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Development of an Integrated Traditional and Scientific Knowledge Base: A Mechanism for Accessing, Benefit-Sharing and Documenting Traditional Knowledge for Sustainable Socio-Economic Development and Poverty Alleviation

Prepared by

Ataur Rahman

University of Waterloo, Canada

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Development of an Integrated Traditional and Scientific Knowledge Base: A Mechanism for Accessing, Benefit-Sharing and Documenting Traditional Knowledge for Sustainable Socio-Economic Development and Poverty Alleviation[1]

Ataur Rahman[2]
University of Waterloo, Canada

ABSTRACT

Various concepts, approaches and methodologies, useful for harnessing the traditional knowledge (TK), are compared. Potentials of a preliminary comprehensive and integrated traditional and scientific knowledge base are discussed – as part of a participatory computer-based decision support system (DSS) for ensuring access, benefit sharing and documentation of TK for sustainable socio-economic development and poverty alleviation in developing countries.

Human Knowledge Systems: Scientific versus Traditional

The study of human knowledge is as old as human history itself. It has been a central subject matter of philosophy and epistemology since the Greek period. Knowledge has also begun to gain a new wave of attention in recent years. For instance, socio-economic theorists such as Alvin Toffler (1990) and Peter Drucker (1993) call for our attention to the importance of knowledge as management resource and power.

In this paper, human knowledge systems are classified into two kinds: formal scientific knowledge (SK) system and traditional knowledge (TK) system. The main difference of these two kinds of knowledge systems is their format. The SK system is essentially in *explicit* format – can be articulated in formal language including grammatical statements, mathematical expressions, specifications, manuals, and so forth. This kind of knowledge thus can be transmitted across individuals formally and easily. This has been the dominant mode of knowledge according to the (Western) scientific philosophy. However, the format of TK system is mostly *tacit* – hard to articulate with formal language. This knowledge is embedded in the experiences of indigenous or local people and involves intangible factors, including their beliefs, perspectives, and value systems.

[1] The concepts and contents of this paper are reflections of the outcome of the author's doctoral thesis research at the Department of Geography, Faculty of Environmental Studies, University of Waterloo, Canada. At various occasions, this research was supported by different agencies, including the Social Sciences and Humanities Research Council of Canada (through a doctoral fellowship), International Development Research Centre (through a doctoral research award), and Asia-Pacific Foundation of Canada (through a business research grant). Comments and/or request for further information are very welcome.

[2] Doctoral Candidate, Department of Geography, Faculty of Environmental Studies, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada [E-mail: marahman@fes.uwaterloo.ca]

Traditional Knowledge Systems: Definitions

Many definitions have been proposed for TK systems, but all of them are incomplete, because the concept is relatively new and still evolving (Johnson 1992; Wavey 1993; Berkes 1993; McCorkle 1994; Quiroz 1996; Berkes and Henley 1997). Literature in related fields uses various terms interchangeably to designate the concept of "traditional knowledge (TK)", "traditional ecological knowledge (TEK)", "traditional ecological knowledge and management systems (TEKMS)", "local knowledge (LK)": "indigenous knowledge (IK)", "community knowledge", "rural peoples' knowledge" and "farmers' knowledge (FK)". While certain distinctions can be made, these terms often refer to the same thing (e.g., Howes and Chambers 1979; Reijntjes et al. 1992; Warren 1992; Mathias 1994; Roach 1994; Agrawal 1995; Lawas and Luning 1997).

As a summary of various definitions, the term "traditional knowledge" may be denoted mainly as a tacit type of knowledge that has evolved within the local (grassroots) community and has been passed on from one generation to another, encompasses not only local or indigenous knowledge, but also scientific and other knowledge gained from outsiders.

Strengths of TK

Today TK systems are seen as pivotal above all in discussions on sustainable socio-economic development and poverty alleviation in developing countries (Brokensha et al. 1980; Compton 1989; Niamir 1990; Warren 1990; Gupta 1992). In both the North and the South, TK is increasingly regarded as a precious resource (Warren 1991; Buttimer et al. 1991). In both the North and the South, TK is increasingly regarded as a precious resource. The focus on traditional knowledge clearly heralds a long overdue move. It represents a shift away from the preoccupation with the centralized, technically oriented solutions of past decades, which failed to improve the prospects of most of the world's peasants and small farmers (Agrawal 1996).

The literature on traditional or indigenous knowledge, agricultural development and environmental management provides abundant evidence of human activities which utilize complex but implicit scientific principles (e.g., Atte 1992; Warren 1992b; McCorkle 1994; Lansing and Kremer 1995). It has also been demonstrated that the exclusion of such knowledge from development activities has had disastrous consequences in every region of the world where outsider knowledge has been imposed without regard to traditional knowledge (Cashman 1989; Lansing and Kremer 1995).

Limitations of TK

A number of literature have argued that the TK has its limitations (e.g., Leach and Mearns 1988; Reijntjes et al. 1992; Bebbington 1993; Howard and Widdowson 1996), and it is not in itself capable of addressing all the issues related to sustainable socio-economic development and poverty alleviation (Murdoch and Clark 1994).

Some researchers argued that TK needed to be formalized, since it is essentially of a fragmentary and provisional nature (e.g., Arce and Long 1992:211). It is in this formalization phase that problems with respect to the application of TK are most likely to arise. This type of knowledge is still not as well known as the coded and circulated objective language and the printed products of scientific discourse.

Others reported that that the collection of TK from diverse indigenous sources is often a laborious, time-consuming and costly process (e.g., Lawas and Luning 1997). They have noted that proper storage and management must be ensured, if the TK is to be made available and accessible for quick analysis and manipulation to all those who need it, including the planners and decision makers.

Comparisons of TK with Scientific Knowledge Systems

The TK is often seen as the antipode of the scientific knowledge. Studies centered on the complementary nature of knowledge systems (e.g., Richards 1985), approaches to linking them up (e.g., Chambers et al. 1991), and studies focusing on their social interfaces (e.g., Long 1989) have occasionally tended to reinforce this notion of differentness. The most important of these are related to how traditional or scientific knowledge is acquired (lived experience versus formal training), and how that knowledge is used on a day-to-day basis (local versus non-local applications) (Agrawal 1996).

A dichotomy between the traditional and scientific knowledge systems may be made on the following grounds (Agrawal 1996): (1) *substantive grounds* -- because of differences in the subject matter and characteristics of traditional and scientific knowledge; (2) *methodological and epistemological grounds* -- because the two forms of knowledge employ different methods to investigate reality; and (3) *contextual grounds* -- because traditional knowledge is more deeply rooted in its environment (Chambers 1980:2; Howes and Chambers 1980:330; Warren 1990:1; Banuri and Apffel-Marglin 1993; Dei 1993).

The SK is an explicit or "codified" knowledge that is transmittable in formal, systematic language. On the other hand, TK is a tacit knowledge of the local or indigenous people, which is personal, content-specific, and therefore hard to formalize and communicate. Local or indigenous people acquire knowledge by actively creating and organizing their own experiences. Thus, the (traditional) knowledge that can be expressed in words and numbers represents only the "tip of the iceberg" of the entire body of knowledge possessed by indigenous people. As Michael Polanyi (1966:4) puts it, "We can know more than we can tell".

The cognitive elements of TK center on what Johnson-Laird (1983) calls "mental models", where human beings create working models of the world by making and manipulating analogies in their minds. Mental models, such as schemata, paradigms, perspectives, beliefs and viewpoints, help individuals to perceive and define their world. On the other hand, the technical element of TK includes concrete know-how, crafts, and skills. It is important to note here that the cognitive elements of TK refer to an individual's images of reality and visions for the future, i.e., "what is" and "what ought to be". Some distinctions between TK and SK are shown in Table 1.

Table 1: Some distinctions between traditional and scientific knowledge systems

Traditional knowledge	**Scientific knowledge**
Tacit knowledge (Subjective)	Explicit knowledge (Objective)
Knowledge of experience (body)	Knowledge of rationality (mind)
Simultaneous knowledge (here and now)	Sequential knowledge (there and then)
Analog knowledge (practice)	Digital knowledge (theory)

Some moderators, however, argued that both traditional knowledge and (Western) science are an attempt to characterize and understand the "universe" of a given society, and at any given point in time that knowledge represents a "best estimate", which will be modified when further evidence is obtained (e.g., Showers 1997). They have pointed out that both knowledge systems are in a constant state of evolution, and both systems have also been developed for their own "universe", and thus are characterized by areas of greater and lesser expertise.

Integration of TK Systems with SK Systems: Rationale and Constraints

Given the complexity and different social perceptions surrounding the resources management issues, one challenge facing science is to develop understanding, knowledge, forums and learning environments to better inform and support more sustainable decision making (Stevenson 1997; Berkes and Henley 1997). Although science is continuously adding to our knowledge through research, the complexity of the resource systems makes it impossible for scientists alone to develop the required comprehensive knowledge base (Hall 1997; Meredith 1997). The sustainable development can only be achieved by developing a science based on the priorities of local people, and by creating a technological base that includes both traditional and modern approaches to problem solving (IUCN, UNEP and WWF 1991; Johnson 1992; Labatut and Akhtar 1992). Sustainable development might be better served by a system that incorporates both traditional and scientific knowledge systems (Icamina 1993).

However, although it is increasingly recognized and expected that traditional perceptions of and perspectives on sustainable development should play an important role in planning and implementing socio-economic development programmes (Mitchell 1997), this expectation is yet to be fulfilled (Reed 1990; Neis 1992). This is mostly attributable to the failure to develop an adequate mechanism for integrating the TK with formal (or scientific) decision-making practices (Fenge and Rees 1987).

Potential Mechanism to Integrate TK with SK

Relevant theories, concepts, methods and empirical understandings were reviewed in a concept paper[3] to address the problem, "How to develop an effective framework to incorporate local knowledge (LK) systems into formal or scientific processes and procedures for resource management in developing countries?" and following conclusions were drawn:

(1) The framework should be able to generate an adaptive, participatory and iterative decision-making process (UNICEF 1991; Jonsson et al. 1992; CCME 1993; Fussell 1995; Greyer 1994; Pearson 1995; Rahman 1996; Allen and Bosch 1996; Meredith 1997; Hall 1997).

(2) The framework should be able to establish an equitable relation between TK and SK systems through an ongoing process of dialogue and partnership building among the stakeholders (local communities, scientists, managers and policy makers) (McKee 1992; Rahman 1996, 1997; Allen et al. 1995; Fedra 1995; Hall 1997). This framework should allow a variety of participatory research methods for collection of TK (Freire 1970, 1974; Brown 1978; Fals-Borda 1979; Hall 1981; Tandon 1981; Maundu 1996).

[3] This paper is entitled "A Participatory DSS to Incorporate Local Knowledge for Resources and Environmental Management in Developing Countries" and published on the web (Internet) at <http://www.fes.uwaterloo.ca/u/marahman/PhD_Comprehensive.html>

(3) The framework should allow cognitive transformation of both the TK and SK among the stakeholders (Moellering 1984; van der Schans 1990; Medyckyj-Scott and Blades 1990; Dewan and Choudhary 1991; Freundschuh and Gould 1991; Mark 1993; Nyerges 1993; Kersten and Noronha 1996). Also, the framework should be supported by an automated part comprising a comprehensive GIS and hypertext conversion facilities for processing, organizing and presenting the integrated knowledge base (Aronoff 1989; Marble 1990; Plant and Stone 1991; Bonham-Crater 1995; Fedra 1995; Huxhold and Levinsohn 1995; Kersten and Michalowski 1996; Hall 1997).

Case Study: *Framework for an Integrated Traditional and Scientific Knowledge Base*

Based on the above conclusions, a case study was conducted in Lao PDR to develop a comprehensive framework and mechanism to establish an integrated traditional and scientific knowledge base to address a priority issue in terms of sustainable socio-economic development and poverty alleviation in a developing country context. In this case study:

- Advocacy[4], social mobilization[5] and program communication[6] approaches (illustrated in Figure 1) were applied and found useful for shared dialogue and partnership building for political leadership's supports and local communities participation in the program.

- A combination of participatory research methods, including "Participant Observer[7]", "Rapid Rural Appraisal (RRA)[8]" and "Participatory Rural Appraisal (PRA)[9]" approaches, were applied and found useful to collect TK from the local communities.

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[4] *Advocacy* consists of the organisation of information into argument to be communicated through various interpersonal and media channels with a view to gaining political and social leaderships' acceptance and preparing a society for a particular development program (McKee 1992).

[5] *Social mobilisation* is a process of bringing together all feasible and practical intersectoral social allies to raise people's awareness of and demand for a particular development program, to assist in the delivery of resources and services and to strengthen community participation (McKee 1992).

[6] *Program communication* is a process of identifying, segmenting and targeting specific groups or communities with particular strategies, messages or training programs through various mass media and interpersonal channels, traditional and non-traditional (McKee 1992).

[7] The "participant observer" attempts immersion, to the extent permitted, in local life in order to understand and document how things work in a community (Freire 1970, 1974; Grandstaff et al. 1987; Chambers 1992; CASL 1995; Yoon 1996; MWLR 1997).

[8] *RRA (rapid rural appraisal)* may be considered as a listening research, and a creative combination of iterative methods and verification, including "triangulation" of data from different sources. Its techniques include: (1) Review of secondary sources, including aerial photos, even brief aerial observation; (2) Direct observation, foot transects, familiarization, participation in activities; (3) Interviews with key informants, group interviews, workshops; (4) Mapping, diagramming; (5) Biographies, local histories, case studies; (6) Ranking and scoring; (7) Time lines; (8) Short simple questionnaires, towards end of process; and (9) Rapid report writing in the field (Grandstaff et al. 1987; Chambers 1992; CASL 1995; Yoon 1996; MWLR 1997).

[9] *PRA (participatory rural appraisal)* is distinguished at its best by the use of local graphic representations created by the community that legitimize local knowledge and promote empowerment. PRA "proper" builds on RRA but goes much further. To RRA it adds some more radical activist perspectives. Its five central additional concepts: (1) *Empowerment:* Knowledge is power. PRA generates or reinforces new local confidence regarding the validity of their knowledge. (2) *Respect:* The PRA process develops researchers' respects about local intellectual and analytical capabilities. (3) *Localization:* PRA encourages extensive and creative use of local materials and representations. (4) *Enjoyment:* Emphasis is no longer given on "rapid" but on the process. (5) *Inclusiveness:* Enhanced sensitivity, through attention to process; include marginal and vulnerable groups (Freire 1970, 1974; Grandstaff et al. 1987; Chambers 1992; CASL 1995; Yoon 1996; MWLR 1997).

- A World-Digital-Graphic-Mental (WDGM) framework[10] (see Figure 2 and Table 2) was applied and found useful for cognitive transformation and refinement of TK (from tacit to explicit) and SK to incorporate them into an integrated traditional and scientific knowledge base.

- A customized information portal or home base platform is developed in the form of a main website for the above integrated knowledge base and is posted on the World Wide Web at <http://www.fes.uwaterloo.ca/u/marahman/Mekong_AquaBase.htm> for easy documentation, access, and benefit-sharing of TK (depicted in Figure 3).

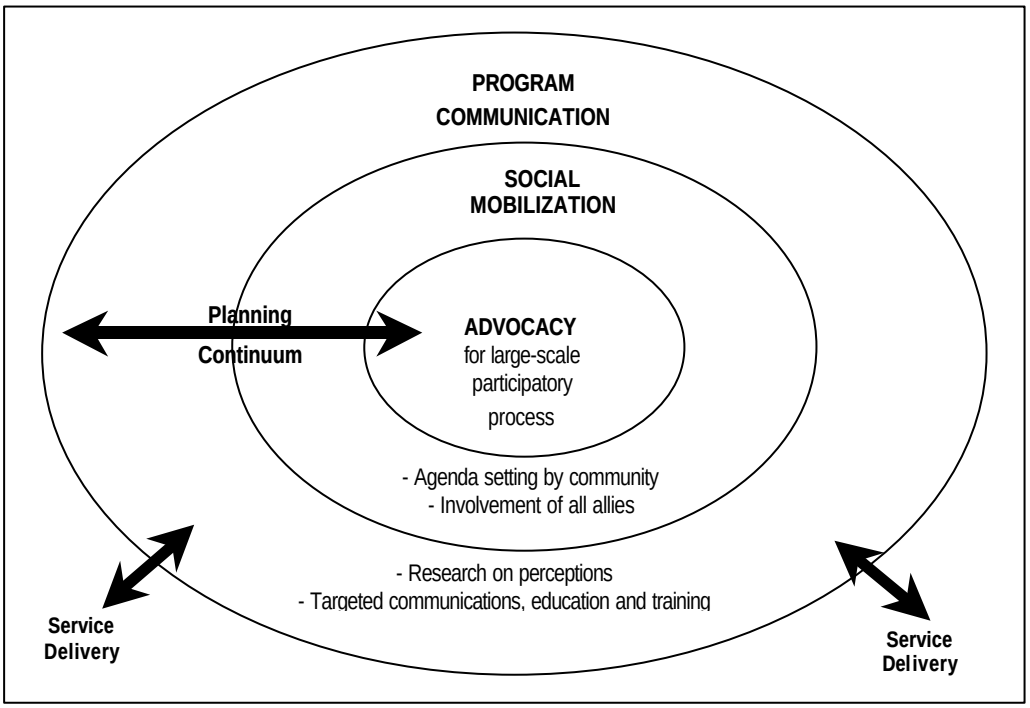

Figure 1: Conceptual framework for shared dialogue and partnership building among local community, scientists, resource mangers and policy makers by advocacy, social mobilization and program communication.

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[10] Based on the idea of Moellering (1984), van der Schans (1990) has proposed structuring the interaction process in terms of cognitive transformations amongst four domains in a World-Digital-Graphic-Mental (WDGM) framework in order to decision making (for problem solving) in a DSS environment. Nyerges (1993) has adapted this framework to frame the process of various knowledge and information incorporation and use in a DSS (see Figure 2). The arrows in Figure 2 indicate transformation processes between the world (everyday, indigenous-scientific observation), the digital database domain, the graphics display domain, and the mental domain. Most importantly, the mental domain has an arrow onto itself to indicate rethinking of a transformation can take place, either through reflective thinking (iteration and/or reflection-in-action) or group discussions. The World and Mental domains in the WDGM framework are oriented to the problem perspective, and the Digital and Graphic domains are oriented to the tool perspective.

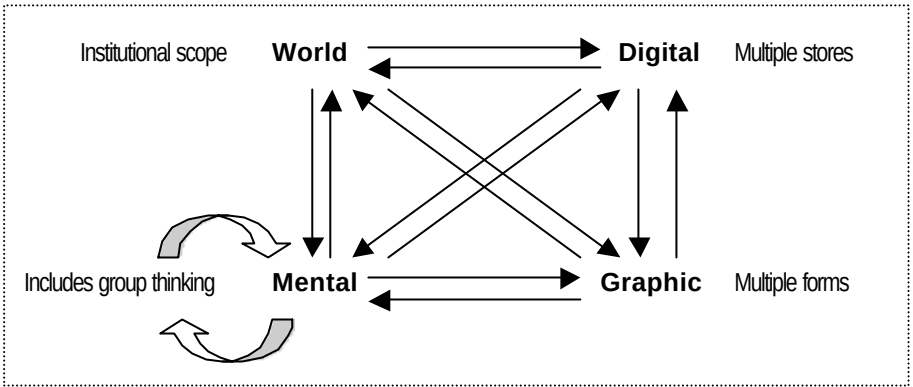

Figure 2: Conceptual Framework for cognitive transformation for knowledge incorporation.

Table 2: Stages and Steps of Cognitive Transformations in a Process of Incorporation of the Local and Scientific Knowledge

Transformations*	Stages and Steps
	Stage I: Defining the Questions, Issues, Problems
MWMM	Step 1: identifying and clarifying relevant questions and issues
MWD	Step 2: gathering and organising data
	Stage II: Processing the Data
MDG	Step 3: interpreting data
GM	Step 4: analysing data
MDMM	Step 5: evaluating evidence
	Stage III: Reaching and Applying Generalisations
MDGM	Step 6: generalizing
MWM	Step 7: drawing conclusions
MMW	Step 8: making value judgments (recommended policy/program)
	Stage IV: Re-evaluating
MM	Step 9: re-evaluating the investigation process
*Transformations among domains of the WDGM Framework. Domains as presented in Figure 2 are: W = World; D = Digital; G = Graphic; M = Mental.	

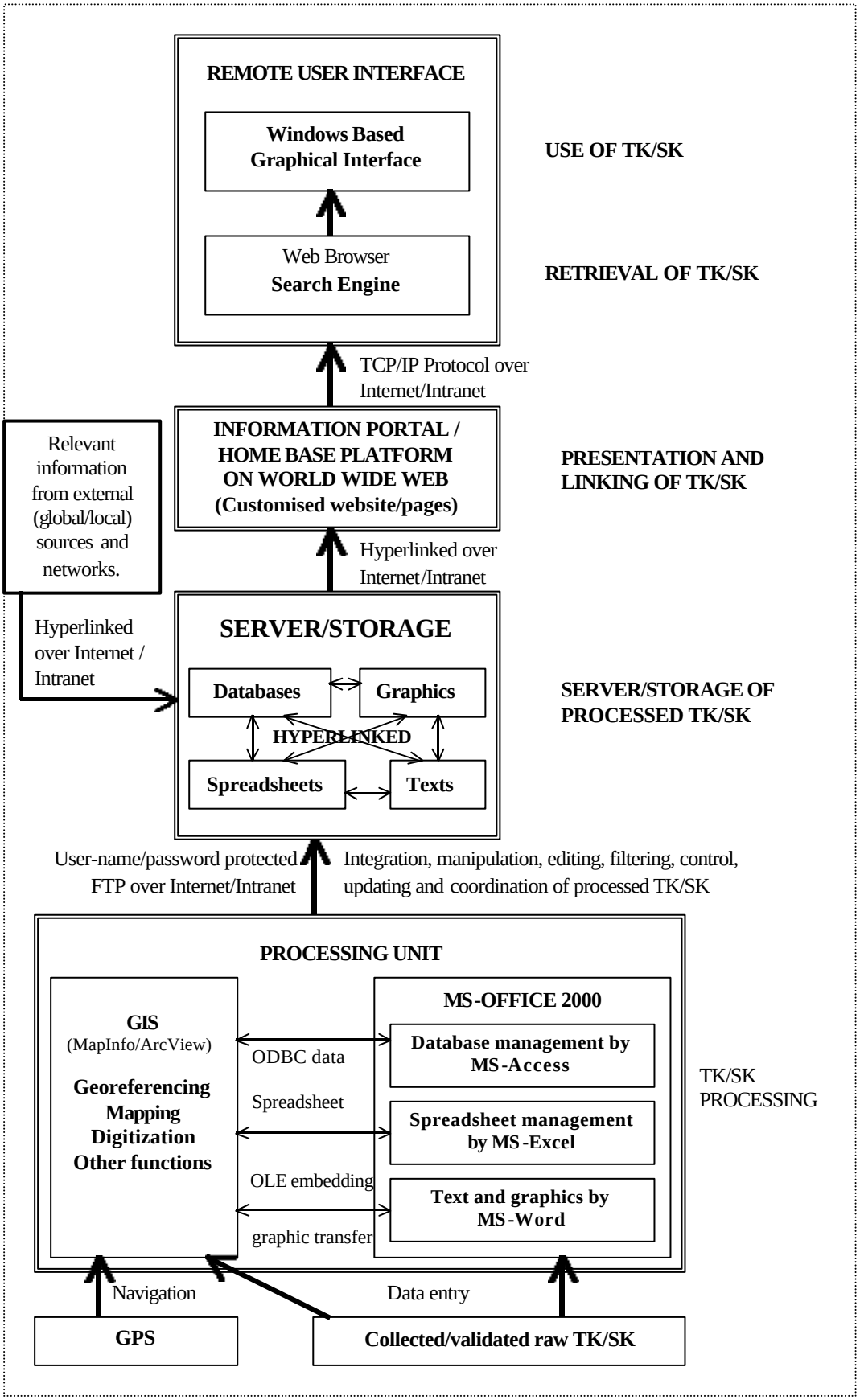

Figure 3: Integrated TK-SK knowledge base and information system delivery of the DSS.

Conclusions and Recommendations

During the above case study, it has been found that the concerned representatives of the local and indigenous communities possess a tremendous amount of traditional knowledge on the local and indigenous natural resources and environment.

It is realized however that this traditional knowledge is primarily in "tacit" format –- something not easily visible and expressible. This knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions and hunches comprise the major portion of this traditional knowledge. It is also seen that the traditional knowledge is deeply rooted in a local or indigenous people's action and experience, as well as in the ideals, values, or emotions he or she embraces. Thus, the amount of (traditional) knowledge expressed by a local or indigenous people in words and numbers represents only "the tip of an iceberg".

The relevant traditional knowledge identified and collected by the above case study can be segmented into two dimensions. The first is the technical dimension, which encompasses the kind of informal and hard-to-pin-down skills captured in the term "know-how". For example, an experienced local or indigenous fisherman develops a wealth of expertise "at his fingertips" on local or indigenous fish and fisheries after his years of experience and also by accumulation of the similar experience of his earlier generations. But he is often unable to articulate the scientific and technical principles behind what he knows.

At the same time, it is also found that the traditional knowledge contains an important cognitive dimension. It consists of schemata, mental models, beliefs and perceptions so ingrained that one must take them for granted. This cognitive dimension of traditional knowledge reflects local or indigenous people's image of reality ("what is") and vision for the future ("what ought to be"). Though they cannot be articulated very easily, these implicit models shape the way the local or indigenous people perceive the world around them.

In the light of the above, it may be recommend here that, in order to proper understanding and incorporation of traditional knowledge systems for sustainable socio-economic development and poverty alleviation, we (the scientific community) perhaps need to "unlearn" our old view of knowledge and should grasp the importance of local or indigenous people's view. We might need to get out of the old mode of thinking that knowledge can only be acquired, taught and trained through manuals, books or lectures. Instead, we perhaps need to pay more attention to the less formal and systematic side of the traditional knowledge and should start focusing on highly subjective insights, intuitions and hunches that are gained (by the local or indigenous people), through the use of metaphors, pictures or experience. For a better understanding of relevant traditional knowledge, therefore, we should "see", "feel" and "sense", rather than "hear", "read" and "calculate".

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