

Weighing Up the Risks: The Challenge of Studying ‘Risk’ in Empirical Research

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Abstract Studying multifaceted risks that are simultaneously and differently perceived and experienced presents significant challenges, but gaining insight into multiple realities and rationalities is crucial for achieving effective and collaborative governance. This article describes the challenges of a recent study that looked at how different actors, ranging from smallholder farmers to international biotechnology development projects, weigh up the risks associated with the uncertain future of maize agriculture in Kenya. It presents personal reflections on a 12-month experience of applying a multi-sited, ethnographic research approach in Kenya and the UK, in an attempt to observe the creation, perception and experience of risks. The article demonstrates the importance of history, knowledge, social and institutional settings, trust and politics in the ways that risks are created, perceived and experienced by these different actors, and argues for the necessity of engaging with these highly contextualised processes at individual, local and institutional levels.

1 Introduction

As a response to the social impacts of major disasters of the 1980s and 1990s (Bhopal, Chernobyl, the BSE crisis and more), academic engagement with the challenges of measuring and managing risk flourished. The fact that these new risks had been created, rather than controlled, by science and technology caused many to question the privileged position that ‘expert’ knowledge held as the lone safeguard of society (Adam, Beck and van Loon 2000). The paradox of science and technology as both risk and safeguard is apparent across a number of sectors today, but particularly within agriculture where modern biotechnologies are increasingly heralded as a response to the risks associated with a changing climate. In reality, the particular combination of risks and benefits presented by climatic change and by new agricultural technologies are differently perceived and experienced by different stakeholders in the future of agriculture.

This article offers reflection and insight from an attempt to study the creation, perception and experience of risk in the context of smallholder farming in Kenya, where this technological approach to agricultural climate change

adaptation is increasingly gaining financial and policy support. It focuses on the multiple ways in which risk is introduced and experienced (e.g. through climate change threats to livelihoods or the development of new agricultural biotechnologies) by different actors, from smallholder farmers to international biotechnology development projects, within this context. The research findings highlight the importance of history, knowledge, social and institutional settings, trust and politics in shaping the ways that risks are created, perceived and experienced by these different actors. It is demonstrated that in order to fully appreciate what risk is it is necessary to both broaden disciplinary scope and narrow geographic focus, replacing universal theories with locally appropriate and historically and socially embedded understandings of risk.

The article begins with an introduction to the concept of the social construction of risk as a theoretical foundation for the research. It describes the methodological approach and some of the key findings, and concludes with a reflection on, and a discussion of, the importance and challenges of studying multifaceted risks.

Table 1 Description of methods, data collection and key questions addressed in the research

Phase	Stakeholder group	Methodological approach	Data collection	Key questions
1	Climate scientists and crop modellers	Assumption mapping Akin to a small-scale value-chain analysis in which the climate or crop model is the product and 'uncertainty' replaces 'value' as the focus of interest, such that the points in the product-cycle of the climate or crop model at which uncertainty accumulates (and where it enters and 'leaves' the chain) can be identified.	<ul style="list-style-type: none"> ● 16 structured interviews were conducted with academics at the UK and Kenya Meteorological Departments, CGIAR institutions, and the Kenya Agricultural Research Institution's Climate Change Unit ● Systematic review of climate/crop modelling literature ● Secondary data from 2010 meta-analysis survey of crop modellers conducted by the CCAFS group of the CGIAR 	<ul style="list-style-type: none"> ● How are climate change risks constructed through climate and crop modelling? ● Where does uncertainty (and ambiguity and ignorance) originate and where is it hidden in projections of future crops/climates? ● How is uncertainty (and ambiguity and ignorance) in modelling communicated across the modelling process/beyond it?
2	Water Efficient Maize for Africa project partners	Institutional ethnography Involves attending and observing all aspects of work that is conducted within an institution, tracing the social connections, operations, regimes, 'ruling relations', discourses, and values that structure and drive that organisation (Devault 2006; Lewis 1998; M'charek 2005; Smith 2005).	<ul style="list-style-type: none"> ● Visits to Kenya Agricultural Research Institute; CIMMYT; Monsanto ● 18 semi-structured interviews ● 3 visits to breeding stations ● Analysis of project documents and literature ● Observation of WEMA partners at agricultural shows, Open Forum on Agricultural Biotechnology meetings, and the National Biosafety Conference 	<ul style="list-style-type: none"> ● How is the WEMA pathway framed in relation to alternative pathways of change? ● How are evidences and knowledges (re)produced within WEMA? ● What knowledges and evidences justify the WEMA narrative of change (and which knowledges and evidences are ignored)?
3	Smallholder farmers (Nyando/Nandi and Makueni districts)	Participatory scenario development Participatory scenario development (Enfors <i>et al.</i> 2008; Kok, Biggs, and Zurek 2007; Patel, Kok and Rothman 2007) workshops bring smallholders together and engage them in the task of developing, analysing and comparing qualitative storylines about future land use.	<ul style="list-style-type: none"> ● Observations of farming practices in Nyando/Nandi and Makueni districts ● Semi-structured interviews with 46 farmers ● 6 participatory scenario workshops ● Secondary data – 280 household survey questionnaires 	<ul style="list-style-type: none"> ● How are livelihood risks/uncertainties/opportunities perceived, experienced and adapted to? ● What future pathways are envisaged in relation to a changing and uncertain climate?

2 Background: tracing a complex trajectory in risk studies

In response to the picture of society painted by Giddens (1990) and Beck (1992), as one which has become concerned, above all else, with the regulation of technologically created, trans-boundary and uncontrollable risks, academic

work in the 1990s produced a dense and complex body of literature which theorised at length about the limitations of knowledge and the legitimacy of risk-regulating protocols and institutions (Adam 1996; Funtowicz and Ravetz 1994; Hinchliffe 2001; Jasanoff 1999; Shrader-Frechette 1996; Wynne 1992, 1996).

Table 1 Description of methods, data collection and key questions addressed in the research (cont.)

Phase	Stakeholder group	Methodological approach	Data collection	Key questions
4	Actors within Kenyan biosafety regulation	Narrative policy analysis Identification of narratives and discourse within policy documents, statements and speeches in order to identify ‘the ways in which practitioners, bureaucrats, and policymakers articulate and make sense of complex realities’ (Roe 1994: 35). This approach is used to characterise the scenarios and arguments that frame regulatory discourse in Kenya.	<ul style="list-style-type: none"> ● 5 semi-structured interviews with members of the National Biosafety Authority (NBA) and the KARI Institutional Biosafety Committee ● A review of policy documents and peer-reviewed literature (including within the NBA archives) ● 3 interviews with academic experts on Kenyan Biosafety politics ● 4 semi-structured interviews with pro- and anti-GM lobby organisations (2 each) ● Attendance at National Biosafety Conference and Open Forum on Agricultural Biotechnology meetings 	<ul style="list-style-type: none"> ● What alternative understandings of biotechnology risks/uncertainties/(ambiguities/ignorances)/opportunities contribute to the biosafety debate in Kenya? ● Whose narratives are being formalised within biotechnology legislation/regulatory frameworks?

The information deficit model, which represented the dominant paradigm within the ‘public understanding of science’ (PUS) studies of the 1980s, was driven by a belief that observed differences between the ‘perceptions’ of the lay public and the ‘objective findings’ of scientists were the product of a lack of understanding about, or lack of effective dissemination of, scientific processes and results within the wider society (Royal Society 1983). However, discontent with deterministic assumptions, coupled with public distrust of the institutions charged with identifying and regulating risks (Owens 2000; Slovic 1999; Wynne 1996), led to the development of alternative theories to explain the continued disparity between scientific fact and public perception (Irwin and Wynne 1996; Slovic 2000).

Through the 1990s, a large body of literature emerged that highlighted the value judgements and subjective decision-making involved in framing ‘scientific problems’ (particularly those which presuppose societal objectives), selecting methodological approaches, and interpreting results (Hinchliffe 2001; Shrader-Frechette 1995). The objectivity of science was increasingly challenged by arguments about the constructed nature of knowledge, and the ambiguous nature

of complex real-world change and, as a consequence, it was increasingly recognised that the contextualised knowledge of ‘non-experts’, developed through real experience of societal behaviour and values, is an important source of information about the realities of risk (Beck 1992; Jasanoff 1999; Wynne 1996).

Douglas and Wildavsky’s (1982) theory that alternative interpretations and acceptabilities of risk are the product of personal cultural traits, which often reflect social structures, has underpinned studies that have attempted to show that the culture of scientific institutions is different from that of a general public or a local farmer (Finucane 2002; Finucane and Holup 2005) and, furthermore, that social interactions reinforce cultural barriers (Herring 2007; Lomax 2000; Priest, Bonfadelli, and Rusanen 2003) and ‘amplify’ risks (Kasperson *et al.* 1988). In relation to understandings of risk, an extensive body of literature considers the ways in which cultural barriers are strengthened through the development of public distrust of regulating institutions (Lomax 2000; Priest 2001; Renn *et al.* 1992; Renn and Levine 1991). Lash and Wynne (1992) argue, along with a large body of more recent sociology literature (Finucane and Holup

2005; Hinchliffe 2001; Irwin 2001; Irwin and Michael 2003; Pellizzoni 2010; Stirling 2003), that it is in these barriers and social and cultural practices that risks are socially constructed.

The challenges of studying risk, then, are clearly evident. Risks are differently created, amplified, perceived and experienced by different people in different social, cultural and institutional settings. Difficult questions arise about how to conceptualise, interpret and govern issues around which knowledge is not only incomplete, but simultaneously exists both in real-world observation and internally in the culture, experience and values of individuals (Horlick-Jones 1998; Slovic 1999). This article focuses on addressing some of these difficult questions, particularly about conceptualisation and interpretation.

3 The challenges of putting a complex concept in to practice: reflections on fieldwork

This complex concept of socially constructed and multifaceted risk was adopted within a 12-month period of fieldwork which aimed to understand the ways in which a whole range of actors with a stake in the future of maize agriculture in Kenya – smallholder farmers, crop breeders, biotechnology regulators, climate scientists – frame the future. The research was designed particularly in response to the recognition that across sub-Saharan Africa (SSA), technological responses to climate change are increasingly being heralded, largely by influential actors within a growing public–private sector, as *the* solutions to a risky and complex problem; but also that such technological futures are often not risk-free themselves and they coexist with multiple alternative ‘pathways to sustainability’ (Leach, Scoones and Stirling 2007). The opening up and ongoing definition of biotechnology regulation (both in Kenya and across SSA), the changing climate, the unstable food prices and markets, and the growing political concern with food security and rural livelihoods, all contribute to a highly uncertain future around which there is a plurality of risk constructions.

The Water Efficient Maize for Africa (WEMA) initiative in Kenya – a public–private initiative that seeks to develop and disseminate genetically engineered drought-tolerant maize to ‘vulnerable’ smallholder farmers in order to

improve their resilience to the coupled risks of drought and climate change – was the central case study of the research and a combination of participatory and ethnographic research methods were applied in engaging with WEMA institutions, international agricultural research institutions, climate-crop modelling institutions, smallholder farmers from two of Kenya’s maize growing districts (with opposing dominant agro-ecological conditions), and biosafety regulatory policymakers.

A multi-sited approach was adopted, with the aim of engaging with the connections and points of departure between multiple stakeholders, multiple constructions of risk, and multiple pathways. The research was organised into four phases, each primarily focused on a different stakeholder group and adopting methods that directly targeted information in response to stakeholder-specific questions. These phases are detailed in Table 1, which includes information about the stakeholder target group, the research methods applied, and the key questions being addressed.

Some of the findings about the contextualised processes by which risks are created, perceived and experienced amongst each of these stakeholder groups are presented below. Through this summary, the fundamental role of contextualised histories, knowledges, politics, priorities, social interactions and trust, in shaping multifaceted risk becomes evident.

3.1 Climate-crop modelling

Within climate-crop modelling, the projections of which increasingly provide the evidence base for the agricultural development work of the Consultative Group on International Agricultural Research (CGIAR), there is an extensive and growing global community of contributing scientists. Within this community, this research found a tension between a ‘complexity logic’ in the construction of Kenya’s agro-climatic future – which equates increasing model resolutions, parameters and model ensembles with increasing proximity to reality and by extension (through an evidence-based policy logic) to better informed policy – and warnings, that actually come from within the modelling community itself, against both objectivist interpretations of modelling outputs and the privileging of science as the sole constructor of this future:

The recent disagreements in the literature (like differences between David Lobell and Chris Funk) about the directions and even model reliability for East Africa suggest to me that we need to implement adaptation strategies for moderately severe cases even if we don't know the exact changes to plan for. The models aren't very good at predicting trends yet. Because of this shortfall, we should be focusing on getting better observations (field size, maize varieties in use, nexrad [Next Generation Radar] rainfall estimates). The observations would do two things: provide better data to farmers, and provide better data for model calibration. (Email correspondence with a US climate scientist, January 2012)

This statement offered by a key climate science informant highlights some of the challenges of using climate impact projections in the light of incomplete knowledge. It is evident in the way that the informant struggles between a realisation of the weaknesses of models' predictions – 'the models aren't very good at predicting trends yet' – and the need for some kind of projection guidelines – 'we need to implement adaptation strategies for moderately severe cases'. This challenge is not uncommon, and its resolution all too often depends on a particular framing of the knowledge gap, in which it is reduced to a probability distribution and, where projections are divergent, the average of a set of models becomes akin to the most likely change. This closing down of incomplete knowledge to over-simplified probability distributions is a cultural convention within the modelling community.

However, the seemingly infinite endeavour towards increasing model complexity in order to narrow probability distributions, is also being countered by an emerging convention, within the same community, that recognises that there is an extent to which agro-climatic futures are not just unknown, but are unknowable and, as such, there are limits to the justifiability of seeking ever greater model complexity:

The community would, I believe, greatly benefit from moving away from 'black box' thinking, whereby crop science knowledge is believed to be contained within models. (CCAFS crop modellers' survey response)

There is the beginning of a backlash – a favouring of simpler and participatory modelling approaches – and particularly a recognition that models are not simply predictive machines, but rather are useful tools for contributing towards particular policy questions, and that they should be designed as such. It is clear, however, that constructions of future risk that are bounded within climate-crop models are shaped by the scientific conventions of the discipline, as well as by a political motivation of defending and legitimising that discipline, and the expertise of modellers.

3.2 The Water Efficient Maize for Africa Initiative

The story of agricultural change advanced within the official communications and reports of the WEMA initiative is of a 'pro-poor' technological solution to problems of poverty and food insecurity that are largely ecologically and climatically driven. Such a narrative is evident in the following statements, which are taken directly from a WEMA policy brief:

Persistent incidences of drought in Kenya have continued to threaten the food security situation and subjected millions of Kenyans to starvation... Modern biotechnology provides a major opportunity to address perpetual maize shortages that are now being compounded by new threats triggered by climate change... WEMA was launched as a demand driven technological innovation designed to strengthen the resilience and adaptive capacity of maize farmers to cope with drought... Stable and reliable yields will revitalise and build the confidence of farmers in maize production. Stability in yields will give farmers the confidence to invest in other productivity enhancing technologies such as sustainable soil management practices... It is projected that maize varieties to be developed could increase yields by 25 percent compared to current varieties. This increase would translate into about two million additional tonnes of food during drought years... Policymakers within the relevant government institutions and agencies should create an enabling environment and make science-based decisions that will facilitate the conduct of confined field trials and other biosafety regulatory steps that will eventually lead to commercialisation of WEMA seed varieties (WEMA 2010b).

Table 2 Summary of evaluation of three broad pathways, and one sub-pathway, of change in maize farming

Change pathways	Nandi/Nyando Makueni		Time horizon	Critical future scenario
	Time horizon	Critical future scenario		
Changing land management, preparation and inputs	Near term	<ul style="list-style-type: none"> ● Rising input costs ● Climate-related crop failures ● Evidence/experience of success 	Very near term	<ul style="list-style-type: none"> ● Climate-related crop failures ● Information/training
Adopting varieties and technologies	Near term	<ul style="list-style-type: none"> ● Climate-related crop failures ● Evidence/experience of success 	Long term	<ul style="list-style-type: none"> ● Availability and accessibility ● Evidence/experience of success ● Financial resources
Adopting GM maize	Very long term	<ul style="list-style-type: none"> ● Evidence/experience of success ● Information ● Favourable regulation 	Very long term	<ul style="list-style-type: none"> ● Information ● Availability and accessibility ● Evidence/experience of success ● Favourable regulation
Alternatives to maize for market and home consumption	Long term	<ul style="list-style-type: none"> ● Financial resources ● Information ● Evidence/experience of success 	Long term	<ul style="list-style-type: none"> ● Financial resources ● Evidence/experience of success ● Climate-related crop failures

It is within the changing nature of the ‘global public goods’ mandate of the CGIAR; the resource limitations of the Kenya Agricultural Research Institute (KARI; one of the WEMA partners); the history and trajectory of research and development in crop breeding; the ‘impact-at-scale’ targets of philanthropic donors; and the commercial interests, business culture and charitable participation of private partners that this WEMA narrative fits, comfortably at points but not so at others.

The approach to crop breeding and social impact assessment within the WEMA initiative is particularly shaped by the institutional and political context from which it has been forged and within which it operates. In adhering to the business-mindedness, state-of-the-art, and impact-at-scale priorities of Monsanto and of the Gates Foundation, WEMA science is geared towards the generation of particular evidences. Crop breeding within CIMMYT (International Maize and Wheat Improvement Center, Mexico) has shifted to a focus on optimal rather than appropriate technology development; crop trials take place in ‘mega-environments’ that represent vast expanses of similar agro-ecologies and essentially deny local social, cultural, economic and political geographies; and socioeconomic impact assessments focus on identifying the barriers to technology dissemination rather than identifying farmer needs and preferences. Within CIMMYT there is

a team of frustrated social scientists, one of whom this quote comes from:

The socioeconomic research is rich and detailed but can be sometimes peripheral to the breeding projects. (CGIAR interview, June 2012)

The WEMA case study, then, is an example of the ways that apparently science-based framings of the future are shaped by institutional and political priorities – and the evidence that legitimises this framing is actually generated within a scientific process that rather than being objective, closes down knowledge gaps through its assumptions and values and is geared towards these priorities.

3.3 Smallholder farmers

Participatory research with smallholder farmers revealed a history of experiences of interactions between farmers and external interventions, projects, policies and information. Experiences ranged from adopting ultimately unsuccessful farming practices on the basis of incomplete advice by agricultural extension workers, to purchasing fake seed through corrupt seed supply systems. As a result of these often negative experiences, barriers of distrust were created between farmers and external interventions, leading to an internalisation of risk.

In response to uncertainty, rather than being dependent on external advice and information,

farmers depend on their own experimentations, indicators and experiences to make judgements about opportunities and risk. Examples from this research include farmers conducting trials of different planting and land preparation strategies on small plots within their compound, and farmer preferences for using local indicators of weather, rather than weather forecasts, to make judgements about planting and harvesting.

As seen in the recent history of agricultural change in the two districts, the scenarios broadly revealed that incremental, reversible and low input cost pathways – changes that farmers could trial for themselves before adopting whole scale – such as changes in land preparation and planting times or the adoption of water conservation techniques, are seen as the most viable in the near term (see Table 2).

More radical changes that require investment in new technologies or changes to crop compositions were seen as potential longer term pathways contingent on significant changes in financial and resource capacity and on evidence of success. Such pathways are often less amenable to incremental adoption or farmer experimentation, so make farmers dependent on the accuracy of external information and advice, and they may see farmers having to engage with new markets and actors. As such they necessarily introduce new uncertainties, not defined by climates, but by social relations. The adoption of GM varieties is a prime example because it is likely to bring farmers into contact with new sets of regulations and new chains of seed supply and post-harvest processing, systems in which there is already little trust.

3.4 Biosafety regulation

Research into the recent history of biosafety regulatory policymaking shows how different framings of a technological future, and particularly different constructions of social risks and benefits, have competed in a highly contested and long running political debate around the drafting and establishment of the Kenyan Biosafety Act, and more recently over the establishment of regulations for labelling genetically modified foods. This can be characterised as a highly polarised political debate. Framings of a technological future of social benefits (which are linked to arguments that regulation should facilitate the promotion of

the technology) sit in direct opposition to framings of a technological future of social risk (and arguments that a precautionary regulation should prioritise social protection). From a pro-GM perspective this debate is often characterised as a science-based approach to regulation versus a value-based approach to regulation, as though the safety of GMOs has been unequivocally and objectively proven, and so taking a precautionary stance is unscientific. In the case of the Biosafety Act, this discourse was fairly well sustained, and it resulted in an Act that was drafted by experts and largely unchanged across a four-year period of very weak ‘public consultation’. An outline of obligations for considering the socioeconomic impacts of the technology within the Act were lobbied for by civil society organisations, but were largely kept out of the Act, for example. The International Food Policy Research Institute published a number of policy notes and guidelines on this subject, and though careful not to reject socioeconomic assessment in principle, these documents often present one-sided warnings about the costs, challenges and negative implications of adopting such assessments, whilst at the same time using the opportunity presented by a discussion of socioeconomics to emphasise the socioeconomic benefits of biotechnology:

Inclusion of socioeconomic considerations may render a biosafety regulatory process a nonfunctional process if it becomes an insurmountable regulatory hurdle...

Unreasonable regulatory delays or uncertainty can affect negatively the stream of societal benefits derived from the adoption of GE crops as developers tend to invest less in such environments or shift to non-regulated technologies. (Falck-Zepeda and Zambrano 2011: 189–92)

By effectively establishing the need for ‘science-based’ regulation early in the process of designing a regulatory framework, a group of politically influential scientists made themselves both indispensable and unchallengeable. Value-based concerns about the implications of the Biosafety Bill, or the suggestion of social risks by the anti-GMO lobby could readily be dismissed as not science-based and therefore not relevant to regulation. (Interview, Kenya Organic Agriculture Network)

However, the more recent regulations for labelling GMO foods, which has adopted quite strict testing, tracing, and labelling requirements, and even more significantly the Ministry of Public Health's ban on the importation of GMO foods, have really challenged the expert monopolisation of risk assessment and have actually been much more oriented towards the implementation of precautionary measures.

There is an increasingly dominant, technology-focused framing of a 'green revolution' future within agricultural policy and research in Kenya and in sub-Saharan Africa more broadly. These case studies suggest that the incomplete knowledge, values and assumptions that underpin this framing (whether in the production of model projections of agro-climatic change or knowledge about the performance and appropriateness of new maize varieties) easily become lost within an evidence base that reinforces expert ownership over knowledge. However, this incompleteness of knowledge might resurface when it is directly experienced by smallholder farmers (for example when they act on inaccurate weather forecasts that have been presented as certain, or when they adopt a technology that doesn't achieve the benefits that it promised). These negative interactions can lead to barriers of distrust being created and risks internalised and can even be the basis for constructions of risk in cases where, for example, adopting a technology is risky because it means becoming dependent on untrusted external actors.

These social barriers can result in entrenched positions that themselves create polarised framings of the future, as seen in the biosafety debate, and the case of labelling regulations or the ban on importation of GM foods are examples of how the framings of the scientific community cannot necessarily win out by sticking within their trench and making claims about the authority or objectivity of their evidence.

4 Discussion

The complexity of the concept of risk that has emerged from the literature of the past decade or so, coupled with reflections on applying this complex concept, suggest that the key to approaching risk might just be to theorise less and contextualise more. As a product of histories, social interactions, knowledge gaps and politics, risk manifests differently in different

contexts and in the different understandings, experiences and constructions of different actors. Understanding the processes through which risks are created, perceived and experienced by different actors requires an approach that can interrogate a history of social interactions and experiences, the origins of assumptions and values, politics and priorities, and trust.

Processes of decision-making are often multilayered and build on a history of assumption-laden experimentation and conclusions; this is particularly the case, for example, in climate modelling, in which there is such a huge production chain of scientific experimentation that assumptions inevitably get lost within the process, but is similarly true of smallholder farmers who are engaged in their own experimentations and make decisions on the basis of their own evidence, values, priorities, and trust.

Appropriate methods for observing and understanding the complex processes by which risks are created, perceived and experienced requires methods that are tailored to the particular contexts of the study, but should be designed to engage ethnographically with micro-scale interactions as well as to understand broader political processes and pressures, and should combine a study of contemporary processes with a retrospective look at how they have evolved and accumulated through (at least recent) history.

In this research, retrospective and real-time observation of decision-making proved to be a much more insightful way of unpacking the process than simply asking questions. Although asking farmers how they make decisions about which varieties of maize to plant revealed that it was a decision-making process that involved many factors, for example, these factors could not easily be articulated by farmers that are used to 'just do[ing] it'.¹ Because farmers participate in a much less formalised process of decision-making than does a climate or crop scientist, for example, the accumulation of experiences and experiments that contribute to this process are internal and even subconscious (as opposed to being laid out in peer-reviewed scientific papers). It proved much more useful to have the farmers participate in an exercise in which they weighted the relative importance of a range of different factors (inclusive of phenological properties of

maize but also price, supply, etc.) and have them explain their weightings in order to simulate a decision-making process.

In the case of climate modelling or crop breeding, there might be peer-reviewed documentation of processes and so assumptions can be traced retrospectively through a systematic review of literature. However, it is important to be aware that the findings of experiments often become translated into certain truths through their citation and recitation across long paper trails, with the consequence that attempting to trace assumptions can be an arduous process. An attempt to discover the assumptions underpinning the much made claims that ‘the maize varieties developed under WEMA are expected to increase yields by 25 per cent under moderate drought’ (WEMA 2010a), by following a string of citations, eventually determined that it was based on experimental research conducted by Monsanto in which a number of trials of transgenic CspB event maize (compared with its conventional hybrid) were conducted under water limited conditions (no rainfall for a span of 10–14 days immediately prior to flowering) in the American Midwest. Confusingly, however, although the data presented in these studies showed that experimental transgenic yields were higher, they did not indicate the 25 per cent growth suggested by WEMA, so whilst it had appeared to be an evidence-based claim, supported by peer-reviewed citations, it turned out to be almost entirely assumption-based.

Furthermore, looking not just to processes that take place within stakeholder groups or contexts, but to how these are shaped by connections and disconnections between groups – communications, trust, and political dynamics – is also critical for understanding multifaceted risks. Again, actual observation of information or knowledge exchanges can provide much more

insight into how information is received, trusted and interpreted than simply asking for recollections in interviews. Within this research a number of attempts were made to simulate information exchanges, including the presentation of information about GM crops to farmers. The responses to information in these cases said a lot about the extent to which they were trusted and accepted. Claims about the potential benefits of the technology were often met with a lot of interest, but also a degree of scepticism. Questions were raised about the cost of the technology, the potential health risks and even the strength of the evidence about the benefits of the technology. However, it is again important to be aware that the extent to which information is trusted may not be immediately obvious within this exchange. Initial responses to information often reflected levels of interest more than willingness to act on the information.

The scale and overlapping nature of knowledge networks that contribute to individual’s constructions of risk, mean that to observe and understand the full process by which risks are constructed is an incredibly difficult undertaking. The production chain of a climate–crop model, for example, is so vast and involves so many different actors, that to fully trace it would require a massive investment of time and energy. The same is true of understanding the risk constructions of an individual farmer, in this case requiring a study capable of capturing the historical interactions and experiences through which knowledges are developed and trust in others is built and eroded.

Such approaches to research will undoubtedly have challenges, but the insight into the origins, perceptions and experiences of multiple risks associated with future change will be invaluable for achieving effective and collaborative development in agriculture as well as other sectors.

Note

1 Farmer interview (October 2012).

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