

## **Finding a Common Ground in Multi-Party Land Use Conflicts through Community-based GIS Applications.**

By

Peter A. Kwaku Kyem, PhD, GISP  
Associate Professor  
Department of Geography  
Central Connecticut State University  
1615 Stanley Street, New Britain, CT 06050, USA

Kyemp@ccsu.edu

### Abstract

The introduction of Geographic Information System (GIS) and related computer technologies into indigenous communities around the world comes at a time when the task of managing local resources has become very contentious. Competition for scarce natural resources, rapid population growth and global demands for the preservation of community forests has increased pressure on local lands. Conflicts and the disputes that arise from them are therefore rampant in community-based resource management activities. Strategies that overtly contribute to conflict management need therefore be part of the strategic planning for PGIS implementation. More importantly, PGIS practitioners need to acknowledge conflict as a potential obstacle and design methods to manage its negative connotations and transform the residual into a positive force for resource management. This paper addresses this task. The paper describes a theoretical framework that can be used to explain the forces that drive land use conflicts. A discussion of the controversy over GIS applications in conflict management is followed by an explanation of the links elements of belief formation and data analysis. The paper concludes with a discussion of how GIS applications can be used to influence human attitudes and bring about changes that promote consensus building.

**Key Words:** Conflict management, Participatory GIS, resource management, community development

## INTRODUCTION

There is a long history of the use of maps in direct and informed negotiations and in promoting free expression and consensus building among heterogeneous groups in local communities (Gupta, 1989; Mascarenhaus and Kumar, 1991; Neela, 1992). Rocheleau (1995) along with other scholars (Poole, 1995; Fox, 1990) have explained that feature categories in maps produced by local groups represent their preferences and negotiated compromises. Geographic Information System (GIS) and related computer technologies are by far better tools for depicting and producing relations among spatial entities (Berry 1993). The mapping capability aside, GIS is also known to create a level of reputation about impartiality, and it also enhances group discussions and increases participation amongst groups (Belcher and Watson, 1993). With the development of GIS therefore, community-based organizations seem to have the tool for structuring resource management practice to make it more iterative and less controversial than before.

The potentials notwithstanding, GIS capabilities for managing resource conflicts has been undermined by conflicting theories about factors that dictate the behavior of disputants. It is argued that because of GIS's inability to affect value conflicts and its propensity to increase fact-based conflicts (through the supply of data that is used to support pre-determined positions), conflicts intensify and increase with expansion in GIS applications. On the contrary, other scholars believe elements of a conflict are malleable and that meaningful communication between disputants can erase misconceptions and induce agreements. Proponents of this viewpoint believe GIS can be used to facilitate discussions that can ultimately lead to agreements. In the wake of widespread GIS applications in natural resource management activities, it is important to ask whether human values or interests and actions that emanate from them can be altered by GIS applications. Can GIS be adopted to explore a conflict situation and prepare disputants for a resolution? These questions form the subject matter of discussion in this paper. The paper describes a theoretical framework that may be used to explain and thereby understand the complex forces that drive land use conflicts. A brief discussion of the disputed role of GIS in conflict resolution is followed by an explanation of the competitive and cooperative forces that govern human behavior during a conflict. After this, the paper explains the role of GIS in belief formation. The paper concludes with a discussion of practical ways that PGIS applications can influence human attitudes to induce changes that promote conflict management.

## CAUSES OF RESOURCE CONFLICTS

A conflict is defined as a condition that involves at least two parties who have a mutual problem of resource scarcity in which there is behavior (or a threat of action) designed to control or gain at the other party's expense (Steele, 1976). A dispute on the otherhand is an encounter involving a specific issue over which the conflict in value or interest is joined. A resolution of the conflict occurs when the basic differences (in value or interest) that sustains the disagreement is removed (Gray 1989; Susskind and Field 1996). The potential for conflict exists whenever two or more people come together in some relationship (Deutsh 1977, Ury et. al, 1988). As people are organized into groups to pursue a common goal, the probability of conflict greatly increases because different interests and perceptions are integrated. The recognition of the role of conflict and conflict management in PGIS applications has partly come in the wake of participatory approaches to natural resources management. The extension of social support for public involvement opens up conditions for conflicts regarding how local resources will be allocated, used and managed (Walker 2000).

Conflict arises over natural resources for a number of reasons. Natural resources are embedded in an environment where the actions of one group often create unforeseen effects on other groups or on another natural resource. A resource such as a forest may be used by some in ways (i.e., clear cut logging) that undermine the livelihoods of others and thereby elicit opposition and protests from other groups. In some situations, people with the greatest access to power may influence natural resource decisions in their favor and in instances where the state has an interest in a public good such as a forest, it may deprive citizens of their land. A conflict can have class dimensions as well, pitting those who own the resource against those who own nothing but whose work makes the resource productive (Walker 2000). Resource scarcity, caused by rapid environmental change, increased demand, or unequal distribution can also lead to conflicts among members of a community. As well, perceptions, access, and use of natural resources vary in every community according to class, gender, ethnicity, age, and other factors and the clash of such differences can cause conflicts. Effective and peaceful management of community resources

therefore involves identifying conflict of interests and developing participatory and planning processes that prevent the conflicts from becoming intractable disputes.

### *Impacts of Conflict on Community Organizations*

Conflict is often perceived as the opposite of cooperation and peace and is associated with violence or disruptive behavior (Walker 2000). If left unresolved, a conflict will cause delays, lack of action and, in extreme cases, a complete breakdown of the social organization. While a prolonged conflict can be quite harmful to human relations, when constructively and timely managed, a conflict can lead to long-term peace and cooperation. In a non-violent situation, conflict can be a positive force for social change. The absence of conflict probably suggests that some people are being suppressed or that they are subordinating their views or wishes to other people (Coser, 1964). Without conflict, attitudes, behavior and relationships stay the same, regardless of whether or not they are fair (ibid). A conflict therefore provides a means for addressing the concerns of disputants. Among members of a PGIS organization, conflict can reveal potential problems and thereby encourage those problems to be dealt with. In fact, a conflict might even be the necessary pre-condition needed to motivate disputants to engage in a cooperative resolution of their long-held differences (Deutsch, 1977). As conflicts intensify so will the effort at cooperation. Conflict also has significant benefits for group cohesion. Conflict and its resolution can give rise to new norms and rules to govern human conduct and create new institutions to enforce rules that can have long-term benefits for the stability of the community organization (Coser 1994). Group cohesion is also strengthened when a conflict provides a safety-valve to clear pent up feelings in a less destructive way than might otherwise occur without the manifestation of the conflict.

### THE CONTROVERSY OVER GIS ROLE IN CONFLICT MANAGEMENT

Two theories dominate current thinking about the role GIS plays in conflict resolution. On one hand, Weber's explanation of instrumental rational behavior and interpretations of the theory dismiss cooperative moves people make to resolve conflicts. Instead, the scholars emphasize competition and self-interest as the factors that drive and sustain conflicts (Weber 1968). 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 argument is that choices over allocation and use of natural resources involve beliefs about nature and peoples' livelihood needs. Resource conflicts therefore involve entrenched values that are difficult to reconcile and therefore when information about a conflict becomes available, disputants use it to confirm their pre-existing positions. As a result, conflicts intensify and increase with expansion in the applications of GIS (Obermeyer and Pinto, 1994:180; Berry 1995)

On the other hand, Habermas' communication theory and supporters of the viewpoint identify social institutions including norms and sanctions as the forces behind conflict resolution. 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 that are geared at maintaining order and harmony. According to Habermas, society maintains itself through the coordinated activities of its members. This coordination is established through communication that is aimed at reaching agreements (Habermas 1984:397). He explains that, in communicating, people relate to others their intentions, feelings and desires that touch on deeply embedded interests and values. Claims are also made regarding the validity of what they imply such as claims to the sincerity and authenticity of their messages. According to Habermas, these claims can be criticized and defended and hence there is the possibility of identifying misconceptions and correcting the mistakes so disputants can reach mutual agreements (Habermas 1984:17). By choosing communication as the mechanism for coordinating actions in society that leads to agreements, Habermas and his supporters recognize language and instruments of communication (including GIS) as the foundation of interpretative action that can lead to conflict resolution.

### *Interplay of the Competitive and Cooperative Factors in a Conflict*

The two theories portray incompatible viewpoints without recognizing the middle ground of potential partnership between the competitive push to claim independent rewards and the social urge to create joint values and restore peace. The trouble with the focus on competition or cooperation as the sole driving force behind a conflict is that the perception confines the dynamics of the conflict exclusively to factors for which stakeholders attach priority at the time they state their positions about

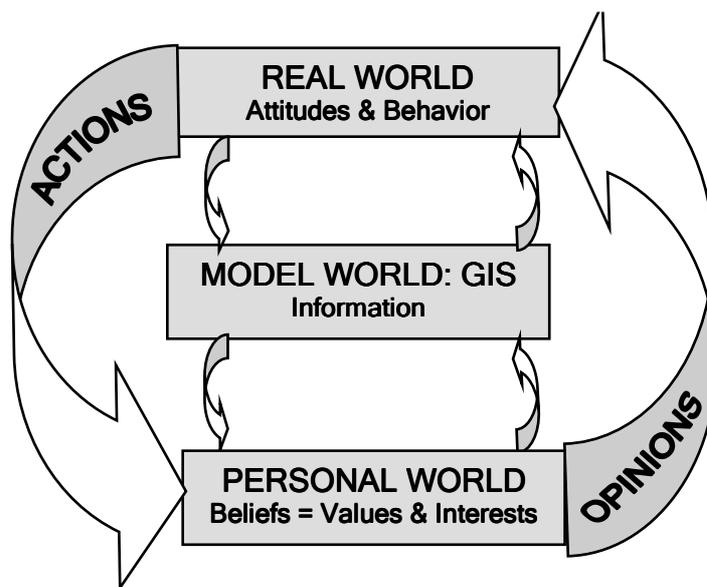
the conflict (Rosenau, 1986). However, the institutional and competitive forces that create the context for a conflict often changes over the lifetime of the dispute. With the passing of time, driving forces of the conflict can either subside with new information and a deeper understanding of the conflict situation, or they can turn into forces that restrain cooperation and competition. Influence of the contextual forces can shift and even the environmental context of the conflict can change (i.e. wildfire burning a forest in dispute). The changes can either lead to the strengthening of positions that sustain the conflict, or could undermine and weaken positions taken by the disputants.

The focus on either competition or cooperation also tends to presume that disputants are aware of all the factors that influence their decisions. We know however that social systems are much complex than is captured through any of the above theories. Eexcept in rare instances when social systems break down through succession or an all-out war, the elements of any social system or organization endeavor to cooperate in order to sustain themselves and the community which they are part of (Rosenau, 1986). Any theory of conflict must necessarily incorporate the full array of competitive self-interest behavior of stakeholders and the dynamics inherent in the use of norms and sanctions, and group expectations to regulate behavior in the community. Accordingly, Raiffa (1982) and Lax and Sebenius (2000) view conflict management as an effort to manage a tension between the cooperative move to create values jointly and the competitive urge to claim rewards independently. Viewing a conflict in this way opens up opportunities to use GIS to facilitate discussions that can ultimately lead to consensus.

### GIS ROLE IN BELIEF FORMATION

Conflict is often the result of subjective misperceptions and distortion of issues and the objective clashes over concrete interests (Forrester, 1999; Steele, 1976). Accordingly, responses to a

**Figure 1: Information and Belief Formation**



Modified after Shepherd, 1994, 358

conflict are sometimes based on perceptions that are faulty. Less costly and less disruptive responses may be induced by the introduction of new information about the conflict situation. Experience, knowledge and effective communication between disputants such as promoted by GIS-mediated discussions can alter these components and produce consensus on issues. A GIS application may suggest a way for resolving the conflict and the success or failure of the application can provide feedback information to illuminate further analysis of the conflict situation.

The potential for GIS's role in conflict management ensues from the influence that applications of the technology have on belief formation. The basic structure of an individual's belief formation and the role GIS play in the process is presented in Figure 1.

As the figure shows, beliefs embody

behavioral elements in the sense that they lead to action when we activate them. Values and interests provide guides to the formation of beliefs that are then expressed externally as opinions, attitudes, and actions. Values refer to what people care most about (e.g. human life, religious beliefs) (Northrup, 1989; Forrester, 1999). Even though values are not static to the point that they are unalterable, because they are inherently personal and subjective, they are believed to be difficult to change by persuasive arguments (Forrester 1999).

Unlike values, interests are the desires, concerns, and fears that underlie the positions individuals take in a conflict (Cohen, 2001). Interests are linked to tangible items that people say they want, such as land, money, or jobs. According to Fisher and Ury (1992) almost all conflicts have negotiable interests but when people define a dispute in terms of positions they have taken, conflicts often appear to be highly intractable because each party wants something that the other completely opposes. Thus, rather than describe a conflict in terms of positions, it is often helpful to redefine the

situation in terms of reasons that underlie the positions. By focusing on underlying interests rather than overt positions, apparently intractable conflicts often become solvable (Forrester, 1999; Ury and others, 1988).

Values and interests serve as guides to human attitudes. Attitudes are the relatively enduring organizations of beliefs around an object or situation that predisposes individuals to respond in some preferential way (Rockeach, 1975, 125). They dictate a specific mode of conduct that is personally and socially preferable to alternative modes of behavior. Attitudes create a state of mind that propels individuals to move beyond the belief that a goal or an object is desirable, into active engagement of the mind to respond to achieve the perceived goal (ibid). Such engagements of the mind may be expressed externally as opinions. Thus, an opinion is an overt behavior which reflects an individual's attitudes (Smith, 1975). As shown in Figure 1, opinion is also the bridge between the personal and psychological world of beliefs and the external world of attitudes and action. An individual's opinion therefore provides a window to the core of his or her beliefs. As a result, when stakeholders represent features on maps or speak about a conflict situation contained in GIS-derived maps prepared for mediation, they make decisions that are influenced by their long-held beliefs and interests about the conflict.

Rational belief formation therefore depends on information acquisition and analysis represented in figure 1 by GIS. The production and analysis of data which relates directly to conditions that define a belief exert an influence on the belief itself. For example, questioning a stakeholder's opinion about features and conditions represented on a conflict map taps into his or her beliefs and can therefore reveal the respondents basic values and interests. By engaging parties to a conflict in open GIS-based discussion of the issues that sustain a conflict, a PGIS specialist may succeed in revealing the real motives that drive the conflict. This will allow the PGIS practitioner to design applications that connect values which sustain the conflict to decisions stakeholders make about the dispute. Through such innovative applications, the PGIS practitioner can help stakeholders understand the conflict in new ways and about each others concerns to prepare them for agreements over issues that sustain the conflict.

## PRACTICAL CONTRIBUTIONS TO CONFLICT MANAGEMENT

In attempting to influence human values and interests to produce changes in attitudes that would lead to the resolution of a conflict, a PGIS expert may use the technology in several ways. These include (a) an educational function devoted to informing the opposing parties about the conflict situation to help them learn about the conflict, (b) a motivational function intended to persuade stakeholders to respond favorably to each others complaints and suggestions (c) an institution building process intended to foster cooperation among stakeholders and (d) an undertaking to re-orient the values that sustain the conflict to bring about final resolution. In the section that follows, we discuss how these objective can be achieved with GIS applications.

### *Educational Function*

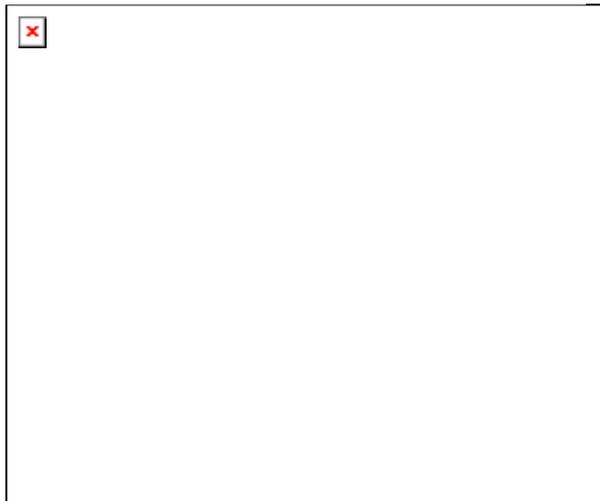
Reaching agreements that can lead to a dispute settlement depends partly upon how well disputants are informed about conditions that caused and sustains the conflict. The establishment of communication between disputants is an important first step in resolving a conflict. The intervention of third parties providing processed information about the conflict is necessary for disputants to gain adequate understanding of the conflict. Generally, the GIS analysis can cause the intensity of some conflicts, or perceptions that sustain disputes to be reduced and at times even eliminated when stakeholders are properly informed about actual causes of the conflict. The PGIS practitioner who is engaged in a conflict management project operates as a facilitator whose duty is to guide disputants to an enhanced understanding of the nature of the conflict. This task requires the skills of a social case worker who attempts to deal with problems of the individual and to assist him in coping with his environment. Alteration of perceptions and attitudes confirmed through the applications of GIS may be usefully applied to the peaceful settlement of disputes.

### *Exploring the Spatial Dimension of a Conflict to Educate Stakeholders*

As part of the educational function for stakeholders, the PGIS expert may create maps associated with the multiple interests that underlie stakeholders positions. With such a conflict map, the parties will be able to identify hot spots of of the conflict as well as areas of opportunity for maximizing joint gains. Explaining the spatial manifestation of a resource conflict, Eastman and others (1993) assume a multi-dimensional decision space where two conflicting objectives (interests) form opposite axes. This allows for criterion scores in two suitability maps to be ranked and allocated according to the objective scales (0-255). With two conflicting interests (i.e., farming and wildlife preservation), a cross-classification of ranked suitability maps based on the two objectives will produce four regions (Figure 2). These include:

1. an area selected for objective 1 (farming) only and hence non-conflicting.
2. an area selected for objective 2 only (preservation) and hence non-conflicting.
3. a sizeable area not selected by either objective (unsuitable choices), and . . .
4. an area selected by both objectives 1 and 2 and hence in dispute (conflict zone).

**Figure 2: Multi-dimensional Decision Space of a Conflict**



It is clear from Figure 2 that areas of the land that are not in dispute are separated from those areas that are jointly demanded by both parties. The illustration also reveals a large portion of the land that is out of the competition loop because it is unsuitable for any of the activities under consideration and as such not vital to the dispute resolution. It

is often the case that conflicts in land use focus on only small portions of the land (hot spot), yet this realization is rarely possible and might hardly ever be noticed in a non-GIS environment (Kyem 2000). Using the conflict map, the PGIS expert can shift the focus of the conflict management process from seemingly intractable philosophical positions onto the conflict zone where tradeoffs that can affect the resolution of the conflict can be easily identified, compiled and managed. It is possible that skilful uses of GIS can help the parties to avoid the distraction of derivative issues and focus on the actual land use problem that initiated and sustains the conflict.

An important GIS contribution to conflict management not possible with any manual process is the assurance of consistency in the processing of information about the conflict (Johnson, 1999). Once spatial information has been registered to a common geometry, it could be propagated uniformly across all support systems, would not change without intervention, and would not be affected by subsequent viewing and use (ibid). An added advantage is the capability that GIS brings to process data more easily and consistently than what could have been achieved manually (Ozawa, 1999). Furthermore, the GIS-derived maps place the discussions into the spatial context of the conflict conditions. A graphic display of entities that are objects in dispute creates a common vision of the conflict situation and this can form the basis of discussions and negotiations. GIS also has a proven capability for exploring “what if” scenarios that can lead to the identification of new options for resolving the conflict. The parties can view varied conditions in each alternate proposal in regards to how it affects their strategic positions. Further creative uses of GIS can help create an awareness of the conflict situation so the parties can get past the preconceptions they bring to the discussion and learn to understand each other’s perspectives.

#### *Motivational function of GIS*

Motivation has an influence on human behavior and can therefore be utilized to encourage stakeholders to make compromises. Conflict behavior is predicated on difficulties which individuals and groups encounter in adjusting to new political, social or economic conditions, or in adjusting to a new physical environment (Warner 2000). For example, a resource scarcity caused by rapid environmental change (wildfire or floods), increased demand, or unequal distribution of available resources can create conflicts. In such a situation, GIS applications can be employed to reveal

conditions that affect the physical and ideologically comfort levels stakeholders have established with their consumption of the resource. A map showing the threats to a resource that is in dispute may compel stakeholders to reconsider positions they have taken in a conflict to ensure their continued consumption of the resource. Again, stakeholders will respond if through effective GIS analyses and maps displays, they come to realize that a position will jeopardize their fundamental values or interests. In these examples, the GIS applications will be the source of motivation for the change in stakeholders' perceptions that will produce conditions for mutual agreements.

#### *Institution Building Function of GIS*

The use of GIS to facilitate conflict management tends to curb outbursts of emotionally charged statements that characterize exchanges between parties engaged in a dispute. The system promotes a search for factual information to support claims. Due partly to the raising of the bar for evidential support for viewpoints, squabbles will usually give way to critical analysis and evaluation of perspectives based upon available data. Direct communication between disputants is also reduced when the analysis of data takes central stage in a conflict management process. A GIS-based conflict management strategy therefore provides a useful medium for harmonizing conflicting interests. In addition, the strategy enjoins stakeholders to undertake joint data gathering and procession sessions. The contacts between disputants create a congenial atmosphere that makes it possible for the parties to develop some trust between them. With the passing of time, stakeholders develop ideas and relationships that may have practical implications for the solution of particular conflicts. The establishment of mutual trust between disputants, gaining of new insights into the conflict and the sharing of knowledge between stakeholders generate positive feelings that later become the building blocks upon which consensus-building efforts are based.

#### *Re-adjusting the value base of the conflict with a GIS*

Perhaps the most promising but also a very difficult task a PGIS expert encounters in a conflict resolution project involves the re-orienting of stakeholders' perceptions and beliefs to bring them in line with objectives of the mediation. This fine-tuning of values and interests that underlie and sustain a dispute is necessary for a final resolution of the conflict. It is when mutual agreements between parties to a dispute are accompanied by changes in the underlying perceptions and values that a long-lasting resolution of the conflict can be attained. Oftentimes, this final stage in the conflict resolution process may not be accomplished with a short-term PGIS application. The final resolution of the conflict is often achieved with the help of other extraneous factors such as advice and exhortations by local leaders, the set of other conflicts that impinge upon the local conflict and pressure from external bodies.

#### POTENTIAL LIMITATIONS AND DRAWBACKS OF THE GIS APPLICATION

Innovative applications of GIS and related computer technologies can succeed in preparing disputants for consensus in conflicts over either values or interests but GIS applications are limited to issues that are distributed in space and can hence be mapped and analyzed (i.e., land use). GIS application in conflict is therefore limited to issues that exhibit a spatial dimension and as such the technology remains a poor medium for resolving ideological and value-loaded conflicts. Accordingly, failure to resolve a value-rational conflict with a GIS may be due to lack of spatial dimension of the conflict situation rather than the irreconcilability of values that sustain the disagreement. The technology's role in mediation is therefore constrained more by the types of conflict (spatial or non-spatial) than the nature of the disagreement (value or interest driven).

GIS applications in conflict resolution are also subject to several restraining conditions. The powerful appeal of the technology and the brightly colored maps produced for discussions can distract decision makers' values and obscure, rather than illuminate the true basis of their decisions. In addition, unequal experience and familiarity with computers such as one encounter in local communities can restrict fair and open discussions through the competency requirements GIS imposes on users (King 2000). Thus, GIS applications might not by themselves ensure a fair, participatory or deliberative mediation process (Hogson and Shroeder 2002). Furthermore, the narrowing of discussion and evidence in dispute mediation to analyses of spatial data reinforces the hegemonic position of technological devices that are not 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 may be filtered out, the individual experiences of certain groups could be ignored and alternative representations might be excluded from the discussions.

## CONCLUSION:

The paper has argued that neither Weber's explanation of instrumental rational behavior nor Habermas's theory of communication adequately explains all the dynamics of the conflict resolution process. Conflict is driven by the combined forces of competitive and institutional factors. When conflict is viewed from this perspective, it becomes possible to use GIS to explore the fears of disputants (i.e. show threats to the resource in dispute), emphasize shared values and interests (map the locations of the resources maximizes joint gains), illustrate the impact of each party's demand on the other (conflict map) and design different scenarios for allocating the resource in question (by changing variables that constitute the conflict maps). It might be possible through such creative applications to get the parties to agree on compromises. Ultimately resolution of the conflict will depend upon a combination of factors within and outside the community.

## REFERENCES

- Belcher, L. W., & Watson, H. J. 1993. Assessing the value of Conoco's EIS. *MIS Quarterly*, 17(3), 239-254.
- Berry, Joseph K. 1995. *Spatial Reasoning for Effective GIS*. Fort Collins, CO. GIS World Books.
- Cohen, S. P. 2001. "Focusing On Interests Rather Than Positions--Conflict Resolution Key." In *Mediate.com*, Mediate.com.
- Coser, L. 1967. *Continuities in the Study of Social Conflict*. New York. Free Press.
- Deutsch, M. 1977. *The Resolution of Conflict: Constructive and Destructive Processes*. New Haven, Yale University Press.
- Eastman, J. R., Kyem, P.A.K., and Toledano J. 1993. *GIS and Decision Making*. Geneva, UNITAR.
- Fisher, R. and W. L. Ury. 1992. *Getting to Yes: Negotiating Agreement Without Giving In*, 2nd Edition ." Bruce Patton, Eds. Boston: Houghton Mifflin Co., 1992.
- Forrester, J. 1999. Dealing with Deep Value Differences. In *The Consensus Building Handbook: A Comprehensive Guide to Reaching Agreements*. L. Susskind, S. McKearman and J. Thomas-Learner (eds). Thousand Oaks/London, Sage Publications. 463-94.
- Fox, J. 1990. Sketch Mapping as a Diagnostic Tool in Forest Management, in Mark Poffenberger (ed.) *Keepers of the Forest: Land Management Alternatives for Southeast Asia*, Westport, Kumarian Press.
- Gray, B. 1989. *Collaborating: Finding common ground for multiparty problems*. San Francisco, Jossey-Bass.
- Gupta, A. K. 1989. Maps Drawn by Farmers and Extensionists. in R. Chambers (ed.) *Farmer First: Farmer Innovation and Agricultural Research*, London, Intermediate Technology Publications: 8-92.
- Habermas, J. 1984. *The Theory of Communicative Action. Vol 1: Reason and the Rationalization of Society*. Translated by Thomas McCarthy. Beacon Press, Boston.
- \_\_\_\_\_. 1987. *The Theory of Communicative Action. Vol 2: Life World and System : A Critique of Functionalist Reason*. Translated by Thomas McCarthy. Beacon Press, Boston.

- Harwell, E. E. 2000. Remote sensibilities, discourses of technology and the making of Indonesia's natural disaster. In *Forests, Nature, People and Power*. M. Doornboss, a. Saith and B. White (eds.) Malden, MA. Blackwell Publishers. 299-332.
- Hogson, D. L and Shoeder, R. A. 2002. Dilemmas of Counter Mapping Community Resources in Tanzania. *Development and Change*. 33: 79-100.
- Johnson, R. G. 1999. *Negotiating the Dayton Peace Accords through DiGISal Maps*. United States Institute of Peace (USIP) Virtual Diplomacy Report, 25<sup>th</sup> February.
- King, B. H. 2000. Towards a Participatory GIS: evaluating case studies of Participatory Rural Appraisal and GIS in the developing world. *Cartography and Geographic Information Sciences* 29 (1) 43-52.
- Kyem, P.A.K. .2000. A Choice Heuristic Algorithm for Managing Land Resource Allocation Problems Involving Multiple Parties and Conflicting Interests. *Transactions in GIS* 5 (2): 113-132.
- Lax, D. A. and James K. Sebenius .2000. *The Negotiators Dilemma: Creating and Claiming Value*. In *Negotiating Environmental Agreements: How to Avoid Escalating Confrontation, Needless Costs and Unnecessary Litigation*. Lawrence Susskind, Paul F. Levy and Jennifer Thomas-Learner (eds). Washington D.C. Island Press: 227-239.
- Mascarenhaus, J. and Prem Kumar P. D. 1991. Participatory Mapping and modeling user's notes *RRA Notes*,12. 9-20.
- Neela, Mukherjee. 1992. Villagers, Perceptions of Rural People through the Mapping Methods Of PRA, *PRA Notes*, 15: 21-26.
- Northrup, T. A., 1989. The dynamic of Identity in Personal and Social Conflict. In Louis Kingsberg, Terrell A Northrup and Stuart J. Thompson (eds.) *Intractable Conflicts and their Transformation*. Syracuse, NY. Syracuse University Press.
- Obermeyer, N. J. and J. Pinto. 1994. *Managing Geographic Information Systems*. New York. Guilford.
- Ozawa, C. P. 1999. Making the best use of Technology. In L. Susskind, S. McKearman and J. Thomas-Learner (eds). *The Consensus Building Handbook: A Comprehensive Guide to Reaching Agreements*. Thousand Oaks/London, Sage Publications. 401-34
- Poole, P. 1995. *Indigenous Peoples, Mapping and Biodiversity Conservation: An Analysis of Current Activities and Opportunities for Applying Geomatics Technologies*. Washington DC. Biodiversity Support Program.
- Raiffa, Howard. 1982. *The Art and Science of Negotiation*. Cambridge, MA. Harvard University Press
- Rocheleau, D. 1995. Maps, Numbers, Text and Context: mixing methods in feminist political ecology. *The Professional Geographer*, 47 (4): 458-66.
- Rokeach. M. 1975. *Beliefs, Values and Attitudes*. San Francisco, Jossey-Bass.
- Rosenau, J. N. 1986. Before cooperation: hegemony, regimes, and habit-driven actors in world politics. *International Organization*. 40(4) Autumn. P. 850-895.
- Smith M. B. 1975. Comment on the implication of separating opinions from attitudes" in R. O. Carlson (ed.) *Communication and Public opinion*, New York, Praeger.
- Steele, J. L. 1976. Conflict Resolution. *Operational Research Quarterly* Vol 27 (1)ii p. 221-230  
Stevens and Sons Ltd. 20-36
- Susskind, L. and P. Field., 1996. *Dealing with an Angry Public*. New York. Free Press.

- Ury William, J. Brett, and S. Goldberg. 1988. *Getting Disputes Resolved: Designing Systems to Cut the Costs of Conflict*, (San Francisco: Jossey-Bass Publishers, 13.
- Warner, M. 2000. Conflict Management in Community-based Natural Resource Projects: an Experience from Fiji and Papua New Guinea. *Overseas Development Institute*. Working Paper 135.
- Weber, Max. 1968. *Economy and Society: and Outline of Interpretative Sociology*. Guenther Roth and Claus Wittich (eds.). Bedminister Press, New York.