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Risk, wealth and agrarian change in India. Household-level hazards vs. late-modern global risks at different points along the risk transition

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ABSTRACT

The global poor often prioritise immediate hazards of food insecurity over temporally more distant risks like global warming. Yet the influence of socio-economic factors, temporal and spatial distance on risk perception remains under-researched. Data on risk perception and response were collected from two sets of Indian villages. Participatory approaches were used to investigate variations by socio-economic status, food security, age and gender. Villagers' risk priorities reflected clear spatial and temporal patterns depending on land ownership, community group and education levels. Poorer groups prioritised household-level risks to health and food security while global environmental risks were mentioned by only three of the wealthiest respondents. The paper concludes that household risk perceptions and responses vary greatly with socio-economic status, age, gender and the spatial or temporal distance of the risk. These factors need to be better understood if the most significant contributors to the global burden of disease are to be reduced.

1. Introduction

Spatial and temporal variations in both the distribution of natural hazards and people's perceptions of them have long attracted the attention of geographers (White, 1945, 1974; Burton et al., 1978). Since the early 1990s, however, attention has tended to shift from more traditional, locally oriented analyses of risk and hazards towards a 'risk society' focus on the dramatic increase of global threats to human life (Beck, 1995). Distinguishing between the risks faced by pre-modern, early modern and contemporary societies, Beck regards 'risk society' as a consequence of modernisation and its 'globalisation of doubt' (Beck, 1992, p. 21). He argues that more 'personal' risks produced by early industrialisation have now been replaced by risks that know no spatial or social boundaries and have potential to threaten all life on Earth. Beck links the concept of risk to that of reflexivity arguing that the process of modernity examines and questions itself though 'reflexive modernisation': 'the combination of reflex and reflections which, as long as the catastrophe itself fails to materialise, can set industrial modernity on the path to self-criticism and self-transformation' (Beck, 1996, p. 34).

Beck also distinguishes between the calculation of risk in late- and pre-modern societies, arguing that pre-modern societies often regarded life-threatening hazards such as famine and plague as incalculable as they were attributed to external or supernatural causes. He argues that such hazards differ essentially from 'risks' in the sense that he uses the term, 'as they are not based on decisions ... that focus on techno-economic advantages and opportunities and accept hazards as simply the dark side of progress ... risks presume industrial, that is techno-economic, decisions and considerations of utility' (Beck, 1999, p. 50). In early modern societies, by contrast, instrumental rational control enabled the attempted calculation of such risks while in late-modern 'risk societies', such calculations fail in the face of the uncertain, long-term and globalised nature of risk (Beck, 1995, 1999).

But as emphases on 'world risk society' have increased (Giddens, 1991; Douglas, 1992), the influence of socio-economic and 'development' status on perceptions of risk/hazard and the ability of individuals or societies to manage these seem to have been somewhat eclipsed, despite obvious spatial variations in how different risks are prioritised. Interestingly, Lupton's (1999) popular overview of the academic literature on risk makes almost no mention of contemporary threats to the survival of resource poor communities in the global South. Yet as Allan (2010) points out, although the 'risk-society mentality' present in many late-modern neo-liberal societies has changed the ways they manage environmental resources 'only one in five people world-wide lives in these c. 35 economies. The risk society has not been much

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established in the five BRICS economies or in the c. 170 developing economies' (p. 30). Yet many of these countries bear a disproportionate share of 'the harmful consequences of hazardous events, activities and processes' (Bowonder and Kasperson, 2005, p. 167) plus most of the health risks associated with climate change (Meze-Hausken, 2004; Smith and Ezzati, 2005).

Although Beck does acknowledge that poverty 'attracts an unfortunate abundance of risks' (Beck, 1992, p. 35), while wealth 'can purchase safety and freedom from risk' (Beck, 1992, p. 35), he argues that the hazards of 'risk society' affect rich and poor alike and that 'reflexive modernisation' refers to the 'distribution of unawareness of unintended consequences' rather than to the distribution of knowledge' (Beck, 1999, p. 127). But their limited resources often means that the poor in both North and South are less well placed to either mitigate personal hazards or contribute to a wider reflexivity regarding global risks because, as Lash comments, 'Just how 'reflexive' is it possible for a single mother in an urban ghetto to be?' (Lash, 1994, p. 120). Citing this quote Lupton rather tentatively points out that access to 'material resources may be a central feature of risk behaviour' (Lupton, 1999, p. 117), but surely this is central to how societies perceive and respond to different risks?

While wealthy members of late-modern risk societies may claim not to want 'a world in which the guarantee of no longer dying of hunger is exchanged for the risk of dying of boredom' (Cohen and Taylor, 1992, p. 160), this is not an option for over 50% of the world's population who continue to suffer most from 'familiar hazards, many of them rooted in nature and in poverty ... [while] vermin, pests and crop diseases destroy fully 50 per cent of the world's food crops' Kasperson and Kasperson (2005, p. 173).' According to the risk transition model (Smith, 2001, p. 159), as societies 'develop' over time, 'a long-term shift occurs in mortality and disease patterns in which traditional risks related to pandemics of infection and rural poverty are displaced at lower and lower levels of total ill-health by modern risks of degenerative, human-caused and global ill-effects'. The World Bank global burden of disease (GBD) study (Lopez et al., 2006), for example, indicates that a third of all deaths worldwide in 2001 were caused by communicable disease, maternal/perinatal conditions and nutritional deficiencies. Virtually all of these 'group 1' deaths occurred in low and middle-income countries and the leading causes of the group 1 disease burden are childhood undernutrition (8.7% of the disease burden in low income countries and 7.9% globally), inadequate water, sanitation and hygiene (3.7% and 3.4%, respectively), indoor air pollution (3% and 2.7%) and unsafe sex (5.8% and 5.3%).

Since comprehensive data on GBD were collated in 1990 (Lopez et al., 2006), population ageing and policy/healthcare interventions to ameliorate group 1 causes have been associated with an epidemiological transition that brought a 20% reduction in their per capita GBD. Over the same period, the 'group 2' noncommunicable disease burden increased by 10% (accounting for 48.9% of the adult disease burden in low and middle income countries in 2001) with key risk factors being high blood pressure (5.6%), smoking (3.9%) and alcohol use (3.6%). In high-income countries, group 2 causes accounted for 86.7% of the disease burden with key risks including smoking (12.7%), high blood pressure (9.3%), obesity (7.2%), high cholesterol (6.3%) and alcohol abuse (4.4%).

In addition to these temporal and income-related changes in disease burdens, Smith and Ezzati (2005) argue that the risk transition has a strong spatial element. Focusing on shifts in environmental risk as development proceeds, they argue that infectious disease burdens stemming from household-level environmental risks account for around a third (9%) of the group 1 GBD and a fifth of all disease in low income countries but do tend to decline with development. Community scale environmental risks account for 5% of the GBD and tend to roughly follow the environmental Kuznets curve (Barbier, 1997); rising and later falling as development progresses. Global-scale late-modern risks such as climate change currently have a small GBD impact (0.4%) and are much lower for high- than low-income populations due to the vulnerability of the latter to climate change risks such as malaria, food insecurity and natural disasters. Conversely, the imposition of risks associated with climate change shows a tendency to rise with development because of wealthier countries' 'historically longer and higher emissions of greenhouse gases' (Smith and Ezzati, 2005, p. 232).

Many communities at the centre of the risk transition therefore face significant 'risk overlap' (Smith, 1997) associated with a triple burden of high (albeit declining) levels of 'traditional' risks/hazards alongside increasing levels of 'modern' community-based hazards and 'late-modern' global scale risks'. According to Kasperson and Kasperson (2005, p. 175) the risk burden faced by late-modern societies is less formidable than 'having to grapple simultaneously with old, traditional perils and new, often hidden or invisible hazards' as the 'handling of hazards in developing countries will reverberate not only on physical quality of life, but on the very survival of the Earth' (p. 168). Yet despite their low contribution to the GBD, late-modern risks associated with the 'destructive potential of modern mega-technologies' (Beck, 1999, p. 50) currently attract far more attention from risk researchers than the ways in which communities at the centre of the risk transition perceive and prioritise 'traditional' hazards.

The 'foregrounding' and 'backgrounding' of different risks has been well studied in the literature (Douglas and Widalsky, 1982) and is constantly carried out by 'communities and higher level polities according to recent events and the way knowledge is constructed in the communal discourse' (Allan, 2000, p. 4). For many of the 'dollar poor' (living on less than $1/day) that struggle to meet their subsistence needs, temporally distant late-modern risks such global warming are firmly in the background compared to the more immediate risk of harvest failure, high mortality levels and debilitating illnesses that restrict livelihood opportunities. Similarly, the tendency for unknown risks associated with genetic modification (GM) to be foregrounded in Western European societies contrasts with the backgrounding of such risks by many resource-poor communities in the global South who want better security from the hazards of farming unpredictable environments (Bouis, 2007; Herring, 2007; Lipton, 1999, 2007; The Economist, 2010). In this context, useful parallels can be drawn between Abraham Maslow's 'hierarchy of needs' and the environmental risk transition model (Smith, 2001; Smith and Ezzati, 2005) in terms of understanding how risks/hazards are prioritised according to socio-economic status and spatial/temporal proximity.

For the dollar poor preoccupied with the satisfaction of their 'physiological needs' including food, shelter and water (Maslow, 1970), for example, more 'personal', household-based hazards of famine, disease and high levels of infant mortality tend to dominate everyday life. For societies whose basic needs are assured, the need for safety, 'belongingness' and 'esteem' tend to become more important (Maslow, 1970) and other, more community-based risks such as falling ill, losing employment and being the victims of crime are often foregrounded.

Applying ideas of a needs hierarchy to late-modern risk societies where material and safety needs are largely satisfied, there is evidence to suggest that 'aesthetic' and 'self-realisation' needs become more dominant; often accompanied by an increase in 'post-materialist values' (Inglehart, 1977, 1997) and concern about global-scale risks. Although the explanatory power of the post-materialist thesis has significant limitations (Brechin and Kempton, 1994; Adeola, 1998), it does provide insights into why anxieties range beyond the immediate family as concerns increase

over spatially or temporally more distant (and often invidious or unassessable) risks such as global warming and acid rain that 'know no boundaries', because they are 'universalised by the air, the wind, the water and food chains' (Beck, 1999, p. 141). Public perceptions of such risk are well studied by proponents of traditional cognitive as well as 'risk society' approaches (Slovic, 1987; Beck, 1992, 1994; Beck et al., 1994). Studies of late-modern risk have also provided better understandings of the political ecology of risk; notably how risk is constructed as social fact with the subjectivity of risk analysis being obscured by the myth of value free scientific facts (Beck, 1995, 1996, 1999).

Less well understood is how 'world risk society' approaches interact with more 'everyday' household and community-based risks/hazard perceptions amongst communities closer to the centre of the risk transition and how these interactions change over time/space and with rising income security. Due to complex or poorly understood cause and effect relationships, local perceptions of (and responses to) risk often fail to reflect their impact in terms of mortality/morbidity; even where the lag time between exposure to the risk and its impact is short (as is the case for diarrhoeal diseases). As a result, household risk perceptions need to be better understood if progress is to be made towards reducing the group 1 GDB using interventions that are sensitive to wider socio-cultural issues within which such risks are contextualised. This is particularly true of water quality-related risks that, even when recognised, are likely to be backgrounded because of the socio-economic and cultural issues taboos surrounding sanitation and defecation practices (Jewitt, 2011a,b).

With these issues in mind, the rest of the paper seeks to provide a 'hazardousness-of-a-place' (Kasperson and Kasperson, 2005, p. 176) study of two sets of Indian villages situated within very different agrarian environments and at different points along the risk transition. Its originality and rigour lie in its efforts to follow up Smith's (2001) emphasis on risks faced by individuals (in addition to national wealth indicators) by testing his risk transition model at the village level and taking on board his argument that a modified risk transition model should include 'non-health risk attendant on development' (pp. 169–170) such as ecosystem sustainability, political and economic risk. Its significance lies in the focus on socio-economic status (alongside the temporal/spatial scales occupied by different risks) as a key influence on household-level risk perception and response that has particular relevance for policy-makers seeking to promote effective interventions/adaptations.

Particular emphasis is placed on how villagers from different socio-economic groups compare late-modern global concerns about biodiversity loss, climate change and GM with community-based concerns about agro-chemical pollution or yield stagnation and more traditional household hazards affecting health and food security. The paper's main focus is on farmers as their role in the management of food and water resources is key to understanding and managing global risks surrounding food, water security and environmental quality (Allan, 2010). As the two case studies will illustrate, farmers have the power to obtain high or low returns to water and land according to how they combine different inputs and endowments including soil, water, seeds and agro-chemicals. But their priorities when addressing risk reflect clear spatial and temporal patterns depending on their household income status, food security and education levels. At the same time, their actions are often constrained by structures including agricultural policies that protect and subsidise farmers but have side-effects 'ranging from the provision of support mechanisms for the poor to the creation of international havoc across a wide range of agricultural economies' (Allan, 2010, p. 14).

2. Background to the research areas

Although India is characterised by the World Bank (2008) as a 'transforming agricultural world', agricultural livelihoods in the case study areas are very different. One set of study villages is situated within Ranchi District, Jharkhand; a predominantly rainfed area 'left out' by the Green Revolution (Lipton and Longhurst, 1989) and characterised by a significant risk of food insecurity. Because local people have to manage many traditional household risks as well as increasing community-based hazards and (as yet largely unrecognised) late-modern global risks, the villages provide good examples of communities towards the centre of the risk transition.

Field research by Sarah Jewitt in Ranchi has been ongoing since 1993 and draws upon detailed ethnographic and participatory research carried out in two villages of Bero Block. The lack of irrigation in the district has limited the adoption of high yielding varieties (HYVs) of wheat and rice and food insecurity is pronounced with less than 50% of households regularly growing enough food to meet their subsistence needs. Ranking 455th out of 569 districts in India on a combination of 'development' indicators (see Table 1), Ranchi sits towards the bottom of India's socio-economic hierarchy (JSAC, 2010). Consequently, it is argued that although risks of climate change and biodiversity loss may be foregrounded in future, at present they are backgrounded relative to the more immediate danger of food insecurity.

The second set of study villages is situated within Bulandshahr District, Uttar Pradesh: a key 'green revolution' district which overcame widespread food insecurity during the late 1960s and early 1970s through the adoption of high yielding varieties (HYVs) of wheat and rice. But while the threat of starvation has diminished for most households, Bulandshahr, like much of Uttar Pradesh, has lower social development indicators than its agricultural prosperity might suggest (see Table 1). In addition, farmers in the district are facing increasing community-based risks associated with yield stagnation, declining economic returns to agriculture and inter-community wealth differentiation. Participatory research in Bulandshahr started in 2001 but has been carried out in collaboration with Kathleen Baker whose research on agrarian change in the district dates back to 1972 when HYVs were just being adopted.

Drawing on these data plus colonial and anthropological information dating from the late nineteenth and early twentieth centuries (Atkinson, 1903; Cautley, 1854; Hallett, 1917; Reid, 1912; Roy, 1912, 1915, 1928) attention is drawn to how risks have changed over time in the two research sites. While such a micro-scale study can hope to add little to the wider theoretical body of literature on risk assessment, analysis or perception, it does seek to challenge analysts in this field to further examine the influence of wealth, food security, temporal/spatial scales and position within

Table 1
Some key statistics for Ranchi and Bulandshahr Districts.

	Ranchi	Bulandshahar
% Mud-built houses	71.8	32.6
% Brick built houses	19.9	65.9
% Villages unconnected to paved road	75.17	1
% Scheduled tribe population	41.84	0.01
% Scheduled caste population	5.18	20.21
Sex ratio (female:male)	938:1000	879:1000
Sex ratio (0–6 years)	961	867
% Total literacy rate	65.69	59.39
% Male literacy rate	77.76	74
% Female literacy rate	52.77	43
% Births attended by skilled personnel	24.6	23

Sources: Government of India (2010), JSAC (2010), Department of Forest and Environment Jharkhand (2010), Raftaar (2010).

the risk transition on the foregrounding and backgrounding of different risks/hazards. Drawing on the work of Tullock and Lupton (2003), Meze-Hausken (2004), Smith and Ezzati (2005), Kasperson et al. (2005) and Parkhill et al. (2010), the intersection of risk/hazard perceptions with the socio-economic, cultural, temporal, environmental and spatial contexts within which they are situated is central to the analysis.

3. Risk and agrarian change in the research areas

Empirical data for this paper were collected during field research in two villages (Ambatoli and Jamtoli) within Ranchi District (see Fig. 1) and in three villages (Sabdalpur, Chirchita and Kurwal Banaras) within Bulandshahr District (see Fig. 2). Sarah Jewitt spent most of 1993 in the Ranchi research sites with roughly biennial visits being made by her and/or her research assistants thereafter. To determine variations in villagers' levels of food and income security, she conducted in-depth interviews with 125 households in two villages as well as using a range of participatory techniques with different socio-economic, age and gender groups. Kathleen Baker spent a full year in Bulandsharh in 1971/2 and returned to the district (often accompanied by Jewitt) on an almost annual basis from 2001. She interviewed over 400 households in her original (1972) study and, during the post-2000 field visits with Jewitt, had in-depth and participatory discussions about a range of risk factors (food security, environmental problems, 'personal' (including gender-related) hazards and wider constraints facing agricultural and livelihoods more generally) with 181 villagers from different generations, communities and landholding groups. Questionnaire data on household income-earning strategies, landholdings, yields, cultivation practices, family composition and market engagement were supplemented with secondary source data on life expectancy, sex ratios and changing cultivation practices dating back to the British colonial period for both field locations. The main participatory techniques used to obtain risk perception data were time lines (illustrating changes in food security, health, technology, crop variety, environmental quality, wealth, income and market engagement) and matrix ranking (of risks identified as significant by different socio-economic groups and scored on a scale of 1–10). These approaches helped us to develop qualitative and rough quantitative (from the matrix scoring exercises) indications of how households from different socio-economic groups prioritised risks. Community-scale 'non-health risks' (Smith, 2001) such as ecosystem sustainability, economic and personal risks plus late-modern global risks such as climate change were investigated alongside household-based risks in both study areas. The impacts of socio-economic status and varying levels of food security on risk perceptions provided the main focus for analysis, but efforts were also made to obtain information on the gendered nature of risk perceptions with particular reference to 'personal risks'.

3.1. Ranchi

Until recently, much of Ranchi District was blanketed with dense forest stands which provided an important subsistence resource for the local population, but with the conversion of much forest for cultivation during the last century, agriculture replaced hunting and gathering as the main form of subsistence. When S.C. Roy undertook his ethnographic work in Ranchi during the early part of the last century (Roy, 1915, 1928), agriculture provided a major socio-religious focus as well as being the prime economic activity. As a majority of the region's tribal population are animists, the risk of food security was (and continues to be) managed through the propitiation of local deities as well as through the skilful matching of different crop varieties, water and other inputs to different land types (Jewitt, 2002a,b).

Because of Jharkhand's undulating and rocky landscape, however, only 27% of the state's land is cultivable and opportunities for large-scale irrigation are few so farmers depend greatly on rainfed farming for subsistence. Low levels of both access and returns to water have long undermined food security as 'water drains away from the uplands (tanr) and even the higher low lands (don) with great rapidity; and unless the crops growing on these lands receive a plentiful and continuous supply of rainfall, they wither and die very quickly' (Reid, 1912, p. 5). Most farmers rely on

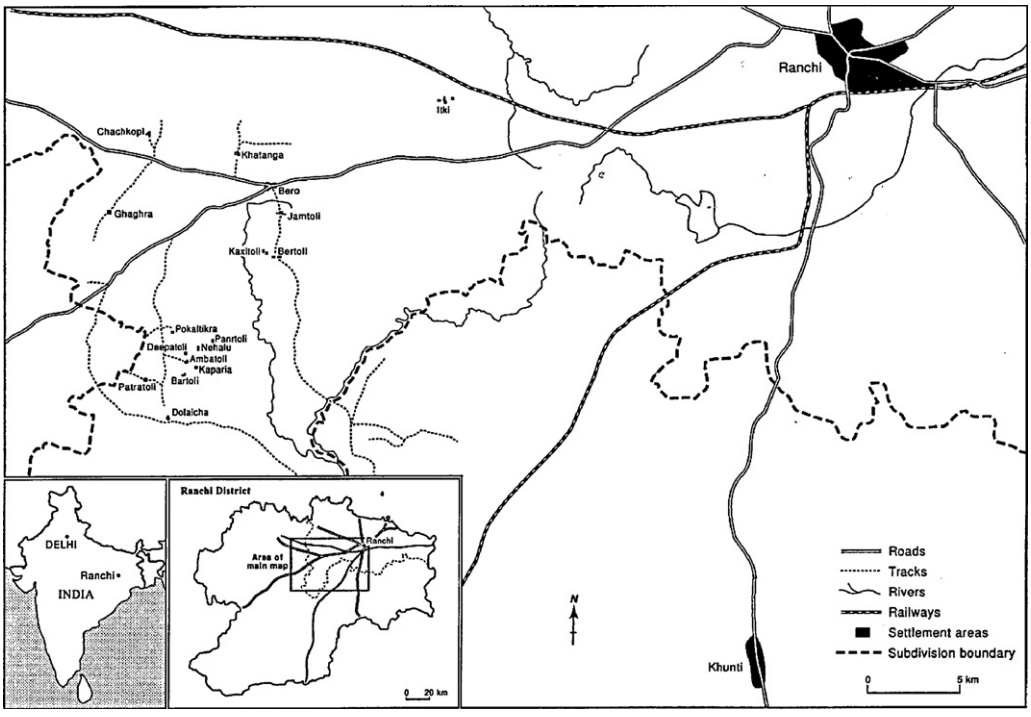


Fig. 1. Map of the Jharkhand study area.

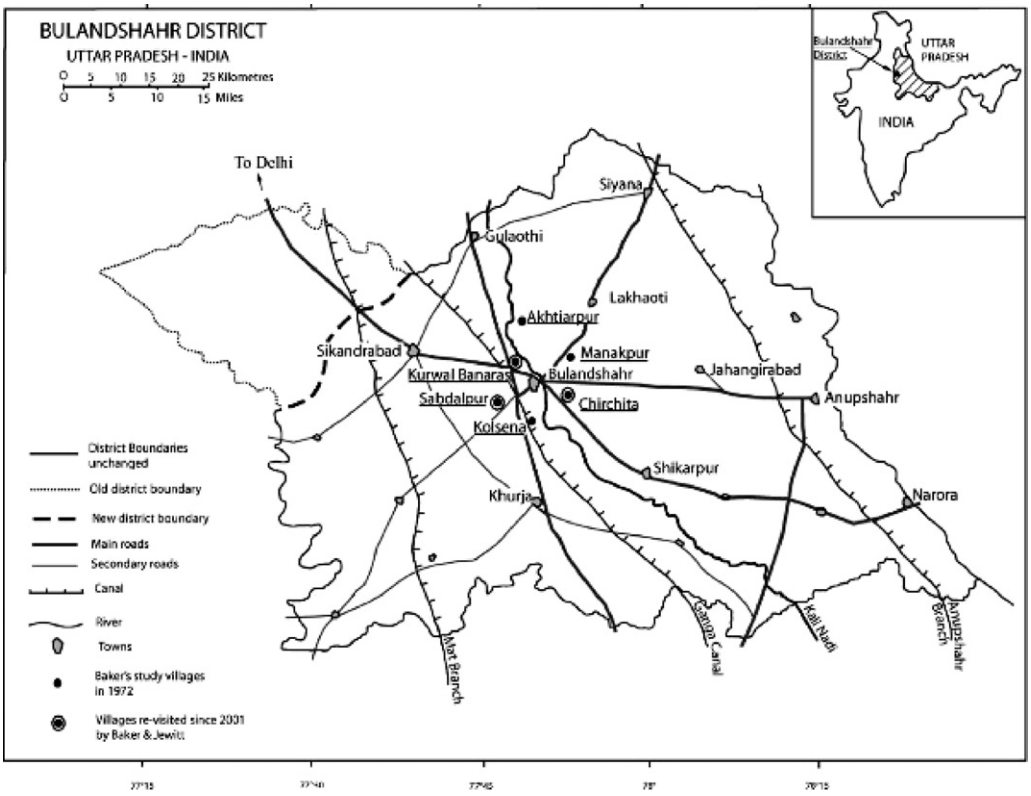


Fig. 2. Map of the Bulandshahr study area.

one annual rainfed (monsoon) crop of paddy and pulses as their main form of subsistence. Apart from the cultivation of hardy millets, pulses and oilseeds on moisture-retaining lowland or garden vegetables on homestead land, winter crops were unimportant until the 1980s.

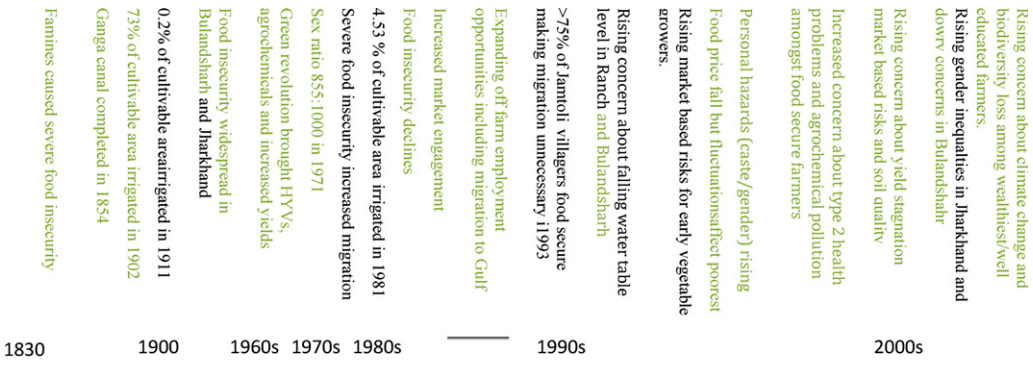
Opportunities to take advantage of new agricultural markets are limited by poor infrastructure. There is little expectation that the study villages will be connected to the national grid in the near future and the local dirt roads become impassable for most vehicles during the monsoon. Health infrastructure is also poorly developed in the district and many villagers continue to rely on herbal medicines derived from forest products although allopathic medicine is increasingly accepted. 'Traditional' diseases such as malaria, dysentery and respiratory problems remain common causes of illness and death and infant mortality rates are 67/1000 (Department of Forest and Environment Jharkhand, 2010). Life expectancy for Jharkhand as a whole is 62.3 for females and 62.9 for males.

A long history of land alienation and fragmentation has reduced the average farm size per household from 3.53 ha in 1935 to around 2 ha nowadays with the result that household survival strategies have become more tenuous. Many households seek to increase their food security by finding off-farm employment such as casual labour or seasonal migration to brickfields in West Bengal and Uttar Pradesh. The latter strategy became widespread after the late 1970s when bad harvests put severe strain on existing household survival strategies.

Families that retained farming as their primary economic activity sought better returns to labour and water by intensifying production (Hallett, 1917). Most villagers now use annual manure (and increasingly chemical fertilizer) applications to enable all of their fields to be cultivated at least once a year. Nevertheless, small field sizes and limited farming incomes inhibit the use of tractors, so cattle remain the primary means of transport and draught power and agricultural equipment has changed little since the early twentieth century (Roy, 1912, 1915, 1928).

Echoing the World Bank's emphasis on water as the major determinant of land productivity and 'stability of yields' (World Bank, 2008, p. 8), the spread of irrigation has been the most important source of intensification. Irrigated land increased from 0.2% of the Ranchi's gross cultivated area in 1911 (Government of India, 1911) to 4.53% in 1981 and is currently available on approximately 13.3% of the net cropped area. In addition to making monsoon crops less vulnerable in dry years, irrigation has increased the importance of winter season upland cultivation and enabled the use of HYVs along with agro-chemicals in certain areas. Although villagers do not (yet) complain of yield stagnation, yield increases (to an average of 2075 and 2016 kg/ha for rainfed monsoon season HYV and local variety paddy) have been insufficient, in the face of fairly rapid population increase, to reduce the risk of food insecurity in most villages.

Participatory risk assessments were undertaken to investigate how different socio-economic groups prioritised different health- and non-health related risks/hazards. To analyse how hazards were perceived to vary at different points along the risk transition, older villagers were asked to indicate how risks/hazards had changed over their lifetimes (see Fig. 3). These exercises clearly indicated that the fear of group 1 risks relating to food insecurity and 'traditional' diseases continued to dominate villagers' risk perceptions (see Fig. 4). Reflecting the region's rise in average life expectancy to well over 50 (the point at which group 2 diseases usually cause more deaths than those in group 1 – Smith, 2001), however, communicable diseases were viewed as being on the decline. Villages linked this trend to increasing education levels which had increased awareness of how to prevent such diseases and improved the acceptability of modern medicine. Conversely, 'modern' group 2 risks such as cancer and heart problems were perceived to be 'on the increase'.



Source: The timeline was derived from interviews with village elders coupled with historical data from secondary sources.

Fig. 3. Timeline of key events.

As Fig. 4 indicates, the fear of food insecurity is more dominant in Ambatoli where only 41% of sample households regularly grow enough food to meet their annual subsistence requirements and most have to find additional funds to make ends meet. Average landholdings are small (1.89 ha) and typical yields are 495–3950 kg/ha for traditional varieties (TV) of lowland paddy, 790–3950 kg/ha for HYV lowland paddy, 495–1480 kg/ha for TV upland paddy and 1180–1480 kg/ha for HYV upland paddy; yields that correspond closely and not particularly favourably with the yields noted in the Settlement and Survey report of 1902–1910 (Reid, 1912, p. 115). Winter vegetable cultivation is undertaken by farmers with access to wells, pumpsets and stream/pond water for irrigation. Reflecting the need to maintain food security, the amount of land that villagers choose to plant with winter crops is usually determined by the success of the previous paddy harvest.

Although Jamtoli has similarly small average landholdings (1.66 ha), food security has improved dramatically over the past 30 years due to a series of dam-building initiatives organised by a village elder. Between 1981 and 2004, the village's irrigable land increased from 23.25 ha to over 80 ha (Government of India, 1981) and over 75% of households now cultivate winter crops. In addition to reducing poverty levels, this has dramatically reduced the risk of harvest failure as villagers can provide supplemental water for their monsoon season paddy when rainfall is poor and maximise cropping intensities by growing additional winter and even summer crops. Reflecting the role of irrigation as the key input influencing yield, irrigated lowland fields close to check dams, canals and wells regularly yield over 4900 kg/ha of paddy while irrigable upland paddy fields yield over 1480 kg/ha. Indeed, higher paddy yields plus the profits made from (and employment generated by) winter vegetables has virtually halted the need for seasonal migration in the village.

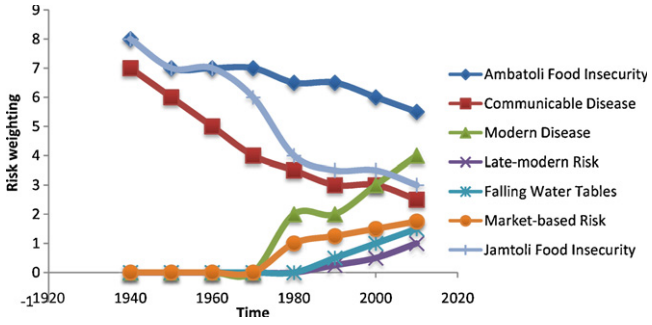


Fig. 4. Participatory risk transition for Ambatoli and Jamtoli.

As irrigated winter and summer crops do not benefit from the nutrients carried in the monsoon runoff, it has become common practice to apply chemical (NPK/urea) fertilizers. To reduce capital expenditure and minimise the risk of the soil becoming 'used to chemical fertilizers and demanding ever increasing quantities' (Ambatoli group discussion, 05/99) as a result of a decline in organic matter content, many villagers supplement fertilizer applications with manure and compost. Farmers in both study villages appeared to be remarkably well briefed (primarily as a result of effective agricultural extension) about the health problems and risks of water pollution associated with agro-chemicals and the need to control input levels while maintaining traditional composting and manuring techniques. Nevertheless, the introduction of HYVs coupled with agro-chemicals and irrigated winter cropping has brought quite dramatic changes to the study villages; the environmental risks of which may not be fully apparent for many years. Echoing Smith and Ezzati's (2005, p. 324) point that low income tends to be accompanied by 'high effective discount rates', however, Fig. 4 illustrates how most farmers tend to background such temporally distant 'community-based' risks (Smith and Ezzati, 2005) in the face of what they perceive to be the far greater risk to immediate household food insecurity in the absence of intensification.

Nevertheless, a number of farmers with wells on elevated land are starting to foreground the risk of falling water table levels caused by increased groundwater irrigation coupled with the loss of forests which, in their opinion 'provide food for the clouds and soak up the rain when it falls' (discussion with Simon Oraon, 10/93). Faced as they are with uncertain monsoon rainfall, increasing population, fragmented land-holdings and declining opportunities for forest-based subsistence, most continue to see irrigation as key for increasing short-term food security, regardless of the longer-term environmental consequences. After all, with irrigation, even the smallest landowners can improve subsistence production while landless villagers have benefited from greater income security due to more year-round agricultural employment. This issue was hotly debated during the participatory risk assessments, however, as villagers were aware that falling water tables may threaten the continued success of irrigated farming as a means of meeting subsistence needs in this rather unfavourable and risk-prone agrarian environment.

Discussions surrounding other non-health risks revealed that concern about biodiversity loss in the villages is negligible as even

the coarsest grains and pulses are still cultivated on the poorest land and farmers argue that the influx of HYVs and vegetable cultivation has increased overall crop diversity in the area (Jewitt, 2002a,b). Unsurprisingly, market-related risks were of greater concern to farmers that cultivated cash crops and 'early winter vegetables' for the Calcutta market than they were to subsistence farmers.

The 'personal' hazards associated with agrarian class differentiation experienced in core green revolution areas (Shiva, 1991), meanwhile, appear to be less pronounced (although intra-community inequality is certainly not absent – Corbridge and Kumar, 2004) in rural Jharkhand; possibly a result of lower levels of initial economic inequality, restrictions on the sale of land to non-tribals and limited scope for large-scale irrigation. There is some evidence of increasing gendered health risks in the region, however, following the steady influx of plains Hindu customs. Over the past 130 years, the female:male sex ratio in Ranchi District has fallen from 1022:1000 in 1881 to a low of 927:1000 in 1991, indicating female foeticide and/or lower levels of healthcare and nutrition for female children. In addition, the risk of violence against women accused of witchcraft appears to be increasing in Jharkhand (Mishra, 2003) and has been linked to uneven social and economic development that 'targets vulnerable women, often widows, as symbols of collective anger and thwarted aspirations' (Gokale, 2003, p. i).

3.2. Bulandshahr

Bulandshahr District forms part of the relatively prosperous area of western Uttar Pradesh that lies between the Ganges and Jamuna rivers. Agriculture there is quite capital intensive and involves the use of HYVs, irrigation from canals or tubewells and large quantities of agro-chemicals. Through the application of this package of inputs, soils are managed to assure the supply of a set of essential nutrients to the HYVs which can be grown in most fields; unlike in Ranchi where the success of crops grown is more dependent on careful management of the risks associated with environmental variability. Two main cropping seasons dominate Bulandshahr's agricultural calendar: the monsoon season (July–October) is dominated by rice, sugarcane and maize and the drier winter season (October–April) is dominated by wheat but irrigation is necessary for a successful crop.

The district has not always been prosperous, however and drought was followed by crop failure in 1837–1838 when 'the extent of human misery caused by utter failure of crops in the Central Provinces, especially in the lower districts of the doab [led] to famine in its most aggravated form' (Cautley, 1854, p. 18). To bring 'stability and certainty to cultivation, and thereby to rent and revenue, by making husbandry easy and profitable' (Atkinson, 1903, p. 45), the British constructed extensive canal-based irrigation networks fed by the River Ganges. The Ganga Canal was completed in 1854 and its irrigation waters reached Bulandshahr the following year allowing rapid agricultural change that foreshadowed the increased returns to land, labour and water achieved by the Green Revolution a century later. Between 1871 and 1883 the district's irrigated area increased by 565% and the cultivable area increased from 54% to 73% of the district between 1854 and 1902 (Atkinson, 1903).

From the late 1960s, cropping intensities were raised using HYVs with shorter maturation periods that allowed farmers to harvest an extra winter crop if they used irrigation. By 1971, HYV adoption was widespread in all three study villages as they yielded 2550 kg/ha with inadequate fertilizer to 4000 kg/ha with adequate fertilizer compared to 1000–1500 kg for traditional varieties of wheat. HYVs thus played an important role in reducing the risk of food insecurity in a situation where 'the stork was beginning to outrun the plough' (Brown, 1970, p. 5). Although most farmers initially proceeded with caution as the new technology was untested in the region, such concerns were quickly backgrounded once its potential to reduce the danger of famine had been demonstrated. Baker (1975) found that most farmers were quickly won over by the new HYVs as they showed considerable tolerance for the harsh environmental conditions of the Ganga–Jamuna doab and were reliable and high yielding, as long as they received adequate and timely inputs of irrigation water and fertilizer (Baker and Jewitt, 2007). As the capacity of HYVs to outyield TVs became apparent, risks associated with the pest susceptibility of early HYVs were often backgrounded by farmers who ignored official recommendations about pre-treating their seed and using pesticide on the plants themselves (Baker, 1975).

In contrast to fears that only rich farmers could benefit from the GR (Byres, 1981, 1983), Baker (1975) found that HYVs enabled even the smallest farmers to lower the risk of household food shortages by increasing the quantity of wheat available for consumption. Nevertheless, her research showed that wealthier dominant-caste Brahmin/Jat/Rajput cultivators could better afford (or obtain credit to purchase) inputs of fertilizer and irrigation water and could thus obtain higher yields than Scheduled caste and Muslim farmers (Jewitt and Baker, 2006).

Nearly 40 years on, Green Revolution agriculture in the Bulandshahr study villages is still winning the competition against population growth. More importantly, the risk of starvation that villagers came to fear in the late 1960s is no longer present for most households as 'nobody sleeps with an empty stomach nowadays' (Chirchita farmer group, 12/04). Indeed, many villagers get 5000–6000 kg/ha of wheat in a good year with an average yield of 4000 kg/ha while basmati-type HYV rice can yield over 5000 kg/ha. Discussions with different landholding and socio-economic groups revealed that even farmers with marginal holdings had increased their food security by achieving HYV wheat yields of 4–5000 kg/ha. Improved infrastructure has accompanied the district's rapid agricultural development and all of the study villages have long had access to electricity and paved roads. Male and female literacy rates have improved steadily over the past 30 years and all villagers have ready access to modern medical care. The infant mortality rate is 68/1000 and although life expectancy data was not available for the district, the average figures for Uttar Pradesh (a state with notoriously low development indicators) are 58.9 for males and 57.7 for females.

Within the study villages, participatory risk assessments revealed clear differences in the foregrounding and backgrounding of risks between households at different positions along the risk transition and within Maslow's needs hierarchy. Life remains particularly hard for the poorest Scheduled caste households that foreground 'traditional' household-level threats associated with food insecurity and communicable diseases (see Fig. 5). In Sabdalpur and Chirchita, landless families from the Balmiki or 'sweeper' caste form the bottom of the village socio-economic hierarchy. Participatory risk assessments revealed that their

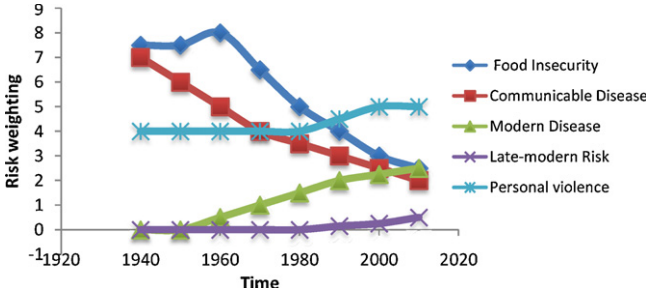


Fig. 5. Participatory risk transition for Balmiki households in Bulandshahr.

concern about (and knowledge of) more temporally distant global-scale late-modern risks such as climate change and GM was greatly overshadowed by more immediate risks of household food insecurity. Most Balmiki women rear poultry and goats within the household in addition to 'sweeping' for around ten families which earns them around Rs. 2500 per year (around 33 UK pounds). Some Balmiki men work as rikshaw drivers and labourers outside the village but most work as sweepers. Consequently many Balmiki families are vulnerable to food price fluctuations that can make it difficult for them to meet their subsistence needs. Other 'personal' risks that they face include routine violence from dominant caste villagers. There are also a number of 'personal' risks linked to wider gender inequalities in the region that tend to have a disproportionate impact on lower/Scheduled caste groups. Although issues of violence against women were never overtly raised during fieldwork, gender discrimination is indicated by the female:male sex ratio in the district which declined from 901:1000 in 1901 to a low of 855:1000 in 1971. Despite the increased affordability of foetal sex determination tests, the district's sex ratio increased slightly thereafter, reaching 865:1000 in 1981 and 881:1000 in 2001, but the increasing cost of dowries was a common complaint.

For many landowners, the yield gains brought by the green revolution have been diluted to a greater or lesser extent by population increase coupled with partible inheritance systems that have caused significant land fragmentation. Average land-holdings are around half what they were in 1971 (3.44 ha) and this, coupled with yield stagnation, means that small/marginal farmers (owning under 1 ha and making up half of the landowning households) are periodically threatened by food insecurity (see Fig. 6). Although this group has gained, as consumers, from improved food affordability and depressed cereal prices, they have high agricultural input costs relative to wealthier farmers coupled with problems in getting credit from banks (at interest rates of 1%/month) which forces them to borrow from neighbours at interest rates of 5%/month (Baker and Jewitt, 2007).

Typically, small/marginal farmers seek to minimise the risk of food insecurity by sowing all of their land with wheat (winter) and rice (monsoon) for self-consumption and selling their labour to meet subsistence shortfalls. Off-farm labour opportunities have increased rapidly since the 1970s and as Allan (2010, p. 21) observes, they play a very important role in protecting farmers from community-based and global risks associated with 'the brutal uncertainties of the environment and the market'. Indeed, there is a perception amongst small/marginal farmers that landless households (that make up 30–40% of the population of the study villages) face fewer food security risks than themselves as Bulandshahr's booming construction industry and opportunities for migration to the Gulf have provided plenty of well-paid employment opportunities (Jewitt and Baker, 2006).

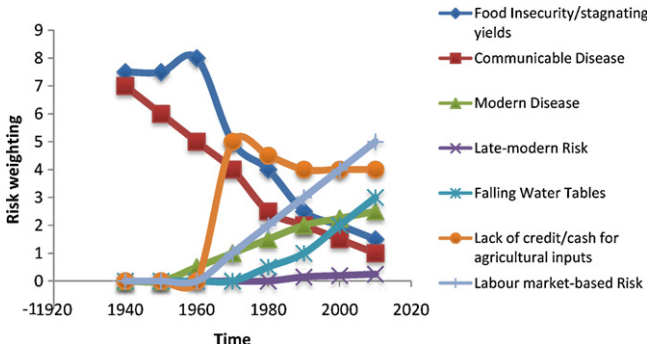


Fig. 6. Participatory risk transition for small and marginal farmers in Bulandshahr.

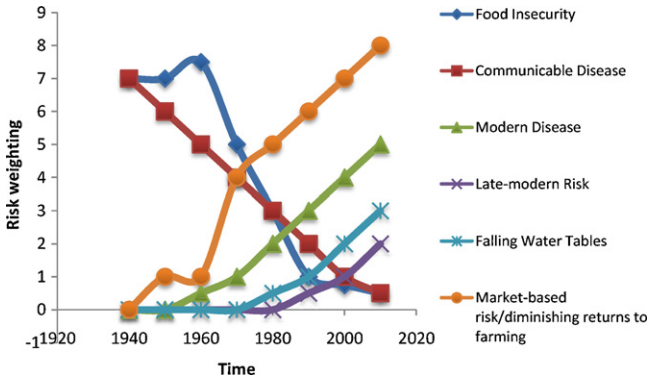


Fig. 7. Participatory risk transition for wealthiest households in Bulandshahr.

Indicating a shift along the risk and epidemiological transitions amongst the medium and large landowners (see Fig. 7), many villagers spoke of improved health care, education and diet which have increased life expectancy and reduced infant mortality rates along with the incidence of malaria, tuberculosis and night blindness; responses that were confirmed by a local doctor (Jewitt and Baker, 2006). Amongst these villagers, household-based group 1 risks associated with communicable diseases and food insecurity have become far less of a worry than concerns about group 2 health issues and more community-based environmental and market-related risks. There was a perception that formerly unknown (or unthreatening) group 2 ailments such as stress, strokes and heart disease were on the increase in the study villages and several women from this group also talked about increased 'mystery illnesses' in children that they attributed to water pollution by agro-chemicals (Baker and Jewitt, 2007).

Most farmers in this group are able to grow enough food to meet their subsistence requirements and those owning over 2 ha typically grow wheat and rice on less than half of their land; the remainder being planted with cash crops such as sugar cane. So while food insecurity is no longer such a risk, many are becoming concerned about economic insecurity and environmental degradation at the community-level because agriculture in the district has been suffering from static and declining yields (Jewitt and Baker, 2006; Baker and Jewitt, 2007). Most farmers attribute yield declines to increasingly sodic soils plus low soil organic matter levels and accept that years of intensive Green Revolution have worsened this problem. To compensate, they apply increasing amounts of agro-chemicals which, when combined with falling state subsidies for agricultural inputs, makes agriculture less profitable for cash-crop growers and more risky for subsistence farmers.

Another environmental problem that concerns all farmer groups is declining water table levels in non-canal irrigated areas. In parts of Chirchita, some fields have had to be abandoned as wells have dried up. There is a general expectation that this problem will become more pronounced in future, but amongst the wealthier farmers who can, if and when necessary, find the funds for deeper wells, there is a tendency to background this longer-term risk in the face of what they consider more 'urgent' problems associated with diminishing economic returns to farming.

Nevertheless, there was also evidence that more global late-modern risks associated with biodiversity loss and climate change were starting to be foregrounded by a few of the wealthier and better educated villagers, along with a more general concern about modern health risks that could not be clearly linked to specific causes (Smith, 2001). The perceived rise of 'mystery illnesses' in children was a good example of this, as was the general feeling, amongst a number of wealthier households, that people in the

village 'are weaker nowadays . . . more sickly than they used to be' (large farmers group, Sabdalpur, 12/04) despite widespread evidence to the contrary.

With regard to biodiversity loss, there was a tendency, as the Green Revolution progressed, for traditional crop varieties to be replaced by fewer HYVs with an even narrower genetic base. From data collected in Sabdalpur, it was evident that small farmers had a narrower cropping base than their larger counterparts and a number of villagers commented that they missed growing pulses which they associate with good health. The main reason for the displacement of pulses is that they have a low yield (1500 kg/ha) compared to wheat and rice and are susceptible to disease, pests, salinity and waterlogging. As one farmer put it: 'wheat and sugarcane are assured crops, so we can't take the risk of growing pulses' (large farmers group, Sabdalpur, 12/04). But several of the wealthiest farmers in Sabdalpur and Chirchita continue to grow pulses and intercrop a variety of vegetables. This is not a short-term risk minimisation strategy to protect against crop failure, but a deliberate attempt to increase soil quality and reduce susceptibility to modern health problems by improving household diets and cultivating more organically (using compost rather than chemical fertilizer). Discussions with three large landowners in Chirchita also indicated more global concerns about the longer terms risks associated with low agro-ecosystem biodiversity. In particular, they mentioned the need to avoid what happened in the 1970s when stands of monocropped HYVs proved susceptible to disease and pest attacks. Amongst most other farmers interviewed, however, there was little concern about biodiversity loss as, like many farmers in Jharkhand, they felt that the frequent introduction of new HYVs had actually improved crop diversity relative to before the Green Revolution.

Late-modern risks associated with the global and more local impacts of climate change also seemed to be of minor concern within the study villages as only one particularly wealthy and well-educated farmer talked about global warming as a significant issue. This was explained in part by the temporal distance and scientific uncertainty surrounding climate change which was expressed in most cases by the feeling that there were more pressing things to worry about than something that may or may not affect them in some as yet unspecified way. Most farmers expressed a belief in the power of technology to ameliorate the impacts of climate change with emphasis being placed on the need to breed new crop varieties that would adapt to any change in environmental conditions. Significantly, genetic modification was seen as having important potential in this adaptation process and nobody mentioned the wider environmental risks. Instead, there was a strong feeling that GM might help to address problems associated with yield stagnation, sodic soils, falling water table levels and excessive agro-chemical use. Given their experience of the Green Revolution it is understandable that most farmers background late-modern risks surrounding GM and foreground those associated with food and economic security; especially given their concern with material rather than 'post-material' needs (Inglehart, 1977) and the short time that has elapsed since most were at the centre of the risk transition.

4. Conclusions

World 'risk society' approaches have played a crucial role in highlighting the dangerous uncertainty surrounding late-modern global risks such as climate change. And while the hazards of 'risk society' are undoubtedly real and affect the rich and poor alike (Beck, 1992), there are significant spatial variations in the extent to which these risks are prioritised. As Smith and Ezzati (2005, p. 324) point out 'rising income affects societal discounting in time and space' so, following Inglehart's (1997) logic, late-modern 'post-material' societies that have secured their material needs can afford to foreground global environmental problems. For many of the 1.1 billion dollar poor in the global South, by contrast, low levels of education coupled with frequent exposure to group 1 risks (associated especially with food insecurity and communicable disease) restrict their capacity to mitigate household-level hazards or be reflexive about spatially and temporally distant late-modern risks. Although many villagers in Ranchi District are broadly aware of global risks such as the greenhouse effect, climate warming, and the meltdown of nuclear reactors, the fact that that they are usually 'delayed and non-specific' (Smith, 2001, p. 151) makes them easier to 'background'. Instead, households tend to prioritise the minimisation of immediate risks to their everyday survival and the avoidance of unattractive alternative livelihood strategies such as migration.

The Bulandshahr case study, meanwhile, demonstrates how increased socio-economic status and food security has brought many villagers greater freedom from group 1 household-level hazards (Beck, 1992) but has exposed some to an increased risk of group 2 health burdens. In addition, most individuals in the study villages have been exposed to a growing range of community-level 'non-health risks' (Smith, 2001) associated with environmental degradation and increased exposure to modern technology and markets (Allan, 2010). But in contrast to late-modern concerns in Europe about the global environmental risk associated with GM foods, most farmers in Bulandshahr view GM as an important potential solution to local ecological problems created by intensive farming. Put simply, they, background the risk of temporally and spatially distant environmental problems in favour of increased livelihood benefits here and now: a situation that may reflect their rapid progress along the risk transition (Smith, 2001) which has not given them time to process the significance of these new risks relative to older, more familiar hazards.

Echoing the views of Lipton (1999, 2007) there is a strong recognition amongst the study villagers that without agricultural intensification, many people alive now would be dead. The rapidity of population increase coupled with fragmented land holdings meant that a shift to double cropping, particularly irrigated winter cultivation, literally represented a life-saving option for some Ranchi households and a substantial increase in annual food security (not to mention better nutrition) for many more. In Bulandsharh, the Green Revolution is not regarded as an environmental catastrophe (Shiva, 1988, 1991) but as an important means of reducing food insecurity and improving resource (land, labour and water) productivity in the face of land fragmentation. By helping villagers in both districts to satisfy their physiological needs, agricultural intensification has allowed them to progress (quite a long way for some households in Bulandshahr) along the 'needs hierarchy' (Maslow, 1970) as well as the risk transition.

As farmers such as these will play an important role in managing future global risks associated with food production, water security, environmental degradation and climate change, better understandings of how they perceive, prioritise and manage household, community and late-modern global risks at different points along the risk transition are vital for determining appropriate interventions (Meze-Hausken, 2004; Smith and Ezzati, 2005). At present, trajectories of change in the global South are in danger of 'rapidly outpacing societal responses' (Kasperson et al., 2005, p. 192) as a desire for economic development results in the backgrounding of community- and global-scale environmental risks. Deterministic approaches to the understanding and prediction of late-modern global risks such as climate change create further difficulties (Meze-Hausken, 2004) while regional variations in risk perception 'complicate efforts to reach international consensus on strong control measures' (Smith and Ezzati, 2005, p. 329).

In a more optimistic vein, Allan (2010, p. 20) argues that over the past century, farmers have delivered adaptive solutions to demographically imposed demands for food that were 'much greater than anything climate change will bring in the current century' and will continue to manage the risk of food insecurity if given appropriate economic and social incentives. To help them achieve this, he argues that it is necessary to protect them from the risk of market uncertainties because 'farmers combine available inputs most effectively if the rural economy and rural social infrastructures are favourable' (p. 19). Drawing from Allan's analysis of water security, risk and governance, an important 'macro scale' message is that there are important relationships between global food and water security and success in reducing risks to farmers in the global South that need to be translated into policy interventions. Farmers make key decisions regarding whether inputs to farming systems are combined in sustainable ways or not. Resource poor farmers in the global South therefore 'need to be protected from the extreme risks of the environment and the global market' (ibid., p.29) if they are to escape from poverty with more sustainable methods of farming. Exactly how this should be achieved will rely heavily on place- and income-sensitive analyses that explore perceptions of and responses to changing household, community and late-modern risk amongst people living close to the centre of the risk transition whose basic needs remain far from secure.

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References

Adeola, F.O., 1998. Cross-national environmentalism differentials: empirical evidence from core and non-core nations. Society and Natural Resources 11, 339–364.

Allan, A., October 2000. Coping with water deficits: foregrounding and backgrounding risk in the semi-arid Middle East. Paper presented at the Department of Geography, School of Oriental and African Studies, London, UK.

Allan, A., 2010. Water: security, risk and governance. Paper presented at the Water & Risk Workshop at Durham University, Durham, UK. An IAS Interdisciplinary Workshop Examining Risks Associated with Water, 12–14 January 2010. Details available at http://www.dur.ac.uk/water.risk/?cat=16 (accessed 25.03.10).

Atkinson, E.T., 1903. Bulandshahr. A Gazetteer Being no. V. of the District Gazetteers of the United Provinces of Agra and Oudh. Government of India, Calcutta.

Barbier, E.B., 1997. Introduction: environmental Kuznets curves. Environment and Development Economics (Special Issue) 2, 369–381.

Baker, K. (1975) Changes in patterns and ractices of wheat farming since the introduction of the high yielding varieties; a study in six villages of the Bulandshahr District Uttar Pradesh Northern India 1965-66 to 1971-71. London: School of Oriental and African Studies. Unpublished Phd Dissertation.

Baker, K., Jewitt, S., 2007. Evaluating Thirty-five Years of Green Revolution Technology in Villages of Bulandshahr District, Western Uttar Pradesh, North India. Journal of Development Studies 43 (2), 312–339.

Beck, U., 1992. Risk Society: Towards a New Modernity. Sage, London.

Beck, U., 1994. The reinvention of politics: towards a theory of reflexive modernization. In: Beck, U., Giddens, A., Lash, S. (Eds.), Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order. Polity Press, Cambridge, pp. 1–55.

Beck, U., 1995. Ecological Politics in the Age of Risk. Polity Press, Cambridge.

Beck, U., 1996. Risk society and the provident state. In: Lash, S., Szerszinski, B., Wynne, B. (Eds.), Risk, Environment and Modernity: Towards and New Ecology. Sage, London, pp. 27–43.

Beck, U., 1999. World Risk Society. Polity Press, Oxford.

Bowonder, B., Kasperson, J.X., 2005. Hazards in developing countries: cause for global concern. In: Kasperson, J.X., Kasperson, R. (Eds.), The Social Contours of Risk. Volume II: Risk Analysis, Corporations and the Globalization of Risk. Earthscan, London, pp. 167–171.

Brechin, S.R., Kempton, W., 1994. Global environmentalism: a challenge to the postmaterialism thesis. Social Science Quarterly 75 (2), 245–269.

Brown, L.R., 1970. Seeds of Change. New York, Academic Press.

Bouis, H., 2007. The potential of GM food crops to improve human nutrition in developing countries. Journal of Development Studies 43 (1), 79–96.

Burton, I.R., Kates, R.W., White, G.F., 1978. The Environment as Hazard. Oxford University Press, New York.

Byres, T.J., 1981. Agrarian structure, the new technology and class action in India. Journal of Peasant Studies 8, 322–342.

Byres, T.J., 1983. Green Revolution in India. Open University Press, Milton Keynes.

Cautley, P.T., 1854. Historical Sketch and Origin of the Progress of the Ganges Canal, vol. 1. Hutchinson, London.

Cohen, S., Taylor, L., 1992. Escape Attempts: The Theory and Practice of Resistance to Everyday Life, second ed. Routledge, London.

Corbridge, S., Kumar, S., 2004. Community, corruption, landscape: tales from the tree trade. In: Corbridge, S., Jewitt, S., Kumar, S. (Eds.), Environment, Development and Ethnicity. Oxford University Press, Oxford, pp. 264–290.

Department of Forest and Environment, Jharkhand, 2010. Environmental Information System. http://jharenvis.nic.in/ranchi.html (accessed 12.04.10).

Douglas, M., Widalsky, A., 1982. Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers. University of California Press, Berkeley/Los Angeles.

Douglas, M., 1992. Risk and Blame: Essays in Cultural Theory. Routledge, London.

Giddens, A., 1991. Modernity and Self-Identity. Polity Press, Cambridge.

Gokale, N., 2003. Foreword. In: Mishra, A. (Ed.), Casting the Evil Eye. Witch Trials in Tribal India. Roli Books, New Delhi.

Government of India, 1981. Census of India, 1981. Government of India, New Delhi.

Government of India, 1911. Census of India, 1911, vol. 1. Superintendent, Government Printing, Calcutta.

Government of India, 2010. Census of India. http://www.censusindia.net/ (accessed 12.4.10).

Hallett, M.G., 1917. Bihar and Orissa Gazetteers. Superintendent, Government Printing, Bihar/Orissa/Ranchi/Patna.

Herring, R., 2007. Stealth seeds: bioproperty, biosafety, biopolitics. Journal of Development Studies 43 (1), 130–157.

Inglehart, R., 1977. The Silent Revolution. Changing Values and Political Styles Among Western Publics. Princeton University Press, Princeton.

Inglehart, R., 1997. Modernization and Postmodernization. Cultural, Economic, and Political Change in 43 Societies. Princeton University Press, Princeton.

Jewitt, S., 2002a. Environment, Knowledge and Gender: Local Development in India's Jharkhand. Ashgate Publishing Company, Ashgate.

Jewitt, S., 2002b. Modern farming, socio-environmental disasters and the displacement of traditional agriculture? A re-assessment from Ranchi District, Jharkhand. In: Bradnock, R.W., Williams, G. (Eds.), South Asia in a Globalising World: A Reconstructed Regional Geography. Prentice Hall, Harlow, pp. 19–50.

Jewitt, S., Baker, K., 2006. The Green Revolution re-assessed: Insider perspectives on agrarian change in Bulandshahr District, Western Uttar Pradesh, India. Geoforum 38 (1), 73–89.

Jewitt, S., 2011a. Geographies of Shit: Spatial and temporal variations in attitudes towards human waste. Progress in Human Geography 35 (5), 608–626.

Jewitt, S., 2011b. Poo gurus? Researching the threats and opportunities presented by human waste. Applied Geography 31 (2), 761–769.

JSAC, 2010. Jharkhand Village Profile. http://210.212.20.94/cmcvp/frmvp.aspx (accessed 12.04.10).

Kasperson, J.X., Kasperson, R., 2005. Priorities in profile: managing risks in developing countries. In: Kasperson, J.X., Kasperson, R. (Eds.), The Social Contours of Risk. Volume II: Risk Analysis, Corporations and the Globalization of Risk. Earthscan, London, pp. 172–179.

Kasperson, R.E., Kasperson, J.X., Turner, B.L., 2005. Risk and criticality: trajectories of regional environmental degradation. In: Kasperson, J.X., Kasperson, R. (Eds.), The Social Contours of Risk. Volume II: Risk Analysis, Corporations and the Globalization of Risk. Earthscan, London, pp. 180–197.

Lash, S., 1994. Reflexivity and its doubles: structure, aesthetics, community. In: Beck, U., Giddens, A., Lash, S. (Eds.), Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order. Polity Press, Cambridge, pp. 110–173.

Lipton, M., October 1999. Reviving the Stalled Momentum of Global Poverty Reduction: What Role for Genetically Modified Plants? Crawford Memorial Lecture, Washington, DC.

Lipton, M., 2007. Plant breeding and poverty: can transgenic seeds replicate the green revolution as a source of grains for the poor? Journal of Development Studies 43 (1), 31–62.
Lipton, M., Longhurst, R., 1989. New Seeds and Poor People. Unwin and Hyman, London.
Lopez, A.D., Mathers, C., Ezzati, M., Jamison, D.T., Murray, C.J.L., 2006. Global Burden of Disease and Risk Factors. World Bank and Oxford University Press, New York http://www.who.int/healthinfo/global_burden_disease/en/index.html (accessed 05.07.11).
Lupton, D., 1999. Risk. Routledge, London.
Maslow, A.H., 1970. Motivation and Personality, second ed. Harper and Row, New York.
Meze-Hausken, E., 2004. Contrasting climate variability and meteorological drought with perceived drought and climate change in northern Ethiopia. Climate Research 27, 19–31.
Mishra, A., 2003. Casting the Evil Eye. Witch Trials in Tribal India. Roli Books, New Delhi.
Parkhill, K.A., Pidgeon, N.F., Henwood, K.L., Simmons, P., Venables, D., 2010. From the familiar to the extraordinary: local residents' perceptions of risk when living with nuclear power in the UK. Transactions of the Institute of British Geographers 35 (1), 39–58.
Raftaar, 2010. Bulandshahr. http://dir.raftaar.in/Hindi-directory/Regional/News/uttar-pradesh/bulandshahr (accessed 12.4.10).
Reid, J., 1912. Final Report on the Survey and Settlement Operations in the District of Ranchi, 1902–1910. Bengal Secretariat Book Depot, Calcutta.
Roy, S.C., 1912. The Mundas and Their Country. Reprinted in 1970. Asia Publishing House, London.
Roy, S.C., 1915. The Oraons of Chota Nagpur: Their History, Economic Life and Social Organisation. Reprinted in 1984. Man in India Office, Ranchi.
Roy, S.C., 1928. Oraons Religion and Customs. Reprinted in 1985. Gian Publishing House, New Delhi.
Shiva, V., 1988. Staying Alive: Women, Ecology and Survival in India. Kali for Women, New Delhi.
Shiva, V., 1991. The Violence of the Green Revolution. Third World Agriculture, Ecology and Politics. Zed Books, London.
Slovic, P., 1987. Perception of risk. Science 236, 280–285.
Smith, K.R., 1997. Development, health, and the environmental risk transition. In: Shahi, G., Levy, B., Binger, A., Kjellstrom, T., Lawrence, T. (Eds.), International Perspectives in Environment, Development, and Health. Springer, New York, pp. 51–62.
Smith, K.R., 2001. The risk transition and developing countries. In: Kasperson, J.X., Kasperson, R. (Eds.), Global Environmental Risk. Earthscan, London, pp. 148–172.
Smith, K.R., Ezzati, M., 2005. How environmental health risks change with development: the epidemiologic and environmental risk transitions revisited. Annual Review of Environmental Resources 30, 291–333.
Tullock, J., Lupton, D., 2003. Risk and Everyday Life. London, Sage.
The Economist, 25 February 2010. Taking Root. The Developing World Embraces a Controversial Technology. http://magic.economist.com/node/15580864.
White, G.F., 1945. Human adjustment to floods: a geographic approach to the flood problem in the United States. Research Paper No. 29, University of Chicago, Department of Geography, Chicago.
White, G.F. (Ed.), 1974. Natural Hazards: Local, National, Global. Oxford University Press, New York.
World Bank, 2008. World Development Report 2008: Agriculture for Development. World Bank, Washington, DC.