

Local Ecological Knowledge (LEK) in Interdisciplinary Research and Application: a Critical Review

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Abstract

An interdisciplinary approach is necessary for the sustainable management and governance of renewable natural resources, in which “Local Ecological Knowledge” (LEK), a quintessentially interdisciplinary field, is regarded as an essential source of information. But the effective use of LEK for this purpose would first demand the recognition and correction of the serious limitations of LEK social research. A recent literature analysis by Davis and Ruddle (2010) demonstrated that the basic problems characterising social research on LEK are the use of unsophisticated theories or concepts with often undocumented and non-systematic research designs and methodologies that result in unwarranted or indefensible outcomes. In addition, standards of accountability and transparency must be raised, beginning with the elementary requirement that researchers provide descriptions of research designs and methodologies that enable assessment of the reliability and representativeness of findings, and facilitate comparison, generalisation and evidence-based conclusions. The related issues of the problems inherent in applying an interdisciplinary approach and the manipulation of the publications process to suppress undesirable opinions and research results are examined.

Introduction

The governance and management of renewable natural resources encompass complex and multi-faceted problems that need to be addressed by interdisciplinary research, planning, and management. In this Local Ecological Knowledge (LEK), also known as “Traditional” (TEK) or “Indigenous Ecological Knowledge” (IEK), has become regarded as an obligatory source of information. In fisheries, for example, a large literature has accumulated since its beginnings in the 1970-80s documenting and debating the practical usefulness of marine harvesters’ knowledge (e.g., Johannes 1978a, 1978b, 1980, 1981a, 1981b; Ruddle and Johannes 1985). It is axiomatic that the domain of LEK quintessentially demands an interdisciplinary approach.

In this article we examine first the interdisciplinary context of LEK, focusing on inherent constraints that limit interdisciplinary studies. The relevant aspects of the recent LEK literature and pertinent aspects of Western alternatives to interdisciplinary studies are summarized. We then make

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a critical examination of LEK by drawing attention to the “definitional approach” adopted by some social researchers, pinpointing some weaknesses in research design and methodology, stressing the importance of selecting reliable informants, the dangers inherent in idealising LEK, and how these factors have an impact on social research and education. Publication of LEK research results is a fundamental and obligatory activity. However, it is subject to manipulation to control contrarian and adverse opinions and data. We illustrate such manipulation of the research publication process using two of our own recent experiences.

Constraints on interdisciplinary studies

Interdisciplinary action is challenged by epistemological, methodological, and other barriers among disciplines. Indeed, the natural and social sciences are separated by such fundamentally distinct and commonly antagonistic epistemological, methodological, practical, and ethical divides that their integration may be neither logical nor defensible.

Research and communication across disciplines is problematical because each has its own perception of reality, together with different conceptual designs and institutional structures (Kuhn 1962). Intra-disciplinary or epistemic communities share beliefs and assumptions about what is valid in their field, and not uncommonly they interact but little with other fields. Such specialisation is needed to acquire an in-depth knowledge within specific and generally narrow conceptual and analytical frameworks. Because specialisation is inculcated in post-graduate education, it shapes decisively scientists’ identities, identification, and ways of thinking. Inevitably, differences of research foci lead to natural barriers among communities within a single scientific discipline. Such barriers are further buttressed by the use of arcane disciplinary terminologies and theoretical frameworks, and reinforced by beliefs regarding the validity of preferred scientific methods and claims, as well as by exclusionist beliefs about who is a “real” scientist (Jasanoff 1990). Perhaps inevitably, therefore, we remain mostly prisoners of our training and intimidated by the potential scorn of our peers (Masson and McCarthy 1995).

In addition, both the natural and social sciences are in flux. Whereas social scientists, with economists outstripping the pack, envious of the success and prestige of the physical sciences since the late-nineteenth century, have turned increasingly to a mathematical and mechanistic approach, and economics now hides behind thickets of algebra (Ormerod 1994), the cutting edge of physics, which they sought to emulate, moved towards non-linear systems, chaos theory and revolutionary concepts in quantum theory. Many social scientists still strive to become “hard” scientists, while in chemistry many synthetic compounds were discovered serendipitously. A theoretical physics pushing the envelope of the known employed the language and concepts of traditional mysticism, a common ground that reaches into psychology, anthropology, religion, and esotericism. The social sciences appear not to have followed suit, which would have seemed more logical for them.

A further difficulty arises when those inadequately prepared by academic background attempt to work alone in the interdisciplinary arena. For example, economist Charles (2001) attempted unsuccessfully to integrate what he viewed as the co-equal biological, human and management subsystems to attain a comprehensive state-of-the-art methodology applicable to the understanding of fisheries systems. But this effort flounders on the dual shoals of the author's lack of substantial field research experience in small-scale fisheries settings and apparent lack of familiarity with the fisheries social and cultural literature, as evidenced in the absence of key items in the bibliography. Although human sub-systems are seen as being co-equal with the biological and management counterparts, the author's derivative treatment clearly belies that statement. Conceptually, as Bavinck (2002) also observed, the book rests on an unsubstantiated belief in the essentially functionalist idea that fisheries actually comprise integrated and comprehensive systems. Working collaboratively with scholars trained in different and more relevant fields combined with firsthand fieldwork might have enabled deeper and more original thinking, like comprehending that the world's enormous dynamic diversity of cultures and social structures, assuming that an economist trained in mathematics and statistics could distinguish them, undercuts the notion of a generic fisheries system.

The breadth of LEK research

The coverage of research has become broad. Noteworthy among more recent studies of harvesters' local ecological knowledge (LEK) that have aided in marine conservation and helped explain trends in exploited fish populations, for example, are Aswani and Hamilton (2004), Drew (2005), Saénz-Arroyo et al. (2005a; 2005b), Silvano and Begossi (2005), and Silvano Valbo-Jorgensen (2008). More specialised are Silvano et al. (2006), Gerhardinger et al. (2006), and Begossi and Silvano (2008), among others, which have focused on a detailed use of LEK to aid in the understanding of severely threatened species. Recent studies aimed at systematising and integrating LEK include Anuchiracheeva et al. (2003), García-Allut et al. (2003), Aswani and Lauer (2006), García-Quijano (2007), and Barreiro et al. (2009).

Interest in user group LEK has been stimulated also by the need to employ ecologically sensitive and sustainable approaches in policy design and to integrate local "voice" in policymaking and management (Ruddle 1995; Davis and Ruddle 2010). In this, collaboration between fish harvesters and scientists is indispensable for at least four reasons. First, participation in collaboration empowers local "voices" by building an independent capacity to conduct and use research and then express their local understanding in ways not easily dismissed. Second, users experienced in conducting research and armed with evidence can compel scientists and resource managers to explain research and resultant management decisions. Third, collaboration gives natural resource and ecosystem scientists an unrivalled opportunity to study with people rich in local ecosystem experiences, those with whom scientists can often unwittingly share concerns about ecosystem and species sustainability. Finally, collaboration enables scientists to access and

document new sorts of data and experiences required for more comprehensive understandings of ecosystems and to use innovative designs in micro-system research, as observed by Neis et al. (1999) and Davis (2007).

Despite enormous and generally indiscriminating advocacy, LEK is inherently limited, as demonstrated in case studies by Ruddle and Davis (2011). Since ecology is an “inexact science”, both “scientific ecology” and LEK have weaknesses. Some depictions of LEK may, for example, represent an incomplete understanding of ecosystem dynamics and complexities, or they might be completely inaccurate. At the same time, the limitations of “scientific ecology” provide an opportunity for LEK to contribute meaningfully to understanding ecosystems and their complexities. As a consequence, linking social research and management foci with scientific ecosystem studies has resulted in interdisciplinary collaboration employing the core tenets and methodologies of science to test LEK claims (Stevenson 1996; Gadgil et al. 2000; Huntington 2000; Harkin and Lewis 2007). Given its epistemological roots, science-based resource management practices anticipate that knowledge claims, before being accepted by “conventional science” and integrated into public policy, will be subject to evidence-referenced, reliable and replicable testing and proof, based on rigorous research (Davis and Wagner 2003) and sound theoretical substance (Davis and Ruddle 2010). The problems inherent in “fitting” LEK with science-referenced approaches to resource management have been discussed by Johannes et al. (2000), Holm (2003) and García-Quijano (2007), among others.

For example, Ruddle and Davis (2011) examined links between fish harvesters’ LEK and science-based research in a study of fish predation in Nova Scotian waters and a test of a hypothesis on the relationship between fishing behaviour and seasonal hemispheric wind regimes off Vietnam. The Vietnam case was intended to overcome the major constraint that most hypotheses on the seasonal aspects of fish behaviour had been developed and tested in the temperate waters of the Northern Hemisphere (Ruddle 1986). Both cases demonstrated the general usefulness of LEK. However, they also show that harvesters’ local experiences and observations did not discern key attributes of ecosystem processes. One conclusion from their study is that in all research it is fundamental to consider carefully the attributes and implications of the ecological content in natural resource users’ LEK. Initially, such ecological content may arise and function directly from little more than the obvious need to learn and use whatever is necessary to secure a livelihood.

However, merely making such a suggestion and requiring proof commonly elicits a knee-jerk response from those who simplistically claim that LEK is incontestably valid (Sahlins 1993; Brook and McLachlin 2005; Ranco 2007). This is unhelpful, since not to interrogate and test LEK claims only encourages those who would dismiss it (Davis and Ruddle 2010). It is equally critical to discuss frankly the limitations of LEK that may emerge from field research, and, conversely to publicise examples of its complementary usefulness in relation with “scientific ecology” (Bundy and Davis 2012).

Alternatives to interdisciplinary approaches

In contrast to interdisciplinary thinking, commonplace is an alternative approach to resource management based partly on deficiencies in Western scientific epistemology and its applications. But arguments are often incomplete, with, for example, reference to the continued hegemonic thinking of a colonialist mentality (Johannes 2003; Ruddle 2007; Ruddle and Hickey 2008; Ruddle and Satria 2010) generally omitted, as are the countervailing opinions of a long list of nineteenth-century dissidents with regard to Western industrial capitalism, beginning with Karl Marx and his contemporaries. In a genealogy of these eminent persons, Martinez-Alier and Schlupmann (1987) demonstrate countervailing scholarship extending from Popper-Lynkeus (1838-1921) through Lewis Mumford (1895-1990). Notably the lineage includes such eminent dissident ecologists as Ramon Margalef and H.T.Odum, all students or “grandstudents” of this illustrious pedigree.

An ironic volte-face is that Western models scorned by armchair critics are commonly replaced with other currently fashionable Western models. One explanation for such a confusing practice lurks in the structure of global power, and the position of critics, advocates and academics within it. Essentially, any dissident thinking that challenges the conformity with agendas set by political power brokers and the institutions that implement their policies is either filtered from the academic funding process, or co-opted and “neutered”, and thereby rendered harmless in a politically correct fashion. That means direct challenges are unacceptable to the capitalistic-industrial powers responsible for uneven resource exploitation that masquerades as “development”, “growth” or “progress”, and that is ultimately responsible for the uneven impact of the hypothesised impending global environmental catastrophe (Fletcher 2010; Büscher et al. 2012). Fortunately, the massive problems now confronting us cannot be concealed by even the most powerful of vested interests, since they are easily exposed and publicised worldwide in an age when simple-to-use pocket technology potentially empowers every citizen as a species of investigative journalist.

The ordained solution is to rally around the latest gold standard for conformist thinking based on consensus, trivialization of problems, and the blind implementation of pre-packaged policies. The resultant pabulum overlooks – most likely by design – the long tradition of social science research that unequivocally demonstrates “socio-ecological” systems (*sic*) as being shot through with the issues and problems of power struggles expressing conflicting interests, and which result in unequal distribution, marginalisation and disempowerment (Hornborg 2009; Davis and Ruddle 2012; Ruddle and Davis 2013).

Local Ecological Knowledge

A recent review (Davis and Ruddle 2010) examined systematically core ideas and arguments of social research contributions to LEK in the most frequently cited literature. The results demonstrated that LEK is most commonly presented via definition, and many authors make untenable, unsubstantiated assumptions regarding some key concepts on which research is based.

Confidence in much social research is further undermined by poor design and inadequate analysis. In addition, the entire undertaking is tainted by a distorted dissemination of results that slants and thus impedes the development and application of the field of LEK.

The definitional approach

Using the definitional approach it is commonly averred, as by Berkes 1999, Berkes et al. 2000, and Berkes 2004, for example, that a body of knowledge can be defined as LEK when it embodies a compendium of at least the following three key attributes: a people's (1) shared system of knowledge or other expression about the environment and ecosystem relationships that is (2) developed through direct experience within a specific physical setting, and (3) is transmitted between or among generations. A crippling problem is the basis for claiming that LEK is constituted of those three attributes, since they beg the fundamental and invariably unanswered question of the basis for asserting that common understandings of such notions as "knowledge," "ecosystem," "direct experience," and "intergenerational transmission" be simply taken for granted as self-evident components of a "system of knowledge" (Davis and Ruddle 2010). In other words, the definitional approach mistakenly treats complex processes and phenomenon as self-evident and socio-culturally simple, rather than as appropriate and necessary foci for systematic research, and misrepresents understanding and misdirects research attention away from the primary components of LEK, which mostly remain to be properly examined. These qualities are of basic importance, because "[w]hether a phenomenon deemed as part of 'ecological knowledge' is presented as just an untested definition for later affirmation based on 'field experiences,' or as a precise concept organized for testing through rigorous research, has fundamental implications for both its intellectual credibility and usefulness in application" (Davis and Ruddle 2010: 883).

It must be acknowledged that there is considerable scepticism among social scientists (for example, Hornborg 1996; Hornborg 2009) that modern societies can learn anything useful from LEK pertaining to pre-existing or traditional systems of resource management, particularly given the manner in which it is commonly presented, as by Berkes and Folke (1998), Berkes (1999), or Berkes et al. (2003), for example. However, some traditional systems may retain much valuable practical information, as in the case of tropical nearshore fisheries, for example, which are poorly understood by Western fisheries scientists (Ruddle 2007; Ruddle and Hickey 2008; Ruddle and Davis 2011). However, this can be known only after local knowledge has been examined in detail and subject to rigorous testing (Ruddle and Davis 2011).

In contrast to the predilection for assumptions is an approach "... based on concepts [that] regard phenomena as abstract ideas, [and] whose attributes arise from a particular and identifiable theoretical framework concerning the factors that organize human relationships and affect the human condition" (Davis and Ruddle, 2010: 885). For example, theoretically grounded LEK "... might be conceptualized as a people's shared system of knowledge or other expression about the environment and ecosystem relationships that is developed through direct experience within a

specific physical setting and transmitted inter-generationally”(Davis and Ruddle, 2010: 885). From established perspectives in anthropology and human geography it is incontestable that “... in every distinct environmental, demographic, and technological context, culture, economics, and politics mediate the satisfaction of social requirements” (Davis and Ruddle, 2010: 885). Such a concept-based approach is far more useful and “researchable” than a limited definitional perspective.

In concept-based LEK social research it is fundamentally important to understand that the local level is further complicated by its socio-political organization, social differentiations resulting from gender, ethnicity, and social class, among other factors, and by often complex and nuanced power relationships. It is in working to understand these complex arenas that social science has a critical role. Society is projected into ecosystems, not vice versa, as demonstrated by sea tenure systems in the Pacific Islands, which reflected social organization and not ecological conditions (Ruddle 1989). In fact, in the Asia-Pacific Region many of the organizations described as “traditional fisheries management systems” have relatively little to do with fisheries management. Rather, they are all about managing human relationships in communities of fishers and their families. This is the basis of the *van chai* of Vietnam (Ruddle 1998; Ruddle and Tuong 2009; Nguyen and Ruddle 2010), for example, and of the *sawen* institution in North Lombok, Indonesia (Satria 2007). And whereas some would likely describe their context in local religion as a perfect example of “sacred ecology”(Berkes 1999), traditional religion in these cases mainly functions to both legitimate traditional authority and cement community harmony. The sceptical among us see the “sacred knowledge” in these cases as cover for a very functionalist underlying intent, as well as legitimation for customary practises and authority.

Some, such as Berkes 2011, contend that “traditional knowledge” and “institutional learning” are at the heart of “resilience thinking”, where they provide essential social-ecological linkages. How these actually function is never explained. There are several problems with this, as can be exemplified just for traditional knowledge. Moreover, to claim as does Berkes (2011) that the notion of “Adaptive Management” is somehow predicated on an institutional and organizational learning ability that is both analogous to the capacity of individuals and results from “Traditional Knowledge” is surely imaginative, but hardly credible. Again, how precisely that might work is never explained. Such a scenario would become unlikely in some of the Kei Islands, of Maluku Province, Indonesia, for example, where exclusive claims to sea territories are contested because their source narrative relating to territorial origins exists in multiple versions open to various and conflicting interpretations (Adhuri 2013). The same occurs in Melanesia, as described for Solomon Islands by Foale and Macintyre (2000) and Papua New Guinea (Macintyre and Foale 2007). So it should not be forgotten that research demonstrates such local complications are more the rule than the exception.

Key concepts

It is critically important at the outset of any interdisciplinary study that includes social research on LEK to define precisely the key concepts being used. There are many potential key

concepts, depending on the nature of the study being done. However, two stand out by virtue of the frequency of their usage. These are: the nature of knowledge, and the concept of “systems of knowledge”. Since it can never be assumed that all persons in even a small, culturally or socially homogeneous community reflect or understand knowledge in common, at the beginning of any study the nature of knowledge must be queried. Several closely related questions must also be asked at this time. These include what such ideas as “commonly” and “shared” mean, and how they should be studied; the relationship between individual knowledge as some amalgam of personal experiences, reflections and social learning, and shared or collective knowledge; how individual experiences and reflections inform, augment and change a knowledge system, and how persons learn of it; the way in which specific attributes of knowledge are learned; whether or not it can be assumed that a knowledge system is essentially closed, an entity unto itself, or whether it should be treated as open and dynamic; the manner in which external processes contribute to and have an impact on an assumed knowledge system, and how that can be known; whether or not there are there contested knowledges; and the social processes/relationships engaged in all of the preceding.

The term “systems of knowledge” is used widely, for example by Berkes (1999), Robbins (2000) and Usher (2000). Assuming that for a particular study a system of knowledge is given, then it becomes essential to describe (1) the extent to which knowledge is shared and can be described as a “system”; (2) the manner in which direct individual or small group experiences create shared knowledge; (3) the conditions causing change in knowledge systems; (4) the functional characteristics of knowledge systems within their specific socioeconomic and cultural contexts; and (5) the ways shared knowledge systems are transmitted from one generation to the next.

Research design and methodology

The credibility of social research on LEK is weakened by the use of non-systematic research designs and practices, failure to operationalise key concepts for systematic study, and a failure to analyse even the most basic attributes and dynamics of social and economic differentiations and power relationships, both at the local level and between the local and external arenas. This is of paramount importance, because poorly designed and badly conducted research will not generate data or knowledge that instils confidence, advances understanding, and thereby provides a solid foundation for designing the study of LEK. On the contrary, it will convey the impression that these are not really important to the outcomes.

Although all aspects of research design and operationalising of key concepts are important, the selection of informants is critically so (Davis and Wagner 2003). In fact, the success of research depends heavily on using the “right” informants. For the practical purposes of designing and managing resources, for example, research should reveal three characteristics of a community’s local knowledge base: (1) the breadth of the knowledge, (2) the depth of the knowledge, and (3) the comparability of one community’s knowledge with the local knowledge of other communities. There are several fundamental considerations: (1) Not all persons in a community are the same in

both the level and character of their local knowledge. (2) Defining the scope of local knowledge, i.e., how widely must claims of fact statements, experience, and so on, be shared by the members within a community before they can be regarded as “local knowledge?” (For example, some knowledge might be held by a single, self-perceived “expert,” and not be shared by the community. So, in such a case, is the material to be regarded as “local knowledge” or just “personal anecdote”?) (3) Knowledge and the vested interests on which it is based and that it expresses will vary among individuals in a community. So, what is the range of this knowing? Who knows what, and how exactly? And, when and how did they come to know? (4) Some items considered LEK might have originated elsewhere. This last consideration has become especially important in a now globalised world with cell phones and rapid information exchange. In addition, the incorporation of the “external” into the “local” likely occurs just because all “local (including aboriginal) peoples” are incorporated into dominant social, political, and economic processes that compel “local” compliance with “external” values, rules, practices, and understandings. That means some parts of a supposedly “local knowledge” likely will be shared widely, and not at all unique to a particular community. An example is the adoption of fisheries science language, e.g. the term “fish stock”, by marine harvesters as a way to describe specific species targeted for exploitation (Holm 2003).

Before any study is planned, its scope needs to be specified. That means prior to actually selecting informants, a researcher must decide on what basis and how to identify such persons. Before making those two key decisions, the “knowledge domain” must be defined. That is, based on a lifetime of experience and observation, a person will specialize, say, in making fermented fish sauce. But s(he) will also know others things. So what is important? Which of those activities (domains) is of main or primary importance? And how important might the other things also be? It is also fundamental to be aware that information is both time sensitive and time rich, from which it becomes important not only to “capture” an expert’s knowledge, but also changes within that knowledge over time.

Further, it is necessary to situate answers to such questions in relation to changes and developments in domains such as (1) local environment and resource availability, (2) social and economic change, (3) required compliance with external agents and power, and (4) other locally relevant factors. “Local ecological knowledge” is a strange term, because it never really is just “local,” and the researcher must discern at least roughly the scope of the geographical area wherein so-called “local knowledge” is shared. If it is widespread, informants will be required within a group of dispersed villages.

The most efficacious way to identify expert informants is through systematically gathered peer recommendations, using a structured sampling technique to ask all local people in the fish sauce business, for example, whom they consider to be the persons who know most about making fish sauce. The names are then rank-ordered by the number of times mentioned, and face-to-face interviews conducted with them according to their rank order. Focused in a specific domain such as

fish sauce manufacture interviews are conducted until information saturation on key questions is demonstrated, i.e., interviewees essentially report similar information and experiences and no more new information is being elicited.

Anything less than a systematic methodology for gathering local knowledge immediately raises important questions about the field data, particular regarding its quality, accuracy, and legitimacy. These must all be of an assured and demonstrated high level to ensure successful and useful research outcomes.

Idealising LEK

There are considerable dangers and intellectual dishonesty implicit in uncritically accepting and romanticizing LEK. Johannes (1994) recognized this when he observed that uncritical appreciation can be almost as bad as none at all, and that overblown claims have provoked a backlash that plays into the hands of those who quickly recognize the powerful rhetorical tool that the notions of traditional resource management and LEK provide; but, then often selectively use only those facts that accord with their case. An example is the equating of “sacredness” with ecological wisdom, as by Durning (1992), Suzuki and Knudtson (1992) and Berkes (1999), and use of such phrases and terms as “sacredness of ecological systems” or “sacred ecology” of indigenous peoples to distinguish LEK (Ruddle 2007).

Describing understandings as sacred and part of a magico-religious worldview is one thing; subjecting them to research-based verification and tests of validity and reliability is entirely another exercise. Certainly any claim, as Berkes (1999) attests, that such culturally embedded beliefs and practices are an important, alternative and empowering basis for sustainable resource use and management must rest on a foundation provided by the aforementioned culturally embedded beliefs and practices. Otherwise, faith in beliefs and the assumption that belief translates directly into behaviour are held as a sufficient basis on which to manage resource allocation and use.

The absence of any effort to determine validity in these matters is a serious deficiency that deepens misunderstandings, disarms the capacity for meaningful social research, and essentialises the human beings concerned. As Harris (2001:51) reminds us, “[b]elieving a given proposition is a matter of believing that it faithfully represents some state of the world, and this fact yields some immediate insights into the standard by which our beliefs should function. In particular, it reveals why we cannot help but value evidence and demand that propositions about the world logically cohere”. While the best of intentions may underscore the conduct and representation of social research, it is the character and quality of the evidence as determined by research design and the ways evidence is gathered and analyzed that enable us to advance understanding.

Social research often misrepresents LEK by a simplistic acceptance as proven of such idealized notions as “indigenous,” “community,” “beliefs,” “knowledge,” and “traditional”. For

instance, the term “traditional” is highly problematical. Mainly it conveys a sense of time, i.e., something is traditional only if it has a long history and extends across generations. By extension, therefore, “traditional” is often used to identify so-called pre-modern cultures. This is confusing because different criteria are applied by mainstream and non-mainstream societies to resource use activities and associated behaviour. They are regarded as routine behaviour by group members but as “traditional” by the larger society. In fisheries, for example, the concept “traditional” is confused and conflated with a fishery type, and usually with subsistence fishing or long standing fishing practices. Further, a binary opposition between “traditional” and “non-traditional” fisheries is illogical, because whether a fishery is “traditional” or not is independent of its type (Ruddle and Hickey 2008).

LEK within interdisciplinary education

The credibility and meaning of the potential of a social research contribution on LEK in environmental conservation and renewable natural resources management educational programmes is contingent on the qualities of the research and its purpose. Arguably, the mandated first task of the social researcher and educator is to provide reliable and meaningful insights and understandings, particularly where the interest is to educate students to analyze and otherwise address matters such as the management of natural resources, which affects the very basis of livelihoods, especially those of the poor.

Thus in the social research literature on LEK analyzed by Davis and Ruddle (2010), the use of non-systematic research designs and practices, the apparent failure to operationalise key concepts for systematic study, and a failure to analyse even the most basic attributes and dynamics of social and economic differentiations and power relationships, both at the local level and between the local and external arenas, are serious omissions for the research directly and for its use in tertiary education. None of the oft-stated goals for documenting LEK, of engaging these as prospective sources for alternative and sustainable natural resource management, and of advancing the social justice agenda of the disempowered and marginalized, are well served through social research practices and treatments that are elementally unaccountable. This is of paramount importance, because poorly designed and badly conducted research will not generate data that instils confidence in its users or advances their understanding. Rather, it will convey to the student the impression that these qualities are not really important!

Further, an intellectual commitment to critical analysis is mandatory, coupled with education and research designed to subject ideas systematically to the burden of rigorous proof. These are key elements to advancing knowledge and deepening understanding (cf. Grayling 2008a; Grayling 2008b). Despite notable exceptions, much of the most cited LEK literature analysed by Davis and Ruddle (2010) lacks even the notion of subjecting LEK claims to systematic examination. Indeed, it is so uncommon that much presented as “knowledge” amounts to little more than statements of belief, faith or preference.

However, to conduct such an exercise in critical analysis these days is daunting, since examining LEK claims for validity and reliability is assayed adamantly and very publicly as just an expression of Western scientific hegemony intended to discredit alternative, particularly indigenous, ways of knowing (e.g., Brook and McLachlan 2005). The proclamation that “testing” claims of LEK is fundamentally disrespectful of alternative ways of knowing and knowledge holders is yet another example of the “resurgent irrationalism” (Davis and Ruddle 2010: 892) of our time. In contrast, scientific rationality fosters “. . . healthy scepticism that asks for good evidence and good argument, that applies critical scrutiny to propositions or claims, that suspends judgment while the evidence is pending, and accepts what the evidence says. . . , independently of prior wishes or partisan beliefs” (Grayling 2008a:55).

Social research on LEK potentially can contribute much to understanding qualities of the human condition, and resource management. However, given the trends evident in the most cited literature, much in the existing LEK social research is not likely to fulfil that potential.

Manipulating the Research Publication Process

The temptation to “manage” general information and research results to one’s personal or epistemic group’s advantage afflicts all branches to knowledge. This is particularly rampant in a highly politicized and contentious field like LEK. However, the public outrage following the “revelation” that climate scientists in the University of East Anglia (UK) “conspired” to block publication of non-conforming researchers’ work, illustrates the extent to which the public is naively optimistic in its general understanding of the research community’s practices, and, on the other hand, how the research enterprise is thoroughly “human”. A couple of our recent experiences further illustrate how political considerations informed by prevailing sentiments and preferences thwart publication of contrary, or “indelicate”, “insensitive”, or unfashionable analyses and interpretations.

In one instance, an editor of a well-known interdisciplinary journal in the field of human ecology claimed that he had been “advised” not to publish a paper that we had submitted. This occurred after we had provided a detailed rebuttal of the single blind review, a peer assessment that was full of factual and analytical errors. Rather than addressing substantively our reply to this one assessment, the editor, who also directed the authors to additional on-line reviews that turned out to be non-existent, cited non-specific “advice” as the reason for his decision to summarily reject our submission. Subsequently, the same paper was published largely unaltered elsewhere, after a rigorous blind review process involving three experts (Davis and Ruddle 2010).

That might have been dismissed as an anomaly were it not for another experience soon thereafter that one of us experienced with a different research journal. In this instance, Ruddle had been invited to comment on a special issue keynote paper (Berkes 2011; Ruddle nd). The commentary was submitted as requested, and according to the conditions specified. Ruddle was informed soon thereafter that his commentary could not be published. When pressed, and after much

prevarication, the journal manager admitted in e-mail correspondence that the author of the keynote paper had threatened to withdraw his manuscript should the journal proceed with publication of Ruddle's commentary. Apparently, the keynote author took great umbrage with the commentary's substance and implications. So, fearing the entire special issue would collapse, the journal decided to acquiesce to this threat and refused to publish the Ruddle commentary.

Our experiences are a further illustration of concerns expressed about climate change scientists privately disparaging and actively seeking to block publication of research results and interpretations that challenged preferences and prevailing sentiments. They also illustrate a couple of critical and troubling issues about the limitations placed by the research community on contention and debate. More important is the probability this will impede contentious analyses and interpretations by compelling conformity to prevailing preferences, particularly when these control editorial and publication decision-making in research journals, in an environment where publication is obligatory for career advancement, reputation, and access to opportunities. Here the conditions that foster intellectual freedom and open debate are fundamentally compromised; and, these are the very conditions essential to advancing research-based knowledge. These conditions also seriously limit the expression of innovative ideas and results by younger scientists and scholars.

Public and professional confidence in and the authoritative "voice" of research outcomes are almost entirely contingent on two fundamental and linked practices. The first is that research is designed, conducted and reported as honestly and transparently as possible. The second is that research and its outcomes will be assessed rigorously and fairly by independent experts, before being judged meritorious and suitable for publication in peer-administered research journals. In theory, these practices honour the requisite intellectual freedom essential for the sorts of innovative research and enquiry requisite for advancing understanding. These practices also welcome the equally necessary condition that research and its outcomes will often be both contentious and disputatious.

Those essential qualities of research and its outcomes are among the very attributes that require the reference points for expert assessments to be transparent, substantial and accountable, particularly given that contentious results are key to challenging received knowledge and to advancing understanding. It is anticipated that the highest standard of peer assessment will examine attributes of research design and methodology to assure that the data generated are reliable and representative. In addition, assessment is expected to examine whether the research is replicable and if the outcomes can be verified. Finally, assessment is expected to focus on whether the analyses and interpretations of research findings are complete, reasonable and advance understanding.

In theory these are the critical attributes of the peer-referenced and administered assessment process that underscores and fosters public and professional confidence in the authoritative "voice" of science research. Public reportage of such notorious cases of research misconduct as intentionally falsifying or misreporting data act to confirm that the peer expert assessment system works as the

solid foundation for situating professional practice and public confidence. Further, many universities and high-impact research journals have implemented ethics evaluation procedures to assure that research is guided by appropriate, accountable and transparent practices. However, the very need for such arm's length monitoring practices recognizes that vested interests and personal preferences are ever positioned to influence judgments and decisions. Expressed in all research is a wide range of motives, from principled curiosity aimed at advancing understanding and improving the human condition through vulgar self-interest and careerism. Whereas assessments are peer-referenced and, within the accepted values of the research community, all research related practice is essentially competitive, whether it be seeking initial funds or publishing final results. And, competition among researchers is assumed to ensure innovation, best practices and meaningful outcomes. Of course, this quality embodies and expresses the neo-liberal belief that competition is the required vortex wherein and from which the most creative and productive outcomes will be achieved. Yet, inherent conflicts, subversion and contradictions are often as not competition's spawn, particularly given the need for researchers to satisfy career benchmarks and requirements. The "publish or perish" axiom captures this real world condition, and the potential it provides for subverting the merits of peer-referenced and administered assessments.

Contrary to opinions such as those expressed in Anon (2010), correcting this entirely destructive set of conditions requires much more than a public relations exercise. In the first instance the basis for editorial judgments must be transparent and accountable. Reliance on rigorous peer assessments is essential. These must be required to be substantial in their treatment of such matters as research design and methodology, and data interpretation relative to prevailing explanations and theories. The research community also needs to be much more committed to public transparency and communication about the assessment procedures that provide the general public with reasons to trust research and its outcomes. Research-based knowledge and public confidence are not advanced by a knee-jerk adherence to political correctness, by editors prepared to acquiesce to threats from researchers unable to tolerate criticism, or by blind adherence to preferential interpretations. Dispute, contention and argument are essential to the intellectual freedom and creativity that underwrites the advancement of knowledge. The research community needs to be much more creative and forthright about championing these conditions. Finally, the general public, as funders and consumers of research, needs to be engaged by the research community in dialogues and education about the conditions, including disputes, essential to advance research knowledge.

Final Discussion

Clearly, like so many other fashionable areas quickly latched onto in the shifting sands of academe, interdisciplinarity is no panacea. On the contrary, in many cases it may be either unnecessary or undesirable. Worse, in the social sciences the mistaken assumptions (Ruddle and Davis 2011), generic models that posit deterministic relationships, flawed methodologies employed to conduct research (Davis and Ruddle 2010), and the controlled and manipulated dissemination of research results (Anon 2010) make interdisciplinary research largely unachievable and undesirable

until these qualities are examined transparently, and preferably corrected. On the other hand, the validity of simplistically employed scientific methods has been challenged by social scientists such as the so-called “political ecologists”, whose focus on power, hegemonies, oppression, and social construction of natural phenomena directly confronts the self-appointed right of natural scientists and resource economists to ordain issues and sanctify solutions (Harvey 1989; Spiro 1996).

Methodological issues include improved acceptance of different disciplinary working methods. Also needing to be addressed head on are the changes that disciplinary theories and methods must undergo to become suitable for interdisciplinary use, as well as the deep-seated problems that make interdisciplinarity unsuccessful.

In large part an integration of knowledge and the full emergence of interdisciplinary thinking have not occurred because contemporary “universal” or “scientific” knowledge is predominately a Western construct, based on often narrow divisions among disciplines, in contrast to other great traditions based on holism. Moreover, this Western construct has until very recently been male dominated, and therefore gender-biased in its considerations. Economic, ideological, and institutional factors combine to perpetuate the marginalisation and neglect of anything but vulgarly framed and situated Western scientific knowledge. Principal among these are (1) an elitist bias virtually deifies objective Western science and regards other knowledge systems as illegitimate. (2) Innovation is dissuaded when only empirical, quantitative methodologies are acceptable, resulting in a standardised technological transfer being promoted by the structure of research institutions and professions, and reinforced by the profit-seeking private sector. (3) Poorly conceived early attempts to integrate “soft” (social science) knowledge, compounded by the difficulty of using conventional criteria and quantifiable results to demonstrate outcomes, reinforced a conventional scepticism; and (4) Similar deeply held stereotypes and mistrust long-inhibited both understanding and practical application of women's knowledge of resources and environments. Such attitudes, formed in pre-colonial days and reinforced by male-dominated colonial research institutions and extension services, have been perpetuated in the successor independent nations.

Specifically with regards to fisheries management, some, like Degnbol et al. (2006) believe that a broad vision is required for integration among technical specialists, management authorities, and others. That is reasonable. But it is impractical to assert as they do that a change in the culture of science to enable cross-disciplinary work is required to bring about such integration; “People would need to rethink their assumptions, values, and ambitions, and the way they speak to each other. The arrogance that often prevails among sciences, and which is nurtured through their disciplinary blinders, is a factor to be reckoned with. However, cross-disciplinary work processes need institutional restructuring as well” (Degnbol et al. 2006: 542).

That, of course, is academic daydreaming. Even now fisheries are “managed” by a tortuously slow political process that is essentially a response to a vast scientific disagreement about the causes of and solutions to fisheries problems (Wilén 2006). Among Western academics specialised in

fisheries a fundamental disagreement exists between scientists and economists. The former have concluded that the principal cause of the “fisheries problem” is the short sighted and “get rich” behaviour of marine harvesters combined with attitudes of politicians who ignore scientists, or even support powerful vested interests (Ludwig et al. 1993), and that such behaviour must be regulated by stringent top-down controls (Hilborn and Walters 1992) monitored and enforced by the nation state’s coercive agencies such as the marine police or coast guards. Scientists have concluded also that fisheries require ecosystem management, the use of marine protected areas, applications of the “precautionary principle”, and adaptive management. In contrast, economists and other social scientists dismiss the scientists’ approach as not addressing the underlying causes of marine harvesters’ behaviour, which, they assert, stems from governance that does not secure harvest rights. This leads to wasteful competition within and between harvesting groups, overexploitation of marine resources, the adoption of dysfunctional gear and other innovations, destructive fishing, and resource degradation, all of which can be overcome by “redesigning governance institutions ... [to] reorient individual initiative and innovation toward conservation and stewardship” (Wilen 2006: 536). However, the economists’ stance is based on a spurious neo-liberal argument regarding property rights and their impacts (Davis and Ruddle 2012).

Moreover, and probably more to the point, those sorts of arguments also assume that fisheries science is something more than a hand-maiden legitimating and enabling mass harvesting and capital accumulation. No serious consideration is given to the structures and relations of economic appropriation, power inequities and domination that drive industrial, especially capitalist, marine resource exploitation. In reality, the worldwide collapse of marine resources consequent upon such relations of exploitation reveals clearly that arm’s length “science” neither exists nor, more significantly, matters. At best, its role is to document and observe as the mayhem proceeds, with occasional interventions primarily intended to save capital from its own follies and self-inflicted injuries.

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