Of Intractable Conflicts and Participatory GIS Applications: The Search for Consensus amidst Competing Claims and Institutional Demands

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This article reviews the discourse about geographic information system's (GIS) potential as a tool for intervening in disputes over access to natural resources. GIS is a planning tool with striking analytical capabilities and a great public appeal that can be utilized for explicitly reasoned discussions to facilitate conflict resolution. However, the technology's reputation as an interventionist tool has been undermined by competing claims about human factors that sustain conflicts. Some scholars believe elements of a conflict are manageable and that meaningful communication between disputants will erase misconceptions and generate consensus. Others reject cooperation and instead emphasize self-interest and competition as the driving forces behind conflicts. This article investigates the two claims and argues that both the competitive push to claim independent rewards and the urge to create joint values are present in a conflict resolution. A more productive discussion of GIS's role in conflict management, therefore, involves unpacking the links between competitive forces that sustain a conflict and the social norms and group expectations that govern human behavior in society. The article discusses the links between value systems, opinions, and actions and how a GIS application might influence such human attributes to induce changes that promote cooperation. The study concludes with a case study involving the use of GIS to manage a conflict over natural resources allocation in a rural community in Southern Ghana. *Key Words: conflict resolution, Participatory GIS, resource management, values and interests, Ghana.*

Two theories are evident in current thinking about the role GIS plays in conciliative attempts that occur in resource management organizations. On one hand, Weber's explanation of instrumental rational behavior and interpretations of the theory dismiss cooperative moves to resolve conflicts and instead, emphasize self-interest and competition as the factors that sustain conflicts. Advocates of this viewpoint maintain that the competitive urge to claim independent rewards compels parties to adopt positions that are often difficult to reconcile. The proponents therefore argue that when information about a conflict becomes available, disputants use it to confirm their predetermined positions. On the other hand, Habermas's communication theory identifies social institutions, including norms, sanctions, and networks of social interaction as forces behind conflict resolution. The viewpoint assumes that elements of a conflict are malleable and that cooperation and meaningful communication between disputants will erase misconceptions and induce mutual agreements.

Each of these theories contains a measure of truth that reflects a real aspect of the conflict-mediation process. They, therefore, provide frameworks for understanding aspects of stakeholders' behavior during a conflict. However, considered separately, the theories do not fully address all the factors that motivate groups to prolong or resolve conflicts between them. The theories do not account for the fact that successful mediation requires strategies for handling both competitive and cooperative forces. They also do not take the type of conflict into consideration. For example, they fail to consider whether a conflict occurs between groups within a sociopolitical system (where institutional forces can restrain competition), or whether the disagreement occurs between groups affiliated with different sociopolitical systems where the urge to protect a group's self-interest can be supreme. Neither of the theories explains changes that occur during the lifetime of a conflict which may either facilitate or restrain competition and cooperation. It is becoming increasingly apparent that resolution of conflicts is subject to contextual forces that are both competitive and cooperative in nature (Raiffa 1982; Lax and Sabenius 1986; Sharfman and Gray 1991; Logson 1991). In spite of this, few authors have addressed the combined impacts of these factors on the mediation process. In particular, debates about GIS applications in mediation have ensued from either the competitive or cooperative approach to conflict. While the competitive approach assumes irreconcilable antagonistic *values* and, as such, dismisses GIS applications, the cooperative approach

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emphasizes mutual relationships and common *interests* and, hence, welcomes GIS applications for the cultivation of shared interests. It is important to note that innovative GIS applications can succeed in preparing disputants for consensus in conflicts sustained by either values or interests. GIS applications are, however, limited to issues that are distributed in space and can be mapped and analyzed (i.e., land use). The technology is therefore constrained more by the types of conflict (spatial or nonspatial) than the nature of the disagreement (value or interest driven conflict).

This article argues that in matters of conflict over land use, the cooperative and competitive forces are present and inextricably intertwined. The study backs up arguments by Raiffa (1982) and Lax and Sabenius (1986, 2000), who view the mediation process as an effort to manage a tension between the cooperative move to create values jointly and the competitive urge to claim rewards independently. The article maintains that although the competitive move to advance self-interest is present in conflicts over land use, group expectations, sanctions, and shared commitments are equally important factors in conflict resolution and its prevention. The competitive and institutional forces aside, the formation of beliefs (values and interests) that sustain a conflict rests upon information that is available to an individual. The disagreement can also result from misinformation and misunderstanding. It is possible that in either of these situations, skillful and innovative applications of GIS can help disputing parties get past initial misconceptions and work together to create joint gains. The article concludes with a case study in which GIS was adopted to manage conflicts arising from competition for access to forest resources. The case study forms part of a larger research project conducted in Southern Ghana to build collaborative institutions to facilitate joint forest management between foresters and local community groups.

Transformation in GIS Research and Applications

The recent upsurge in the implementation of community-based GIS projects[1] provides clues to how forces of technological change, advocacy, and public expectation have reshaped the course of GIS development and power relations that have until recently defined its research and applications. As GIS has continued to play an expanded role in the way we analyze spatial data and view and understand spatial phenomena, empowerment of underprivileged groups has emerged as a new and popular field of GIS research and applications. The new GIS initiative aims to develop a system that will be "adaptable to inputs from ordinary citizens" and other nonofficial sources (Obermeyer 1995, 65). Under the initiative, GIS applications have spread from large public, and private establishments into inner-city neighborhoods in the West and community-based organizations throughout the world. To advocates and experts engaged in these Participatory GIS (PGIS) applications, the technology provides a critical complement to grassroots efforts that are undertaken to empower communities (Craig and Elwood 1998; Ghose 2001; Craig, Harris, and Weiner 2002). On the other hand, the expanded involvement of communities with little experience in the use of complex technologies (such as GIS) generated a great deal of concern among GIS scholars. Prominent among the early misgivings were unequal access and the imbalances of power generated by GIS applications (Obermeyer 1991; Curry 1994; Aitken and Michel 1995). Some scholars argued that the technology's primary function of preparing data to facilitate decision making identifies it more with public officials and powerful members of society than with underprivileged groups (Curry 1994; Pickles 1995). Taylor (1991) and other authors (Sheppard 1993; Krygier 1996) contended that GIS technology imposes a particular logic and a way of knowing and representing nature spatially. There were claims that GIS presents only the official version of a worldview that is biased toward a scientific, masculine, and data-driven representation of reality, with little opportunity for representing the experiences of underrepresented groups (Taylor 1991; Mark 1993; Gregory 1994; Goss 1995; Roberts and Schein 1995; Shroeder 1999). Other authors expressed the concern that GIS empowers rich and powerful members in society and disenfranchises the weak and poor through its ability to promote selective participation of groups in public policy decisions (Pickles 1991; Mark 1993). In a direct challenge to the emerging PGIS initiative, some scholars argued for an end to GIS applications in traditional societies because of the technology's assumption of subject–object dualism (Lake 1993) and incompatibilities between Western culture and the culture of people in non-Western societies (Rundstrom 1995).

The critiques about equal access to data and technology, public participation, and impacts of GIS adoption on society were not only suggestive of problems with GIS applications, but such reminders also highlighted the need to introduce the technology to groups who would likely lose out in public policy debates that involved GIS applications. In an early attempt to ensure a level playing field for GIS implementation, Chrisman (1987) advocated the development of a GIS that would facilitate multicultural and cross-cultural applications. Other scholars

argued in support of expanded applications by claiming that the technology is socially constructed and that GIS assumes its identity within specific social contexts (Campbell 1991; Campbell and Masser 1995). The belief is that the social and geographic location of a community provides its people with a context through which they learn to use GIS technology and interpret and use information (Fox 1998; Aitken 2002; Stonich 2002). The importance of the social context in GIS development was amply illustrated recently in the book *Community Participation and Geographic Information Systems* (Craig et al. 2002). In several chapters, the authors demonstrated GIS applications across multiple axes of difference. Thus, recent developments in community-based GIS applications undercut the claim that GIS represents particular epistemologies and that local knowledge cannot be translated into cartographic maps. Such arguments deny the agency of advocates and experts who spearhead GIS applications (Sieber 2000a; Ghose and Huxhold 2001; Kwan 2002). For some scholars, the lack of access to the technology was a limitation on the freedom of communities that had a good understanding of their needs but could not verbalize their problems within a context that included GIS (Bevan 1988; Metzendorf 1988). Accordingly, to ensure public participation and equal access to information at a time of widespread computer usage, it became necessary to address imbalances in access to GIS technology among some of society's most vulnerable groups (NCGIA 1996; Shroeder 1996; Craig and Elwood 1998). Thus, propelled by popular advocacy, favorable developments in the computer industry, and support from public and grant-awarding organizations, the PGIS initiative has spread into several remote locations worldwide.

A Challenge to the PGIS Initiative

The use of cartographic representation to empower underprivileged groups and counter dominant viewpoints about property regimes and land-use practices is not new. PGIS applications draw on participatory strategies and an intellectual tradition that includes planning, social forestry, and community development. Advocates and other scholars have integrated a variety of mapping techniques with public participatory methods to demonstrate conflicting sets of knowledge about local geographic space and natural resource use (Kabutha, Thomas-Slayter, and Ford 1990; Chambers 1994; Peluso 1995; Poole 1995b; Rocheleau 1995, 1997; Hogson and Shroeder 2002). Generally, the countermapping projects are designed to represent the viewpoints of particular underprivileged groups (Rocheleau et al. 1995; Sieber 2000b; Kwan 2002), demarcate and protect indigenous land rights (Beltgens 1995; Smith 1995; Bond 2002), record and appraise local knowledge (Neitschmann 1995; Laituri 2002) and assess local and neighborhood needs (Elwood 2002; Ghose and Huxhold 2001; Sawicki and Burke 2002). Besides empowerment and provision of alternative representations to counter official interpretations, community maps have been employed as powerful communication tools to present information in different ways to convey an impact on choice selections of individuals and groups (Harley 1988; Wood 1993; Fox 1994; Keates 1996; Craig and Elwood 1998; Eghenter 2000; Jordan 2002; Kyem 2002). There is a long history of the use of maps in direct and informed negotiations and in promoting free expression and consensus building among community groups (Gupta 1989; Mascarenhaus and Prem Kumar 1991; Neela 1992; Fox 1990, 1994). Rocheleau (1995, 1997), along with other advocates (Fisher 1994; Rocheleau, Thomas-Slayter, and Edmunds 1995; Poole 1995a; Huffman 1997; Poffenberger 1990), associates feature categories in community maps with preferences and negotiated compromises realized by the groups. As well, it is believed the mapping equips communities with the power to realize their priorities in cooperation or competition with other groups. A GIS is a far better tool for depicting and producing relations among spatial entities (Berry 1993; Chrisman 1997), and a more "persuasive tool" (Goodchild 1999, 3) than what one can achieve with ordinary maps. Consequently, if creatively applied, the technology can do more to facilitate the resolution of conflicts than ordinary maps. Mapping capability aside, GIS offers opportunities for parties to collect and analyze data jointly, explore alternative scenarios, create a medium for stakeholders to exchange views about their values and interests, see results of value choices, and learn to develop trust for each other (Leidner and Elam 1995; Kyem 1997; Janowski and Nyerges 1997; Jordan 2002). Computer-based information systems are also known to create a level of reputation about impartiality, and enhance and increase participation in discussions among groups (Belcher and Watson 1993; Ozawa 1993). The technology is closely linked to centers of power and influence in society (Rockart and DeLong 1988; Watson, Rainer, and Koh 1991; Paese and Sniezek 1991). Besides, the data that a GIS expert produces and the confidence that stakeholders develop in such information convey an increasing level of influence to the expert. With the development of GIS, therefore, community-based organizations seem to have the right tool for structuring resource management practice to open up the processand make it iterative and less controversial than before. Accordingly, as GIS adoption in communities grows in significance, it is likely

that capabilities of the system will be challenged to address complex problems resulting from competition for access to scarce local resources.

Notwithstanding the technology's capabilities and expectations about its potentials, GIS's ability to facilitate conflict management has been undermined by claims about irreconcilability of human factors that sustain a conflict. The argument is that because of GIS's inability to affect value conflicts and its propensity to increase fact-based conflicts (through the supply of data that can be used to support arguments), conflicts would intensify and increase with expansion in GIS applications (Obermeyer and Pinto 1994; Berry 1995). On the other hand, other GIS scholars believe the technology can be adopted to manage competing claims to land-based resources. Capabilities of the system have, consequently, been utilized in association with multiobjective models, to create arrays of solutions to land-use problems to facilitate the resolution of land-use conflicts (Armstrong, Densham, and Rushton 1986; Diamond and Wright 1988; Carver 1991; Densham 1991; Eastman, Kyem, and Toledano 1993; Kyem 2000). The questions we need to ask in light of widespread community-based GIS applications include the following: Are subjective human values amenable to influence from a GIS application? Do GIS applications produce desirable changes in interests and values that sustain a conflict? Can GIS be adopted to explore a conflict condition and prepare disputants for the creation of joint values? There are currently no agreed-upon answers to these questions. However, the indeterminate status of the technology's role in conflict mediation poses a challenge to rapid development of GIS for use in community-based organizations. The situation raises questions about whether the analyses and display of spatial data influence how communities digest and interpret information about local resources to reach decisions about land use. An investigation into how GIS contributes to conflict management is therefore critical at this period of rapid expansion in the implementation of PGIS projects in resource management institutions in local communities. This study could highlight the strengths and/or limitations of GIS applications in conflict management and create an opportunity for fruitful discussions about the future of community-based GIS applications.

Values, Interests, and Conflict Management

A conflict is a disagreement that ensues from incompatible interests, values, or actions between individuals, groups, organizations, or nations (Deutsh 1977; Gray 1989; Moore 1996; Susskind and Field 1996). The incompatible elements can occur within individuals, between groups, or between nations. The disagreement can also occur in a cooperative or a competitive context[2] such as when incompatible interests or values[3] develop between two or more persons, groups, or nations. The interests that sustain a conflict are generally reflected in the needs, desires, concerns, and even fears that underlie the positions parties take in a dispute (Coser 1967; Deutsch 1977; Moore 1996; Susskind 1999). For example, when a group protests against logging, several interests will be at the core of their position. Such interests might include a concern for land degradation or a desire to preserve wildlife and protect local resources. Unlike interests, values are types of beliefs that dictate standards that guide human action in society and serve also as the basis for judgment, opinion, and behavior (Forrester 1987; Northrup 1989; Moore 1996; Susskind and Field 1996). Values refer to issues such as the sacredness of land or the sanctity of human life. Interests are about what people want (e.g. material goods), but values relate to what they care most about (e.g. human life, religious beliefs) (Northrup 1989; Forrester 1999; Susskind 1999). In view of the fact that values are inherently personal and subjective, they are believed to be difficult to change by persuasive arguments. This belief seems to have generated skepticism about the potential of dealing with conflicts in values. Value differences are serious, but Forrester (1999) contends that the rhetoric about deep fundamental differences makes it less possible that mediators will even attempt to reconcile conflicting values. The author explains that

> the more we mystify value differences as ultimately personal, subjective, irrational, or spiritual, the more we pull the wool over our own eyes and simply fail to appreciate or understand those differences. The more we presume that values are so subjective that they are virtually undiscussable, the less likely we will even try to discuss them. The more our own rhetoric of deep and fundamental value differences presumes unbridgeable chasms between those who hold differing values, the more likely we will be to wring our hands and the less likely we will be to look for practical ways to live together, honoring rather than fearing, shunning, or obfuscating our real value differences.
>
> —(Forrester, 1999, 464)

Continuing, Forrester explains that public skepticism feeds into the belief that parties who agree to negotiate over values open themselves up to be pressured to compromise their principles and betray their commitments. Under such conditions, he argued, "the neutrality of mediators" or their strategies are doubted because consensus is viewed as "induced betrayal" (Forrester 1999, 466). Consequently, when values are at stake, a GIS

application might not begin with public confidence but amid suspicion and skepticism. The point here is that value irreconcilability can be real, but as Forrester has explained, such a conclusion must be discovered through real mediating efforts and not be based on presumptions. In the section that follows, I discuss theories that form the basis of contradictory claims about GIS applications in conflict management.

Max Weber on Instrumental Rational Behavior and Conflict Resolution

Writing about instrumental rational behavior, Max Weber (1968) argued that society is composed of multiple, competing, and often irreconcilable values that cannot be rationally grounded. Weber challenged claims about objective reality on which parties in a conflict reach agreements over conflicts in values. He explained that competition and conflict occur in the sphere of power and not of reason, and, as such, the legitimacy of a claim does not lie in a rational justification, but a de facto acceptance of an order of authority (247). According to Weber, rational arguments might succeed in eliminating superstitions, errors, and prejudices, but they cannot replace traditional religious beliefs and values that form the basis of individual behavior. He maintained that rational exchange is possible when individuals are expected to benefit from it or when they are compelled to do so by some "recognized economic power" (246). Weber distinguished a value-rational action from affectual behavior. He described affectual behavior as desires, intentions, and interests determined by an individual's specific affects and emotions. Continuing, Weber declared that affectual behavior is tied to language and culture and is therefore inherently susceptible of "interpretative discussion and change" (32). On the contrary, he described value-rational actions as behavior that is rooted in strongly held beliefs, moral, and ethical principles that cannot be easily reconciled (31–32). He therefore concluded that arguments based on values are "ends rational" because individuals cannot be swayed from such beliefs (246).

Drawing inferences from Weber's argument, Obermeyer and Pinto (1994, 169, 181) observed that disputes over land use are sustained by value conflicts that generate emotions that are not easily influenced by objective analysis of spatial data. The authors explained that if parties to a conflict were presented with the same data, they would often interpret it to reach different conclusions. The different spins that opposing parties put on research findings in support of their long-held beliefs is said to be a manifestation of the varying interpretations of data. Accordingly, the authors concluded that "all forms of data are only as useful as their interpretation" (179) and, as a result, increased availability of geographic data would elevate rather than lower the level of a dispute. Ultimately, they argued, the conflict would level off but at a higher level of intensity than previously existed (180). Berry (1995) reached a similar conclusion and argued that computational solutions to conflicts over land use are not possible because the disagreements are driven by conflicts in facts and irreconcilable values. Weber's explanation of individual rational behavior and subsequent interpretations linking GIS to conflict management raise several questions: Are conflicts driven entirely by competition and self-interests, or do the desires of individuals (i.e., not to disrupt a long-term relationship) enter into the complex decisions disputants make during a conflict? Is a rational behavior grounded in information that is available to an individual? If it is, can skillful applications of a data-driven technology such as GIS influence disputants' decisions about conflicts? Answers to these questions are explored below in a discussion of Weber's ideas about instrumental rational behavior and conflict resolution.

Some Omissions in Weber's Explanation

Weber's explanation of instrumental rational behavior and how it relates to the resolution of conflicts in society is, for most part, clear and convincing. Some of the persuasive arguments include: (1) analysis of the role of emotion in human behavior, including the distinction between spontaneous emotion that short-circuits rationality and more durable emotions that can harness instrumental rationality; (2) discussion of ways by which human behavior can be guided by (a) adherence to a value, (b) anticipation of disapproval caused by deviation from social norms, and (c) anticipation of practical inconvenience caused by deviating from social norms; and finally, (3) recognition of the role of emotions, notably shame, as a regulating social norm. However, Weber's ideas are set in a specific historical time frame and a context that involves experiences other than what we know today. First, Elster (2000) has argued that Weber does not integrate his analysis of rational action with the analysis of rational belief formation and information acquisition. Weber did not explicitly confront the issue that since the rationality of a behavior depends upon the soundness of the beliefs upon which the action is based, a theory of rational behavior must necessarily include "a theory of rational belief formation and of optimal information acquisition" (39). If belief formation requires information acquisition (which, I will argue, it does), then innovative applications of GIS might be able to influence decisions

that are based on those beliefs. This aside, Elster has criticized Weber on the grounds that he did not explain whether the cognitive assumption that underlies a rational behavior is rational or irrational. According to Mackie (1996), when parties become involved in a conflict, they often find themselves in a belief trap that they cannot revise because of the conviction that the cost of testing the belief or reversing it would be too high. From that standpoint, Mackie explains, the false belief becomes rational and would then be used to encourage behavior that prolongs the value-rational conflict. Thus, an individual's behavior may not always be prompted by instrumental rationality: self-interest.

Second, Weber seems to substitute a customary behavior with a tradition when he defines the latter as an "almost automatic reaction to habitual stimuli which guides behavior in a course which has been repeatedly followed" (26). Weber's neglect of the impact of social institutions on an individual's rational behavior is reflected in his explanation of how convention transforms custom into a tradition. He argues that "it is by way of conventional rules that merely factual irregularities of action (i.e., customs) are frequently transformed into binding norms guaranteed primarily by psychological coercion" (29). It is Weber's belief that "custom is devoid of any external sanction . . . conformity with it is not demanded by anybody" (29). On the other hand, he acknowledges that social sanctions could influence human behavior. He contends that an individual who does not adapt to a custom is subject to social control mechanisms including: (1) both petty and major inconveniences and (2) annoyances (30). In fact, what Weber calls conventions are what modern sociologists describe as norms that guide, control, and regulate acceptable behavior in a society. We are aware today that customs differ from conventions because any deviation from custom triggers expressions of disapproval and sanctions rather than inconveniences and annoyances. If conventions and traditions are maintained by disapproval of practical inconveniences because of deviation, then it can be expected that those same behavior-control mechanisms will be assimilated into instrumental rationality. The sanctions can then become the source of pressure that will influence an individual's behavior during a conflict.

Third, Weber claimed that "action is affectual if it satisfies a need for revenge, sensual gratification, devotion, contemplative bliss or for working off emotional tensions" (25). He maintained that affectual behavior and a value-rational action have a common element because the meaning of any such actions does not lie in the achievement of a result ulterior to it, but "in carrying out the action for its own sake" (25). In spite of this, Weber distinguished a value-rational action from an affectual behavior by claiming that the former is exemplified by its "clearly self-conscious formulation of the ultimate values governing action and the consistently planned orientation of its detailed course to these values" (25). It is necessary to point out that while the emotional (affectual) person may ignore the cost of a risky action in the passion of the moment, the value-rational person may be fully aware of the cost and consequences but might not let them affect his decision. Besides, some actions such as revenge contain elements of both affectual and value rationality. Consider the case of an individual who is angry and seeks retaliation. For such an aggrieved person, an emotionally charged revenge behavior is affectual, but such an action is often carried out with great tactical and strategic skill and hence is instrumental rational as well. Consequently, an individual's behavior in a value-rational conflict may not depend entirely on instrumental rationality but can be determined by several factors including self-interest, group expectations, and tactical considerations.

Finally, in Weber's arguments and indeed in many of the inferences that ensue from his explanation, attempts are made to pull apart the desires and beliefs that sustain a conflict. However, several social actions are prompted not by independent psychological elements but by a combination of affective, cognitive, and value-rational mechanisms (Rokeach 1975). It would be unusual (although not impossible) to find concrete cases of social action that were oriented entirely in one of affective, cognitive, or value-rational domains. For example, among the Akans of Southern Ghana, among whom the case study explained later in this article was conducted, a forest is an abode for spirits and ancestors that protect the communities (Rattray 1923; Pugocki 1968; Agyeman 1993). However, the forest also contains trees, and other nontimber products that provide sources of income and economic activity for the people. Among the Akans therefore, both the economic interests in resource use and beliefs about the sanctity of a forest converge on the exploitation of resources. Conflicts arising from competition for access to local forest resources are, therefore, conflicts over interests (economic) as well as values (sanctity of land). With such collusion between interests and values, it will not be surprising that disputants will not always be clear about specific psychological elements that sustain a conflict. In fact, Northrup (1989) has observed that often in conflicts over values, original causes become entangled with derivative issues that are not directly connected to the issue that caused the conflict. It may therefore be possible to use a strategy that can help stakeholders to avoid the distraction of derivative issues and focus attention on

actual causes of the conflict to prepare disputants for the resolution of value conflicts.

Habermas's Communication Theory and Conflict Resolution

Unlike Weber, who believed the move to reach agreements in a conflict is motivated by self-interests, Habermas argued that cooperation is an important goal among rational individuals in a society. In his thesis on communicative action, Habermas (1984, 1987) viewed society as a self-regulating system in which human actions are coordinated through functional interconnections geared at maintaining order and harmony. He explained that rational and goal-directed individuals use communication to effectively engage in cooperative processes. According to Habermas, "It is possible to reach agreement about disputed claims by way of argument and insight and without recourse to force other than that of reasons and grounds [that provide] a reflexive medium for dealing with problematic validity claims" (Habermas 1984, 17). Habermas saw communication as an effective tool in conflict management because, he wrote, the process allows disputants to incorporate their opponents' interpretation of the conflict into their own in such a way that "the divergent situation definitions can be brought to coincide sufficiently" (Habermas 1984, 100). Habermas said that such discussions do not occur without reference to underlying values because one cannot understand an opponent's response or claim if he or she is not aware of the reasons why the opponent is making those claims. However, by following the deliberations and responding to claims, the individual becomes involved in the process (115–116). Accordingly, Habermas argued that because validity claims (reasons and grounds) can be criticized and defended, there is the possibility that disputants can identify and correct their mistakes and misunderstandings and learn from them to facilitate consensus building (Habermas 1984, 17). By choosing communication as the medium for coordinating actions that would lead to agreements, Habermas recognized language and other instruments of communication (including GIS) as critical for managing conflicts. We note in this regard that GIS has been adopted to facilitate communication between groups and integrate multiple perspectives and interests in land use (Sedogo and Groten 2000; Carver 1991; Eastman, Kyem, and Toledano 1993; Eastman, Toledano et al. 1993; Harris, Weiner, and Levin 1995). It follows from the above discussion that although the drive to claim rewards influences disputants' behavior in a conflict, social institutions (i.e., commitments and group expectations) also affect their attitudes in disputes. It was for this reason that Zartman (2000) argued that even if we discount the claim that social harmonization is a common characteristic of traditional societies (Gluckman 1965; Rose 1992) or the broader sociological thesis that social equilibrium is a universal characteristic of human societies (Parsons 1937), the fact remains that all human societies develop mechanisms to deal with conflict. The conflict mechanisms, which range from shared values, norms, and group expectations to sanctions imposed by formal social institutions (i.e. courts) are used to monitor human behavior and punish deviation. Gluckman (1956, 1965), and other scholars (Boahen 1973; Kouassi 2000; Uwazie 2000) have reported that conflict prevention and peace preservation efforts in many societies are interlaced with social relations including marriage and common membership of ethnic groups, businesses, and professional associations. For example, among the Akans of Ghana and the Yoruba of Nigeria, marriage is not only a union between a man, a woman, and their respective extended families, but the union is also conceived as a cooperative venture that fosters intergroup relations between communities (Rattray 1936; Gluckman 1956; Kouassi 2000; Uwazie 2000). The authors further explain that traditional rulers in the region use their common membership of clans and extended family ties to build relationships that transcend conflicts (Boahen 1973; Kouassi 2000). Those social networks also embody past successes in resolving conflicts that "serve as cultural templates for future conflict management efforts" (Hibbard and Lurie 2000, 188). Thus, when relationships are enduring, conflicting parties come under pressure to suppress their self-interests and find ways to live together. Consequently, if the GIS application appeals to values that are shared between disputants, it might be possible to alter adversarial relationships by validating the core identity of both parties. For example, by using a GIS to illustrate how a forest resource (e.g., timber) that is a source of conflict could be jeopardized by a prolonged conflict (e.g., by wildfire, poachers, and so on), a GIS expert might draw disputants closer together to think about creating joint gains that protect the resource in question. On the other hand, Uwazie (2000), has observed that even in societies where the tendency to seek cooperation in conflicts is very strong, individuals and social groups occasionally sacrifice long-term relationships and take extreme measures (e.g., summons in official courts) to compete for, or protect scarce resources. A case in point is the internal conflict that recently led to the destruction of human lives and property in Sierra Leone and Liberia in West Africa. In each case, the conflict ensued from competition for access to valuable but also scarce minerals (diamond and gold).

A Perspective on Conflict Resolution and GIS Applications

It is important to note that neither of the two theories that currently support the main approaches to conflict resolution provides a complete account of the mediation process. For example, Weber's explanation of instrumental rationality emphasizes benefits to individuals but assumes away the influence of social institutions, without which the rewards to individuals might not materialize. Weber also failed to realize how disputants can reach tactical agreements to avoid a conflict while also retaining some independent gains. His attempt to explain all social phenomena (including conflict resolution) in terms of rational behavior and self-interest removes any role for group expectations, relationships, and sanctions in mitigating cases to facilitate conflict resolution. There are circumstances (particularly, when the parties are involved in several mutual interactions) in which groups may find it necessary to make adjustments in their values to maintain a long-term relationship. It is often the case in mediation that an attempt to claim values and self-interest while ignoring the need to create joint gains leads to undesirable outcomes. In a similar way, Habermas's communication theory acknowledges the rationality of individuals and the potential for pursuing self-interests, but emphasizes collective action as the force behind social cohesion and harmony. Habermas also failed to anticipate a situation where intense competition resulting from scarcity of resources could compel rational beings to focus entirely on their own means of survival and hence pursue their self-interests. Given that individuals in a society do not have all the resources they need, and because resources are essential to human survival, there will always be some competition for existing resources. In competing for scarce resources, individuals and groups are often concerned with their own survival and, as such, their actions are prompted more by self-interest than the overall interest of society. It is necessary to point out that intense competition can create motives for strategic cooperation between disputants. For example, escalation in competition for scarce forest resources can exacerbate environmental turbulence and raise the level of risk in such a way that it that can be offset only by a negotiated agreement that minimizes self-interests (Gray 1989). Thus, although the need to protect relationships by cooperating to create joint values can be very strong among disputants in a sociopolitical system, there are instances where competition drives individuals to engage in actions with the sole aim of protecting their self-interests.

It is clear from the above discussion that the cooperative and competitive elements of a conflict are inextricably intertwined. It is therefore necessary for mediators to recognize the dual forces that drive the process. When conflict resolution is seen in this light, communication between disputants and, hence, GIS applications become necessary for negotiating joint values and facilitating the formation of strategic alliances that would lead help resolve disagreements. Under this perspective, GIS can be utilized to explore the expectations and fears of disputants (e.g., with maps showing threats—fire, poaching, floods, and so on to a resource in dispute) and emphasize their shared values and interests (e.g., mapping the locations of resources that are in dispute to show the spatial relationships between such features). Applications of the technology can focus on the impact of each party's demand on the other (i.e., produce a conflict map) and the design of different scenarios for allocating the resource in question between disputants (e.g., by changing variables that constitute the maps). It might be possible through such creative GIS applications to get the parties to agree on compromises that might resolve the conflict between them.

Types of Conflict and GIS Applications in Mediation

I have argued elsewhere that values can be altered, but it needs to be emphasized that the inflexibility of values that sustain a conflict depends upon several factors, including whether the disagreement occurs within or between sociopolitical systems. One cannot fully understand a conflict situation or deal effectively with it without understanding the context within which the conflict occurs. This is because the context provides knowledge that imbues human action with a meaning. It also provides background experiences upon which disputants evaluate their situations and decide to either curtail or prolong a conflict. A richer understanding of GIS's role in conflict management, therefore, requires familiarity with the type of conflict, that is, whether the disagreement occurs between parties located within the same or different sociopolitical systems.

Between-System and Within-System Conflicts

According to Zartman (2000, 7–9), *between-system conflicts* are disagreements that occur between individuals, organizations, or subgroups located in separate sociopolitical systems Figure 1a). The entities share few or no values in common and may not be engaged in intimate and long-term relationships. As a result, they may be less

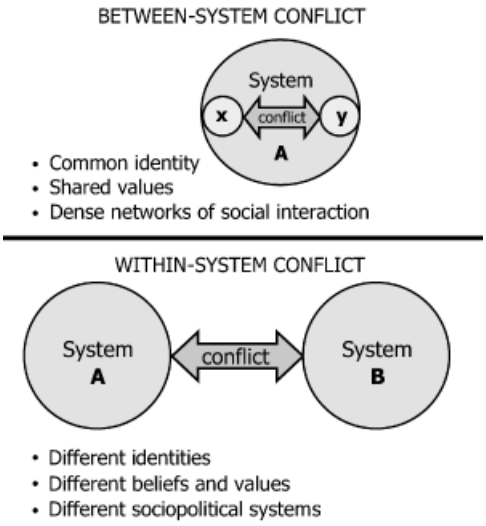


Figure 1. Types of conflict.

obliged to work toward the resolution of conflicts between them. Prolonging a conflict could even be a way of ascertaining the relative strengths of their antagonistic values. Accordingly, the competitive urge to protect independent values makes such between-system conflicts more difficult to resolve than conflicts that occur between parties within a sociopolitical system. This, and the fact that several between-system conflicts occur mainly over nonspatial issues (i.e., negotiating rights) renders GIS applications a poor setting for reconciling such contradictions. In disputes over forests, oceans, air, and space, disagreements arise mainly from the negotiation of rights to such resources. Between-system conflicts therefore require negotiation rather than mediation to resolve (Mastenbroek 1989; Druckman 1997).

In contrast, conflicts between individuals and groups within a sociopolitical system (*within-system conflicts*) occur amid a constellation of relationships and group expectations. This type of conflict (illustrated in Figure 1b) pits individuals, groups, or organizations within a community against each other. Within-system conflicts, such as occur among groups competing for scarce local resources, strain relationships within a community. Resolution of the conflict restores relationships and reinforces harmony and unity among the people. Conflict management strategies (including GIS) can therefore take advantage of referents in values and binding relationships to induce compliance, cooperation, or consensus by essentially calling the parties to order to preserve relationships and the community (Boahen 1973; Osaghae 2000; Kouassi 2000; Zartman 2000). Accordingly, several community-based GIS projects have been implemented in the context of within-system conflicts. For example, in South Africa, an integrative PGIS project involving the use of interviews, participatory workshops, transect walks, and Global Positioning System (GPS) boundary identification, has been conducted to incorporate local knowledge and integrate multiple and competing perspectives into land reforms that are occurring in the former apartheid state (Weiner, Harris, and Levin 1995; Harris and Weiner 1998, 2002). In another African example, Sedogo and Groten (2000) combined participatory methods with GIS to transform competing perspectives and conflicting interests of local groups in a Burkinabe village into a plan for managing local resources. In the cases above, GIS applications were essential in getting the parties to understand their problems, explore alternative solutions, and work together to realize joint gains.

In the context of within-system conflicts, some disagreements do not pose a direct threat to authority. Such disputes (termed *intergroup conflicts* and shown in Figure 2a) result from competition for scarce local resources, power, or recognition between individuals or groups located within a sociopolitical system. There are, however, some grievances within society that pitch individuals or groups against the status quo. Such conflicts (termed *against-system* conflicts and illustrated in Figure 2b) occur between groups in a community against part of or the complete sociopolitical structure (Zartman 2000). Of the two internal cases of disagreement, against-system conflicts are often viewed to be difficult to resolve because of the imbalances of power and resources between groups and the overall political authority. Notwithstanding this expectation, a large number of reported community-based GIS applications occur in the context of against-system conflicts. For example, GIS has been adopted to assist some Native American Indians of North America prepare counterclaims to their territories and ancestral lands

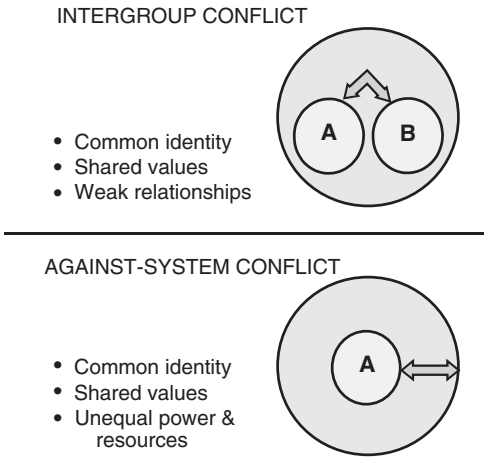
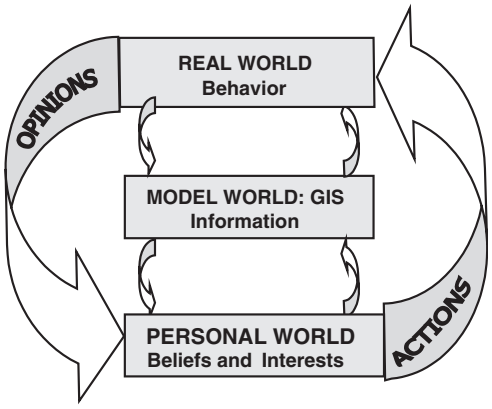


Figure 2. A subdivision of within-system conflicts.

(Beltgens 1995; Smith 1995) and to facilitate bottom-up transformation of existing political structures and public discourse (Arvello-Jimenez and Conn 1995; Forbes 1995). GIS is also the tool of choice for activism organized at local, national, and global scales (Sieber 2002; Stonich 2002; Tulloch 2002). Reporting on a case that is imbued with all the characteristics of against-system conflicts, Harwell (2000) revealed that in the aftermath of a 1998 forest fire in Indonesia, GIS became the medium in which competing accounts of the fire disaster were contested. He explained that using GIS and remote-sensing data, representatives of the country's peasant farmers retraced the origins of the fire to large plantation farms owned by companies supported by the state. The evidence enabled the farmers to challenge official interpretations that blamed them for starting the fire. By publicizing satellite images containing the evidence on the Internet, the farmers were able to bring pressure to bear on the Indonesian government to concede the veracity of the technological proof. In the end, the government was compelled to join the farmers in prosecuting the offending companies. This was a case where GIS application provided the medium for reforming the way discourse about forest degradation was handled in the country. The remote-sensing and GIS data might have contributed to the controversy, but the technologies later became the source of verification of truth that brought an end to the conflict. Together, these applications suggest that creative applications of GIS can play a beneficial role in reconciling seemingly intractable disagreements over values that occur between groups within a sociopolitical system.

GIS and Belief Formation

The type of conflict aside, GIS's role in conflict management ensues from the impact that the applications exert on belief formation. The basic structure of an individual's belief formation and the role GIS can play in the process are presented in Figure 3. The model rests on the assumptions that (1) an individual's action or behavior is rational for it best satisfies his or her desires and beliefs and (2) the belief itself is grounded in information. As explained earlier, an individual's rational behavior depends upon the clarity of the beliefs from which the actions are derived. There are occasions when gathering too much information before reaching a decision can be dangerous (e.g., a rescuer requesting detailed description of a drowning boy before embarking on the mission to save him), but it would be irrational not to invest in any information before deciding on an issue that is of utmost interest to



Modified after Shepherd, 1994, 358

Figure 3. GIS and information interchange between personal and the real worlds.

oneself (e.g., choosing a college to attend). A rational belief formation therefore depends on information acquisition (Elster 2000). In Figure 3, the information requirement for belief formation is fulfilled by GIS. It can be inferred from the figure that the production and analysis of data that relates directly to some value or interest could exert an influence on the belief itself. For example, if a GIS application reveals conditions that affect the physical and ideologically determined comfort and safety levels of stakeholders (as conditioned by regular consumption of a resource that is now in dispute), the parties would respond to the situation in an attempt to protect or maintain their levels of consumption and welfare. Again, stakeholders would respond if through effective data analyses, the GIS expert convinces them that a desired response might jeopardize their interests or enhance their fundamental values. In these cases, the GIS application would become the source of motivation for the change in stakeholders' positions.

Again, as the illustration shows, beliefs and desires (or values and interests) embody behavioral elements because they lead to action when we activate them. According to Fishbein and Ajzen (1975), values provide guides to the formation of beliefs and desires that are then expressed externally as opinions, behavior, and actions. Values arise from the resolution of the challenges presented to a group by their unique and particular situations (Freud 1964). As well, they serve as guides to human attitudes, which Rokeach (1975, 175) describes as "the enduring organizations of beliefs around an object or situation that predisposes an individual to respond in some preferential way." According to Rokeach, the attitudes that emanate from a value attempt to render the world more comprehensible and psychically comfortable for the

individual. Consequently, a group might hold on to their values or find ways to rationalize and justify them so they would feel secure and comfortable in their decisions and actions (Fishbein and Ajzen 1975; Rokeach 1975). But do values that underlie an individual's behavior in a conflict undergo changes? I believe they do because compelling situations (i.e., wars, natural catastrophes, or even persistent mistakes) often challenge individuals and society in general to reevaluate their views and update their values and beliefs accordingly. Attitudes maintain strong links with human actions because they create a state of mind that propels individuals to move beyond a belief that a goal or an object is desirable into active engagement of the mind to respond to that object (in the form of actions, expressed opinions, etc.) to achieve the perceived goal (Rokeach 1975). As shown in the figure, an opinion is the bridge between the personal world of beliefs and desires and the external world of behavior and actions. Expressed opinions are overt behaviors that reflect an individual's attitudes (Smith 1975) and hence the values they hold and treasure. An opinion therefore provides a window to the core of an individual's beliefs and desires (or values and interests). Consider a mediation process where parties represent the objects in dispute on maps or speak about the objects contained in GIS maps prepared for the discussions. In these instances, the parties would be making decisions that are influenced by values which dictate their positions in the conflict. Questioning stakeholders' opinions about conditions represented in the maps therefore taps into their beliefs and can consequently reveal the values underlying the positions they have taken. By engaging disputants in such open discussions of issues that sustain a conflict, a GIS expert might succeed in revealing the real motives that drive the dispute. The information could then be utilized to design applications that would help the parties understand the conflict in new ways and prepare them for consensus building. In the remainder of the article, I describe how GIS was adopted to facilitate the management of an intergroup conflict between parties competing for access to local forest resources in a community in Southern Ghana.

Case Study: Managing a Conflict over Forest Resource Allocation with a GIS

Background to the Conflict

While implementing PGIS projects in Southern Ghana, this author and a team of local foresters were confronted with a dispute that threatened peace and tranquility among the people of Kofiase in the Mampong Administrative District of the Ashanti Region of Ghana. The dispute began when some inhabitants of the town raised objections to an attempt by a lumbering company to log a local forest (Aboma Forest Reserve) that had already been severely damaged by wildfire. Sustained opposition to the logging caused a rift between several inhabitants of the town who were against the logging and those that supported the venture. The supporters felt the logging would create jobs for them, while their opponents chose to preserve the remaining forest and thereby protect the nontimber forest resources (i.e., water from streams, materials for handicrafts, and building materials) the inhabitants obtained from the forest.[4] Realizing that the dispute would hinder our efforts to forge collaboration between foresters and the inhabitants, we invited representatives of the two groups to attempt a management of the conflict with GIS.[5] In managing the ensuing conflict, we treated the demand from each group as a single-objective, multiple-criteria problem, after which the results of the single-objective solutions were used to determine areas of conflicting claims in need of a compromise solution. The GIS procedures that have been explained in earlier reports (see Kyem 2000, 2002) are summarized below:

- Meetings were held with the parties to understand their concerns and learn about their demands. Those participants who sought to preserve the remaining forest and thereby protect some resources requested about 400 hectares of the 4,566 hectare forest while the loggers requested 350 hectares.
- The two parties were assisted to identify relevant criteria (*continuous factors and constraints*) that were later used to determine the suitability of each party's demand (objective).
- The factors were scaled to a standardized range (0–255) to allow for their comparison, and a set of weights was developed to express the relative importance of the factors to the objectives under consideration.
- The criteria were then combined by means of a weighted linear combination method (Voogd 1983) and subsequently masked by each of the boolean constraints, in turn using an MCE module in the Idrisi for Windows GIS used for the study. This resulted in separate suitability maps for both logging and preservation.
- Thereafter, each suitability map was ranked and a quantity of the top-ranked cells were selected to meet areal targets demanded by the parties.

Exploring Values, Interests, and Spatial Dimensions of the Conflict

The zone of maximum suitability in both maps converged at the southwestern portion of the forest. The suitability maps thus illustrated the conflicting nature of the groups' demands. Explaining such a conflict, Eastman, Kyem, and Toledano (1993) have assumed a decision space where two objectives form opposite axes. This allows for criterion scores in the two suitability maps to be allocated according to their objective scales (0–255). Dividing up the decision space among the two objectives is equivalent to moving a perpendicular decision line down from the position of maximum suitability until enough cells are captured to make up the areal goals for each objective. With two objectives (logging and preservation), the decision lines clearly delineate four regions as shown in Figure 4. These include:

1. An area selected for objective 1 (logging) only and hence nonconflicting
2. An area selected for objective 2 only (preservation) and hence nonconflicting
3. A sizeable area not selected for either logging or preservation (unsuitable choices)
4. An area selected by both objectives 1 and 2 and hence in dispute (conflict zone)

Based on the above illustration, we cross-classified the two ranked suitability maps of the Aboma Forest to create a conflict map (shown in Figure 5). In the map, areas in the forest that were not in dispute were separated from those areas that were jointly demanded by both parties. The map also revealed a large portion of the forest that was either out of the competition loop or unsuitable for the activities under consideration and, as such, not vital to the dispute. The interests of the parties overlapped at the southwest where timber, as well as many nontimber forest products

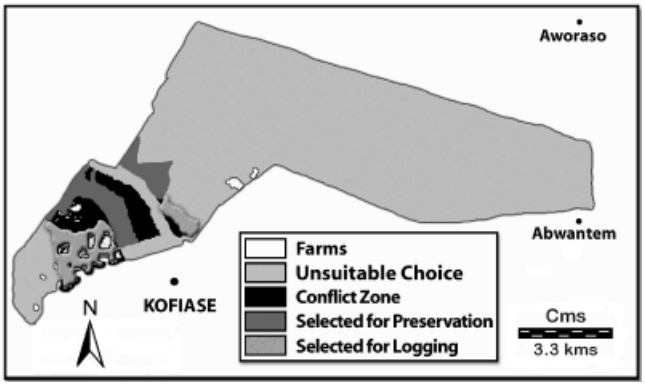


Figure 5. Aboma Forest Reserve: A conflict map for logging and forest preservation.

had been protected from the annual wildfire that had destroyed much of the Aboma Forest. We led the groups into the forest to verify the allocations shown in the conflict map and also to take stock of resources that were available at the conflict zone. The conflict map was then used to shift the focus of discussions away from strong philosophical positions onto actual conditions in the forest that sustained the conflict. Finally, the two ranked suitability maps were input into the GIS and a multi-objective land-allocation procedure in the GIS (MOLA) was used to resolve conflicting cells (Eastman 1993). In the process, the top-ranked cells in each suitability map were allocated until area targets for the two objectives were attained. This process is illustrated in Figure 6, and the accompanying final allocation map appears in Figure 7. The final map was accepted by participants who supported logging, but the inhabitants of Kofiase who chose preservation were divided on the results. After realizing the degraded state of the forest from evidence they gleaned from GIS maps and field visits, some members of the latter group insisted on preserving the remaining forest. Our efforts did not therefore result in the immediate resolution of the conflict. The ultimate result

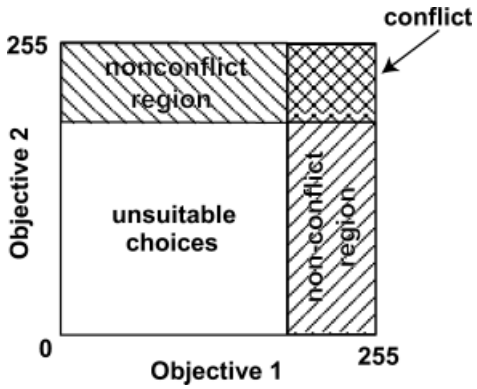


Figure 4. Distribution of conflicting objectives in a multidimensional decision space.

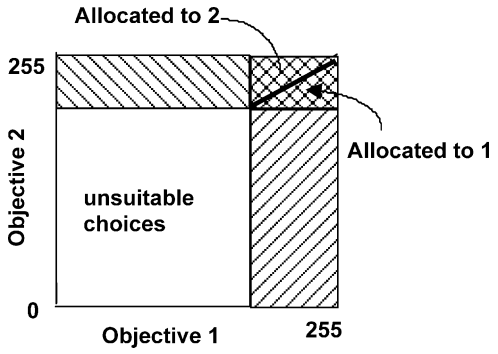


Figure 6. Allocation of conflicting cells in a multidimensional decision space.

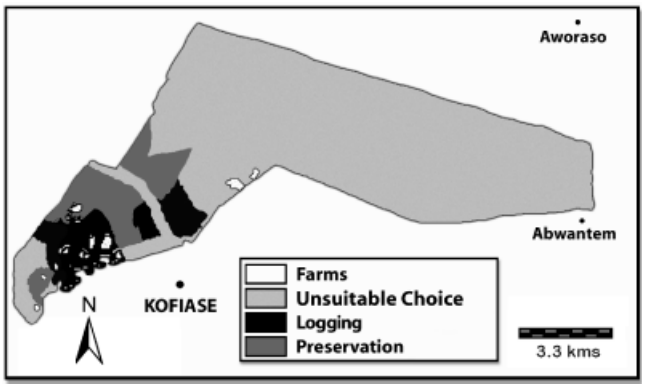


Figure 7. Aboma Forest Reserve: Final allocation between logging and forest preservation.

of the mediation effort was attained several weeks after the PGIS project. At a meeting with the chief and elders of the town, the two parties agreed to a negotiated compromise solution that limited logging to confined areas within the conflict zone shown on Figure 5.

Discussion of Results

The Ghanaian case study and others reviewed in this article reveal that GIS applications in conflict mediation occur amidst a complex set of contextual factors. Some of the factors are competitive in nature, while others are rooted in institutions including norms, sanctions, and customary practices in society. All such factors are important in determining the outcome of a mediation process.

Competitive Forces

Competitive forces that are derived from self-interest behavior of stakeholders tend to foster a zero-sum game which leads to individual advantage in a conflict (Rubin and Brown 1975). However, competition can either become a driving or a restraining force in conflict resolution (Whetten 1975; Gray 1985). For example, in cases such as the conflict at Kofiase which involved competition for scarce forest resources, or in conflicts that involve resources deemed to be of very high value (e.g., diamonds, gold, and so on), collaboration is difficult to attain even among members of a close-knit family (Whetten and Gray 1984). Yet, competition can facilitate cooperation, such as when disputants find a need to resolve a conflict for the sole tactical reason of dealing with a common threat. For example, at some point during the Kofiase project, the two parties realized that prolonging the conflict could cause them to lose the forest resources that sustained the conflict to wildfire[6] that swept through the area annually. Some participants later revealed that the possibility of losing the forest to wildfire was a major factor in their decisions to accept a compromise solution. The nature of the object in dispute was equally important in participants's decision to curtail or prolong the conflict. Conflicts over life-supporting resources (i.e., forest resources and fertile farm lands in farming communities such as Kofiase) are often sustained by concerns for survival and, hence, values and interests over which there might be little room for trade-off and compromise. In such cases, competition can drive disputants to hold on to their positions in the way the inhabitants of Kofiase prolonged the dispute for over three years[7] to protect the means of their livelihoods. The combination of social networks and shared norms of trust and reciprocity, however, created a conducive environment for civic engagement (Moemeka 1998) that finally helped the parties to reach a compromise solution.

Institutional Demands

In contrast to competitive forces, institutional factors that drive a conflict resolution are characterized by elaborate rules of behavior to which individual members of society must conform. The institutional factors, including a web of social networks, customary practices, and group expectation, are often developed with little reference to individual self-interests but they apply in relatively similar ways across all members of a socio-political system. Pressure from these institutions can either stimulate or impede conflict resolution. Consider again the scarce resource situation experienced at Kofiase where benefits to one group could have come at the expense of the other group. In such a case, perceived gains to one group mean a loss to the other, and this could arouse resentment and deepen antagonism. Other social institutions impose impediments on conflict that include historical, cultural, political, and legal disincentives (Gray 1989). As we noted earlier in the Kofiase case study, the advice and exhortation from the local chief and heads of various clans in the community played a significant role in getting the parties to agree on the compromise solution. Additionally, pressure from government officials and even concerns about rapid degradation of tropical forests expressed remotely by international bodies such as the World Bank added to the urgency to resolve the dispute and protect the local forest reserve. Besides, the parties in the Kofiase study were engaged in long-lasting relationships including intermarriages, common memberships of clans, allegiance to a common authority (the local chief) and a long history of cooperation between them. The dense network of social interaction between the groups embodied past experiences with conflicts that could have served as cultural templates for the resolution of the dispute.

The Timing of the GIS Application

Social interactions are initiated by motives, but with the passing of time, the interactions generate new motives and also alter existing ones (Deutsch 1977). As a product of social interaction, conflicts develop and change over time. These changes exert a significant influence on the outcome of the mediation process (Moore 1996). There are times when some parties need to develop some basis of power (prior to the mediation) to assert their influence during the process. Such power is developed in a number of ways, including legal challenges, grassroots political organization, and the use of negative or disruptive tactics. It might even be necessary not to initiate the mediation process until after the development of intense emotions. Thus, if the GIS application is injected into the dispute in its early stages prior to the development of power or intense emotions, the approach might fail to prepare disputants for the resolution of the conflict. According to Cormick (1982, 5) an "early intervention that promises a mutually derived outcome could inhibit the development of sufficient power to ensure true mutuality" and equal participation. The timing of a GIS application, and for that matter, any mediation strategy, is therefore critical for a successful outcome. An equally important but often underplayed factor in conflict resolution is the fact that the institutional and competitive forces that create the context for a conflict often change over the lifetime of the dispute. In the course of time, the driving forces of the conflict can either subside with new information and a deeper understanding or they can turn into forces that restrain cooperation. Again, the influence of contextual forces can shift, and even the environmental context itself can change over time. These changes in contextual factors could either lead to strengthening positions that sustain the conflict or to undermining and weakening positions taken by the disputants, as they did with threats to the forest from wildfires in the Kofiase case study.

An Appraisal of GIS's Role in Conflict Management

Potential Negative Influences of the GIS Applications

Amid the enthusiasm that often accompanies PGIS applications, there is a need for caution about the limitations of GIS applications in conflict management. Far from being a perfect interventionist strategy, GIS applications in mediation are subject to several restraining conditions. For example, among groups with unequal experience and familiarity with computers such as we encountered at Kofiase, GIS can restrict fair and open discussions through the technology's ability to cause selective participation due to the competency requirements it imposes on users (Hogson and Shroeder 2002; King 2000). In addition, the narrowing of discussion and evidence in dispute mediation to analyses of spatial data reinforces the hegemonic position of technological devices that might not be equally available to all concerned parties (Harwell 2000). Consequently, if the conflict management process is based entirely on GIS applications, it is possible that some voices could be filtered out, the individual experiences of certain groups could be ignored, and alternative representations might be excluded from the discussions. This is irrespective of the fact that all such representations might be vital to the resolution of the conflict. In addition, GIS applications might not by themselves ensure a fair, participatory, or deliberative mediation process (Ozawa 1999; King 2000; Hogson and Shroeder 2002). Our experience from the Kofiase project reveals that participation does not happen by chance. There is a need for the GIS expert to make a concerted effort to ensure equal participation at all times during the mediation process. One reason for this could be that GIS applications occur within existing power structures (Kosek 1998), and the injection of the technology into the mediation process does not automatically change the dynamics of power relations between disputants. Short of a conscious effort to ensure equal participation, those participants who have prior knowledge of the conflict situation, those with some experience of spatial data analysis, or those close to positions of power would dominate the discussion and alter the results. Furthermore, Harwell (2000) has noted that GIS applications might not necessarily lead to the resolution of conflicts by virtue of stakeholders' connections with intersubjective recognition based on insights from spatial data. GIS models, she argues, are abstractions of reality that might represent a simplified and inaccurate form of the natural conditions that sustain a conflict. The models could highlight some data (e.g., land use) and omit others (such as external pressure) entirely. In addition, the powerful appeal of the technology, particularly the production of brightly colored and professional-looking maps, could distract stakeholders' attention and obscure, rather than illuminate, the true basis of their decisions.

Positive Contributions of the GIS Applications

The problems with GIS applications might not limit the potential and proven capabilities of the technology to be appropriated for the management of land use conflicts.

Kwan (2002), for example, has argued that the open nature of GIS software allows possibilities for alleviating some of its limitations. More than anything else, the noted shortcomings of GIS applications call for vigilance, resourcefulness, and innovation whenever the technology is used in a local community. For example, the provision of geographic data could lead to more disputes within a community, but, as already noted in this article, disagreements that result from divergent interpretations of GIS data need not follow a negative course. In the Indonesian example, the technology was the battleground as well as the medium in which the different viewpoints competed and the differences were resolved. We also noted in the Ghanaian case study that innovative visual representations of the conflict condition in map displays allowed the parties to focus a bit less on contesting one another's claims and to concentrate on a fresh source of ideas, specific concerns, and issues needing attention at the moment. The GIS applications promoted a search for evidence to substantiate opinions, allegations, and accusations. This evidential requirement reduced reliance on speculation, and as a result, factual considerations formed the basis for reaching final decisions. Ultimately, it was ideas rather than proponents of those views that became the objects of discussion in the Kofiase case study. With the maps and other data serving as points of reference in the discussions, the expression of dissenting views was directed more toward the search for evidence (contained in maps and other GIS products), than it was to persons to whom opposition was intended. This helped to reduce direct confrontation among the parties. The applications also provided opportunities for the parties to jointly collect and analyze data, share resources, and exchange ideas about the local forest. The joint visits to sites and joint participation in GIS exercises created conditions that encouraged stakeholders to develop trusts, cordial relations, and friendships. Such coalitions later became the building blocks for collaboration and the foundation upon which the final compromise solution was based. In addition, the technology equipped us (GIS experts) with the capability to draw links between subjective values that triggered and sustained the conflict and the external conditions about the conflict. A computer screen projection of maps showing resources in the Aboma forest that sustained the conflict created a common focal point for discussions. With their eyes fixed at the screen, the participants became physically as well as mentally engaged in the discussions. We were therefore able, through such effective map representations, to bridge perception gaps between the parties and facilitate common interpretation of events. This paved the way for mutual understanding of the issues that confronted the parties. The GIS application had an added advantage of providing a record of the discussions that we could conveniently replicate, store, print, and share with all participants. These examples show that if the provision of spatial data is well organized and the data is effectively utilized in the mediation process, GIS applications can lead to a deeper understanding of the conflict situation and thereby help prepare disputants for compromise.

Furthermore, raising of the level of conflict with the provision and analysis of spatial data might not always signify a failure of an application. In research on collaborative decision making, Janowski and Nyerges (2001) reported that a low level of conflict often characterizes the exploratory phase of a group decision making process. The authors revealed that the intensity of disagreements grows during the analytical phase when maps are employed to explain conditions underlying the problem at hand. One might conclude that the increase in the conflict level noted at the analytical phase of the discussion is suggestive of the impact of spatial data analyses and the intense discussion of issues directly related to the problem. For example, in a single graphic, participants in the Kofiase case study were able to see the spatial relationships between land use patterns, degraded portions of the forest, and the location of resources involved in the dispute. Facilitating the mediation process with GIS applications could therefore raise stakeholders' awareness of the conflict situation and drive home the real import of the choices the parties make to either escalate or resolve the conflict. According to Bolan (1967), the outcome of mediation depends upon how best a conciliator or a technique highlights or obscures the subtle value choices stakeholders make during the process. This, he explained, is because stakeholders understand the true choices they face in a dispute settlement only when "the values underlying the conflict are explored" and brought to bear upon the decisions the parties make during mediation (236). The coincidence of intensified conflict level with the analytical phase of a collaborative decision-making process (observed by Janowski and Nyerges) could therefore mark the break point in the dispute resolution and hence be a necessary part of the progress toward final resolution of a conflict. Besides, conflicts are often the root of personal and social change (Coser 1967; Deutsch 1977; Moore 1996), and the increased adoption of GIS in against-system conflicts, for example, could help communities adjust to norms consistent with changing relationships between them. For example, by permitting direct expression of rival claims, as happened in the Indonesian case, GIS applications can offer opportunities to loosely structured communities to stabilize and become integrated by identifying

and eliminating the source of discontent. Again, a GIS-induced conflict might even be the precondition needed to motivate disputants to engage in cooperative resolution of long-held differences. For example, Indonesian state officials were unresponsive to concerns of the dissatisfied but powerless farmers until they utilized GIS and remote-sensing data to challenge and compel government officials to concede to their interpretation of the fire. PGIS applications can therefore provide the medium for nurturing and transforming local struggles into national debates to draw attention to community concerns. One hopes that the proliferation and ultimate coalescing of such PGIS projects would catalyze political pressure that might encourage leaders to attend to the needs of underprivileged groups in society.

Conclusion

In this article, I have argued that neither Weber's explanation of instrumental rational behavior nor Habermas's theory of communication adequately explains the dynamics of the conflict-resolution process. I have explained that GIS applications do not occur in a vacuum but amid a complex set of forces and institutions, all of which come into play to determine the outcome of a mediation process. Conflict resolution, therefore, involves crucial and unavoidable links between the cooperative move to create values jointly and the competitive push to gain independent advantage. This approach to conflict resolution creates opportunities for the adoption of GIS to explore the conflict situation and prepare disputants for a better understanding of the conflict, search for common interests, delve into common concerns, and facilitate the creation of joint gains. However, it is important to recognize that GIS application is limited to issues that exhibit a spatial dimension and, as such, the technology remains a poor medium for resolving ideological conflicts that are usually sustained by values. Accordingly, failure to resolve a value-rational conflict with a GIS could be due to factors other than the irreconcilability of values that sustain the disagreement. It could be that the issues involved in the conflict lack a spatial component or that the GIS application might occur amidst intense suspicion, skepticism, and distrust. The spatial limitation of GIS, coupled with the impact of institutional demands on human behavior and other factors, make it feasible for GIS to be more effectively applied to manage within-system conflicts than disagreements that occur between individuals and groups located in different sociopolitical systems. Furthermore, although the supply of data through GIS applications might lead to an increase in land use conflicts, I have made it clear in this article that, given certain conditions (i.e., common beliefs in the data and evidence produced with GIS), the technology could become the medium through which such conflicts might be resolved. The study confirms the claim that without an effective analysis of data to provide guides to decision making, available information would be interpreted by disputants to confirm their preexisting beliefs. In fact, undertaking to resolve conflicts through GIS applications requires that stakeholders do not become mere consumers of information. The parties must be involved in the collection, processing, and uses of the data to create a congenial atmosphere for a dialogue that could lead to the resolution of disputes. Passing on information makes no distinction between providing raw facts and figures about an issue (what Moemeka 2000, 12, calls "the talking-to model") and exchanging ideas about the problem (termed "the talking-with model"). Without joint processing of the GIS data, the active participation of stakeholders, and effective uses of opportunities offered by local contextual factors, the GIS applications cannot create conditions needed for successful resolution of conflicts in land use.

Notes

1. A survey of the current GIS literature reveals the following additional terms used to describe community-based GIS Applications: Public Participation GIS (PPGIS), Participatory GIS (PGIS), Community Integrated GIS (CIGIS) and recently, Participatory 3-Dimensional Modeling (P3DM).
2. The terms "competition" and "conflict" are often used interchangeably to describe conflicts, but competition and conflict are not synonymous. Competition produces conflict but not all conflicts reflect competition. According to Deutsch (1977), competition implies opposition in the goals of disputants such that the chance of one party attaining its goal reduces the probability for the other party. In conflicts dominated by competition between disputants, the incompatible actions that cause the dispute reflect incompatible goals. On the other hand, conflict occurs in the absence of incompatible goals. An example is when there is disagreement between couples about how to save for retirement (see Deutsch 1977, 10–11). Such a conflict will be driven by disagreements over what is right or wrong, but the goal (saving for retirement) remains the same.
3. The two basic types of conflicts described in this article, "interest conflicts" and "value conflicts," have been variously described by authors whose works have been referenced in the article. These include value conflicts and fact-based conflicts (Obermeyer and Pinto 1994), conflicts induced by affectual behavior and value-rational conflicts (Weber 1968) and, facts and value conflicts (Berry 1995, 11–17).
4. The disagreement over allocation of portions of the Aboma Forest Reserve was sustained by values and interests. For those inhabitants who chose preservation over logging, the dispute was about the protection of forest resources that had a great religious significance and served also as the economic back-

bone of their survival. On the other hand, supporters of the logging placed their economic concerns over the religious significance of the forest.

5. Several attempts were made (prior to the PGIS application) by traditional leaders in Kofiase to settle the dispute, but all such efforts proved futile. The traditional consultative problem-solving approach, with characteristic public meetings presided over by the chief and elders in the community involved exhortations, persuasion, and even threats to compel the parties to agree to a settlement. On the other hand, local customs that promoted obedience and reverence to elders often left stakeholders with no choice but to resist such attempts. Many of the earlier attempts, therefore, failed to resolve the conflict, partly because they sought to impose the creation of joint gains without providing avenues for the parties to satisfy their self-interests.
6. Interviews with the representatives in the Kofiase case revealed a common concern about threats posed by wildfires that annually swept through the area during dry seasons that lasted from November to March. This period coincided with the dry harmattan winds season (northeast trade winds). In preliminary GIS exercises prior to the group discussions, participants went into the forest to map forest cover types and record previous fire damage. The information was used to create a fire hazard potential map of the forest reserve (see Kyem 2002). Many of the participants were surprised to find that over 85% of the remaining forest was at very high risk of being destroyed by the annual wildfires that swept through the area.
7. In view of the fact that the inhabitants of Kofiase depended mainly on nontimber resources from the local Aboma Forest Reserve for many of their livelihood needs, their representatives on the mediation committee found it difficult to agree to trade-offs and compromises that would have left them with insufficient resources for their daily needs.

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