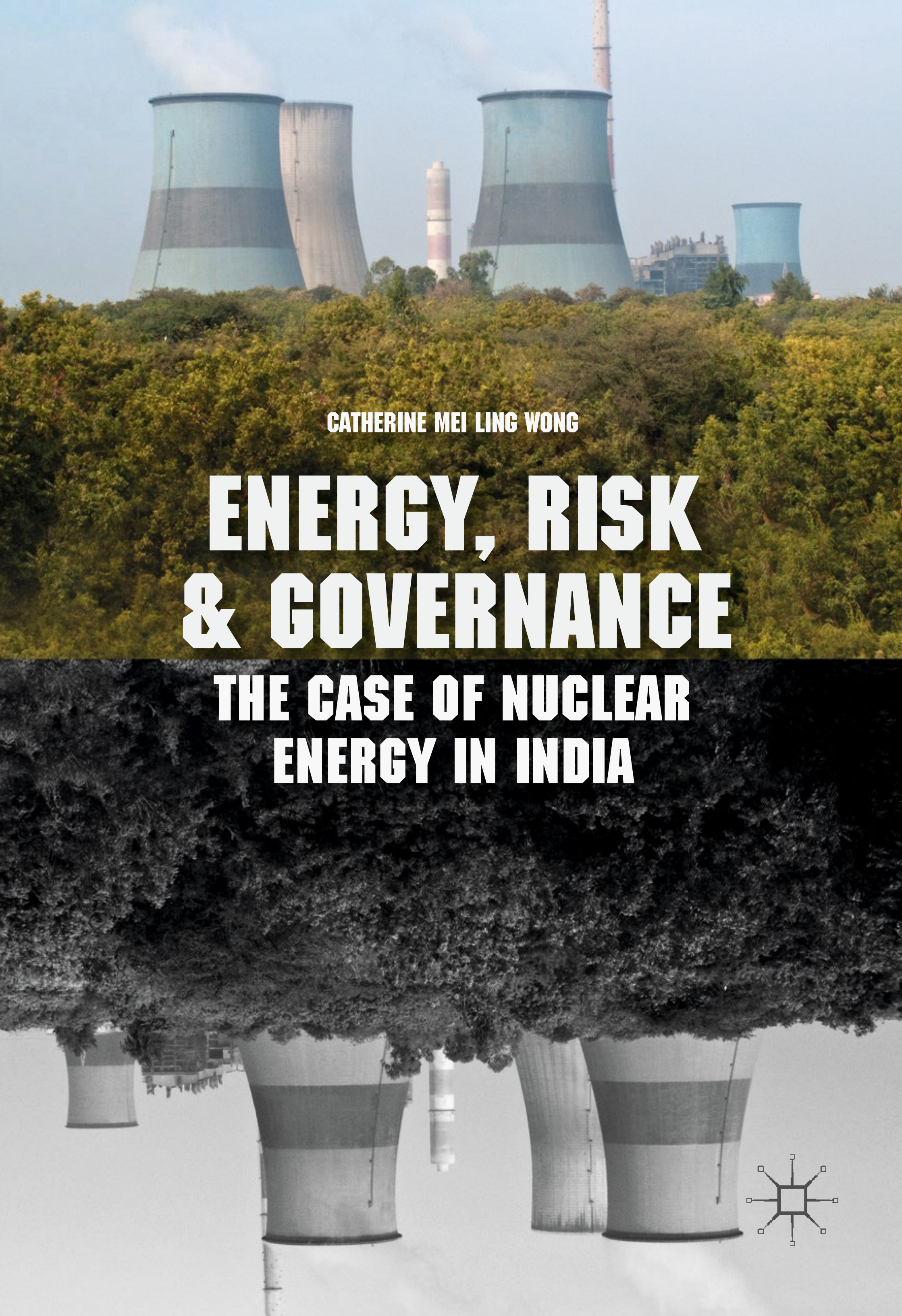

CATHERINE MEI LING WONG

ENERGY, RISK & GOVERNANCE

THE CASE OF NUCLEAR ENERGY IN INDIA

Energy, Risk and Governance

Catherine Mei Ling Wong

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Contents

List of Abbreviations

AEC	Atomic Energy Commission
AERB	Atomic Energy Regulatory Board
ANT	Actor–Network Theory
BARC	Bhabha Atomic Research Centre
BHAVINI	Bharatiya Nabhikiya Vidyut Nigam Limited
BOAS	Bulletin of Atomic Scientists
CDA	Core Disruptive Accident
CNS	Council of Nuclear Safety
CRZ	Coast Regulation Zone
CSIR	Council of Scientific and Industrial Research
DAE	Department of Atomic Energy
EIA	Environmental Impact Assessment
ENR	Enrichment and Reprocessing
FBR	Fast Breeder Reactor
GOI	Government of India
IAEA	International Atomic Energy Agency
IRGC	International Risk Governance Council
KKNPP	Kudankulam Nuclear Power Plant
LWR	Light Water Reactor
MDEP	Multinational Design Evaluation Programme
MoEF	Ministry of Environment and Forestry
NEA	Nuclear Energy Agency
NGO	Non-Governmental Organisation

NPCIL	Nuclear Power Corporation of India
NPT	Non-Proliferation Treaty
NSG	Nuclear Supplier Group
NSRA	Nuclear Safety Regulatory Authority
OECD	Organisation for Economic Cooperation and Development
PFBR	Prototype Fast Breeder Reactor
PHWR	Pressurised Heavy Water Reactor
PMANE	People's Movement Against Nuclear Energy
RTI	Right to Information Act
SARF	Social Amplification of Risk Framework
TNPCB	Tamil Nadu Pollution Control Board
WANO	World Association of Nuclear Operators

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Nuclear Energy, Risk and Governance

Energy production has always been a risky enterprise, largely considered a necessary evil for modern life to flourish. Risk was traditionally seen as technological in nature and its control mechanisms located squarely within technical systems. But as industrial accidents started to increase in frequency and magnitude in the 1950s, the cracks in technological systems and the wider impacts on environments and societies became more apparent. It was increasingly clear that risk could no longer be understood in technical terms alone. This was further compounded in the 1980s when governments around the world began to take global warming and subsequently climate change more seriously as a policy concern. Energy production came to be understood, not only as dangerous for individual safety, but also as a threat to the eco-system upon which modern markets, technologies and societies depend. The notion of risk as simply the mathematical anticipation of future hazards, therefore became much more complex and difficult to apprehend. The acceptability of risk and questions about whose and what other values were at stake became a less straightforward calculation of costs and benefits, and a more contested discourse.

It is partly within this context that *risk* evolved from being a modelling frame for calculating probabilities, effects and adaptive capacities, to a discursive device used to reveal the more ambiguous nature of risk

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problems and the more complex set of actors involved. The recognition that a wider range of stakeholders needed to be involved in decision-making processes was increasingly accepted but the framework for implementing this process was lacking. It was against this backdrop that *risk governance* began to gain prominence in the last two decades as a normative framework for integrating a more diverse set of expertise (lay and expert) and values (technical, social, ecological, etc.) in decision-making on risk problems.

For better or worse, nuclear energy became the poster child for the co-evolution of energy production and risk, and all the ambiguities that came with this relatively short history. It is arguably the most hazardous form of energy production, though by conventional indicators, it is the least hazardous given that it has the lowest number of direct deaths caused by nuclear operations. In light of climate change, it has also gained new support even among environmentalists as a short-term solution to growing carbon emissions without compromising economic growth. Yet, the enigma of high-level long-lived nuclear waste remains a problem for generations to come, though some contend that we have even less time to deal with climate change. Indeed, these competing priorities and time frames—set within enduring uncertainties about technological maturity, tipping points, runaway effects, etc.—represent one of the greatest dilemmas of our time even as we run out of time to take action.

It is within this context that this book was crafted as a way to unpack these cross-cutting problems, deconstruct some of the underlying assumptions about the problems and their solutions, and to piece together a different way of thinking about risk and nuclear energy that is less fatalistic, less polarised and more hopeful.

1.1 Nuclear Energy After Fukushima: A Mixed Picture

On 11 March 2011, the improbable happened and the world was reminded, yet again, about the magnitude of devastation that could come with nuclear energy production. In the early hours of that day, a magnitude nine earthquake triggered a 15-metre tsunami that slammed into the eastern coastal city of Fukushima in Japan, knocking out the power supply to four nuclear reactors at the Fukushima Daiichi power plant. Within three days, three of the four reactors suffered a meltdown, releasing large amounts of radioactive material into the atmosphere, sea and land. Some estimates put the total number of evacuees at 160,000, half of whom remained displaced in 2017 (McCurry 2017). The latest cost of the disaster, including decommissioning, compensation to victims and decontamination work, was estimated at no less than 21.5 trillion yen (approx. US$188 billion) at the time of writing (Obayashi and Hamada 2016). The Fukushima nuclear disaster put sudden brakes on a nuclear renaissance that had been quietly underway since the early 2000s as countries across the world were beginning to consider nuclear energy as a viable source of carbon-free energy supply in light of climate change. Switzerland and Germany were the first in Europe to announce that they would abandon nuclear energy and shut down their reactors by 2034 and 2022 respectively. In Italy, a national referendum to revive the country's nuclear energy programme was soundly rejected by the public. Key Southeast Asian countries like Malaysia, Indonesia and Vietnam, which had been in talks with Japan, South Korea, France and Russia to build nuclear reactors, also put their plans on hold. Vietnam, with the most ambitious plan in the region, was looking to build eight plants by 2030 producing 16,000 MW with the help of Russia and Japan but finally decided to suspend the project due to safety concerns and soaring costs (The Straits Times 2016). Thailand had two reactors in the pipeline and was considering four more. Malaysia also had plans to build two reactors on the southern coast of Johor by 2021, while Indonesia had earmarked Banka island and West Kalimantan for four reactors, producing 6000 MW by 2025 (Desker 2013; Velloor 2011). These plans have now been put on hold.

Indeed, the immediate global response and subsequent wave of negative public perception of nuclear energy should have marked the demise of the nuclear industry. But even before the debris from the tsunami could settle, it was back to business for the global nuclear industry. Barely a year after the disaster, licences for two new reactors were granted in the US, the first since 1978 (Black 2012). Europe's largest nuclear countries—France, the UK and Russia—continued to operate their nuclear power plants and even saw an increase in the share of nuclear energy in their overall energy mix between 2010 and 2015 as did nine other countries.[1] Just two years after the Fukushima nuclear disaster, the residents of Satsumasendai who host the Sendai nuclear power plant voted "yes" to restarting its two reactors (Associated Press 2014).

Within three years of the disaster, forecasts for nuclear power plant construction worldwide by 2030 returned to their pre-Fukushima level (Schneider et al. 2013). The UK, which had no plans to build new reactors before the Fukushima disaster, started talks with Russia's nuclear power corporation, Rosatom, on possible joint ventures for new plants (Interfax 2014). In more recent developments, the UK's new Prime Minister, Theresa May, gave the green light for a new 3200 MWe power station to be built at Hinkley Point C with two French Evolutionary Power Reactors (EPR) co-financed by China.[1] Towards the end of 2016, anti-nuclear sentiment in Switzerland also started to wane as the Swiss public voted against an earlier timeline for phasing out nuclear energy in the country in a public referendum (BBC 2016). China has more than doubled its number of reactors since 2010 and currently has 24 more units under construction (IAEA 2016b). The UAE became the most recent country to join the nuclear club with four reactors under construction and its first nuclear power plant slated to come online in 2017 (Malek 2017).

If history is any indication of the nuclear industry's resilience, one could argue that these post-disaster nuclear developments are not surprising even if they may be unnerving. The nuclear industry has seen three other major accidents: a severe fire at the Windscale reactor in the UK, 1957; a core meltdown in the Three Mile Island reactor in the US, 1979; and the complete destruction of the reactor in Chernobyl, Ukraine (then part of the USSR), in 1986. These are but the most renowned events. There is a litany of other equally severe, but less prominent, as well as smaller incidents in the industry, some of which were covered up or went unreported (see Appendix Table A.1). But these events did not stop the nuclear renaissance from emerging in the 2000s.

Yet, there is reason to believe that it is not all back to business as usual since the Fukushima-Daiichi nuclear disaster. IAEA records show that nuclear energy's share of global electricity generation was on a downward trajectory since 2000 (see Fig. 1.1) and currently only generates 11 per-

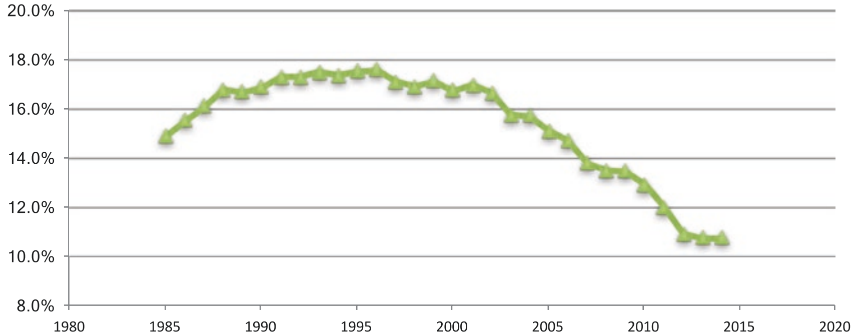

Fig. 1.1 Nuclear energy's share in global electricity generation, 1985–2013
Source: Ramana, M. V. (2016). Reproduced with Author's permission.

cent of global electricity supply compared to its peak of 17 per cent in 1996 (Ramana 2016: 366). Venezuela, Israel, and Italy abandoned plans to build nuclear power plants, and the two largest economies in the world (excluding the EU), the US and China, reduced their projections for future installed nuclear capacity (Ramana 2016; Yu 2015). Even the IAEA's own projections for 2030 nuclear energy capacity fall within such a wide range—between 1.9 per cent and 56 per cent—that it offers no indication of where the industry is headed in the near future (IAEA 2016b—News).

It is clear that the future prospects of nuclear energy remain contested. But what is a less ambiguous is that Asia seems to be the saving grace for the nuclear industry, with China and India leading the way (see Table 1.1). Even though China reduced its 2020 projections for installed nuclear capacity, the commissioning of new nuclear power plants that were in the pipeline before the Fukushima nuclear disaster has largely continued apace, albeit with some delays. India only very temporarily halted expansion plans to conduct stress tests following the disaster. But barely four months later, the government declared its nuclear plants safe, and construction of two new 700 MWe indigenous reactors in Rajasthan resumed by July 2011. Despite vehement and sometimes violent protest by local communities in the state of Tamil Nadu (see Chap. 6), the largest and most controversial nuclear power station in India, the Kudankulam Nuclear Power Station (KKNPS) I and II were commissioned in 2014 and 2017 respectively, adding 2000 MWe to the grid. Indeed, there are

Table 1.1 Top 10 countries by number of nuclear reactors[a]

Country (Top 10 by number of units[a])	Reactors in operation		Reactors under construction		Reactors planned for construction		Total number of units	Total net capacity MW(e)
	No. of units	Net capacity MW(e)	No. of units	Net capacity MW(e)	No. of units	Net capacity MW(e)		
USA	99	99,185	5	5633	8	10,384	112	11,5202
France	58	63,130	1	1630	0	0	59	64,760
Japan	43	44,215	2	2650	0	0	45	46,865
Russia	35	25,443	8	6582	26	27,779	69	59,804
Korea Rep. of	24	21,733	4	5420	8	11,600	36	38,753
India	22	6780	5	3300	34	31,600	61	41,680
Canada	19	13,524	0	0	0	0	19	13,524
China	31	26,774	24	24,128	41	46,850	96	97,752
UK	15	8919	0	0	0	0	15	8919
Ukraine	15	13,107	2	1900	0	0	17	15,007

Adapted from sources: IAEA 2013, 2016b; Kumar 2013; http://www.npcil.nic.in/main/AllProjectOperationDisplay.aspx; http://www.npcil.nic.in/main/Clearances_for_New_Projects.aspx; http://www.world-nuclear.org/information-library/current-and-future-generation/plans-for-new-reactors-worldwide.aspx

[a]Countries are ranked by number of units instead of production capacity because the latter is a weak indicator of the impacts on the environment and populations. It is however, important to note that some countries like Sweden and Belgium have fewer reactors than India but rank higher than India in terms of energy produced from nuclear reactors. Sweden has 10 units but has a production capacity of 9395 MWe; Belgium has 7 units but produces 5927 MWe, more than India's 20 reactors combined. This is due to higher reactor capacity and load factor. Similarly, Germany has fewer reactors than the UK (nine units), but produces 12,068 MWe more than the UK (see IAEA 2013: 10–11)

few signs of a nuclear slow-down in India. Political will to pursue nuclear energy is stronger than ever under the Bharatiya Janata Party (BJP) government, which replaced the Congress Party in the 2014, and the goal of increasing the share of nuclear energy from the current 3.5 per cent to 25 per cent by 2050 remains the holy grail of the nuclear industry's political mandate (IAEA 2016b; GOI 2013).

1.2 The "Real World" Problem: Truth Crisis

These seemingly counter-intuitive responses to a nuclear disaster as devastating and expensive as in Fukushima raises a number of questions about risk and the nuclear industry: why, in spite of the catastrophic outcome of the Fukushima nuclear disaster, are some governments still such strong advocates of nuclear energy? Why do they and the global nuclear industry still consider the risks of nuclear energy acceptable in spite of the magnitude of devastation seen in Japan and the incalculable long-term cost of the cleanup, compensation, and healthcare? Why, in spite of widespread public opposition to nuclear energy, is the nuclear industry still relatively resilient? Are the nuclear industry and its proponents delusional or have we, as lay people, been more swayed by negative risk perceptions that do not fit with the facts?

Indeed, these questions are even more pertinent in the present context of the so-called "post-truth" era. This book is not about "post-truth" politics and will not digress into an epistemological discussion about its validity as a descriptor of our time. But there are lessons and insights that decades of risk controversies around nuclear energy can offer to the so-called crisis of truth we face today. The label "post-truth" implies there to be only one universal truth, whereas in risk, truth is, by sociological definition, constructed, open-ended and ambiguous. Even in the scientific community, the experts disagree with each other and the facts are always contextual and contested. What the reader will find in this book is that both experts and lay publics are subjects of perception. The nuclear scientists that were part of this study perceived the risks of nuclear energy as very low because they had a deep trust in science, systems and engineering to ensure safety despite evidence to the contrary. What became clear was that this trust was not based on scientific facts and rational calculations of risk, but the outcome of decades of shared history of scientific exclusion, socialisation and institutional conditioning (Chaps. 3 and 4). On the other hand, there is the high level of perceived risk among the Indian publics, especially host communities, spawned from a deep distrust of nuclear scientists and their scientific claims. This also developed over many decades of industrial negligence, miscarriages of justice, broken promises and denigration by the elite scientific institutions of India

(Chap. 6). It should, therefore, not be any more surprising or considered less rational that the lay publics reject the truth claims of experts and disagree with the facts, especially when they contradict the experiences of their past and present everyday lives.

That there is more than one version of the "truth" is not the problem. The problem lies in the stratification of "truths" along hierarchies of power, class, caste, etc., and when the validation of knowledge and distribution of risks and benefits are dispensed along these social structures. As we have seen, when the voices and truth-claims of marginalised segments of society are ignored for too long, they will resist against what they perceive to be the institutions of the elite, sometimes to the detriment of a wider set of democratic institutions and processes aimed at producing more equitable outcomes for society. The challenge this raises, therefore, is in how to make marginalised "truths" known, heard, and represented. This further begs the question of what we should do with these different "truths". How do we start a constructive dialogue that may bring different points of view closer to a common understanding, or at least closer to a set of arrangements that is acceptable to all affected stakeholders? This problem lies at the very heart of social theories of risk and subsequent developments into more applied fields of risk governance and participatory decision-making.

1.3 The Theoretical Problem

Social theories of risk emerged as a response to the narrow definition of risk as a technical exercise. The conceptual contributions that came from the social sciences, therefore, were centred on the social processes and structures that produce and construct risk, as well as the social impacts of hazardous activities. These works can be broadly characterised as leaning towards either realist or constructivist epistemological orientations applied to social processes at different scales of society: from (1) individual perception and decision making to (2) socio-cultural structures and organisations; and (3) global systems of economic and political ordering. Each of these loosely defined sets of scholarship take interest in different aspects and processes of risk, but all share, more or less, a research curiosity in what constitutes acceptable risk and who gets to decide. The first group, mainly from social psychology, delves into individual cognitive processes that are believed to produce rational trade-offs between risks and benefits mediated by various socio-environmental factors (see for example Slovic 2010; Pidgeon 2009; Fischhoff et al. 1984). The second group, of mostly cultural theorists and organisational sociology, on the other hand, considers acceptable risk to be the outcome of societal definition embedded within cultural norms, thought collectives, belief systems and organisational cultures and practices (see for example Douglas and Wildavsky 1982; Perrow 1999; Short and Clarke 1992; Vaughan 1996). The third group, comprised of Systems Theory and Risk Society theorists, is more concerned with the ways in which broader societal systems of law, political orders, the market, globalisation, etc., produce risks that affect individuals irrespective of national, social or cultural boundaries. For Risk Society theorists, the relations of power that steer processes of globalisation are inherently unequal and those with the greater means of production tend to have greater means to define risk and to dictate the distribution of risks and benefits (Beck 1992, 2010). Whereas for Systems Theorists, risk is not real but socially constructed when an external threat to one social system is internalised, thereby, transforming the "threat" into "risk" axiomatically (Luhmann 1990, see also Rosa et al. 2014: 102–5). These early theoretical ruminations laid the ground for subsequent inter-disciplinary approaches found in the Social Amplification of Risk Framework (SARF) and risk governance. These works attempt to reconcile the dichotomy between structure and agency, and incorporate both social and technical dimensions of risk in decision making respectively.

The social theories of risk have come a long way in providing insight to the social dimensions and manifestations of risk. But as a whole, they mostly suffer from a material blind spot in that each have an implicit analytical bias for social values over ecological values; and human (i.e. social, organisational, systemic) agency over non-human (i.e. ecological, material, technological) agency. This is problematic for a number of reasons. First, the assumption that agency lies primarily with social actors and social institutions has little empirical basis. The case of nuclear energy is a prime example. In spite of decades of scientific and technological advancement, nuclear scientists and technologists have failed to fully tame the process of nuclear fission. Atomic reactions may be contained within a highly controlled environment in a nuclear facility but, as the Fukushima disaster and the long history of nuclear accidents have shown, when the uncontrollable forces of nature are combined with only a partial control over atomic reactions, socio-technical systems can be rendered impotent. Components fail, systems do not function as planned and organisational cultures breed latent risks into the very walls of a nuclear plant no matter how well a plant or an operational manual is designed. In short, the processes of nature, technologies and organisations can take on a life of their own and humans are not always in control.

Second, methodological frames that focus only on social actors and processes do not provide satisfactory explanations for the sometimes jarring differences in risk perceptions even within social groups. For example, nuclear experts with the same pool of knowledge and from similar socio-cultural backgrounds still disagree with each other on the risks of nuclear energy. Culturally deterministic approaches also offer few solutions to the problem of conflicting risk perceptions across social groups since cultures are difficult to change. Others from social psychology who emphasise better risk communication, whether it is about providing more information or communicating in a more culturally sensitive manner, have produced few insights to the contingent reasons for and solutions to conflicting risk perceptions between experts and lay persons, as well as within these broad groups. It follows that risk perception comes from a much more complex set of relations that are constituted not only by social actors and social settings, but also their material components from the biophysical environment to technological infrastructures.

Third, risk is not just an outcome of social relations or social interactions with technologies and environments. Risk also shapes the way society is organised and the technologies we consider necessary to prevent major disruptions to key social systems such as markets, economies, governments, etc. But far less attention has been given in both theoretical and empirical research in the social sciences to how risk reconfigures the way society, organisations and socio-technical systems are organised, designed and operate. In short, risk needs to be understood not just as an *effect* of socio-technical relations, but also a *cause* of socio-technical orders.

This recursive relationship between risk as a product of society and simultaneously producing society needs to be a central point of investigation.

As such the investigative frame of this book was formulated around the questions of: (1) what were the social and material relations that constituted risk in the case of nuclear energy in India; (2) how the risks of nuclear energy mobilised new alliances among different stakeholder groups that were previously not associated; (3) how it instigated new assemblies of laws, institutions, infrastructures, environments and technologies; and (4) how fairer and more robust risk governance outcomes can be achieved through a reconfiguration of these actors and components. These are the questions that anchor the analysis throughout the book even as each chapter branches out into more specific lines of investigation taken up in Chaps. 3, 4, 5, 6, and 7.

1.4 Why India

India is the ninth largest economy in the world and the second most populous nation with 1.2 billion people. With a real GDP growth rate of 8.7 per cent in the last five years, a rate few countries can boast, it is one of the most watched emerging economies in the world (GOI 2013). This growth has been largely fuelled by coal. Over 70 per cent of the electricity generated in India is from coal-based power plants. Renewable energy sources such as wind, geothermal, solar and hydroelectricity represent a meagre 2 per cent share of the Indian fuel mix. Nuclear contributes about 3.5 per cent (IAEA 2016b).

India, nevertheless, remains one of the world's poorest populations. A third of the world's extreme poor live in India, up from 22 per cent in 1981 (Olinto et al. 2013). More than 800 million Indians—60 per cent of the population—live on less than 20 Rupees (US$ 0.40) a day. In spite of growing energy supply, more than 40 per cent of its households still lack access to electricity (The World Bank n.d.) and almost 85 per cent of rural households still depend on traditional biomass fuels for their cooking and energy needs (GOI 2013).

At the same time, India is faced with ever growing pressure to reduce its carbon emissions and deal with climate change. It is the world's third largest emitter, just behind China and the US, and renewable technologies only contribute marginally to the overall energy mix. India has made an international commitment to reduce its carbon intensity by 20 to 25 per cent in comparison to its 2005 levels by 2020, which puts pressure on the government to find quick solutions to its carbon emissions without jeopardising economic growth. Partly for this reason, nuclear energy has been considered a viable and key technology for India's future economic development. These material realities make India a distinct and important case study for the following reasons:

1. As the second most populous country in the world, the magnitude of impact from a nuclear accident would be immense. Added to that, India is extremely vulnerable to natural disasters, placing nuclear power plants in India at greater risk of an event or accident occurring. Between 1990 and 2008, more than 80 per cent of the population was affected by natural disasters and cost the country nearly 2 per cent of GDP and 12 per cent of central government revenues (Meijer et al. 2009). This begs the question of whether India is adequately prepared for the worst case scenario and if the potential costs are worth the benefits. Current nuclear ambitions of India indicate that the full range of social, economic, political and environmental risks involved in nuclear energy production has not been adequately examined.
2. The paradox of India as an emerging global economic power that is home to great wealth and great poverty at the same time places this study at a unique juncture of the country's history where the collision among people, technologies, and environments is particularly acute and when significant changes are occurring (see Chaps. 4 and 6). This book is, therefore, particularly well-timed, not just as a record of India's nuclear industry at a nexus of change, but as a unique opportunity to reflect on how people, technologies and environments interact and become intertwined in the process.
3. Considering the country's nuclear ambitions, India will likely be a key player in the future of nuclear energy in Asia (see Table 1.1). The way India's nuclear establishment manages risk and public perception, therefore, will have implications for the rest of the region and other developing countries that are pursuing nuclear energy. It is, thus, important to have an understanding of how the country's nuclear

establishment thinks about risk, and how risk is embedded within organisational cultures, nuclear infrastructures, and in the minds of the nuclear scientists and lay publics. In terms of practical importance, this provides policy learning opportunities for other emerging economies in Southeast Asia, the Middle East and Africa where nuclear energy is still considered a viable technology choice. And in terms of research, this lays the ground for future comparative studies.

1.5 Notes on the Field

Fighting food poisoning with masala chai at a local café while waiting to start an interview in Mumbai, Anushakti Nagar. Taken 22 March 2012

1.5.1 A Woman's Place in the Field of Elites

The challenges of qualitative research, from data collection to the data analysis, is often underrated. Doing fieldwork is always chaotic, unpredictable and physically and emotionally challenging. But what has been even less appreciated in methods literature, are the challenges of doing qualitative research on institutional and industry elites *as a woman*. These research fields are indelibly male-dominated habitats. No amount of literary review on research methods could have prepared me for the challenges that I would face doing fieldwork in a country known for being a patriarchal society, and in an industry run by men. In fact, there was

From inside the military police guard post at the Bhabha Atomic Research Centre in Mumbai, Anushakti Nagar. Taken 20 March 2012

scarcely any literature on gender issues in studying elites using qualitative research methods. But before the reader thinks that this is about all the disadvantages of being a woman in a man's world, it is not.

Contrary to common assumptions of power, gender and exclusion, being one of the few women in a room full of men had great advantages. I stood out in the crowd and people remembered me when I sent them follow-up emails or when I met them again at other nuclear energy events. People were curious about what I was doing at a conference on nuclear energy or a workshop on the nuclear fuel cycle, and that made them more willing to talk to me. Some of them were patronising, of course, when talking about complex nuclear scientific details or econometric calculations of risks and costs, but that also meant that they spent more time explaining things to me in simple terms (things that I truly did not understand and would not understand even if I read a hundred books on nuclear physics or economic cost-benefit analysis). And yes, I was often dominated in conversations and interviews, but that gave me time to listen, and in that process, people revealed more of themselves, their underlying beliefs, convictions and concerns to me. Sometimes, this led to unexpected findings and at other times led to questions that I did not initially think to ask or consider important. In other words, a conversation between "unequals" can sometimes yield greater insights than a conversation between "equals".

So where is a woman's place in the field of elites? It is not to be meek, neither is it to be just like our male counterparts. It is to be a place of curiosity and creativity. It is a place where our research subjects can trust to speak their minds and where they can be challenged to reflect upon their own assumptions and rationales without being judged. Understood in this light, one realises that being in control of the conversation is not the most important thing, especially if the objective is to get into the minds of our research subjects and to understand the underlying beliefs and rationales that guide their decisions. I let my subjects have their power and I let them enact their power. What I *wanted* was perspective and what I *had* was also perspective as an outsider in more than one way. And this was where the richness of data and depth of analysis came from.

1.5.2 Personal Motivation

Interest in this topic started with my early experiences in India, first as an exchange student, then as a research intern at the Global Development Network, a former subsidiary of the World Bank. These early flirtations with India were the beginnings of a deeper reflection on the stark contradictions in the country which is home to the world's largest and most sophisticated IT companies and the most backward infrastructure at the same time. Every day I was met with images like those below in the richest districts of New Delhi, which sparked my sociological curiosity about embedded social risks, risky behaviour induced by the built environment, and the vastly different ways in which people perceive risk. Perhaps most fascinating for me, were the frequent encounters with situations where things seemed to be on the verge of complete meltdown; but somehow, someone would make an unexpected move, another would intervene, people would rally at the very last minute, disaster would be averted and everyone would go back to their daily lives as if nothing had happened. These experiences imbued in me a deep fascination with the coping mechanisms of the Indian publics that brought me back to the country to study

A pedestrian crossing at Lodhi Road, one of Delhi's upmarket, expat districts where the UN and other international organisations are located in India. Taken 14 May 2012

Everyday I take this path to the office where cars are parked on the pavement meant for pedestrians who, instead, have to walk on the road as vehicles whizz pass from behind, sometimes within a whisker of people walking on the road. The irony, however, was that it was often safer walking on the road than the pavement where you risked breaking your foot on one of the many potholes or stepping on animal manure. Taken 10 February 2012 what is arguably its most controversial technological enterprise in the country.

Hence, in addition to the significance of India within the larger context of the international nuclear energy industry, my interest in risk governance in India's nuclear industry lies deep within my personal history with the country and its people. The memories, images and stories collected in India in the years prior to the research for this book contributed to an acute awareness and curiosity about "the Indian way of doing things"; how that plays out in a complex and highly hazardous industry such as nuclear energy; and how local host communities perceive and cope with the risks of nuclear energy.

1.5.3 About the Data

The analysis in this book is based on over three years of research and nearly a year of fieldwork in India conducted between 2011 and 2012. A total of 81 subjects were contacted, of which 32 in-depth semi-structured interviews were selected to be included in the final analysis based on the quality of the data and the authoritativeness of the research subject to speak on behalf of his or her organisation and area of expertise. These included the senior executives of nuclear power corporations, both Indian and international companies engaged in joint ventures with India; government agencies in charge of nuclear energy—i.e. the Atomic Energy Commission (AEC), Department of Atomic Energy (DAE), the Atomic Energy Regulatory Board (AERB) and the Ministry of Environment and Forestry (MoEF); and civil society representatives and senior scientists from non-affiliated research institutions who have worked with the nuclear establishment or who represent local communities hosting nuclear power plants (see Table 1.2 for breakdown). The reader will notice that I refer to the nuclear *industry* at times and the nuclear *establishment* at others. This is because there are certain issues that pertain more specifically to the commercial entities—i.e. the nuclear power corporations—which I call the "nuclear industry". Whereas, other issues cut across the AEC, AERB, DAE and its research arms, MoEF, as