Industrial Pollution and Environmental Health in Rural China: Risk, Uncertainty and Individualization*

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Abstract

After more than three decades of extremely rapid industrial growth, China faces an environmental public health crisis. In this article, I examine pollution in the rural industrial sector and its implications for community health. Drawing on recent ethnographic research in an industrial township in rural Sichuan, including interviews with government officials, environmental regulators, industrial workers and local residents, I explore how community members understand the linkages between air and water pollution from nearby factories and their health and well-being. The article has two main goals. The first is to examine the various ways in which uncertainty about pollution sources, about the severity of pollution levels and about the links between pollution and human health shapes villagers' experiences of pollution on a day-to-day basis. The second goal is to examine the rising trend of "individualization" taking place in China today and explore how this process is related to people's experiences of toxic exposure. I consider the implications of this trend for how social scientists should approach the study of environmental illness in contemporary China.

Keywords: industrial pollution; environmental health; scientific uncertainty; individualization; Sichuan; China

China's meteoric rise on the global economic stage has garnered the attention of media outlets around the world. So, too, have the epic environmental consequences of this rise. News headlines such as "Pollution turns China village into cancer cluster" and "Choking on growth" have become routine in recent times. Most of these stories cite a litany of dismal statistics about the percentage of China's rivers receiving poor water quality assessments or the hundreds of thousands of people who die of respiratory illnesses related to air pollution each year.

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It is one thing to state the figures, but quite another to ask how people experience environmental illnesses on an everyday basis. Studying the intersection of development, environment and health in contemporary China is an undertaking that is both critically important and somewhat discouraging. Over the past decade of research on this topic, I have been involved in various ethnographic projects to document people's exposure to, perceptions of, and coping strategies related to, air and water pollution from industrial sources. I have taken note of an array of sensory details that people have to deal with on a daily basis: the haze in the air that makes people choke and cough; factory workers clad in soot-covered clothing; the deposition of grey particulate matter covering the ground; the serpentine rows of coal trucks coming and going between factories; the black, lifeless stream that became useless for irrigating crops.

How do people in rural China perceive the environmental health risks they face, and how do they cope with the consequences of such risks? I have previously explored the divergent narratives of farmers and industrial workers in a township in southern Sichuan province that is undergoing dramatic social, economic and environmental changes.[1] In my analysis, many industrial workers downplayed the risks they faced from pollution related to small-scale factories primarily because of their financial dependence on the factories and their perennial fears that, given the increased enforcement of pollution standards all over China, the district environmental protection bureau would close the factories for emissions violations. By contrast, farmers and other non-industrial workers in the township were aware of, and concerned about, the ecological and health risks from local factories.

This article focuses in particular on local understandings of industrial pollution and explores the various aspects of uncertainty embedded in villagers' narratives about environmental health. The sociologist Phil Brown has defined environmental health problems as "health effects caused by toxic substances in people's immediate or proximate surroundings (soil, air, water, food, household goods)."[2] Environmental health problems are often characterized by ambiguity and uncertainty as many environmental health hazards are difficult to detect and because it remains extremely difficult to demonstrate a causal link between environmental contamination and human health outcomes.

This article has two objectives. The first is to examine the various ways in which uncertainty about pollution sources, about the severity of pollution levels, and about the links between pollution and human health, shapes villagers' experiences of pollution on a day-to-day basis. Who knows what about pollution, and how do they know it? What forms of knowledge and experiences frame these perceptions?[3] I use ongoing ethnographic research in southern Sichuan to provide a

1 Tilt 2010.
2 Brown 2007, 1.
3 Leach and Scoones 2007.

window into the knowledge, perceptions and actions of local people regarding pollution and environmental health problems in the face of uncertainty.

My other objective is to examine the rising trend of "individualization" and to explore how this trend relates to people's experiences of toxic exposure. Individualization is a circumstance in which the institutions of modern society – the market economy, the wage labour system, land tenure, civil rights, access to complex medical and legal systems – are increasingly set up for the individual rather than for the group. This trend, indicative of modernity, has far-reaching effects for the movement of people and ideas across spaces and borders, for the transformation of long-standing systems of economic class and social status, and for the previously fundamental building blocks of society such as the family and the place-based community.[4] It also profoundly shapes how people perceive, experience and cope with the risks associated with industrial pollution.

Background and Study Site

The site of this research is Futian township 福田镇, where I have conducted several periods of ethnographic research since 2001 (see Figure 1). Futian is located on the western edge of Panzhihua municipality 攀枝花市, on the foothills of the Qinghai-Tibet Plateau in southern Sichuan. A small stream running through the township feeds into the Jinsha river 金沙江 as it flows from its source on the plateau towards Panzhihua, at which point it becomes known as the Changjiang 长江 (Yangtze). The township is situated in a valley that ranges in elevation from 1,000 metres along the streamside, where household land plots consist of terraced rice paddies, to more than 1,600 metres, where the ground is steep, dry and covered in scrub brush, Yunnan pine, and eucalyptus. It is in this south-western region – on the ethnic, cultural and economic margins of the nation – where China's developmental dilemmas can be seen most clearly. Villagers in Futian have drastically improved their standards of living over the past several decades, but they must now cope with the negative environmental and health consequences of unfettered industrial development.

Like most rural communities in China, Futian has recently undergone a profound transformation in its political economy, particularly in the rural industrial sector. Over the past several decades, the central government has facilitated the concentration of wealth and the privatization of collective assets by espousing policies that have allowed for greater private ownership of industry. These policies have moved cautiously but steadily away from the Maoist ethic of the means of production being owned by the people (*quanmin suoyou zhi* 全民所有制) and towards a restructuring of industry called "grasp the large and let go of the small" (*zhua da fang xiao* 抓大放小). In Futian, what villagers called the "industrial compound" (*gongye yuanqu* 工业园区) was situated at

4 Beck and Beck-Gernsheim 2002. For an application of the individualization thesis to contemporary Chinese society, see Yan 2009.

Figure 1: **Map of Study Area**

the north-western edge of the township. A patchwork of low-tech, dilapidated factories, including a zinc smelter, a coking plant and a coal-washing plant, the compound was home to about a hundred industrial labourers and their families, many of whom had migrated hundreds of kilometres to live and work in Futian. These factories began in the 1980s as collectively-owned township and village enterprises; however, in line with central economic policies of privatizing the means of production, all three of these factories were purchased by investors from outside the region in the late 1990s or early 2000s.

Air and water pollution were constant facts of life in Futian. On a typical day, plumes of black smoke could be seen rising above the industrial compound. The air had an acrid, metallic smell, and the water in the stream often ran black with effluents from the coal-washing plant. Piles of coal and ore slag lay strewn about the factory compound, which also housed many of the workers and their families. Children played on the piles of slag, and many poor households in the village scavenged bits of coal to burn for heating and cooking in their homes. In short, exposure to environmental health hazards was woven into the fabric of everyday life for most villagers.

Uncertain Sources and Severity

Across China, the annual death toll from air pollution, primarily from industrial and household emissions, is estimated to be 300,000 people.[5] These macro-level figures on pollution emissions are easy to find in databases such as the China Statistical Yearbook and the China Environmental Statistical Yearbook.[6] However, the reliability of these data is suspect. Moreover, when researchers attempt to drill down beyond nationally aggregated figures, information about local environmental quality in rural areas is extremely hard to come by. Although the rural industrial sector is a major contributor to the national pollution burden, air- and water-quality monitoring in the countryside is infrequent, sporadic and incomplete. To complicate matters, what little environmental quality data exist tend to be aggregated into county or provincial reports, which makes it difficult to get any resolution at the township or village levels. Given the ubiquity of point-source air pollution in highly populous Sichuan province, it is often difficult for local residents to pinpoint exactly which emissions are of greatest concern.

As part of a study in 2002 and 2003, I conducted a small-scale air sampling programme, with a focus on PM10 over a five month period. Particulate matter (PM) includes any substance other than water in the atmosphere with a size greater than molecular dimensions. The sizes of particles within the PM mixture may vary greatly, from 10^{-4} to 10^{4} micrometres. Fine particulate matter, which is smaller than ten micrometres in diameter (PM10), can be inhaled deeply into the lungs and absorbed into the blood stream. It is linked to increased rates of respiratory diseases, cardiopulmonary problems and mortality.[7] It is a significant, if somewhat rough, proxy for overall air pollution levels.[8]

The results of the air quality monitoring are shown in Table 1. The average PM10 concentration for the sampling periods was 205.9 micrograms per cubic metre of ambient air, two times higher than the Chinese Ministry of Environmental Protection's (MEP) annual standard for class II areas, and roughly ten times higher than World Health Organization guidelines.[9] Based on this data, it can be expected that township residents are susceptible to the kinds of health risks often associated with chronic exposure to PM10, including cardiovascular and pulmonary diseases. In addition, the observed levels of PM10 are likely to have a severe effect on vegetation, including crops, and on soil chemistry.

5 Economy 2004, 19.
6 Managi and Kaneko 2009.
7 Peng et al. 2002.
8 In 2012, the Ministry of Environmental Protection (MEP) initiated a national programme for monitoring PM2.5, ultra-fine particles that are more closely linked to adverse health outcomes. However, at the time of this study, there was no national standard for PM2.5.
9 In China, the MEP sets primary, secondary and tertiary air-quality standards, based on geographic zoning. The MEP standard listed is for class II areas, which include residential urban and rural areas, such as the study area. During the study period, the State Environmental Protection Administration (SEPA), under the direction of the State Council, was the key regulatory agency. As of 2008, however, this agency was upgraded to full ministerial status as the Ministry of Environmental Protection.

Table 1: **Observed Concentration of PM_{10} in the Study Area**

Sample Period	PM_{10} Concentration ($\mu g/m^3$)	Factory Activity
Sample Period 1 (22–29 Dec 2002)	247.6[a]	Only coking plant operating
Sample Period 2 (15–23 Jan 2003)	356.4	All factories closed
Sample Period 3 (1–8 Mar 2003)	114.7	All factories closed
Sample Period 4 (20–24 Apr 2003)	104.7[a]	Only zinc smelter operating
Average of All Sample Periods in Study Area	205.9	
SEPA / MEP Annual Standard	100	
WHO Annual Guideline	20	

Note:
[a]Indicates that the difference between averages is statistically significant (independent-samples t-test, $p < .01$).

Establishing annual standards for pollutants means that a given agency has determined, based on varying degrees of scientific evidence, how much of a given pollutant is "safe" to breathe on an ongoing basis. As Table 1 indicates, World Health Organization guidelines are considerably more stringent than MEP standards; they are based on the lowest levels at which total mortality and mortality specifically linked to cardiopulmonary problems and lung cancer have been shown to increase in response to long-term exposure to particulate matter.

But is it possible, with any level of precision, to assign blame to the local factories for the elevated levels of ambient PM10? The answer to this question turns out to be exceedingly complicated. As Table 1 shows, there was no simple correlation between factory activity and observed pollution levels. The highest concentrations of PM10 were recorded during the second sample period in early 2003; at this point, all of the township factories had been ordered to close by the district environmental protection bureau (EPB).[10] The second-highest concentrations were recorded in late 2002, when only the coking plant was in operation. The two periods during which any factory activity took place differed markedly in their ambient concentrations of PM10. Sample period 1, during which the coking plant was the only factory in operation, showed a concentration of 247.6 micrograms per cubic metre, while sample period 4, during which the zinc smelter was the only factory in operation, had a concentration level of 104.7 micrograms per cubic metre. An independent samples t-test revealed that the difference in concentration between these two periods was statistically significant at $p < .01$.

This reflects, in part, the importance of environmental-mitigation technology. Both the zinc smelter and the coking plant, under orders from the district EPB,

10 Tilt 2010; Tilt 2007.

had installed smokestacks in order to disperse pollutants higher into the air and mitigate potential health effects for workers. However, the coking plant's smokestack had been badly damaged by an explosion in 2001 and remained inoperable afterward; coking-plant emissions were vented from open coking ovens directly into the working environment where factory labourers went about their work with no eye protection, respirators or other protection equipment. The difference between these two sampling periods can thus be partially explained by the differences in the basic environmental mitigation technologies between the two factories.

However, the story does not end there. In order to determine with greater precision the health risks associated with the observed levels of pollution, researchers would have to know something about the composition of the particulate matter. It is extremely difficult for researchers to isolate the effects of any one pollutant within the ambient air mixture, since there are often interactive and synergistic effects between pollutants. One path of inquiry is to analyse the air samples for polycyclic aromatic hydrocarbons (PAHs), a group of chemical compounds that are associated with coal combustion, many of which are known carcinogens. The air samples collected in Futian were analysed by an organic chemistry laboratory that specializes in atmospheric PAHs. As it happened, another scientist was collecting air samples in the city of Guangzhou at roughly the same time, and the laboratory examined both batches of samples. The laboratory technicians were surprised to learn that the rural samples from Futian showed considerably higher levels of PAHs than the urban samples, suggesting greater health risks from air pollution in this small township of 4,000 residents than in the megalopolis of Guangzhou. However, it remains difficult to determine the exact sources of the elevated levels of PAHs. The laboratory technicians found high levels of levoglucosan, a known biomarker for biomass burning, in the air samples from Futian.[11] This finding correlates with my field notes, taken during the air sampling periods, which note the presence of forest fires in the region as well as sporadic agricultural burning by local farmers. In other words, we cannot cleanly divide the risks from industrial pollution from the risks posed by other forms of exposure to particulate matter.

This speaks to my own foray as a researcher into the knowledge politics of pollution exposure. Interviews with scientists and regulatory officials within the local EPB revealed that extremely limited air and water quality monitoring had taken place over the years. In the absence of systematic data, I viewed my own air-quality monitoring sessions as a step towards answering the fundamental question: to what level of air pollution are people being exposed? These rudimentary scientific results can be easily summarized in a table or a chart and shown to people who ask, during public presentations, a common set of questions: how bad is the air quality? What are the likely health effects of the kinds of exposures

11 Murray et al. 2007.

that people face? In this sense, scientific air quality monitoring can be seen as a step towards answering these basic questions and capturing the "objective reality" of environmental health risks.

But, in another sense, these data obscure more than they enlighten. From the perspective of average villagers, the everyday sensory details of pollution were easily detected: residents often complained that soot and coal smoke soiled their clean laundry before they had a chance to bring it in off the drying line, and township cadres could be seen wiping a layer of soot from the courtyard table tops where they enjoyed a lunch break each afternoon. However, it was not so easy for villagers to pinpoint the pollution sources of greatest concern. The township is situated in a valley that is surrounded by industrial activity: Daxing 大兴 township, to the east, was home to a cement factory and a coal-washing facility; Shilongba 石龙坝, to the west, had a nonferrous-metals smelting facility, a petroleum refinery, as well as a coal mine and coal-washing plant; and beyond the immediate vicinity, 50 kilometres to the east, lay Panzhihua Iron and Steel Corporation, a state-owned behemoth with a record of serious air pollution. Particulate matter from these sources cast a constant haze over the valley. Even when local factories within the township were not operating, the horizon was dotted with smokestacks and billowing plumes of smoke.

As a consequence of this uncertainty, many villagers expressed the opinion that local government leaders had an obligation to inform them of their risk of exposure to pollution, but they were sceptical of local cadres and county-level officials, who played dual and conflicting roles as development promoters and public health protectors. As one villager explained:

> The government is supposed to tell you when pollution is bad [so you can take steps to avoid exposure]. The small-scale factories have grown so fast, with very little regulation. But they [the local government] don't care about the interests of the common people (*laobaixing* 老百姓). All they care about is more investment and more money.[12]

Scholars who study the intersection of environment, health and development in contemporary China are making considerable efforts to understand what types of information are available to the public on environmental health risks. Zhang Lei, for example, undertook a study of information disclosures (*xinxi gongkai* 信息公开) from EPBs to their constituents about pollution incidents,[13] and Tilt and Xiao have examined a range of media reports on the 2005 benzene spill in the Songhua river 松花江, including state-sponsored media outlets such as Xinhua News and China Central Television.[14] However, this work is unfortunately still extremely modest in scope, which leaves us with an incomplete understanding of how the Chinese public receives information about pollution-related health risks, and how this information shapes their perceptions and attitudes. As Anthony Giddens has noted, "[i]n circumstances of uncertainty and multiple

12 Interview, 11 January 2003.
13 Zhang 2010.
14 Tilt and Xiao 2010.

choice, the notions of trust and risk have particular application."[15] But the question that arises time and again in this case, where industrial entrepreneurs and local cadres alike push for increased development, is: trust in whom?

Uncertain Causation

In addition to uncertainty about the sources and severity of pollution, villagers faced considerable uncertainty about the causal links between pollution exposure and adverse health outcomes. This is a common concern for researchers, too, who struggle to understand causation in the midst of conflicting evidence. One basic challenge is how to deal with different aetiologies and lexicons in the lay understanding of environmental health problems. As Lora-Wainwright found in north-east Sichuan, stomach and oesophageal cancers can be caused by chronic exposure to farm chemicals; but for villagers, these cancers are often conflated with myriad folk maladies such as "spitting illness" and "vomiting illness."[16]

Furthermore, people may feel ambivalent about pollution sources that play an important role in the political economy; they may blame farm chemicals for cancer rates, for example, but they also rely heavily on chemical inputs to produce market-quality vegetables and earn a cash income.[17] In Futian, most of the factory workers were migrants from hundreds of kilometres away; disconnected from their home towns and extended family networks, and highly dependent upon wage labour in industry. It is no surprise that they often overlooked the health risks involved in their jobs. One worker in the zinc smelter, who lived with his wife and young son in a soot-covered house made of scavenged building materials just a few steps away from the smelter, insisted that "the pollution has no effect on people's health. I've been doing this kind of work for years with no health problems." Industrial workers earned cash incomes that were typically many times higher than local farmers. Moreover, cut off from their extended family and social networks, they depended on this cash income to buffer them against economic risks and job insecurity. As a consequence, they experienced what Brown, Kroll-Smith and Gunter might call "ontological insecurity,"[18] that is to say, a state of uncertainty about the future and about how to weigh up the various risks they faced in their daily lives.

Risk assessment methodology, which is the established process by which scientists seek to understand environmental health problems, typically consists of four stages: hazard identification; dose-response analysis; exposure assessment; and risk characterization.[19] Many of the recent studies on environmental struggles have noted the prominent, if polemical, role of science in public debates about

15 Giddens 1991, 3.
16 Lora-Wainwright 2010.
17 Lora-Wainwright 2009.
18 Brown, Kroll-Smith and Gunter 2000; Giddens 1991.
19 Checker 2007; Tesh 2000.

causation in environmental health. Such works, grounded in a critical science studies approach, rightly point out the fallacy of looking to science to provide rational and indisputable data to override the "irrational" fears of the lay public.[20] These arguments encourage us to see science not as an objective compilation of data and facts, but rather as "science-in-the-making," a body of knowledge that reflects the situated perspectives, values and agendas of the individuals and institutions that produce it.[21]

But how can we seek to understand the causal links, however tenuous, between pollution exposure and illness? Since it is often impossible to observe directly a causal relationship between event A and event B, researchers are forced to make inferences. In the field of environmental health, researchers look for probabilistic causation by asking a simple question: does the presence of A increase the probability of B occurring? Sir Austin Bradford Hill, a British scientist, is credited with breakthroughs that led to the randomized controlled trial in medical health studies and to foundational research showing a link between smoking and cancer in the 1960s.[22] The "Bradford-Hill Criteria" have since become the centrepiece of epidemiological studies on environmental illnesses. These criteria essentially measure the relationship between an explanatory variable and an outcome variable by examining the relationship's strength, consistency, specificity, temporality, biological gradient (dose-response curve), plausibility, coherence, experimental evidence and analogy. Using these inferential methods, researchers can gain an understanding of how a complex set of variables relate to one another, and this understanding is usually conveyed as a series of odds ratios. As Giddens has noted, "[w]e often think of risks in terms of parameters of probability that can be precisely assessed – rather in the manner in which insurance companies make their calculations."[23] Moreover, scientists by necessity conduct epidemiological research at the level of large populations in order to overcome all kinds of sampling errors in the data. As a result, individual illnesses are considered anecdotal and idiosyncratic, while the "real" trends are observable only across comparatively long stretches of time and in populations sufficiently large to make statistical inference possible.

This kind of numerical, macro-level analysis is crucial in order to detect population-level patterns with statistical significance. Yet, there is also a clinical detachment in this approach that masks the reality of environmental illness, since the experience of such illness is always profoundly personal. In fact, in most instances, causation can never be fully determined. To illustrate this point, I will briefly recount the story of a family who lived in the central part of the study township, near the industrial compound. I had known this young couple, who were in their late 20s, since shortly after they were married in 2001. They

20 Brown 2007; Leach and Scoons 2007; Fischer 2003; Jasanoff 2004.
21 Latour 1987.
22 Hill 1965.
23 Giddens 1991, 32.

operated a small restaurant where, during a period of field research in 2006, they introduced me to their two-year-old daughter. My son was the same age at that time and I enjoyed chatting and playing with the girl. I noticed right away that both of her feet were malformed and that she moved around by crawling on scarred, calloused knees. According to her parents, she also had difficulty speaking and performing tasks that other children her age could do. Although it is impossible to link the girl's condition to exposure to toxins with any scientific validity, the couple was convinced that exposure to pollution – including arsenic, lead, mercury and other by-products of metal smelting – during the mother's pregnancy had played a role.[24] During the course of my field research, I encountered echoes of this kind of "anecdotal" evidence everywhere: a teenage girl with diminished cognitive abilities and slurred speech; a new water distribution system that brought piped water into the homes of several villages, but also brought the fear of arsenic and mercury contamination, since the well and pump were located just downhill from the factory compound.

In the face of such uncertainty and anxiety among villagers, what do experts – scientists and environmental regulatory officials – understand about local environmental health threats? In the course of my research, I interviewed a number of scientists in the district EPB, the agency with jurisdiction over Futian's factories. Most of them were capable and dedicated professionals, but they generally conceded that they had conducted few monitoring activities in Futian over the years; with limited manpower and technology, and with more than 120 rural factories under their charge, officials often felt overwhelmed by the scale of their responsibilities. As a result, little systematic information about pollution was available to local residents; yet many people possessed a sophisticated knowledge of environmental health threats from personal experience. People discussed with me the deleterious effects of pollution on individual, family and community health, although there was little consensus on the precise nature or severity of the health threat. I was often surprised at the sophisticated knowledge many villagers possessed regarding the health effects of toxic substances. Although there was no systematic environmental education in the township, many villagers expressed concern about the possibility of soil contamination from arsenic and mercury from metal smelting; about the accumulation of such toxins in the local food chain; and about chronic high-level exposure to particulate matter in the air. In general, these were not acute exposures that resulted in immediate health effects, although some factory workers were occasionally treated in the township sanitation clinic for acute smoke inhalation. On the contrary, these cases were more akin to what Petryna has called "slow disasters"[25] – events that unfold over a sufficiently long time horizon and in tandem with such an array of other risks that it makes any link between exposure and illness extremely tenuous. Such uncertainty can, over time, contribute to a sense of fatalism. One

24 Interview, 4 July 2006.
25 Petryna 2002.

of the questions on my standardized interview protocol asked residents whether they routinely took steps to lessen their exposure to pollution. One villager responded in a manner that summed up the sentiments of many: "there's nothing that common people can do. We just take what comes."

Although many villagers shared this sense of fatalism, others took a variety of steps to combat local air and water pollution. A coalition of farmers, for example, contacted a news crew at the Sichuan Television Station, who travelled to the township to film an exposé on local factories. This media scrutiny had a powerful effect on officials in the EPB, who acted swiftly to close down factories that violated emissions standards. Recent scholarship has suggested that while contemporary China is experiencing many disparate acts of environmentalism, the country lacks a coherent environmental movement.[26] However, official government statistics reveal that environmental protests number in the thousands each year;[27] such mobilization undoubtedly exerts pressure on environmental regulators and policy makers.

Environmental Health and the Individualization of Chinese Society

The German sociologists Ulrich Beck and Elizabeth Beck-Gernsheim have undertaken an analysis of what they call the "individualization" of modern society.[28] They are referring not simply to the idea, central to liberal economic theory, of the rational individual seeking to maximize his utility in the free market, but rather to a form of "institutionalized individualism." Institutionalized individualism is a circumstance in which the institutions of modern society are set up for the individual rather than for the group. This trend, indicative of modernity, has far-reaching consequences for the movement of people and ideas across space, for the transformation of long-standing systems of economic class and social status, and for the previously fundamental building blocks of society such as the family and the place-based community.

In the realm of environmental health, there are two important implications of "individualization." First, people are increasingly exposed to a host of hazards that are new, poorly understood, and sometimes undetectable to the senses. The modern environment is replete with invisible hazards – nuclear radiation, groundwater contamination, food- and water-borne illnesses – which make it difficult for individuals to assess the risks associated with taking a certain job, or living in a certain area, adequately.

Second, because of this individualization process, people must often face these risks without many of the safety nets previously supplied by the state or the community. Beck and Beck-Gernsheim have given this phenomenon various names, including a "do-it-yourself biography," a "tight-rope biography," and a state of

26 Stalley and Yang 2006.
27 French 2005.
28 Beck and Beck-Gernsheim 2002.

"permanent endangerment." This is a story that resonates with people around the world who struggle to keep pace with the changes of modernity, but it is one with particular salience for contemporary China where the past several decades of economic reform have unravelled many of the previously foundational social institutions such as the family, the rural collective and the work unit. In a recent book, entitled *The Individualization of Chinese Society*, the anthropologist Yan Yunxiang builds upon the "individualization" thesis by reminding scholars of China that many of the reforms of the 1980s, for example, were seen not only as "reform and opening up" (*gaige kaifang* 改革开放), but also as "untying" (*songbang* 松绑): untying the villager from the collective, untying the economy from the central plan and untying the individual from his natal community. Ironically, of course, the Communist Party-state has engineered and directed the policy changes that allow for such transformations. As Yan notes:

> Unlike in the West where the market functioned as the primary mover behind the rise of the individual and the transformation of the private sphere into a more intimate domain, in China it has been the party-state that created such changes by enforcing a number of top-down institutional changes to build the new socialist person and society.[29]

In my interviews with the residents of Futian, I often heard the refrain "you have to rely on yourself" (*xuyao kao ziji* 需要靠自己). I would like to explore this theme briefly for both factory labourers and ordinary farmers in the township. Factory labourers in Futian, as noted above, tended to overlook or minimize the environmental health risks they faced and the process of "individualization" was key to this oversight. Once the individual is a meaningful unit, new possibilities of movement, employment and self-fulfilment open up. How else can the rise of a consumer class, the freedom to seek different jobs, the decline of filial obligations to elders, the trend towards nuclear family residence patterns, and other important trends now examined by social scientists in China be understood? Yan reports that "as a field ethnographer, I have long noted the rapid changes in mentality and behavior among Chinese individuals who increasingly have been demanding the rights of self-development, happiness and security against the backdrop of age-old moral teachings of collective well-being."[30]

In Futian, the factory owners and workers were only tenuously embedded in the social fabric of the community: they were migrants from other towns or provinces without local residence permits; they did not participate in township or village meetings; and their only contact with local villagers consisted of a foray every few days to the market to buy food. In this regard, they were atomized individuals who could pollute with relative impunity because they stood largely outside the moral economy of the township. At the same time, these factory bosses and workers experienced considerable financial vulnerability. Mr Zhang, the owner of the zinc smelter, and many of the workers in his factory frequently described themselves as being capable of "eating bitterness" (*chi ku* 吃苦), by

29 Yan 2009.
30 Ibid.

which they meant that they were willing to travel far from home, endure harsh living conditions and even expose themselves to toxic contamination if it meant creating economic opportunities for themselves and their families. "All I'm trying to do," remarked Mr Zhang, "is to pave a road for my children to walk on (*pu yi tiao lu wei haizi zou* 铺一条路为孩子走)."

Mr Zhang's investment in the zinc smelter constituted a considerable financial risk. Along with his wife and adult son, he had invested his retirement savings from many years working as a secondary school teacher, plus money from personal bank loans (approximately 450,000 yuan in total), in the purchase, enlargement and improvement of the smelter, which had been under the collective ownership of the township government since its construction in the 1980s. Mr Zhang had been attracted to the area by a series of brochures published by the district government, which offered one-year tax holidays and three-year periods of reduced taxes for new investors. However, he and the other industrial entrepreneurs faced a rapidly changing regulatory environment, including increased scrutiny and monitoring by the EPB.[31] Small-scale rural factories have been under increased regulation since the late 1990s, rightly targeted by the environmental bureaucracy as serious sources of air and water contamination. Ultimately, the EPB closed down his operation after the provincial television station broadcast a programme that showed blatant emissions violations in the township. This threatened Mr Zhang and his family with financial ruin. He told me, with dismay, "Our investment is great, and so is our risk (*touzi da, weixian ye da* 投资大, 危险也大)."[32]

Mr Li, a farmer in the township, provides a similar narrative of the atomized individual, but from the perspective of the farming segment of the township. A 48-year-old farmer, Mr Li lived with his wife and two children on an extremely small parcel of land consisting of only three *fen* 分, an area equal to three-tenths of a *mu* 亩, or less than one-twentieth of an acre. He grew primarily rice and sweet potatoes, the latter of which he sold in the local market, earning him a cash income of approximately 200 yuan per month, a sum that was spent almost entirely to support the educational expenses of his eldest son. He complained that the effluents from the coal-washing plant in Futian and in the neighbouring township of Daxing ruined his livelihood: "The whole river turns black. We don't want to irrigate our crops with it, and the animals can't drink from it."[33] With such a narrow margin of economic viability, born of a high degree of dependence on an agro-ecosystem that was under assault by industrial pollution, Mr Li could not afford to lose even a portion of his crop.

His vulnerability stemmed directly from the process of individualization. When the household responsibility system was instituted in the early 1980s, his family had fared poorly, receiving a small and ecologically marginal land parcel. Like

31 Tilt 2007.
32 Interview, 15 February 2003.
33 Interview, 9 December 2002.

all farmers in rural China, he held usufruct rights to his land but no transferrable title. This ambiguous form of tenure, termed "institutional indeterminacy" by Peter Ho,[34] allows the agro-economy to function at its current stage of economic reform, somewhere between state-controlled and market-oriented. The continuing liberalization of the farm economy means that farmers must participate in the market economy in order to provide a decent standard of living for their families, send their children to school and provide themselves with other social benefits. This process of "untying" from the rural collective of the socialist period meant that farmers were more exposed to environmental and economic risks. As a way of managing these risks, farmers were encouraged to boost their cash incomes through the production of commodity crops; in Futian, the output of fruits such as melons and mangos grew ten-fold between 2001 and 2005.[35] Many village households chose to forego planting subsistence crops and instead participated in the government-sponsored reforestation campaign (*tuigeng huanlin* 退耕还林), planting little or no rice and gambling that the market for fruit crops would continue to grow. In turn, they planted their fields entirely with commodity crops for sale in the regional market, using cash profits to purchase food for household consumption.

Such an "untying" from the collective agro-economy left many farming households feeling economically well-off but vulnerable to a new range of risks. They had made a calculated decision to forego growing rice in favour of cash crops; they were responsible for evaluating market demand and distributing these crops; and they had to pay cash for medical treatment or educational expenses for family members, when the need arose. Meanwhile, they experienced the daily possibility of pollution contamination and the daily reality of reduced or damaged crop yields from industrial pollution.

Ironically, individualization can be experienced by social entities beyond the individual. When asked about the fiscal consequences of factory closures in Futian, the vice-mayor answered that the local government would now have to be more self-sufficient. In late 2002, the township government held its semi-annual people's congress (*renmin daibiao dahui* 人民代表大会), in which representatives from the four villages in the township gathered to discuss the year's progress and outline future development goals. The Communist Party secretary gave an impassioned speech about self-reliance:

> Look at the economy of China's eastern regions such as Guangdong and Shanghai. You have to say that there's a big difference between them and us in terms of development. We've only just solved the warmth and fullness problem (*wenbao wenti* 温饱问题). We have a long way to go, and we have to depend on ourselves to solve our economic problems. We can't rely on the national government, or even the district government.[36]

34 Ho 2001.

35 For an examination of the risks and benefits of commodity crop production under the household responsibility system, see Tilt 2008.

36 Speech given by Communist Party secretary, Futian, 23 December 2002.

These are forms of uncertainty that stem from China's rapidly changing political economy, as local cadres must help their governmental units navigate economic reform and uneven development, but they are also intricately connected with environmental health concerns and uncertainties.

Conclusions

Futian's zinc smelter, coking plant and coal-washing plant were all ordered to close by the district EPB in early 2003 for air-quality violations. The coking plant and coal-washing plant remain closed, while the zinc smelter has moved its operations across the provincial border into Yunnan and continues to operate. Air and water quality in the township have noticeably improved, although little or no scientific monitoring takes place there.

This article has described how villagers' everyday experiences of pollution are infused with uncertainty about the sources and severity of pollution and about the potential causal links between pollution levels and environmental illness. A fundamental piece of this analysis hinges on how people experience environmental illness and, consequently, how we as social scientists should seek to understand it. As Sheila Jasanoff has argued in the context of global environmental issues, such as climate change, which are characterized by high degrees of uncertainty, "Scientific facts arise out of detached observation whereas meaning emerges from embedded experience."[37] While it is important to understand the scientific facts involved in environmental health problems – observed levels of air pollution, for example, and the links illness trends at the population level – it is also crucial to understand how environmental illness is embedded in the knowledge, moralities and lived experiences of people:

> Representations of the natural world attain stability and persuasive power, in my view, not through forcible detachment from context, but through constant, mutually sustaining interactions between our senses of the *is* and the *ought*: of how things are and how they should be.[38]

A logical next step in this analysis is to ask how these forms of knowledge frame public engagements or political mobilizations.[39] As the Chinese Communist Party has liberalized the nation's economy over the past three decades, it has also gradually reduced the scope of its administrative power, increasing the space within which non-governmental and civil society organizations may operate.[40] This is especially important in the environmental arena, where a new Environmental Impact Assessment Law, promulgated in 2002, mandates public hearings for major development projects. Scholars now point out that environmental law suits are increasingly common, as are environmental NGOs which number in the hundreds.[41] Yet, little is currently known about how these

37 Jasanoff 2010.
38 Ibid., 236.
39 Leach and Scoones 2007.
40 O'Brien and Li 2007.
41 Yang 2005.

organizations actually participate in decision-making processes, and with what outcomes. As I have briefly described above, villagers in Futian forced environmental regulators to enforce pollution standards more strictly by applying pressure through the television media.

What about the process of "individualization" in Chinese society? How does it change the way in which social scientists must understand the intersection of development, environment and health? For one thing, it will shift our analytical and methodological focus from the social collective to the individual. As Beck and Beck-Gernsheim note, the "prevailing sociology has usually made things easy for itself by cutting off the questions that arise here with the strict injunction, backed up by thick volumes, that individuals can only be or become individuals within society."[42] In the social sciences, this idea is at least as old as Durkheim, who envisioned society as an entity that existed sui generis and that exerted considerable control over the lives and possibilities of the individuals living within it. However, people's understandings of environmental health risks, and their tactics for coping with these risks, are born of the fact that they have been "individualized." In many ways, they face environmental risks as atomized individuals and families, despite the ironic fact that the Party-state itself has presided over this transformation. As the anthropologist Yan Yunxiang notes,

> The individual has emerged as a key unit in both discourse and action in everyday life, but consciousness of individual rights is based on a Chinese understanding of rights as earned privileges through individual efforts. Such an understanding of rights and the limitations to political freedom in public life are mutually reinforcing; consequently, the assertion of individual rights is primarily achieved through public appeals to the state.[43]

In the end, understanding people's perceptions and actions in relation to environmental health will require analysis at multiple scales, from the individual to the collective. In Futian, villagers' concerns about their health and livelihoods motivated them to get involved in collective acts of environmental advocacy, including petitioning the EPB and alerting the provincial media of the infractions of local factories.[44] Throughout rural China, popular protests on a range of issues from pollution to land annexation tend to be most successful when people work together towards shared goals and when they invoke the policies and rhetoric of the state itself.[45] In this sense, the process of individualization in Chinese society has its own unique profile and must be understood on its own terms.[46] As scholars of contemporary China who seek to understand the contours of environmental health problems, we have the task of formulating a methodological approach, informed by various disciplines, that recognizes the collective exposures and responses of communities while also highlighting individual variation and lived experience.

42 Beck and Beck-Gernsheim 2002, 12.
43 Yan 2009, 13.
44 Tilt 2010.
45 O'Brien and Li 2007; Cai 2010.
46 Beck and Beck-Gernsheim 2002, xiii.

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