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An Influence of Social Network on Knowledge Transferring in Flood Mitigation and Preparedness: A case study of Waju Area, Ogaki City, Gifu Prefecture

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Waju (a community surrounded by a dike to protect it from floods) in Gifu Prefecture, one of the most flood-prone areas of Japan has suffered from flood damage. In the 14th century, communities built a ring dike to protect its people. Those dikes were managed by local groups of people aimed at flood control. This paper tries to examine the knowledge of flood mitigation and preparedness which exits in Waju. Moreover it tries to find the influence of social network on knowledge transferring, seek for the factors or motivations of transferring in Waju.

Key Words : *Knowledge Transferring, Social Network, Flood Mitigation and Preparedness.*

1. Introduction

The Ogaki City, Gifu prefecture, is located in the junction of three rivers: the Kiso, Nagara and Ibi Rivers. These rivers surround the Noubi plain, a low altitude flood plain. Flood disaster happens very often in the alluvial plain and delta area of the Gifu prefecture. For over 600 years, people have struggled to protect lives and asset from flood disaster.

Fig. 1: Types of traditional knowledge and technology [1)]

In the past, people had no control system of the rivers; yet life and assets were protected through small scale technology, knowledge, tradition and cooperation in communities. During the late 19th century (Meiji period), many flood control system were implemented by Satsumahan Landlord, Kagoshina prefecture. People were able to safeguard life and assets better by technological interventions such as concrete dikes, check dams, water gates and pump facilities, among others. In earlier times, flooding from the river was considered a natural phenomenon in which people never tried to block the flood but rather developed some knowledge-based tool to reduce the damage. Three important types of traditional knowledge and technology in the Gifu prefecture are depicted in Figure 1.

As the results of physical countermeasures taken by the government in the Kiso, Nagara and Ibi Watershed

Areas in 18th century, the frequency of flood in those areas has been reduced than before. Consequently, importance of the ring dikes became low, and in some cases they were broken in order to renew the land use patterns. After which the importance of the ring dike became low and some were brought down so land can be put to other use [1)]. Recently, Waju community still has cooperation to maintenance of Waju system in a good condition.

The typical knowledge as well-known as Waju is well known among communities without putting it through the education system. Waju, from authors' opinion, is a local knowledge which at the same time is common knowledge among Waju community. Not only knowing what Waju is, but also community members deeply understand the essence of Waju.

What is interesting is, Waju was built more than 600 years ago and even recently, the role of Waju has been decreased up to the declining of annual flood but consequently, the objectives of this paper are set as follows:

(1) To examine flood mitigation and preparedness knowledge in Waju case;
(2) To find an influence of social network on knowledge transferring in Waju case, and;
(3) To seek for factors or motivations of transferring in Waju case.

Table 1: The organization of questionnaire

Total Distribute	Received	Valid	Missing
60	47	28	19

To satisfy those objectives mentioned above, this research has distributed 60 copies of questionnaire to two communities, which seem to be familiar with local traditional knowledge and which may clearly show how the knowledge is transferred, in Ogaki City, for collecting the data with kind cooperation of the Ogaki City Hall. Questionnaires contain open-end questions to satisfy the authors' intention to collect the fact from respondents, which properly was overlooked during the observation by the authors. Rather than checklist questionnaires, the result of this survey was not so good but still reflecting many movements and opinions from the small data.

2. Flood Knowledge in Waju

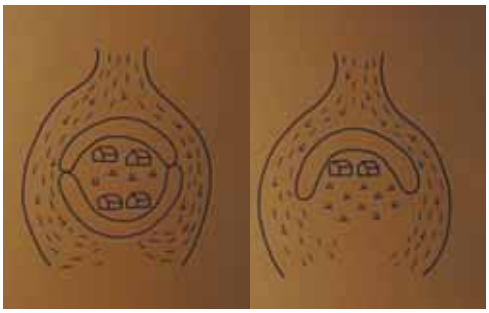

Fig. 2: The origin of Waju (taken by authors)

In the time when residents started to build embankments of Waju, embankments were built to protect direct flow of river, such that they shaped like U or V against the upper of rivers. These types of embankments were called Shirinashi-zutsumi or Tsukizute-zutumi.

Lower place which has no embankments was called Tsukizute. This name is remained as a place name in Ogaki City. To protect backflow from the lower place, residents built embankments in the lower place as well. They were called as Kakemawashi-zutsumi. These embankments got shaped like circles, and were started to be called as Waju. The place inside embankments like figure 2, is called as Kuruwa; it means inside circle. Waju expanded from 1660s in Edo era.

Jo-gui was built to settle water conflicts generated from the heights of embankments. By standing up stakes, residents promised not to build embankments higher than the stakes or lower than (Figure 3).

Fig. 3: Jo-gui (taken by authors)

Waju embankments take a role of not only embankments, but also of important roads

which connect residents between Waju. Because of development of car transportation and upkeep of embankments, they needed gentle slope roads going over Waju and straight roads cutting through Waju, as well as steep slope roads going over Waju. Embankments of Waju are a lifeline for residents inside Waju. In emergency, they pile up sandbags on and close by boards or steel plates straight roads cutting through Waju, to protect from floods.

(1) Flood Mitigation Knowledge

Fig. 4: The Waju protects the community from floods[1)]

a) Waju

To reduce the impacts of flood, traditional ring dikes have been built in the area, protecting several houses and cultivated land areas as shown in Figure 4. This is known as **Waju** (**inside ring**). In historical maps, these types of ring dykes can be observed in several locations, interconnected in many places. A key point of the ring dyke is its maintenance by communities. Every village maintains special committees that look after the ring dykes. This cooperation helps to develop self-esteem and strengthen local community ties. [2)]

b) Hijiri-ushi

To minimize erosion, simple structures have been built on river banks, especially on the winding portions of the river. This structure is called **Hijiri-ushi**, meaning **Grand Ox**, possibly due to its similar form to the ox. The objective of this structure is to reduce the force of the water in the river to lessen the impact of erosion. There are several types of Hijiri-ushi based on the kind of material used. Most common types are shown in Figure 5. Typically, a set of hijiri-ushi consists of 5 structures. In each winding portion of the river (depending on the length of the winding portion), 13-15 sets are usually placed. Nowadays, concrete is used instead of wood to give the structure a longer life span[1)].

Fig 5: Hijiri-ushi made of concrete and Hijiri-Ushi at Nagara River[1)]

c) Drainage System

Waju have been modernized by the progress of water control projects, land improvement and following maintenance. To reinforce embankments and to making drainers make easy that factories and houses were built in Waju areas. Land improvement projects enlarged the areas of arable lands by filling in low-land farm and promoted farm mechanization.

Fig. 6: Left-top: Improved overflow
Right-top: Drainer in Watergate River Drain Facility
Left-bottom: Factory surrounded by embankment
Right-bottom: Land improvement projects
(landfill with sand pump) (all are taken by authors)

(2) Flood Preparedness Knowledge

a) Mizuya

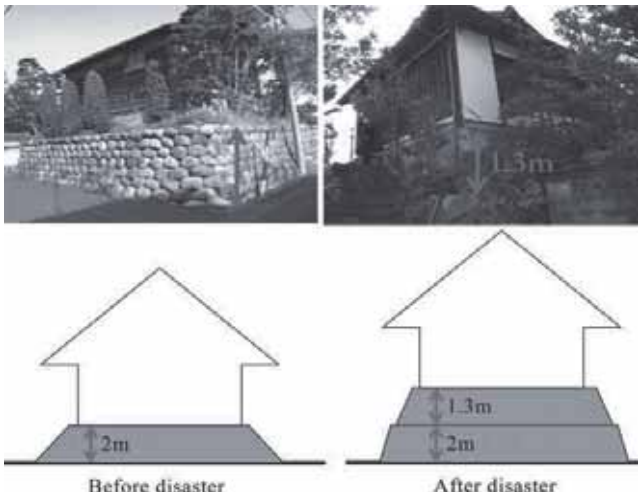

Fig 7: Mizuya, the flood house[1)]

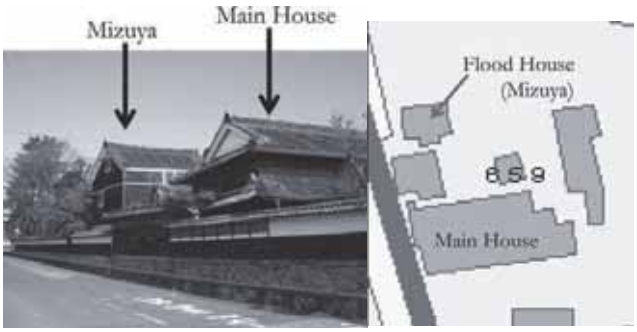

Fig 8: The Mizuya (Flood House)'s plinth height increased after the 1896 flood disaster[1)]

In order to construct those technologies, they are criteria and condition as mentioned follow: for Ring Dike, it needs an agreement of Community-Make management team to construct the construction. Evacuation House needs agreement of Family and need to research type of floods with depth of water using previous disaster records [1)]. Grand OX will decide where to install it and decide the material for the construction by management by local flood control team who representative of whole community. And both Prepared Boat and Lift Up Buddhist Family Alter depended on the family decision (From authors' interview and survey on 17th October 2008).

To prepare from floods, houses for evacuation called Mizuya have been built (Figure 7). Well-off families commonly have the Mizuya in addition to their main houses to use in case of flooding. Initially, the Mizuya was built as a storage room to protect household assets. When a severe flood disaster occurred in 1896, the Mizuya's plinth height was only 2 meters. When the flood destroyed the Mizuya, house owners had the Mizuya reconstructed by raising the plinth level 1.3 meters higher than the previous level (Figure 8). The Mizuya was further modified so that people can stay inside for a longer period. The modified Mizuya consisted of two rooms, a storage room and a toilet. Well-off families also have an emergency boat for evacuation (Figure 9). Moreover, Buddhist Family Alter is important item in this area. This system lifts up alters in order to protect them from submerging (Figure10).

Fig 9: Age-fune (Preparedness Boat)
(left taken by authors and right from [1)])

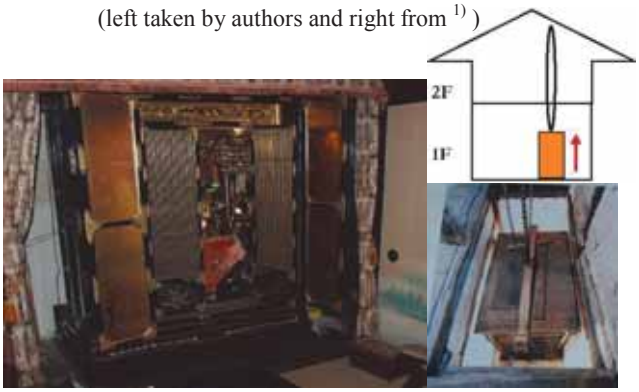

Fig 10: Age-Butsudan
(Lift up Buddhist Family Alter) System
(taken by authors)

3. Theoretical Framework

This research states on 2 main concepts which are: Knowledge Transferring and Social Network. This part will briefly review and introduce those concepts mentioned above. Finally, it tries to link both concepts and shows how those concepts are related.

(1) Knowledge Transferring

University of Toronto study defines Knowledge Transferring as the process of transferring nearly 100% of a subject's essential knowledge into long-term memory. Knowledge transfer is complete when the individual is able to apply this knowledge to appropriate situations. Knowledge transfer aims to satisfy the epistemological need for understanding and explaining the nature of knowledge transfer itself. In addition, knowledge transfer is theorized by distinguishing between situational, source, transfer, relational, recipient, utilization and organizational context[4].

As well as Malhotra who gives the short definition of Knowledge Transferring as "Movement of knowledge from one location to another." He also introduces 4 different modes of knowledge conversion which are mentioned as **Socialization, Externalization, Combination and Internalization.** He argued that **Socialization** is the process of sharing experiences and thereby creating tacit knowledge, such as shared mental models and technical skills. The key to acquire tacit knowledge is experience. Without some shared experience, it is extremely difficult for one person to project her/himself into another individual's thinking process[5].

His argument supports that the tacit knowledge as Waju is suitable for transferring modes as Socialization modes. Here, Social Network has automatically been involved with this modes of transferring.

(2) Social Network

David Lazer (2000) raises the measurement of the concept of tie strength. Using survey data on friendship ties, apply multiple indicator techniques to construct and validate measures of tie strength and he agued that "a measure of closeness intensity is the best indicator of strength[3]."

Hence this research prioritizes the strange of the ties according to the closeness as a kinship, that Waju members have answered in the earlier mentioned questionnaire, as following:

Fig 11: The strange of ties in this research (by authors)

a) Myself

b) My Relative: as parents, grand parents, children, etc.

c) My Friend: as Friends, Co- Worker, Community, Neighborhood or one who you are not stranger and used to have any activity together but your relative.

d) My Government: as Government Official, Staff, etc.

e) Stranger

The strange of the typed also mention **Myself** which in this paper **will not conclude** it to analyze the effectiveness of transferring, because transferring concept in this paper is transfer knowledge, from someone to someone. Hence **Myself**, it will be excluded from analysis (0 Level of Network tie).

In the same way as **"Stranger"**, which show here to created the limitation of the tie. For Stranger, its call "An absent-tie" and this paper **will not include** it in the analysis. That is why this level is also 0 as the same as **Myself**.

The important point for this paper is **"Which types of Social Network is the best network to transfer flood mitigation and preparedness knowledge?"** The question mentioned earlier finally has becomes this

paper's **Research Question.**

(3) The Conceptual of Social Network and Knowledge Transferring

David Lazer (2000) Agued that Social Network has an influence on Information Transferring and in the way that Strong –Tie Network has trend to good at transfering information which is not complex and trend to be experience knowledge rather than theoretical knowledge. Meanwhile Weak- Tie Network is workable with complex and technical Knowledge. Considering Waju knowledge, it is obvious that Waju trends to be classify as experience knowledge not as theoretical one. Therefore, this paper has suspicious to it and set the **Research Hypothesis** as **"Stronger- Tie Social Network has influence to Knowledge Transferring Effectiveness as Waju rather than the Weaker- Tie Social Network."** To make the statistic prove, this paper set the **Statistic Hypothesis** as follows:

$$H_0 = \mu_1 = \mu_2 = \mu_3 \quad (1)$$

$$H_1 = \mu_1 > \mu_2 > \mu_3 \quad (2)$$

H_0 : Null Hypothesis : Strong- Tie has effectiveness to transfer knowledge in the same level as Weak- Tie

H_1 : Alternative Hypothesis : Strongest- Tie has effectiveness to transfer knowledge rater than Weakest- Tie

μ_1 : Variable 1: The knowledge transferring effectiveness of **"My Relative"** Group

μ_2 : Variable 2: The knowledge transferring effectiveness of **"My Friend"** Group

μ_3 : Variable 3: The knowledge transferring effectiveness of **"My Government"** Group

(4) Research Framework

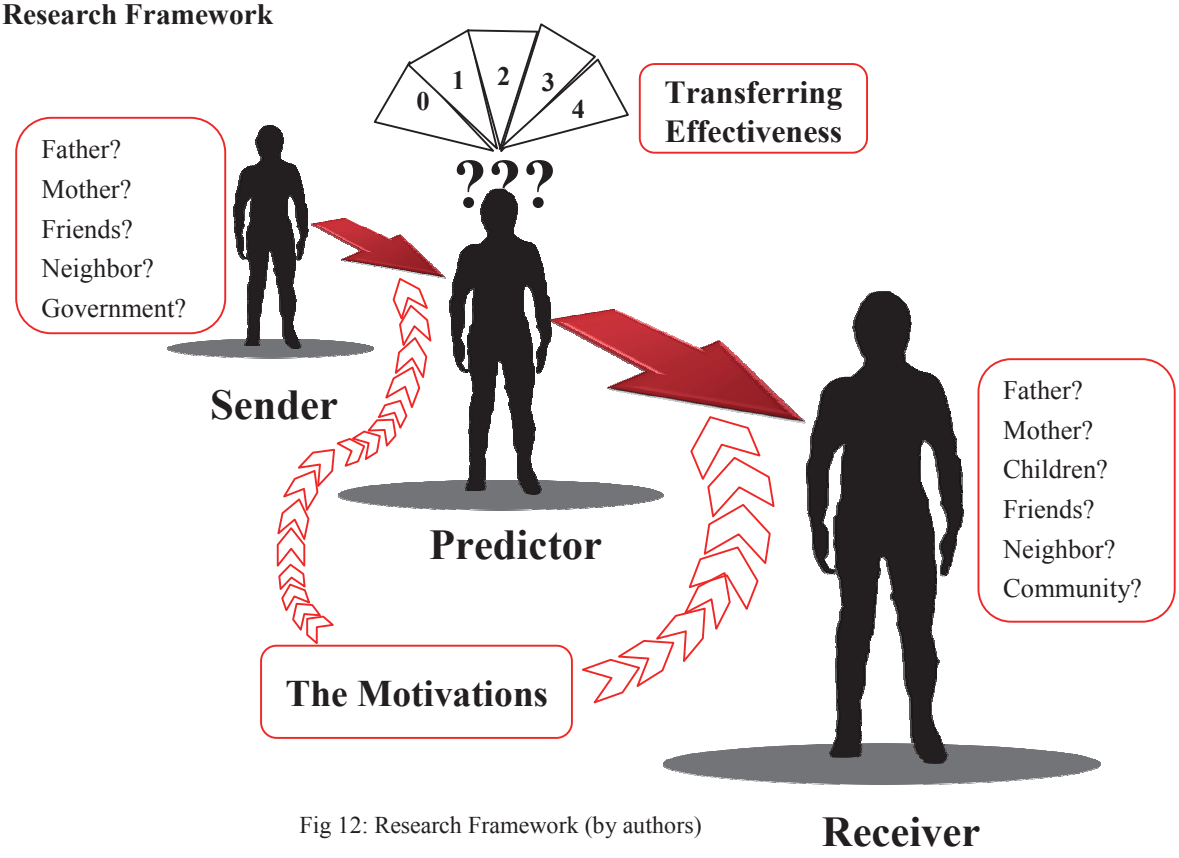

Fig 12: Research Framework (by authors)

To illustrate the framework of this paper, the authors have drawn the picture to simplify the process of thinking and also shows the data which is needed for analyzing. This paper tries to find out who the best effective senders (indicate by the level of transferring) is and then classify which social network tie they belong to, as well as receiver to understand the tendency of transferring for the next generation. Meanwhile try to understand the factors or motivations of transferring.

4. The Influence of Social Network to Knowledge Transferring in Waju

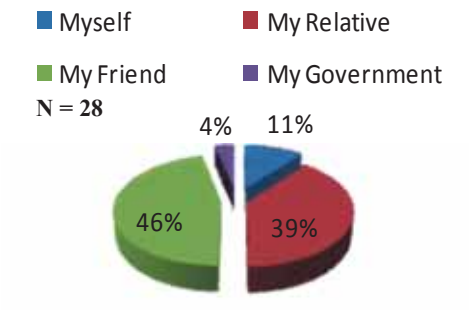

Fig 13: The percentage of Sender

(1) Social Network in Knowledge Transferring

From the observation and questionnaire interview found that the **Predictor** trended to had the most **Sender** in **"My Friend"** Group and **"My Relative"**, **"Myself"** and **"My Government"** in ordering. The proportion in percentage is shown in figure 13

In the same way as **Receiver** who the predictor claimed that the most social network group which willing to transfer the knowledge to is **"My Relative"** Group and **"My Friend"** in ordering. The proportion in percentage is shown in figure 14.

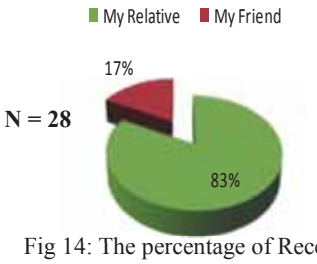

Fig 14: The percentage of Receiver

Table 2: The level of knowledge transferring effectiveness.

Sender	The Level of Knowledge Transferring Effectiveness						Total	Average Score
	Level 1 *Value = 0	Level 2 *Value = 1	Level 3 *Value = 2	Level 4 *Value = 3	Level 5 *Value = 4	Level 6 *Value = 5		
My Relative μ_1	-	-	2	3	5	1	11	3.45
My Friend μ_2	-	-	-	5	3	5	13	4.00
My Government μ_3	-	-	1	-	-	-	1	2.00
Total	-	-	3	8	8	6	25	3.38
Percentage %	-	-	12%	32%	32%	24%	100%	

Level 1 = Do not understand at all (0 Score for Non Trasferring)

Level 2 = Understand and believe that this knowledge can reduce the flood damage (1 Score for Collecting Knowledge)

Level 3 = Understand, believe and using this knowledge to deal with flood (2 Score for Using Knowledge)

Level 4 = Understand, believe, using this knowledge and have plan to adapt/adjust in the future (3 Score for Organizing Knowledge)

Level 5 = Understand, believe and already adopt/adjust this knowledge before using (4 Score for Adapting Knowledge)

Level 6 = After all understanding and adaptation, I found my own method to deal with flood (5 Score for Innovation Knowledge)

*The average score came from the no. of predictors who chose this choice multiply by the value, gave by the authors as shown eariler.

From Table 2, the number of predictors who, answering about the Level of knowledge transferring effectiveness is **Level 4 and Level 5**, are equal at 8 predictors. It means the predictors understand, believe, use this knowledge and have plan to adapt/adjust in the future and understand, believe and already adopt/adjust this knowledge before using . The level of effectiveness from this study is pretty good. No one chooses the choice 'do not uderstand at all' or 'just understand and believe without using the kmowledge' (Level 1 and 2).

The bigest average score is the effectiveness from the sender as **My Friend** group at 4.00 and **My Relative** 3.45 and **My Government** at 2.00 in ordering. The result of this study is

$$\mu_2 > \mu_1 > \mu_3 \quad (3)$$

Therefore, this paper's hypotheses are **"INVALID"**, according to the first hypothesis, ($H_0 = \mu_1 = \mu_2 = \mu_3$) Strong- Tie has effectiveness to transfer knowledge in the same level as Weak- Tie is **"INVALID"** and similarly as Second Hypothesis, ($H_1 = \mu_1 > \mu_2 > \mu_3$) Strongest- Tie has effectiveness to transfer knowledge rather than Weakest- Tie is also **"INVALID"**.

(2) Motivation of Transferring

In the past, Waju community has struggled to survive from flood many times. The old citizen had to deal with flood together and it brought out that Waju was successful. Belief in Waju and Community flood management skill came along with successful, the feeling of proud and self esteem has increased, and Waju community has trend to maintain their Waju knowledge in many ways. Motivation to transfer knowledge is awareness that they are living in flood risk area, that is, "Flood may come every minute and it always generates huge damage when we are careless." It is necessary for them to learn how to protect themselves from flood. Moreover, they realized and worried about the risk of next generation's safety and they are willing to protect their prosperities.

5. Conclusion

Consideration about transferring experience knowledge like flood mitigation and preparedness knowledge as Waju should concentrate on transferring among communities, neighborhoods and friends according to the result of this paper. Even though, the trend of transferring to next generation (receiver) from current knowledge holder (predictor) is mentioned pretty much to relative, kinship person as children and grandchildren. It is not surprising that people tend to think that they should transfer important information to the people who they have closeness to and anxiousness about the most. It is so called Strongest Tie.

According to this study, the effective transferring knowledge should be from communities, neighborhoods or friends (μ_2). Encouraging strengthening community is one recommendation to maintain the level of transferring knowledge in the future. For the predictors, besides transferring the knowledge among relative people, should also try to transfer knowledge to people in their community, neighborhoods or friends as well. To emphasis understanding of wisdom that ancients leant in fighting against water together within their community, to understand the weight of victims, and to raise each of citizen consciousness of disasters, that is, not to leave our life to others, are important.

As a suggestion of this paper, to strengthen communities in Waju, community leaders (Mentioned as "Jichi-kai") can be the great supporter in Waju case. The research found that Jichi-kai was most mentioned by the respondents to be the first contact person to ask help and they were ready to follow the rules of Jichi-kai if flood occurs. Jichi-kai can operate some activities in the community in order to stimulate opportunities of the community to transfer knowledge among them. The activities can be started from making documents about flood knowledge together in community then next trying to find the channel to distribute all knowledge in the community.

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