101 **2.1. Study site and Methodological approach**

102 The present study was conducted in district Khanewal located in Southern Punjab, Pakistan. District  
103 Khanewal is divided into four Tehsils (townships): Jahania, Kabirwala, Khanewal, and Mianchannu. On its  
104 west lies the largest city in southern Punjab: Multan, which harbors the largest population in the region.  
105 While on the north, there are districts Jhang and Toba Tek Singh that is also populated and industrialized  
106 cities of Punjab. As per the census of 2017, Khanewal had a population of 2376000.

107 According to Köppen–Geiger classification, the climatic condition of the area is the desert climate (Figure  
108 1) The area receives an average annual rainfall of up to 346 mm and experiences an average annual  
109 temperature of 25.2 °C. This region has constantly been experiencing heavy smog for the last decade. The  
110 smog episodes here start in late November and remain till the end of January. Smog in this region is most  
111 dense in mid and late December, lowering visibility even by less than 1 meter. Due to this, motorways and  
112 highways are often shut down in order to prevent accidents. According to studies in the national context,  
113 high levels of Particulate Matter (PM<sub>2.5</sub>–PM<sub>10</sub>), organic aerosols, SO<sub>2</sub> NO<sub>x</sub> and trace pollutants are recorded  
114 in smog-affected areas (Raza et al 2021). Environment departments in the national context have their offices  
115 set up in big cities, but in rural areas, such offices are often absent (Anjum et al 2021).

116 The current research utilized a descriptive survey approach. This method was used to attain data from the  
117 rural population to determine the perception of smog with respect to one or more variables (Schweighart et  
118 al 2020). Descriptive surveys ensure that all detailed and factual information describing an existing  
119 phenomenon can be gathered (Glasow, 2005). This particular research design is of key importance when it  
120 comes to an understanding human perception regarding a certain issue, especially in observing a large  
121 population that could not be observed directly (Sukamolson, 2007). Due to these reasons, this survey  
122 approach was selected and employed in the study.

123 Data from 25 union councils, or administrative divisions, in the chosen district tehsil were gathered for the  
124 current study (Figure 2). Fieldwork was done in 2022 between March and July. The timing of the visits was  
125 important because this particular area had recently experienced a severe pollution outbreak. From the  
126 chosen administrative units, 225 persons were interviewed in all,  
127 and everyone of them provided an answer. The general populace of rural villages near large cities was the  
128 study's target audience. These were chosen because of periods of extreme pollution brought on by  
129 numerous, busy companies in the suburbs of the city.  
130 Respondents were approached in the lead of the local guide from each union council following a snowball  
131 sampling technique, also known as chain referral sampling (Zubair et al 2019; Yasin et al 2024). The  
132 selected sampling method is very useful in identifying those parts of the population that usually remain  
133 unexplored because of a lack of local knowledge and other socio-economic barriers.



134  
135 **Figure 1. Average annual temperature and precipitation of the study site.**

## 136 **2.2. Organization of the questionnaire.**

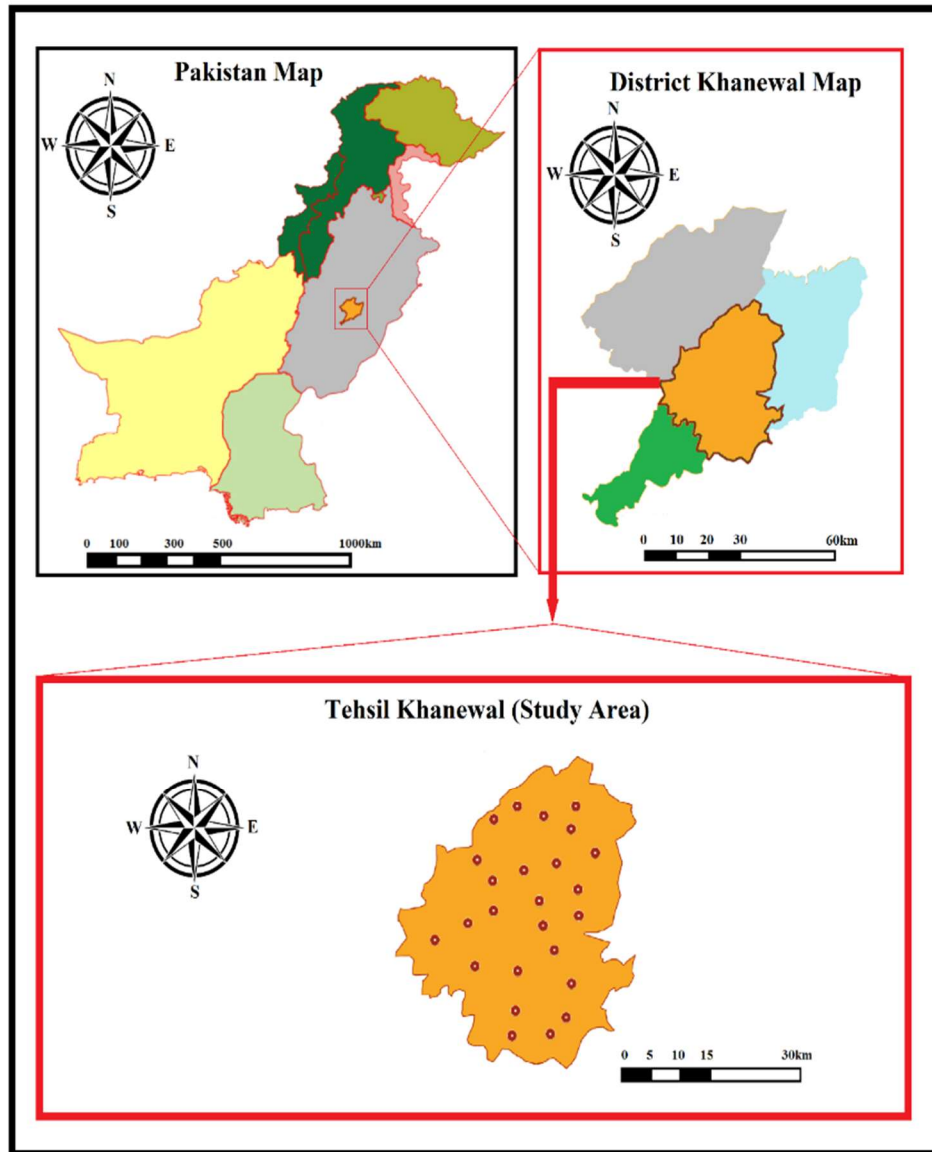
137 In order to get the public perception and awareness about smog pollution in the rural areas of the selected  
138 area, a validated questionnaire was prepared. The reliability of the questionnaire was checked using

139 Cronbach's alpha coefficient for questions related to perceptions, awareness and adaptation with a  
140 coefficient score of 0.85, 0.80, and 0.79, respectively, showing the contents of variables included in the  
141 questionnaire are reliable. The questionnaire was originally composed of five parts: Demographic  
142 information such as age, education, income, income source, etc. The demographics and background  
143 information were important to this survey's purpose to clarify public opinions as well as to clarify how  
144 people were affected by smog pollution.

145 The second part was related to the valuation questions (1. Most appropriate reason for smog as per your  
146 understanding 2. Source of information regarding smog 3. How severe is smog in your region as per your  
147 experience?). In the third section of the questionnaire, respondents were asked whether they were satisfied  
148 with the government's performance of smog pollution control. In the fourth section of the survey, the impact  
149 of smog on the health of rural people was assessed. This section focused on clarifying how the participants'  
150 health is being affected by the smog pollution levels. The purpose of the questions in this section was to get  
151 first-hand information on what kind of health effects were experienced in the last year due to smog pollution.  
152 The fifth and final part was about the participation and potential of the public to intervene in the smog-  
153 causing activities in the study area.

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156

**Figure 2. Location map of the study area showing the distribution of union councils in  
tehsil Khanewal.**

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### **2.3.Data Analysis.**

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The data collected during the survey was organized into a Microsoft Excel spreadsheet and later on imported into Statistical Package for Social Science (SPSS Inc, IBM Corporation, Somers, NY, USA) version 21.

160

161

The data were initially analyzed to present a descriptive analysis with respect to different socio-economic aspects, including age, profession, and education on the smog's perception, awareness, and adaptability.

162

163 Further chi-square analysis was applied for determining an association between the education of the  
164 respondents and the smog intervention practices adopted by them. Our study also utilized a binary logistic  
165 regression model for depicting the relationship between potential interventions/ adaptations against smog  
166 and Respondent perceptions.

#### 167 **2.4.Binary logistic Model explanation.**

168 The binary logistic regression model assesses the association among one or more independent variables and  
169 a categorical target variable. It allows the researchers to determine how well selected independent variables  
170 are predicting the dependent variable and hence finds the model's goodness of fit. These models are  
171 particularly used when there is a need to identify key factors having an impact on the selected target  
172 variable. It is also important as it describes the nature of association among independent factors and  
173 dependent variables. Many similar studies have utilized a binary logistic model in which the relationship of  
174 a single categorical dependent variable is depicted with certain independent variables (Zubair et al 2019;  
175 Haq et al 2015; Qazalbash et al 2021; Malik et al 2021).

176 The binary logistic regression model is used to determine the relationship between potential interventions/  
177 adaptations against smog and respondent perceptions (i.e., education, the reason for smog, Source of smog  
178 information, smog effects on the body, concern about smog, the problem of smog on daily life and  
179 government performance) Table 1. While intervention to smog is a dichotomous variable (0= No, 1= Yes)  
180 and p, the success of probability assumed as

$$181 \text{ Logit Model } (p_i) = \text{Log } (p_i/1-p_i)$$

182 Where  $p_i$  donates the probability of yes and  $(1-p_i)$  is the probability of no.

183 Intervention to smog (Yes/No) = (0 + Education + reason of smog + source of smog information+ smog  
184 effects on body + concern about smog + problem of smog on daily life + government performance). While  
185 all the explanatory/ independent variables were in dichotomous/binary in nature. Education (0 = Illiterate,  
186 1 = literate), reason of smog (0 = industries (construction, brick backing), 1 = others (coal and straw burning  
187 etc.) Source of smog information (0 = Conventional Methods, 1 = Modern methods), smog effects on body

188 (0 = respiratory, 1 = eyes/immunity decrease), concern about smog (0 = no concern, 1 = very concerned),  
 189 problem of smog on daily life (0 = disagree, 1 = agree) and government performance (0 = satisfied, 1 = not  
 190 satisfied).

### 191 3. Results

#### 192 3.1. Demographic Information of the respondents.

193 Table 1 represents the various demographic characteristics of the sampled population interviewed during  
 194 the survey. Most of the respondents engaged in the survey were male because females and their families  
 195 were not comfortable with them taking part in the interview session. The respondents aged between 25 to  
 196 35 accounted for 45%, which was the highest proportion. While people aged above 50 had the lowest  
 197 proportion (8%). It is in accordance with the fact that Pakistan is now identified as the nation having the  
 198 largest youth population in the world. The empirical evidence showed that the larger proportion of the  
 199 sampled population had only completed basic education that passed the matriculation examination (24%).  
 200 There were only 14% of the people had gone to colleges or any university (Table 1).

201 **Table 1. Demographic information of the respondents, including age, education, income,**  
 202 **and income source.**

Selected Characteristics	Categories	Percentage (%) of Respondents
Age	Very young (<25)	15.55 ± 2.62
	Young (25-35)	45.77 ± 4.51
	Middle aged (36-50)	30.66 ± 3.69
	Old (>50)	8 ± 1.88
Education	Illiterate	12 ± 2.3
	Primary	14.22 ± 1.9
	Middle	15.56 ± 2.6
	Matric	24 ± 3.3
	Intermediate	19.56 ± 1.2
	>Intermediate	14.67 ± 2.5
Income per annum	<200(000) PKR	10.22 ± 2.13
	200-300(000) PKR	30.22 ± 3.66
	300-400(000) PKR	40.88 ± 4.26
	>400(000) PKR	18.66 ± 2.88
Income Source	Farming	21.33 ± 3.07
	Farming + Job	14.66 ± 2.01

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Farming + Business	27.55 ± 2.55
Working in cities	36.44 ± 4.02

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203

### 204 **3.2.Income and income source of the respondents.**

205 The descriptive statistics show that 30.2% and 40.8% of the participants received annually an income  
206 ranging from 200,000-300,000 and 300,000-400,000 Pakistani Rupee, respectively, contributing to the  
207 highest percentage of the annual incomes of the family livelihood. A small proportion of the local residents  
208 reported their family income to be greater than 400,000 Pakistani Rupees depending upon the success of  
209 the cultivated crop (Table 1). The primary income of the respondents in the sampled population came from  
210 working in the cities, accounting for about 36% of the total incomes. Local employment coupled with  
211 farming represented the second place for a participant's income sources. It is not a surprise that most of the  
212 income of these families comes from working in the city due to increasing modernization, industrialization,  
213 and urbanization.

### 214 **3.3.Information access channel to smog.**

215 The empirical evidence depicts that only 5% of the sampled population had never heard about smog (Figure  
216 3). A major proportion of the population was quite aware of the smog and had information about it via  
217 various avenues. The most widespread hub of smog information was found to be the news and the weather  
218 forecasts aired on television (34%). The other proportion of the population got to find out about the smog  
219 through neighbors and relatives in the village (21%). In contrast, only a small part of the sampled population  
220 used social media to access information regarding smog (15%).

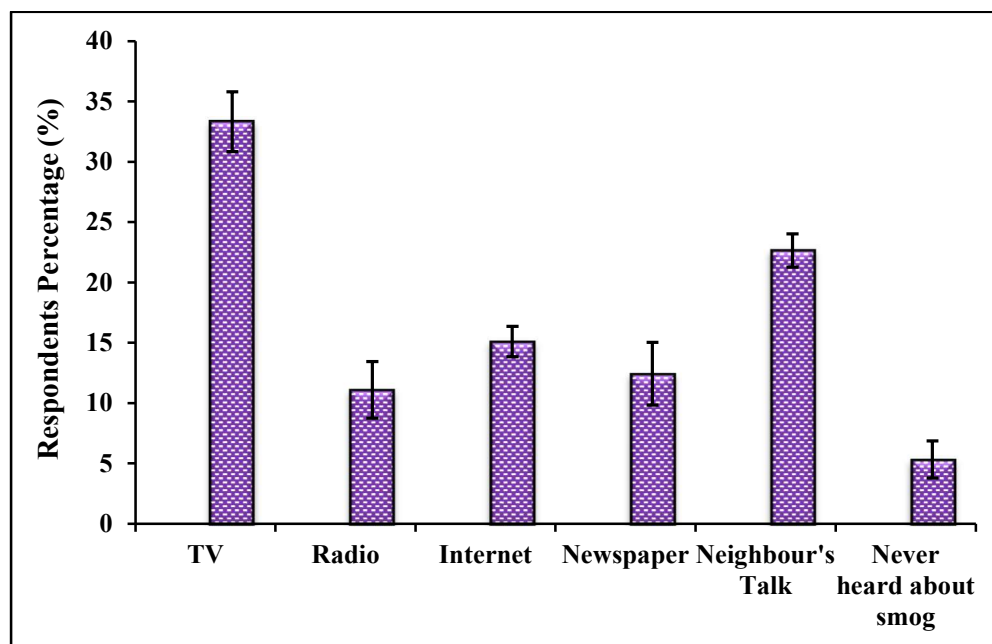
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### 222 **3.4.Awareness and attitudes on severity degree of smog pollution in villages.**

223 The attitude of people regarding smog living in the villages was found out to be moderately severe. Severity  
224 is mainly based on knowledge, perception, and subjective feelings and judgments. Further, the level of  
225 awareness of people living in various regions could have differed. The results showed mixed attitudes

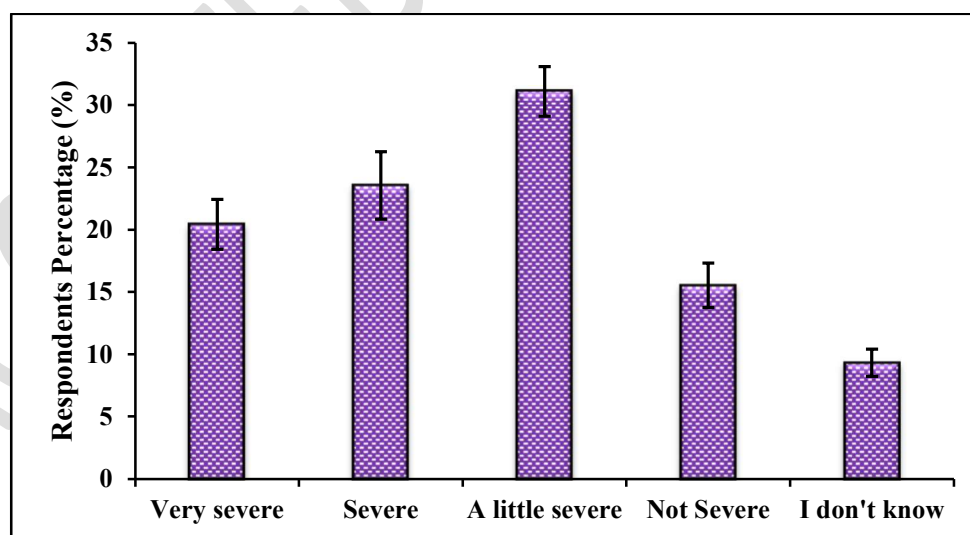
226 regarding smog pollution in the selected rural sites. It was observed that the highest portion of the  
227 respondents (35%) were saying that smog was a little severe for them (Figure 4). While in contrast, 24%  
228 and 20% of the residents agreed that smog for them was severe to very severe, respectively.

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230

231 **Figure 3. Information source for respondents to access smog pollution in the study area.**



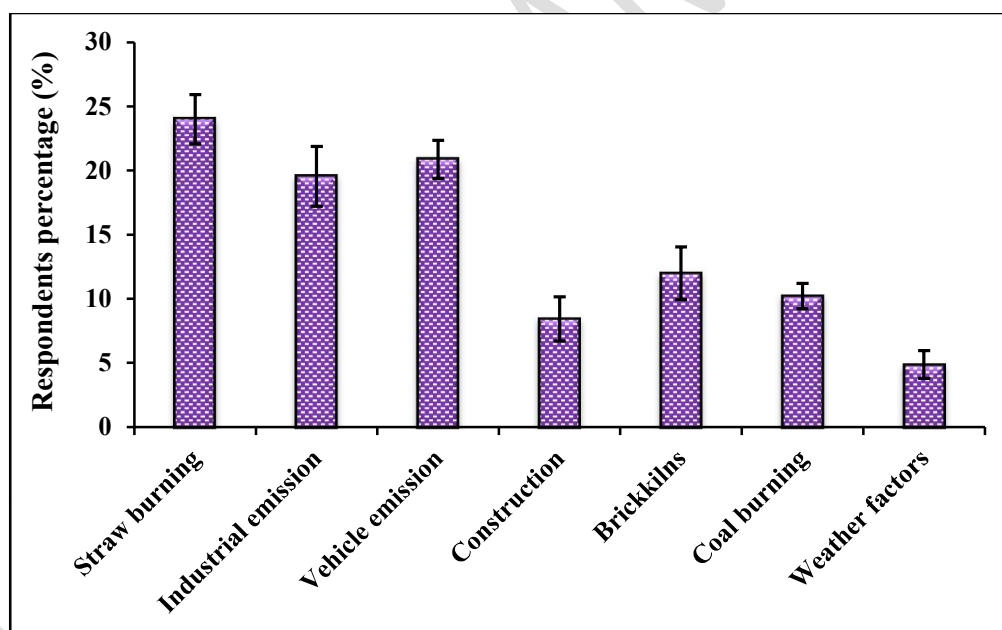
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233 **Figure 4. The attitude of respondents about the severity degree of smog pollution in the**  
234 **study area.**

235 **3.5.Perception and Recognition of main causes of smog.**

236 The people living in villages near the big city depicted a moderate level of awareness regarding smog  
237 pollution. The results show that the residents of these villages perceive anthropogenic activities as the main  
238 culprit of inducing smog. Straw burning (24%) is widespread activity in rural Pakistan to dispose of  
239 agricultural waste. Most of the farmers burn their agricultural residues in the field or on the site. However,  
240 during the survey, it was observed that farmers and other residents in the villages perceived straw burning  
241 as the main contributor to smog in the region. Further vehicular emission (21%) and industrial gas emission  
242 (20%) were recognized as the 2nd main factors of smog generation. Comparatively, meteorological factors,  
243 coal burning and brick kilns were considered as less important factors for heavy smog (Figure 5).

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**Figure 5. Respondent's percentage about the recognition of main causes of pollution in the study area.**

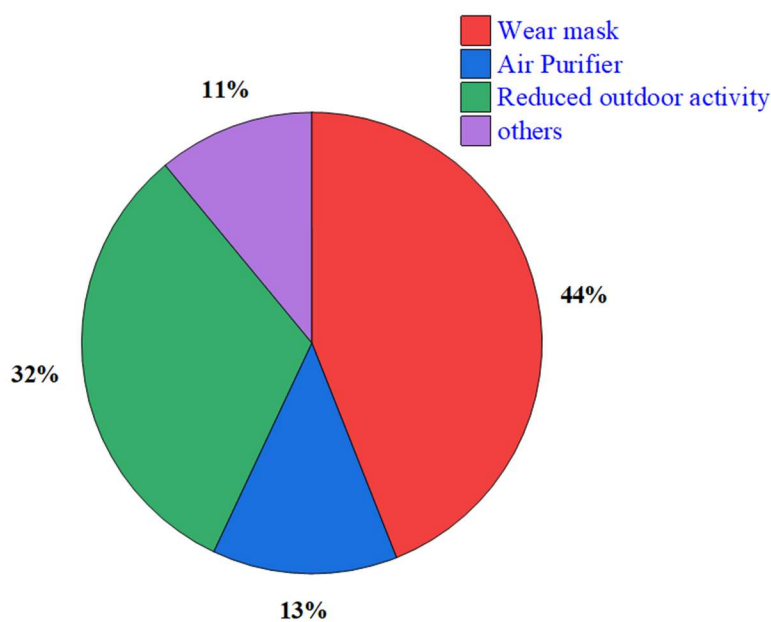
249 **3.6. Potential protection measures against smog.**

250 It was observed that the people with more concerns regarding smog episodes wanted to take protection  
251 measures and intervention against it. There were 44% of respondents that were using facemasks during a  
252 smog episode. While about 32% of the participants believed that they had reduced their outdoor activities  
253 during the smog period (Figure 6)

### 254 3.7. Perception of Government performance in smog Control.

255 The government role from the lens of the study sites was very minimal in the control of smog episodes in  
256 the region. It appeared that about 61% of the people in the survey site were only a little satisfied with the  
257 government's role in curtailing smog. Further, 23% were not at all satisfied with the government's  
258 performance (Figure 7). While only 16% of the people were showing signs of satisfaction regarding the  
259 role of government in controlling smog.

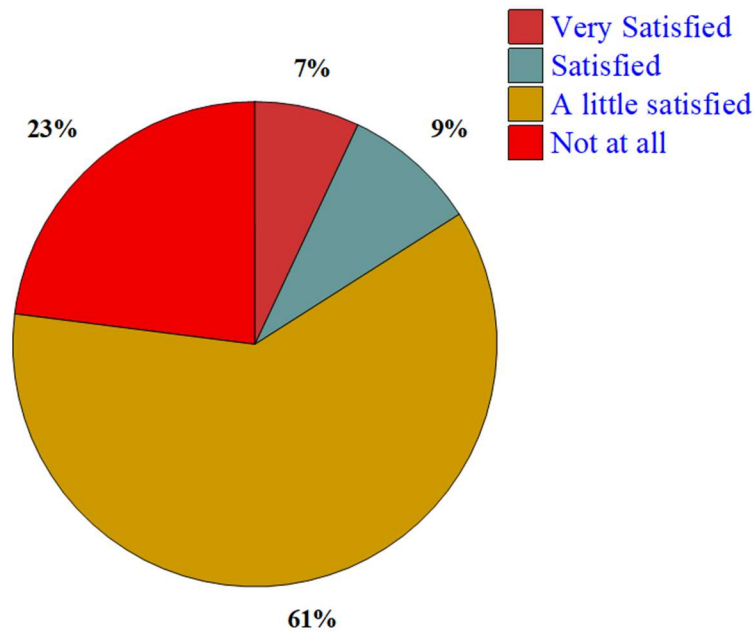
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261

262 **Figure 6. Potential protection measures taken by respondents to protect themselves from**  
263 **smog pollution.**

264



**Figure 7. Satisfaction regarding the government performance in the study area to control smog pollution.**

### 3.8. Nexus of education and Smog intervention practices.

The Chi-square analysis was applied to the data for determining an association between the education of the respondents and the smog intervention practices adopted by them. The results showed a significant relationship; it displayed that the intervention practices adopted by the community in order to curtail the effects of smog were certainly dependent upon the education of the people in the rural settings (Table 2).

**Table 2. Chi-square analysis regarding education and protection measures.**

		Potential protection measures about smog		$\chi^2$ Statistics
		Yes	No	
Education of respondents	Illiterate	12	15	20.631
	Primary (5 <sup>th</sup> standard)	9	22	
	Middle (8 <sup>th</sup> standrad)	16	19	



Matric (10 <sup>th</sup> standard)	36	18	(0.001)
Intermediate	29	15	
Graduation	25	9	
Total	127	98	

### 3.9. Empirical Findings based on the logistic model.

The study incorporated a binary logistic regression model including maximum likelihood evaluation utilizing the chi-squared test. The model analyzed how perception regarding smog influences the intervention/adaptation to smog of the residents in the villages present near big, industrialized cities.

The model assesses how the choice of taking interventions against smog is affected by education, the reason for smog, sources of smog information, smog effects on the body, concern about smog, the problem of smog in daily life, and government performance. The maximum likelihood is a typical method utilized for evaluating probability functions as the results of the model are concordant, asymptotically, and satisfactorily disseminated. In this model, a total of 7 variables were used, among which about 5 variables showed a significant relationship in the model. Education, the reason for smog, smog concern, smog effects on the body, and the problem of smog on daily life came out to be significant. The present research results show that the perception of smog is a significant determinant of smog-related interventions and adoption practices (Table 2).

Among significant independent variables, education was displaying a negative correlation ( $B = -1.052$ ,  $Wald = 5.064$ ,  $p < 0.05$ ) with the variable held dependent (i.e., intervention to smog). The negative sign of beta depicts that the people who had only a basic education were more likely to take immediate interventions against smog. It is because most populations in the sampled villages were mainly illiterate and recently had suffered the wrath of intense smog episodes. The reasons for smog show a negative correlation with the intervention practices to smog ( $B = -.659$ ,  $Wald = 4.010$ ,  $p < 0.05$ ). It was observed that people who perceived smog as a result of industrial and agricultural emissions were more active in taking interventions against smog as compared to the people who believed smog as a result of various meteorological factors. The

296 community's concern about smog was considered significant and displayed a positive correlation (B=.570  
 297 Wald=3.100  $p<0.05$ ). As it was observed that the people who thought of smog as a deep concern would  
 298 quickly react and take preventive practices against smog. Smog effect on the body was another variable that  
 299 displayed a negative correlation against the dependent variable (B=-1.403 Wald= 17.336  $p<0.05$ ). The  
 300 people who considered that the smog had considerable effects on their respiratory system were depicted to  
 301 take more and intermediate interventions against the smog. Furthermore, the problem of smog in daily life  
 302 had a significant relationship (B= -.307 Wald= 3.262  $p<0.05$ ). The model suggests that the participants in  
 303 the study considering smog a significant problem in their life were more active in taking interventions while  
 304 the people perceiving it as a little problem were not active participants in interventions and adoption to  
 305 smog.

306 **Table 3. Binary Logistic Model (Dependent Variable: Do you have Potential for**  
 307 **intervention/Adaptation (Yes/No)? / Predictors: Respondent's perceptions.**

Variables	B	S.E	Wald	df	Sig.
Education	-1.052	.468	5.064	1	0.024
Reasons of smog	-.659	.329	4.010	1	0.045
Source of Smog information	1.186	.872	1.852	1	0.174
Smog effects on body	-1.403	.337	17.336	1	0.001
Concern about smog	.570	.324	3.100	1	0.048
Problem of smog on daily life	-.307	.170	3.262	1	0.049
Government Performance	.056	.436	.016	1	0.898
<b>-2 Likelihood</b>	247.607 <sup>b</sup>				
<b>Chi-Square</b>	3 4.485				
<b>df</b>	7				
<b>Significance</b>	0.000				

308 B = Beta, S.E = Standard Error, Wald = Wald Chi Square, Df = Degrees of Freedom, Sig =

309 Significant  $p<0.050$ .

#### 310 4. Discussion

311 The current study investigates awareness of smog and its interventions from the rural communities  
312 inhabiting around the proximities of mega industrialized cities in Pakistan. The research has revealed some  
313 interesting results and new implications for policymakers to control and mitigate both direct and indirect  
314 effects of smog at rural levels. Although there have been a few studies in Pakistan investigating the  
315 perception and awareness of smog among the major urban centers of Pakistan (Hussain et al 2018; Saleem  
316 et al 2019). The literature has shown that the nexus of smog and rural areas are yet to be appropriately  
317 explored (Jiang et al 2016). Many of the smog and other pollution studies conducted in the countries are  
318 solely based on the urban population, thus neglecting the rural population (Hussain et al 2018). Pakistan is  
319 usually considered an agricultural country, having a larger proportion of the population in the villages. Thus  
320 the current study has tapped into smog perceptions of the rural population and the factors behind their  
321 willingness to take interventions against smog.

322 The main highlight of the study is a depiction of a good level of understanding of smog among the rural  
323 population. It is a widespread myth that the villages are cleaner and greener; thus, the effects of air pollution  
324 and smog in these areas are often reduced (Amann et al 2017; Karambelas et al 2018). But according to  
325 Karambelas et al (2018), a study conducted in north India depicted that the death counts in rural India due  
326 to air pollution were equal or more as compared to urban India. This is in compliance with the current study  
327 as quite a few people in the study site were aware of the problem and had described pertinent reasons that  
328 were playing a part in smog generation. Our results showed that the information regarding smog was  
329 induced mainly from electronic and social media. This is attributed to the fact that most of the villages in  
330 the study area were adjoining a big city, so communications and social media were in the grasp of most of  
331 the people (Mei et al 2014). Furthermore, we found that considerable people in the villages considered smog  
332 a severe problem. These findings contrast with Jiang et al (2016) which describes that the knowledge of  
333 smog and its factors was quite minimal in the rural population of various Chinese villages. Our results  
334 suggest that the people in the villages in south Punjab, Pakistan, have displayed efficient smog literacy,

335 which conforms to people's knowledge and smog literacy in much developed and informed urban centers  
336 such as Lahore (Saleem et al 2019) .

337 It was observed that people in the villages of south Punjab were equipped with the same knowledge and  
338 concern level from smog as some of the improved and developed people residing in the cities (Saleem et al  
339 2019; Ahmed et al 2019). The findings in the current research depicted that the people in the villages  
340 perceived straw burning as a major source of smog generation as they thought the smoke and pollution  
341 created from this type of burning is more as compared to the brick kilns and vehicular emissions. These  
342 results were in accordance with other studies in which they depicted that the people in various south Asian  
343 villages also perceived straw burning as a major cause of smog generation (Jiang et al 2016; Ahmed et al  
344 201; Ranabhat et al 2015). An important thing that the study depicts is the willingness of the rural people  
345 to act against the smog in order to protect themselves and their families. The findings contrast with the  
346 research in some Chinese villages where people were not taking any preventive measures to protect  
347 themselves from the smog effects (Jiang et al 2016). These findings were similar to the willingness of people  
348 in major smog-stricken cities where the use of masks and reduced outdoor activities were on top to avoid  
349 smog (Saleem et al 2019; Zhu and Yao, 2018).

350 The binary logistic regression model used in the study suggests that there are a few extremely important  
351 factors that induce such a willingness to take interventions against smog. The model suggests that literacy  
352 levels had no role to play in taking prevention actions against smog ( $B = -1.052$ ,  $Wald = 5.064$ ,  $p < 0.05$ ) As  
353 most of the illiterate people in the villages were more concerned hence taking protective measures. This is  
354 attributed to the fact that knowledge regarding a specific issue has more capacity to form perceptions as  
355 compared to general education (Vogel et al 2017). Further, the channel of smog information was observed  
356 to be a strong predictor in taking preventions against smog ( $B = 1.186$   $Wald = 1.852$ ,  $p < 0.05$ ). The model  
357 suggests that the people who had obtained information from media had been more likely to take protective  
358 measures.

359 This could be explained by the fact that the influence of social media is so deep and strong that various  
360 researchers prove it as a tool to form perceptions and trends in human society in this era (Bacey-Giles and  
361 Haji, 2017). Evidence suggests the local community that perceives smog to be caused due to straw burning  
362 was more likely to take preventive measures ( $B = -.659$  Wald= 4.010  $p < 0.05$ ). It is a crucial factor as this  
363 conventional practice releases huge amounts of incomplete combustion products that generate lots of  
364 particulate matter, thus increasing the pollution index of that specific area (Oanh et al 2018). The concern  
365 of smog is a critical factor that governs the willingness of the people to take preventive measures ( $B = .570$   
366 Wald=3.100  $p < 0.05$ ). It is supported by various studies around the world in which health is the main concern  
367 that lead people to take a special interest in protecting themselves from the menaces of air pollution Qin et  
368 al 2018; Wang et al 2019).

## 369 **5. Conclusion**

370 The present study depicts awareness levels of smog among the general rural population residing near big  
371 cities. Further relationships among smog literacy and information source with preventive measures against  
372 smog practiced by these rural communities were studied. Our study concluded that the targeted rural  
373 community in the vicinity of the big city had enough understanding of smog, understood its sources, and  
374 mildly practiced general preventive measures. It was observed that social and digital media were major  
375 drivers in providing the source of smog-related information. The research concluded that education was a  
376 significant factor when it comes to preventive practices. Somehow educated people were more inclined  
377 towards practicing preventive measures. The main finding of this study is the willingness of rural  
378 communities to participate in smog preventive activities. The logistic model employed in the study also  
379 depicted that the education and problems of smog in daily life were the major factors that encouraged rural  
380 communities to adapt to smog.

381 The rural communities in the selected sites had shown moderate awareness of smog literacy. This is an  
382 important sign and implies that the related government departments must involve the people in the villages  
383 for smog awareness and adoption activities. The perception of people regarding smog differs mainly from

384 monitoring results; people are liable to have biases in their judgment depending upon the longevity of smog  
385 episodes and the demographic of the people. Thus it is recommended that in order to change people's  
386 confirmed convictions, heavy investment in resources regarding publicity and education must be focused  
387 on. Our findings have shown that the people in the rural areas were considering straw burning as the major  
388 cause of smog generation. So it is important to understand the major sources of pollution demand of a  
389 certain policy in various regions depending upon the scientific analysis and public opinion. Implementing  
390 strict control of agricultural residue burning is necessary, and an alternative residual elimination method  
391 must be introduced. It is pressed through this research that local conditions must be considered when  
392 developing atmospheric policies.

393 It is concluded in the study that people in the villages are willing to take precautionary measures in  
394 order to avoid smog. Alongside disaster management authorities, the environment department must  
395 collaborate with the local pro smog adopters to develop effective and efficient smog control policies to  
396 lessen the smog effect in coming smog episodes.

#### 397 **CONFLICTS OF INTEREST**

398 The authors declared that there are no conflicts of interest.

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