

修 士 論 文

The reconstruction of water supply
in a post-conflict country
—In case of Dili, Timor-Leste—

紛争後国における水道事業の復興
—東ティモール首都ディリを事例に—

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主査 _____

Table of Contents

1. Introduction	1
1.1. Background	1
1.2. Reason for selected	2
2. Overview of the current situation in Timor-Leste	3
2.1. Conflict and independence	3
2.1.1. Way to independence	3
2.1.2. Development policy	4
2.2. Post-conflict society	5
2.2.1. Timor-Leste Review	5
2.2.2. Features of post-conflict society	7
2.3. Literature Review	9
2.3.1. Reconstruction in post-conflict societies	9
2.3.2. The effects of infrastructure for poverty reduction	10
2.3.3. Infrastructure to be managed well	10
3. Perspective of analysis	13
3.1. Phase	13
3.2. Subject	14
3.3. Objective	14
3.4. Methodology	15
4. The case	16
4.1. Overview of Dili water supply	16
4.2. Support for water supply	20
4.2.1. Aid projects	20
4.2.2. Aid policy	22
4.3. Current problems	23
5. Discussion	25
5.1. The tariff collection	25
5.2. Comparison to other countries	26
5.2.1. Developed countries	26
5.2.2. Developing countries	27
5.2.2.1. Taiwan	28
5.2.2.2. Malaysia	29
5.2.2.3. Cambodia	30
5.2.2.4. Sri Lanka	30
5.2.2.5. Uzbekistan	31

5.3.	Way to good management	33
5.3.1.	The standard	34
5.3.2.	Technical concern.....	36
5.3.3.	The reasonable support.....	37
6.	Conclusion.....	40
6.1.	The support for water supply system in Dili.....	40
6.2.	How can DNSAS collect tariff?.....	40
	Reference.....	41
	Acknowledgement.....	47

Table of Figures and Tables

Figure 1	The population in Timor-Leste as of 2004 and 2010	6
Figure 2	The transition of GDP and growth rate	7
Figure 3	Map of Literature review	12
Table 1	Transition of phases after conflict in Timor-Leste.....	13
Table 2	The current situation of connection to the taps.....	16
Table 3	Summary of requirement for water service level to promote health	18
Table 4	Complaints from consumers (January-July, 2012).....	18
Table 5	Water tariff for each sector	20
Table 6	The aid projects facilitated for water supply system in Dili in emergency phase and reconstruction phase	21
Table 7	Number of items included in drinking water standard (guideline).....	34
Table 8	Level of parameter in drinking water standard (guideline).....	35

1. Introduction

1.1. Background

Despite water is indispensable for all people, there are still millions of people who do not have access to safe drinking water. The United Nations (UN) advocated Millennium Development goals (MDGs) and set a target for water to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation (target 7-C). It encourages international aid agencies to provide access to safe water for everyone. Aid agencies constructed many facilities for water supply. Thanks to these efforts, it seems that the MDGs target 7-C will be achieved in most regions. Timor-Leste is one of the countries which will achieve. Especially the situation in urban areas is better. The ratio of access to improved water source in urban areas has been constantly increased and the target was almost achieved in 2007. However, having access to improved water source does not mean having access to stable supply of drinkable water. That is, achieving MDGs is the first step to supplying drinkable water.

In developed countries, people take it for granted to get good quality of tap water. On the other hand, there are few developing countries which supply drinkable water. As seen in the custom that people get drinking water by boiling tap water or purchase bottled water, it seems that people in developing countries do not think that the tap water is drinkable. This is different from developed countries. However, the water supply systems constructed by aid agencies within the context of development assistance aim at supplying drinkable water. Is this reasonable?

This study is inspired by the idea that the reasonable support for water supply system in developing countries is different from that of developed countries. If it is true,

who should what for sustainable water supply? This study focuses on the water supply system in Dili, the capital of Timor-Leste, and the relation with support by aid agencies.

1.2. Reason for selected

There are two reasons why this study focuses on Dili. First, it is easy to implement tactical city planning after conflict because of devastated situation¹. The scale of constructing facilities for water supply is so large that it needs to turn over the road and develop lands. The end of the conflict is the chance to make a significant progress. Timor-Leste has experienced conflict and everything was devastated in Dili. Therefore, Dili can be a good example of development of water supply system. Second, the poor suffer from water problem more than rich people². Whereas most consumers can get tap water only 3 hours on average, few rich people can get water 24 hours by using facilities such as tanks on roofs. There are actually inequities as for water. For these reasons, it is worth considering the development of water supply system in Dili.

¹ MacDonald (2005).

² ADB (2001).

2. Overview of the current situation in Timor-Leste

2.1. Conflict and independence

2.1.1. Way to independence

Timor-Leste is a new country which won independence from Indonesia in 2002. After the end of the rule by Portugal, in 1975, Timor-Leste has been occupied by Indonesia. Indonesia strongly suppressed the movement of Timor-Leste for separation from Indonesia strongly and Timor-Leste struggled against Indonesia from the start of ruling by Indonesia.

The situation changed in 1998 when Soeharto government in Indonesia was collapsed. The referendum for independence was held in 1999 and people in Timor-Leste supported independence from Indonesia. Indonesia did not agree to the result and made the army, which was on the annexing side backed up to attack the independence side. The army invaded Dili and other cities. It is said that a number of people were killed and more than 200 thousand became refugees. Moreover, the buildings or infrastructures were destroyed and Dili was fully devastated. The UN organized International Force for East Timor (INTERFET) and the UN Transitional Administration in East Timor (UNTAET) to control this situation.

After the start of intervention by the UN in 1999, the Timor-Leste got safer. In 2001, parliamentary election was held under the supervision of the UN and Revolutionary Front for an Independent East Timor (FRETILIN) won the election. In 2002, the government of the people in Timor-Leste was established and Timor-Leste officially achieved independence. Humanitarian aid by international society continued

after the independence. The UN Office in East Timor (UNOTIL) started fostering Policia Nacional de Timor-Leste (PNTL) to take up the role of maintenance of security.

However, in 2006, the soldiers in national army who were dissatisfied with the gap of treatment rioted in Dili. A number of buildings and infrastructures are destructed during the riot. The UN Integrated Mission in Timor-Leste³ (UNMIT) was organized to overcome this crisis⁴ and strengthen the security. Moreover, some incidents such as the attempted assassination of the president Jose Ramos-Horta in 2008 and riots resulted in delay of parliamentary election from 2006 to 2012. Therefore, anxious factors for the safe and security still remain in Timor-Leste. She is making effort to improve the situation as the chairperson of g7+⁵.

2.1.2. Development policy.

When achieved independence, National Development Plan (NDP) was published by the lead of international organizations and donor countries such as the UN. NDP aimed at expanding legislative institutional capacity, development of infrastructure, education and health in the short run (five years). Acceleration of development was anticipated to the basis on these foundations⁶. This is followed by National Priorities published every year from 2008 to 2010. National Priorities were published based on the consideration of the peace and stability that are two most important elements to achieve long term state building and development and made the government of Timor-Leste and aid agencies to cooperate. In 2011, Strategic Development Plan was published. This is the first plan published exclusively by the government of Timor-Leste herself and aims at becoming a semi-developed country by 2030.

³ Withdrawal is scheduled by Dec 31, 2012.

⁴ Website of UNMIT.

⁵ The conference of countries which have possibility to go into conflict.

⁶ National Development Plan (2002).

Through the transition of these development policies, the government of Timor-Leste has put the priority first on the public safety and security by around 2008, and then on food security and development of infrastructures⁷. When SDP was published, the government showed their target that she aims at realizing shift from aid to investment⁸. The development of Timor-Leste is valued as “the fastest development in the world,” on the other hand, the series of policies are infamous as their ambiguity⁹.

2.2. Post-conflict society

2.2.1. Timor-Leste Review

Figure 1 shows the transition of population from 2004 to 2010 in Timor-Leste and Dili. The increase rate of Timor-Leste is 15.5% and that of Dili is 33.1%. Also, the ratio of Dili in Timor-Leste has increased from 19.0% (2004) to 21.9% (2010). This shows that the population increased rapidly after the end of the conflict and that the concentration of population to Dili also progressed fast.

⁷ Ministry of finance, the government of Timor-Leste (2010).

⁸ For example, Japan decided to facilitate a project as loan in 2012.

⁹ Asahi (2011).

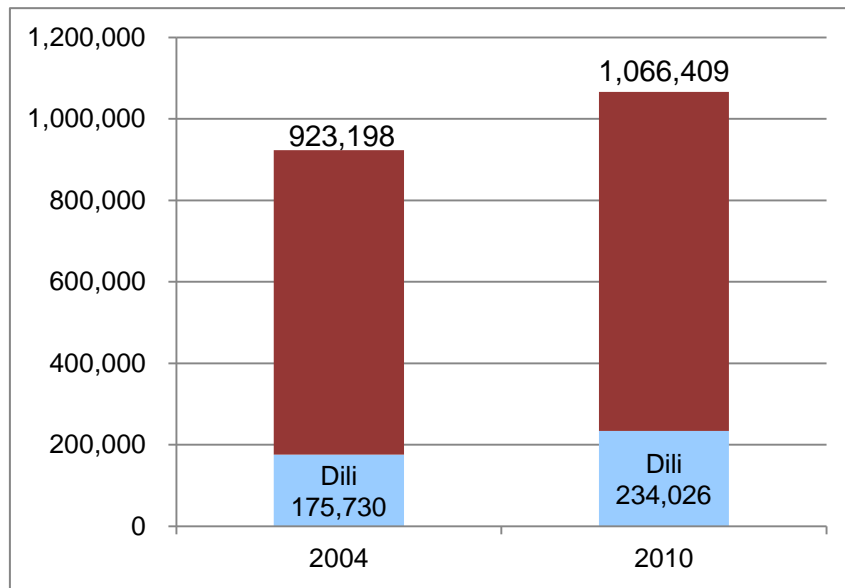


Figure 1 The population in Timor-Leste as of 2004 and 2010

(Source: Timor-Leste population and housing census 2004 and 2010)

The economy has been also rapidly developing. Figure 2 shows the GDP per capita (PPP) and the GDP growth rate. Although GDP growth rate used to be low immediate after the independence, it has been constantly more than 5% since 2007. This is due to export of oil and natural gas which are abundant in Timor-Leste. The dependent ratio of natural resource in national budget is about 90%. This implies that the increase of economic indicator such as GDP does not mean development because industries such as agriculture and manufacturing do not develop. It is said that Timor-Leste would possibility fall in resource curse in the future¹⁰. Actually, Timor-Leste is still counted as one of Least Developed Countries and the proportion of people living below poverty line was 41%¹¹ (2009 estimated).

¹⁰ Ibid.

¹¹ Website of CIA.

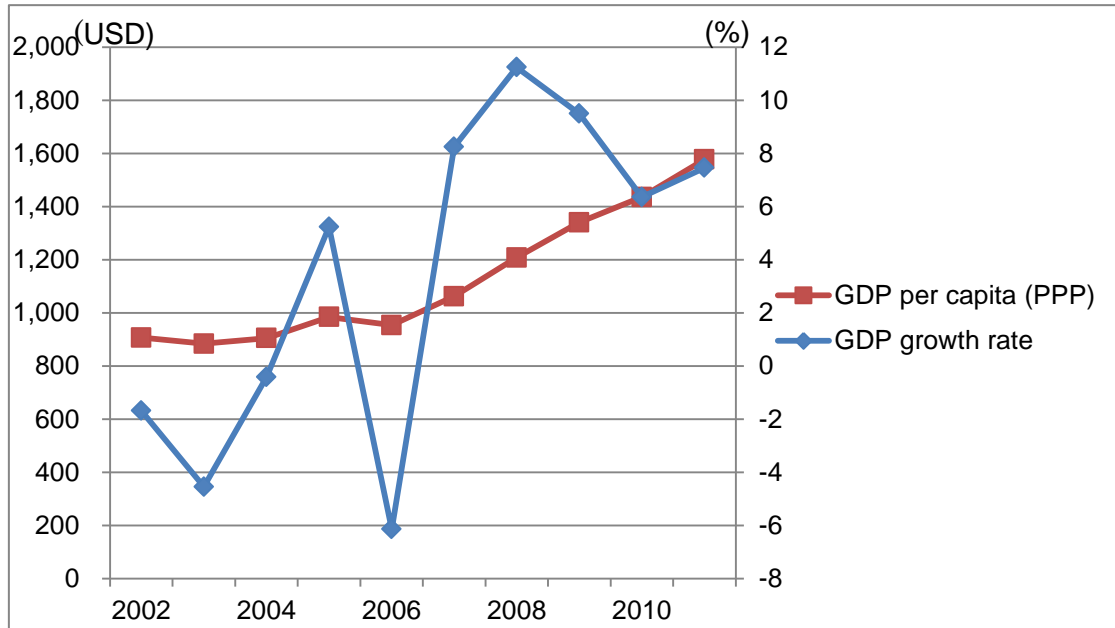


Figure 2 The transition of GDP and growth rate

(Source: World Bank)

2.2.2. Features of post-conflict society.

When consider the development process of Timor-Leste or Dili, the experience of conflict must be considered. This feature should also be considered when develop water supply system.

First one is lack of capacity. Since Timor-Leste was one of the prefectures in Indonesian era, most people who were in charge of important role for the foundation of this area came from Indonesia¹². They were the elites of Indonesia. After the conflict, the elites went back to Jakarta or other part of Indonesia and there were only local people who were not acknowledged. Thus, this is the first time for Timor-Leste to govern a country by herself. Moreover, attacks and destructions caused losing knowledge such as maps, manuals and documents. This prevented Timor-Leste from smooth transition to reconstruction after the conflict. When apply this situation to Dili

¹² Haughton (2002).

water supply, in respect of human resource, there were and are not people who can operate and manage facilities for water supply. Lack of operators and managers made the government to adopt few people who hardly know about water supply. For example, one manager had been farmer before conflict.

Second one is weak market. The conflict collapsed the distribution economy of Timor-Leste and the flow of goods slowed down. Although the current situation is better than immediate after the conflict, as can be seen in the situation, Timor-Leste depends largely on oil and natural gas, it cannot be said that the market for all goods has been developed. Because of the weak market and the lower extent of industrial development, the materials for improving quality of water both water purification system and the materials used in water treatment plant are not diffused. Therefore, there have been difficulties to purify water at the end of the pipes and to produce clean water at the head of water production. This is one of the reasons for consumers to have difficulties to get clean water.

Third one is rapid increase of population. As oppose to the elites going away from Timor-Leste, the population in Dili has increased from 175,730 (2004) to 234,026 (2010) as shown in Figure 1 The population in Timor-Leste as of 2004 and 2010. The increase was caused by two factors. One is the large movement population who evacuated from the conflict and the other is the immigration of people who are looking for jobs because of economic problem. There is large number of spontaneous return of refugees with peace¹³. The conflict caused a large number of refugees and the return of 180,000 refugees that was quarter of the population of Timor-Leste¹⁴. The movements and the fact that Timor-Leste does not have any industry other than agriculture made people to look for jobs which they can get more money. Both factors resulted in dense

¹³ Haughton (2002).

¹⁴ Ibid.

population in Dili. Rapid increase of population means rapid increase of demand for water supply. Therefore, aid projects for maintenance of water supply system should take into account the demand.

Since Timor-Leste is a post-conflict country, she needed “Quick wins¹⁵.” While target that aims at supplying drinkable water for 24 hours in the long run must be needed, target that is far from comprehensive but brings gains to a number of people are strongly needed stronger in this situation to recover from the catastrophic situation as soon as possible. Therefore, different ways of support should be considered.

2.3. Literature Review

2.3.1. Reconstruction in post-conflict societies

In general, international organizations start reconstruction immediate after the conflict. The situation for development is different between post-conflict countries and other developing countries.

It is pointed out that the recurrence risk of conflict within five years in countries which have experienced conflict are 44%¹⁶. In case of Timor-Leste, as mentioned above, political unrests happened in 2006 and 2008. International organizations implement support for economic development and humanitarian aid. Economic development is one of the factors that can substantially reduce the recurrence risk of conflict; however, it takes long time¹⁷. Moreover, the elites in these countries do not have capacity to overcome the situation. For example, institutional capacity is scarce

¹⁵ A concept advocated in UN millennium project and saying, although far from comprehensive, some Quick Wins could bring vital gains in well-being to millions of people and start countries on the path to the goals (UN, 2006).

¹⁶ WorldBank (2003).

¹⁷ Soderbom (2008).

and corruption is high, and so on¹⁸. Therefore, aid agencies should analyze the situation and consider the appropriate way of aid when support for post-conflict countries.

2.3.2. The effects of infrastructure for poverty reduction

A number of people living in developing countries are suffering from poverty and the living standards remains low. In general, infrastructures are said to be one of the contributors for poverty reduction¹⁹. It is said,

Infrastructures have an effect for chronic poverty reduction directly and indirectly. Stabilization of production process through preparation infrastructures for disaster prevention, stable supply of electricity and water, consolidation of markets of goods and services, labor, and funds through preparation of roads, railways, ports, and information systems, and stabilization of the price of goods and services and wages can be quite important for transient poverty reduction²⁰.

However, these studies are discussed based on an assumption that infrastructures are managed and functioned well. In developing countries, while some infrastructures contribute to development economically and socially, exist many infrastructures are left not being used. Then, what is the decisive factor for good management?

2.3.3. Infrastructure to be managed well

The studies which discuss well managed infrastructures are divided into two groups. One is about the appropriate technology and the other is implementation of infrastructure construction.

¹⁸ Elbadawi (2008).

¹⁹ Calderon & Serven (2004).

²⁰ Sawada (2000).

Appropriate technology is defined as the technology which (1) must be sustainable and (2) must be locally acceptable and adapted²¹. The less developed the economy is, the larger the destruction probability gets²². It is implied that when construct or refresh infrastructures in developing countries, it is not appropriate to construct as same level as developed countries. The substitution of quantity for quality is referred to and it is said that in respect of construction of infrastructures,

*Speeding up construction may have a cost in terms of quality, so we must now take into account the possibility that sacrifice of quality may be compensated by more rapid construction of a given quantity or -and this comes to essentially the same thing- by an increase in quantity.*²³

The mainstream of support for infrastructures in developing countries is to include both hard components and soft components. That is, since the smaller capacity makes developing countries not to manage infrastructures well, aid agencies are required to foster the people who will be in charge of managing. Focusing on post-conflict countries, while infrastructures can contribute to peace building in post-conflict countries, there are tradeoffs or negative impact to them²⁴. This is an example that shows that a lack of capacity impairs the effects of infrastructure. That is, hiring foreign technicians to make up for lack of managers impairs fostering local workers. It is suggested that it is useful to develop infrastructures strategically but just restore as original when reconstructing infrastructures which are devastated in conflict²⁵.

²¹ Jurvelius (1997).

²² Tsunokawa and Nisino (1999).

²³ Hirschman (1967).

²⁴ Yoshida & Yamamoto (2007).

²⁵ MacDonald (2005).

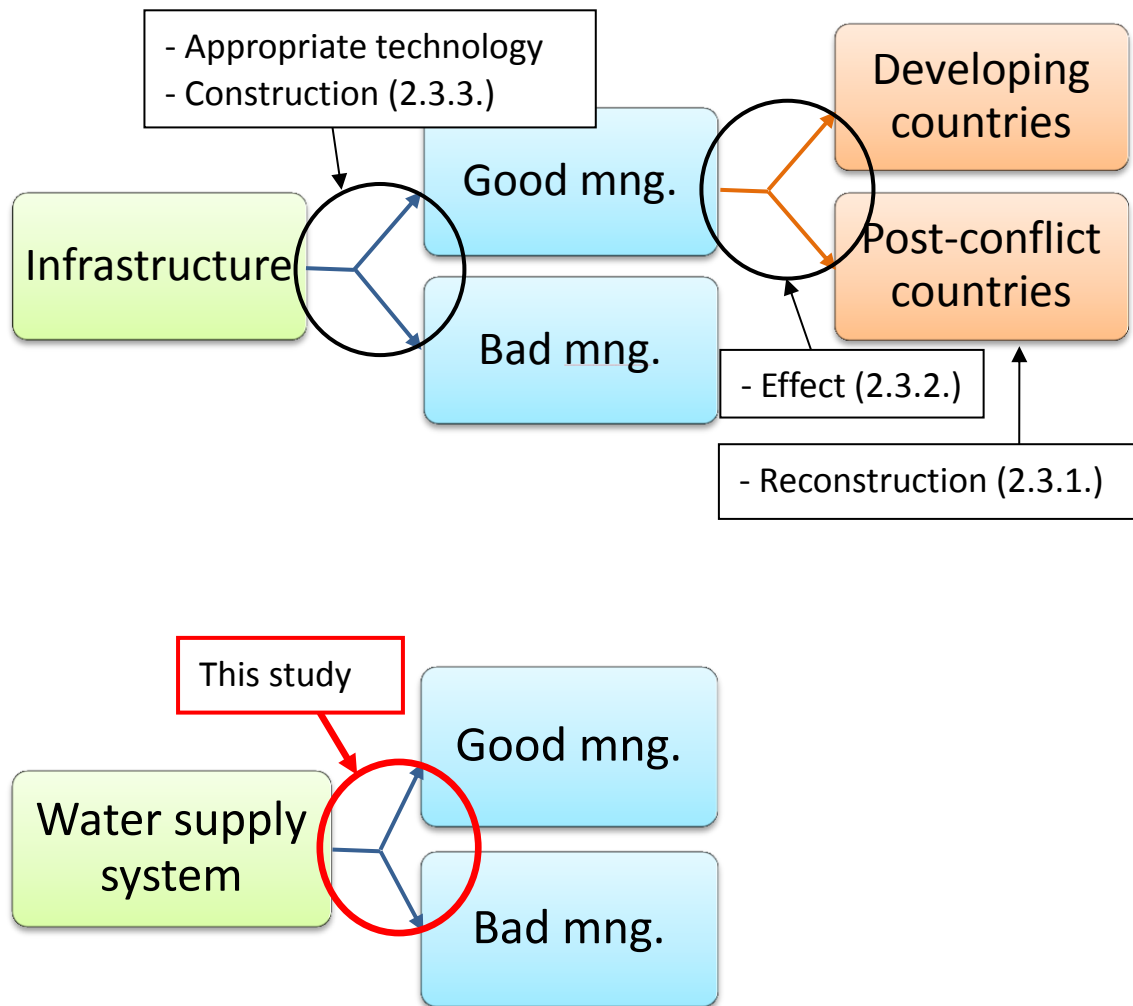


Figure 3 Map of Literature review

(Source: made by author)

3. Perspective of analysis

3.1. Phase

It is said that when considering the development process in post-conflict society, it is effective to divide the process into three phases, emergency phase, reconstruction phase, and development phase²⁶. Table 1 shows the transition of phases in Timor-Leste.

Table 1 Transition of phases after conflict in Timor-Leste

Phase	From	Turning point
Emergency	Sep, 1999	Riot after Referendum
Reconstruction	May, 2002	Official independence
Development	Jan, 2013	Withdrawal of the UN

(Source: Yoshida & Yamamoto (2007))

It is obvious that the development policy is different between reconstruction phase and development phase. In case of Timor-Leste, the policies are NDP and National Priorities in reconstruction phase and SDP in development phase. While NDP and National Priorities which were established mainly by aid agencies aimed at taking off of messy situation after conflict, SDP which was made by Timor-Leste herself aims at long term development. Therefore, the policies for implementing infrastructures are different between phases and it is impossible to discuss of the two phases at the same time. In this study, objective period is defined as emergency phase and reconstruction

²⁶ Yoshida & Yamamoto (2007).

phase to analyze appropriate support by aid agencies for water supply immediate after the conflict.

3.2. Subject

This study focuses on the support by aid agencies especially JICA and ADB. In emergency phase and reconstruction phase, the subject which led stakeholders to the reconstruction of water supply system was not the government of Timor-Leste or DNSAS, but the aid agencies. Since the system was completely collapsed during the conflict, it can be said that the current system was constructed by them. That is, the responsibility of the result is on them. Actually, as mentioned above, the current water supply system in Dili is not managed well and it may take long time to be able to sustain by itself.

3.3. Objective

Previous studies have clarified the effects of infrastructures to developing countries and post-conflict countries and suggest the better way for management infrastructures. However, there is no study which focuses on management of water supply in post-conflict society. In post-conflict situation, rapid reconstruction is needed for securing people. Reconstruction of water supply system is particularly important.

Therefore, the objective of this study is to clarify the best way of support for water supply system in Dili implemented in emergency phase and reconstruction phase. This study aims at being a help to facilitate support for water supply in post-conflict society.

3.4. Methodology

This study takes two steps. First step is comparison of water supply services in other countries to know the level of services for USD0.2/m³ ²⁷. The targets of comparison are developed countries which charge consumers more than USD0.5/m³ and developing countries and areas which are a little more developed than Timor-Leste and charge consumers USD0.2/m³. The point of comparison is economic conditions, the effects of water supply to human health, and the offered water supply service. Second step is to apply the gained level to Dili. It is considered that which water supply system in Dili should aim at the goal of support or the gained level. Then, it is clarified how aid agencies should facilitate aid projects.

²⁷ The water use is 28.3L/person/day (see below in further details) and the household size in Dili is 6.46 (National census 2010) on average. Then, the monthly water use by household in Dili is 5.48m³. Therefore, the tariff is USD0.2/m³.

4. The case

4.1. Overview of Dili water supply

Water supply system is diffused in the whole of Dili city. However, the consumers are not satisfied with the current system.

Table 2 shows the current situation of formal connection to the taps.

According to the table, the diffusion rate of tap water is 29.5%. However, a number of people use water from the pipes. This is the evidence of illegal uses.

Table 2 The current situation of connection to the taps

Number of household connection (as of July 25, 2012)*	10403
Number of household in Dili (2010)**	35224
Ratio of connection (estimated)	29.5%

(Source: *DNSAS (as of Aug 2012), **The government of Timor-Leste (2010))

Moreover, since most of the facilities for water supply were constructed in Portuguese or Indonesian era and have not been managed enough, aging of them has been on the progress. For these two reasons, a number of leakages and stealings happen, and the rate of Non Revenue Water (NRW) is said to be about 80%²⁸. The number of leakages reported is 50/day. This high level of NRW directly affects the amount of available water. The amount of water which is distributed to the end of the pipes is only 20% of the water produced in water treatment plants and bombas. The total amount of produced water is 33,073m³/day²⁹ and that of available at the end of

²⁸ Kobayashi (2012).

²⁹ The sum of the amount of produced water which is calculated by the capacity of water of water

the pipes is 6,615 m³/day³⁰, meaning that the amount of water available to consumers is 28.3L/person/day³¹. Since NRW includes the stealing and stolen water is consumed by people, the available water may be more than this amount. However, even if the share of stealing added to, the available water per person may be less than the target of optimal use³². Moreover, consumers can use tap water only about 3 hours/day, 24 hours supply has not been achieved yet. However, three out of four water treatment plants does not work 24 hours. Although the less water problem looks to be solved by increasing the length of operation time of these plants, it is impossible. This is because of the small capacity of the reservoirs. The water stored in reservoir runs out immediately and water producing cannot make up for the running of water. Then, water outage happens every day.

The low amount of water supply and outage irritate consumers. Table 4 shows the complaints from the consumers in Dili between January and July of 2012. Outage and low pressure can be considered as a quantity concern and contamination can be considered as quality concern.

treatment plant and bombas multiplied by the working hours of each facility.

³⁰ On the basis of the assumption that NRW is 80%.

³¹ The amount of available water is divided by the population in 2010.

³² Howard & Bartram (2003) says that 20L/person/day is the minimal amount of water use for drinking, food, and personal hygiene and more than 100L/person/day water use is optimal to protect hygiene (Table 3).

Table 3 Summary of requirement for water service level to promote health

Service level	Quantity (L/person/day)	Needs met	Level of health concern
No access	Below 5	Consumption -cannot be assured hygiene- not possible (unless practiced source)	Very high
Basic access	Not exceed 20	Consumption -should be assured hygiene- hand washing and basic food hygiene possible; laundry/bathing difficult to assure unless carried out at source	High
Intermediate access	Average 50	Consumption -assured hygiene- all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access	Above 100	Consumption -all needs met hygiene- all needs should be met	Very low

(Source: Howard & Bartram, 2003)

Table 4 Complaints from consumers (January-July, 2012)

	Outage	Low pressure	Contamination
January	14	2	0
February	14	1	1
March	10	0	0
April	12	1	0
May	27	9	4
June	21	2	9
July	28	1	7
Total	126	16	21

(Source: DNSAS, 2012)

In 2004, the government of Timor-Leste published “The Modalities of Distribution of Water for Public Consumption Decree” which mandates Water and

Sanitation Authority (the former organization of DNSAS) to distribute safe water to district capital and main part of sub-district. Even though it is referred to the safety of water, the quality of supplied water is not safe enough to drink directly. The produced water at water treatment plants is said to be safe, however, supplied water is contaminated through the process of distribution. Since DNSAS does not have capacity to establish own drinking water quality standard, it uses WHO guideline as an internal reference. This decree also refers to the tariff for water (Table 5 Water tariff for each sector shows). The tariff was set to match the level in Indonesian era and is about 1.4% of GDP per person³³. Despite the decree refers to the tariff, tariff is not collected from consumers. The removal of most meters on pipes during the riot in 2006 triggered the stop of tariff collection. In current situation, 20% of all connections have meters and DNSAS is making effort to set meters to new connection. However, tariff collection has not yet resumed. Therefore, water supply system can be managed owing to subsidy.

The source of water is rivers and groundwater. Timor-Leste is a mountainous country and streams of rivers are fast. Therefore, the water source is comparatively clean and does not need complex treatment. The adopted way of treatment is rapid sand filter.

The DALYs³⁴ of Timor-Leste is 14.3%. This is the data not only of Dili, but also of other cities of all Timor-Leste. That of Dili may be lower than the whole Timor-Leste because the environment of sanitation and hygiene is the best in Dili. However, since the average amount of water supply per person is much lower than other countries, the DALYs of Dili is considered to be higher than other capital cities.

³³ JICA (2001).

³⁴ Disability Adjusted Life Years. The sum of years of potential life lost due to premature mortality and the years for productive life lost due to disability (WHO HP). In this study, DALYs means the ratio of DALYs related to water, sanitation, and hygiene in total DALYs.

Table 5 Water tariff for each sector

User	Quantity	Price (USD/m ³)
Household	< 14m ³ /month	0.20
	≥ 14m ³ /month	0.40
Public tap	All	0.10
Church, Hospital, and School etc.	All	0.15
Others (Ministry etc.)	All	0.60
Tank truck	8-10m ³	3.00
New connection to the tap		USD 55/connection

(Source: JICA(2011))

4.2. Support for water supply

4.2.1. Aid projects

Immediate after the conflict, aid agencies started facilitating aid projects for reconstruction from the devastating situation. Table 6 shows the aid projects that were facilitated for water supply in Dili (some target not only Dili but also other sub-districts). These projects are generally classified into two areas. One is reconstruction of facilities which can be used for a long time. The other is capacity building of workers for water supply system. As for water supply system in Dili, JICA and ADB are the main donor.

Table 6 The aid projects facilitated for water supply system in Dili in emergency phase and reconstruction phase

Year	Agency	Project name
1999-2001	UNTAET	Water supply and sanitation project
2000-2001	JICA	The Study on Urgent Improvement Project for Water Supply System in East Timor
2000-2003	TFET	Rehabilitation of water supply and sanitation project
2000-2004	JICA	Improvement plan for water supply system in Dili
2001	CFET	Project for management of water supply and sanitation system
2001-2002	AusAID	AusAID short term advisers support capacity building and institutional development of the WSS
2002-2004	JICA	Improvement plan for water supply system in Dili
2004-2006	JICA	The Project for Improvement of Water Supply in Dili
2004-2005	JICA	Water Supply Advisor
2006-2007	ADB	Urban Water Supply and Sanitation Project
2008-2010	JICA	The project for capacity building of DNSAS
2008-2010	ADB	Dili Water Supply Performance Improvement
2008-2012	ADB	Dili Urban Water Supply Sector Project
2009-2010	JICA	Emergent reconstruction plan of Bemos-Dili water supply facilities (1)

(Source: Report of (1), JICA, ADB and AusAID HP)

After the end of the conflict, more than 10 projects listed above have been implemented by some aid agencies for reconstructing the facilities and capacity

building. Then, how have aid agencies implemented support for water supply system in Dili?

4.2.2. Aid policy

When aid agencies facilitate projects, they implement them in accordance with aid policy. Intention of aid agencies in aid projects of JICA and ADB for water supply is discussed below.

First one is policy of JICA. JICA has set the goals for strategic development for water sector. One of the goals is “making progress in efficient, safe and stable water supply³⁵” and to achieve this goal, mid-term goal is aim at securing the quality of both tap water and water source. JICA projects for water have facilitated in accordance with this policy. Therefore, some PDMs of aid projects for water supply include the word, “safe water.” For example, one of the goals of project for capacity building of DNSAS is “aim at supplying *safe water* stably in Dili and other citie³⁶.” Like this project, JICA takes securing the quality of water for granted.

As for ADB, the situation is the same. The intended outcome of second district capitals water supply project is that DNSAS provides safe and reliable water supply to selected district capitals. The common point of the way of support by two aid agencies is to intend improving both quantity and quality of water. Although aid policies listed above are just examples, the common point is regarded important and taken in project targets or something like that in all water supply projects.

³⁵ JICA (2009)

³⁶ JICA (2008)

4.3. Current problems

Immediate after the conflict, a number of aid agencies took part in urgent rehabilitation support projects and contributed to reconstruction from the catastrophe. Thanks to these supports, living standards of people have improved and the economy has made progress rapidly in 10 years. Upon 10 years after independence, the government of Timor-Leste made “Strategic development plan (SDP)” to aim at becoming a middle-developed countries by 2030. This is the first time for her to make development plan by herself and aid agencies regard it as manifesting of her will to develop by herself as far as possible.

Despite these improvements, when we want to use tap water in Dili, we cannot get enough amount of water. Also, this water is not good enough to drink. This is because the infrastructures for water supply are not managed well. For example, failures are left, chemical for disinfection is not enough, no one knows where and how distribution pipes run and only 11 operators³⁷ are in charge of water treatment plants. These troubles make the offered water supply services worse.

Why infrastructures for water supply are not managed well? The answer is that resources such as money and people are insufficient since it has passed only 10 years after the conflict and independence. The conflict devastated many things, and a number of elites who have played important role in the society went back to Indonesia. Moreover, since consumers do not pay tariff for water, depending on the subsidies by the government is the only way to finance water system. Therefore, it is the task of DNSAS to collect tariff from consumers.

³⁷ The international standard of the number of staffs is 2 in 1,000 connections (OECD, 2009). In case of Dili, when every household has connection to water supply, the number of connection is 34,416 (2010). Then, the appropriate number of staff is about 34 and lower than the actual.

In such post-conflict situation, aid agencies constructed infrastructures which can offer same level service as that of developed countries. In respect of water supply, the water treatment plants in Dili can make high quality of water which is enough clear for direct drinking and enough amount of water for 24 hours supply in all Dili city. However, the required level is too high for Timor-Leste to manage the infrastructures. In other words, Timor-Leste does not have capacity to manage such high level infrastructures constructed by aid projects. Then, what should aid agencies do in emergency phase and reconstruction phase?

5. Discussion

5.1. The tariff collection

Since consumers do not pay for water, DNSAS has not yet achieved self-supporting account. This is because the low level of service and not the poverty or political issue caused by conflict. The reasons are discussed below.

As for the water supply service, after the suspension of collecting tariff, DNSAS put every effort into making consumers to pay for water. However, consumers told DNSAS that they would not pay unless DNSAS achieve 24 hours water supply³⁸. The current service is inferior to other countries as for quantity. Although the truth of this testimony is unknown, as clarifies, the improving of service quality contribute to increasing willingness to pay especially in respect of quantity³⁹. Therefore, it is obvious that if the quality of offered service is different for same tariff, the consumers who is offered lower one are not satisfied.

However, are there any other reasons for suspension of collecting tariff such as political issue and poverty? As for political issue, as mentioned above, removal of meters triggered the suspension of collecting tariff. However, the cause of the riot was the disparity treatment of between soldiers born in western part of Timor-Leste and eastern. The removal of meters was the extra and consumers took advantage of it. It is said that the government took so-called “scattering policy” to conciliate people after the riot and it accelerated lowering willingness to pay for water⁴⁰. However, the riot was just one of the triggers and political issue is also not the reason why no payment of tariff. The other is for poverty. The GDP per capita immediate after the conflict was

³⁸ Amedo (2011).

³⁹ Genius et al. (2008).

⁴⁰ Asahi (2011).

sharply fallen. However, thanks to support, the economy has recovered rapidly and exceeded the level before the conflict⁴¹. Especially from 2006 to 2007, the growth rate was as high as 8% (Figure 2 shows). On the other hand, the tariff is same level as pre-conflict period. Moreover, a number of people in Dili pay for electricity. Therefore, it cannot be said that consumers do not pay tariff because of poverty. According to the discussion above, the reason why consumers do not pay for water is the low quality of offered service.

5.2. Comparison to other countries

In general, developed countries have their own standard for drinking water and with decreasing the extent of development, the number of countries which do not have capacity to establish their own standards and alter WHO guideline is increasing. That is, there is a possibility that there is positive correlation between the size of economy and the tendency of establishing standard for drinking water quality? It is discussed that the relationship between presence of own standards and the quality of service for economy size.

5.2.1. Developed countries

Many developed countries have used tap water for a long time, and developed their own standards. Standards are different from each other. However, considered parameters are similar to the WHO guideline. Many standards adopt Drinking Water Quality Index because the governments of developed countries have capacity to

⁴¹ JICA (2001).

manage the facilities well and supply drinkable water stably. These standards are same as or above the level of the WHO guideline.

Most developed countries set the tariffs for water higher than developing countries. For example, the tariffs of the countries belonging to Organization for Economic Co-operation and Development Development Assistance Committee (OECD-DAC) range from USD0.5/m³ to USD2.6/m³ ⁴². The reason why they set high tariff is that they aim at providing high quality of services to consumer. Consumers pay more tariff and required better service. With some exceptions, most developed countries have achieved full cost-recovery and manage water supply system sustainably.

5.2.2. Developing countries

As mentioned above, a number of developing countries alter the WHO guideline to their own standards. However, most of developing countries do not supply water which meets the WHO guideline.

This low quality of service is reflected in the tariffs. That is, the worse the quality of service is, the lower the tariff tends to be. Tariffs of most developing countries are very low but some consumers do not pay even if their tariffs are not so high for them.

Developing countries also suffer from NRW more than developed countries. This is because infrastructures are not managed well and a number of leakages and water theft happen. Water operators face difficulties to achieve full cost-recovery due to lower tariff and NRW.

While consumers in developed countries pay more for water and require high level of service, consumers in developing countries pay less and do not require high

⁴² OECD (2010).

level of service. The level of service is linked with the tariffs to some extent, how can this relationship be explained? To show this relationship, some examples of a little more developed countries than Timor-Leste are discussed below.

The selected countries and areas are Taiwan, Malaysia, Cambodia, Sri Lanka, and Uzbekistan. These are Asian countries same as Timor-Leste, especially southern part of Asia. Taiwan and Malaysia uses their own water quality standard and supply water for 24 hours. They can be considered as the target of Dili in the future. Cambodia and Sri Lanka are countries who have experiences of conflict. Cambodia adopts the WHO guideline for her water quality standard and Sri Lanka achieves supplying more than 200L/person/day. Uzbekistan charges consumers half of the countries listed above and instead of lower tariff, the amount of water supply also lower than others.

5.2.2.1. Taiwan

The natural condition of Taiwan is similar to that of Timor-Leste in two points. One is that Taiwan is mountainous country and the stream of rivers is rapid. Therefore, the quality of water source is comparatively good to other countries. Second is that the amount of rainfall. Taiwan belongs to the tropical climate region and gets a lot of rain. Then, she hardly suffer from water shortage.

Consumers in Taiwan can get water 24 hours and use 281L/person/day⁴³ on average (in Taipei city). However, tap water is not suit for direct drinking. Water is contaminated by two ways. One is arsenic in the soil and the other is some minerals such as iron caused by aging of facilities. Despite the government set their own drinking water standard and Environmental Protection Administration (EPA) declares

⁴³ Website of Global Water Intelligence.

the quality of supplied water is good enough to drink, consumers use water but for direct drinking. Tap water will become drinkable after boiling more than five minutes.

Why consumers agree with this level of service? There are two reasons. First one is the culture. People can get clear water such as bottled water or purification systems for taps easily⁴⁴. Therefore, consumers do not need to care about the quality of tap water. Second reason is the tariff. The tariff is USD0.224/m³ on average (in Taipei, 20m³ use, adopt sliding scale) and this is cheaper than other countries whose extent of development is same as Taiwan. The ratio of DALYs of China is 4.3%. That of Taiwan is considered lower than this because the diffusion rate of tap water is higher than China and the hygienic environment is better.

5.2.2.2. Malaysia

Consumers in Malaysia can also get water 24 hours and use 203L/person/day⁴⁵ on average. Even though water is supplied stably, not suit for direct drinking. This is because large cities in Malaysia have experienced rapid development and urbanization. This triggered explosion of water demand and waste water discharge by household and industrial sector. As in case of rapid economic growth in Japan in 1960s, the improvement in water supply sector cannot follow the development⁴⁶.

In Malaysia, the market of purification system is developed in large cities and people can get purification systems easily. The tariff is also set low. Each household in Kuala Lumpur has to pay USD0.19/m³ (<20m³use), USD0.34/m³ (from 20m³ to 35m³use). The cost of attaching purification system is lower than purchasing bottled water to meet the demand of drinking⁴⁷. Therefore, people use purification system to

⁴⁴ Website of Turton.

⁴⁵ Website of Suruhanjaya Perkhidmatan Air Negara National Water Service Commission.

⁴⁶ Website of Bureau of Waterworks Tokyo Metropolitan Government.

⁴⁷ Website of Cross Index corp., Ltd.

get drinking water. The DALYs of Malaysia is 3.5% and lower than other South Eastern Asian countries.

5.2.2.3. Cambodia

Cambodia has a common experience with Timor-Leste. That is conflict. After the conflict, reconstruction progressed rapidly especially in Phnom Penh. The case of Phnom Penh is recognized as a rare case which succeeded developing water supply system in developing countries because Phnom Penh is one of the cities which supplies drinkable water for 24 hours. It has succeeded to manage infrastructures well and produce clear water which follows the WHO guideline. Consumers use 101L/person/day⁴⁸ on average and pay USD0.28/m³. It is noteworthy that almost all consumers pay for water. Thanks to the high willingness to pay, the water supplier can make profit more than others even though the tariff can be set as same level as other developing countries.

The DALYs of Cambodia is 14.8% and very close to that of Timor-Leste. This is because the value is calculated of whole Cambodia. There are a gap between Phnom Penh and other cities. The diffusion rate of tap water is largely different from Phnom Penh to other areas and hygienic environment of Phnom Penh is far better than other areas. Therefore, the DALYs of Phnom Penh should be lower.

5.2.2.4. Sri Lanka

Sri Lanka is also one of the countries which experienced conflict and is taking steps to reconstruction. Consumers in Sri Lanka cannot get water all day long. Consumers use 275L/person/day on average⁴⁹ for 20 hours/day. Although the ratio of people who have

⁴⁸ Van den Berg & Danilenko (2011).

⁴⁹ Ibid.

access to safe water is 84.8% which is higher than most of other developing countries, people or commercial sector who have access to water pipe is only 35.5%⁵⁰. The tariff is USD0.17/m³ on average (in case of 20m³ use)⁵¹, cheaper than most other Asian countries. This is the evidence that a number of people rely on other sources such as public taps. The cheapness is one of the reasons why consumption of water is greater than other countries. The DALYs of Sri Lanka is 3.2%.

5.2.2.5. Uzbekistan

Consumers in Uzbekistan cannot get water stably. In Tashkent, the capital city of Uzbekistan, the water supply is comparably stable and achieved almost 24 hours supply. On the other hand, the further the cities are from Tashkent, the less hours the water supply works. This is reflected in the amount of water use. This is only 49L/person/day (2007)⁵², very lower than other Asian countries and same level as Dili. Therefore, the tariff is USD0.11/m³ which is lower than that of Dili but increasing little by little. The DALYs of Uzbekistan is 2.1%. This looks lower in spite of the small amount of water supply. The reason why DALYs is lower is considered that Uzbekistan has less rain than South Eastern Asian countries.

5.2.3. Acceptable level of water supply service

As mentioned above, the tariff for tap water is USD0.2/m³ (less than 14m³ use) in Dili. This is as much tariffs as some of a little more developed countries. However, the comparison shows that the offered water supply service when we pay USD0.2/m³ is different between Dili and other countries or areas. The difference is discussed below.

⁵⁰ Lanka business online (as of Apr 16, 2010).

⁵¹ National water and drainage board (Sep 18, 2012).

⁵² Van den Berg & Danilenko (2011).

The examples listed above are the cases of a little more developed countries than Timor-Leste. Even though these countries have not achieved supplying drinkable water directly from the taps, it is difficult for the water supply system in Dili to achieve it. Then, what level of service is appropriate for Dili water supply? There are two common points which allow consumers to accept undrinkable level of water. These are the undrinkable and enough amount water.

The first point is quality of water. As mentioned above, there are few countries who can supply water which is suit for direct drinking from the taps. Although supplied water is not suit for direct drinking, this becomes drinkable through boiling or purification. Therefore, even such lower quality of water, consumers pay USD0.2/m³ for water.

The second point is the quantity of water. In case of the examples above, the supplying time is much longer than Dili and most of them achieve 24 hours supply. Since the consumers can use water whenever they want, they are satisfied and willing to pay tariff for water. There are two reasons why they consider the quantity as important. One is the better access to drinkable water. In addition to direct drinking from the taps, there are some other ways to get better drinking water such as attaching purification system to the taps or pipes, purchasing drinkable water tank or bottled water at water stand or other stores, and so on. In a little more developed countries, the market for getting drinkable water is developed. The consumers make use of the market and get drink water easily. The other is lower DALYs. It does not mean that water affect consumers' health badly just because the quality of water is compromised. The lower DALYs of these countries are the evidence of the contribution of stable supply to satisfying consumers despite quality not. In case of South-Eastern Asian countries listed above, the more water consumers can use, the less DALYs they are exposed. These two reasons make consumers be satisfied with the offered service.

In case of purification system users, since they can get it easily and the tariff of tap water is kept lower, they can get drinkable water by reasonable price as a result. In case of purchasing water, although the price of it is higher than the tariff of tap water, the easiness to get drinkable water makes consumers satisfy with the situation. On the other hand, even though purification system is diffused among consumers, it is impossible for consumers to be satisfied with less amount of water. Among the countries listed above, the countries that have their own standard tend to let consumers to use more than 200L/person/day. The optimal amount of water is said to be more than 100L/person/day⁵³ which is for washing hands, cooking, bathing, and so on other than for drinking. 200L/person/day is much more than optimal amount of water and almost achieve almost 24 hours supply.

From the discussion above, it can be said that the reason why consumers are satisfied with the provided water supply service is that they can somehow get enough drinking water by purifying the undrinkable water or purchasing drinkable water. The water supply service for USD0.2/m³ in most of these countries is not suit for direct drinking from the taps, but enough amount for various use. Moreover, thanks to the water which they get, they can get better sanitation and hygiene.

5.3. Way to good management

From the discussion above, two points are clarified. First one is that the reason why DNSAS cannot manage water supply system well is the intended service is not suit for Dili. Second one is that the countries which charges consumers to pay USD0.2/m³ satisfy consumers with enough amount of water and not with quality of water. Then,

⁵³ Table 3 shows.

what kind of service should Dili water supply system aim at in emergency phase and reconstruction phase?

5.3.1. The standard

DNSAS aims at supplying water in accordance with WHO guideline. Therefore, aid agencies also have constructed facilities which can supply better quality of water than the WHO guideline. Table 7 is the comparison of the number of items targeted in standards of developed countries and WHO guideline. This shows that the WHO guideline includes more items than most of developed countries. It needs to be paid attention that the WHO guideline does not require to be followed legally. It can be said that even the standards of most developed countries refer to less items than the WHO guideline.

Table 7 Number of items included in drinking water standard (guideline)

	WHO*	US**	China*	Japan*	EU*
Number of items	155	304	106	50	45

(Source: *THE LANCET as of Nov. 3, 2012, **USEPA HP)

Moreover, in respect of the stringency of each item, the WHO guideline is more stringent than other countries. Table 8 is the comparison of the level of each parameter. According to the WHO guideline, Coliforms and Cadmium are in health category and Turbidity and pH are in acceptability category. These items are the examples of which parameters are different by each standard. Table 8 shows that while the permissible amount of the E-coli and fecal coliform is 6 individuals in the standard of Taiwan, the others permit zero. On the other hand, since pH is considered not

affecting to human health, it is not included in the WHO guideline and the EU standards. Moreover, in respect of carcinogens, the supplied water which follows the WHO guideline will not make consumers⁵⁴ be ill. Although these developing countries who have their own standards also want to supply drinkable water⁵⁵, they cannot supply because of their capacity and the condition of water source.

Table 8 Level of parameter in drinking water standard (guideline)

	WHO*	EU**	Taiwan***	Sri Lanka****
E-coli and fecal coliforms (CFU/100mL)	None	None (/250mL)	6	None
Cadmium (mg/L)	0.003	0.005	0.005	0.005
Turbidity (NTU)	1	Acceptable to consumer and no abnormal change	2	8
pH	-	-	6.0-8.5	6.5-9.0

(Source: *WHO (2011), **EU (1998), ***Taiwan EPA (2009),
****Board of Investment of Sri Lanka (2011))

The water qualified with WHO guideline is considered as drinkable. On the other hand, it is said that WHO guideline is just a guideline, and each country should make her own standards which meets the situation such as climate in which she is⁵⁶. That is, countries are not required to supply drinkable water if needed. It is also said that making the standards should be included in aid projects⁵⁷. In accordance with the division of WHO guideline, proper use of three indices is effective for better aid⁵⁸.

⁵⁴ In WHO guideline, the target people are defined as weighing 60kg and drinking water 2L/day whole his/her life.

⁵⁵ Website of Environmental Protection Administration, R.O.C. (Taiwan).

⁵⁶ MHLW (2006).

⁵⁷ Ibid.

⁵⁸ UNEP & GEMstat (2007).

These three indices are drinking, health, and acceptability water quality index (DQWI, HQWI, and AQWI⁵⁹). It can be said that each country should adopt an index that suits to the situation. For example, one country should take DQWI if people used to drink water directly from the taps and another takes AQWI if people do not drink tap water and her budget is too stringent to keep up with high level standards.

Generally, the lower the level of standard is, the higher the risks will be. Since a number of developing countries which depends on international support cannot determine the most appropriate standard because of their small capacity, they adopt the WHO guideline for tap water. In this background, the standards for drinking water quality are considered as a key to supply much water stably.

5.3.2. Technical concern

24 hours water supply is requirement for achieving drinkable water supply. This is because the water should be contaminated during being distributed when suspension happens even if water treatment plant made drinkable water. This mechanism only happens in a situation that the facilities are broken or becoming old since they are not managed well. When the streams of water in distribution pipes stop, the pressure in the pipes gets lower. Then, soil will go into the pipes with microorganisms at the broken point. Therefore, the water is contaminated at the taps. There is no country whose ratio of NRW is zero. That is, the facilities for water supply are not perfectly managed in all countries. The fact shows that contamination may happen in most of countries and the higher the ratio of NRW is, the more possibility of contamination gets.

⁵⁹ The WHO guideline defines two categories, health (including microbial) and acceptability and classified each parameter into them. DWQI, HWQI, and AWQI are consisted of the two categories. DWQI includes both health and acceptability categories. That is, includes all parameters from the WHO guideline. HWQI includes only health category to assess human health issue. AWQI includes only acceptability category to assess unacceptable taste and odor (UNEP & GEMstat, 2007).

In case of Dili, the ratio of NRW is considered about 80%. Not only the infrastructures have not been managed well, but also no one knows that how many and where pipes run. This is because the ruler of Timor-Leste has been changed from Portugal, Indonesia, to Timor-Leste herself after World War 2 and the technique has not been taken over. The high ratio of NRW causes the water outage and low pressure and results in making lower quality of tap water at the end of pipes. Therefore, improving quantity of water is needed to improve the quality.

5.3.3. The reasonable support

From the discussions above, it can be said that it was difficult for in Dili to supply drinkable water in emergency phase and reconstruction phase. On the other hand, it is rational for DNSAS to aim at supply drinkable water for 24 hours. This is "ideal." A number of countries which charge consumers to pay USD0.2/m³ compromise the quality. In case of Dili, what is reasonable water supply system? Since the most current system has been reconstructed by aid agencies, in other words, what is the reasonable support by aid agencies?

In post-conflict societies, it is needed rapid reconstruction from the devastated situation. Water supply system generally should supply enough amount of water as soon as possible. However, it is too difficult for post-conflict societies to achieve supplying drinkable water for 24 hours. Even a number of other developing countries have not achieved it. Then, achieving it is the "ideal." That is, support for Dili aimed at the "ideal."

For rapid reconstruction, aid agencies facilitated aid projects and spent much money for Dili. They aimed at achieving drinkable water supply stably. On the other hand, there is lack of capacity because of conflict. In respect of water supply sector,

since the size of infrastructures are larger than other sectors, it needs more time and resources than others. Therefore, the offered service is undrinkable and unstable water supply. This is worse than other countries.

This study shows "reality". This is, water supply system which can supply for 24 hours regardless of the quality as well as other developing countries listed above immediate after the conflict. Timor-Leste is on a way to becoming a developed countries and the level of the infrastructures as well. Therefore, the water supply systems in these countries are the models of Dili in the future and it is reasonable to follow them.

Support for water supply system in Dili has been implemented following "ideal." Aid agencies took securing quality and increasing quantity for granted. There is a gap between "ideal" and "reality." That is, there is a gap between target of the support by aid agencies and the suitable way of water supply system in emergency phase and reconstruction phase. The gap resulted in the current situation which made little progress from immediate after the conflict despite 10 years has passed.

Then, should support aim at eliminating the gap? In other words, should aid agencies facilitate aid projects which implement "reality"? In case of other sectors, such as the lives of road and bridge are shorter and the quality of offered service is lower than developed countries⁶⁰. The "reality" of water supply system in Dili is to have priority on achieving 24 hours supply over supplying drinkable water. There are two reasons. First one is that Dili is in post-conflict priod. That is, Dili needs rapid reconstruction from the devastated situation to recover the standard of living as soon as possible. Second one is that achieving "ideal" needs a lot of time. As mentioned above,

⁶⁰ Tsunokawa & Nisino (1999) shows an example of bridge (Jyamuna) in Bangladesh. This bridge was constructed based on the standard of UK. However, the traffic volume was less than that of UK and the load on this bridge is lower. Although the live of this bridge is set as 120 years and during the period, the load may be the same level as UK, Bangladesh may be developed more and it will be easier for her to deal with.

following the WHO guideline is too stringent for developing countries and it is needed that facilities are managed well and achieve 24 hours supply to distribute drinkable water. It is not easy to overcome these problems in the short run in Dili. By achieving the "reality," the level of offered service will be improved and the willingness to pay of consumers for water will increase. Improve of the tariff collection ratio contributes to the improve of whole management of water supply system.

However, the supports are for developing countries by aid agencies are based on the demand of recipient country. The policy is applied to both JICA and ADB. That is, if the government of Timor-Leste required aid agencies to facilitated projects of which target is achieving supplying drinkable water for 24 hours in the short run, it is difficult to compromise the quality. In case of Dili, as mentioned above, most of people in charge of water supply in Indonesian era went back and the capacity of DNSAS to manage the system is too small. SDP aims at supplying drinkable water. Therefore, the government of Timor-Leste must require aid agencies to make a system to supply drinkable water if no one offered the option which is more effective. For this reason, aid agencies should offer an option that focuses on quantity while they ready to facilitate projects that aim at achieving ideal when the government of Timor-Leste wants.

6. Conclusion

6.1. The support for water supply system in Dili

This study shows that support should aim at the "reality" and not "ideal" since achieving the "ideal" takes much time and is not suit for the post-conflict situation in the short run. The "reality" is the support that focuses on increasing the capacity of quantity of water supply and compromises quality. However, the demand of the government of Timor-Leste should be considered when facilitate aid projects. Therefore, aid agencies should offer the option that aims at improving in respect of water quantity regardless of quality and let DNSAS choose the best way of reconstructing water supply system.

6.2. How can DNSAS collect tariff?

Tariff collection is important to manage water supply system sustainably and to decrease the subsidy by the government. The willingness to pay of consumers for water will be increased with an improve of the level of water supply service. Other developing countries which charges USD0.2/m³ satisfy consumers with the service which have priority on quantity of water supply. This service is suitable for Dili which is in post-conflict period. By improving the level of service, tariff would be collected more and better cycle of water supply system will appear.

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