A Consideration on Hierarchical Conflict System

-A Case of Local River Basin in Japan-

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Background 1

- Public involvement has become an important part in public project planning.
- It will be more necessary to consider local residents as players who are stakeholders in planning. ⇒player ≠ stakeholder
- In Japan, many conflicts among residents, governments, and some other concerned parties have seen in water resources development projects with respect to development and environment.
- In particular, in a water resources development project the influence is usually widespread so that lot of stakeholders are involved in planning. Therefore, a conflict tend to happen so often and it is difficult to get a resolution among a lot of stakeholders.

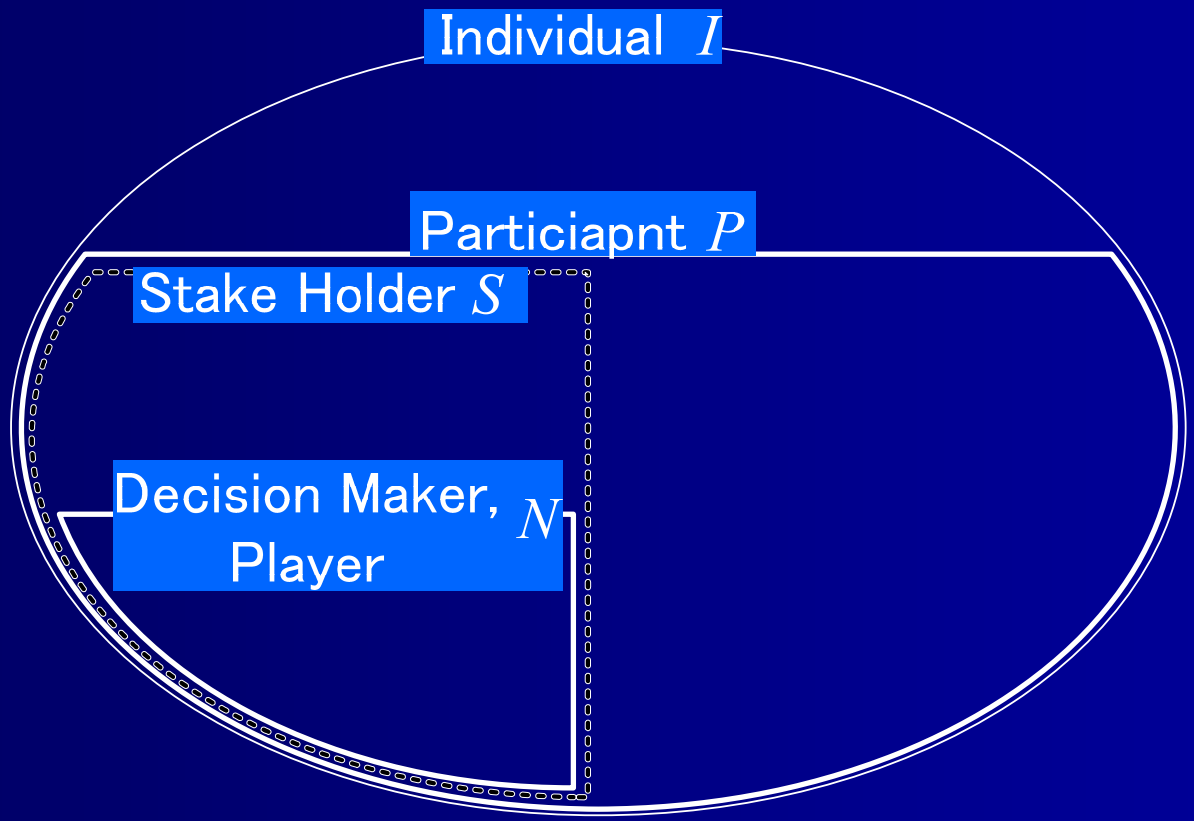
Background 2

- Game theory is generally used to analyze a conflict problem among players who have different concerns.
- In game theory, a conflict is modeled with players (decision makers), strategies and payoff functions.
- If lots of stakeholders who are differently concerned with a conflict, how are they set into several players?
- If we consider local residents as players, how can we know and set their preferences? Questionnaire? Interview? ⇒ The more players, the more time and cost
- In general, setting of components of game theoretical model depends a lot on an analyst, and discussion about a model usually focuses on payoff functions. However, setting of players is a first step of modeling a conflict, and it is also important part of modeling.

Purposes

- In this study, the process of setting players among lots of local residents is proposed.
- This process is applied to the Yoshino river weir construction problem in Japan, and it is shown how this process can be help in analyzing the conflict.
- Furthermore, the possibility of managing the conflict in the Yoshino river basin where recomposition of the municipalities have been promoted is considered with the results of model analysis.

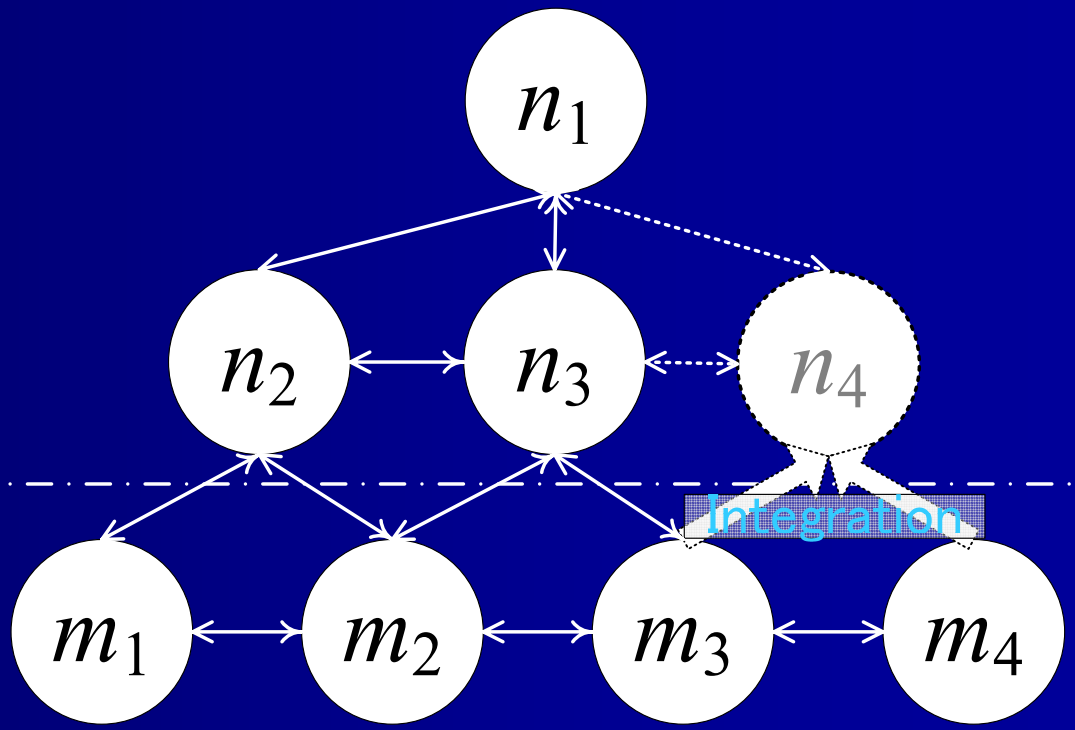
Sub Sets of Individual Set



Hierarchical System in Conflict

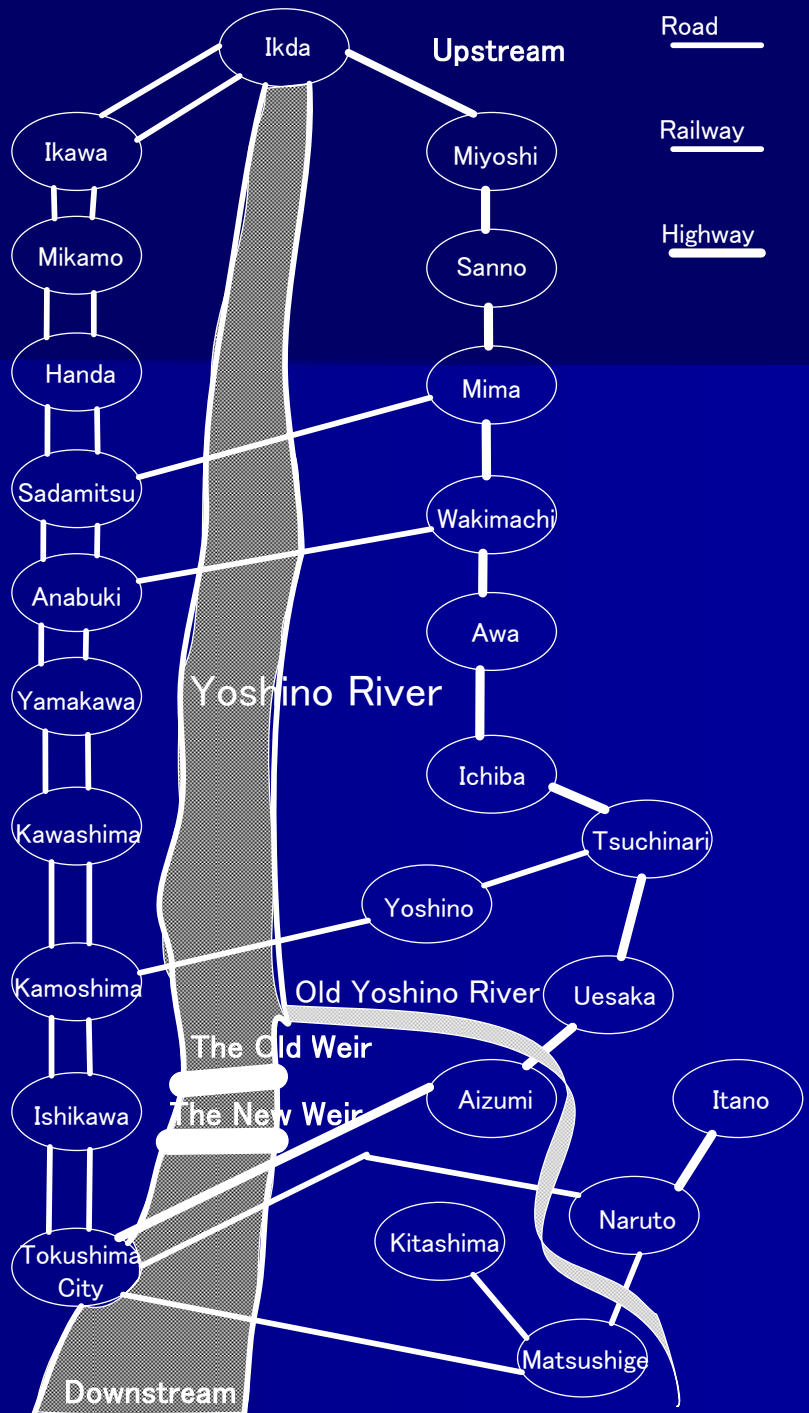
N: Decision Maker

S-N : Stake Holder,
but not Decision Maker



Background of Yoshino River Weir Construction Conflict

- 25 Municipalities
- The old weir was constructed about 240 years ago.
- The old weir is pointed out that it has lots of problems.
- As a counter measure, in 1991, Ministry of Construction planed to construct a new weir.
- Some of local residents were against the plan because the new weir would pollute the environment and the old weir was a monument of history for them.



Background of Yoshino River Weir Construction Conflict

- In 2000, the referendum was held in Tokushima city, which is one of the cities located in the Yoshino river basin.
- Tokushima city assembly designed a rule of the referendum; only if more than half of residents in Tokushima city cast votes, the votes are counted.
- As a result, the votes were counted, and 90% of the vote presented opposition to the construction. After the referendum, the project has been suspended.
- In 2003, governor of Tokushima prefecture heard opinions of mayors from 25 municipalities in the Yoshino river basin.
- Some mayors urged for the construction, some urged against the construction, and others insisted that it was not fair to consider the result of the referendum in Tokushima city because Tokushima city is just one of the municipalities in the Yoshino river basin.

Method of Analyzing a Conflict Structure with a Lot of Stakeholders

Analysis on Regional Backgrounds
of Municipalities in the Yoshino River Basin

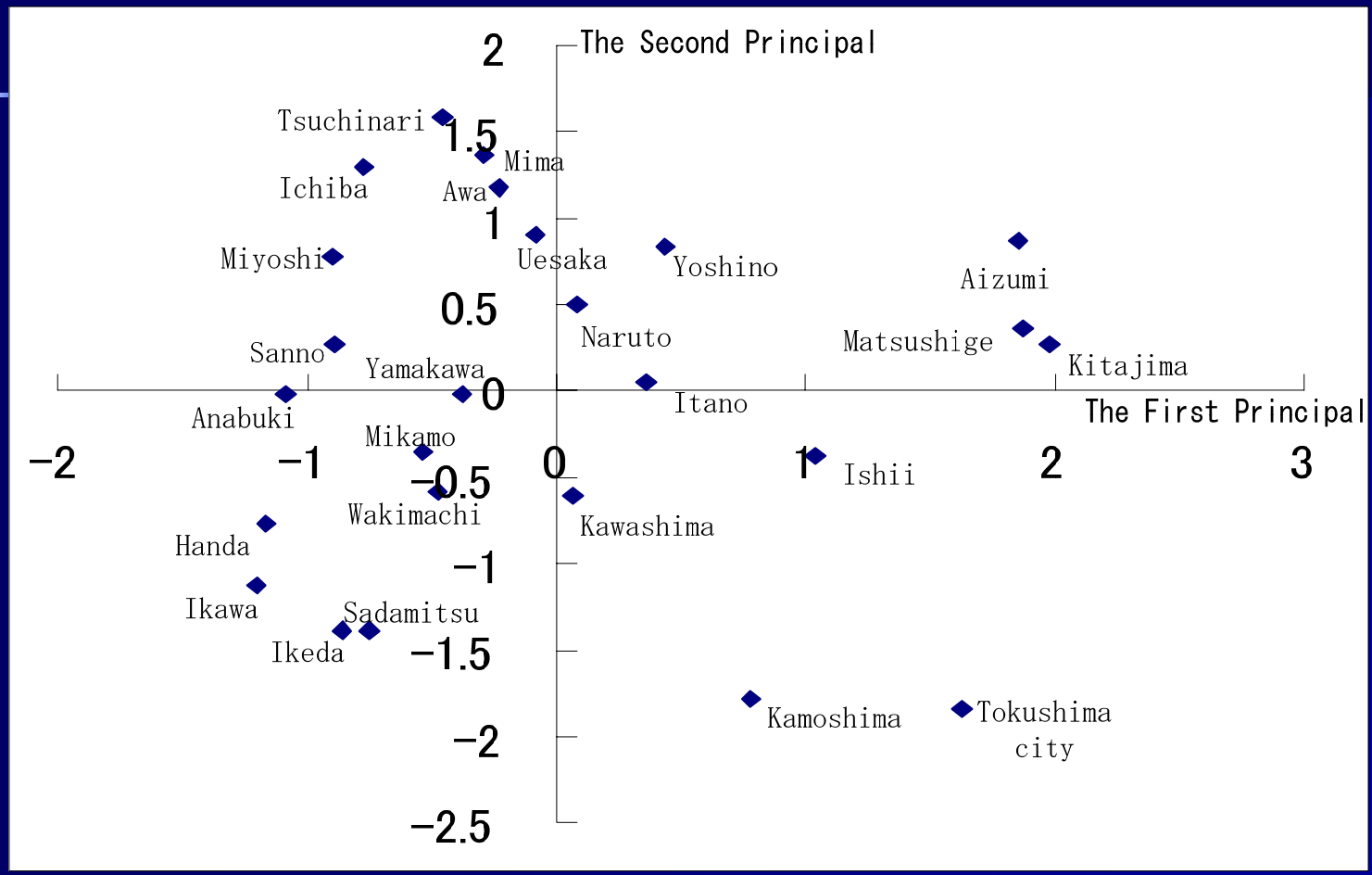
- Evaluation of Socio-Economic Properties of Municipalities in the Yoshino River Basin
- Evaluation of Flood Risk of Municipalities in the Yoshino River Basin

Classification of Municipalities in the Yoshino River Basin

Settings of Players and Preferences

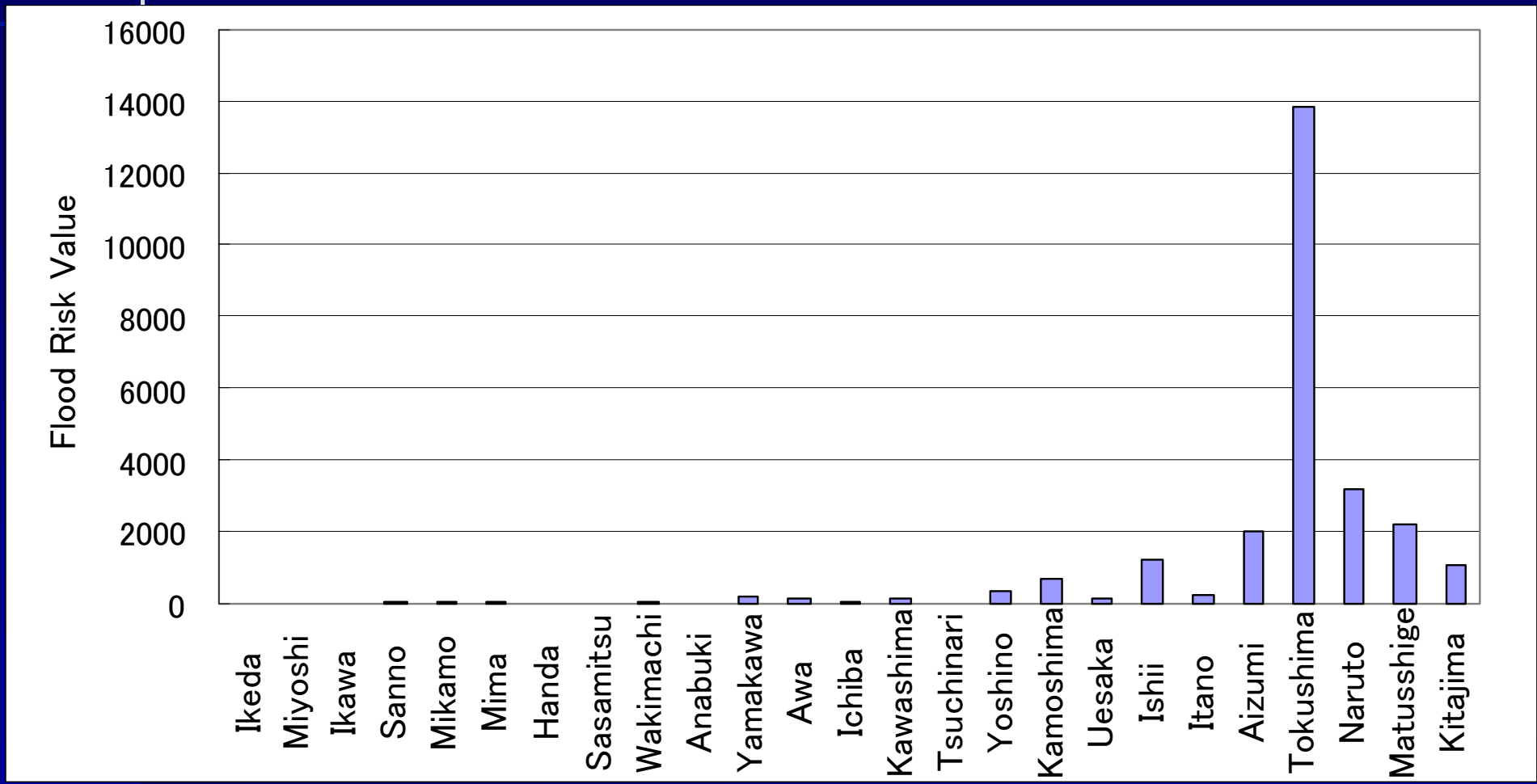
Conflict Analysis

Evaluation of Socio-Economic Properties of Municipalities in the Yoshino River Basin



- The first principal component (43.3%) : degree of urbanization
- The second principal component (18.2%) : degree of poorness of welfare facilities
- The third principal component (11.9%) : degree of depopulation

Evaluated Flood Risk Values of Municipalities in the Yoshino River Basin



Integrated Index of Evaluated Socio-Economic Properties

- 25 municipalities are classified by referring to the results of socio-economic properties evaluation and flood risk evaluation.
- First, the equation below is introduced to transform the third dimensional result of socio-economic properties evaluation into the first dimension value. The values calculated with equation are called regional function values in the following.

$$F_i = \sum_{\alpha} C_\alpha z_{i\alpha}$$

C_α : Contributed proportion of the αth principal component

$z_{i\alpha}$: Score at the αth principal component for municipality i

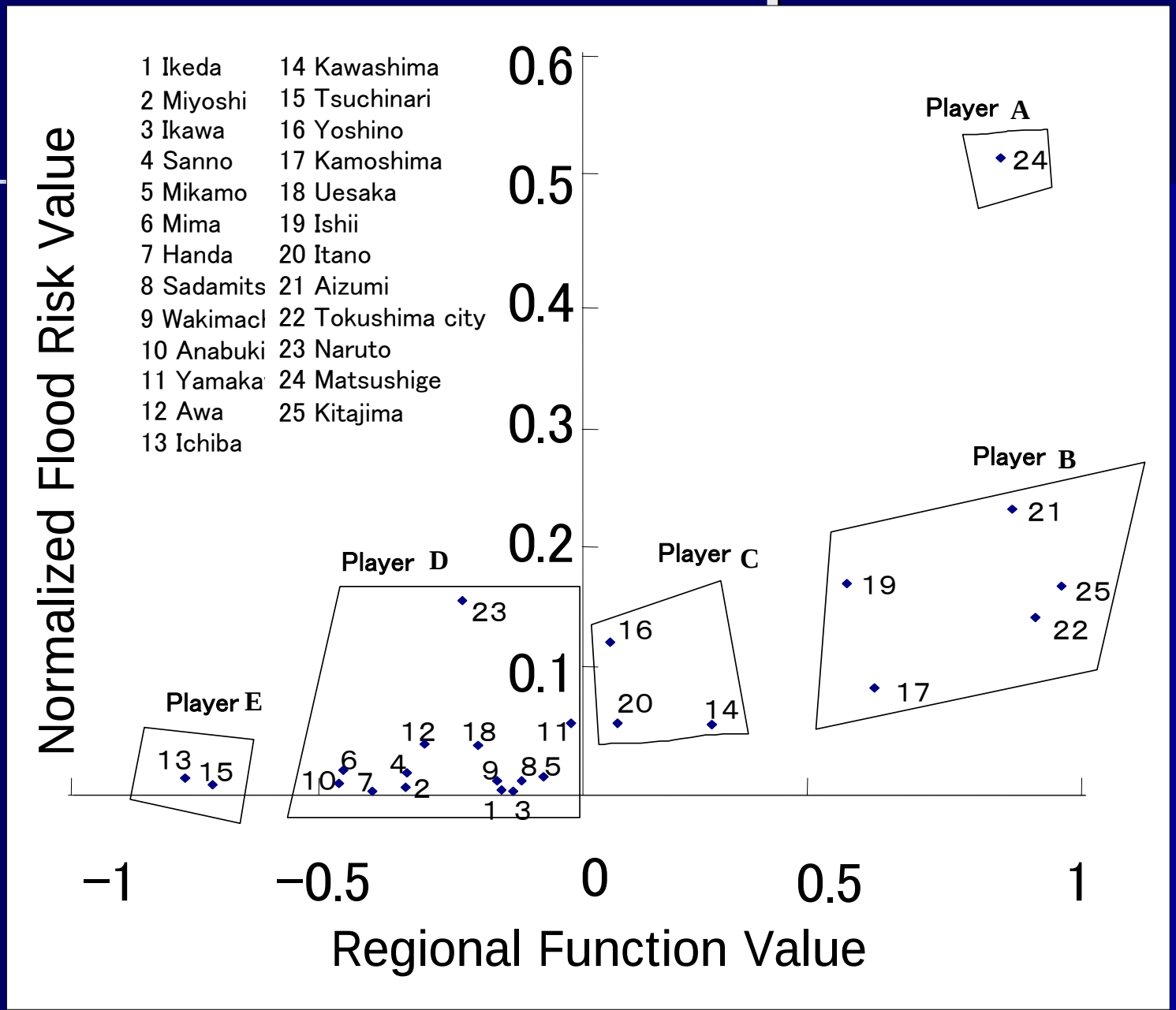
$F_i = C_1 z_{i1} - C_2 z_{i2} + C_3 z_{i3}$: The degree of maturity of municipality i

Classification of Municipalities

- Second, flood risk value is normalized to evaluate relative flood damage among municipalities. Tokushima city represents the extremely high flood risk value because it is the largest city and people concentrates Tokushima city which is the most urbanized area in Tokushima prefecture. In the following, normalized values which are obtained by dividing flood risk values by the number of all houses in a municipality.

- Third, regional function values and normalized flood risk values for each municipality are plotted in the two-dimensional space. Now, we can define distance of each municipality in this two-dimensional space so that cluster analysis can be applied to these points.

Classification of Municipalities



Topographic Map of Clustered Municipalities

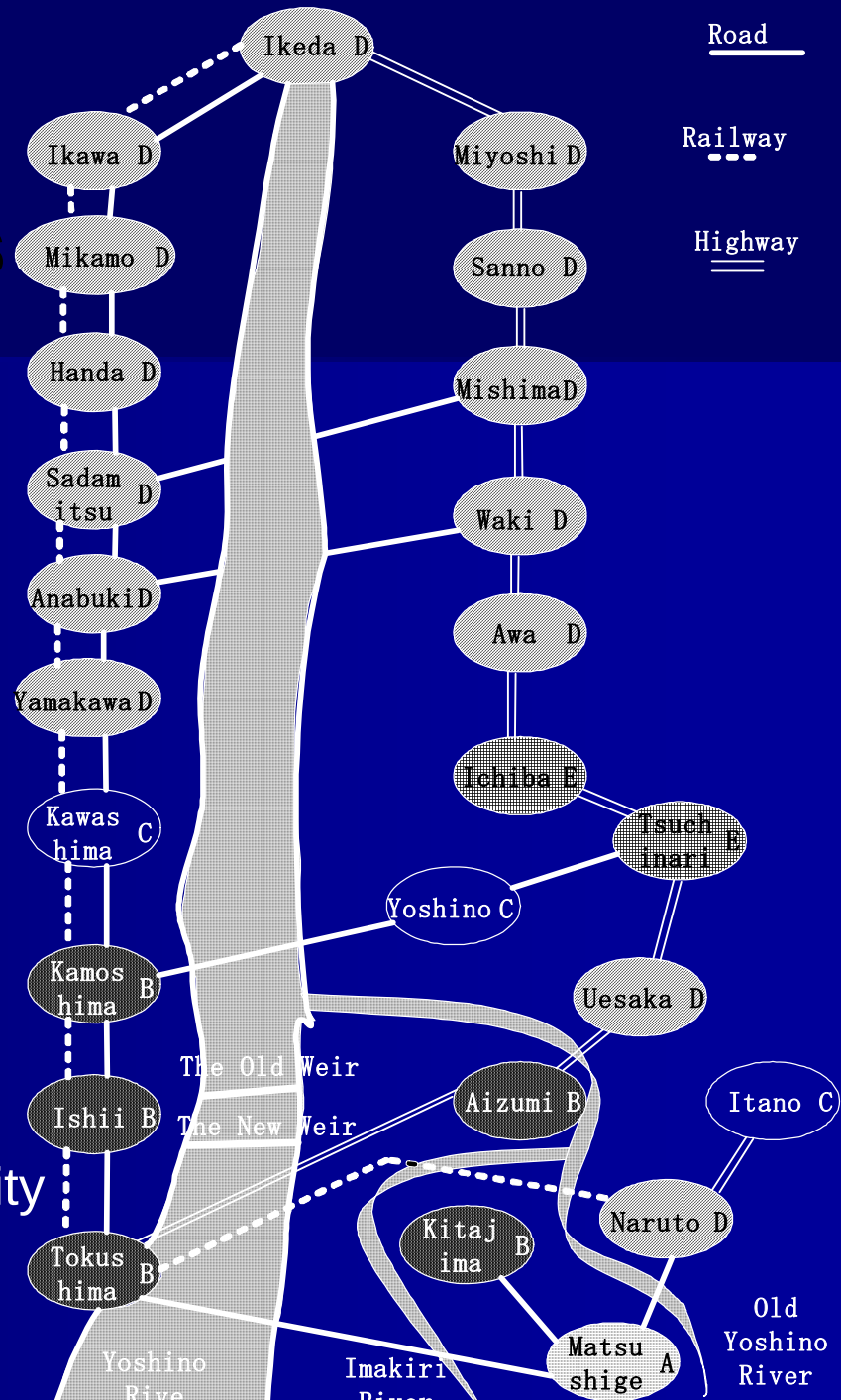
Player A: Outstanding high flood risk and
High degree of maturity

Player B: High flood risk and
High degree of maturity

Player C: Comparatively high flood risk and
positive maturity

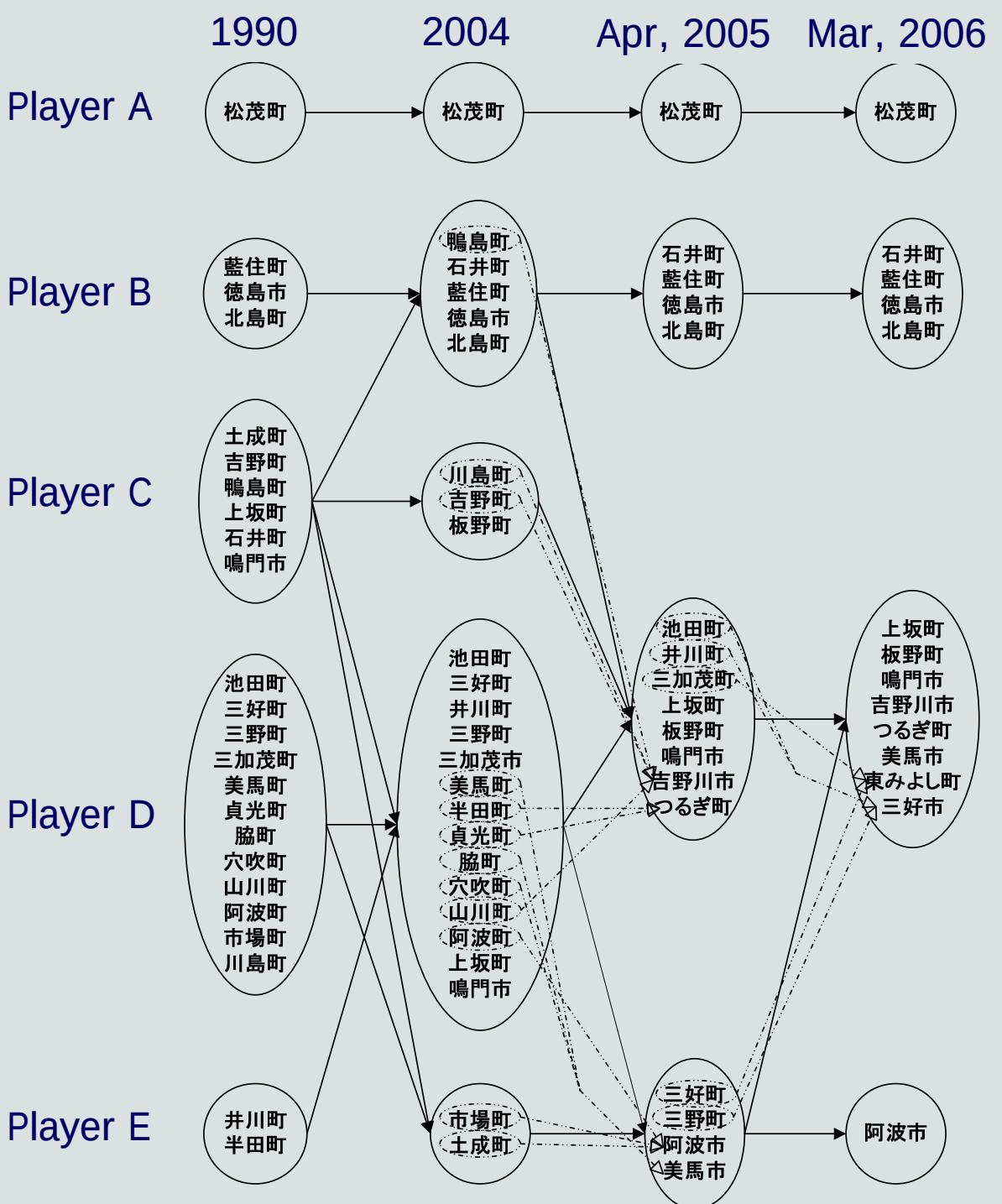
Player D: Middle or low flood risk and
negative maturity

Player E: Low flood risk and
negative and lowest value of maturity



Process of Recomposition of Municipalities and Players

- Lots of small municipalities are recently going to be clustered and recomposed into larger municipalities in Japan.
- Along the process, municipalities are clustered with respect to socio-economics and flood risk aspects at each phase.
- For analyzing the possibility of conflict management in the future, we focus on the player clustering in 2006.



Settings for Conflict Analysis

- GMCR (Graph Model for Conflict Resolution)
  - Based on Non-cooperative game theory
  - Players, Options, Preference orders are required to be set as an input.

Player A: ‘Agree to the construction of the new weir.’

Player B: ‘Agree to the construction of the new weir.’ ‘Compromise on the construction of the new weir.’

Player C(D): ‘Agree to the repair of the old weir.’

Player E: ‘Support the construction of the new weir.’ ‘Support the repair of the old weir.’

Player & Option	Outcome																																			
Player A																																				
•Agree to the construction	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1
•Compromise the construction	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1
Player B																																				
•Agree to the construction	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Player C (D)																																				
•Support the construction	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
•Support the repair	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Player E																																				
•Agree to the repair	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Label	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

- Option Priority of each player

Player A: A's most important priority is that the conflict is resolved as early as possible. It is difficult to consider this specification of preference In model setting of GMCR so that Player A's preference is considered in the examination stage of equilibriums.

Player B: 'Player B agrees to the construction of the new weir.'
'Player C(D) supports the construction of the new weir.'
'Player C(D) supports the repair of the old weir.'
'Player A compromises on the construction of the new weir to resolve the conflict earlier.'
'Player A agrees to the construction of the new weir.'
'Player E agrees to the repair of the old weir.'

Player C(D): 'Player E agrees to the repair of the old weir.'
'Player A compromises on the construction of the new weir to resolve the conflict earlier.'
'Player A agrees to the construction of the new weir.'
'Player C(D) supports the repair of the old weir.'
'Player C(D) supports the construction of the new weir.'
'Player B agrees to the construction of the new weir.'

Player E: Player C(D) does not have clear preferences so that Player C(D) is assumed to prefer all the options equally.

Mayors' Opinion

- Opinions of mayors from each municipality were heard in 2003.
- Their opinions about the new weir construction conflict can be classified into 4 types.

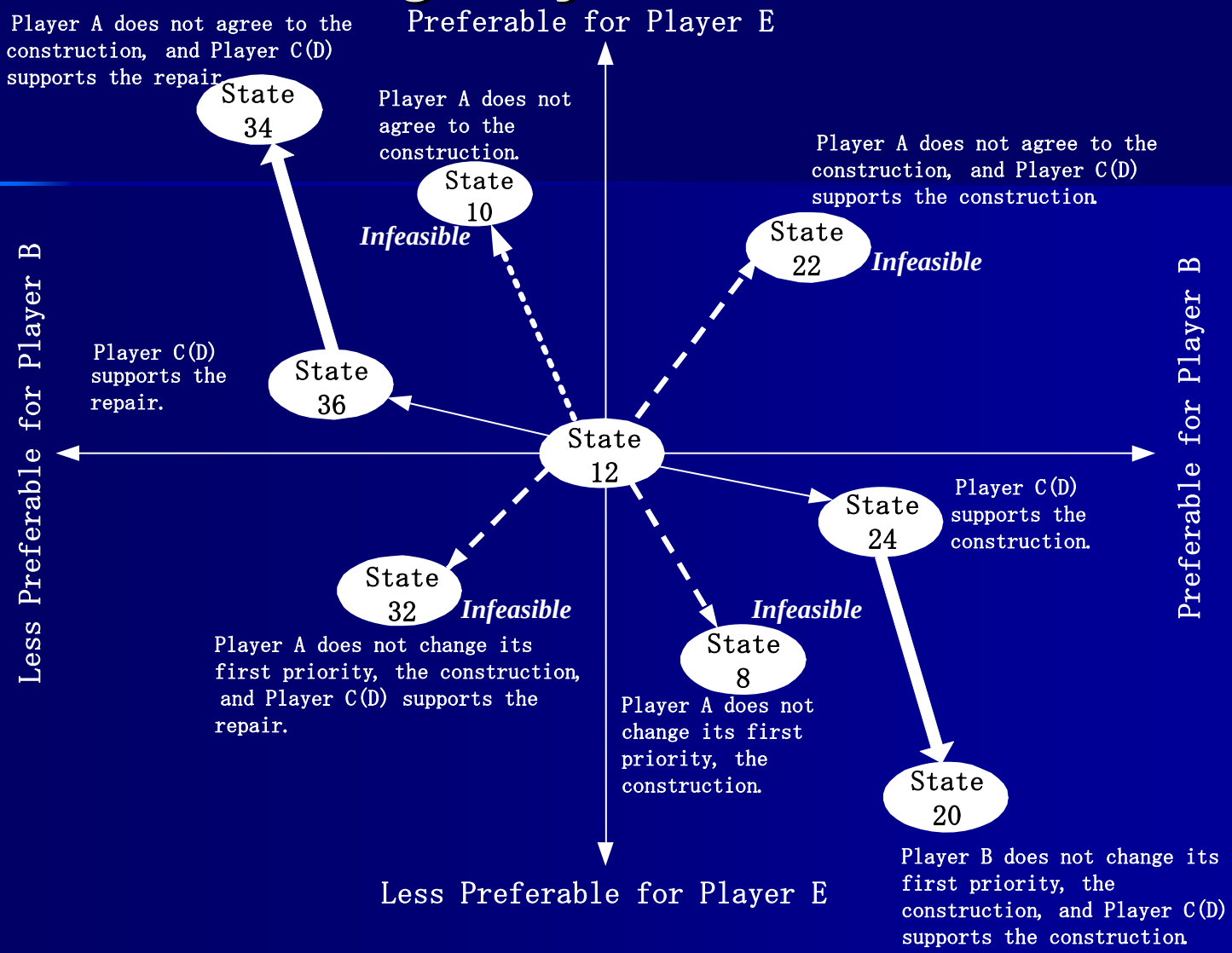
Opinion I: The construction of the new weir is better than the repair of the old weir.

Opinion II: The construction of the new weir is better than the repair of the old weir. However, the conflict is desired to be resolved as early as possible. Therefore, if the conflict is resolved early, the construction of the new weir is not necessarily the first priority as a compromise.

Opinion III: The repair of the old weir is better than the construction of the new weir.

Opinion IV: There is not definite difference between the construction of the new weir and the repair of the old weir.

Transition form the Actual Situation With Considering Player It's Preference



Infeasible : Infeasible in terms of early settlement of the conflict

: Player A will follow the majority to resolve the conflict earlier

How can the conflict be managed?

- Outcome 20 and 34 are the equilibriums that is highly possible to be achieved with considering the preference of Player A.
- The ways how municipalities in Player C(D) behave will decide a way that the overall conflict moves to. In other words, less interested players have a casting board in Yoshino river conflict.
- The number of the municipalities in Player C(D) reduced because of recompositon in 2005 and 2006. This means that each municipality which is reborn after recompositon come to have more influence to the conflict.
- After referendum in 2004, the conflict is calm down and discussions are held sometimes. Then understanding of situations seems to be improved among the municipalities along the Yoshino river. Therefore, the municipalities in Player C(D) should know the conflict structure more clearly, and consider their decisions without influence of other players who have a big voice (for example, Player B). This is what is needed for future conflict management in Yoshino river basin.