1 Indigenous Knowledge and Natural Resources Management: An Introduction Featuring Wildlife

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Since the 1930s there have been periodic bovine tuberculosis (bTB) outbreaks in British cattle herds, continuing into the 21st century. The search for vectors and their control has featured a long-running argument over the part that wildlife, notably badgers, play in transmitting the disease to cattle and how to prevent it. On one side, there are livestock farmers who think that badgers are significant in spreading the bTB bacterium (*Mycobacterium bovis*) to their herds. They advocate culling populations in areas adjacent to their pasture land, and organizations representing them such as the National Farmers' Union[1] have lobbied successive governments to waive wildlife protection legislation and allow the slaughter of badgers using a range of methods including shooting, trapping and gassing setts. On the other side, there are animal conservationists who think that badgers play a negligible role in spreading bTB to cattle, some even arguing the reverse. They maintain that culling is not only cruel, but also ineffective, and animal welfare bodies such as the Badger Trust[2] advocate vaccination if control of the infectious bacterium really is necessary in the badger population (Caplan, 2010, 2012).

The differences of opinion prompted governments to employ scientists to examine the evidence, authorizing the conduct of trials in some regions of the West Country, such as the 'Randomised Badger Culling Trials', to assess the role of badgers in spreading bTB to cattle and the effectiveness of culling in reducing infection rates (Ares and Hawkins, 2014). While the scientific evidence suggests that badgers may play a part in spreading bTB, it largely supports the protectionists' position, arguing that culling badgers is not an effective or cost-effective approach to controlling the disease. According to independent scientific experts, culling yields modest benefits that are short term without ongoing control programmes, which are more expensive than the financial returns gained from reduced herd infection rates. Furthermore, it can make matters worse on farms outside cull areas by disrupting animals' territories and movements, resulting in infected animals roaming more widely than previously. They argue that improving control of cattle movements and bTB testing could more effectively reduce herd infections.

The conclusions continue to fuel furious debate. 'Badger culling … is a highly politicized arena, involving the national and local state, scientists, farmers and organizations such as farming unions, and those for animal protection and nature conservancy' (Caplan, 2012, p. 17). The farmers, who stand to lose tens of thousands of

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pounds with herd infection, are annoyed by the outsiders' thwarting interference in their affairs, as their deep personal knowledge of animal management and extensive experience of the countryside convinces them that culling badgers on and around their farms reduces bTB infection of their herds. The scientists, on the other hand, with less at stake personally, seek to present the objective evidence of monitored trials dispassionately, albeit counteracted by strident activists with their sometimes disruptive demonstrations; both of these parties use the trial evidence to argue that culling is ineffective and even counterproductive in reducing the infection of herds with bovine tuberculosis. The evidence on either side of the argument is equivocal, particularly when seen from the other side. It is a stand-off: indigenous knowledge (IK) versus scientific knowledge (SK).

This book addresses such commonly encountered differences in the understanding of agricultural issues, focusing on IK. It seeks to further understand what IK amounts to, as shown by current cutting-edge research, and to showcase the part it plays in natural resources management, for those who may be unaware of the possibilities it offers in tackling, as pointed out in the Preface, such currently pressing issues as food security worldwide, promoting sustainable practices and conservation, and halting environmental degradation.

What is the Indigenous Knowledge Approach?

Although IK is increasingly acknowledged within natural resource research circles, it is perhaps advisable to start with a definition of the approach, which is not as straightforward as it sounds. The ongoing argument over appropriate terms for the field,[3] an indication of the flux within it, intimates the challenge, some arguing that 'indigenous knowledge' is inappropriate as it is difficult to define in a globalizing world and potentially divisive politically (Sillitoe, 2015, pp. 349–352). The semantics need not detain us: indigenous knowledge and IK are the term and acronym employed widely in development circles. Furthermore, people from a range of disciplines are contributing to the IK project – from anthropologists and human geographers to ecologists and environmental scientists, including agronomists and foresters – who, coming at it from a range of directions, give IK a diverse intellectual perspective and methodological heterogeneity. Nonetheless, whatever the differences, the fundamental premise behind all IK is unexceptionable, namely that an understanding and appreciation of local ideas and practices should inform any interventions in people's lives, as declared some years ago (Kloppenburg, 1991; DeWalt, 1994; Warren *et al.*, 1995). As a working definition, IK is any understanding rooted in local culture and includes all knowledge held more or less collectively by a community that informs interpretation of the world (Sillitoe, 2002, pp. 8–13). In this volume it concerns knowledge that relates to natural resource management. It is both mindful and tacit, often passed on through experience as the legacy of practical everyday life. It varies between communities; being culturally relative understanding learned from birth that informs how people interact with their environments. It comes from a range of sources and is a dynamic mix of past 'tradition' and present innovation with a view to the future. Although widely shared locally, its distribution is uneven, often according to gender, age, occupation and so on, maybe with political power implications.

The definition is redolent of anthropology, albeit focused on applied not academic problems, and in a sense IK research originated with the discipline. But as it relates to natural resources in development contexts, IK is more recent, appearing in association with some provocative work in the 1980s that marked a significant change of approach to development. This was from previous dominant top-down paradigms that were oblivious of IK issues – modernization with its transfer-of-technology model and dependency with its Marxist-inspired model of development – to bottom-up oriented participatory approaches (Chambers, 1997). These latter approaches attempt to bring the planning and implementation of interventions nearer to people, following growing discontent with expert-led approaches and expensive project failures. Participation features flexible methods that encourage local communities to analyse their own problems and communicate their ideas, promoting a better fit culturally and environmentally between research and technological interventions. It tackles some

of development's most challenging problems today, albeit several problems attend participatory and, hence, IK approaches, centring on the facilitation of meaningful participation (Mosse, 2001). They vary widely in the scope they afford farmers to participate, from consultative (outsiders retain control), to collaborative (insiders cooperate as equal partners).

From an agricultural perspective, farming systems research, with affinities to participation, also contributed to IK's emergence (Collinson, 1985; Biggelaar, 1991). It promoted a holistic systems approach – encompassing agronomic, environmental, socio-economic, etc. components – given the complexity of natural resource management in different environments. It took research beyond the experimental station and on-farm to understand local practices and management constraints and advance more appropriate technological interventions. It encountered similar problems to participation, namely how to promote meaningful problem-centred farmer cooperation rather than expert-led scientifically driven analysis and intervention. Its systems concept was narrow and static, rarely extending beyond the farm boundary (whereas diverse farm-household livelihoods do), and overlooking their dynamic nature and scope for endogenous change. It also got bogged down in complex systems analysis, caught on the horns of the conundrum of how to identify and focus tightly on particular researchable constraints without losing the overall farming systems view. It is a paradox that IK addresses, being embedded by definition within the wider context. It also addresses the shortcomings of researching highly complex environmental–cultural systems using multidisciplinary teams that spend short periods of time on farms, which is crippling from an anthropological standpoint.

Indigenous and Scientific Knowledge

It is common, in the applied contexts where IK features, to contrast it, often unfavourably, with SK that informs many interventions. SK is characterized as global whereas IK is local (Sillitoe, 2007). The former is openly international and cosmopolitan in outlook while the latter relates closely to a particular cultural context. While SK has broad, universally generic, intellectual ambitions, IK has narrow, culturally specific, practical concerns. This contrasts with their approaches to understanding problems, where SK is reductionist, comprising the in-depth understanding of narrowly trained specialists, while IK is unitarist, comprising system-wide understanding of broadly informed citizens. One aspires to be objective and analytical, while the other is considered subjective and tacit. The scientist is formally taught in institutions that are keepers of knowledge, arranged in an orderly manner by discipline; the indigene is informally taught in the community where knowledge is organized in less systematic ways. Scientific method is more deductive with protocols agreed to test a consistent model of the world regularly through purposefully designed experiments (which are only predictable to varying extents, not always going to plan), while indigenous practice is more inductive with serendipitous assessment of a changeable world irregularly during everyday chance experiences (which are knowable to varying extents to others, as hotly disputed by postmodern thinkers).

In this comparison, SK is regularly characterized as dominant and IK as subordinate (Failing *et al.*, 2007). This judgement rests in considerable part on the scope that scientifically informed technology allows us to intervene in the world, as seen in such amazing achievements as organ transplant surgery, space exploration and electronic communications. In seeking to redress this judgement, the IK agenda is liable to misunderstanding. It is a common misapprehension, particularly among scientists and technocrats, that IK somehow implies denigration of these technological advancements, even advocating regression (Dickson, 1999; Anonymous, 1999; Ellen, 2004). A speaker at a conference in Bangladesh typified this view (Sillitoe, 2000), criticizing our interest in IK for promoting, it seemed to him, the undoing of the advances made in the scientific breeding of high-yielding varieties (HYVs) of rice and associated technology of fertilizers, biocides and so on, without which, he argued, the country would have been unable to feed its expanding population. An unspoken question was: what could IK research do to increase production similarly? It reflects the current confusion among many natural scientists, even those who are willing to countenance IK, who are often unclear what its contribution

might amount to, how to access it and how to incorporate it effectively into their research.

It is necessary to clarify the possible role of IK in scientific research, which is one of this book's aims with respect to natural resources and environmental science. Those of us promoting IK research certainly do not intend to move communities backwards in any way. Indeed the opposite: for instance, with respect to HYVs in Bangladesh, collaboration with farmers during the rice breeding programme would arguably have helped avoid some of the problems that have subsequently emerged with their widespread cultivation, which include declining soil fertility and structure (exacerbated by reduced annual silt deposition with embankment construction diverting the monsoon floods) and increasing poverty among those unable to adopt the technology as too expensive (exacerbated by hierarchical social arrangements that support unequal politico-economic relations). Some trends in the scientific community are favourable; the award of the 2015 Nobel Prize in Physiology to the Chinese pharmacologist Youyou Tu for the discovery of the anti-malarial drug, artemisinin, which involved combing traditional Chinese medical texts, has prompted positive comments about the potential contribution of IK to science (Cesare, 2015). Furthermore, it is questionable to overly privilege SK in view of the increasingly evident costs of associated technology, such as climate change, land degradation and water pollution, when respect for IK could advance more sustainable ways, increasingly called for with such deleterious impacts becoming ever more worrisome.

Variations in Knowledge

The view of IK and SK as monolithic polar opposites distorts both. This stark discrimination misrepresents the distinctions and connections between them, even where used to argue for a review of the relationship to promote IK's equal participation. We do not have two tenuously connected knowledge traditions separated by a cultural–epistemological gulf, but rather a networked spectrum of relations. While at one end of the spectrum there are poor farmers with no formal education, who we may think represent 'pure' IK derived entirely from their own cultural tradition, and at the other end formally trained natural scientists, who may seek to accommodate aspects of local ideas and practices in their research, the majority of actors will fall between them with various intergradations of local insider and global outsider knowledge depending on community of origin and formal education. Many local people have some formal schooling and familiarity with science, which they will blend with their locally derived knowledge and cultural heritage. Many British farmers have gone through school to college and university, often to study agricultural subjects, environmental science and so on. And farmers worldwide receive scientifically informed extension advice via government agencies, non-governmental organizations and increasingly the mass media (Shepherd, 2005). In development contexts there are national scientists with extensive scientific backgrounds, some with higher degrees and occupying university posts, who as metropolitan native speakers are familiar with indigenous culture. Those from rural families may serve as a further pathway for SK to reach local communities, passing on some of their learning to relatives and friends. Foreign scientists working in local communities may do likewise, and those sympathetic to IK gain some understanding of local views in return. Both IK and SK are in a constant process of change, being continually influenced by new ideas. It is contemporary globalization in action, knowledge passing to and fro, blending with what is known locally to inform today's ideas and practice, such that natural resource management understandings are a difficult-to-disentangle mix of knowledge from various sources.

The variability is even more pervasive. The conflation of local knowledge traditions into an indigenous category and its contrast with global scientific knowledge overlooks differences within them. The knowledge held by people making up a local community is not all the same, being structured, as pointed out, according to gender, age, occupation, caste, class or whatever. And the knowledge of scientists varies between disciplines; the specialist knowledge of a soil chemist, for example, is different to that of a crop breeder and both differ markedly from that of a social scientist. Each has a unique perspective, with its own potential insights and blind spots. It is a complexity of relations, different stakeholders

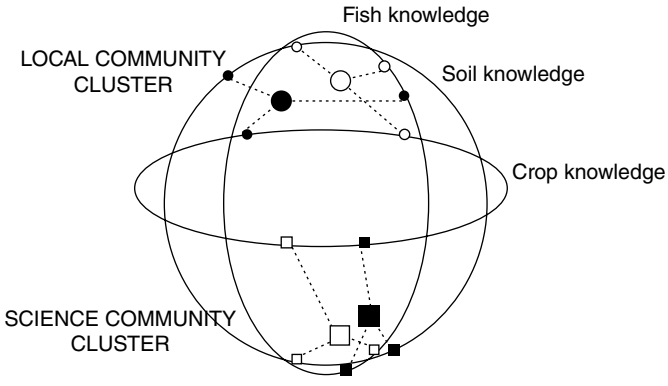

Fig. 1.1. The global knowledge meridians model (from Sillitoe, 2002, p. 119).

having a range of perspectives informed by their differing viewpoints that apprise their multiple objectives. A way to envisage this network of relations between different bodies of knowledge is as a series of meridians arranged around a globe (Fig. 1.1), each meridian representing a different knowledge domain; for example, the various fields in natural resources management, such as crops, soils, water resources, livestock and so on (Sillitoe, 2002). It accommodates variations in knowledge according to disciplines in the science cluster and life experience in the indigenous one. The meridians can represent any knowledge domain, from plants to animals and economics to politics, allowing the setting of enquiries as necessary within a holistic cultural context. The globe represents an interaction domain. It can plot the positions of individuals who interact within the domain, according to their knowledge of any range of meridian issues, extrapolating from these where they are located within the globe. While individuals' configurations vary, some will overlap more than others, comprising interest communities; for instance, plotting the global coordinates for farmers and scientists regarding natural resources knowledge in a region will result in two clustered points within the globe. The global model not only represents IK and SK as individually variable and not monolithic, but also subverts any hierarchical arrangement, the meridians arranged randomly about the globe, precluding any tendency to polarize clusters with dominant SK above subordinate IK, putting all on a par in a complex multidimensional network.

According to some critiques of development, it is dubious to conflate local knowledge traditions into an indigenous category and contrast it with global scientific knowledge, not only because it overlooks differences within them, but also because it overlooks similarities between them (Agrawal, 1995, 2009; Parkes, 2000; Sillitoe, 2007). They argue that these knowledge systems may be similar in rudiments and content, which is undoubtedly so because without substantial similarities and overlaps in the substantive contents of various knowledge systems, it is difficult to conceive of communication with one another. Also, there are some parallels between the methods that SK and IK use to explore reality and it is questionable to distinguish between them on methodological grounds; for example, that SK exclusively tests ideas through experimentation or is more objective, because, after all, local farmers are often keen experimenters and are among some of the world's most pragmatic people. Furthermore, SK is just as culturally located and value-laden as any other knowledge tradition, being rooted in European society where it largely took off, although contemporary globalization-driven hybridization is diminishing the influence of Western sociocultural heritage.

Accommodating Different Knowledge

Regardless of globalizing trends, and the differences within and similarities between IK and SK, it is defensible to distinguish between such local and global knowledge traditions. Many people do so, such as those in lesser developed countries

who wish to share in the technological advances that SK underpins – allowing humans, as pointed out, unheard of ability to exploit resources – not only to increase their standard of living, but also sometimes to stave off starvation and sickness, particularly with the relentless population expansion. The dissemination of this technology is central to development, where awareness of IK can play a part in advancing appropriate interventions in accord with local ideas and practices. Well intentioned arguments that seek to redress the power imbalance between scientific and other perspectives are unhelpful in suggesting that it is illegitimate to distinguish between them. Indeed they are ironically supporting hegemonic relations by questioning people's cultural identity (Sillitoe, 2002), which they may deploy in their fights against cultural imperialism, including asserting a place for their knowledge. They are also liable to allegations of ethnocentrism, for implying that the 'they' of contemporary cross-cultural discourse is the same as 'us'.

People in different regions have unique cultural traditions and histories, which continue to inform significantly their understanding of being in the world. They concern different issues and priorities, reflect differing interests and experiences, formulated and expressed in differing idioms and styles, which outsiders may understand to varying extents. While individuals do not duplicate each other, they share a sufficient but indefinite amount of knowledge to make up a discrete cultural community sharing a common history, values, idioms and, likely, language. They are inculcated into these distinct cultural heritages, developed over generations albeit not in isolation but mutually influenced by other traditions that they have some connection and overlap with, while retaining their uniqueness, with the similarities between them correlating closely with geographical distance until recently. The rate of hybridization may have increased with the current boom in worldwide communications and associated acceleration in globalization processes eroding distinctions between different culturally specific knowledge systems (Dove, 2000; Shepherd, 2004; Thomas and Twyman, 2004), but these continue to inform different peoples' understanding of the world. So long as such communities exist with their differently framed cultural understandings, the struggle over the standing of different views – of which the IK versus SK debate is an aspect – is going to continue, being an aspect of contemporary global processes, extending to debates over such knotty issues as ideology, values and belief (Stiglitz, 2003; Rodrik, 2012). It follows that the IK and SK dichotomy is inescapable in some measure and to argue in effect that we should not distinguish between different knowledge traditions is unrealistic, however laudable the aim of overriding intellectual imperialism, and any privileging that occurs is not necessarily inevitable; it is dubious, as pointed out, to esteem overly scientific discourse as its technological costs become increasingly apparent.

The duck–rabbit image made famous in Wittgenstein's (1958) discussion of 'seeing' can be used to illustrate how the IK approach seeks to further the understanding of different views in both directions (Sillitoe, 2015, pp. 345–346) (Fig. 1.2).[4] It is mistaken, looking at the image, to ask: 'What view is "correct": is it a duck or a rabbit?' What you recognize may depend on what you are used to. If you are not accustomed to ducks, for instance, you will see a rabbit. If you see in turn a duck and then a rabbit, you make out the image's two different aspects. In the same way, the approach advocated here seeks to clarify the dual aspects of the IK and SK discrimination in natural resources management, both of which likewise focus on the same environmental issues 'out there'. The challenge of the duck–rabbit image – of striving to see both images when you can only see one or the other at any one time – conveys the ambiguity of IK research in attempting to get local and scientific understandings, which represent different perspectives on the same phenomena, to correspond

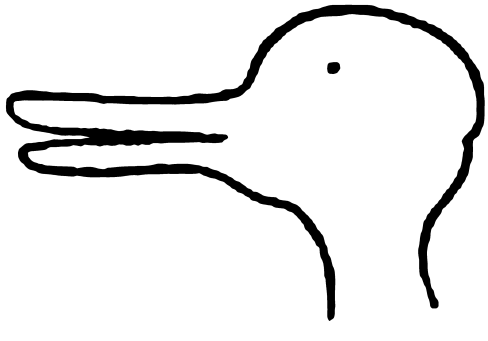

Fig. 1.2. The duck–rabbit (from Wittgenstein, 1958, p. 194e).

in some measure, or more likely, to complement one another. The inference is not that this approach advocates the translation of farming IK into agricultural SK, in all probability diminishing the former in the process, in addition to privileging the latter. Rather it attempts to connect them, as many farmers do who demonstrate the shortcomings of depicting IK as contrary to SK, intermingling both to produce many-sided hybrid knowledge. They may assimilate new information both coming from without and generated within to give a place-specific mix of local and global knowledge (Robertson, 1996).

Predation on Scotland's Moorlands

A recent review of predation on the Scottish moorlands illustrates the duck–rabbitness of differing IK–SK views of the same phenomena (Ainsworth *et al.*, 2016). The study of predation, organized by Scotland's Moorland Forum,[5] set out to compare and assess similarities and differences between scientific and local knowledge, and the scope for integration of different perspectives. It involved both natural and social scientists, the former engaging in an extensive zoological literature review of animal population trends, including an analysis of changes in Scottish wild bird populations using *Bird Atlas 2007–11* data (Balmer *et al.*, 2013), and the latter conducting a web-based questionnaire survey supplemented by a series of workshops and seminars (Fig. 1.3) to enquire into the issues with members of organizations concerned about bird predation in Scotland. The respondents were classified as either oriented to 'Local Knowledge' (e.g. land agents, gamekeepers, farmers and crofters) or 'Scientific Knowledge' (e.g. researchers, administrators, naturalists and green activists), according to what they identified as

Fig. 1.3. Scotland's Moorland Forum Workshop held at Scottish Natural Heritage Headquarters, Great Glen House, Inverness on 3 November 2015. (Photograph by kind permission of Simon Thorp, Forum Director.)

their primary source of predation information (either 'personal field management experience' or 'scientific peer-reviewed articles'), although predictably several relied on a combination of both sources, underscoring the point about hybridity.[6] The responses of the 'Local Knowledge' group were compared with those of the 'Scientific Knowledge' group and the data from the natural science review.

Some may query a discussion of moorland wildlife in an introduction to a volume on natural resource management that largely focuses on agriculture. While the culling of badgers to protect cattle herds may qualify, the protection of game birds seems to be of a different order, albeit the issues are arguably similar. They raise the question of what qualifies as agriculture. This takes on a particular salience in cross-cultural IK contexts, which can challenge conventional categories, opening up new ways to approach issues. The manipulation of the environment by hunter-gatherers, for instance, arguably makes them farmers; such as the actions of Australian Aborigines, who promote the growth of plants edible for both humans and hunted animals, often by firing vegetation and increasingly referred to as fire-stick farming (Gammage, 2011). The management of moorlands to encourage game birds is similar, involving intervention in predator/prey relations to protect game birds that supply food, albeit harvested largely as sport. It helps to think outside the box in this way because it encourages us to consider how other livelihood regimes may manage natural resources in ways not immediately apparent, which merit the same attention as more readily recognized conventional environmental management regimes. It also reduces the unequal relations between IK and SK to realize that tensions between these two ways of knowing feature in our culture too.

The Moorlands research found that there was broad agreement over population changes of the focal species[7] with predator numbers increasing and prey numbers decreasing, although the 'Local Knowledge' group thought that the predators had increased much more, and both groups differed over the *Bird Atlas* abundance data. The majority of 'Local Knowledge' respondents thought that predators, particularly crows and foxes,[8] had a 'medium to high negative impact' on prey species, including protected ones, followed by recreational disturbance (walkers, often with dogs; cyclists; birdwatchers, etc.), whereas 'Scientific Knowledge' respondents more often thought that habitat differences and interactions between a range of ecological and anthropogenic factors had the largest impact on predator–prey numbers (Ainsworth *et al.*, 2016, pp. 32–33, 231). Reasons suggested for the disagreements included differences in geographical and temporal perspectives, with 'Local Knowledge' holders considering restricted areas and events of immediate interest in the context of long-term experiences and intimate knowledge of the land, whereas 'Scientific Knowledge' holders focus on larger regions and processes over extended periods of data collection albeit with short-term field work and less familiarity with places. Also, predators and their impacts on prey are more immediately visible and locals may more readily perceive their numbers to have increased, whereas other environmental factors such as changes in habitat are less obvious and longer term in their effects on predator–prey populations. While the local concerns are direct and considered in straightforward cause-and-effect terms, the scientific ones are indirect and addressed in complex ecological feedback terms. The impact of predation is difficult to determine whatever your approach and experience, because a decline in prey populations is not necessarily due to increased predator numbers. Other drivers of demographic change include climate and weather, disease and parasites, and human activities involving land use and habitat change. These make assessment and resolution of different views problematic. They confound scientific studies on predation, making experiments difficult to devise and leading to ambiguous results. It is difficult to distinguish, for instance, between the effects of different predator species on the various prey populations that occupy an area. These sorts of issues may further account for the disagreements between survey respondents and the *Bird Atlas* data, concerning problems with species identification and bird counts (particularly of highly mobile or fluctuating populations).

While both respondent groups agreed that they wanted to ensure a sustainable long-term balance between healthy prey and predator populations, they disagreed on how to achieve it. The 'Local Knowledge' respondents predictably

supported direct control of predator numbers to maintain prey populations, being of the opinion that predators posed the most immediate threat. They saw culling as a successful and swift management strategy. It has an immediate observable effect, which recommends it. They collectively had long-established experience of this management technique and its effectiveness, unlike other approaches, and this gave them confidence in it. Some studies support their faith in it; reducing predator pressure in the breeding season of prey species is particularly significant, though the effects are difficult to verify because if only one predator is targeted the numbers and behaviours of others may change, replacing it, especially if prey become more available, whereas if several predator species are culled it is impossible to know what the effect is of the reduction in each. An alternative strategy, particularly when breeding game birds, is to erect enclosures that exclude predators.

The 'Scientific Knowledge' respondents advocated landscape management to maintain healthy predator and prey populations by improving the quality of habitats for birds. They cited management of vegetation to increase plant and insect food availability and to provide nesting sites – from encouraging understory thickets and closed canopies in woodlands and controlled grazing and mowing of grasslands, to management of field margins and hedgerows on farmland, along with reduced pesticide and herbicide use. Research predictably supports the effectiveness of such habitat management for maintaining bird populations. Problems with it include the considerable time it takes for such ecological management to have a noticeable effect, and also it is necessary to cover considerable and preferably interconnected areas to be effective, which in turn implies cooperation between several parties, unlike predator control undertaken by a single gamekeeper. And teasing out the effects of particular measures in complex ecological systems can be a challenge. A wish to protect all species can complicate matters further.

Promoting Collaboration

The challenge is to facilitate cooperation and communication across the indigenous-to-scientific knowledge spectrum through the promotion of knowledge partnerships (Eversole, 2015) and beyond to planners, policymakers and politicians. It is unwise for scientists to underrate indigenous understandings, as it can breed defiant localism, even conflict, if those in power deny the validity of place-centred knowledge. While IK is more circumscribed than SK, it often matches and sometimes betters science-based understandings of, for instance, land use. It is increasingly recognized that indigenous peoples have their own effective 'science' and resource management systems (Sillitoe, 2007). There are many examples of the soundness of their knowledge and practices, and the need to respect them; some of them were previously thought 'primitive' and in need of modernization. It is widely acknowledged, for example, that local ways of managing natural resources are an integral part of any environment; notably in biodiversity management and conservation that may include culling, where the cessation of such practices may be as damaging as the loss of species (Posey, 1999; Knight, 2000; Anderson and Berglund, 2003). In reconciling IK with SK, we cannot assume that the one will be congruent with the other; rather we have to tease out parallels and contrasts, each potentially influencing the other. But some conflict is inherent in the process, because it is not just about furthering understanding, of advancing more rounded views, but of deploying knowledge to effect some action, and sometimes the values that underpin IK and SK are not readily reconcilable (Young *et al.*, 2010). The negotiations become far more complex but policies and interventions are more likely to be appropriate for more people, notably local actors, and so more sustainable (Harrison and Burgess, 2000; Taylor and Loe, 2012).

The Scottish Moorlands project illustrates the IK–SK tensions in advancing both rabbit and duck views. The management of predatory species is an emotive topic with, on the one hand, concerns about the negative impacts of predators on prey species and calls for their lethal control, and on the other, recognition of predation as an aspect of natural ecosystems and arguments that these benefit from conservation-minded human interference that aims to promote a sustainable balance. The subject is of policy interest to governments (the Moorlands review was presented to the Scottish Government) which typically rely

on scientific evidence when making decisions. The assumption is that it is independent, unbiased and objective, undertaken by reputable academic bodies that use experimental methods and sound observation to collect data, statistically analysed for reliability, and scrutinized by peers before publication. Yet, whatever the quality of the evidence, other interested parties may reject decisions based on it as externally imposed by those ill-informed about local conditions who fail adequately to address relevant questions (Wynne, 1992). The reductionist approach of science tends to overlook wider context and may address issues that local resource managers think inappropriate, such as focusing on problems at the wrong spatial and temporal scale (Fig. 1.4). They value first-hand experience of dealing with predation, for instance, which they think gives them deep and reliable understanding. They mistrust science, thinking that the framing, reviewing and funding of research biases it, while scientists mistrust local views as subjective, lacking rigorous evidence, even featuring hearsay 'proof' (Failing *et al.*, 2007). Both are open to unintended bias informed by different values and understandings, of stewarding, or 'working with', versus managing, or 'working on', nature, which can polarize views.

Nonetheless, the majority of participants in the Moorlands review agreed that both viewpoints have their strengths and weaknesses and that cooperation might advance a better informed overall understanding of the role that predators play within ecosystems and the effectiveness of various management strategies to maintain healthy predator and prey populations. They identified a need to develop a new collaborative approach that includes locals and scientists from the outset in designing research, collecting data and interpreting results, to tackle perceived biases and generate new understandings acceptable to both sides. Building necessary trust is central through improved communication and networking, promoting the exchange

Fig. 1.4. Visit by Scotland's Moorland Forum to Invermark Estate (by kind permission of the Earl of Dalhousie) on 5 June 2015. (Photograph by kind permission of Anne Stoddart, Forum Administrator.)

of views and data, which aims to lead to 'co-production of knowledge'. The participants acknowledged the challenges of reconciling divergent views and objectives over issues such as what constitutes a suitable balance between predator and prey numbers, which relate to differing values, perceptions and experience of moorland environments; for example, some species, such as game birds (e.g. grouse, partridge and ptarmigan) are more important to some stakeholders than others. It is widely acknowledged that values influence understanding – such as the differing values signalled by affiliation to game management versus nature conservation organizations, which broadly correlate with relying on local and scientific knowledge, respectively – but accommodating the different views or beliefs engendered presents tricky problems and may even amount to trying to obviate paradox when parties hold opposed values, such as overcoming contradictory demands for managed versus wild environments. A particular challenge is to harmonize different views and experiences of scale, in respect of both time (short- versus long-term measures and outcomes) and space (interventions over small areas versus entire regions), which are as relative here on planet Earth as they are in the wider universe. The diversity of interests and priorities also varies between like-interested individuals, even those affiliated to the same conservation or shooting organization, which further complicates agreement.

Challenges of Integration

The IK approach presumes a methodology that mediates effectively between the contradictions that characterize the promotion of scientific research informed by an indigenous knowledge perspective. A range of eclectic approaches have been pioneered that favour techniques that directly involve local people (Sillitoe *et al.*, 2005), such as participatory mapping using all manner of media (mixing crayons with stones, beans and twigs) and drawing up calendars and activity diagrams, through to game playing and theatricals, and more conventional collaborative paper-and-pencil surveys that mix semi- to unstructured interviews with field observations. These are not culturally neutral but subject to external influence and may fail to access local knowledge with the subtlety expected by anthropology. Furthermore, deciding what to focus on is an individually informed judgement too, such that the drawer, game-player or whoever controls the representation may manipulate it according to their interests. Another approach is to encourage farmers' experimentation, though the connection between their problems and ideas and scientific research and possible technological interventions is not always clear, unorthodox farmer-led experiments being incompatible with scientifically designed trials and data analysis.

We not only have intercultural problems between scientists and locals, but also interdisciplinary problems among the scientists. This work often features a range of disciplines to promote different perspectives on complex problems and to facilitate action research (Sillitoe, 2004). The harnessing of an anthropological background to knowledge of a scientific–technical field that informs interventions, such as agriculture or environmental science, is useful in furthering interdisciplinary interfacing with local knowledge. The facilitation of such broad research is a major methodological challenge facing IK-through-SK research. It involves the resolution of longstanding strains between the natural and social sciences, conveying local knowledge to natural scientists such that they can appreciate its relevance. Both techno-scientific and socio-political issues feature, inextricably entwined, striving to reach a plausible consensus. It returns us to the issue of the domination of science and associated power issues, featuring on the one hand the association of technological interventions with natural scientists and on the other local community empowerment with social scientists. It is a battle of perspectives characterized as hard versus soft systems and so on.

At the local level, intercommunity problems further complicate aspirations of equitable negotiation central to such participatory research. Communities of interest are not homogeneous, as aforementioned. The distribution of knowledge and experience within a local community may be markedly uneven, which presents challenges in selecting participants, often of a political sort. The promotion of a locally informed perspective should extend to an awareness of local power structures. There is the possibility of

self-selection by those with particular interests to promote these or the more influential or pushy dominating and directing enquiries and negotiations to their benefit. These are likely to be wealthier and more powerful persons in development contexts who seek to exclude the marginalized such as the poor and women. The Scottish predation project used a 'snowball sampling' strategy, for instance, drawing on the networks of the Moorland Forum organizations' members, which was subject to potential biases, not ensuring proportional representation from organizations according to membership size or extent of experience or differing interests.

The integration of local stakeholders' knowledge in the decision-making process can improve the quality of judgements (Huntington, 2000; Beierle and Konisky, 2001) and collectively agreed decisions that acknowledge local values and interests are more likely to be socially and politically acceptable to actors (Harrison and Burgess, 2000), and may lessen conflicts between parties (Young *et al.*, 2010). The challenge is to promote a rapprochement between different perspectives, playing off the advantages and disadvantages of different knowledge traditions, generating synergy to improve overall understanding of issues and problems, which at root comes down to reconciling differences in values and priorities. It is exciting work as the chapters in this book show. It is necessary to be open to the unexpected and new. Allowing the know-how and aspirations of local populations to inform development, for example, opens up the prospect of a redefinition of the meaning and aims of the very process. The IK agenda intimates such a shift, albeit there are concerns about the reaction of development agencies, which are likely to see it as subversive, reducing their control. It denotes the reduction of outsider hegemony, challenging the assumption that strangers have a right to impose interventions, through the promotion of what some call endogenous development (Haverkort and Reijntjes, 2006) that allows people to follow their own lines of enquiry and contribute meaningfully to the determination of 'development' objectives that concern them.

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Notes

[1] See, for instance, http://www.nfuonline.com/science-environment/bovine-tb/badger-cull-is-a-key-part-of-tackling-bovine-tb/.

[2] See, for instance, http://badger.org.uk/threats/bovine-tb.aspx.

[3] The alternative terms include local knowledge, rural people's knowledge, insider knowledge, indigenous technical knowledge, traditional environmental knowledge, peoples' science, local agricultural knowledge and folk knowledge.

[4] The source of the image, as Wittgenstein acknowledges, was Jastrow's (1900: 312) Victorian lithograph, used to argue that perception involves both eye (physical stimulus) and mind (mental activity).

[5] A partnership of 28 organizations that focuses on issues concerning the Scottish uplands with a view to informing and influencing policy, management and practices (http://www.moorlandforum.org.uk/).

[6] 'Local Knowledge' group = 211 respondents and 'Scientific Knowledge' group = 110 respondents; six of the nine workshops (involving 15 of the participating organizations) involved the former and three the latter, while the three 1-day seminars were joint.

[7] The focal prey species identified by the Moorland Forum were *Black Grouse Tetrao tetrix*, *Curlew Numenius arquata*, *Golden Plover Pluvialis apricaria*, *Grey Partridge Perdix perdix*, *Lapwing Vanellus vanellus* and *Oystercatcher Haematopus ostralegus*; predator species were *Common Buzzard Buteo buteo*, *Crow Corvus spp.*, *Northern Raven Corvus corax* and *Red Fox Vulpes vulpes*.

[8] The status of Ravens and Buzzards, like Badgers and Pine Martens also frequently mentioned by 'Local Knowledge' respondents as significant predators, is controversial as they are protected species under UK law.

References

Agrawal, A. (1995) Dismantling the divide between indigenous and scientific knowledge. *Development and Change* 26, 413–439.

Agrawal, A. (2009) Why 'indigenous' knowledge? *Journal of the Royal Society of New Zealand* 39, 157–158.

Ainsworth, G., Calladine, J., Martay, B., Park, K., Redpath, S. *et al*. (2016) *Understanding Predation: a Review Bringing Together Natural Science and Local Knowledge of Recent Wild Bird Population Changes and Their Drivers in Scotland*. Report for Scotland's Moorland Forum, Newtonrigg, Holywood, Dumfries.

Anderson, D.G. and Berglund, E. (eds) (2003) *Ethnographies of Conservation: Environmentalism and the Distribution of Privilege*. Berghahn Books, New York.

Anonymous (1999) Caution: traditional knowledge. Principles of merit need to be spelt out in distinguishing valuable knowledge from myth. *Nature* 401(6754), 623.

Ares, E. and Hawkins, O. (2014) *Badger Culling: TB Control Policy*. Library of the House of Commons, London. Available at: http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN05873 (accessed 5 June 2016).

Balmer, D., Gillings, S., Caffrey, B., Swann, B., Downie, I. and Fuller, R. (2013) *Bird Atlas 2007–11: The Breeding and Wintering Birds of Britain and Ireland*. British Trust for Ornithology, Thetford, UK.

Beierle, T.C. and Konisky, D.M. (2001) What are we gaining from stakeholder involvement? Observations from environmental planning in the Great Lakes. *Environment and Planning C* 19, 515–528.

Biggelaar, C. den (1991) Farming systems development: synthesizing indigenous and scientific knowledge systems. *Agriculture and Human Values* 8(1,2), 25–36.

Caplan, P. (2010) Death on the farm: culling badgers in North Pembrokeshire. *Anthropology Today* 26(2), 14–18.

Caplan, P. (2012) Cull or vaccinate? Badger politics in Wales. *Anthropology Today* 28(6), 17–21.

Cesare, C. (2015) From speculation to surprise, science Twittersphere reacts to Nobel prizewinners: online responses ranged from wonder to disappointment. *Nature* 526 (7573), 297.

Chambers, R. (1997) *Whose Reality Counts? Putting the First Last.* Intermediate Technology, London.

Collinson, M. (1985) Farming systems research: diagnosing the problems. In: Cernea, M.M., Coulter, J.K. and Russell, J.F.A. (eds) *Research–Extension–Farmer: a Two-Way Continuum for Agricultural Development*. The World Bank, Washington, DC, pp. 71–86.

DeWalt, B. (1994) Using indigenous knowledge to improve agriculture and natural resource management. *Human Organisation* 53(2), 123–131.

Dickson, D. (1999) ICSU seeks to classify 'Traditional Knowledge'. *Nature* 401(6754), 631.

Dove, M. (2000) The life cycle of indigenous knowledge, and the case of natural rubber production. In: Ellen, R., Parkes, P. and Bicker, A. (eds) *Indigenous Environmental Knowledge and Its Transformations.* Harwood Academic Publishers, Amsterdam, pp. 213–251.

Ellen, R.F. (2004) From ethno-science to science, or 'what the indigenous knowledge debate tells us about how scientists define their project'. *Journal of Cognition and Culture* 4(3,4), 409–450.

Eversole, R. (2015) *Knowledge Partnering for Community Development*. Routledge, Abingdon, UK.

Failing, L., Gregory, R. and Harstone, M. (2007) Integrating science and local knowledge in environmental risk management: a decision-focused approach. *Ecological Economics* 64, 47–60.

Gammage, B. (2011) *The Biggest Estate on Earth: How Aborigines Made Australia.* Allen and Unwin, Sydney.

Harrison, C. and Burgess, J. (2000) Valuing nature in context: the contribution of common-good approaches. *Biodiversity and Conservation* 9, 1115–1130.

Haverkort, B. and Reijntjes, C. (eds) (2006) *Moving Worldviews: Reshaping Sciences, Policies and Practices for Endogenous Sustainable Development*. Compas Worldviews and Sciences Series no. 4. ETC Foundation/COMPAS, Leusden, Netherlands.

Huntington, H.P. (2000) Using traditional ecological knowledge in science: methods and applications. *Ecological Applications* 10, 1270–1274.

Jastrow, J. (1900) *Fact and Fable in Psychology*. Houghton Mifflin, Boston, Massachusetts.

Kloppenburg, J. (1991) Social theory and the de/reconstruction of agricultural science: local knowledge for an alternative agriculture. *Rural Sociology* 56(4), 519–548.

Knight, J. (ed.) (2000) *Natural Enemies: People–Wildlife Conflicts in Anthropological Perspective*. Routledge, New York.

Mosse, D. (2001) 'People's knowledge', participation and patronage: operations and representations in rural development. In: Cooke, B. and Kothari, U. (eds) *Participation: The New Tyranny*. Zed Books, London, pp. 16–35.

Parkes, P. (2000) Enclaved knowledge: indigent and indignant representations of environmental management and development among the Kalasha of Pakistan. In: Ellen, R., Parkes, P. and Bicker, A. (eds) *Indigenous Environmental Knowledge and Its Transformations*. Harwood Academic, Amsterdam, pp. 253–291.

Posey, D.A. (ed.) (1999) *Cultural and Spiritual Values of Biodiversity: A Complementary Contribution to the Global Biodiversity Assessment*. Intermediate Technology Publications (for the UN Environment Programme), London.

Robertson, R. (1996) Glocalization: time–space and homogeneity–heterogeneity. In: Featherstone, M., Lash, S. and Robertson, R. (eds) *Global Modernities*. Sage, London, pp. 25–44.

Rodrik, D. (2012) *The Globalization Paradox*. Oxford University Press, Oxford, UK.

Shepherd, C.J. (2004) Agricultural hybridity and the 'pathology' of traditional ways. The translation of desire and need in postcolonial development. *Journal of Latin American Anthropology* 9(2), 235–266.

Shepherd, C.J. (2005) Agricultural development NGOs, anthropology, and the encounter with cultural knowledge. *Culture and Agriculture* 27(1), 35–44.

Sillitoe, P. (2000) Introduction: the state of indigenous knowledge in Bangladesh. In: Sillitoe, P. (ed.) *Indigenous Knowledge Development in Bangladesh*: *Present and Future*. Intermediate Technology Publications, London, and Dhaka University Press, Dhaka, pp. 3–20.

Sillitoe, P. (2002) Globalizing indigenous knowledge. In: Sillitoe, P., Bicker, A. and Pottier J. (eds) *'Participating in Development': Approaches to Indigenous Knowledge*. Routledge, London, pp. 108–138.

Sillitoe, P. (2004) Interdisciplinary experiences: working with indigenous knowledge in development. *Interdisciplinary Science Reviews* 29(1), 6–23.

Sillitoe, P. (2007) Local science vs global science: an overview. In: Sillitoe, P. (ed.) *Local Science vs Global Science: Approaches to Indigenous Knowledge in International Development*. Berghahn, Oxford, UK, pp. 1–22.

Sillitoe, P. (2015) Indigenous knowledge. In: Stewart, P.J. and Strathern, A.J. (eds) *Research Companion to Anthropology*. Ashgate Publishing, Farnham, UK, pp. 343–368.

Sillitoe, P., Dixon, P. and Barr, J. (2005) *Indigenous Knowledge Inquiries: A Methodologies Manual for Development.* Intermediate Technology Publications, London.

Stiglitz, J.E. (2003) *Globalization and Its Discontents*. W.W. Norton and Company, New York.

Taylor, B. and de Loe, R.C. (2012) Conceptualizations of local knowledge in collaborative environmental governance. *Geoforum* 43, 1207–1217.

Thomas, D. and Twyman, C. (2004) Good or bad rangeland? Hybrid knowledge, science and local understandings of vegetation dynamics in the Kalahari. *Land Degradation and Development* 15, 215–231.

Warren, D.M., Slikkerveer, L.J. and Brokensha, D. (eds) (1995) *The Cultural Dimensions of Development: Indigenous Knowledge Systems*. Intermediate Technology Publications, London.

Wittgenstein, L. (1958) *Philosophical Investigations*, 2nd edition (translated by G.E.M. Anscombe). Blackwell, Oxford, UK.

Wynne, B. (1992) Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science* 1, 281–304.

Young, J.C., Marzano, M., White, R.M., McCracken, D.I., Redpath, S.M. *et al*. (2010) The emergence of biodiversity conflicts from biodiversity impacts: characteristics and management strategies. *Biodiversity and Conservation* 19, 3973–3990.