32 THE POLITICS OF KNOWLEDGE IN USING GIS FOR LAND MANAGEMENT IN INDIA

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Abstract This paper focuses on understanding the knowledge politics that inhibit effective use of geographic information systems (GIS) for managing the land degradation problem in India. It is argued that the issues of power and politics of knowledge are ubiquitously embedded in representation of the problem domain and the technology itself. Addressing these issues is an inseparable part of the challenges to information systems design and implementation. Theoretical perspective is first developed around political considerations involved in the co-construction and use of knowledge domains relevant to the design of GIS applications to address land degradation. This theoretical framework is drawn upon to analyze the politics of representation, the politics of invisible work, and the politics of institutions observed in the case of a GIS implementation in rural India. The analysis also demonstrates how the insidious impacts of such politics may be somewhat mitigated by creating socio-material networks to cultivate communicative action that leads to better design and technology acceptance by the end users.

Keywords: GIS, rural development, India, politics of knowledge, Habermas, participation, socio-material networks, communicative action.

1 INTRODUCTION

Various attempts to use geographic information systems (GIS[1]) for land manage-

[1]The spatial data on which GIS operates, which distinguishes it from other IS applications, is linked to locations which implies that each data element has a unique set of relations to all other data (Reeve and Petch 1999, p. 99).

ment in many developing countries, including India, have not yielded very effective results (Sahay and Walsham 1997). While various social and organizational reasons have been emphasized as contributing to this relative lack of success, we argue that the power and politics of knowledge that surround the issue of land degradation and the technology itself are crucial aspects to understanding the design and implementation challenges.

Politics of knowledge around GIS applications in the land management domain in India arise because of the various interest groups including international agencies, government administrators, scientific institutions, and community beneficiaries. Contributing to the challenge is the nature of the land degradation phenomenon that has been shaped by various historical and institutional forces. Dealing with land degradation, which implies the loss or attenuation of the vigor and productivity of land (Sehgal and Abrol 1992), is an important aspect of the government's agenda because agriculture contributes to nearly 29 percent of the country's GDP (as compared to 2 percent, for example, in the U.S.) (Singh 2002). The Indian agriculture sector employs 69 percent of its workforce, as against 2 percent in the U.S. (ibid.), prompting it to be described as a biomass-based civilization (Gadgil 1993). India also contributes to a significant proportion of the World's biodiversity (WCMC 1996). Consequently, the heightening land degradation problem has attracted global attention in venues such as in the 1992 Rio Earth Summit. Arising from the national prioritization and international attention, considerable financial resources are being invested to improve land use practices, including better information management through the use of ICTs like GIS and remote sensing.

Political meanings have been historically inscribed into the land degradation problem, being shaped by the interests of those in power. The historically existing colonial interests of the British in exploiting forest and other land-based resources (Gadgil and Guha 1995) were further reinforced by the government's post-independence policies of state control over much of the common property land resources (Kumar et al. 2000). Land development programs, by and large, were designed and executed without the involvement of the local people and communities. These policies represented a "relic of the colonial administrative practices" (Haeuber 1993, p. 492). In recent years, there have been some signs of shifts taking place in these policies arising from the inculcation of more integrated watershed-based resource management models, adoption of participatory practices, and large-scale attempts to introduce GIS technology. The use of this rather complex technology, however, brings in its own particular political dynamics arising from questions of who is trying to introduce it, who owns it, and what kinds of knowledge get used or excluded in the process.

Drucker (1988) describes the organizational structure adopted by the British during their 200-year rule of the Indian subcontinent as "totally flat" (p. 49). The subcontinent was divided into nine administrative provinces. Each district in a province was headed by an Indian Civil Service (ICS) officer, called district collector (referred to as district officer by Drucker) who reported directly to the provincial secretary. The principal tasks of a district collector (DC) were maximizing revenue collection and maintaining law and order. The entire subcontinent was thus managed with a relatively lean bureaucracy. The independent India adopted a federal democratic polity, in which both the central and state governments are involved in development management and administration of the

about 500 districts. The flat organizational structure described by Drucker has since given way to a system of top-down, hierarchical governance. In the context of use of GIS for land development, the typical organizational structure is shown in Figure 1. The role of the DC, which now subsumes socio-economic development of the district, however, continues to be crucial in the implementation of development related policies and plans.

The aim of this paper is to develop a perspective on the politics of knowledge that elaborates on the nature of knowledge and the dynamics around it that arise in the context of GIS applications for land management in India. Using this political perspective, we draw upon Habermas to develop a critical approach on how these political considerations can be addressed more meaningfully to guide GIS implementation efforts. In the next section, we develop a theoretical perspective on the politics of knowledge in relation to GIS for land management. In section 3, the research approach is presented, followed by the case study description in section 4. Section 5 presents the case analysis, drawing upon the theoretical framework presented in section 2. In the final section, some ideas are presented on how to meaningfully engage with the political challenges.

2 THE POLITICS OF KNOWLEDGE IN GIS APPLICATIONS FOR LAND MANAGEMENT

This section focuses on developing a theoretical perspective around the politics of knowledge, specifically as it relates to the application of GIS technology for land management, arising from the needs and interests of the various competing groups (Floyd 2002, p. 203). In the context of land degradation, three domains of knowledge that are relevant are technical, scientific, and indigenous. These are discussed.

2.1 Technical Knowledge

Technical knowledge relates to GIS and remote sensing technologies, and the epistemological basis on which it is situated. GIS, which is an information system that is designed to work with data referenced by spatial or geographic coordinates (Star and Estes 1990), has its roots in the scientific principles of cartography and mathematics, situated in a positivist epistemology, which are employed in map-making within standard scientific representation of knowledge and cognition (Harley 1992). Sahay (1998, p. 184) has argued that the positivist epistemology in which GIS is grounded was contributed to by the quantitative revolution of the 1980s within geography departments in U.S. universities, which emphasized the "conceptualization of reality in spatial, map-based terms," and promoted a rational conceptualization of the world in which space, assumed to be objective, "can be dominated and restructured very efficiently and rapidly through the use of GIS." Harvey (1989) argued that GIS technology furthered the objective image of maps, based on the mathematical rigor of their preparation, and the assumptions that the correspondence between maps and the real world was unproblematic and context-free. This naive empiricism (Taylor 1990) is grounded in the belief that the technical and the social realms exist in mutual exclusivity (Sahay 1998), and represents a form of power that can be presented in the "guise of scientific disinterestedness" (Poster 1982, quoted in Harley 1988, p. 279).

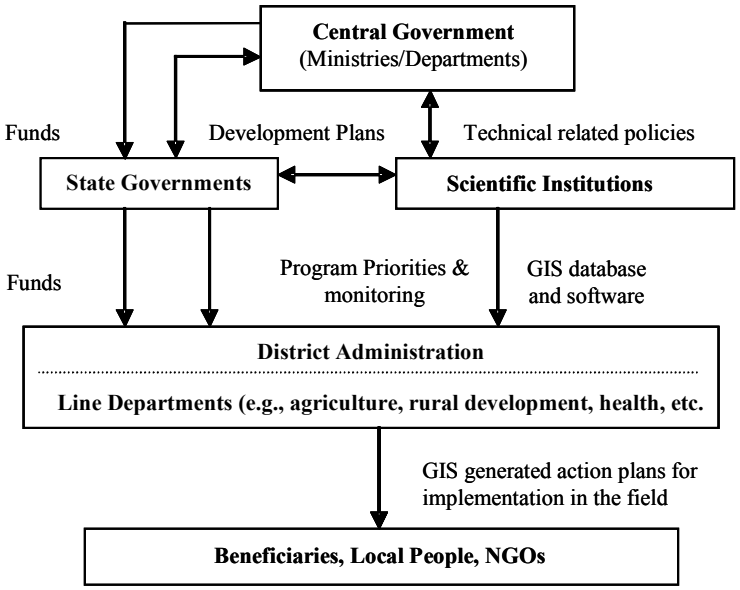

Figure 1. Interplay between Concerned Agencies

The political nature of construction and use of cartographic knowledge is typically exemplified by the detailed cartographic survey and mapping of India undertaken during the British rules. It proved indispensable for "the rationalization of the extraction of surplus, administrative strategies and techniques of control" (Baber 2001, p. 44).

2.2 Scientific Knowledge Around Land Management

Scientific knowledge concerns the application domain that derives from the scientific parameters relating to, for example, soil types, slope of the land, vegetation patterns, runoff, etc. Two relevant domains of scientific knowledge relate to selecting spatial themes for analyses and modeling techniques employed.

The major relevant spatial themes concern land use and land cover data, geo-morphology, drainage, groundwater potential, etc. (NRSA 2002). Typically, maps of scales 1:50,000 or smaller are used in India in GIS applications for land management, which are not sufficient to design micro-level interventions. Another important concern is the availability of maps and, citing reasons of security and military concerns, many governments, especially in developing countries, are reluctant to share the maps with the public and sometimes also with other government departments (Fox 1991). This reluctance tends to ensure that most GIS development work continues to be largely confined to select scientific departments.

A key aspect of addressing land degradation is the use of GIS modeling. Approaches to GIS modeling, which are largely shaped within a positivist epistemology, tend to rely on remotely sensed data. As a result, these models are limited in depicting

the complex reasons of land degradation arising from socio-cultural aspects such as anthropogenic pressures, and other deep-rooted political considerations. Sahay and Walsham (1996) provide a vivid example of this with respect to the criteria adopted for building the models. They argued that scientists tend to use rationalistic criteria of profit maximization in the models to specify land use strategies, while the farmers when asked indicated their preference for the criteria of risk minimization.

Hoeschele (2000) described the organizational politics in Kerala state of India which led to the GIS model overestimating the extent of wastelands by deliberately misrepresenting the current land use data. As a consequence, the local bureaucrats argued that farmers were not able to manage community lands effectively and thus required dominant government intervention. Inappropriate use of apparently neutral technology can lead to further marginalization of the poor and the powerless, and also underscores how modeling may be misleading if the relevant social data are not properly taken into account.

As a result of the politics around scientific knowledge, land degradation, despite being a complex social-historical phenomenon, tends to be modeled primarily on a scientific basis. This leads to a separation between sites of technological production and locations of its use. This separation is reflected in how GIS systems are designed and produced by scientists in laboratories for subsequent transfer to the districts. The divide arising from a specialization of technology contributes to a "design from nowhere" (Suchman 1994, p. 27).

2.3 Indigenous Knowledge

Indigenous knowledge is held by local communities and evolves over time through being field-tested for its suitability to local needs, conditions, and ethos (Mundy and Compton 1995). It may be defined as the "systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture" (Rajasekaran et al. 1994, p. 26). Such knowledge has historically been excluded and made invisible from the westernized scientific models of land and water management on the assumption that it was inferior, unscientific, and static (Howard and Widdowson 1996, 1997). As a result, this context-specific knowledge, which is embedded in the practice of community members (Banuri and Marglin 1993), has remained largely unarticulated to external domains like those of the state and scientists.

This condition of marginalization of indigenous knowledge is, however, gradually being revised due to various reasons such as the changes in politics of development aid, examples of the breakdown of technology-driven applications, cases of success of community-driven efforts, and a high level of political advocacy by non-governmental organizations (NGOs), activist groups, and international conventions. For example, the 1992 Rio Earth Summit formally recognized the importance of indigenous knowledge in achieving sustainable development, and the issue found mention in 17 of the 40 chapters of Agenda 21 (Mathias 1994). Indigenous knowledge is not static, as assumed in scientific thinking, and undergoes changes with learning as a response to new external stimuli, and communities adapt and integrate new technologies into their knowledge

domain over time (ibid.). Agrawal (1995) perceived the divide between scientific and indigenous knowledge based on methodological considerations rather than substantive grounds as superficial, arguing that any form of knowledge is embedded within a specific social context, which influences the processes around knowledge creation and use.

In summary, the theoretical discussion above has tried to describe the disparate knowledge systems that are in play in the context of GIS for land management, the political interests that shape how these systems are manifested, and the challenges in their synthesis. These conceptual ideas provide the basis to analyze the case in section 5, after the presentation of the research approach and the case in sections 3 and 4 respectively.

3 RESEARCH APPROACH

The research strategy adopted for the present study, overview of the research setting, approach used for data collection, and analysis are presented.

3.1 Background

Efforts to use GIS for land management in Anantapur district were first taken up in 1995 under a large-scale technology initiative of the Department of Space in India, in which a natural resource spatial database for the district was developed by the Andhra Pradesh Remote Sensing Application Centre (APSARAC) mainly using satellite remote sensing data. The application software was developed by other leading scientific institutions like NRSA and the Space Application Centre. Subsequently, during 2001-02, a local GIS team redesigned the database for which both spatial and non-spatial data were collected mainly through physical surveys conducted in association with the local people and NGOs using a global positioning system (GPS). It constituted a major departure from the earlier top-down methods in which scientific institutions assumed ownership of the design mostly without consulting end-users in the concerned district departments and the communities who have a livelihood stake in how land use is planned. The motivation to take up this study in Anantapur arose from the desire to understand the impact of this locally inspired, bottom-up approach on technology diffusion and its use in context of the problem domain.

3.2 Research Setting

Anantapur, a poorly developed district of Andhra Pradesh, is situated in the rain-shadow zone of peninsular India, with a low annual precipitation of 521 mm. A total of 31 percent of its land area is heavily degraded.[2] The district has historically been drought-prone, the adverse impact of droughts having been further exacerbated in recent times due to massive deforestation, excessive withdrawal of ground water, increasing soil salinity, etc. (Rao et al. 1993).

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[2]Source: *Anantapur District—A Profile*, dated December 20, 2002, complied by district administration.

3.3 Research Method: Data Collection and Analysis

The case study described in this paper is based on field work carried out in Anantapur district during 2002-2003. In all, we conducted 81 semi-structured interviews with officials of the concerned district/line departments, concerned scientists, bureaucrats in the state and central governments' rural development departments, academics from a local university, and NGOs. We also participated in meetings with villagers.

Individual interpretations of interviews were transcribed to identify relevant issues and also to prepare summaries. These were subsequently discussed between the authors and respondents. Examination of the secondary data (maps, guidelines, etc.) provided insights into the efforts made by the district administration to involve communities and NGOs both in development and GIS work.

The research method adopted in this study was the interpretive case study approach, which proceeds on the assumption that "the social world is essentially relativistic and can only be understood from the point of view of individuals who are directly involved in the activities which are to be studied" (Burrell and Morgan 1979, p. 5). The interpretive paradigm seeks to understand the fundamental nature of the social world, as it is, at the level of subjective experience (ibid., p. 31), how people assign meaning to those experiences (Devine 1995, p. 138), and how intersubjectivity is constructed. The focus is not on establishing truth claims but on understanding the processes through which intersubjectivity is reached. Interpretive approaches in IS research take the stance that knowledge of reality is socially constructed by human actors (Walsham 1995) through shared meaning (Klein and Myers 1999). The case study is a useful approach to adopt when the phenomenon of study is difficult to disengage from its context, for example, the introduction of a new technology like GIS in rural settings of India.

4 THE CASE STUDY

We discuss the case under four main themes, viz. (1) how GIS-based recommendations provided earlier by scientific institutions fared in the district, (2) how institutional structures were redefined to facilitate design and implementation of the development agenda set by people, (3) design and use of a locally identified GIS database and applications to support development, and (4) the trajectory of participatory processes, and implicating knowledge of people both in development and GIS work.

4.1 Applying GIS-Based Recommendations of Scientific Institutions

The methodology adopted by scientific institutions comprised the use of remotely sensed satellite data along with other resource and topographic maps, and socio-economic data obtained from secondary sources to develop locale-specific action plans for land and water management at the micro-watershed level (about 500 hectare area). These plans suggested land use and water augmentation measures based on GIS analysis and modeling of the above data vis-à-vis a set of decision rules based on criteria of soil classification, ground water potential, and slope (NRSA 2002).

The action plans for Anantapur were accordingly generated by APSRAC in 1995. We asked the project director (responsible for land/water development programs as well as ICT/GIS-related work in the district) how the above database and the accompanying software had been put to use. She explained that these action plans were based on 1991 satellite data. The land degradation situation had since changed due to natural phenomenon like recurring drought, reclamation efforts made in the intervening years, etc. Therefore, action plans and concerned maps needed continuing review and update. APSRAC's recommendations were consequently being used as one parameter for prioritization of areas to initiate current developmental activities. The scale (1:50,000) of these maps was also too small to be of much practical use in the field.

We were keen to find out how participation of end-users was viewed and taken up by scientists. A senior scientist, referring to practices adopted until recently, stated

> There exists a cultural gap between scientists working in so-called elite institutions vis-à-vis the prospective users in district line departments and village communities. Therefore, effective communication amongst these different groups is problematic. A useful dialogue requires the two parties to be genuinely convinced of its relevance, which requires a positive change in mindsets in the context of your question. What is really happening is that action plans are sent to districts, some training is provided to district staff, they might make suggestions knowing from past experience that scientific institutions would not change their style of functioning, while scientists are equally convinced that they are doing their "job" while being aware that the outputs will not be seriously considered. To tell you the truth, it is a political game being played all the time.

The view of middle-level officials in line departments was that scientists and the concerned institutions took considerable time to respond to their needs and queries, they were not available for discussion when required, not being colocated, and the district had no administrative or functional control over them. In summary, the tension among scientists and users implicated in GIS work at districts was evident.

4.2 Redefining Institutional Structures

The watershed-based rural development guidelines promulgated by the government of India in 1995 envisage that such development would no longer be carried out solely under the government umbrella (Government of India 1995), but with active cooperation and involvement of the local people. The recommended procedure is to assign development design and implementation to local Watershed Development Teams (WDTs) comprising officials of concerned line departments and elected individuals from the watershed villages, to be chaired by a non-official. WDTs have also been financially empowered.

The project director explained that in Anantapur, this decentralized model was taken a step closer to empowerment of people by making provisions that while the WDTs would be established as above, the actual design of village level development activities

be decided by the communities in *gram sabha*.[3] Implementation of works corresponding to each identified activity was also taken up by people themselves through user-teams elected in *gram sabha*, with the power to incur expenditure. It was realized by the district administration that if ICTs including GIS were to be effectively used to support development, then these facilities had to be locally available so that the database and application design was carried out as per local vision and needs. Also, availability of trained GIS professionals on-the-spot and within the local administrative control would greatly assist in developing new applications as the needs arose, as well as to update the databases to ensure their currency and topicality. Accordingly, IT/GIS infrastructure had been locally instituted.

4.3 Designing the GIS Database and Applications Locally

We met the local GIS scientists several times to understand how the new database had been generated. It was explained that data collection had been carried out by field teams set up locally for this purpose. Each team comprised a civil engineer, one person from the village concerned, one NGO representative, and a scientist from the local GIS unit. During 2001-02, these teams surveyed villages to mark the latitude/longitude values of various relevant features such as wells, check dams, agriculture parcels, etc., on cadastral maps[4] (1:80,00 scale) using a GPS. The present condition and use of these features, and the relevant attribute data, was also noted alongside. These maps (with the manually recorded data) were sent to NRSA for preparation of a digital database for GIS use, which had since been completed (Rao et al. 2003). It was now routinely used locally for multifarious purposes. For example, a recent water audit in Anantapur district had been carried out by utilizing this database in partnership with the British Department for International Development (ibid.).

We witnessed several demonstrations of the GIS work being done in Anantapur, and the use of the locally created database. One striking example was how survey and recording of all water harvesting structures, and subsequent analysis of this data, led to the identification of 29 redundant structures out of a total of 176 built under various government programs in the past years. Besides incurring wasteful expenditure, such redundant constructions potentially had a negative impact on downstream water availability and recharge of ground water. The GIS helped to make visible the inefficiencies associated in past projects, and provided the impetus for change. As a result, the district administration has formally decided to revive the traditional water harvesting structures, and future proposals for new constructions would need to be closely justified.

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[3] *Gram sabha* is the village council, the body constituted of all adult members of the village.

[4] Land records with ownership are shown on cadastral maps in India. This mapping has generally not been based on any systematic scale or datum.

4.4 Enabling Participation and Implicating Indigenous Knowledge

The facilitation of a decentralized approach to development, and local improvisation to strengthen it further, came about because of the personal belief of the DC in the positive role of people's empowerment in achieving meaningful development. During a meeting with villagers, we asked their opinion about the changes brought about by the administration in development procedures. An elder responded that

> Things are different now. Our voice is listened to and we implement the activities approved in the *gram sabha*. There is not much interference from the government people. Their people check accounts and also monitor work progress. All this has happened because of wise political leadership in the state and of the DC here in Anantapur. He visited this village three times in two years to see how things were progressing. I have never seen anything like this in all my life.

We asked them whether they were overawed by the presence of officials and scientists during meetings of *gram sabhas*. The response was emphatically in the negative although it was admitted that villagers were somewhat sceptical of the new openness in the beginning. We asked them how it was that the scientists and engineers now listened to them. The villagers said that it was mainly because of the interest taken by the DC in ensuring that development activities and their locations were decided in *gram sabhas*.

In the meetings of *gram sabhas*, one of which we witnessed, development plans for the area were discussed and finalized. The local understanding of the people about land, water, and vegetative resources and their perceptions on how these should be developed and used were jointly noted by administrators and GIS scientists. People explained their perspective through participatory mapping. Resource maps were drawn by them on the ground (not to scale) to depict the location of various existing resources, and the proposed location of mooted development activities. The scientists acknowledged that some of the elders had an astute sense of the local topography and the drainage pattern including how traditional water harvesting structures had been used beneficially in the past. These markings by the community members on the ground maps were subsequently incorporated into the GIS database. The government officials and the GIS scientists present also had an equal opportunity in these meetings to put forward their points of view, and the final plan for local development was evolved through negotiations in these meetings.

5 CASE ANALYSIS

Through the case description, we have identified several issues including those relating to participatory processes and how these were enabled or not, how knowledge of the community was elicited and integrated with the GIS approach, and how the institutional structures were redefined to facilitate more effective GIS efforts. The case

analysis presented relates to three issues concerning the politics of representation, the politics of invisible work, and the politics of institutions. Following this, the manner in which the integration of various disparate knowledge systems was attempted, given the existing politics, is described.

5.1 The Politics of Representation

In the case described, the GIS technology was being used to, first, represent the land degradation problem, second, to model intervention strategies, and third, to depict the changes that came about as a result of the interventions. Various issues become relevant in examining the effectiveness of these representation processes. For example, the small scale of maps used (1:50,000) is not effective to represent crucial aspects of land degradation such as micro-level dynamics of how soil erosion, an important determinant of land degradation, is taking place. But by drawing upon context-specific inputs from the community members, richer resource perspectives can be introduced and the reasons for land degradation more effectively incorporated. There are similar issues relating to modeling, for example, relating to its more selective use primarily for prioritizing the extent of degradation in different areas, and based on these selecting particular geographical areas for action. The more specific intervention strategies were not based on GIS models but through drawing upon the understandings of what the community members considered appropriate.

These examples suggest issues around the politics of representation and how they were dealt with in the particular context. The politics of representation has been an important issue for discussion among researchers especially from within the science and technology studies (STS) and feminist domains (Verran 1995). In the context of land degradation, the politics of representation arises from at least two issues. The first concerns the kind of maps that are used, and the associated issues of who owns them and how they are used. This leads to the historical problem of how land degradation has been represented and problematized primarily based on the interests and visions of remote sensing scientists in the Indian context (Sahay and Walsham 1997). The second issue concerns modeling. Historically, attempts to construct land intervention strategies have been primarily within a natural science epistemology, with attempts to apply similar principles to systems development (Klein and Lyytinen 1992). As emphasized through the case, information system design, especially in the context of land degradation, requires a different approach to modeling than that practiced in natural sciences due to the added complexities of the socio-cultural aspects.

5.2 The Politics Around Making Certain Forms of Knowledge Invisible

An important insight from this case relates to the manner in which knowledge that the community members, especially the elders, have about the location of traditional resources such as waterbodies was elicited through various forms of dialogue. Such knowledge which has traditionally remained invisible in the context of designing information systems, has parallels with Bowker and Star's (1999, p. 230) description of

"invisible work" in the context of nurses' roles in hospitals. These researchers described nurses' work to include the interplay between professional practice, information systems, classification, and organizational change. They describe how important work carried out by nurses as part of overall patient care in hospitals tended to be marginalized at the expense of the more visible work of doctors. This marginalization leads to an incomplete representation of work and poorly designed information systems. Recent feminist writings have also emphasized the importance of taking into equal consideration such invisible work (Star and Strauss 1999). Such work is often based on unarticulated knowledge and embedded in work practices developed over time. The setting of the workplace for nurses' roles is different from that of the community in the context of land management, and thus brings out different challenges to its articulation.

5.3 The Institutional Politics Involved Around GIS Use

Analysts like Pfeffer (1992) have argued that two key aspects contributing to institutional politics are the struggle over centralization and decentralization, and the ambiguity around what goals are in question. Questions of centralization/decentralization are associated with issues of power asymmetries and how they are negotiated through the introduction of new information systems. In the context of land management, the district administrators sometime see scientists' efforts to embed technology into their workplace as an intrusion into their domain. Similarly, scientists view the inclination of some administrators to locally control the GIS as something not required or desirable. Decentralization of control over the use of GIS and access to resources is thus a contentious issue, and strongly negotiated. The ambiguity of goals around GIS-based land management, interventions stems from a number of issues. The first concerns the long gestation periods of these projects compounded by the problem of government officials being frequently transferred, which makes accountability extremely diffused and ambiguous. The second concerns the multi-departmental nature of land management which makes it problematic to pin down responsibility to particular people or positions. A third issue relates to the fact that GIS helps to develop land use strategies that have direct budget implications, bringing in various interests such as contractors and politicians who are not directly accountable. The resulting ambiguity around the aims and objectives of the land management and GIS efforts contribute to create the potential for institutional politics to be exercised.

The analysis emphasizes the multiplicity and situated forms of knowledge, its dynamic nature, and it being intricately linked to the practices and political interests of different relevant groups. Knowledge around GIS is not something objective and "out there" but, as the STS researchers have argued over the years, knowledge is a construction of its social, political, and historical contexts (Berger and Luckmann 1967). This political perspective around the analysis helps to emphasize the dynamics of representation, invisible work, institutional context, and their interconnections.

5.4 Integrating Disparate Knowledge Systems

Some strategies for developing integration of technical and organization knowledge have been developed in the context of GIS in Western organizations, for example,

through the adoption of socio-technical design approaches which emphasize identification of user needs, seek to develop commitment to participation, and propose strategies to help absorb technological change (Campbell and Masser 1995). These researchers also pointed out that organizations that successfully adopted GIS had focused on (1) implementing simple applications albeit of fundamental importance to the users, to start with, and (2) recognizing and keeping in view limitations of the organization (particularly, accepted practices and availability of resources). While these findings emerged in Western workplace settings, they provide some useful insights, especially to emphasize the multiplicity and situated nature of knowledge forms, and how they should be considered in an integrated manner.

User participation in the design of IS has evinced varying trajectories, methodologies, and aspirations in the Western contexts (Asaro 2000), a basic motivation being "people who are affected by a decision or event should have an opportunity to influence it" (Schuler and Namioka 1993, p. xii). One strand of this approach, viz. ETHICS (Mumford 1995) consciously takes into account the cultural and other socially relevant value systems of the people who would use and be impacted by the proposed system. Through participatory methods, the designers and users are expected to arrive at consensus about shared system goals, and bring in the open the conflicts among stakeholders. Such thinking is also evident in the work of Checkland and Scholes (1990) in their articulation of the soft systems methodology. However, these approaches arose primarily within Western organizational settings and their socio-economic and political contexts. These do not adequately emphasize how the broader interorganizational structures can be addressed in developing-country contexts, given the historically existing attitudes of the bureaucrats and scientists and the different community politics, and largely an absence of a tradition of participatory approaches in development programs.

A starting point in the process of creating a framework for dialogue is the need for scientists to acknowledge the importance of indigenous knowledge, which in itself is a critical change, as it challenges the existing and deep-rooted assumptions of the superiority of scientific knowledge. The challenge is to try and develop greater intersubjective understanding as a basis to create relevant sociomaterial networks while acknowledging the structural conditions, especially around power and politics, within which it is constructed. While the rhetoric of indigenous knowledge and empowerment of marginalized group is a recurrent theme in current debates around development thinking, its advocates rarely "emphasize that significant shifts in existing power relations are crucial to development" (Agrawal 1995, p. 416).

One source for the development of such a critical perspective comes from Habermas, whose ideas have to a limited extent been drawn upon by IS researchers. Habermas posits "science and its project of improving the human conditions as a collaborative effort where people (scientists and non-scientists) work together to achieve its ends" (Ngwenyama 1991, p. 271). Creating such intersubjective understanding underscores the importance of free and fair communication. Habermas' theory of communicative action (1984) seeks to unravel the set of norms which constitute the basis of all social action by human actors. Instrumental action is aimed at the object (agent) to act as per sender's (actor's) dictates and needs, agents being assumed as passive or inanimate recipients. The top-down, externally driven mode of participatory develop-

ment, and decision-oriented IS models which shaped the prevalent "managerial ideology by strengthening the instrumental rationalization of organizations" (Lyytinen 1992, p. 166), conform to this type of action. Strategic action aims at similarly controlling another rational actor's response but provides some opportunity to the recipient actor to act otherwise or differently. Thus, the outcome is rendered uncertain, being determined by the actions of the originating actor. Participatory development approaches in which the beneficiaries play a role in defining the agenda of development arise from strategic action. In communicative action, the objective is to achieve mutual consensus and understanding based upon a shared pool of implicit assumptions and beliefs, through means of formal or informal dialogues. Development of such communicative action helps to redress the dominance of instrumental rationality guided by scientific thinking, and engage with the problem of alienation and colonization of the life-world (ibid.) experienced by the users. Participatory development approaches in which the agenda is jointly set by those in authority and the local communities represent forms of discursive action. Examples of such action, at least in the IS domain, are rather rare.

The Habermasian ideal speech situation (IDS) (Habermas 1984) seeks to outline conditions that favor the development of communicative action in which the pros and cons of an action can be debated by the groups on the criteria of clarity, veracity, sincerity, and social responsibility (Lyytinen 1992). Such dialogue, it is argued, can help provide the basis for creating effective sociomaterial networks in which scientists locate themselves in wider set of accountabilities. These ideas of Habermas were drawn upon by Hirschheim and Klein (1994) to try and provide a linkage between a critical perspective and emancipatory goals of IS design.

The concept of IDS has attracted several critiques, particularly from feminists like Braaten (1995) who point to Habermas' purely procedural form of consensus, and the focus on the conditions for discourse which ignore emotions and feelings linked to the cognitive and intellectual maturity of the subject. Nevertheless, the IDS provides useful insights on how enabling conditions should be established to facilitate more meaningful dialogue between relevant groups.

The procedure used in the case described to develop dialogue between the scientists and community focused on demystifying the technology by making selective use of the participatory modeling approach. The scientists used the GIS only to prioritize the areas for land degradation, and then sought input from community members to identify the traditionally existing waterbodies on paper-based maps. These inputs were then incorporated by the scientists into the GIS database.

This approach helped to deal with the politics of representation by providing a mechanism by which people could try and agree upon what was being represented and whether it was adequate or not. The resource maps served as useful boundary objects (Star and Griesemer 1989) for scientists to understand the local environmental conditions and people's needs and aspirations for development. These maps allowed for increased opportunities for analysis and reflection, to identify stakeholder interests more closely, and to provide a spatial structure to discussion on water harvesting approaches. The maps were simple to understand although they inscribed complex social and resource perspectives, and provided a starting point for establishing a dialogue between scientists and the local communities.

This participatory development approach, where the agenda was jointly set by those in authority and the local communities, also helped to engage with the politics of

invisible work by "providing a channel and environment for symbolic interaction" (Lyytinen 1992, p. 166). Through communicative action, the knowledge of the communities, which was historically rendered invisible in and through the use of technical and scientific methodologies, could be freely expressed and embedded in the GIS design. This understanding could be articulated and then inscribed more meaningfully with the analytical strength provided by GIS.

Putting both scientific and indigenous knowledge to collective use acknowledges the contextual and situated nature of reality, and provides mechanisms to deal with the politics of institutions. Practicing disparate knowledge systems together is a political process, since it concedes contesting cognitive authorities (for example, of scientists and communities in the land degradation scenario), while seeking to locate work responsibility within their diverse and contesting authority structures, according them equal consideration (Verran 1998). This cultural approach explicitly acknowledged that there are arenas of political and social domination of the majority "by the most powerful within society" (Campbell and Masser 1995, p. 19), and that participation on its own cannot redress power and political asymmetries (Beck 2002). An implication of this is to understand how approaches to participatory design can be developed that do not magnify power asymmetries. The case presented provides an example of one such approach by trying to demystify the technology so that dialogue between scientists and community members could take place on relatively more equal terms.

6 CONCLUSION

The efficacious role of both end-user participation and integration of relevant knowledge for improving development efforts and GIS-based interventions to address land degradation has been emphasized in the above theoretical discussion. It has been argued that local knowledge of the environment can provide context-specific understandings that can complement scientific knowledge. The link between participation and knowledge for meaningful use of GIS is crucial. Participation under conditions approaching Habermasian IDS can potentially lead to the "crossing of boundaries" (Suchman 2002, p. 93) and the creation of procedures in which the land managers and scientists are able to interact. It then provides the bridge between technical and indigenous knowledge to facilitate development of more meaningful IS. Suchman (1994) has argued for reframing of objectivity to develop alternative systems of technology production and use. Her argument emphasizes that the objective epistemology of scientific and technical knowledge needs to be rearticulated to "multiple, located and partial perspectives that find their objective character through ongoing processes of debate" (Suchman 2002, p. 92) to accommodate lived experience. IS designs based on such critical perspectives then seek to foster mediation between stakeholders and provides the bridge to cross the boundaries.

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