ANALYSIS OF THE CHIZU ICHINOSE COMMUNITY DISASTER MITIGATION CONFLICT: THE PROCESS MATTERS[*]

by Suman Ranjan SENSARMA [**], Norio OKADA[***]

1. Introduction

Conflicts often arise when two or more decision makers' interests are mutually exclusive to each other. Though the notion of conflict has some negative connotation, yet sometimes conflict can evolve into a constructive outcome also. The modern theories of conflict emphasize that it is a process and it involves the perceptions, thoughts, feelings and intensions of all the participants[1].

In 1940s, Von Neumann and Mogenstern[2] developed Game theory to explain the strategic interaction between different players. Game theory has found extensive applications to explain the conflict and predict the possible solution(s). But this theory also has limitations in real world applications, mainly due to its strong assumptions of the modeling conditions. In 1980s, Fraser and Hipel[3] developed conflict analysis model to overcome some difficulties in traditional game theoretic analysis and further they extended this model as the Graph Model for Conflict Resolution (GMCR).[4, 5] This model gives some insights to understand the problems within which the possible strategic interaction among the decision makers (DMs) can be systematically analyzed in order to ascertain the possible resolutions, or equlibria.

The objective of this paper is to formulate and interpret the structure of this actual conflict by using the GMCR. The case study area is the Ichinose community (Chizu, Tottori, Japan), which has been involved in a disaster mitigation conflict. We will also turn our attention to its change in conflict structure, and will carry out a qualitative analysis of its dynamic process.

2. Background of the Conflict

Ichinose, a mountainous community, is located in Chizu (Tottori prefecture) in Japan. It is a very small community having 32 households. Due to potential land resources, the local government planned to explore the rock resources from this area for the construction of roads and other civil work. Thus, the rock quarry became a resource base for local development. Around 30 years ago, one local quarry company (Hisamoto Company) entered this area in support of the local government, and this contract agreement intended to include safety measures from the company side. Confrontation evolved when the local company refused to take what seemed to be possible action for disaster mitigation work ordered by the local government. In order to model the conflict, the information is synthesized from many sources like the news paper articles[6] and the interview with the stakeholders. The history of the conflict is described here in different time periods in Table 1.

3. Conflict Resolution: The Matter of Process

Conflict can be apprehended as a potentiality or a situation, as a structure or a manifestation, as an event or process[7]. Okada and Sakakibara[8] proposed "Scoping" as the dynamic process for changing structure of the game. Recent conflict scholars are in opinion that process is very important to understand the root causes of conflict and its possible resolution. Conflict theorist Robbins[9] proposed a perspective of the complex of conflict resolution process

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which can help to understand the dynamic mechanism of the conflict (Fig.1). [1, 9]

Table 1: Chronology of the Conflict

Year	Occurrence	Action taken
1985	On March 23, a landslide occurred and the debris fell into the River Sendai (43,000 m³).	Notification by the local government • Clearance of the piled-up waste from the river. • Taking emergency measures.
1996	Again on September 27, another landslide occurred, the debris fell into the River Sendai (30,000 m³), and a large crack was discovered along the ridge.	Notification by the local government • Clearance of the piled-up waste from the river. • Order for emergency measures. • Notification for suspension of rock quarry operation.
1998	On September 24 and 25, due to heavy rainfall, another landslide occurred at the quarry site and the earth fell into the River Sendai.	Notification by the local government Clearance of the landslide (securing of a pocket) and construction of a deposit pond.
	Again on October 25, earth (50,000 m³) that was piled up at the quarry site crumbled due to a typhoon (1825 mm ppt) and fell into the River Sendai. Six houses in the Ichinose community were affected very badly. National highway no. 53 and part of the tunnel was blocked. The JR line and some quarrying equipment of Hisamoto Company were also washed away.	The local government rebuilt the riverbed and the local company cleared the disposed of earth.
2002	On January 25, a big landslide occurred and the piled-up waste was dumped at the waste treatment site. The river flow was blocked due to the landslide (dam formation).	The local government ordered Hisamoto Company to remove the rocks and debris from the site. However, Hisamoto Company refused to do this job and local government thus ordered Hisamoto Company to make reimbursement for expenses incurred in the restoration process in accordance with river loss. The amount claimed was 1,736,604,804 yen and on March 12, the property of the company was totally confiscated.
2004	Owing to the heavy rains caused by typhoon no. 21 on 29th to 30th September, the Sendai River flooded. Furthermore, due to the heavy rains, the left-hand cliff of the mountain collapsed, and soil and rocks fell to the riverbed, which resulted in dam formation. Because of this, ten houses and the community center were completely flooded, the JR line was closed by for one and half days, and mud and rubbish accumulated on the tracks.	Temporary shelters were arranged by the local government and they also established a disaster mitigation office in the Ichinose community to monitor the disaster mitigation work and operate an early warning system. On June 20, a new governor was elected.
2005		Monitoring the Early Warning System (EWS) by the local government.

Stage I: Potential Opposition

In the first stage of the conflict, there is some potential opposition as an opportunity to evolve a conflict situation. Maybe, this does not directly lead to a conflict but one of the components may be to facilitate the conflict. Different factors are involved in this stage, like, communication, organizational structure, scare resources, and threats of redundancy and take over, as well as a history of conflict. The recent research in conflict management focuses on informal or hidden disputes that occur off-line, behind closed doors, or in the crevices of organizations[10]. The potential oppositions include complaining, ignoring requests, retailing, having hidden agendas etc.

Stage II: Realizations and Personalization

The potential for explicit opposition become realized in this stage. However, because a conflict is perceived does not necessarily mean that it is personalized. People may be aware that they had a co-worker are in disagreement, yet it may not make them tense or anxious and it may not influence work behavior towards the co-worker. It is at that level where conflict is felt, when individuals become emotionally involved.
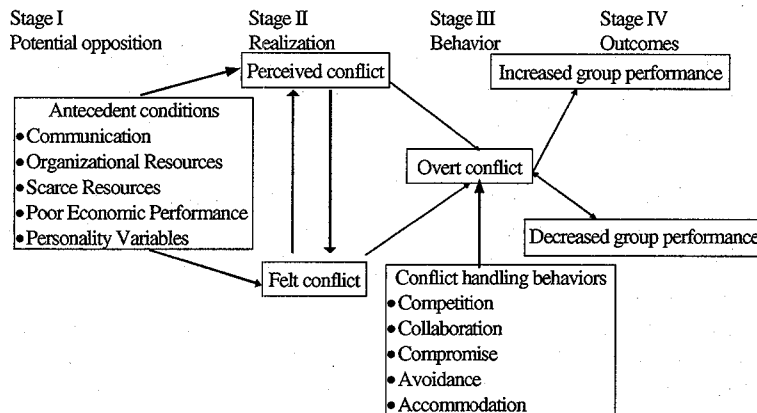

Figure 1: The Conflict Process
Source: Reproduced from Robbins (1991), Furnham (2005)

Stage III: Behaviors

In this stage, the conflict becomes revealed and unfolded. Overt conflict covers wide range of behavior. The level of the conflict may be in low level or may suddenly escalate. In this relation we address also the two-dimensional diagram of conflict behavior, which was proposed by Thomas as shown in Fig. 2. [11), 1)] It identifies two conceptually independent dimensions of interpersonal behavior as assertiveness and cooperativeness. The dimensions combine to identify five conflict – handling 'modes', i.e., avoiding, competing, collaborating and compromising. This model is very useful to analyze the practical conflict situation where parties perceive the conflict in their own way from competition to collaboration point of view.
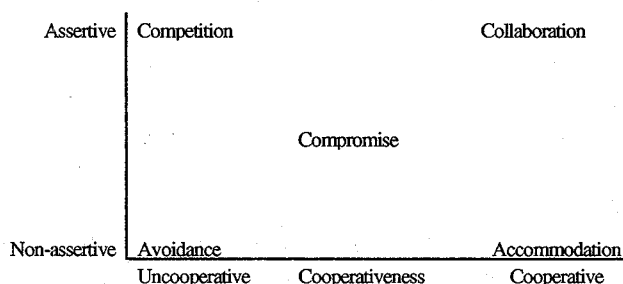

Figure 2: Dimensions of conflict-handling orientations
Sources: Reproduced from Thomas (1976), Furnham (2005)

Stage IV: Outcomes

The outcomes of the conflict could be positive or negative or may be partially mixed. We interpret it as an outcome of structural change in the time evolving conflict. Conflict can improve the quality of multiple stakeholders' decision making process, and can create an environment to solve the problems in a better way. But some times, conflict can escalate in a destructive way also. The third outcome is mixed when it seems to be bad for specific party but can enhance the other groups' performance.

4. The Graph Model for Conflict Resolution

We propose to apply GMCR to formulating and analyzing the static structure of a real-world conflict. The major advantage of this model is the ease with which it models the interplay structure among multiple players who have their own effective strategies from a particular outcome and who can only order possible outcomes in terms of preference.

GMCR (Fang et al., 1993) is founded upon a mathematical framework utilizing concepts from graph theory, set theory and logical reasoning[5]. It represents a conflict as moving from one state to another state (the vertices of a graph) via transmissions (the arcs of the graph) controlled by the decision makers. Mathematically, this multi-player conflict game can be formulated in the following way:

Let $N = \{1, 2, ..., n\}$ be the set of players and $K = \{K_1, K_2, ..., K_u\}$ be the set of states of the conflict, and n-tuple $\{D_i\}$ ($i = 1, 2..., n$) be the set of directed graphs where $D_i = (K, V_i)$. Set of arcs V_i means player i's possible move between states. Let $k_l k_m$ be the arc from state k_l to state k_m. If $k_l k_m \in V_i$, it implies that player i can move from state k_l to state k_m unilaterally. Payoff function P_i specifies player i's preference order for states. If $P_i(k_l) > P_i(k_m)$, player i prefers state k_l to state k_m. The Graph Model for Conflict Resolution (GMCR) is presented by 4-tuple $\{N, K, V, P\}$, where $N = \{1, 2, ..., n\}$, $K = \{1, 2, ..., k\}$, $V = \{V_1, V_2, ..., V_n\}$ and $P = \{P_i \backslash i \in N\}$.

Below are other definitions used in GMCR:

State k's reachable list: $S_i(k)$ $\qquad (k \in K)$

$k_l \in S_i(k)$ iff player i can move unilaterally from state the k to the state k_l ($kk_l \in V_i$)

State k's unilateral improvement (UI): $S_i^+(k)$

$k_l \in S_i^+(k)$ iff $k_l \in S_i(k)$ and $P_i(k_l) > P_i(k)$

In GMCR, players can make a transition of conflicts. When a player does not have an incentive to move from a particular state, the state is called stable for the player, and the state is called equilibrium. In this paper two solution concepts are employed.

Nash Stability

State K is the Nash stable for player i iff i cannot improve his payoff by changing his own strategies. In the other words,

$$S_i^+(k) = \{\varnothing\} \quad .... (1)$$

Sequential Stability

State k is sequentially stable for player i iff for every $k_1 \in S_i^+(k)$, there exists $k_2 \in S_j^+(k_1)$ with $P_i(k) > P_i(k_2)$.

5. Two Phases of the Conflict

We divide the whole process of the conflict into two phases plus the instantaneous period of change in the structure that is interpreted to have occurred between the end of the first phase and the start of the second phase. To model the static structures of both the first and second phases, GMCR is used as follows.

(1) Phase I

March 1985 saw the start of phase I and is the point in time for which the modeling and analysis was conducted.

Two players have been identified in this conflict i.e., the local company and the local government. The local government consists of the prefectural government and the town office. Based on the authors' interviews with the stake holders and careful interpretations of related information collected in that time players' preference and their relative options and the status quo state are specified and listed below (Table 2). Mathematically there are total 32 ($2^5=32$) possible states, but after removing all the infeasible states there are 14 feasible states in total (Table 3). Some states are infeasible because they are mutually exclusive. In Tables 2 and 3, 'Y' means 'Yes' and indicates that the option is taken for a corresponding state, and 'N' means 'No', where the option is not taken. The local company's ranking state from most preferred to least preferred was $5 \succ 1 \succ 13 \succ 9 \succ 3 \succ 11 \succ 7 \succ 6 \succ 2 \succ 14 \succ 10 \succ 4 \succ 12 \succ 8$, and the local government's preference order was $10 \succ 8 \succ 9 \succ 7 \succ 14 \succ 12 \succ 13 \succ 11 \succ 2 \succ 1 \succ 6 \succ 4 \succ 5 \succ 3$ The desirability of each state of each player is structured in the following way. A positive number means that a player prefers that this option be taken, and a negative number means that a player does not prefer that this option be taken. Players have the following options.

Local company's desirability
- The local company wants to quarry rock deposits. (1)
- The local company does not want to operate and maintain the EWS. (-2)
- The local government allows them to dump rock at the site. (3)
- The local government can operate and maintain the EWS. (4)
- The local company does not want to monitor work by the local government. (-5)

Local government's desirability
- The local company can quarry rock deposits and dump rock at another site. (1)
- The local company can operate and maintain the EWS. (2)
- The local government allows the local company to dump rock at the site. (3)
- The local government does not want to operate and maintain the EWS. (- 4)
- The local government wants to monitor the local company's work. (5)

Table 2: Players and their options, March 1985 (Phase - I)

Players and their options	Status Quo State
Local company	
1. Rock quarrying and dumping at the site	Y
2. Operating and maintaining the EWS	N
Local government	
3. Allowing rock dumping by local company	Y
4. Operating and maintaining the EWS	N
5. Monitoring safety performance	Y

Table 3: Feasible states of the conflict in Phase – I

Option	States	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Local company	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	2	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Local government	3	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
	4	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
	5	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y

Here, we obtained only one equilibrium, i.e., state 9 (both Nash equilibrium and Sequential equilibrium), which was also the status quo state at that time. The graph model helps to describe the actual outcome as equilibrium in this game. It seems that although the local government suspended the local company's quarry work for a while, they again gave approval to continue the rock quarry work. However, the company was not ready to take the proper measures for the disaster mitigation work ordered by the local government. Under this condition, the agreement was not stable and neither did the local government use their power to enforce the agreement. Thus, the delay of a concrete agreement upset the status quo state (modeled as a stable state). Neither the local company nor the local government made potential improvements from the status quo state.

On 25th January 2002, a large-scale landslide occurred, and this natural disaster accidentally triggered a social shock that forced the game to move on to another phase of the conflict. We interpret that in this instantaneous period some structural change has occurred. This is conceived to correspond to the stage IV of the conflict perspective shown in Fig. 1. We will elaborate on this intervening change later.

(2) Phase II

The second phase of the conflict started on 25th January 2002. At that time, the local community became a player in this game and the different issues and sub-issues thus changed the structure of the game. The players and their options, and the status quo state are listed below (Table 4). In this conflict, there are a total of 512 states ($2^9=512$). However, many of the states are not feasible for actual conflict for different reasons. For example, the local community has two options: to stay in the same village with disaster preparedness, or to shift the village with public facilities. Both are mutually exclusive, so they are infeasible options. However, in case of the local government, out of four options, there are two options, i.e., rock and debris clearance from the site, and operation and maintenance of the EWS, both of which are mutually exclusive for the local company. This may be possible with the coordination of both players. So, in this case, it is regarded as a feasible state for both players. After removing the infeasible options, a total of 18 states were identified for this conflict (Table 5). The players' ranking of states from most preferred to least preferred is as below:

The local community: $13 \succ 11 \succ 12 \succ 17 \succ 10 \succ 5 \succ 3 \succ 4 \succ 15 \succ 2 \succ 9 \succ 7 \succ 8 \succ 16 \succ 6 \succ 14 \succ 18 \succ 1$
The local company: $1 \succ 10 \succ 2 \succ 6 \succ 12 \succ 4 \succ 8 \succ 11 \succ 3 \succ 7 \succ 13 \succ 5 \succ 9 \succ 17 \succ 15 \succ 16 \succ 14 \succ 18$
The local government: $18 \succ 1 \succ 13 \succ 5 \succ 9 \succ 11 \succ 3 \succ 7 \succ 12 \succ 4 \succ 8 \succ 17 \succ 15 \succ 16 \succ 14 \succ 10 \succ 2 \succ 6$

Table 4: Players and their options, January 2002 (Phase – II)

Players and their options	Status Quo State
Local community	
1. Staying in the same village with disaster preparedness	Y
2. Shifting the village with public facilities	N
Local company	
3. Clearing rocks and debris from the site	N
4. Operating and maintaining the EWS	N
5. Appeal to the national government	Y
Local government	
6. Assisting the local community to shift the village	N
7. Order to clear rocks and debris from the site	Y
8. Operating and maintaining the EWS	N
9. Waiting for the national government's judgment	Y

The player's preferences over the states defined by the combination of options can be ranked by using option prioritizing (Table 6). In this case, option prioritizing is defined by the importance and desirability of two properties of

a state from the viewpoint of the player. Based on the evidence and interview of different stakeholders the lexicographical statements have been prioritized. The higher desirability state order has the higher priority and the same way the lower desirability state has the lower priority. Desirability state of each player is assumed as follows.

Local community's desirability
- The local community intends to stay in the same village with disaster preparedness. (1)
- The local community does not want to shift from their place. (-2)
- The local company should clear the rocks and debris from the site. (3)
- The local company should operate and maintain the EWS. (4)
- The local company should not appeal to the national government. (-5)
- The local government should not assist the local community to shift the village. (-6)
- The local government should clear the rocks and debris from the site. (7)
- The local government can operate and maintain the EWS. (8)
- The local government wants to wait for the national government's judgment. (9 IF -3, -4)

Local company's desirability
- The local community does not intend to stay in the same village with disaster preparedness. (-1)
- The local community wants to shift from their place. (2)
- The local company does not want to clear the rocks and debris from the site. (-3)
- The local company does not want to operate and maintain the EWS. (-4)
- If the local government will appeal to the national government's judgment, then they will file a case. (5)
- The local government can help the local community to shift the village. (6)
- The local government can clear the rocks and debris from the site (7)
- The local government can operate and maintain the EWS (8)
- The local government should not appeal to the national government (-9)

Local government's desirability
- The local community does not intend to stay in the same village with disaster preparedness. (-1)
- The local community can shift their village. (2)
- The local company can clear the rocks and debris from the site. (3 IFF 1)
- The local company can operate and maintain the EWS. (4 IFF 1)
- The local company should not file a case. (-5)
- The local government can assist the local community to shift their village. (6)
- The local government can clear the rocks and debris from the site. (7)
- The local government can operate and monitor the EWS. (8)
- If the local company does not cooperate, then they can wait for the national government's judgment. (9)

Table 5: Feasible states of the conflict in phase II

States / Options		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Local community	1	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-
	2	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	-
Local company	3	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	N	N	N	-
	4	N	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	N	N	-
	5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
Local government	6	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	-
	7	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	Y	N	Y	-
	8	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	-
	9	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y

Table 6: Option prioritizing

Local community	Local company	Local government
-6	-9	3 IFF 1
7	-3	4 IFF 1
8	-4	9
3	5	6
4	6	2
1	2	-1
-2	-1	7
9 IF -3, -4	7	8
-5	8	-5

To understand the behavior of each player in this conflict, situation stability analysis has been conducted. In this analysis, the status quo state does not appear as an equilibrium state. States 1, 11, 12, 13, 17 and 18 are possible equilibria in this conflict. Practically the game has ended up at this stage (as of the end of year 2005) as a noncooperative way (in the form of adversary positions taken by both the local government and local company). Since the local community was not ready to move from their location, equilibrium 1 was found not to be a possible solution in this game. The local company was reluctant to cooperate with the local government thus the local government took the legal step against the local company. The game did not proceed in a cooperative way perhaps due to mistrust and miscommunication among the players. In this game all the equilibria are on the pareto frontier except for equilibrium 17, which is dominated by the states11, 12, and 13.

6. Polarization of the Conflict in a Game

As referred to in the above, we can qualitatively analyze how the structure of the conflict has changed over time. We can interpret the whole conflict as a combination of the static states and the dynamic states. Since we have already modeled and analyzed the static parts of the conflict by GMCR, we will now shift our focus on to its dynamic part. Our interpretation is that the intervening social shock caused by the repeated landslide has triggered the contextual shift in the development of the conflict. We may also infer that some political climate change such as a new governor being elected and coming in office could have also contributed to such a quantum jump in the structure of the conflict. In fact, there are evidences to infer that the incumbent governor who was elected in 1999, and reelected in 2004, has taken an initiative to change the context of conflict. From the Figure 2, we can interpret that the competition between the local company and the local government took place which shifted the situation towards a polarization, however, the compromise were possible between the local government and the local community. The situation is reflected in the stage III to stage IV of Figure 1. In this case none of the players might realized their full goal before escalate the conflict. In this very complex situation, the dilemma has arisen suddenly within a limited time to act strategically. Thus it provides only the cost to all the players involved in this game without any benefit and the conflict continued. Perhaps, there were uncertainty and misunderstanding between both the parties to perceive each other's standpoint or both of them were waiting to come up with an acceptable offer to resolve the dispute. It is assumed that neither the local company nor the local government had the appropriate information from the other side. Otherwise, a new proposal either from the local company or the local government side could have brought the conflict to state 11, 12 or 13, or this could also have changed the structure of the game. . We can interpret that both the local government and the local company perceived the conflict as a zero-sum game in the polarization phase.

7. Conclusion

If we use the perspective of Fig. 1, the above specified structural change can be conceived as a shift from stage III (Behaviors) to stage IV (Outcomes). The change could evolve into positive or negative in stakeholders' coping

(resolving) capacity. In this particular case the actual outcome was the latter case, somewhat degraded and escalated into an adversary position for all the players (stakeholders). It is also noted though our analysis has focused on only the explicit aspects of the conflict, i.e., stages III and IV, there must be many creeping metaphases before the escalation of the conflict. The potential phases or hidden phases such as stages I and II could have also contributed to the escalation of the conflict into what we observed as evidences. There could have been more potential oppositions like ignoring proper rules and regulation, unclear agenda etc. Probably for some possible further analysis in future, we may well refer to the research conducted by Paul Olczak and Dean Pruitt[12] who focused on the polarization as the stage II of the four stages of the conflict escalation. We may also interpret that the some behavioral change of players' attitudes took place in the above referred stages. We can further explain it in the perspective of Fig.2. From the evidence we know that the later in the phase III, the local government considered the local community's preferences and made efforts to collaborate with the local community. But the local company and the local government took the win-lose strategy and thus the bilateral conflict has been polarized in this stage.

The Graph model is an effective tool to model the real world conflict in a strategic point of view. But this model cannot explain why within a limited time the conflict turned to worse and how the conflict evolved over time. To complement this shortcoming, we proposed to conduct a qualitative and interpretive analysis based on the examination of the actual process of the conflict. Alternatively the drama theory [13), 14)] seems also promising for this purpose. It can model how players apply rational emotional pressure on each other to redefine the game prior to be played. It gives more insights about the emotional, psychological and rational-irrational tradeoff in decision making process. Drama theory explains contextual and behavioral analysis of the confrontation. Combining both the models may help to better understand the dimensions of the conflict. We intend to continue to further work on these problems.

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In order to understand the historical evolution of the Chizu-Ichinose community disaster risk mitigation conflict, The dispute is modeled as a static structure for each of two phases, one from 1985 to 2002, and the other from 2002 to date (2005). The GMCR model (Graph Model for Conflict Resolution) is used to systematically describe the process of changes in the structure of this conflict. Then we focus on the structural change, which is interpreted to have occurred instantaneously between the end of the first phase and the beginning of the second phase. This structural change is qualitatively interpreted as the outcome of the intervening social shocks identified as a natural disaster impact, which may have been compounded by some political shift in the local government. This combined approach is found to be a useful methodology to systematically describe the combined process of both static and dynamic structure of the real conflict focused in this paper.

智頭町・市瀬集落の災害リスク軽減問題のコンフリクト分析:プロセスの重要性[*]

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本研究では智頭町・市瀬集落の災害リスク軽減問題に伴うコンフリクトの時間的展開のプロセスを理解することを目的として、当該コンフリクトを二段階(1985-2002, 2002-2005 現在)に分けてモデル化する。各段階のコンフリクトは静的な構造とみなして、それをGMCRモデル(Graph Model for Conflict Resolution)により定式化し、分析を行った。ついで、第一段階と第二段階の間のごく短期間に構造変化が発生したと定性的に解釈した。そのような構造変化が結果として生じたのには、社会的な衝撃が関与していたと考えた。すなわち自然災害のインパクトに、地方行政主体における政治的な転換が相乗的に関係したと推測されることを定性的に分析した。このように二つの分析法を組み合わせた方法論を提示することにより、本研究で取り上げたような静的・動的構造特性を有した実コンフリクトをシステム論的に記述することが有用であることを示した。