

Public Perceptions of Urban Air Pollution Risks

Sumeet Saksena, *East West Center*

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Abstract

Understanding public perception and attitudes toward air quality and regulation is critical for successful citizen involvement as shifts toward new technologies and management alternatives take place. While urban air pollution continues to be a major risk in most parts of the world, very few studies and surveys have been conducted to systematically study public perceptions related to air pollution. Even fewer studies have focused on developing countries. This gap is critical because of the complex interaction between poverty, livelihoods and sustainable development in developing countries. A Pressure-State-Response framework is used to review studies of public perceptions of air pollution and knowledge gaps are identified. The paper highlights unique characteristics of urban areas in developing countries in the context of air pollution related perceptions.

KEYWORDS: public perceptions, air pollution, livelihoods, poverty

Introduction

Risk perception plays a crucial ongoing role in public response to environmental exposure (Slovic 2000). Public response in turn forms the basis of citizen involvement in mitigating risks. Relationships between environmental exposure (e.g., air pollution) and health (e.g., respiratory effects) are mediated by perceptions of the “exposure” (e.g., air quality), which are in turn influenced by a host of both individual and contextual factors (Kasperson et al. 1988; Cutter 1993). Research in North America and the United Kingdom underscored the need for additional research in this area in order that we may both increase our understanding of the community context in environmental perception (Petts 1995) as well as increase our capacity for planning and related decision making aimed at improving the state of local communities (Greenberg and Schneider 1997).

Increasingly over time, community activists have asserted themselves in the process of recognition and management of environmental hazards (Freudenberg 1984; Mastersonallen and Brown 1990). Such participation has been enlarged as part of the environmental justice movement in which the claim is asserted that populations marginalized or disadvantaged in some way (i.e., the poor, people of color, people with lower levels of education) bear a disproportionate share of environmental hazards (Phillips and Sexton 1999). The focus of the environmental justice movement, however, has now broadened to include issues of process as well as issues of outcome. That is, communities are demanding stronger participation in decisions that affect their health and homes. The focus on process and outcome requires risk assessments that are acceptable to both the “scientific” and “lay” communities. Creating and communicating assessments acceptable to community requires a thorough knowledge of perceptions of risk.

While research interest in the field of risk perception has recently increased (Slovic 2000), only a few studies have addressed the public perceptions of risk associated with urban air pollution (defined here as excluding issues such as climate change, indoor air pollution, noise, and radiation). This paper describes the current understanding of how the public perceive urban air pollution and the individual and community level factors that influence those perceptions. After a brief discussion of the history of research in this field, the existing knowledge is described using a Pressure–State–Response (PSR) framework which is commonly used in environmental management and policymaking. This paper is the first known attempt to organize our understanding of environmental perceptions using the PSR framework—a framework which is otherwise familiar to environmental managers and decision makers. Under the “response” section, the paper uniquely highlights perception issues in situations where authorities respond to air pollution problems with certain actions that pose real or perceived threats to livelihoods,

especially in developing countries. The paper also discusses how people compare perceptions of air pollution with other environmental risks. The paper ends by describing needed research, especially in the developing countries context.

Brief History of the Air Pollution Perceptions Literature

The earliest studies of people's perceptions and attitudes regarding air pollution were conducted in the 1950s–1960s in the United States using social survey techniques (e.g., Smith, Schueneman, and Zeidberg 1964; deGroot 1967; Schusky 1966; Johnson et al. 1972; Crowe 1968). These studies had a practical aim: to measure the level of awareness among people about air pollution. The methodologies used in these studies were highly quantitative—questionnaires and opinion polls. These studies did not examine if, for example, awareness varied across social groups and time. Therefore the studies revealed a high variability and inconsistency in findings. For example, awareness about the source of pollution differed, depending on whether an individual had a direct perceptual experience or media exposure. During the 1970s and 1980s very few studies were conducted, perhaps because governments in developed countries had seriously begun to formulate policies and implement laws. The public and researchers began paying more attention to other environmental problems such as acid rain, global warming, pesticides, etc.

There was a renewed interest in research on air pollution-related perceptions in the 1990s using qualitative methods. The approaches recognized the role of politics and culture in influencing perceptions as well as the inconsistencies in how people act and think. During the same time new evidence had emerged about the effects of air pollution, especially fine particulate matter, on human health. Air pollution was back on the political agenda. However, at least in the more developed countries, the pollutants of concern had changed. The more easily sensible (visual and odorous) pollution associated with power plants and industries was replaced by a range of pollutants that were less sensible. A common policy response was expanding monitoring networks with highly sophisticated instruments. Information technologies such as the Internet and Geographical Information Systems (GIS) have greatly facilitated the communication of results and forecasts from these networks.

The recent studies can be categorized as (a) those which have a practical aim to improve official risk communication (Beaumont et al. 1999; Cole et al. 1999; Howel et al. 2003) and (b) those which focus on how social and cultural factors influence perceptions (Bailey, Yearley, and Forrester 1999; Bickerstaff and Walker 1999; 2001; Bush, Moffatt, and Dunn 2001a; 2001b).

Framework to Describe Existing Knowledge

The Pressure–State–Impact–Response framework (OECD 1993) is used to examine the literature on perceptions related to the air pollution problem (see Figure 1). The PSR framework is based on a concept of causality that implies that human activities exert pressures on the environment and change its quality and the quantity of natural resources. Society responds to these changes through environmental, general economic, and sectoral policies. The “responses” form a feedback loop to “pressures” through human activities. In a wider sense, these steps form part of an environmental policy cycle that includes problem perception, policy formulation, monitoring, and policy evaluation.

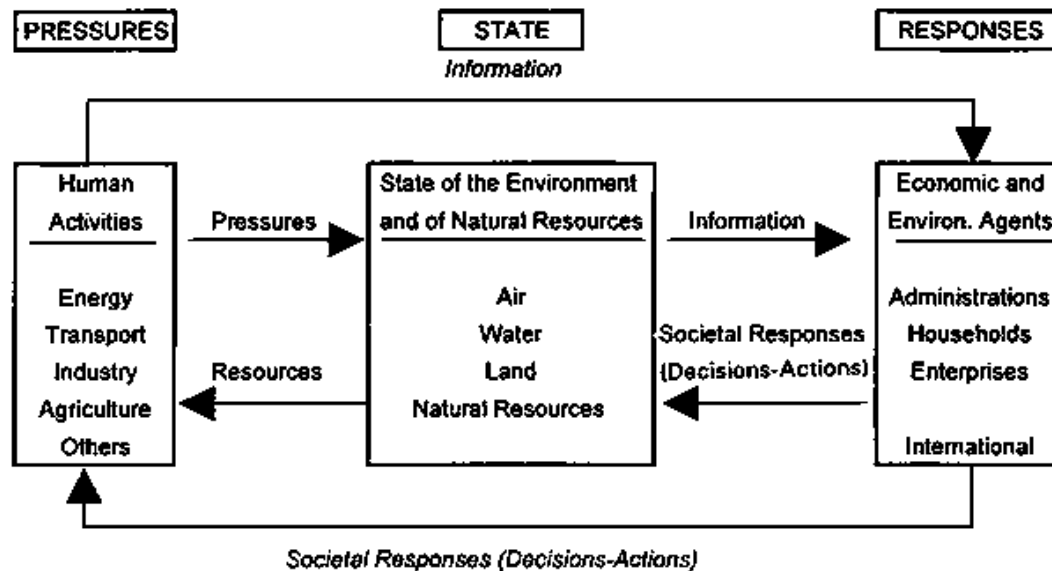


Figure 1. Pressure–State–Response Framework

While the PSR framework has the advantage of highlighting these links, it tends to suggest linear relationships in the human activity–environment interaction. This should not obstruct the view of more complex relationships in ecosystems and in environment–economy interactions. Within the context of air pollution, pressure represents the social, economic, ecological, and institutional driving forces that cause the emissions. State represents physical, chemical, and biological changes in the state of the biosphere. Impact represents social, economic, ecological, and institutional impacts of pollution. Response represents human interventions in response to the societal impacts. By establishing cause–

effect relationships between activities and subsequent environmental impacts, the framework helps in developing statistics that are useful for taking both preventive and curative measures for protecting the environment and mitigating the adverse environmental impacts of development activities. The main justification for using this framework to categorize the literature is that it is currently the most popular framework among international agencies and national regulatory bodies to collect environmental statistics as well as diagnose and manage systemic problems.

“Pressure”: Perceptions about the Causes and Sources of Air Pollution

Research findings have shown that people largely perceive automobiles as the major source of pollution (Bickerstaff and Walker 1999; Howel et al. 2003; Jacobi 1994). However, Bickerstaff and Walker (1999) have suggested that not all automobiles are viewed equally—more blame is assigned away from an individual to “other” polluters such as buses and other commuters. Bickerstaff and Walker suggest that this is the way an individual absolves oneself (and his or her lifestyle) of direct blame. Industry is also often identified as a significant polluter (Bickerstaff and Walker 1999; Howel et al. 2003). The role of temporal and historical issues has been shown to be important. Also, the type of industry and past associations about an industrial area have been suggested as powerful determinants of perceptions. Winneke and Kastka (1987) observed a positive attitude towards a chocolate factory compared to a brewery or a tar oil refinery. Bush, Moffatt, and Dunn (2001a) and Irwin, Simmons, and Walker (1999) observed that perceptions were influenced by community memories of incidents sometimes passed over long periods of time. Perceptions about the main contributors to pollution were found to vary across socioeconomic groups (Jacobi 1994). In Kuwait people identified air pollution to be the fifth most important consequence of traffic congestion out of eight possible consequences. But few parents were willing to use a free school bus service if provided (Koushki et al. 2002).

“State”: Perceptions about the Level of Air Pollution

Studies have stressed the role of practical everyday experience in how people perceive the quality of air. Most studies have highlighted the role of vision (Bickerstaff and Walker 1999; 2001; Howel et al. 2003; Malm, Leiker, and Molenaar 1980). These studies suggest that people are concerned about the potential for pollution to cross political, social, and personal borders. Sensory

visual perception of air pollution appears to increase with higher concentrations of suspended particulates within certain size ranges (Schusky 1966) and with greater dustfall (Stalker and Robison 1967). In addition to vision, other forms of sensory awareness were important, such as olfactory evidence (Clarenburg 1973; Mukherjee 1993; Wakefield et al. 2001) and the experience of physiological or psychic affects. In an Austrian study, although air pollutant levels complied with World Health Organization guidelines, there was a perception of a problem because of odorous fumes, visible dust, and preexisting symptoms such as fatigue, eye irritation, recurrent colds, etc. (Lercher, Schmitzberger, and Kofler 1995).

It has been shown that people form perceptions about the level of pollution from the density of presumed sources (cluster of industries, congested road) or other observable effects of air pollution on the wider environment (color and growth of vegetation) (Bickerstaff and Walker 2001; Howel et al. 2003). It has also been observed that local knowledges, as obtained through social interactions, play an important role in the shaping of perceptions (Howel et al. 2003). Studies have suggested that lifestyle factors such as time spent outdoors can influence perceptions. Thus, younger people who have an active outdoors life have a greater concern for air quality than older people who lead comparatively sedentary lives indoors (as mentioned in Flachsbart 1980).

Not much work has been done to study how human perceptions correlate with physical measurements of pollution. This is an important question, because it would explain why experts, who rely more on physical data, perceive problems differently from the general public. A comparative study was undertaken at two different sites (one urban, one suburban) in Greater London in order to examine whether there was a relationship between publicly available air quality data and the public's perception of air quality (Williams and Bird 2003). The survey results revealed how seriously the public regards air pollution from road traffic in terms of their quality of life and identifies the attitudes of the public to nuisance from road traffic. The results revealed that the public's perception of air quality was not a reliable indicator of the actual levels of air pollution in their area. Although the suburban area (Wimbledon) had slightly better air quality than the urban area (Wood Green), the ambient concentrations were not significantly different. However, the public of Wood Green generally perceived that air quality was lower in their area than the public in Wimbledon. The results also revealed that air pollution issues generated as a result of road traffic were of high importance in terms of people's quality of life when compared to other aspects of their quality of life. The study revealed that residents in the urban area (Wood Green) were more disturbed by road traffic than residents in the suburban area (Wimbledon). Out of all the disturbances listed, it was found that residents were more disturbed by vehicle-derived fumes, dust, and dirt than other aspects of road traffic-related nuisance.

Malm, Leiker, and Molenar (1980) found a linear relationship, independent of demographic background, between human perception of visual air quality and physical indicators such as color and contrast in a landscape. Flachsbart and Phillips (1980) used physical data for a variety of air pollutants and weather indicators and, more importantly, for a variety of averaging times and tested the correlation with indicators of perceived and desired air quality. They discovered that as compared to other pollutants (for all time frames), levels of ozone and visibility were more correlated with perceived air quality. Their study suggested that people based their perceptions on the quality of air they experienced over a long period of time. Short-term variations of all pollutants except ozone, carbon monoxide, and visibility (as a surrogate indicator of pollution) were unlikely to influence perceptions. An important observation, consistent with previous studies and intuition, was that human perception depends on baseline conditions. That is, people who are accustomed to relatively poor air quality may be less sensitive to further degradations of air quality. This is important to remember in the context of prevailing conditions in developing countries. This study defined four measures of human response to air quality—perception, preference, satisfaction, and salience—and examined the relationships between the four measures. The study raised important questions such as “Does the preference for clean air influence one’s perception of reality, such that one begins to perceive clean air?” Finally, they observed that factors such as ethnicity/race and income influenced perceptions. Air quality was valued less by those with more pressing problems.

Despite the increased efforts by governments to provide air quality information services, recent studies show (a) a very low level of awareness and use of these services and (b) skepticism about the motivation of information providers (Bickerstaff and Walker 1999; Bush, Moffatt, and Dunn 2001b; Howel et al. 2003). Highly technical terms and jargons made the information seem irrelevant to people. The issue of spatial scale is important, too—people cannot relate to regional or national statistics, but demand local information (Howel et al. 2003). Often data published by governments seems contrary to people’s own perception (Bailey, Yearley, and Forrester 1999; Bickerstaff and Walker 1999; Cole et al. 1999; Yearley 1999; 2000). Based on a case study and survey in the north-west region of the United Kingdom, researchers cautioned that the lack of well-grounded methodology and guidance for handling and representing spatial aspects (using tools such as GIS) of air quality data sets fosters ambiguity in public perceptions (Lindley and Crabbe 2004). Not surprisingly, air quality awareness programs had a greater impact on well-educated people than on the less educated, implying the need to supplement such programs with special efforts directed at the less educated (Stieb, Paola, and Neuman 1996). Though it is recognized that perceptions about the general environment are being increasingly

influenced by non-official modes of communication such as television, literature, and the Internet (Bulkeley 2000; Ungar 2000), not much of this research is specific to problems of urban air pollution.

A related aspect is how people perceive local versus regional air quality. Both early and recent studies have shown that people evaluate their local neighborhood differently from the wider region (Bickerstaff and Walker 1999; Bush, Moffatt, and Dunn 2001a; 2001b; deGroot 1967; deGroot et al. 1966; Rankin 1969; Schusky 1966; Francis 1983). Bush, Moffatt, and Dunn (2001a) found that people did not feel that air pollution was a problem in their neighborhood but rather associated it with poorer communities living closer to industries. This is a way some people would disassociate themselves from the problem. However, some research questions were still left unanswered: Do residents always disassociate themselves in this way? If not, why not? (It is possible that in order to get governments to do something in their neighborhood, people may consciously or unconsciously exaggerate their perception of the problem, especially if they believe that pollution has crossed into their side of the “border” from other sources.) Similarly, social status and ethnicity have been linked to concern for air pollution, with white suburbanites having expressed more concern than inner-city blacks (Schusky 1966). This contrasts with the findings of another study in Hispanic communities of El Paso, USA, where poorer people, as compared to wealthier people, perceived air pollution to be a greater risk (Byrd, VanDerslice, and Peterson 1997).

While being aware of air pollution, people in an industrial area of India did not feel it was a matter of concern because of other problems they faced (Bladen and Karan 1976). However, differences across ethnic groups attributable to cultural, psychological, and philosophical traits were observed. They used a modified version of a standard natural hazard research questionnaire.

Bickertsaff and Walker (2001a) observed that the tendency to rate one's neighborhood differently from a wider region depended on (a) their sense of power to take action, and (b) their attachment to the place. Where people are not strongly attached to their neighborhood, their perceptions tend to be more negative about air quality and other attributes. Such a relationship between perceptions of air pollution and indicators of local social capital and place attachment were identified by Wakefield et al. (2001) in Canada. Thus perceptions that seem “ignorant” or “irrational” are very likely related to issues of place, identity, power, and control.

Jacobs et al. (1984) observed that in addition to actual physical levels, perceived smog was related to prior undesirable life events and psychological symptoms and stress. The more stressed people are, the more likely they are to be irritated by pollution.

How people's perceptions change over time is a neglected area of study. In Toronto, Canada, it was observed that within a span of a decade air pollution declined as a public concern as other socioeconomic problems emerged (Dworkin and Pijawka 1982). Gould and Golob (1998) studied how people's attitudes to cleaner vehicles change over time. In both these studies the role of mass media was found to be significant.

“Impact”: Perceptions about the Health Effects of Air Pollution

There has been a realization in recent times that health impacts are a major way by which people realize the extent of the risks associated with air pollution. However, it has been observed that here too people's perceptions tend to be influenced less by scientifically derived information and more by local and personal experiences (Bickerstaff and Walker 1999; Elliott et al. 1999; Howel et al. 2003). It is very likely that the “invisibility” aspect of air pollution discourages people from drawing strong links between air pollution and health. Consequently, health problems are dismissed as being imaginary or causation is attributed entirely or partly to other causes—climate change, bad housing, pollen, etc. Improvements in public health services and changes in cultural attitudes towards healthcare have also been shown to influence perceptions about the link between pollution and health (Bickerstaff and Walker 2003).

Perhaps the most interesting observation has been that, like perceptions about the neighborhood, people related air pollution to ill health in a general way, but only a few believed that health problems affected them directly (Bickerstaff and Walker 2001; Bush, Moffatt, and Dunn 2001a; 2001b; Wall 1973a; 1973b). Byrd, VanDerslice, and Peterson (1997) observed that people across all socioeconomic strata felt that air pollution poses a greater risk to the community as a whole than to the self and family. Thus most do not deny the risks, but deny its personal effects, possibly to avoid anxiety. Bush, Moffatt, and Dunn (2001a) observed that wealthier individuals felt that ill health associated with air pollution was mainly a problem for poorer individuals living near industries. It is not clear if wealthier individuals felt that they were less exposed or less vulnerable to exposure or both.

A survey of 745 adults from Queensland, Australia was conducted to examine perceived health effect risks from air pollution during the work-related commute by socio-demographic and travel mode variables (Badland and Duncan 2009). Approximately 45% of the sample perceived that air pollution negatively affected health outcomes when commuting to/from work, yet only 13% recognized air pollution as a major barrier to walking or cycling to/from work. No relationships existed between usual travel mode to/from work and perceived

health risks associated with air pollution. Those higher educated or living in major cities were more likely to recognize that air pollution harmed their health during their work-related commute when compared to respective referent categories.

Chattopadhyay, Som, and Mukhopadhyay (1995) found that individuals living in industrial areas complained more about respiratory problems, psychobiological stress, and anxiety than those living in residential areas. This pattern had earlier been observed by Evans et al. (1987) and Zeidner and Shechter (1988). However, it is not known if the people themselves are aware that their mental stress can be attributed to air pollution and, more importantly, whether this stress affects their perceptions about other aspects of the air pollution problem. Navarro, Simpson-Housley, and de Man (1987) noted that individuals in Santiago de Chile with high trait-anxiety were more concerned about air pollution problems. They suggested that “visible” pollution provides an objective threat. They also observed that individuals with high trait-anxiety were more likely to personally undertake anti-pollution measures.

In addition to health effects, there are the nuisance and aesthetics impacts of pollution—“it dirties the house” (Jacobi 1994; Bickerstaff and Walker 1999; 2001; Howel et al. 2003). Dwellers further away from the city center placed more emphasis on the dirtiness of dust and soot (Jacobi 1994).

“Response”: Perceptions about Government Actions and Policies

Very few studies have attempted to assess people’s perceptions about governments’ interventions. Interventions mean either direct mitigative actions or data gathering efforts. Were these the right interventions? How successful were these interventions in terms of either process or outputs? McDonald et al. (2002) found that such perceptions were largely media influenced. Jacobi (1994) found that respondents felt that both the public and private sectors had an equal responsibility to improve the air quality. However, reluctance was observed to change individual or community behavior. No differences were observed across the socioeconomic strata regarding beliefs of what actions need to be taken. In Istanbul respondents felt that local authorities had more responsibility than federal agencies to do something about the problem (Kurtulus 1992).

A survey of 81 stakeholders in India revealed that there was a popular perception that lack of political will was the main barrier to effective air quality management. Following this, lack of information was viewed as the second most important barrier to effective management. The judiciary was identified as the institution most actively involved in air pollution management (60% of respondents), followed closely by government (World Bank 2004).

Impact of Government Responses on Livelihoods and Poverty: Perception Issues

Responses to air pollution do not occur in a vacuum, and context influences the effects and perception of government actions and policies. Poverty and unemployment are rampant in urban areas of developing countries. Low-income residents tend to be among the most vulnerable to exposure from environmental health hazards; they are most susceptible when they are exposed, and the least able to cope with the consequences. The literature regarding urban air pollution has so far not addressed livelihood impacts in a comprehensive manner. However, the few studies that have examined these relationships indicate that factors such as socioeconomic status as well as race and ethnicity influence environmental perception and concern. Mukherjee (1993) sampled 1,724 residents of Calcutta. Respondents with lower education and socioeconomic status showed less awareness and concern in response to air pollution.

In the United States, cross-cultural studies of risk perception and environmental quality have indicated a link between the social context of risk exposure and environmental concern. Baird (1986) found that community tolerance for the risks presented by a copper smelter plant was influenced by knowledge, benefits, voluntariness, and environmental attitudes. Respondents showed variation in the perceived voluntary/involuntary nature of their exposure, with workers at the plant exhibiting the greatest level of denial in assessing their objective risk. In addition, people had a tendency to substitute informal risk analysis, based on their own or family members' experiences, for formal analysis based on scientific estimates by the EPA. And their factual knowledge of formal risk estimates or proposed standards did not reflect their own risk estimates or their desired level of regulatory control.

Early studies finding a positive relationship between income and environmental concern have suggested that the poor tend to be less concerned about air quality because of one or more of the following reasons: (a) they are accustomed to dirtier environments, (b) they feel they have more pressing problems to attend to, and (c) sense of lack of control—they feel they have little influence over actions and decision makers. In contrast to these studies carried out in the late 1960s and 1970s, meta-analysis studies have suggested that response by poor or minority groups is both heterogeneous (Vaughan and Nordenstam 1991) and dependent on the sociopolitical context (Taylor 2000). The poor will respond differentially to pollution risks if faced with real or perceived threats to their livelihoods as a result of laws, programs, and actions that governments undertake to manage the air pollution problem.

Unfortunately, only a few studies have investigated the interface between threats to livelihood and attitudes and perceptions of air quality and air quality management options. The few cross-national comparative findings on concern for environmental quality indicate that there is strong growing environmental concern in developing countries (Dunlap, Gallup, and Gallup 1993; Brechin and Kempton 1994). However, specific case examples indicate that this environmental concern is also tempered by perceived and real threats to jobs and livelihood. For example, in New Delhi, three people died in violent protests by factory owners and workers against new pollution controls after the Supreme Court ordered authorities to seal polluting industries in residential areas and cancel their licenses (Reuters 2000). In a second example, a strike by tens of thousands of auto rickshaw and taxi drivers in the Indian capital, Delhi, caused travel chaos for the city's commuters. Office and factory workers had to find alternative means of transport as the striking drivers protested against new anti-pollution measures which, they said, were threatening their livelihoods.

The poor's heightened level of vulnerability in developing countries is expected to elevate the level of real or perceived threats to their livelihoods, either as a result of environmental hazard exposure or because of laws, programs, and actions put into place to manage the air pollution problem. Examples are mandatory closure or relocation of factories, taxi drivers giving up their occupation because they cannot afford to install new control devices or switch to cleaner fuels, daily wagers being affected by strikes provoked by air pollution regulations, roadside vendors having to relocate because of road widening projects, etc. In India, small- and medium-scale industries had to close down or relocate out of the cities of Agra (in the vicinity of the Taj Mahal) and New Delhi. In New Delhi, taxi drivers and private bus operators were required by law to start using natural gas instead of gasoline. Studies have indicated that mere threats to lifestyle (such as having to switch to car pools) are enough to influence perceptions about air pollution problems. In particular, future studies should examine the degree to which level of concern about air pollution changes as a function of the perceived impact of government regulations.

Threats to livelihoods, especially for the very poor, could mean either a job loss or increased expenditure. For example, air pollution-related actions may result in a hike in mass transport fare. For the poor, even a minor increase in expense means hardship. The number of people who rely on mass transport is also very high—in developing Asian countries 37.8% (54% in Delhi) of workers use mass transit as compared to only 9.0% in the United States (Kenworthy, Laube, and Newman 1999). Alternatively, there may be a belief that ill health associated with air pollution affects personal productivity at work leading in the extreme to absenteeism. These are the direct threats. Then there are the indirect threats: people, even those whose jobs are not threatened, may feel that air pollution

programs affect the economy as a whole and therefore there must be some indirect negative effect on their well-being. This would be most likely to occur if the public also exhibits low levels of knowledge about the health benefits of air pollution. Higher levels of knowledge by the public about the causes of environmental degradation are associated with both increased support for government initiatives and voluntary actions (O'Connor et al. 2002).

This review of literature suggests that past studies have not looked in detail at the relationship between livelihood and perceptions regarding air pollution. How do those who have lost their jobs/are likely to lose their jobs perceive these problems? How do people react when they have to pay more for buses, etc.? They may feel that the government exaggerates the problem. Instead of blaming the industry they may feel that government is more responsible for their plight because government forced the industries to shut down. As the examples cited in India suggest, this type of vulnerability threat can occur on a relatively large scale depending on the type of regulation.

Those who feel they are neither directly nor indirectly affected by job losses may sympathize with the “victims.” But this may depend on whether they think that the person who lost the job is a “source of pollution” or not. A rich person may sympathize with the poor workers who lost their jobs after a polluting factory was shut down, but may not sympathize with the driver of a smoke belching taxi who stopped his business because he could not afford to upgrade his taxi. A local authority’s stated intention to prohibit certain types of new industries may be viewed as negatively affecting the economy. Bickerstaff and Walker (2001), in their study of public perception of urban air pollution in Birmingham, UK, identified a number of cognitive patterns in which the individual seeks to move responsibility for air quality onto other groups.

Past studies have suggested that prior stress and anxiety caused by non-environmental events can influence the perception of environmental risk. The loss, or potential loss, of one’s job is ranked as one of the highest stress experiences (Castro, Romero, and Cervantes 1986). Typically, increasing levels of stress would be expected to correlate with increasing perceptions of risk, but in this situation the stressor—job loss—is actually (or perceived to be) due to air pollution control actions. This may influence both perceived risk and support for air control measures. Poor daily-wagers may view job threats due to air pollution as just one of many reasons for the temporary nature of their job and hence may have less of a negative attitude to the threat. People with more permanent jobs may tend to have more of a negative attitude. Satterfield, Mertz, and Slovic (2004) found that increased perceptions of vulnerability and injustice resulted in higher risk rating across a range of hazards.

Knowledge Gaps and Needed Research

From this review of studies it is apparent that much of the work has focused on perceptions of the state of air quality and the determinants of these perceptions. In the context of public participation and governance, there is a crucial gap related to public perceptions of government and policy responses (either past, current, or anticipated).

Very few studies have been conducted by inter-disciplinary teams comprised of social and physical scientists. Cross-cultural comparisons are lacking. If mass media is important, as some studies have suggested, it is necessary to know how journalists themselves perceive air quality issues. On the other hand, in developing countries, owing to poverty and literacy levels, there is considerably less exposure to mass media. Therefore, personal experiences and social interactions are more likely to play a greater role in influencing perceptions than the mass media, compared to more developed countries. Even those who are exposed to mass media may not find much information on air pollution issues, because journalists, reflecting society's preoccupation with non-environmental risks, do not provide adequate coverage.

Longitudinal studies—repeating the same set of questions with the same individuals regularly over a period of time—have not been conducted. Barring a couple of studies, there is no information about people's perceptions to specific pollutants. It is possible that people view air pollution in an “aggregate” sense, while experts like to design pollutant-specific solutions. While a few studies have studied the variation of perceptions across demographic and socioeconomic groups, very few have examined the differences across various stakeholder groups (citizens, small and big industry, government, unions, activists, journalists, non-governmental think tanks, etc.)

In much of the developing world, urban areas still witness extremely high levels of both visible (particulate matter) and invisible (gases) forms of air pollution. The high levels may well yield a “saturation” effect, such that there is little variation in perception across social and demographic groups. Therefore the framing of the right questions is a crucial task. Also, due to factors such as aridness, topography, etc., the levels of natural (background) dust are higher than those observed in more developed countries. Therefore, one can speculate that people are more “accustomed” to visible forms of pollution and any man-made increase in air pollution does not cause as much concern as in other countries. This speculation needs to be verified through carefully designed surveys.

Future studies of perceptions of urban air pollution in developing countries should focus on sources (e.g., motorcycles, buses, refuse burning, small industries) and pollutants (e.g., dust) that are comparatively unique and of greater concern in their setting. More importantly, the effect of poverty and livelihoods-

related variables on public perceptions needs greater research attention. Only through a better understanding of these issues can risks be more effectively communicated, participation more effectively streamlined, and responses more effectively crafted.

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