MULTI-STAKEHOLDER MENTAL MODEL IN MONOBE RIVER IMPROVEMENT AND MAINTENANCE

MULTI-STAKEHOLDER MENTAL MODEL IN MONOBE RIVER IMPROVEMENT AND MAINTENANCE

Takuya Komatsu[1], Susumu Nakaya[2], Piriya Uraiwong[3], Tsunemi Watanabe[4]
Undergraduate Student, School of Frontier Engineering, Kochi University of Technology[1]
Graduate Student, Graduate School of Engineering, Kochi University of Technology[2,3]
Professor, School of Management, Kochi University of Technology[4]

***ABSTRACT*:** Monobe River, flowing from the Shikoku Mountains in neighboring Tokushima prefecture, is located in central part of Kochi prefecture, Japan. Three main dimensions of water management that Monobe River is now concerned are "chisui," flood control, "risui," water utilization, and "kankyo," environment. The Ministry of Land, Infrastructure and Transport (MLIT) prepares the River Improvement and Maintenance Plan (RIMP) for Monobe river to realize in these three dimensions. Another milestone to develop and manage Monobe River was originally proposed by Association of forest and water in Monobe River for the 21st century (the 21st century) whose vision is to strengthen water resources through aiming at global optimum in the region by co-operating each other.

As currently envisioned, conflict between MLIT and the 21st century emerged form MLIT planning process and project implementation. To address this problem and identify root causes of conflict issues, this study aimed at analyzing the different understanding between the MLIT members and the 21st century members by employing mental model approach. In order to elicit the multi-stakeholder mental model, interviews and dialogue conversation, related to implemented projects, were conducted regarding project management process. The study results showed that MLIT takes flood control as a priority consideration and pays attention to improvement of environment while the 21st century understands importance of flood control but perceive that MLIT's efforts for environment improvement is not sufficient in some concrete projects. Insufficient consideration of environment by MLIT is observed in some areas due to their lack of experiences or their internal constraints. In order to contribute to more equitable, efficient and sustainable water use and management of the Monobe River, therefore, it is suggested that MLIT should incorporate with the 21st Century to utilize both experiences and wisdoms.

KEYWORDS: Monobe River, Conflict, mental models

1. INTRODUCTION

The basic goal of river basin management is to accomplish integrated results for human needs and sustainable ecological system [Grigg, 1996]. In order to achieve river basin goals, it is demand for a dynamic and continuum relationship between basin local stakeholders and central and local governments, who have worked together to ensure the viability of their decisions in meeting the basin development goals. Taking Monobe River in Kochi prefecture, Japan as a case study, the Ministry of Land, Infrastructure and Transport (MLIT) and the association of forest and water in Monobe River for the 21st century (the 21st century) are two of main agencies who are involved with Monobe River planning and management (Watanabe, 2009). As

currently envisioned, conflict between MLIT and the 21st century emerged form MLIT planning process and project implementation. To address this problem and identify root causes of conflict issues, this study aimed at analyzing the different understanding between the MLIT members and the 21st century members by employing mental model approach. This paper presents a theoretical framework to compare mental model between the MLIT staffs and the 21st century group to Monobe River planning adopted in five projects. The analysis focuses on how different mental model has been pursued in each project in light of four main items; project goal setting, project analysis, project means derivation and project results comparison.

This study is one effort to reflect public participation attempts to strengthen cooperation among Monobe River stakeholders in order to achieve more sustainable use of water resources and improve water resources management outcomes.

The rest of this paper is organized as following. Section 2 briefly explains overview of Monobe River and problems that Monobe River has been encountered, and section 3 presents methodology applied to this research study. Section 4 presents overall comparative findings and conclusions, and Section 5 describes implications of this study for future research and river basin planning.

2. OVERVIEW OF MONOBE RIVER

2.1 Summary of Monobe River

Located on Kochi prefecture, the Shikoku island of Japan, Monobe River is a first class river covering a catchment area of about 508 km^2, with a total mainstream length of approximately 71 km (Figure 1). The Monobe River origin lies in the north-eastern mountains in Kochi prefecture and takes south-westwards down into the Pacific Ocean.

Figure 1 Monobe River basin map (http://www.skr.mlit.go.jp)

Approximately 83% of the catchment area is covered by mountains and 17% of the catchment area is utilized mainly in the paddy field and farmland. The river can be divided into the upper, the middle and the lower parts from its characteristics. The river slope of upstream part is 1/40 and middle stream and downstream is 1/280 and 1/145 approximately (MILT, 2007). Three main dams are located along the Monobe River; Nagase dam, Yoshino dam and Siuta dam. All of them were constructed in 1950's for social benefit in terms of power generation, water use and flood control (Kurata & Watanabe, 2008).

The annual average temperature of the Monobe River region is roughly 17°C, showing a mild climate throughout the year. The average annual precipitation of the Monobe River is reaching approximately 3,000 mm in the mountainous areas and exceeding 2,400 mm in the plains. Annual rainfall is concentrated in the rainy season and typhoon season from June to September (MILT, 2007).

2.2 Current status and issues in Monobe River

Three main dimensions of water management that Monobe River is now concerned are "chisui," flood control, "risui," water utilization, and "kankyo," environment.

2.2.1 Flood control issue

Lower part of the Monobe River had been suffering from flood damage due to the fact that ground level height of the flat land is lower than the water level. For this reason, large scale flood control measure for the Monobe River has been established in the early Edo period (1664) to prevent majority of assets from flooding. To protect inundation area from flooding, levee and embankment system were promoted in associated with river excavation in order to increase flow rate. As part of Monobe River comprehensive development plan, a construction of Nagase Dam for food management purpose began in October 1950 and completed in March 1957.

After the revision of the River Law of 1964, numbers of construction projects in Monobe River have been carried out to focus on responding to river development plan including levee erosion protection and local scour protection, levee leakage prevention, preparedness for large-scale earthquake and tsunami, disaster-related facilities maintenance.

2.2.2 Water utilization

Monobe River is utilized to support agriculture, hydroelectric power plants, industry and household consumption as well as environmental protection in Kochi prefecture. In lower area of the Monobe River basin, agriculture area has been expanded, approximately 3,270 ha, along the plain in order to produce rice and vegetables which makes agriculture sector become main water consumption sector in Monobe River basin. The average drought flow rate (average from 1962 to 2007) at the Sugita station is 7.55m^3/s approximately, and a mean low water flow is 11.72m^3/s approximately.

One of recent critical issues in the Monobe River water utilization is the low minimum maintain flow for environment caused by hydropower dam operation. It is reported in Kurata and Watanabe (2007) that the mean daily flow were below 1 m^3/s through October and November 2007, resulting that most of Ayu (sweet fish) could not migrate to upstream for spawning. However, the minimum maintain flow standard for Monobe River had not been set. There had been an urgent need to improve flow regime from current obstacles.

2.2.3 Environmental issue

Water quality of Monobe River in the upstream part is satisfied for environmental standard (BOD > 75%). However, water pollution problem has been detected in the downstream area caused by local industry untreated water draining and household careless draining. In addition, river mount blockage caused by accumulated sand and gravel is found. Another problem that Monobe River has been facing is large amount of muddy water caused by mountain fire and landslide in mountain which gives rise to Ayu (sweet fish) population decreasing. In addition, the number of deer population who eats tree barks and vegetation covering soil in mountain is increasing explosively from global warming effects. As a result, it may bring about landslide and depletion of the Monobe River resources.

2.3 The River Improvement and Maintenance Plan (RIMP) for Monobe River

The basic policy subcommittee for river improvement and maintenance meeting was held by the River Subcommittee Panel of Infrastructure Development to formulate the basic policy for the Monobe River improvement and maintenance. The river improvement and maintenance plan embraces long-term viewpoint considering the balance of the Monobe River. River improvement and maintenance measures taken by the MLIT includes floods disaster prevention, securing the water resources, erosion control, safety and serenity at the sea, river information system, disaster education and training,

river environment improvement and international cooperation. Necessity of setting the minimum maintain flow standard and making efforts to achieve it are described (MLIT, 2007).

3. METHODOLOGY

As noted in introduction, this study adopted a qualitative approach providing detailed narrative descriptions and explanations of phenomena investigated, with lesser emphasis given to numerical quantifications by observing and interviewing. The objective of this study is to identify differences in common understanding toward the implementation of Monobe River improvement and maintenance cases between MLIT and the 21st century. The study utilized the comparing mental model approach by eliciting the multi-stakeholder mental model related to implemented cases regarding project management process (presented in Figure 2) through interviews and dialogue conversation.

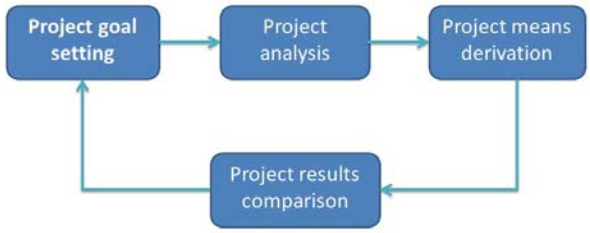

Figure 2 Flow of project multi-stakeholder mental models comparison

Mental models are simply defined as "an internal representation of the world that supports understanding, reasoning and prediction and that drives action" (Biggs et al. , 2008). Mental models approach has been employed as a tool to integrate stakeholder dimension into integrated water resources project management. To elicit mental model from MLIT members and the 21st century, key members of the 21st century were interviewed their opinions and understandings regarding implemented projects. After that, face to face dialogue discussion between the MLIT members and the key members of the 21st century was held at the MLIT office in Kochi prefecture to identify how they view the projects and what concepts that both parties consider important. The interviews and dialogue discussion were recorded and transcribed to provide accurate account for future references. Qualitative analysis was conducted to determine the similarity and dissimilarity in stakeholder's views. Five implemented cases mentioned for discussion between the MLIT and the 21st group are

1. "Wando," terrain or pond, located in front of Kochi National College of Technology.
2. River bank erosion protection located opposite Kochi technical school
3. Covering work on river boulders surface located at opposite Kochi National College of Technology
4. Removal of trees and shrubs in the river channel
5. Failure of revetment work constructed in the year of Heisei 15th (year 2003)

4. RESULTS AND DISSCUSSIONS

This section presents findings from interviews and dialogue conversation of stakeholders, first by giving background of each implemented project and then by moving on to the MLIT and the 21st Century mental models comparing of the project management process presented in Figure 2 in attempting to deal with such conflict. Finally, this section will present results from the compared mental models and alternative perspectives on conflict and convergence of interests.

4.1 Wando located in front of Kochi National College of Technology

Wando is a terrain or pond connected with the

mainstream of the river where function as a treatment habitat of aquatic organisms and fish.

Figure 3 Wando location

This wando (Figure 3) is located near Kochi National College of Technology. In order to prevent embankment erosion from high stream flow rate, the MLIT conducted embankment erosion protection construction project on the Noichi city side (left side bank along the stream flow direction). For efficient and economic construction purpose, the MLIT diverted river flow to the other side of the river bank where the wando was located.

As a result, the wando became shallow and affected by turbid and muddy water. Comparing mental model between the MLIT and the 21st century of the wando case is presented in Figure 4.

4.2 River terrace located opposite Kochi technical school

A river terrace construction project was carried out to prevent from severe scour and erosion on the Monobe River embankment. The MLIT increased river floodway by reconstruction of the 10 m width river side terrace with grass lawn planted and protected embankment slope by aggregates collected from the river itself as shown on the left side of Figure 5. In addition, the purpose of this wide glass

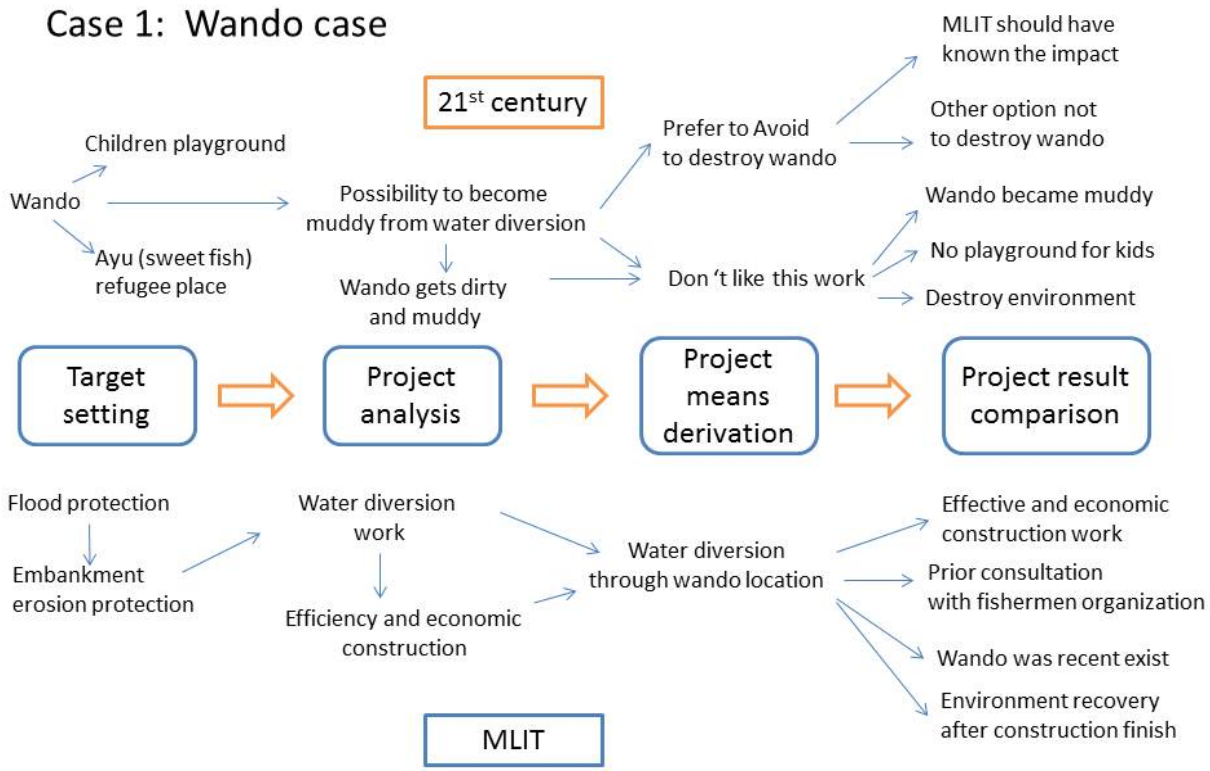

Figure 4 Comparing mental models regarding to wando case

Figure 5 River bank erosion protection and river terrace

Figure 7 Covering work on river boulders before re-construction

lawn was to encourage people to utilize this area as a recreation area and get close to the river nature.

However, the 21st century's opinion toward this project was that this 10 m width lawn yard was a place for weeds and unwanted plant to grow which required extra maintenance and management cost. Comparing mental models between the MLIT and the 21st century of this case is presented in Figure 6.

4.3 Covering work on river boulders located at opposite Kochi National College of Technology

This case is continued from case 4.2. The former condition of river bank before the MLIT constructed new river terrace in case 4.2 is shown in Figure 7.

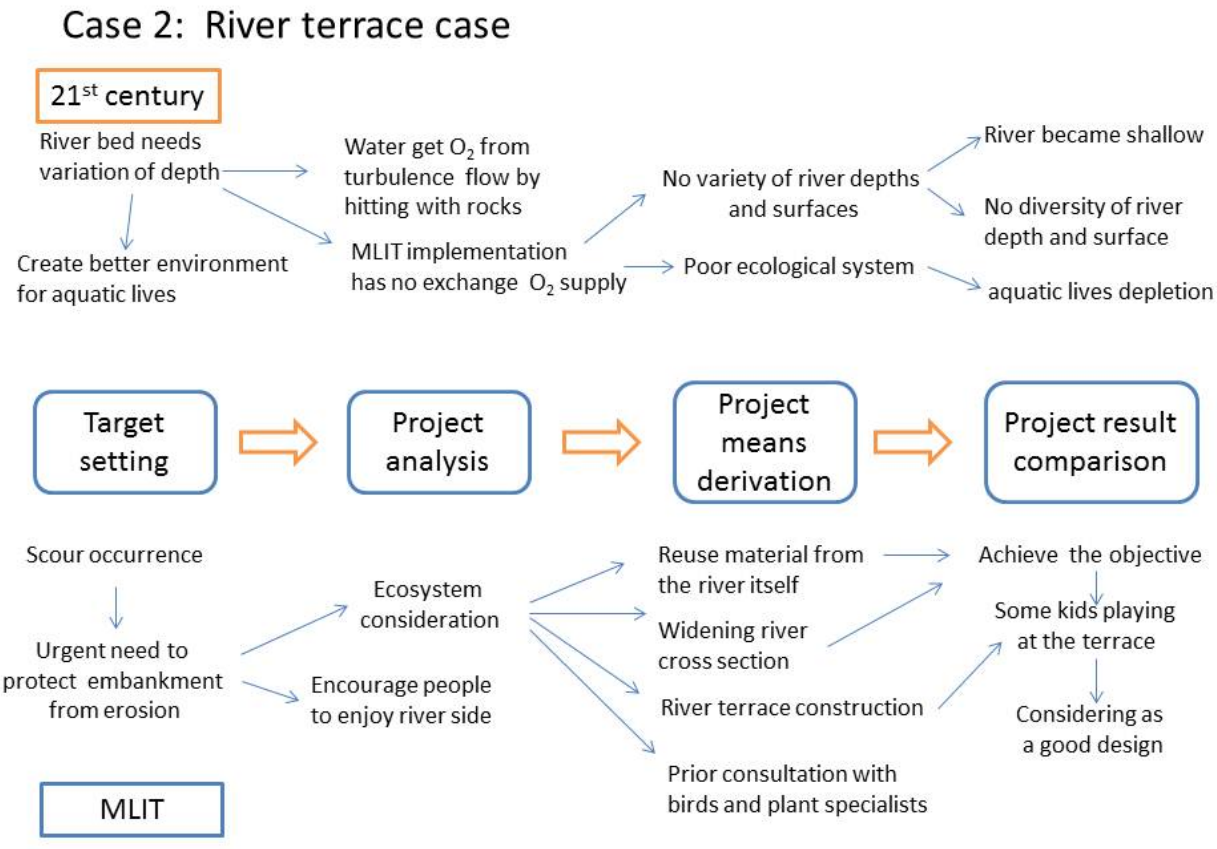

Figure 6 Comparing mental models on river terrace case

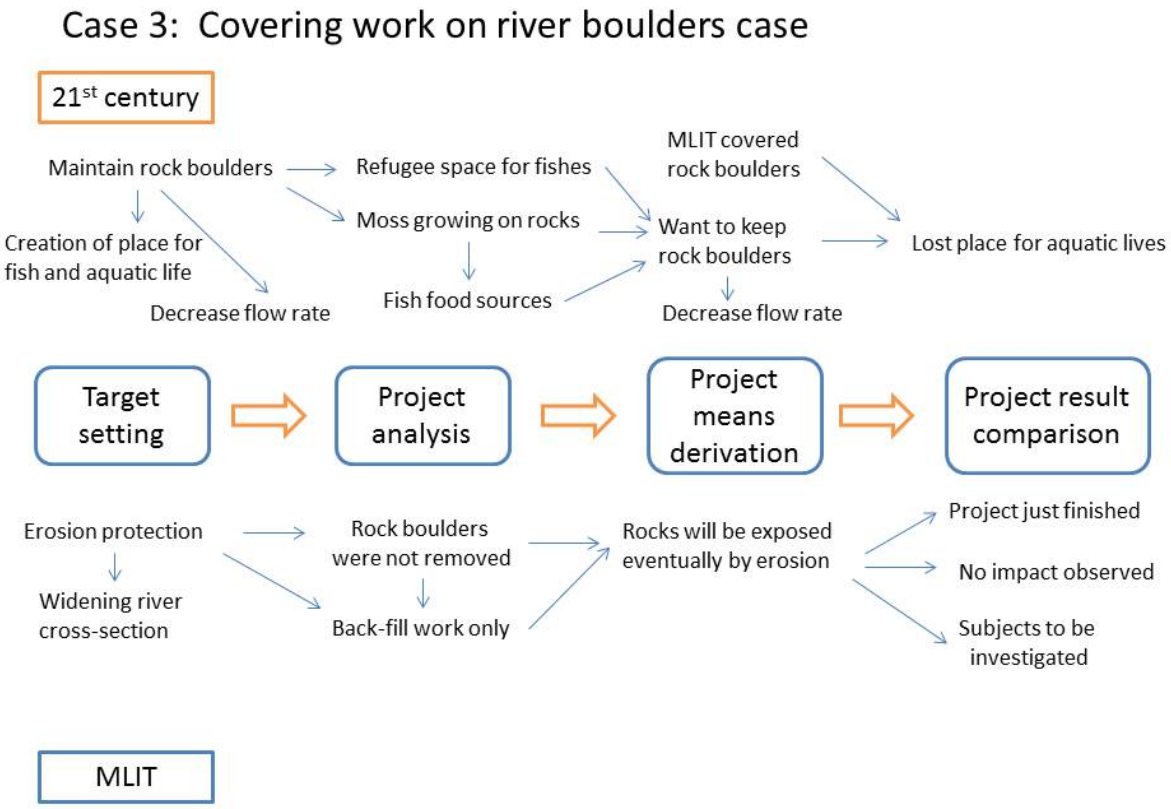

Figure 8 Comparing mental models on covering work

The MLIT constructed the river terrace (in the case 4.2) by filling up soil on top of former river bank where large size boulders were placed (right hand side of Figure 7). The 21st century was concerned about importance of rock boulders. They argued that covering the river boulders and changing into the terrace was to damage aquatic organisms' living space. However, the MLIT claimed that those covered rocks boulders would eventually emerged by the river current influences. It is evident that the 21st century focuses on short-term or even immediate impact whereas the MLIT focuses on the long-term impact. The 21st century mental models comparing with the MLIT mental model towards this case is presented in Figure 8.

4.4 Removal of trees and shrubs in the river channel

Another issue between the MLIT and the 21st century is impact from removal of trees and shrubs in the river channel. This issue was occurred and continued from the similar location as case 4.2 and 4.3. As mentioned earlier, the MLIT target was to improve the Monobe River flood capacity by widening the river channel and improving flow condition. One of the MLIT tasks was to remove trees and shrubs retarding flow capacity in the river channel by excavating and removing all debris

Figure 9 Removal of trees and shrubs in the river channel case

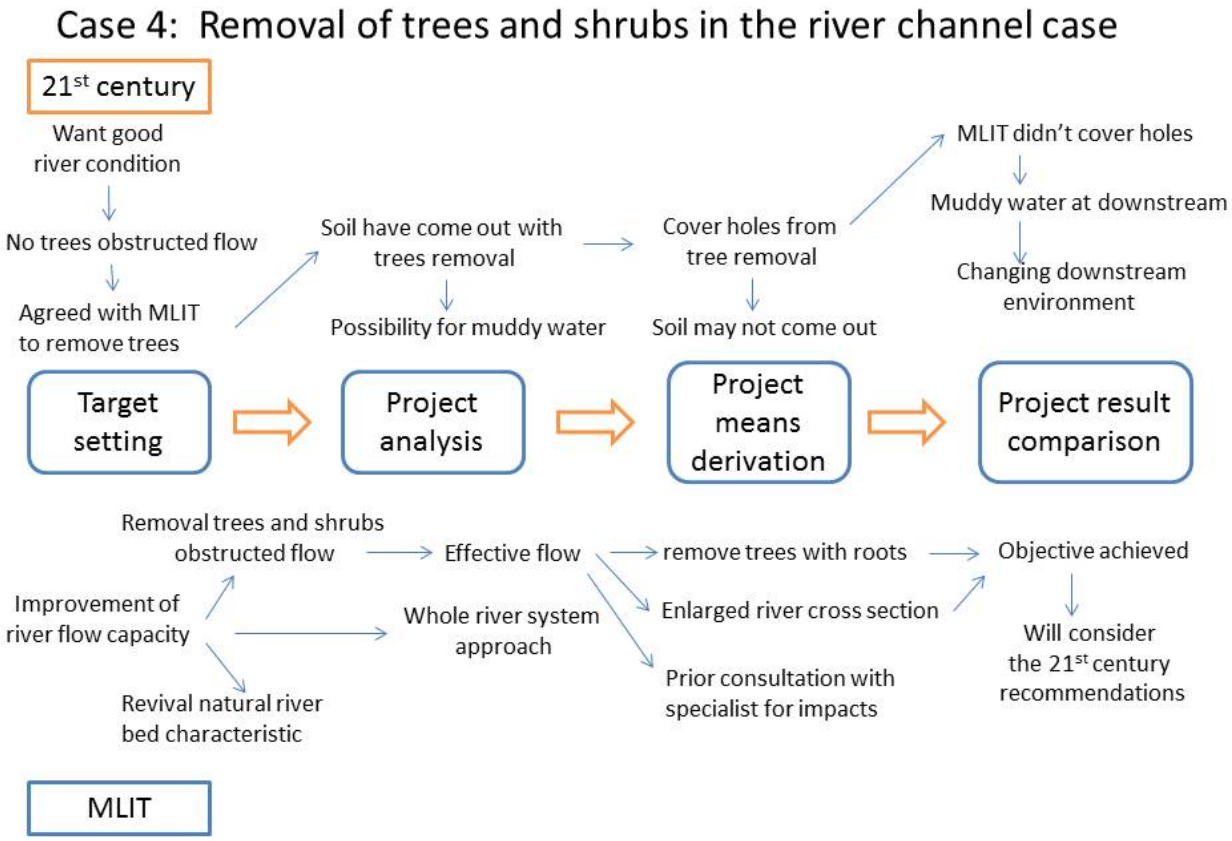

Figure 10 Comparing mental models on removal trees case

(Figure 9). It was observed by the 21st century that the consequence of removal trees and shrubs was sediments and turbid waters occurring at the downstream due to uncovered excavation holes afterward trees removal. This water turbidity affected downstream environmental condition and changed aquatic life ecosystem. Actually, the 21st century agreed with the MLIT in terms of flood capacity improvement by removal of trees and shrubs form the river channel.

However, the 21st century claimed that the MLIT should have more concerned about impacts and consequences of this implemented method to the river environment. Figure 10 presents a comparing mental models between the MLIT and the 21st century regarding this issue.

4.5 Failure of revetment work constructed in the year of Heisei 15th (year 2003)

One issue that the MLIT and the 21st century share the similar opinion was related to a revetment work constructed in the year of Heisei 15th (2003). This revetment work concept was natural type construction utilizing timber from forest thinning and rocks. The failure of revetment work was raised by unexpected water level decreasing which causing revetment wall to expose to the atmosphere. As a result, timbers lost load carrying capacity and bolts became corroded as shown in Figure 11. Both the MLIT and the 21st agreed that water level decreasing was not expected phenomenon that yielded negative impact to the Monobe River improvement and maintenance work. The comparison mental models is shown in Figure 12.

Figure 11 Revetment work constructed in 2003 (top) and current condition (bottom)

5. CONCLUSIONS

In Monobe River improvement and maintenance work, conflict between the MLIT and the 21st century has occurred due to insufficient opportunity for discussion over impacts from project planning and implementation among related stakeholders. Dialogue conversation and comparing mental models of the MLIT and the 21st century were advantages in being able to identify stakeholder mindset to inform stakeholders and researcher understanding of the conflict that was hidden and evident. Summary of comparing mental models that proving clarity to stakeholder situation and objectives regarding issues in the Monobe River is presented in Table 1.

Results from compared mental models between the MLIT and the 21st century from five cases indicated that the both parties are concerned with

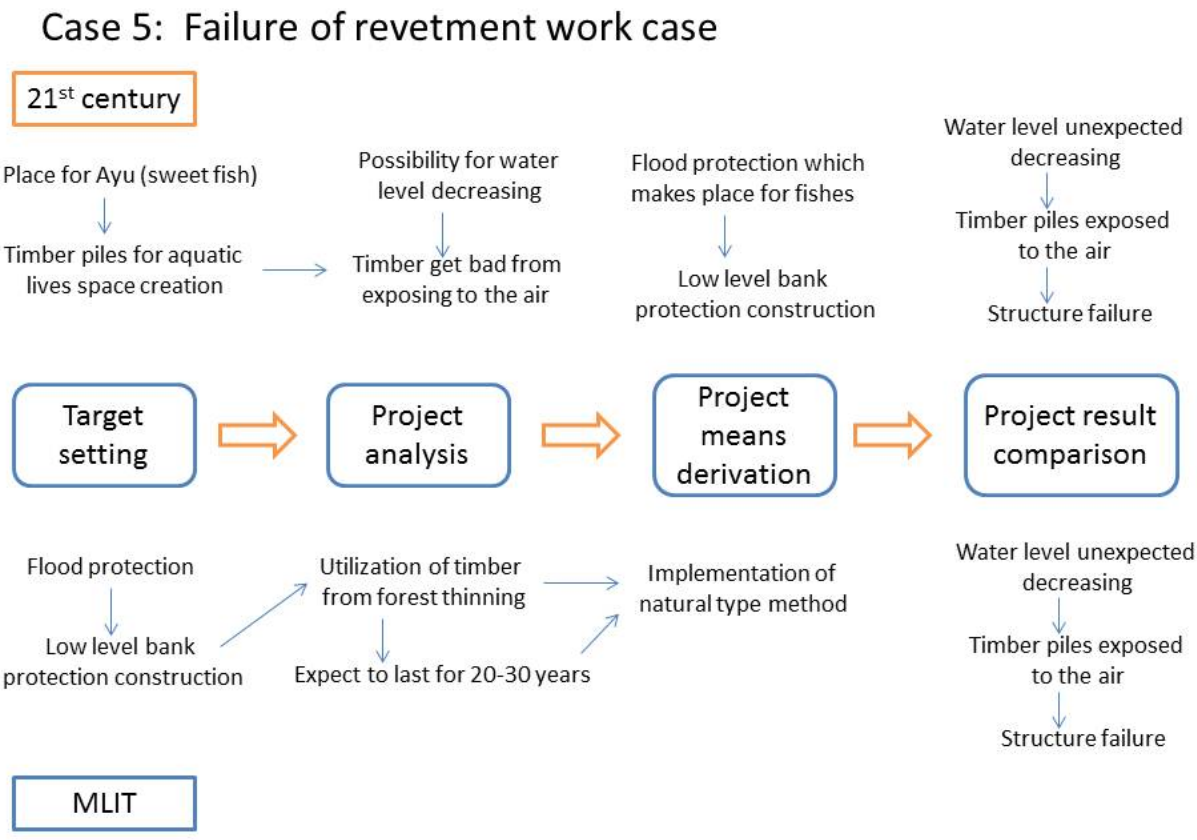

Figure 12 Comparing mental models on failure revetment work

environmental issues in the Monobe River as well as the 21st century. However, many issues have to be studied in environment. Moreover, it is desirable to set the both mid-long term goal and short term goal. The MLIT did not necessarily have sufficient consideration regarding Ayu refugee places, environmental educations for children

		Mid-long term goal	Short term goal
Flood control		MLIT	MLIT
Environment	Ayu spawning	MLIT & 21st	MLIT
	Muddy water	MLIT & 21st	MLIT & 21st
	Access to water side	MLIT	MLIT & 21st
	Aquatic life food sources	MLIT	MLIT & 21st
	Ayu refugee places	21st	21st
	Environmental education	21st	21st

Table 1 Summary of compared mental models

In order to better manage each development and maintenance project implemented by the MLIT, therefore, it is needed to strengthen cooperation between the MLIT and local organizations; for example, fisherman cooperative, Japan Agriculture (JA) and the 21st century, In this river actually, there exists the Monobe river council for conserving clean stream. It consists of multiple governmental, private, and civic organizations and discusses action plans and projects for better river basin management. In Monobe River, there already exists the atmosphere that key stakeholders cooperate to achieve the global optima as well as sufficient establishment of river environmental knowledge.

If the MLIT could utilize experience, knowledge, and wisdoms from the 21st century, implementation of concrete projects discussed in the river improvement and maintenance plan by the MLIT could contribute to more equitable, efficient and sustainable water use and management of the Monobe River.

6. ACKNOWLEDGEMENTS

The authors would like to express our grateful thanks to the MLIT and the 21st century members who gave invaluable interviews and suggestions to this paper.

References

Biggs et al. . (2008). *A preliminary exploration of two approaches for documenting 'mental models' held by stakeholders in the Crocodile Catchment, South Africa.*

Grigg, N. S. (1996). *water resources managment : principles, regulations, and cases.* New York: McGraw-Hill.

Kurata , H., & Watanabe, T. (2008). *Optimization of dam operation rule to improve water environment in Monobe River*. Retrieved 03 21, 2012, from Research Center for Social Management System: http://management.kochi-tech.ac.jp/PDF/COEReport_2008/2.4/02%20HirotoshiKurata-watanabe%20tsunemi.pdf

MILT. (2007). *Monobe River (in Japanese)*. Retrieved 03 21, 2012, from monobeseibikeikaku: http://www.skr.mlit.go.jp/kochi/river/monobeseibikeikaku/home/01gaiyou.html

MLIT. (2007). *River Improvement Measures Taken by the MLIT*. Retrieved 03 29, 2012, from Ministry of Land, Infrastructure and Transport and Tourism (MLIT): http://66.163.168.225/babelfish/translate_url_content?.intl=us&lp=ja_en&trurl=h

ttp%3a%2f%2fwww.mlit.go.jp%2friver%
2fbasic_info%2fenglish%2friver.html

Watanabe, T. (2009). Monobe River Basin Management and Myself. *Journal of Society for Social Management Systems(Peer-reviewed)*.