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INDIGENOUS KNOWLEDGE IN THE CONTEXT OF NATURAL RESOURCE MANAGEMENT: AN INFORMATION SYSTEMS PERSPECTIVE

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Abstract  
With heightened global concern regarding climate change, poverty and hunger, natural resource management is becoming increasingly important. However, in many developing countries, the local custodians of natural resources are indigenous farmers who have been working the land for generations. Over time, they have built up a large amount of informal indigenous knowledge concerning sustainability in the local environment that could be disseminated more widely. This paper reviews previous research on indigenous knowledge and discusses the possible contributions that the disciplines of information systems and innovation studies could provide.

Keywords: Indigenous Knowledge, Knowledge Management, Innovation Studies

1.0 Introduction  
Over recent decades knowledge management has become the mantra of most contemporary organizations while knowledge associated with local communities has been largely ignored. However, there has been a growing recognition of the role that local communities’ knowledge, especially indigenous knowledge (IK), plays in the management of natural resources. At the same time, worries about food production and global hunger have been enhanced by increased public concern over the rapid deterioration of the Earth’s ecosystems. A large proportion of the world’s population depends upon IK to meet their food and medicinal needs, especially in developing countries. This paper reviews the existing indigenous knowledge (IK) literature and relates it to mainstream information systems and innovation studies issues, within the context of natural resource management (NRM).
2.0 Natural Resource Management (NRM)

According to The World Bank (1997), natural resources refer to a broad spectrum of ‘environmental assets’, including air, water, land, plants, animals and micro-organisms. These assets are linked together to form natural systems, such as rivers and forests, and NRM reflects these linkages within and between natural systems. It integrates the management of social, economic and environmental values by involving the community in planning and other activities. NRM is fundamentally about people as its success is ultimately determined by the level of community involvement and the adoption of ecologically sustainable practices across the community (Ashley, 2000).

The extensive literature on NRM (e.g. Norfolk et al, 2003; Pritchard & Sanderson, 2002), highlights the importance of participatory development and knowledge management. There is widespread recognition (Bessette, 2004) that participatory development is critical for achieving sound resource management but this means empowering local communities. Information describing the natural resources forms the base upon which sustainable development is built (Tabor & Hutchinson, 1994) and hence it is important to manage knowledge resources effectively. However, the local knowledge resources in many communities in developing countries are not codified in Western scientific terms but instead comprise what is known as ‘indigenous knowledge’.

Natural resource exploitation provides the livelihoods for a high proportion of the world’s population (Pimental, et al., 2002). Since the 1992 Earth Summit in Rio, and culminating in the Copenhagen Conference in 2009, there have been increasing concerns about climate change and the sustainability of the world’s natural resources. As human activity is the major destructive force in nature, improving NRM primarily requires changing human behaviour at ‘grassroots’ level (Röling, 2000). Today it is widely agreed that local people’s perspectives need to be at the centre of research efforts for development and that innovations need to be ‘owned’ by the local land users, if changes in decision-making and behaviour leading to a positive impact are to be achieved. Such ownership can be created effectively through development and implementation of innovations by local people themselves in cooperation with outsiders (Hagmann & Chuma, 2002).
3.0 Indigenous knowledge (IK)

Various scholars (e.g. Murdoch & Clark, 2005; Norgaard, 2003) argue that IK plays an important role in the sustainable management of natural resources. At the same time, there has been a realization that scientific knowledge may have contributed little to the development of particular communities; rather, it may have hastened the depletion of their social and natural resources (FAO 1999).

However, what is meant by ‘indigenous knowledge’ is by no means clear and Antweiler (2004) identifies no fewer than twenty-two similar terms, such as ‘local knowledge’ and ‘folk knowledge’, which are often used interchangeably. Sillitoe & Marzano (2009, p14) find that IK “varies within and between societies, comes from a range of sources and is a dynamic mix of past tradition and present innovation. It is heterogeneous and complicated which is an inconvenience for development.” It is also diffused ‘skills as knowledge’, held by various people within a society and communicated through various symbols, myths and rites in an apparently piecemeal everyday fashion. They argue that “it is neither static nor uniform but ever-changing and subject to continual negotiation between people … it is a process featuring the acquisition and integration of current information and experience” (p15).

Berkes & Berkes (2009) emphasise the relationship between IK and the local natural world and note that IK comprises institutions, in terms of rules and norms, about how to treat the environment, as well as comprising a particular worldview that influences how they make sense of this natural world. They also emphasise the holistic nature of IK, compared to Western reductionism. Thrupp (1989) points out that, while at first IK was seen as a potentially useful source of mere ‘technical ideas’, it also extends to “non-technical insights, wisdom, ideas, perceptions, and innovative capabilities which pertain to ecological, biological, geographical and physical phenomena” (p.15).

An IK system therefore provides the basis for decision-making, which is operationalised through indigenous organizations, which provide the foundation for local innovations and experimentation. IK systems are therefore adaptive skills of local people, usually derived from many years of experience, which have been
communicated through oral traditions and learned through family members and generations. Local people, including farmers, landless labourers and rural artisans are all stakeholders of IK systems.

Dewalt (1994) identifies the following features of IK, which are relevant to NRM:

- **locally appropriate**: IK represents a way of life that has evolved with the local environment.
- **restraint in resource exploitation**: production is for subsistence needs only.
- **diversified production systems**: there is no overexploitation of a single resource.
- **respect for nature**: a “conservation ethic” often exists. The land is considered sacred, humans are dependent on nature for survival; all species are interconnected.
- **flexible**: IK is able to adapt to new conditions and incorporate outside knowledge.
- **social responsibility**: there are strong family and community ties, and with them feelings of obligation and responsibility to preserve the land for future generations.

Furthermore, Grenier (1998) points out that IK:

- Is usually parochial, confined to a small area, and limited to what rural people can sense, observe, and comprehend using their own terms and concepts.
- Is not uniformly spread. Individuals vary in their aptitude for learning, storing, and generating knowledge. Specialized knowledge often belongs to certain groups or individuals; for example, male elders, midwives, traditional healers (Eythorsson 2000).
- Includes both explicit and implicit knowledge, some of it intuitively practised through cultural rituals or revealed through stories and legends.
- Is embedded in culture.
- Can be complex. Attempts to “scientize” IK by removing it from its owners will tend to compromise the subtle nuances of this knowledge (Thrupp 1989).

Turnbull (2009), quoting a position paper from the World Summit on the Information Society in Geneva in 2003, argues that IK is the basis of people’s cultures, identities, institutions and value systems and cannot be separated from their spiritual and material relationships with their lands. Furthermore, these cultures provide the rules for sharing and applying this knowledge. Berkes & Berkes (2009) see IK as “a body of knowledge built up by a group of people through generations of living in close contact with nature” (p7). IK is therefore understood to be the starting point for NRM in rural communities.

### 3.1 Indigenous knowledge and scientific knowledge

It is very difficult to discuss different systems of knowledge and different cultures without considering the realities of political and economic power. Bryan (2009, p24) notes that “the very concepts used to identify certain kinds of knowledge as indigenous remain steeped in colonial power relations”. He discusses the production
of maps and, in particular, the difficulties of ‘indigenous mapping’ where the traditional relationships between a people and the land are often considered to be ‘unmappable’. Nevertheless, he argues that indigenous people are in the position of having to “map or be mapped” (p24). Maffie (2009) critiques the notion that Western hegemony, reflected in the triumph of the Gatling machine gun, somehow demonstrates the superiority of Western epistemology. As he argues: “indigenous knowledges have been defeated, not disproven, by Western technology” (p56).

IK is seen to be different from scientific knowledge and conventional wisdom has been that scientific knowledge is somehow more advanced and global than IK. However, the onset of ‘global warming’ and adverse climate change raises questions as to how advanced Western science actually is. Turnbull (2009) makes the point that scientific knowledge itself is ‘local’, based on the sociological notion that science is ‘what scientists do’ and is based on highly situated practices. Both knowledges are based on observation, some form of experimentation and the desire to create order out of apparent disorder (Berkes & Berkes, 2009) and “in some sense we are all indigenous and all knowledge including science is local” (Turnbull, 2009, p.3). Similarly all knowledges are “the product of human movement, actions, practices and protocols. … [they] are dynamic, heterogeneous, social and distributed” (p.3).

The knowledges have different epistemologies, with science based on evidence, repeatability and quantification while IK is often more related to spiritual and religious practices. However, there is no meaningful meta-theory to compare the different varieties. IK may be lacking in terms of scientific (positivist) epistemology but it rests on a very different epistemology. Furthermore, Sillitoe & Marzano (2009) argue that the distinction between IK and science is ‘misleading’ as, in practice, they borrow from each other.

In trying to ‘square the circle’ between IK and scientific knowledge, authors offer various solutions in terms of providing a space for different knowledges. Green (2009) talks about a ‘duality’ of IK and science, suggesting that different epistemologies, based on different ‘moral economies’ should be accepted, such that different knowledges are not seen as mutually exclusive. She argues for a ‘reflective equilibrium’ to compare the different epistemologies. Berkes & Berkes (2009) note a
similarity between IK and ‘fuzzy logic’, a form of science proposed by Zadeh (1965) which is seen as being highly legitimate within, for example, the artificial intelligence community. Sillitoe & Marzano (2009) argue for a model comprising ‘linked spheres of knowledge’, in the absence of a single theory of knowledge that would link IK with science, while Maffie (2009) proposes a ‘polycentric global epistemology’ that would accept such practices as dance, song and ritual performance as legitimate knowledge mechanisms.

Many authors (Labatut & Akhtar, 2005) have stressed the value of IK for development. But IK has its limitations (Bebbington, 1999) and is not in itself capable of addressing all the issues related to sustainable development (Murdoch & Clark, 2005). Sustainable development may well be better served by a system that incorporates both indigenous and scientific knowledge systems (Icamina, 1999) and creating a technological base that includes both traditional and modern approaches to problem-solving (Johnson, 2005).

### 3.2 IK for sustainable NR management

In most developing countries, the majority of the population are small-scale farmers with less than one hectare of land. Their knowledge systems have never been recorded systematically in written form and hence are not easily accessible to researchers. While remaining invisible to the development community, many indigenous organizations (e.g. farmers’ associations) operate in rural communities identifying solutions to community problems. NRM planners and policy makers are beginning to recognize the need to understand existing knowledge systems and decision-making processes. There is a general agreement that agricultural innovations based on IK have been tested through time (Warren & Rajasekaran, 1993).

Despite the evidence, there is scepticism about the relevance of IK for NRM, partly because indigenous communities never record their accomplishments, never attach their names and patents to their discoveries and inventions. As a result, the history of natural resource development is written without reference to the main stakeholders (Kajembe & Wiersum, 2004). According to the FAO (1999), NRM has been much more concerned with conserving resources ‘without’ local communities. Protection of
natural resources has at times been seen as necessitating disruption of traditional ways of life.

As documented by IFAP (1990), neglecting IK undermines farmers’ confidence in their traditional knowledge, which in turn forces them to become increasingly dependent on outside expertise. IFAP (1990) also asserts that small-scale farmers are often portrayed as backward, obstinately conservative, resistant to change, lacking innovative ability, and even lazy due to:

- a lack of understanding of traditional agriculture which further leads to a communication gap between promoters and practitioners giving rise to myths;
- the accomplishments of farmers often are not recognized, because they are not recorded;
- poor involvement of farmers and their organizations in integrating, consolidating and disseminating what is already known.

Atte (2004) argues that the under-utilization of IK systems leads to the loss of indigenous acquired knowledge, which results in the inefficient allocation of resources and manpower. With little contact with rural people, planning experts have attempted to implement programs which do not meet the goals of rural people, or affect the structures and processes that perpetuate rural poverty. Human and natural resources in rural areas have remained inefficiently used or not used at all. Planners think they know what is good for these ‘poor’, ‘backward’, ‘ignorant’, and ‘primitive’ people (Atte, 2004).

Timely attention is now beginning to be paid to incorporating IK into NRM processes as, in North America for example, indigenous perceptions of land use and landscapes have been transcribed into maps (Brody, 1982). Nakashima & Reed (2005) note that IK has been applied to historical climatic research, geophysical research, rural land use and resource management planning. Indeed, the IK of local flora and fauna often exceeds that of western scientists. However, while indigenous peoples have profound knowledge of local ecology, the apparent informality of such information does not sit comfortably with the western scientific tradition. Local knowledge about the land identifies issues of immediate significance and encodes information in a language that local people understand (Ramisch, 2002) unlike much scientific land use information. Attempts to involve Canadian native indigenous populations in planning through the Northern Land Use Planning Programme and environmental assessment processes
were unsuccessful, partly because of a failure to develop adequate frameworks for dealing with indigenous knowledge (Fenge & Rees, 1987)

In addition to NRM, IK is widely used in medicine and, according to Kaya (2009), 65% of poor people in sub-Saharan Africa depend on traditional medicine for basic health care. Furthermore, the commercialisation of traditional medicines is an important part of pharmaceutical research and development with world sales of herbal medicines reaching $30 billion in 2000. This raises difficult issues concerning the division of profits and intellectual property rights.

3.3 Preservation of IK
IK, which has generally been passed through generations by word of mouth, is in danger of being lost unless it is formally documented and preserved (Warren, 2004). Such a loss would impoverish society because, just as the world needs genetic diversity of species, it needs diversity of knowledge systems (Labelle, 1997). The rapid change in the way of life of local communities has largely accounted for the loss of IK. Younger generations underestimate the utility of IK systems because of the influence of modern technology and education (Ulluwishewa, 1999).

If IK is not recorded and preserved, it may be lost and remain inaccessible to other indigenous systems as well as to development workers. Development projects cannot offer sustainable solutions to local problems without integrating local knowledge (Warren, 1991). IK is the key to local-level development (Schoenhoff, 1999) and ignoring people’s knowledge is likely to ensure failure (Brokensha et al., 1997). One should not expect all the expertise for Third World development to come from the West; in the face of dwindling resources, IK could provide vital tools for rural development (Atte, 1989).

Since IK is essential to development, it should be gathered, organized and disseminated, just like Western knowledge (Agrawal, 1995) but this raises issues related to methodology, access, intellectual property rights and the media and formats in which to preserve it (Msuya, 2007). Underlying these challenges is the dilemma of whether to use the Western paradigm for collecting and preserving IK.
Some scholars (Ulluwishewa, 1999) recommend *ex situ* conservation strategies, i.e. isolation, documentation and storage in external archives. In the 1990s this strategy was used to document the healing practices of the Fulani pastoralists in the north-west province of Cameroon (Nuwanyakpa, 2006). On the other hand, those who advocate maintaining distinctions between scientific knowledge and IK have supported *in situ* preservation of IK (Agrawal, 1995).

Lawas & Luning (1996) point out that the collection of indigenous information is time-consuming and costly. They argue that library and information professionals should design collection development policies but it could be argued that the collection of IK in the field should be left to ethnographers, anthropologists, and related professionals. Instead, information professionals should collaborate with national IK resource centres to enhance access to IK.

A contentious issue in the management and preservation of IK is the protection of intellectual property rights. In this regard, the United Nations Draft Declaration on the Rights of Indigenous Peoples underscores the fact that indigenous peoples have the right to own and control their cultural and intellectual property (Valsala & Kutty, 2002).

Although most IK is held in the minds and practices of people, and is commonly held by communities rather than individuals, intellectual property rights that are intended to protect the ownership of the intellectual content of the works of an individual can be applied. In the Western tradition the intellectual property must be tangible, taking the form of a written document, a recording of music, a painting or drawing, and the like. Sometimes IK is tangible. For instance, there are songs, stories, music, statues, paintings, designs, processes and drawings that embody traditional knowledge. These are capable of being protected either individually or communally. Upholding intellectual property rights should benefit indigenous communities by the commercial use of their traditional knowledge. This could be an area where information professionals could contribute.

### 3.4 Challenges and limitations of IK
Although the knowledge of indigenous communities has been found to be very useful, the spread of industrialization threatens its preservation and continued development (Sherpa, 2005). Industrialization, along with its attendant processes of urbanization, exploitation of NR, and increased competition for employment, has set off a problematic chain of events. IK can also be eroded by wider economic and social forces. Pressure on indigenous peoples to integrate with larger societies is often great and, as they become more integrated, the social structures which generate IK and practices can break down. Added to this is the commercial pressure by multinational agrochemical companies eager to break into new markets (Thrupp, 1989).

As Grenier (1998) puts it:

“the growth of national and international markets, the imposition of educational and religious systems and the impact of various development processes are leading more and more to the “homogenisation” of the world’s cultures. Consequently, indigenous beliefs, values, customs, know-how and practices may be altered and the resulting knowledge base incomplete.”

As with scientific knowledge, however, IK has its own limitations and these must be recognized. IK is sometimes accepted uncritically because of naive notions that whatever indigenous people do is naturally in harmony with the environment. Thrupp (1989) argues that we should reject “romanticized and idealistic views of local knowledge and traditional societies” (p15). There is historical and contemporary evidence that indigenous peoples have also committed environmental ‘sins’ through over-grazing, over-hunting, or over-cultivation of the land. It is misleading to think of IK as always being ‘good’, ‘right’ or ‘sustainable’.

Like scientific knowledge, sometimes the knowledge which local people rely on is wrong or even harmful. Practices based on, for example, mistaken beliefs, faulty experimentation, or inaccurate information can be dangerous. Some IK that was once well-adapted and effective becomes inappropriate under conditions of environmental degradation (Thrupp, 1989). Although IK systems have a certain flexibility in adapting to ecological change, when change is particularly rapid or drastic, the knowledge may be rendered unsuitable and possibly damaging.
As shown in the above brief review of the IK literature, much of the debate is normative, political and pragmatic. This can be useful in making quick improvements to NRM but adds little to our deeper understanding of IK. Very little of the existing literature has much of a theoretical base and it is conjectured that progress could be made by exploring IK from the perspective of relatively modern disciplines, such as information systems, knowledge management and innovation studies.

4.0 Indigenous knowledge, information systems and knowledge management

Apart from knowledge management, IK has been little explored within IS research and development projects, with the possible exception of geographical information systems (GIS), many of which have been concerned with NRM (Mbile et al., 2003). There are important spatial aspects to IK and GIS offer the opportunity to facilitate the management and utilization of IK (Lawas & Luning, 1996). Tabor & Hutchinson (2004) and Gonzalez (1995) describe the advantages of using GIS to document IK.

However, as argued by Walsham & Sahay (1999), the use of GIS in developing nations provides a classic example of the utilization and transfer of technology problem, which typically involves the introduction of Western technical systems into developing countries. Furthermore, Sahay & Walsham (1997), in discussing the use of GIS in India, highlight various problems; for example, the development of systems that are not considered relevant by users, the lack of continuity in project management practices; and inappropriate co-ordination between the various agencies.

Many approaches to integrating IK into GIS have been participatory in nature. These include Gonzalez (1995) in the Philippines and Rundstrom, (2006) in Nepal. McConchie & McKinnon (2003) pioneered a technique called Mobile Interactive Geographic Information System, developed for integrating IK to produce community-based maps for collaborative NRM. While there is an increasing interest in using GIS in a participatory context (Abbot et al., 1998), there are fears that it could be misused, wrongly interpreted, or not used at all and, if poorly designed, it could dis-empower underprivileged groups (Jordan & Shrestha, 2005).
However, rather than within information systems, it is within the field of knowledge management that IK can be more readily discussed. The notion of knowledge management grew from the early predictions that we were entering a post-industrial society (Bell, 1973) which would feature a knowledge economy (Toffler, 1990). Nonaka (1994), one of the most influential theorists, built a theory of organizational knowledge creation, based on Polanyi’s (1967) distinction between tacit and explicit knowledge. According to Polanyi, tacit knowledge was based on experience, behaviour and skills, which is held in the brain of the person, whereas explicit knowledge is articulated and can be documented and stored on paper or electronically. Nonaka (1994) argued that knowledge is created within the firm through modes of interaction between tacit and explicit knowledge and these different modes act together dynamically to form a spiral of knowledge creation.

Nonaka’s model implicitly views knowledge as an object (Thompson & Walsham, 2004) that is constructed and can then be shared by others. This led to definitions, such as the one by Brooking (1997): “knowledge management is the activity which is concerned with strategy and tactics to manage human centred assets”. However, Thompson & Walsham (2004, p.726) argue that “the meaning of any objective ‘knowledge’ will always remain the subjective product of the person in whose mind this is constituted, always relationally defined, and therefore does not transfer easily to others in a form which may be operationalised to the benefit of the organization”. They also point out that Polanyi himself regarded explicit knowledge as self-contradictory.

The alternative approach to knowledge as object is to take a practice-based view (Blackler, 1995) where objective knowledge is considered more as an inter-subjective process, resulting in the recipient knowing. This also fits better with Weick’s (1995) notion of sense-making and Lave & Wenger’s (1991) situated learning. Thompson & Walsham (2004) emphasise the importance of the organizational context for these processes and they view knowing as “mediated, situated, provisional, pragmatic and contested” (p.743). Habermas (2003) dismisses the notion of knowledge as the representation of reality but regards it rather as a competence to do something successfully in practice. From an actor-oriented perspective, both scientific and IK are fragmentary, partial and temporal. They are constantly being generated and
constructed as products of dynamic processes of interaction between various actors with different cultural backgrounds and understandings (Katani 2005).

Knowledge is not just a commodity but is the outcome of a process which is a result of negotiation on the ‘social interface’ between multiple actors (Long & Villareal, 1994). From this perspective, local stakeholders (individuals or groups) should be seen as situated agents (Kajembe, 2003). Within the limits of existing information, uncertainty and other constraints (e.g. physical, social and politico-economic), local actors are knowledgeable and capable (Chambers et. al., 1989). They attempt to solve problems, learn how to intervene in the flow of social events around them, and monitor continuously their own actions, observing how others relate to their behaviour and taking note of various contingent circumstances. Human agency, or the capacity to devise ways of coping with life, plays an important role in the way actors create new possibilities.

McAdam & McCready (2000) compare what they call the ‘social paradigm’ of knowledge construction, using Lave & Wenger’s (1991) and Demerest’s (1997) models, which emphasise practice, interaction and communication, with the ‘scientific paradigm’ (equivalent to knowledge as object), which produces a “canonical body of facts and rational laws” (p.158). For them, the social paradigm seems more useful within the business context. Sutton (2001) concludes that “knowledge may be codified into texts and artefacts but only functions in people” (p.87).

Alavi & Leidner (2001) discuss the various conceptualizations of knowledge and go on to develop a framework comprising four sets of ‘socially enacted knowledge processes’:

- knowledge creation
- knowledge storage/retrieval
- knowledge transfer
- knowledge application

Lave & Wenger’s (1991) work led to a growing research interest into ‘communities of practice’. According to them, a community of practice is “a system of relationships between people, activities, and the world: developing with time, and in relation to other tangential and overlapping communities of practice” (1991, p.98). Such
communities are seen as being hugely important for knowledge creation as they provide the interaction, the shared basis of understanding and the propagation channels for the creation and sharing of knowledge (Wenger, 1998).

These different conceptualizations of knowledge suggest different epistemologies and Spender & Scherer (2007), among others, argue for a tolerance of these differences and a ‘pluralistic conversation’ between them. Similarly, Schultze & Leidner (2002) argue that the ambiguity regarding the nature of knowledge, and the different types of knowledge, imply the need for different ‘discourses’ and they propose the adoption of the four discourse types of Deetz (1996) – normative, interpretive, dialogic and critical - in order to examine knowledge management.

The dominant information management model has been based on acquiring, organizing and preserving recorded and codified knowledge, which is largely generated by researchers, laboratories and research institutions. Such a model has little room for IK, which is not formally codified and resides largely in the minds of local people. Nevertheless, the growing importance of knowledge and knowledge management implies that IK should be accorded a suitable place in the pluralistic conversation of Spender & Scherer (2007).

5.0 IK and Systems of Innovation

Innovation studies is a fast-emerging multidisciplinary field within the social sciences (Fagerberg & Verspagen 2009) and innovation is high on the agenda of most governments in their attempts to reinvigorate flagging economies. The literature is usually traced back to the work of Schumpeter (1934) who saw innovation as the driving force behind economic and social change. His work, which formed much of the foundation of evolutionary economics, was continued by Freeman et al (1982) and Nelson & Winter (1982).

Mytelka & Smith (2002) emphasise the shift over the years from viewing innovation as a process of discovery to seeing it more as ‘a non-linear process of learning’, based largely on the evolutionary ideas of Rosenberg (1976). Rogers’s (1962) theory of the
diffusion of innovation, based on an S-curve, is regularly referred to within the information systems literature.

Amabile et al (1996) define innovation as “the successful implementation of creative ideas within an organization” and this reflects the management literature that seeks to enhance the innovative capacity of individual firms. According to Schumpeter (1934), innovation includes the introduction of new products, methods of production, markets, sources of supply and forms of organization.

Another strand of innovation research refers to national systems of innovation (e.g. Edquist, 2004), which is more concerned with the political economy of innovation at the regional, national and supra-national levels. Lundvall (1992) defines them as “elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge … and are either located within or rooted inside the borders of a nation state”.

However, most writers (e.g. Niosi 2002) regard them more specifically as networks of firms, universities and government agencies. These networks include Triple Helix and Globelics, which have grown over the last seven years or so with the purpose of sharing and refining knowledge, learning and development, as well as linking the ‘helices’ of university-industry-government. It is this stream of research that has largely driven innovation policy and it has little to say about IK or community innovation. Various authors (e.g. Ernst 2002) have discussed innovation systems in developing countries mostly focusing on the networks of formal institutions.

There is clearly a considerable overlap between knowledge management and innovation studies. Swan et al (1999) offer a framework that maps process and product innovation against ‘cognitive’ and ‘community’ knowledge management. McAdam (2000) views knowledge management as a ‘catalyst’ for innovation within organizations and he goes on to fit innovation ‘drivers’ within a framework based on Demerest’s (1997) model of knowledge management.

distinguish between three approaches to national systems of innovation (culture and politics-bounded; technological/sectoral; and regional/local) in terms of knowledge links while Popadiuk & Choo (2006) discuss the relationship between knowledge creation and innovation.

A recent link between innovation and information systems research is the growing interest in ‘open innovation’, based on the ideas of Chesbrough (2003). Open innovation refers to the notion that, rather than relying on internal sources, organizations should seek innovative ideas and projects externally, particularly through joint ventures and other partnerships with universities, small businesses and individual entrepreneurs. Such partnerships are facilitated by knowledge sharing and improved communication using the Internet.

Despite the use of the term ‘indigenous innovation’ by Lazonick (2004) in discussing the economic development of China, there is very little mention of IK within the innovation literature. As noted above, the emphasis is mostly on formal networks of institutions or the more radical open innovation.

A rare exception is Kaya (2009) who discusses IK and innovation systems in public health in Africa, as well as noting the complementarity between traditional food and traditional medicine. He describes various research and development projects and initiatives in IK and innovation and repeatedly uses the phrase ‘IK and innovation systems’, suggesting that innovation is an inherent part of IK. He goes on to refer to the process where large multinational pharmaceutical, agricultural and biotechnological corporations patent IK techniques and products as turning “the owners of traditional knowledge into beggars” (p.103).

A little recognised aspect of IK is its experimental and innovative nature. The term IK may create an impression of knowledge that is static, having been handed down through countless generations. However, in reality this knowledge is constantly evolving and being updated with new information. Various authors (e.g. Muchie & Baskaran 2006) emphasise the importance for developing countries to build their own innovation capabilities, rather than relying on the West for innovations that may not be appropriate for the local context.
Rhodes & Bebbington (2001) identified three kinds of indigenous farmers experiments: curiosity experiments (where farmers experiment simply out of curiosity to test new numbers and sizes of crops); or problem solving experiments (where farmers carry out experiments to solve problems); or adaptation experiments (where farmers can either test unknown technology in a known environment or test known technology in a new environment).

Studying experiments undertaken by rural people gives an understanding of their ‘sense making’ activities (Brouwers 2002). Scientists tend to regard an experiment as an enquiry during which all the variables are highly controlled except those under study. Local people differ in the sense that the experiment has to be included in daily circumstances (Kajembe, 2003). Richards (2002) concludes that in recent IK literature the experimenting, innovative, adaptive indigenous farmer is now accepted as the norm, not the exception.

6.0 Conclusion

Natural resource management has grown in stature with the increasing concerns stemming from the global problems of climate change, poverty and hunger. Within this context, participatory development and knowledge management have been identified as important factors. In developing countries this raises the issue of indigenous knowledge, which is the knowledge that local people have built up over generations concerning agriculture and the management of local natural resources.

Indigenous knowledge (IK) differs from scientific knowledge in many respects, not the least of which is that it is not systematically recorded. IK is not necessarily inferior, or superior, to scientific knowledge but combining the two knowledge systems is not straightforward. However, IK does offer potential benefits for sustainable natural resource management and there is a strong argument for its preservation, as it is threatened by the forces of globalisation and modernisation.

The literature of information systems and knowledge management has largely neglected indigenous knowledge but there is scope for using frameworks and
techniques from these disciplines to foster the preservation and continued development of indigenous knowledge. Similarly, although there is considerable evidence that local innovation plays a strong role in indigenous knowledge, the literature on innovation also generally ignores this community innovation.

We believe that there is an opportunity to rectify this neglect and to contribute to sustainable natural resource management through the application of the ideas and experience of researchers in information systems and innovation.

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