Participation through communicative action: A case study of GIS for addressing land/water development in India

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Abstract. Attempts to alleviate land degradation and water scarcity in arid/semi-arid regions of India have historically been carried out within the ambit of government schemes implemented disparately by concerned departments. These sectoral methods are being increasingly replaced by a watershed-based approach in which local communities are encouraged to assume ownership of development programs, albeit within the government’s overarching control. This decentralized model of governance has also in some cases had a positive impact on the more effective use of ICTs like Geographic Information System (GIS) in locally relevant applications. In this paper, the need for integrating disparate knowledge systems around GIS-based applications to mitigate land degradation, and the facilitating role of participation in achieving such integration, are discussed. It is argued that such participatory processes can be effectively enabled through communicative action whilst taking into consideration the historically existing power asymmetries. The Habermasian Ideal Speech Situation (IDS) provides a conceptual framework to argue how such communicative action can be enabled. This framework is applied to an empirical analysis of a GIS project for land management in India. The paper contributes to unpacking knowledge systems implicated in the use of GIS for addressing land degradation, foregrounding the importance of indigenous knowledge, and in espousing the crucial need to draw upon critical social perspectives in IS research.

Keywords: GIS in rural development, land degradation, India, knowledge, indigenous knowledge, user participation, habermas, communicative action, ideal speech situation

1. Introduction

Land degradation, which implies the loss or attenuation of the vigor and productivity of land [65], is a historical, complex and multi-faceted phenomenon in India caused by faulty government policies, increasing population pressure, and indiscriminate deforestation [67]. Consequently, 40% of the total landmass has been assessed to have “productivity much below its potential” [18, p. 168]. With nearly 72% of its over one billion population residing in villages (www.censusindia.net), depending primarily on land-based activities for meeting their day-to-day sustenance, the development of degraded lands has become a key concern of government programs.

The government is currently making wide-scale attempts to try and rejuvenate the land, including the use of GeogrFaphic Information systems (GIS) for identifying and prioritizing land areas that are degraded and the creation of action plans for intervention. However, despite a variety of projects being initiated, effective results have not been obtained. For example, the first attempt was made by the

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Ministry of Environment and Forests (MoEF) in 1991 by way of 10 pilot projects in selected districts, implemented by leading scientific institutions [37]. These projects failed to realize the potential of GIS for a variety of reasons including the centralized and dominant technical-focused design approach in which user needs were largely ignored [74].

Subsequent GIS applications have also been generally characterized by a techno-centric approach, with minimal user participation [57,58]. However, there is an increased realization of the need to involve the district-level government departments responsible for implementing land-based programs in the field, and also the target beneficiaries of these programs (farmers and local communities), who have a direct stake in the land use, more actively in the implementation process [22,23]. Despite these stated intentions, achieving effective participation is extremely problematic to realize in practice due to the complexity of both the land degradation phenomenon, and of the technical nature of GIS technology. In this paper, we describe one interesting initiative from Anantapur district of Andhra Pradesh state where the district authorities have used GIS technology in innovative ways to try and mitigate land degradation problems. The aim of this paper is to analyze the Anantapur experience with respect to three key research questions: (i) how have participatory processes been enabled? (ii) How has the prior technical-focus been transcended to incorporate a more socio-technical approach? (iii) What outcomes can be seen around the use of GIS related to the mitigation of land degradation and water scarcity problems?

The rest of the paper is organized as follows. In the next Section 2, theoretical perspectives around participation and knowledge are described, leading to our framework based on the Habermasian notion of communicative action. A brief outline of the research method used is given in Section 3, followed by the case study description in Section 4. The case analysis is described in Section 5. Finally, some concluding remarks are presented in Section 6.

2. Theoretical perspectives

Analyses of GIS implementation projects, both in the context of developed and developing countries, have emphasized two key problematic issues. Firstly, the lack of effective user participation in GIS design [61], a problem magnified in contexts like India where governmental structures are extremely top-down and hierarchical [64]. Secondly, the issue of drawing upon disparate knowledge systems relevant to the application domain. Implementation takes a primary technical focus where the various social-cultural-political reasons that contribute to land degradation are marginalized. A key question here is how can the technical knowledge about GIS be meaningfully integrated with scientific knowledge about the application domain (land degradation), and the indigenous knowledge that communities have about nature of land and how it is used? The theoretical issues around participation and knowledge are discussed in the following two sub-sections respectively.

2.1. User participation in IS/GIS design

Over time, IS researchers have increasingly argued that information systems should be viewed as socio-technological heterogeneous networks [75, p. 60], rather than primarily technical artefacts [44]. These arguments have led to the adoption of various socio-technical design approaches [5], an increased sensitivity to the social context of IS design [6], and a greater emphasis on enabling user participation [9]. Notions of participation in IS primarily evolved in the West, and limited attempts have been made to incorporate these ideas in IS projects in developing countries. However, in recent years, with increasing emphasis on how the lack of the social systems approach contributes to partial or complete failure of
many IS projects in developing countries [31,46], researchers have emphasized the need to develop more effective ways to engage with the particularities of local culture [41,56], including the structures that typically inhibit participatory processes in IS design [10,64]. However, despite this increased realization, achieving participation in practice is extremely complex. This complexity is magnified in GIS projects because of the spatial context of the data [20,61, pp. 241–242;99], multi-disciplinary nature of the technology [13,21, pp. 42;11], and the extremely socio-political nature of the application domain. The political nature of land management is reflected in the following quote of a district collector\(^1\) responsible for a GIS implementation in India [8, p. 13]:

You ask me how I use GIS. I have just got this phone call from the MLA (a local politician) who has told me where exactly to put the new wells – in his constituency. There are two processes taking place in parallel – the scientific and the political. Decisions over here are made by political process, and GIS helps to legitimize what we do.

In summary, while participation is increasingly being acknowledged as being important to nurture, it is difficult to achieve in practice due to various reasons including a lack of tradition, complexity of both the application domain and technology, and the political nature of the land management process.

2.2. Knowledge

Three kinds of knowledge are pertinent to the analysis of GIS applications for land management: technical, scientific and indigenous. These are discussed.

2.2.1. Technical knowledge

The first concerns the ‘technical knowledge’ around GIS and remote sensing technologies. GIS 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 [26]. GIS encourages an objective image of maps, based on the mathematical rigor of their preparation, and the assumptions that the correspondence between maps and the real world is unproblematic and context-free [29]. This naïve empiricism [69] is grounded in the belief that the technical and the social realms exist in mutual exclusivity, “ignoring the material and social dimensions of IT” [63, p. 149].

Political, religious and social forces have historically played a significant role in producing the context of cartography, representing a form of knowledge and power [28, p. 279]. For example, map-based representations of forest cover have to be analyzed with respect to government’s intentions of what it wants to make visible and transparent to the public at large [28]. Remote sensing, which provides satellite-based data of land cover that becomes an important input to GIS, raises particular knowledge considerations relating to image processing, and visual interpretation techniques [4, pp. 49–52]. These require considerable skills for generating ‘training sets’ and ground-truthing. The power which has historically been applied by system professionals over users [47] is enhanced in the case of GIS because of the nature of expertise required and its exclusivity [3,66,70].

2.2.2. Scientific knowledge around land management

‘Scientific knowledge’ relates to the application domain including pertinent spatial themes, for example, soil types, vegetation patterns, drainage, and run-off. In the context of addressing land degradation problem, inputs from the scientific domains of spatial mapping of various themes, and their modeling are relevant.

\(^1\)District Collector (DC) is the head of district administration hierarchy.
2.2.2.1. Spatial mapping

The major relevant spatial themes concern land use and land cover data, geomorphology, soils, drainage pattern, groundwater potential, run-off, etc. [54]. Scientific methods are employed to delineate land and classify it as homogenous landscape map units, using techniques of field data collection, digital interpretation of remote sensing data and ground-truthing. Typically, maps of scales of 1:50 000 or smaller have been used in India, which are, however, not sufficient to design micro-level interventions. While, in theory, it is possible to use high resolution remote sensing techniques to obtain larger scale maps (ibid.), this is an expensive proposition.

An interesting example of how contextual conditions shape spatial mapping is provided by Hoeschele’s [34] study of GIS use in the state of Kerala in India. Hoeschele demonstrated how the substitution of land cover data with land use by state agencies in a GIS model led to overestimating the extent of wastelands, leading to the argument that the farmers were not able to manage community lands effectively, making out a case for the adoption of government-led interventions (ibid., p. 299). Interestingly, Hoeschele also revealed that land use data was never collected in the first place, emphasizing the historically existing power of the state bureaucracy.

2.2.2.2. Modeling

Modeling is frequently resorted to draw upon the analytical power of GIS software. For example, in pilot projects of MoEF, relevant thematic maps (like land cover, soil, geo-morphology, water potential etc.) were digitized and overlaid in various combinations, according them varying weightages to visualize potential land reclamation possibilities. Such modeling processes reflected interventions on theoretical considerations of ‘what ought to be’ rather than ‘what people need.’ Sahay and Walsham [64] argued that GIS models are often formulated on rationalist assumptions of profit maximization while the land owners instead preferred the criterion of risk minimization.

In summary, while land degradation is an extremely complex socio-historical phenomenon, interventions are based primarily on techno-scientific criteria, largely ignoring an understanding of the local environment including the land use practices of the communities.

2.2.3. Indigenous knowledge

Community members, who depend on local ecosystems to meet their subsistence needs, have accumulated a rich body of indigenous knowledge about natural resources by trial and error over time [18], based on experience, and is passed down through generations (International Institute of Rural Reconstruction (IIRR) 1996). For example, community members have intimate knowledge about the kind of water harvesting structures that have historically existed in villages. The changing course around development thinking, involving a shift from economic and scientific growth [50,62] to community participation [2,49], and sustainable development [71,72], has also in recent years recognized the pivotal role of indigenous knowledge [39].

Such indigenous knowledge has been historically excluded from the scientific models on the assumptions that it was inferior, unscientific, static [35,36], and that villagers were ‘uneducated’ and inferior because of their lack of a scientific and English-speaking education. Indigenous knowledge is context-specific, embedded in the practice of community members [7], and has remained largely unarticulated to external domains like those of the state and scientists.² This is similar to what Lam described as knowledge that is deeply embedded in organizational routines and shared norms [42, p. 49].

²The term scientist has been used in this paper to denote researchers from remote sensing and GIS related government institutions in India, engaged in GIS application design for land regeneration in selected rural areas of the country.
Indigenous knowledge is not static, as assumed earlier in scientific thinking; it undergoes changes through learning and by trial and error [48]. However, it is not being implied that indigenous knowledge offers a complete panacea for existing problems, or that scientific knowledge is not pertinent. Murdoch and Clark [53, p. 115] warned that “local knowledge, like scientific knowledge, can be reified, given virtues it simply does not possess.” Agrawal [1] perceived this divide between scientific and indigenous knowledge based on methodological considerations rather than substantive grounds as superficial, and that both are shaped by their social contexts [27].

In summary, GIS applications for land management involve the interplay of various forms of knowledge that are historically disparate and shaped by varying contexts. In the next section, we describe our theoretical framework that seeks to integrate these different forms of knowledge, and elaborate on the key role of participation in this process.

2.3. Theoretical framework around knowledge integration: The role of participation

A starting point in the development of the theoretical framework is to acknowledge the importance of indigenous knowledge and seek ways to develop partnership with communities. This thinking is in itself 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 while acknowledging the structural conditions within which knowledge is constructed. Agrawal [1, p. 46] points out that while in the rhetoric of indigenous knowledge, empowerment of marginalized groups is a recurrent theme, its advocates rarely “emphasize that significant shifts in existing power relations are crucial to development.” Thus, there exists the need to develop design strategies that can foster mutual sharing of different forms of knowledge and practices, and seek to create conditions in which effective communication can take place. Enabling effective communication and creating conditions for it is fundamentally problematic because of dynamics of politics and power that are inherent in the structures around land ownership and government practices. As a result, participants might manipulate communication to “impose political agendas which may control the social construction of the place” [3, p. 23].

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 [12, pp. 159–160]. These researchers have identified successful implementation strategies to involve (i) accomplishing simple applications albeit of fundamental importance to the users, to start with, (ii) recognizing and keeping in view infrastructural limitations of the organization. While these findings emerged in a western context and within particular workplace settings, they help to emphasize the multiplicity and situated nature of knowledge forms, and the need for their integration. However, these approaches do not adequately emphasize how broader structures can be engaged with in an inter-organizational context. The proposed theoretical framework based on a critical perspective seeks to address this problem of knowledge integration.

2.4. Participation through communicative action

The existing approaches to address the problem of land degradation in India tend to extend the power of technical control at the cost of cognitive interests of the individuals concerned. Habermas’ [25] critical perspective applied to IS development tries to address the problem of dominance of technical control by encouraging the scope of emancipatory cognitive interests and action [33, p. 304], and emphasizes the importance of “free and undistorted communication” (ibid.) to achieve this.
The typology of human actions categorized by Habermas [25] is: purposive-rational (which may be instrumental or strategic), communicative and discursive. Instrumental action is aimed at the object (agent) to act as per sender’s (actor’s) dictates and needs, agent being assumed as passive or inanimate recipient. The success of this type of action is derived from empirical technical knowledge [45]. The top-down, externally-driven approaches to participatory development, and also to systems development, conform to this type of action [44, p. 166]. Open strategic action aims at controlling another rational actor’s response but provides a certain degree of leeway to the recipient actor to act otherwise. It is based on the knowledge of social settings and values, and the degree to which the desired outcome is achieved [45]. Participatory development modes in which the beneficiaries/end-users are actively involved in defining the agenda of development fall under this type of action. In communicative action, the objective is to achieve mutual consensus, common understanding of norms, meanings and values and to maintain social relationships through formal or informal communication. Discursive communication aims at undertaking cooperative efforts among communities to unveil the pros and cons of an action based on the criteria of clarity, veracity, sincerity and social responsibility [44, p. 166].

Information systems development approaches have generally been based on perspectives of purposive-rational action within an ontology of technical knowledge, including socio-technical methods in which social perspectives are also sought to be considered [45, p. 225]. For example, user participation in socio-technical approaches is mostly emphasized for its purposive rationality. These researchers further argue that the nature and scope of such participation fails to consider the practical knowledge of users, and also does not afford the opportunity for an “open and informed debate” between development groups and users (ibid., p. 229). To correct this situation, consideration of practical and emancipatory knowledge interests is also required for which the Habermasian Ideal Speech Situation (IDS) provides a critical conceptual perspective.

Habermas emphasizes the need to develop communicative action through participatory processes, especially focusing on the conditions and procedures within which communication can take place. Drawing upon these concepts, Hirschheim and Klein [32] describe four sets of conditions to foster communicative action in the context of systems development. These are:

(i) provide equal opportunity to all participants to raise issues, points and counterpoints to other views, thus placing perceived disagreements on the open agenda for discussion;
(ii) all participants placed on equal footing to give or refuse orders, insist on gaining deeper understanding through clarifications that must be provided, aimed at diffusing asymmetrical power distribution among participants;
(iii) all participants should have the opportunity to question clarity, veracity, sincerity and social responsibility of the actions proposed, aimed at testing legitimacy and correctness of “factual, instrumental, and normative claims” (ibid., p. 90);
(iv) all participants have an equal opportunity to articulate feelings of doubts or concerns, aimed at exposing manipulative intents, ulterior motives etc., and also ensure that members who lack the felicity of expression are also heard.

2.4.1. Critique of Habermas

Habermas’ ideas, especially the notion of IDS, have also come in for criticism from many quarters, for example by feminist writers for the exclusion of gender issues, emotions, the questions of identity, and the neutral perspective assigned to the observer [11,14]. Another criticism is that Habermas restricts the analysis of power to hierarchically structured relations such as in bureaucratic settings, largely ignoring power issues arising from asymmetrical social relations in other institutional and societal settings [17].
An example is the asymmetrical distribution of power within communities which determines the course of participation and expression of indigenous knowledge [51].

The above critiques emphasize, in different ways, Habermas’ conceptualization of rationality as being acontextual, for example in ignoring the structures of patriarchy. While being sensitive to the above critiques, we draw upon Habermas to describe a procedural rather than substantive form of rationality. These procedures relate to how conditions can be established to facilitate communication. The specific kind of procedures to be employed in different settings can of course be modified for local use, but the important point foregrounded is the need for certain procedures by which the fairness of a communicative situation can be analyzed, and arising distortions tried to be addressed. Distortions to communication exist in different settings although the reasons for them may be different. For example, in Western contexts, distortions may arise due to time pressures wherein the actors do not have enough time to simultaneously sit together and debate issues at length, while in developing country settings, the distortions may arise from historically existing power asymmetries. Therefore, the theoretical ideas espoused in the Habermasian IDS are relevant not only to developing country settings, but can also be drawn upon in Western organizational contexts.

The theoretical aim of this paper is to see how, given the existing contextual conditions, a meaningful dialogue and understanding between scientists, administrators, and rural people can be promoted. The Habermasian IDS, embodied in the above-mentioned four conditions, while always being an ideal, and thus unreachable, however, provides a normative goal to strive for in building partnerships among different communities. The IDS helps to understand the distortions that exist in practice, which inhibit achieving the ideal, and provides us with some analytical tools to try and address these distortions.

The key features of our conceptual framework are summarized below:

– The importance of understanding the different forms of knowledge (technical, scientific, indigenous) and the contextual conditions in which they are shaped.
– The important role of participation through communicative action to bridge the divide among the above three forms of knowledge.
– The need for a critical perspective on how communication can be drawn upon to try and redefine the structural conditions within which projects take place.

3. Research methods

In this section, the research approach adopted for the present study is described including brief details about the background, research setting, data collection and analysis.

3.1. Background

The case study presented in this paper is part of an ongoing longitudinal research taken up in 2000 to examine the implementation process of particular GIS projects in different districts in India. In this paper, we report from field studies in Anantapur, a district which is chronically drought-prone, making land degradation a serious problem. Anantapur was also chosen because it is situated in Andhra Pradesh, a state which is in the forefront of e-governance efforts in the country. The country’s premier remote sensing institution (NRSA), the nodal agency for the GIS-based national programs for land management, is also located in Andhra Pradesh.
3.2. Research strategy

Based on the ontological assumption that reality is a socially constructed, an interpretive case study approach was adopted [40,73, pp. 376;69]. Interpretive researchers take the stance that the social world can only be understood from the point of view of individuals and how they assign meaning to their everyday experiences [15, p. 138]. The focus is not on establishing truth claims but on understanding the processes through which intersubjectivity is reached. The interpretive perspective has guided both the data collection and its analysis.

3.3. Research setting

Anantapur district experiences a low average annual rainfall of 521 mm, is poorly developed, and has a long history of drought, with 31% of its landmass afflicted with severe degradation. The frequent failure of monsoons, deforestation, excessive drawl of ground water, increasing soil salinity exacerbate the impact of drought [60]. The location of the district is shown in the following index map (Fig. 1).

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Source: Anantapur District – A profile, dated 20th December 2002, complied by district administration.
Field work was carried out in two phases, with a gap of about 4 months, commencing in December 2002. Interviews were conducted with officials from various organizations including the district, local university, NGOs, scientists at NRSA and Andhra Pradesh Remote Sensing Application Centre (AP-SRAC) located at Hyderabad, and officials from rural development ministries in the state and central governments. A detailed break-up of these interviews is summarized in Table 1.

The method adopted to obtain primary data from the field comprised of semi-structured interviews of people, either singly or in groups. In Table 2 below, we summarize the key themes discussed with various groups of people.

As we were dealing mainly with government departments, tape-recording of discussions was not undertaken, as it not a customary practice in the Indian government. However, detailed notes were taken, which were soon transcribed verbatim. Much of the conversation with villagers was carried out in Telugu (the local language) for which services of local interpreters were obtained.

In addition to the interviews, secondary data in the form of maps, guidelines, presentation material, project reports as well as evaluation reports of independent agencies were obtained. We also witnessed several GIS demonstrations, and participated in meetings with villagers both in the presence of government officials, and also independently. Newspaper reports about government initiatives provided further contextual information about the research setting. Study of the official memos and reports provided insights into the efforts being made by the district administration.

### Table 1
Summary of Field Work in Anantapur district in 2003

<table>
<thead>
<tr>
<th>No. of villages/ visited</th>
<th>No. of persons interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scientists</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

### Table 2
Key themes discussed during interviews

<table>
<thead>
<tr>
<th>Target group</th>
<th>Topics discussed/interview objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Officials from district administration</td>
<td>Overall development strategy and methodology adopted; envisioned role of GIS therein, effectiveness of the past efforts in this context; level of participation in the implementation process.</td>
</tr>
<tr>
<td>Local GIS team</td>
<td>Support provided by NRSA; how local knowledge was drawn from community members; details of GIS database constructed based on fresh data collected locally and the role of NRSA in this process.</td>
</tr>
<tr>
<td>NGOs</td>
<td>Opinion of the role of ICTs in local development, envisaged versus actual contributions.</td>
</tr>
<tr>
<td>Villagers, watershed teams and communities</td>
<td>Elicit the ‘ground truth’ to gauge the gap between policy prescriptions and their actual realization in the field; solicit people’s perspective about changes, if any, that might have come about in the earlier dominating attitude of government officials while dealing and communicating with them.</td>
</tr>
<tr>
<td>Scientific institutions</td>
<td>Perceive attitudinal changes vis-à-vis earlier unre lenting belief of scientists in the universal superiority of techno-centric GIS design; how they saw their role in a more decentralized, locally inspired GIS applications designed by the district teams.</td>
</tr>
<tr>
<td>State/central government officials</td>
<td>Analyzing policy level issues relating to participation of people in watershed-based development programs, and envisaged role of ICTs therein.</td>
</tr>
</tbody>
</table>
3.5. Data analysis

We made individual interpretations of notes taken during the meetings, and subsequently discussed them between ourselves and also with the respondents. The analysis process focused on three questions: (i) What has been the nature of partnership and communication at the two levels of institutions and communities? (ii) How have attempts been made to integrate the different kinds of knowledge and practices? (iii) What tangible effects are seen by people to have arisen from the use of GIS?

4. The case study

The case is discussed under three main themes, viz. institutional arrangements, building partnerships, and integrating knowledge.

4.1. Institutional arrangements – Rural development scenario

An institutional shift in the government strategy of implementing rural development programs in India came in 1995 with the adoption of the watershed-based methodology [22,23]. In the traditionally employed sector-oriented approach, individual departments like forest, agriculture, water resources, were in control leading to a multiplicity of efforts, wasteful expenditure, redundancies, with the same land resource being seen from different sectoral perspectives. Consequently, the involvement of people was limited. The watershed approach in contrast takes as its unit of focus a micro-watershed rather than a single resource like land or water. Watershed is a geo-hydrological resource unit which drains to a common point, and subsumes all bio-physical resources such as soil and water, vegetation like trees, grasses and crops [16, p. 1], as well as human resources [68, p. 16]. The development and management of a watershed is, therefore, based on holistic considerations of relevant resources, including land use, soil and water, and linkages between upland and downstream areas (ibid.). In this approach, therefore, the focus of development shifts from individual resources to their interaction [16, p. 1], and how people’s participation can help to find the right balance.

The Project Director, 4 Desert Development Program of Anantapur district, explained that Government guidelines [23] specified that the local watershed development design and its implementation would no longer fall within the sole purview of the government, but would also be the co-responsibility of watershed development teams (WDTs). Majority membership of a WDT comprised people’s chosen representatives from the concerned villages, government representatives, and was formally chaired by a non-official. The WDTs were empowered to incur expenditure subject to monitoring and audit by the government. In Anantapur, this decentralized model was taken a step further by making provisions that while the WDTs would be established as above, the actual design and implementation of village-level development activities would be finalized by the community in the gram sabha 5 and implemented through their nominated user teams.

During meetings with people, officials and NGOs, the success of the new development approach was unanimously attributed to a number of institutional and political changes including the political leadership in the state, enduring shifts towards e-governance, decentralization of governance, and, above

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4 Responsible for watershed development programs as well as ICT/GIS related work in the district.
5 Gram sabha is the village council, the body constituted of all adult members of the village.
all, a people-centered approach adopted for rural development. The district also installed its own computer/GIS infrastructure manned by well-qualified professionals. The technology was used to try and rapidly respond to changes in the prevailing drought conditions, make alterations in the budgetary provisions, and for the monitoring of projects. New applications like the water audit of Kalyandurg *mandal*6 (also in Dhone *mandal* of the adjoining Kurnool district) became possible to execute because of the availability of current data, and the ability to collect, verify and augment GIS databases as per local needs. The local GIS team had constructed a new and more comprehensive GIS database for Kalyandurg *mandal* through an extended field survey, including spatial and non-spatial data considered essential by the district management in consultation with line departments, NGOs and subject matter experts from a local university.

During discussions with scientists at NRSA and APSRAC, a key change noticed was that each district in which GIS initiative had been taken to address land degradation was assigned to one of the scientific institutions, thereby ensuring continuity, and building up long-term relationships. This increased responsibility of scientists towards districts was in contrast to the earlier arrangements where the scientists had a primary aim of technology experimentation rather than its implementation in the districts [74].

In summary, four key institutional changes noted were (i) watershed-based development approach; (ii) the WDT being administratively and financially empowered to implement identified interventions directly; (iii) setting up of local GIS unit; and, (iv) the changing role of scientific institutions with respect to their responsibilities vis-à-vis the districts.

### 4.2. Building partnerships

In Anantapur, further strengthening of watershed management approach since 1999 was made possible through the personal initiative of the district collector (DC) who strongly favored a participatory process. The Project Director acknowledged the role of the DC and the people-centered model of development. She explained:

This positive change was brought about by the deep personal involvement of the DC. A striking feature of the development methodology adopted in Anantapur is that all such programs are determined, finalized and implemented by the villagers as per their felt needs, with power to incur expenditure within allocated budget. The government only plays the role of a motivator and adviser, and also oversees the progress of implementation and financial expenditure.

During a meeting with villagers, we asked their opinion about the changes brought about by the administration in development procedures. An elder responded:

I have observed the government sponsored programs for many years. No one consulted us earlier. They did what they wanted. Now, things are different. We know what we want by way of development, and design the activities accordingly, and also implement them. There is hardly any interference from the government people. They check accounts and see whether the progress is as per the approved schedule.

Adoption of a decentralized WDT approach thus enabled participatory models of development to be incorporated into the governance structures of Anantapur. In this revised approach the role of remote sensing institutions was also redefined, especially involving the integration of different knowledge forms. This is discussed below.

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6A *mandal* is an administrative unit in a district.
4.3. Integrating knowledge

Since the inception of the efforts to use GIS in land-based applications in India, the development of both spatial and non-spatial databases, as well as the application software, has been the responsibility of the concerned scientific institutions. The official system development methodology employed, as described in an NRSA document, is schematically depicted in Fig. 2.

The APRSAC (the assigned scientific institution) approach in Anantapur based on the above methodology was critiqued by the Project Director:

The maps and the other outputs, including recommended action plans for land and water resources development in the district were prepared by APSRAC on the basis of 1991 data. The scenario has since changed here. Hence, apart from using this information as one parameter for prioritization of areas for taking up developmental activities within the financial resources available, these maps etc. cannot be used for planning current work in the field. The scale (1:50 000) of these maps is also too small to be of practical use in the field.

The adapted approach in Anantapur was described by the GIS team:

For Kalyandurg mandal, field data collection teams were formed. Each team comprised a person with background in civil engineering, a non-technical person and a local village person. Xerox copies of relevant cadastral maps (1:8000 scale) were used by survey teams to mark the location of various features such as wells and check dams. At the same time, GPS handsets were used to record the latitude and longitude of these features.
The survey teams walked along each and every gully collecting data relating to the gully dimensions every 200–300 m. For each survey point, the latitude and longitude were recorded, the point was marked on the concerned cadastral map, and the nearest survey (plot) number was also noted in the relevant table used for recording non-spatial data. The present condition of each gully, e.g. whether under cultivation, was also noted. All the water harvesting structures such as masonry check dams, earthen bunds, and rock-fill dams, as well as tanks, agricultural fields, and wells were also similarly surveyed. For wells, data collected included: type of well, its current use, extent, dimensions, year of construction, area irrigated, pump capacity, reliability, latitude and longitude and survey (plot) number.

The GIS team leader explained that the above datasets had been sent to NRSA for digitization, quality control, and preparation of the database. This database had since been locally installed and was being used in multifarious applications including the recently concluded water audit. During a subsequent meeting with the NRSA scientists, it was confirmed that the database preparation for Anantapur had been carried out by them using the field data collected by the district teams.

We witnessed several demonstrations of the GIS work being done in Anantapur, and the use of the above database. One striking example was how survey and recording of all water harvesting structures, and the subsequent GIS analysis of this data, led to the identification of 29 redundant structures out of a total of 176 built under various government programs in previous years (Fig. 3). 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 these inefficiencies, and provided the impetus for change. As a result, the district administration had formally decided that future proposals for construction of any new structure would have lower priority to the rejuvenation of traditional structures.

The APSRAC scientists acknowledged that the resource maps on 1:50 000 scale had not found much practical use in the field, except for prioritization of intervention areas. They agreed that the development plans now emerging from discussions with people, as per local needs and perceptions through the institution of gram sabha and WDT, was a more effective way to gain indigenous knowledge to bridge the gap between people and scientists.

The Project Director also explained other applications of ICTs developed locally. Progress reporting formats had been computerized, in which every milestone of each project activity, including financial transactions, were recorded, and were available for audit and public scrutiny. A local journalist whom we met testified to the public availability of these records. Another important monitoring feature adopted was that details of all sanctioned development projects were displayed at prominent places in concerned villages indicating the dates of commencement/ proposed completion, expenditure involved, and names of the respective user team leaders. These public displays brought in greater accountability and responsibility amongst the user groups, something which was absent in the past.

In the meetings of gram sabhas, one of which we witnessed, development plans for the area were discussed. 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 a member of the GIS team. People often explained their perspective through participatory mapping. These maps were drawn on the ground (not to scale) to depict the location of various existing resources, and the proposed location of mooted development activities. The officials acknowledged that some of the elders had an astute sense of the local topography and the drainage patterns. These markings by the community members on the ground maps were then incorporated into the database by the GIS team.

In another village, where a canal was under construction to irrigate 260 acres of land, we were told that this work was being implemented by several user groups comprising about 80 local farmers. Considering
that execution of such tasks requires engineering knowledge, we probed the group further with a few questions about the local drainage pattern. Responded a villager:

We are better than engineers. The officials are welcome to check all the accounts, see the quality of work and progress. We assure you that we have much better knowledge of the area because of long local experience than any outsider can develop in a few days or weeks or even years. I know where each and every drop of rain falls here, and where it goes.

In our second visit to Anantapur, a new DC had taken over. We were keen to find out if the initiatives taken by the previous incumbent were still in place. We visited several villages, participated in a gram sabha meeting, and also met with the Project Director and the GIS team. We found no evidence of any discernible change, and the new DC said:

In several districts, the use of remote sensing and GIS has been largely symbolic, with colorful maps adorning various offices. I intend to strengthen the decentralized style of technology diffusion adopted in Anantapur, and the immediate plan is to complete database construction as per the procedure adopted for Kalyandurg mandal for the entire district. NGOs and the local villagers will continue to play a key role in this activity along with the scientific and technical staff.

In summary, the GIS technology was being used for the prioritization of intervention areas and for monitoring the progress of projects. The GIS database also included people’s knowledge about existing water-bodies elicited through participatory processes. The public displays and access to such knowledge enhanced accountability and commitment to the project. A summary of key features emerging from the above case description are summarized in Table 3 below.
Table 3

Key features of Anantapur case study

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<tbody>
<tr>
<td>1.</td>
<td>Co-ownership of defining and implementing local development devolved to people through decentralization of the WDT model.</td>
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<tr>
<td>2.</td>
<td>Further empowerment of villagers by changing accounting procedure, and establishment of user groups of local residents to implement projects in which they have long-term stake.</td>
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<tr>
<td>3.</td>
<td>Situating use of ICTs within the overall development process.</td>
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<tr>
<td>4.</td>
<td>Participation of users in GIS exposed insufficiency of scientific methods alone, e.g. by highlighting the importance and relevance of traditional water harvesting structures of the past.</td>
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<td>5.</td>
<td>ICTs contributing to the shift towards people-centered development, better management of projects by computerizing milestones, ‘before’, ‘in-process’ and ‘after’ photographic evidence linked to activity records, drawing upon local knowledge during field surveys, GIS team incorporating indigenous knowledge expressed in gram sabhas and participatory mappings into GIS database.</td>
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5. Analysis

Our theoretical framework emphasized the need to develop critical partnerships between scientists, district staff and community members. The Habermasian Ideal Speech Situation (IDS) provides a normative framework against which such an evaluation can take place. In this section, we analyze these partnerships with respect to four sets of conditions outlined earlier to be the basis for the IDS.

5.1. Providing opportunities to participants to air their views

Development needs are being envisioned not only through people’s discussions in gram sabhas, but are also visualized through participatory mapping in which people graphically depicted the spatial distribution and status of various lands, water and vegetative resources, and the location of proposed activities. This mapping makes indigenous knowledge more explicit and understandable to outsiders, for example to the GIS team. The capability of villagers to give a clear spatial expression to their knowledge was not generally acknowledged earlier by scientists, an assumption that was negated in Anantapur.

The participatory maps serve as “boundary objects” [30] between communities and GIS experts in developing understanding of villager’s perspectives and to be able to draw upon their knowledge in GIS design. The boundary objects are useful in sharing different perspectives, while retaining each culture’s domains and distinct understanding (ibid.). Use of participatory maps as boundary objects creates conditions for facilitating an interactive and iterative dialogue between scientists and local people aimed at ‘negotiation’ to arrive at mutually understood, shared and acceptable design.

5.2. Dealing with power asymmetries

The devolution of power to the communities and the local people by empowering them to define, implement development, and to incur expenditure, has removed some of the historically existing power asymmetries, and corrupt practices manifest in the previous centralized, contractor-based implementation mechanisms. Similarly, the setting up of a local GIS team has attenuated the power exercised by scientific institutions over the district bureaucracy. In the action plans developed by these institutions in the past, there was minimal involvement of the local line departments and communities. Since the local GIS team functions within the overall development paradigm and vision of the district administration, it is easier to incorporate their perceived needs as also the indigenous knowledge in GIS design. The inclusion
of local residents in the data collection teams reflects the desire of the administration to draw upon on indigenous knowledge in GIS design.

Criticisms of participatory approaches have been made earlier because often the local community is conceptualized as an unproblematic monolith entity [24,52]. This problematic view of community as the basis to design development interventions was addressed to some extent in Anantapur by the diffusion of authority to gram sabhas and also by encouraging user teams of local residents to participate in implementation of programs in which they had a direct stake.

Participation of the GIS team and administrators in gram sabhas also provides the opportunity to share knowledge, and particularly to the local scientists to understand and draw upon people’s understanding of the local environmental resources. Another important step in this direction was that the tasks which required greater understanding of the technology, as well as the availability of appropriate hardware and software, such as the construction of the database and its quality assurance, were assigned to the scientific institution.

5.3. Providing opportunities to participants to express doubts, argue the legitimacy of truth claims

The gram sabha provides a platform for relatively free and frank dialogue between the local people, administration, experts from line departments, GIS team, and NGOs. During discussions and debates about the nature of development required in the local context, people express their opinion as well as question and query others. Participatory mapping also provides an opportunity to argue the legitimacy of truth claims put forward by individuals or groups. The quote of a villager claiming to be more knowledgeable than engineers demonstrates that as villagers gain in confidence and trust of their knowledge, they tend to be more emphatic in putting forth their views. They also develop the capacity to debate the hitherto unquestioned knowledge claims of, for example, scientists around the nature of local development. In the example of political interference to locate wells, cited earlier in this paper, the location of these resources may be claimed by administration to have been decided on the basis of GIS analysis. However, the gram sabhas provided a mechanism for people to take recourse to discursive modes of communication to question such claims on the basis of their local knowledge. The structural changes brought about through the amendment of rules, introduction of new policies, and according constitutional authority to gram sabhas provide opportunities for such discursive communication by the people.

The case description underscores how, in Anantapur district, the nature of communication underwent changes and transformation from the erstwhile instrumental mode to a stronger emphasis on communicative action both in land/water development and use of technology therein. This is summarized in Table 4 below.

6. Conclusion

The case description and its analysis presented above are reviewed below in context of the three research questions listed at the end of the introductory section.

6.1. Were participatory processes enabled?

The decentralization of development design and implementation provided an equal opportunity to the poor and marginalized people to participate and assume ownership of these projects. In the ensuing
Table 4

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<th>Conditions to foster communicative action</th>
<th>Evidence from Anantapur</th>
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<tr>
<td>Opportunities to participants to express their views. Participants placed on equal footing.</td>
<td>Gram sabhas and participatory mapping provide the forum. Involvement of NGOs a positive move due to their closer proximity to people. Development defined by people and implemented by local groups (decisions as per consensus or majority). Local GIS team and scientists communicate on more equal terms with the GIS work also being decentralized.</td>
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<tr>
<td>Participants able to question veracity of action proposed Participants able to express doubts, argue legitimacy of truth claims.</td>
<td>Development activities widely publicized; computerization of progress and its availability to public and press. People gaining confidence, begin to question ‘scientific’ outputs, e.g. location of water harvesting structures; NGO and academia presence facilitates participation; administrators and local GIS teams questioning the validity of maps and action plans generated by scientific institutions.</td>
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In a democratic environment, people showed themselves to be capable of shedding their inhibition of interacting with the more powerful bureaucratic and elite scientific communities. Through communicative action, the local communities were able to articulate their understanding and knowledge, as well as express their views relatively freely in gram sabhas. This paradigm change also influenced the ICT and GIS design processes to be taken up in more participatory ways at two levels: (i) consultation between local GIS teams and the communities, and (ii) development of GIS based on local needs, while, simultaneously, utilizing the scientific knowledge and technical infrastructure of the scientific institutions for building the final GIS database.

6.2. Did socio-technical approach to GIS design take place?

The inculcation of socio-technical approaches is evidenced in the consultations GIS team had both with district-level users and the communities. These consultations not only provided a clearer statement of design goals relevant to and consistent with the local needs, but also enabled the GIS experts to understand local practices, knowledge and priorities around development. Presence of a GIS team member during gram sabhas and participatory mapping to articulate their perspectives as well as to understand indigenous knowledge and needs of people were indicative of communicative action coming to the fore in these processes.

6.3. What outcomes emerged from the use of GIS?

The change in design approach (from technology-focused to socio-technical) shaped scientific thinking in the use of technologies like GIS in a local context. This use has penetrated everyday activities of land/water governance in the district. Based upon GIS analysis of updated and locally verified data in partnership with people, new policy directions emerged in Anantapur, for example in encouraging use of discarded traditional water harvesting structures in preference to new structures which was the earlier practice. The recent water audit carried out in Anantapur and an adjoining district was also greatly facilitated due to the availability of redesigned GIS database in which additional spatial layers and non-spatial attributes were added in consultation with the end-users, local NGOs and academia. The water audit brought into clearer focus the availability, rates of usage and recharge of this resource, to enable government and people to formulate more effective long-term policy for its effective use and augmentation [59]. A change in cropping patterns used by farmers in the districts was also witnessed.
with growing emphasis on raising horticulture crops in place of paddy alone, which contributes to a wiser use of scarce water resources.

The relative success of rural development programs and conjunctively of the GIS system in Anantapur came about due to effective institutional building to promote decentralized decision-making, methodological integration with locally understood work practices in which indigenous knowledge was given equal consideration. The gram sabha, a constitutionally recognized institution, comprising all adult villagers, has become an “obligatory passage point” [43, p. 150] in the new developmental paradigm. However, the positive role of the DC and Project Director was crucially important. Sustenance of this successful model in the future would provide insights into the durability of decentralized institutions, the impact of GIS on land/water management planning and implementation, as well as the role of political institutions.

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