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Perceptions of Risk from Industrial Pollution in China: A Comparison of Occupational Groups

Bryan Tilt

As economic reforms have transformed the People’s Republic of China over the past several decades, rapid industrialization has resulted in air and water pollution problems that threaten the health of China’s citizens and damage the environment. Small-scale rural factories called “township and village enterprises” play a major role in China’s growing pollution problem. However, very little is known about how rural Chinese citizens perceive industrial pollution. This paper examines how community members in an industrial township in China’s southwestern province of Sichuan perceive the environmental risks associated with industrialization. The paper first focuses on identifying salient risks from pollution, as defined by local informants. Next, the risk perceptions of three occupational groups in the community (industrial workers, commercial and service sector workers, and farmers) are compared. In contrast to the common view that poor individuals and communities worry less about environmental problems, most informants in this study perceived industrial pollution as posing considerable risk to themselves and the community, despite the community’s heavy reliance on industry. This study also finds that different occupational groups perceive industrial pollution quite differently, and that these differences in risk perception are related to a number of factors, including the distribution of financial benefits from local factories. The paper concludes with theoretical and applied considerations for the study of environmental risk perception and risk management.

Key words: environmental risk, perception, industrial pollution, economic development, China

Introduction

The economy of the People’s Republic of China has grown with unprecedented speed over the last quarter century. With a sustained average annual increase in gross domestic product (GDP) of nearly ten percent, China is widely expected to become the world’s largest economy, surpassing the United States, in the next two decades (Mittleman and Pasha 1997). One of the main driving forces behind this growth trend is the township and village enterprise (TVE) sector, which is comprised of some 20 million small-scale factories throughout the Chinese countryside. Taken together, TVEs employ more than 130 million rural workers and account for one-third of China’s GDP (Chinese Statistical Bureau 2001). This economic success story has an equally dramatic downside. Township and village enterprises emit 60% of China’s air and water pollution, endangering human health and posing a serious threat to agro-ecosystems (World Bank 1997). The TVE sector thus represents one of the most significant threats to the environment and human health in a country facing a pollution problem of enormous proportions.

Because of their geographical dispersal, township and village enterprises are notoriously difficult to monitor and regulate. As a result, air pollution (including particulate matter, sulfur dioxide and volatile organic compounds) and water pollution (including industrial waste water and heavy metal emissions) are common byproducts of rural industrialization which affect many of China’s 800 million rural residents. Some recent studies have begun to shed light on how urban Chinese perceive environmental risks, including industrial pollution (Lai and Tao 2003; Zhang 1994). To date, however, there has been no systematic examination of how China’s rural residents view the risks associated with industrial pollution, despite the fact that 70 percent of the country’s population lives in rural areas where industrialization is currently occurring most rapidly.

The general aim of this paper, which draws on ethnographic data, semi-structured interviews, and a survey conducted during six months of fieldwork in 2003, is to examine how community members in a rural industrial township in China perceive air and water pollution emitted by local township and village enterprises. Different groups within

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communities often perceive the risks and benefits of industry in disparate ways, which can create conflict when these groups try to reconcile the complex array of environmental, social, and economic factors involved in industrialization. Much of the research on perceptions of environmental risk comes from the "psychometric approach," which explores the cognitive aspects of risk perception (Fischhoff, et al. 1978; Slovic 1987). However, anthropologists and other proponents of a socio-cultural approach to the study of environmental risk increasingly analyze how people's perceptions of risk are formed within larger social, cultural, and political contexts (Oliver-Smith 1996; Wolfe 1988). This paper contributes to a socio-cultural understanding of environmental risk by examining community perceptions of industrial pollution in one township in Sichuan, China.

The paper has two specific goals. The first is to identify, through the use of ethnographic methods and semi-structured interviews, the specific ecological and health risks from pollution that are most salient to people in the study community. The second goal is to understand whether and how the perceived severity of these risks varies within the community across occupational groups. This is accomplished by asking informants to rate the severity of each risk on a five-point scale, and then comparing risk ratings across groups using a proportional odds model. Occupation is considered as a key variable because recent economic reforms in rural China, driven by changes in national policy, have dramatically altered the occupational structure of rural communities. Township and village enterprises were once small, collectively owned factories that employed local workers and generated revenue for community development. In response to economic liberalization driven by China's "Reform and Opening" policies, most TVEs since the late 1990s have become privately held factories that employ migrant laborers and seek to maximize investor profits (Oi 1999). As a result, the financial benefits of industrialization increasingly accrue to a select group of industrial workers, while farmers and other workers in the commercial and service sectors receive little or no financial gain. Furthermore, the costs of industrialization, including threats to health, livelihood, and environment, are borne by the community as a whole.

How people perceive environmental risks is a topic of both theoretical and practical importance. From a theoretical perspective, environmental risk perception involves questions of social and economic equity of interest to anthropologists and other social scientists. From an applied, practical perspective, understanding how people perceive environmental risks will largely determine the successes and failures of future risk management efforts, including in this case the introduction of environmental mitigation technologies and increased governmental regulation of pollution emissions. Identifying the environmental risks posed by industry and examining how risk perceptions differ within the community is an important first step toward creating risk management strategies that foster environmental sustainability and social equity.

The paper is organized as follows. First, a brief overview of research on environmental risk perception is provided, along with a description of the contributions of this paper to a socio-cultural understanding of environmental risk. Next, the field research site is described, with particular emphasis on the pollution problems of township and village enterprises and on how different occupational groups in the study community are affected by the costs and benefits of industrialization. Next, the methods of sampling, data collection, and analysis used in this study are described. Findings are presented, including a description of the ecological and health risks posed by pollution according to informants, and a comparison of how informants in different occupational groups rate the severity of each risk. The paper concludes with theoretical and applied considerations for the study of risk perception and the management and mitigation of environmental risks.

The Study of Environmental Risk Perception

Risk analysis is a scientific field that is concerned with predicting and mitigating environmental and other threats to human health and well-being. Prior to the 1970s, little was known about how lay people thought about risk; it was generally assumed that individual perceptions mirrored actuarial data and that people thought about risk as actuarial do: in terms of mathematical probability. Real progress toward understanding the human aspects of risk began in the 1970s when researchers found that lay people often perceived risk in ways that differed dramatically from expert assessments and from actuarial data about risk probabilities (Fischhoff, et al. 1978). The question was how to account for the observed differences. The "psychometric approach," employed primarily by psychologists, emerged as the dominant paradigm in risk perception research (Fischhoff, et al. 1978; Slovic 1987; Slovic, et al. 1984). This approach has consistently shown that people's perceptions of a variety of risks can be explained by the characteristics of the risks themselves (Slovic 1987) and that risk perception reflects an underlying and universal cognitive structure.

The psychometric approach is geared toward developing a taxonomy for hazards that can be used to understand how people respond at a cognitive level to the risks around them. Using this approach, researchers found that two factors (labeled "dread risk" and "unknown risk") explained a great deal of the variance in how people perceived a set of 30 hazards (Slovic, et al. 1985). This has become the hallmark of the psychometric paradigm and has been tested in studies involving research subjects from all over the world (Flynn, Slovic and Mertz 1994; Keown 1989; Kleinheeselink and Rosa 1991). An important component of psychometric research has been the study of environmental risks, from air pollution (Brody, Peck and Highfield 2004), to changes in natural resource use (Burger, et al. 2000), to nuclear power (Slovic, et al. 2000).
Over the past decade or so, the acknowledgement that risk perception is inherently related to broader social processes has led to the view that a purely psychological analysis can account for only part of what shapes the perception of environmental risk. Anthropologists have played a key role in this transformation. Anthropological studies of risk perception tend to focus more broadly on the ways that risks are situated within social, political, economic, and cultural contexts (Wolfe 1988). For anthropologists, the “actual” risk itself is only part of the equation of risk perception, which, as Anthony Oliver-Smith has noted, is “grounded in the cultural norms and values that both govern and are embedded in the relationships that human communities have with their physical and social environments” (1996:320).

Anthropologists have used their training to study a wide array of environmental risks, including groundwater contamination (Fitchen 1988), radioactive contamination (Paine 1992; Petterson 1988), global climate change (Gerlach and Rayner 1988), toxins in fish (Beehler, McGuinness and Vena 2001; Johnson and Griffith 1996), and toxic-producing micro-organisms in marine environments (Griffith 1999; Paolillo and Maloney 2000). Although quite diverse in terms of research methods, much of the anthropological work on environmental risk is grounded in the cultural theory approach put forward by Mary Douglas in her path-breaking co-authored book, Risk and Culture (Douglas and Wildavsky 1982). In short, anthropological studies view risk perception as a socio-cultural phenomenon guided by the values, institutions, and relationships that make up social life. Taking a socio-cultural approach to the study of risk perception allows us to change our analytical focus from “how does risk perception reflect similarities and differences in cognition?” to “what are the broader social, cultural, and economic factors that influence how people think about risk?”

This paper uses insights from several decades of psychometric research insofar as it quantitatively measure people’s perceptions of risk from industrial pollution. It also brings two key strengths of applied anthropology to bear on the subject. First, the primary question asked of the data is a social question: how is industrial pollution perceived differently across occupational groups within the community? Second, as a methodological feature, this study employed ethnographic field methods and semi-structured interviews to ask community members themselves to identify salient risks from pollution. Informants were subsequently asked to rate the severity of each risk as a basis for measuring differences in risk perception. One of the main criticisms of psychometric attempts to measure risk perceptions is that the researchers themselves generally define a set of risks and then ask study participants to rate the perceived severity of these risks. This practice has limited validity, since informants are not able to say what really matters to them about the question under investigation (Pidgeon, et al. 1992). Particularly within cross-cultural settings or when little is known about the nature of environmental risks in a community, ethnography is both a valuable first step toward identifying salient risks and a tool for interpreting the result of risk ratings.

Field Research Site: Industry, Pollution, and a Changing Occupational Structure

After rural land reforms were enacted in the early 1980s as the initial step in liberalizing China’s economy, central economic planners needed a way to absorb rural surplus labor and provide operating revenues for township and village governments. They created national policies that encouraged the expansion of industrial production in the countryside; township and village enterprises, which were generally owned and operated by local governments, grew quickly in response to this policy initiative. There are currently close to 20 million small-scale rural factories in China, employing some 130 million workers (Chinese Statistical Bureau 2001).

China’s State Environmental Protection Administration, which is responsible for setting national emissions standards and enforcing compliance, has identified the TVE sector as a major contributor to national air and water pollution levels since the mid-1990s. A number of factors contribute to this assessment. Because TVEs are located in rural areas without access to significant capital, they typically employ few if any environmental mitigation technologies. Coal, the most abundant energy source in China, is the primary fuel for industrial boilers, and most coal is burned unashed. In addition, a high degree of interdependence between local government and industry often contributes to the pollution problem by creating financial incentives for government compliance officials to look the other way (Ren and Li 2002). In 1997 the National Environmental Protection Agency (the predecessor of today’s State Environmental Protection Administration), in conjunction with the Ministry of Agriculture and several other national agencies, issued “Regulations Concerning Environmental Protection at Township and Village Enterprises.” These regulations have succeeded in closing some of the worst polluters, but the TVE sector remains one of the most serious threats to the environment and human health in China (Ma and Ortolano 2000: 30).

Futian, the site of this study, is a township of 3,500 people located in Panzhihua Municipality, in China’s mountainous southwestern province of Sichuan (see Figure 1). It is a mixed ethnic community of Han Chinese and Yi minority people. Like most communities in China’s southwestern region, Futian lags behind the national average on most development indicators, including income, educational attainment, and poverty rates. Prior to the 1980s, economic life in Futian was centered on subsistence agriculture, supplemented in some cases by cash from the sale of agricultural products. Township and village enterprises began operating in the 1980s under the collective ownership of the township government and were primarily geared toward providing industrial inputs to Panzhihua Iron and Steel, China’s third-largest state-owned steel smelting plant. TVEs in Futian include a zinc smelter, which produces refined zinc that is alloyed with other metals in the production of consumer goods and construction materials; a coking plant, which produces coke, a hard, porous carbon material used for high-heat industrial operations; and a coal-washing
plant, which uses a water slurry to reduce the sulfur content of raw coal prior to its use in industrial boilers. All of these factories burn coal for fuel and lack basic environmental mitigation technologies. Industrialization has dramatically altered Futian’s environment. Plumes of black smoke rise daily from the local factory complex, and the water in the nearby tributary stream that feeds into the Yangtze River often runs black with untreated effluents from the coal-washing plant. A recent study of ambient air pollution in the community found that local residents are exposed to levels of particulate matter from factory emissions that far exceed air quality standards set by China’s State Environmental Protection Administration and the World Health Organization (Tilt 2004).

An issue of key importance for this study is that changes in national policies governing rural industry have dramatically altered the occupational structure of Futian in recent years. TVEs, as their name suggests, were originally established as collectively owned factories designed to absorb rural surplus labor and promote local development through the generation of tax revenues, which generally stayed within the local community (Naughton 1992; Whiting 2000). In Futian, industrial revenues were used for community development programs throughout the 1990s, including new primary schools, road construction, and new government offices. Although only a small fraction of local households relied directly on industry for their livelihood, the benefits of industrialization accrued to the community as a whole.

Beginning in the late 1990s, however, local factories began to privatize in an effort to increase efficiency. This transformation in the ownership structure of rural enterprises, supported by national policy changes that allowed for greater private ownership, is one of the most significant recent developments in the Chinese economy (Pei 1998). It allowed township and village governments to sell collectively held industrial assets to private investors, who subsequently controlled the direction of local industrial development and profited from industrial activity (Oi 1999). Futian’s zinc smelter, coking plant, and coal-washing plant were all purchased by investors from outside the community, most of whom had successfully operated small-scale factories in other parts of the province or in neighboring provinces. Most crucially for this study, the private investors in Futian laid-off the local factory workforce and brought in skilled workers with prior experience in other factories under their management. As a result, the privatization of local industry was compounded by the outsourcing of wage-labor opportunities.

As a consequence of these political and economic changes in the rural industrial sector, there are currently three main occupational groups in the study community. Industrial workers labor in one of Futian’s three factories and earn a monthly wage. Commercial and service sector workers sell goods in local retail shops or provide services such as basic health care or agricultural extension. Farmers cultivate a variety of crops—including rice, potatoes, beans and melons—both for subsistence and to sell in local and regional markets. This recent change in Futian’s occupational structure provides an ideal site to study how different groups of people, who are situated differently in relation to the costs and benefits of rural industry, perceive industrial pollution. How do people in the community define locally salient risks from pollution? Are there significant variations in environmental risk perception by people belonging to different occupational groups? If significant variation exists, what accounts for it?

**Methods and Sampling Procedures**

**Phase One: Identifying Locally Salient Risks from Industrial Pollution**

Data collection methods for this study included semi-structured interviews and a standardized survey instrument, supported by participant observation in the study community over a six-month period. Phase One of this study involved asking informants to identify and characterize salient risks from industrial pollution. In the spring of 2003, a stratified random sample of 36 informants was drawn from among the three primary occupational groups in Futian, including industrial workers, commercial and service sector workers, and farmers. Informants included both men and women and both Han and Yi ethnic groups in roughly equal proportion to their
appearance in the study population. Semi-structured interviews were conducted, during which informants were asked about the costs and benefits of local industry. Additionally, informants were asked to list and discuss the specific environmental and health risks posed by industrial pollution, as they saw them. Interviews were conducted in Mandarin Chinese and lasted from one-half hour to more than two hours. A typical interview lasted one hour. Semi-structured interviews are a valuable way of uncovering patterns of meaning in informants’ statements, particularly when the interviewer has limited familiarity with the issues at hand (Agar 1996; Bernard 1995).

Extensive notes of each interview were taken by the researcher, with the aid of a Chinese research assistant when necessary. These interview transcripts served as the textual basis for analysis. Using the N6 qualitative analytical software (QSR International), interview transcripts were first open-coded, a process by which data are analyzed line by line. The open codes were used as categories that encapsulated the meaning in informants’ responses. Similar categories were then clustered together to build the data into larger conceptual constructs, or “risk themes,” each theme representing a specific risk posed by industrial pollution to the community according to local informants.

**Phase Two: Rating the Risks**

Phase Two of the study set out to examine whether and how perceptions of risk from industrial pollution differed across occupational groups in the study community. A standardized survey instrument, based on the themes that emerged from semi-structured interviews, was used for this purpose. In the spring and early summer of 2003 a new, larger sample of informants was drawn from the community using a stratified random sampling frame. Occupation was again used as the primary sampling criterion, based on the major occupational groups in the community: industrial workers, commercial and service sector workers, and farmers. An initial sample of 146 was recruited to participate in the survey. Twenty-four informants either chose not to participate or only completed part of the survey, for an overall sample of 122 and a response rate of 83.6 percent. Using this sampling framework, 17 percent of the roughly 700 households in Futian were represented in the survey sample. The demographic characteristics of informants in the survey are shown in Table 1.

A standardized survey instrument was devised that consisted of several sections including demographic and socioeconomic information, views on local living standards, and perceptions of industrial pollution from local factories. In the section on perceptions of pollution, the seven risk themes that emerged from semi-structured interviews in phase one of the project were used as the basis for risk ratings. Informants were asked to rate the severity of each risk theme using a five-point scale as follows: “little or no risk,” “slight risk,” “moderate risk,” “considerable risk,” and “high risk.” The five- or seven-point scale is the most common approach to measuring the magnitude of risk perceptions (Slovic, et al. 1990). It produces ordinal data that allows the researcher to compare ratings across individuals and groups (Bernard 1995: 254-255; Ross 2004:105-107).

The survey was translated into Chinese with the help of colleagues from Sichuan University and pre-tested with a sample of 12 informants from across occupational, ethnic, and gender groups. It was administered with the help of four undergraduate research assistants and one doctoral student in economics from Sichuan University. The risk ratings from the survey were analyzed using a proportional odds model, a statistical method, described below in more detail, that facilitated the comparison of risk ratings across occupational groups (SAS Institute 2000). Finally, participant observation was used throughout fieldwork to record ethnographic data about the role of industry and pollution in the everyday lives of community residents.

**Risk Themes: Locally Salient Risks Posed by Industrial Pollution**

Analysis of the semi-structured interviews revealed that the following seven “risk themes" stemming from industrial pollution were most salient for informants in the study: direct health effects, damage to plants or crops, damage to visibility or scenery, threats to animal health, economic losses, effects on food chain, and threats to longevity. Overall, these seven themes represent a diverse set of concerns for local informants and stem from direct experience in coping with pollution on a daily basis. The seven risk themes, along with their frequencies

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>Sample Size (N)</th>
<th>% of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation</td>
<td>Industrial Worker</td>
<td>33</td>
<td>27.0</td>
</tr>
<tr>
<td></td>
<td>Commercial/ Service Worker</td>
<td>42</td>
<td>34.4</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>47</td>
<td>38.5</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>77</td>
<td>63.1</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>45</td>
<td>36.9</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Han</td>
<td>67</td>
<td>54.9</td>
</tr>
<tr>
<td></td>
<td>Yi/Other *</td>
<td>55</td>
<td>45.1</td>
</tr>
<tr>
<td>Total Sample</td>
<td></td>
<td>122</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Included primarily Yi, the largest ethnic minority in the community. Other ethnicities represented in the sample included Dai, Naxi, Nisu, and Nuosu.

Note: Columns may not total 100% due to rounding.
Table 2. Locally Salient Risks Posed by Industrial Pollution

<table>
<thead>
<tr>
<th>Risk Theme</th>
<th>Informants Using Theme (N)</th>
<th>(%)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1- Direct Health Effects</td>
<td>34</td>
<td>94.4</td>
<td>Pollution causes health problems for the informant, his/her family, or the community in general.</td>
</tr>
<tr>
<td>Theme 2- Damage to Plants or Crops</td>
<td>23</td>
<td>63.9</td>
<td>Pollution damages agricultural crops and other plants.</td>
</tr>
<tr>
<td>Theme 3- Damage to Visibility or Scenery</td>
<td>23</td>
<td>63.9</td>
<td>Air pollution impairs visibility or otherwise damages the aesthetic quality of the area.</td>
</tr>
<tr>
<td>Theme 4- Threats to Animal Health</td>
<td>14</td>
<td>38.9</td>
<td>Water pollution contaminates drinking water for livestock.</td>
</tr>
<tr>
<td>Theme 5- Economic Losses</td>
<td>8</td>
<td>22.2</td>
<td>Air and water pollution damage crops, lowering yields and resulting in economic losses in the township.</td>
</tr>
<tr>
<td>Theme 6- Effects on Food Chain</td>
<td>5</td>
<td>13.9</td>
<td>Eating plants and animals that have been contaminated by pollution poses a health threat for humans.</td>
</tr>
<tr>
<td>Theme 7- Threats to Longevity</td>
<td>3</td>
<td>12.0</td>
<td>Exposure to pollution limits peoples' ability to live a long life, an important cultural value in China.</td>
</tr>
</tbody>
</table>

of appearance within the semi-structured interviews and a brief description of each, are shown in Table 2.

Nearly every informant in the sample cited direct health effects of industrial pollution as a primary concern. Comments included references to the deleterious effects of industrial pollution on individual, family, and community health. However, there was little consensus on the precise nature of the health threat. Some informants cited contaminated water as an exposure pathway of primary concern, while others worried most about respiratory problems caused by air pollution. One farmer expressed the sentiment that chronic exposure to air pollution exacerbated existing health problems: “Everyone here experiences it [exposure to pollution]. It makes you get sick more often and it makes it harder to recover.” A young man who worked in the coking plant, where he was exposed daily to high levels of sulfur dioxide and particulate matter, was aware of the potential health threat but uncertain about the nature and seriousness of the problem: “It’s harmful to human health (dui reni you hai). They say it’s harmful, but I’m not sure how.”

Damage to plants or crops was another widely cited theme. Unsurprisingly, farmers cited this theme most often in their narratives about pollution. Their comments reflected concern about both dry deposition of particulate matter on their crops as well as contamination from polluted irrigation water in local streams and canals. Industrial workers and workers in the commercial and service sector also cited this theme, since trees and shrubs throughout the township are often coated with a grey-colored soot that is hard to overlook. One farmer noted, “Our crops have been directly damaged by emissions from the coal washing plant. We have four mu of land [roughly one-half acre] directly downstream from the plant, and the untreated water washes down to us.” A commercial worker in a local shop commented on widespread damage to the township’s silkworm crop, which had failed several years previously: “People had a lot of silkworms, but they’re mostly gone now. The air pollution killed them.”

Concern about damage to visibility or scenery was widespread among informants. Visibility was cited both as an indicator of ambient air quality and as a marker of the aesthetic beauty of the township. Nearly everyone who cited this theme mentioned the billowing puffs of smoke that routinely rose above the factory complex. Many informants made reference to how air quality has declined in recent years as industrial operations in the township and surrounding areas have expanded. One farmer mentioned that “you can’t even see across to the other side of the valley through all the pollution.” A worker in the zinc smelter acknowledged that the smoke from the factory complex was visible throughout the township, but doubted whether this interfered with the
aesthetic beauty of the area: "I know you can see the smoke from our factory, and some people think it damages the scenery, but I don’t think it’s that bad."

Many informants cited threats to animal health as a key concern. Informant narratives on this theme were of two kinds. First, those people whose livelihoods depended at least in part on farming recognized the vital importance of stock animals in the agricultural system. Cows and water buffaloes provide labor as draft animals and fertilize agricultural fields. Goats, pigs, and other animals are raised to sell on the market and provide a cash income. Undermining the health of these animals has a direct, negative impact on the local economy. Second, many informants in the study, including industrial workers, viewed animal health as an indicator of ecosystem stability and a predictor of human health impacts from pollution. In this view, animals who fell ill from exposure to air or water pollution served as warning signs that a threshold of safety was being crossed. One farmer noted, "The pollution, especially water pollution, can make stock animals sick."

Informants citing the economic losses theme mentioned that the integrity of the agro-ecosystem, which is the mainstay of the local economy, is often undermined by industrial pollution. Crop yields can be directly affected by both air and water pollution levels. When crop yields decline, individual farmers suffer a financial loss and, in response, township tax revenues, which are based in part on crop yields, are also affected. One farmer noted, "The pollution can be very harmful to crops, even if it’s not so bad for people’s health. If our crops are damaged, we feel the financial impact."

Informants in the study who cited the effects on food chain theme expressed concern about the accumulation of toxins in local food sources. This is not surprising, given that most food is produced and consumed within the township. The zinc smelter raised special concern for many informants, since toxic substances such as mercury and arsenic are produced as byproducts in the smelting process and may leach into soils and underground water sources. Although community residents did not have access to scientific information about the risk of toxins in food, many informants reported hearing about the danger of toxins such as mercury through the news media. One informant noted, "toxins get into the plants and animals—cows, pigs, ducks—and then people eat them. It’s not healthy." Most residents of the community, however, did not cite specific cases of people falling ill from a contaminated food supply, since toxic effects of this nature tend to accumulate slowly over time.

Informants citing the threats to longevity theme felt that air and water pollution presented cumulative health effects that ultimately limited the longevity of community residents. Longevity (changshou) remains an important cultural value in rural China, where elders typically live in extended families and receive considerable respect. Informants did not mention specific cases in which industrial pollution limited the life span of community members; rather, as one commercial shopkeeper noted, "people just don’t seem to live as long as they used to."

Risk Ratings: Differences between Occupational Groups

One of the aims of this study was to examine whether occupational groups differed in terms of the way they rated the perceived severity of each risk theme related to industrial pollution. A proportional odds model using maximum likelihood estimation was computed through PROC GENMOD in SAS for this purpose (SAS Institute 2000). The proportional odds model is a method for testing association between two variables when the dependent variable is measured on an ordinal scale. The primary statistical procedure is usually to test whether there is a difference in the dependent variable between groups (Agresti 2002; O’Connell 2005). The null hypothesis is that the groups are identical in terms of the distribution of their responses on the scaled dependent variable. For a variable such as a 1-5 Likert scale, this means that for each of the five response categories, the proportion of one group’s responses in that category equals the proportion of the other group’s responses in that category. In this study, informants were asked to indicate their level of agreement with a set of statements, each representing a risk theme drawn from semi-structured interviews; for example, "pollution affects peoples’ health." If the proportion of industrial workers who "strongly agree" that pollution affects human health equals the proportion of commercial and service sector workers and farmers who strongly agree with this statement, then the response distributions would be considered the same and the null hypothesis would not be rejected. The null hypothesis is rejected if the observed difference between the response distributions of any two groups is larger than would be expected due to random chance. Subsequent contrast tests using the Chi-square statistic are then run to see which groups differ in their response distributions at a given level of statistical significance (p-value).

Figure 2 shows how informants in each occupational group rated the severity of each risk theme. This is expressed by the percentage of responses from each occupational group that fell into each response category ("high risk," "considerable risk," and so on). In this figure, the white area reflects the percentage of informants in each occupational group who rated a given risk theme as "high risk" ("strongly agree"), the lightly shaded area the proportion of informants who rated the theme as "considerable risk," and so on.

Results indicate that a majority of informants in the study, regardless of occupation, perceived industrial pollution as posing some risk to themselves and the community. For most of the seven risk themes, more than 50% of informants in each occupational group provided ratings of "considerable risk" or "high risk." By itself, this finding is significant in that it calls into question some of the inherited theoretical wisdom in risk studies, namely that economic need ensures that environmental risks remain "largely invisible" (Beck 1992:41-42). Many scholars and policy analysts assume that environmental consciousness tends to be linked with material affluence and that poor countries, communities, and
Figure 2. Risk Ratings by Occupational Group

Note: For each risk theme, different letters (a or b) indicate occupational groups whose risk ratings distributions differ at the p<.05 level of significance as determined by Chi-square contrast tests in the proportional odds analysis. For example, for Risk Theme 1: Direct Health Effects, industrial workers (a) differ in their risk ratings from both commercial and service sector workers (b) and farmers (b), p<.05. Commercial and service sector workers and farmers do not show statistically different risk ratings distributions.
individuals are less concerned about environmental risks than their more well-off counterparts, preferring to sacrifice environmental quality for economic growth (Dunlap and Mertig 1997; Inglehart 1995). This logic is frequently applied to China, whose rural population in particular is often seen as too poor, too uneducated, or too concerned with making a living to worry about environmental problems (Edmonds 1998: 726; Wheeler, Wang and Dasgupta 2003). But informants in this study, despite economic conditions below the national and provincial averages, were keenly aware of and concerned about the environmental risks posed by their local factories, which are the very engines of local economic growth.

The most interesting findings illustrated by Figure 2 relate to the comparison of risk ratings across occupational groups. Insights gained from semi-structured interviews and participant observation help to provide a framework for interpreting these differences. The risk ratings provided by farmers and commercial/service sector workers appear similar. A large percentage of informants in these groups responded to most risk themes with “strongly agree” or “agree.” Contrasts between occupational groups, marked by “a” or “b” in the chart, indicate that the ratings distributions of farmers and commercial/service sector workers are not statistically different. Two risk themes (theme 2: damage to plants or crops and theme 6: effects on food chain) elicited “high risk” ratings from more than 60 percent of farmers and commercial/service sector workers. The response distributions of these two occupational groups differed significantly from industrial workers on these themes (p<.01). In addition, more than 50 percent of farmers and commercial/service sector workers provided “strongly agree” responses on two risk themes (theme 3: damage to visibility or scenery and theme 4: threats to animal health). The response distributions of these two occupational groups differed significantly from industrial workers on these themes (p<.05).

In examining the pattern of these responses, it is clear that farmers and commercial/service sector workers share a concern about the effects of industrial pollution on the agrarian ecosystem, on food safety, and on general environmental quality as reflected by visibility. Most farmers and commercial/service sector workers are long-term residents of the township with extended kinship networks that have lived in the community for many generations. This rootedness in the community likely gives farmers and commercial and service sector workers a historical vantage point from which to view how environmental quality in the township has deteriorated over time.

Farmers, as a result of their long-term engagement with and dependence on the natural environment, were perhaps in the best position to judge how industrial pollution affected plants and animals. Agriculture in Futian operates only slightly above the subsistence level; the vast majority of farming households eat what they produce, selling or trading small surpluses at the local township market. Many farmers were acutely aware of their position on the margins of the local economy. As one informant put it, “agriculture puts a roof over your head and fills your belly, but it doesn’t make you well off.” Within this position of socioeconomic marginality, farmers were facing the very real possibility that their livelihoods could be undermined by untreated air and water pollution from industry. Threats to their livelihoods thus underlay the heightened perception of risk from pollution for many farmers. One farmer noted,

Water pollution is the biggest problem. It comes from the coal-washing plant and sometimes it turns the whole river black for days or weeks at a time. The river water is what we use for irrigation and for the animals, so it’s a big problem. We have no water to use when the pollution is bad.

The heightened perceptions of risk exhibited by both farmers and workers in the commercial and service sector tended also to be linked with broader concerns about the changing occupational structure in the township, which deepened their economic exclusion from the financial benefits of industry. During the period of collective ownership of local TVEs, many households had at least one family member who worked in a local factory and earned regular wages. After the privatization of local industry, which was facilitated by changes in national policy that allowed for greater private ownership of the means of production (Oi 1999), factory managers had the latitude to hire their own labor force from outside the community, and households who had previously gained a portion of their income from industrial wages lost this important income source. Many farmers and commercial/service sector workers used the colloquial, mildly derogatory term waidiren (“outsiders”) to refer to the migrant laborers. As one farmer noted, “It [factory privatization] has brought a lot of waidiren into the community to invest and work in industry, but we don’t get any of the benefits from industrial development.” The primary benefit was increased income from industrial wages. Socioeconomic data from the survey used in this study reveal that industrial workers earned nearly twice the monthly income of commercial/service sector workers, and more than five times the monthly income of farming households. Another farmer, a man in his fifties and a life-long resident of Futian, was openly contemptuous of the factory workers who relocated to Futian from the neighboring province of Guizhou and profited from industrial activity: “They come from outside our town, ruin our environment, make money, and then go home.”

A related, and perhaps more striking finding illustrated by Figure 2 is that industrial workers consistently provided risk ratings that were well below those of other occupational groups. The proportional odds analysis revealed that the response distributions of industrial workers differed from the other two occupational groups on all seven risk themes, and that these differences were statistically significant at the p<.05 level. Specifically, for each risk theme, a considerable percentage of industrial workers responded with “strongly disagree” or “disagree.” Similarly, the percentage of industrial workers who “strongly agreed” with any risk theme was significantly
smaller than for the other occupational groups, as illustrated by the comparatively short white portion of the bar chart for industrial workers across all risk themes. This is likely due in part to the fact that many of the risk themes dealt with harms to the agro-ecosystem, which had comparatively little importance for industrial workers.

Most notably, however, industrial workers’ lowest risk ratings were for theme 1, direct health effects; 28.8 percent of workers strongly disagreed that industrial pollution posed only “little or no risk” to human health, as compared to 11 percent of commercial/service sector workers and 11.5 percent of farmers. Less than one-quarter of industrial workers strongly agreed that pollution posed “high risk” to human health, as compared to roughly half of commercial/service sector workers and farmers. With respect to this theme, the risk rating distribution for industrial workers was significantly different from that of commercial and service sector workers and farmers (p<.01). Theme 7, threats to longevity, produced a similar response distribution; 27.6 percent of industrial workers strongly disagreed, compared to 12.5 percent of commercial and service sector workers and 13 percent of farmers (p<.05).

This finding is particularly remarkable given that industrial workers labored on a daily basis under highly polluted conditions. Ambient concentrations of particulate matter from factory emissions routinely exceeded air quality standards set by China’s State Environmental Protection Administration and the World Health Organization (Tilt 2004), and factory workers typically worked six or seven days a week with little or no protection from breathing harmful emissions. Fumes from the zinc smelter and coking plant were often so noxious that the researcher had difficulty conducting on-site interviews without choking and coughing. During semi-structured interviews many industrial workers made reference to their bodies as barometers of health risk, but their statements were almost always used to downplay the risks they faced. As one man who had migrated to Futian several years previously to take advantage of labor opportunities in the local factories said, “The pollution from these factories has no effect on human health (da ren shi meiyou yingxiang).” To emphasize his point, he added, “I’ve been doing this kind of work for years with no health problems.”

What explains industrial workers’ consistently lower risk ratings under such conditions? Anthropological research on environmental risk has suggested that the denial of risk may constitute a form of adaptive agency insofar as it allows individuals to participate in activities that are otherwise financially rewarding (Rappaport 1988). In this case, such downplaying of the risks of pollution might be termed “strategic risk repression.” It allows factory workers to persist in the production of industrial products and profits while compromising their own health and the ecological integrity of the community. A comparatively high monthly income provides some impetus for industrial workers to engage in strategic risk repression. As migrant laborers, these workers also lack access to local agricultural land, which many rural Chinese consider an economic safety net when wage labor jobs disappear. In short, strategic risk repression allows workers to persist in a profitable line of work despite risks to the environment and human health. Industrial workers’ perceptions of pollution likely involved a cost-benefit calculation in which their economic livelihoods were seen as the issue of greatest concern and ecological and health risks were secondary. Ulrich Beck, whose influential book Risk Society considers the social implications of technological risks, including industrialization, has observed that “affliction by hazards need not result in awareness of the hazard…Dangers can always be interpreted away” (1992:75).

Conclusions

Taking a socio cultural approach to the study of environmental risk perception allows us to situate environmental risks in appropriate political, economic and cultural contexts. A key component of this approach is the use of research methods that allow informants themselves to identify salient risks. Informants in Futian were concerned about a broad array of ecological and health risks stemming from industrial pollution in the township. Their nuanced understanding of the effects of pollution was sometimes startling. Informants with no more than an eighth-grade education often used technical terms such as “sulfur dioxide” (erliang huaihu) and “inhalable particulate matter” (kesiure keiliwu) in their assessments of the local pollution problem. Many informants discussed in detail how emission levels had changed through time, how pollution affected the livelihoods and health of their families, and how political and economic processes shaped the changes in Futian’s occupational structure and the privatization of local factories.

Risk ratings from informants in all occupational groups reflect a widespread concern about pollution from township and village enterprises. This finding is in contrast to the widely accepted view that poor individuals and communities do not have the “luxury” of worrying about environmental problems (Dunlap and Mertig 1997; Inglehart 1995). However, the perceived severity of risk from industrial pollution was hardly uniform. Farmers, along with workers in the commercial and service sector, were concerned about the effects of industrial pollution on the agrarian ecosystem. Farmers were particularly vulnerable to the ecological damage wrought by the industrialization process, which threatened their economic livelihoods. At the same time, their heightened perceptions of risk tended to be linked with a widely shared dissatisfaction over policy changes that effectively excluded them from the financial benefits of industry, especially wage labor. The risk ratings provided by industrial workers are an interesting corollary to this story. Factory workers practiced “strategic risk repression,” and tended to disagree that industrial pollution posed serious health or ecological risks to the community. In light of the fact that industrial workers, by nature of their occupation, are exposed daily to high concentrations of pollution, their risk ratings underscore the fact that exposure
to environmental risks does not necessarily translate into heightened risk perception.

The dramatic differences in risk ratings between occupational groups in this study serve as a reminder of the social dimensions of environmental risks. People in Futian did not make judgments about pollution in a social vacuum. Rather, they constantly situated their understandings of the pollution problem in the context of their economic and social lives and also in the context of national and regional policies governing industrialization. In short, the question “who loses from industrial pollution?” cannot be separated from the question “who gains from industrial profit?” As the People’s Republic of China heads into a third decade of economic reform, bringing with it one-fifth of the world’s population, the magnitude of environmental problems it faces—industrial pollution, deforestation, agricultural runoff, desertification—suggests a need for a serious consideration of the linkage between natural and social systems. In rural China, where unchecked industrial development has produced pollution problems of immense proportion, exposure to environmental risk has particular significance. Left unchecked, these problems constitute an ecological and public health experiment whose outcome is unknown but likely undesirable.

The divergent views on industrial pollution in this study also highlight the on-going debate about what role public perceptions and participation should play in shaping risk management efforts. On one side are those who argue that environmental risk assessment should be left to the experts, whose unique knowledge and objective judgment enables them to do a better job identifying, characterizing, and communicating about risks than the general public. On the other side of the debate is an array of social scientists and public advocates who call for broad public participation in risk management. The people who are most affected by the potential harm of a risk-inducing activity, the argument goes, should have the prerogative to determine the level of risk that is tolerable to them and their communities (For a recent overview of the debate see Slovic 1997). Recent anthropological research on toxic dinoflagellate blooms in the mid-Atlantic coastal waters of the United States has highlighted considerable disagreement between scientific experts and various stakeholder groups over the nature and magnitude of the problem (Griffith 1999; Paolissio and Chambers 2001). The findings presented in this paper provide similar support for the heterogeneous nature of public opinions about environmental problems.

Understanding the patterning of risk perception between stakeholder groups is important because public perceptions of risk routinely influence the priorities and expenditures of regulatory agencies responsible for environmental oversight (Slovic 1997). Regardless of where one stands in the debate over public participation in risk management, it is no longer possible to study environmental risks apart from issues such as participation, trust, and regulatory transparency. This presents us with a special problem in a place such as the People’s Republic of China, where governmental respect for individual rights and views is poor, and where citizens have little legal recourse to voice concerns about environmental problems. There is a danger for anthropologists and other social scientists to say, “what does it matter how local people perceive pollution? They have no input.” This is changing, however. As industrialization and environmental degradation proceed at a rapid pace, peasant protests over industrial pollution are on the rise throughout rural China and represent a growing threat to political and social stability (Jing 2000). There is evidence that environmental problems in China increasingly present a forum for pushing the “boundaries of political possibility” (Weller 1999:127) as rural Chinese turn dissatisfaction with environmental quality into political dissent.

More crucially, scholars and policymakers are in general agreement that the key shortcoming in China’s environmental protection program is a lack of enforcement of existing laws and regulations (Ma and Ortolano 2000:117-121). Growing public awareness of the environmental and health risks posed by industrial pollution may provide the impetus to step up enforcement measures. As a case in point, as fieldwork for this study was concluding in 2003, a group of farmers in Futian succeeded in obtaining monetary compensation from the township for damage done to their crops by contaminated irrigation water. There is also an on-going debate between the township government and the district environmental protection bureau about how to balance industrial growth with environmental protection. Pollution control strategies under consideration in the township include government subsidies for sulfur-scrubbing smokestacks and, as a more extreme measure, permanently closing factories that do not comply with emissions standards. Understanding how community members view the risks associated with industrial pollution will help illuminate possible risk management strategies as well as predict how these strategies will affect community members. The results of this study suggest that views about industrial pollution are linked with broader social and economic concerns for many community members; strategies designed to mitigate pollution may likewise be most effective if undertaken with consideration for social and economic equity.

References

Agar, Michael H.

Agresti, Alan

Beck, Ulrich

Beehler, G.P., B.M. McGuiness, and J.E. Vena

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Bernard, H. Russell  

Brody, Samuel D., B. Mitchell Peck, and Wesley E. Highfield  

Burger, Joanna, et al.  

Chinese Statistical Bureau  

Douglas, Mary, and Aaron Wildavsky  

Dunlap, Riley E., and Angela G. Mertig  

Edmonds, Richard Louis  

Fischhoff, Baruch, et al.  

Fitchen, J.  

Flynn, James, Paul Slovic, and C.K. Mertz  

Gerlach, L.P., and S. Rayner  

Griffith, David C.  

Inglehart, Ronald  

Jing, Jun  

Johnson, Jeffrey C., and David C. Griffith  

Kellow, C.F.  

Kleinhesselink, R.R., and E.A. Rosa  

Lai, Julian Chuk-Ling, and Julia Tao  

Ma, Xiaoying, and Leonard Ortolano  

Mittleman, James, and Kamal Pasha  

Naughton, Barry  

O'Connell, Ann A.  

Oi, Jean C.  

Oliver-Smith, Anthony  

Paine, Robert  

Paolisso, Michael, and Erve Chambers  

Paolisso, Michael, and R. Shawn Maloney  

Pei, Xiaolin  

Peterson, J.  


Ren, Hongwei, and Gong Li 2002 Xiangzhen Qiye Huanjing Wurande Jingji Fenxi [An Economic Analysis of the Environmental Pollution of Township and Village Enterprises]. Zhongguo Xiangzhen Qiye [China Township and Village Enterprises] 1(81):34.


Tilt, Bryan 2004 Risk, Pollution and Sustainability in Rural Sichuan, China, Doctoral Dissertation, University of Washington.


