An Incentive-Based Beneficiary Compensation Scheme for the Construction of Rural Water and Sanitation Systems in East Timor

By

Jesse Shapiro

A REPORT
Submitted in partial fulfillment of the requirements
For the degree of

MASTER OF SCIENCE IN CIVIL ENGINEERING

MICHIGAN TECHNOLOGICAL UNIVERSITY

2007

This report “An Incentive Based Beneficiary Compensation Scheme for the Construction of Rural Water and Sanitation Systems in East Timor” is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN CIVIL ENGINEERING.

Civil and Environmental Engineering
Master’s International Program

Signatures:

Report Advisor _____

James R. Mihelcic

Department Chair _____

Neil J. Hutzler

Date _____

Preface

This report is based on the 24 months I spent living and working in East Timor as a volunteer with the U.S. Peace Corps and for nongovernmental organizations (NGOs). I spent the first 10 months in the town of Baucau, as a volunteer Water and Sanitation Engineer with the U.S. Peace Corps' Health Promotion Program until unfortunately, due to civil and political unrest, all Peace Corps volunteers were evacuated on May 7, 2006 and the program subsequently closed

In August 2006 I returned to East Timor to work for an International NGO, Triangle G.H as a water and sanitation project manager; the systems and case studies described in this report were a Triangle G.H. project for which I was employed during the last four months of the project. After the completion of the Triangle G.H. project, I continued to work in East Timor with Plan International as a water and sanitation engineer, managing Internal Displaced Peoples' (IDP) camps where displaced people lived due to the ongoing violence and instability in the country. In May 2007, I accepted a position with the Department of Water and Sanitation (DNSAS) as an advisor to the Chief of urban water supply. This position, funded by Oxfam Australia, focused on building government capacity to meet the increased requirements of IDPs.

Although this report is based specifically on work performed during a four-month period spent in the sub-district Laleia, much of the cultural knowledge, language, and understanding of the East Timor context is a culmination of my two-year service in the country with Peace Corps, Triangle G.H., Plan International, Oxfam Australia, and DNSAS.

This research report is submitted to complete my master's degree in Civil Engineering from the Master's International Program in Civil and Environmental Engineering Michigan Technological University. It focuses on the work I completed and explains my experiences with an incentive based worker compensation scheme for the construction of community water and sanitation systems in Laleia, East Timor.

Table of Contents

Definition of terms

Compensation Something, such as money, given or received as payment or reparation, as for a service or loss. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

Incentive Something, such as the fear of punishment or the expectation of reward, that induces action or motivates effort. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

Payment A gift, payment, declaration, or other acknowledgment of gratitude, respect, or admiration. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

Scheme A A systematic plan of action. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

Voluntary Done or undertaken of one's own free will. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

List of figures

List of tables

Acknowledgements

I would like to thank the many friends and colleagues who have been part of my experience in East Timor and at Michigan Technological University especially the following:

Firstly thank you to James Mihelcic, my graduate advisor, and the rest of my graduate committee Blair Orr and Veronica Griffis for their support.

For the opportunity and life changing experience at Triangle G.H., including all the materials and hard work I utilized for the case study, I would like to thank Cedric Brenda, Vincent, Francisco, Maun Ze, Argapitu, and Marcelo. Moreover, I would like to thank my host family during my stay in Cairui, Mana Esperanza and the whole family; and Jesse Wright, who undoubtedly paved the road for the Triangle project with his work as PCV (Peace Corp Volunteer) in Cairui for almost two years.

Thank you to all the other people that have helped me along the way in East Timor including: Bob Reed, Dave Holland, Antoninho 'Chico' Santos, Alexio dos Santos, Brian Hanley, Cindy Kushner, Tim Budge, Dinesh Bajracharya, Ian Blake, Natalie Young, Virginia Dawson, Jessica Waite, all of my fellow PC East Timor volunteers, Sarah Meyenathen, Erin Eckerman, Backary, Sarah Winnan, and my host family in Baucau the Belo's; Miro, Sonya, Mizo, Nencio, Nanetty and Mestre Julio.

All my coworkers from DNSAS; Joao Pereira Jeronimo, Celso Pereira, Elias Moniz, Rui de Sousa, Francisco Xavier, Francisco dos Santos, Florindo de Jesus, Pascoal Riberio, Deo, Rui, and Alan Smith and Anor Sihombing colleague advisors, and others.

Emily Owens, Stephen Good, Drew Snaffer, Jennifer Post, Essa Gross, and all the other graduate MI students whom have become irreplaceable friends along the journey.

Finally, I would like to thank my family and friends for their support during my two years abroad.

Abstract

East Timorese culture and society are the result of almost 500 years of Portuguese colonialism, 25 years of Indonesian occupation, a revolution, and multiple conflicts in the past 30 years. Moreover, the extreme amount of trauma that continues in East Timor has taken a large social toll on the population increasing the sizeable task of development in the small nation. The UN Millennium Development Goals (MDG) have set high targets for water and sanitation coverage to the world's poor, where in East Timor 76% of rural households do not have access to safe water supplies and 87% of rural households do not have access to adequate excreta disposal facilities (Republica Democratica de Timor-Leste, 2006).

Throughout the world, the traditional beneficiary compensation scheme for development projects in poor and rural areas rely on voluntary labor. Although voluntary schemes are preferred, there are various alternatives which can be applied to more complex contexts and cultures of trauma such as East Timor. In 2006 a small study was conducted to analyze and compare the results of a beneficiary compensation scheme in the sub-district of Laleia, East Timor. The water and sanitation project included three villages located in one of the driest and neglected regions of the country. The project used a combination of voluntary and incentive-based compensation to mobilize the communities for construction of 3 water and sanitation systems including 152 latrines, 32 public fountains, and 4 reservoirs.

Four indicators were developed to analyze the scheme including Time, Cost, Quality, and Ease. Results show the project and beneficiary compensation scheme were a success. The two rural communities have working water and sanitation infrastructure with a higher than average level of quality and functionality. For the study latrines in the village of Cairui received an average quality score of 3.9 out of 5, indicating a higher than average quality of construction. While, the third community, has a fully rehabilitated and extended system that has initiated a user-pay scheme; a social success. Additionally, the completed project utilized only a minimal amount of funding and human resources.

Although a success, many trends emerged describing many other key factors for the success of the project other than the beneficiary compensation scheme. These factors describe how the project and the scheme can be improved building upon the strongest successes to promote a truly sustainable model for construction of water and sanitation systems in East Timor and around the world.

1.0 Introduction and objectives

This chapter provides the objectives of the study and an explanation of the motivation that prompted the study of beneficiary compensation schemes for the construction of water and sanitation systems in the developing world.

1.1 Background and Justification

1.1 billion people in the world do not have access to safe water and approximately 2.6 billion do not have access to adequate sanitation. Due to these poor conditions, approximately 1.8 million children die each year from unclean water and poor sanitation (UNDP, 2006).

UN Millennium Development Goal (MDG) #7 has created targets of halving, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation (United Nations, 2006). Reaching targets associated with MDG #7 is estimated to require an investment of approximately $10 billion a year (UNDP, 2006). Although funding of this quantity is not easily obtained, it is clear that this will not be the only struggle in reaching the targets. Reaching the targets for MDG # 7 will involve the provision of services to an additional 300,000 people a day over the next decade thus requiring an increase of current efforts by approximately one third. To reach the sanitation target, services would need to be provided to an additional 450,000 people a day until 2015; approximately doubling current efforts (UNDP, 2006). One of the most important issues to consider when for this requirement will be how to provide these increases in services.

Throughout the developing world, the most predominant scheme for engaging beneficiaries is through the utilization of voluntary labor and materials. Although this is the most preferred scheme by which to engage beneficiaries a increase in the provision of services will require additional resources. Moreover, use of other schemes will be necessary especially in nations and areas with complex contexts such as recent war, civil conflict, occupation or natural disasters.

East Timorese culture and society are the result of almost 500 years of Portuguese colonialism, 25 years of Indonesian occupation, a revolution, and multiple conflicts in the past 30 years. The extreme amount of change and trauma that continues in East Timor has taken a large social toll on the population. In the areas of conflict and occupation, the social toll is especially visible with the East Timorese lack of connection to the land and communities in which they live. Deforestation, domestic violence and intra-community conflict, are all indicators of the Timorese lack of connection to land and community bond.

In East Timor 76% of rural households do not have access to safe water supplies and 87% of rural households do not have access to adequate excreta disposal facilities. (Republica Democratica de Timor-Leste, 2006). Consequently, achieving MDG #7 will require significant investment in the water and sanitation sector. As investment in East Timor is increased, it is important to analyze the success of beneficiary compensation schemes that have been used or could be used in East Timor.

1.2 Objectives of the Study

The following research report will explain and analyze the benefits and drawbacks of an incentive based worker compensation scheme for the construction of community water and sanitation systems in East Timor.

The report will:

1. Provide information on the background of East Timor.
2. Present a case study of a water and sanitation project in Laleia, East Timor.
3. Present the context in which compensation schemes are used to mobilize poor rural communities around the world and analyze the specific compensation scheme utilized by the water and sanitation project in Laleia, East Timor.
4. Provide recommendations on the appropriateness of the compensation scheme and its application to future development projects.

Chapter 2 provides the history and background information for East Timor, including demographic, historical, political, and economic overviews. Additionally there is information included on the current state of the water and sanitation sector in East Timor.

Chapter 3 describes the case study communities and provides a description of the water and sanitation project; including local and regional background information on the communities and a detailed description of all the construction works completed in each location. Additional information is provided on the method of implementation including the staffing and the incentive project description.

Chapter 4 presents the different beneficiary compensation schemes through which communities may be mobilized for construction of infrastructure.

Chapter 5 explains the methodology of the data collection, more specifically which indicators were chosen and how the information was gathered.

Chapter 6 presents the results of the case study in the three project locations. First presented in summary and then according to location for a more detailed explanation.

Chapter 7 reviews and analyzes the information presented, then suggests recommendations for future construction of water and sanitation systems in East Timor and around the globe.

2.0 Background and history of East Timor

This chapter provides the history and background information for East Timor, including demographical, historical, political, and economic overviews. Additionally there is information included on the current state of the water and sanitation sector in East Timor.

2.1 Geography and Environment

East Timor is the eastern half of a small island located approximately 15,007 km^2 at the eastern end of the Indonesian archipelago (Figure 1). The climate is tropical and lies between 8-10^o south of the equator. The island has extremely varied and rugged terrain from deserts to rainforests, with its highest peak at 3,200 meters above sea level (Central Intelligence Agency, 2008).

Figure 1: East Timor's Location(shaded in red) in South East Asia
From : http://en.wikipedia.org/wiki/Image:LocationEastTimor.svg
Licensed under Wikimedia Commons.

2.2 History

According to the Democratic Republic of East Timor (RDTL, 2007) the original inhabitants of East Timor came in three waves: the people of New Guinea and Australia, Austronesians, and finally proto-Malays. Due to the extremely mountainous and rough terrain, these cultures were able to remain separate preserving much of their diverse language for many years.

In the sixteenth century, the Portuguese colonized the South-East Asian region where they set up posts in many areas. However, it was not until 1702 that an official post was located on the island of Timor whereas most other areas had been colonized by the Dutch, including Indonesia. At the end of the seventeenth and into the eighteenth century, the western half of the island was colonized by the Netherlands and a formal border was drawn.

During World War II, East Timor's geographic importance in the region made it the subject of attempted invasions by the Dutch, Australians, and Japanese. Consequently, a war was waged against the Japanese by a coalition of forces, which, although successful at resisting the Japanese invasion, left many Timorese dead and East Timor in ruins. In 1945, Portugal reinstated itself until the decolonization of East Timor in 1974.

On November 28, 1975, East Timor declared independence and became República Democrática de Timor-Leste (RDTL). Unfortunately, only 9 days later, Indonesia invaded East Timor and began an extremely violent and brutal occupation, which lasted until the 1999 referendum for independence. Some reports say as many as 200,000 East Timorese died during this period due to direct violence, hunger, and disease.

In 1999, the Indonesian government finally agreed to allow a UN supervised referendum in East Timor. On August 30, 1999 78% of East Timorese voted for independence. The Indonesian military and pro-integration gangs that had warned against the separation immediately started a violent campaign as they slowly withdrew from East Timor. They systematically destroyed infrastructure and indiscriminately murdered people in their

path, forcing as many as 35% of the population to flee and take refuge over the border in west Timor.

Subsequently, an Australian led UN force called International Force for East Timor (INTERFET) entered Timor and began to restore order. Following that United Nations Transitional Administration in East Timor (UNTAET), lead by UN Police, served as an interim administration guiding East Timor toward its independence. Finally, on May 20, 2002, Portugal recognized East Timor as an independent country and it became the newest democracy in the world.

In May 2006, violence broke out after close to one third of the country's military were fired for leaving their barracks in protest against alleged unfair conditions. In the weeks that followed, as many as 30 people were killed and 100,000 fled their homes (Barker, 2006). Some quick politics led to the deployment of UN and foreign military forces to East Timor, who brought the large-scale violence under control and stabilized the country. Nevertheless, in 2008 East Timor struggles to move forward, with as many as 150,000 people still displaced due to recent violence and ongoing conflicts such as the February 2008 attacks on the President and Prime Minister.

2.3 Demographics: People and Culture

East Timorese are of mixed Malayo-Polynesian and Melanesian/Papuan descent. Currently most ethnic groups are separated by region and are frequently named after their local language or region, including, Frataluku, Makasae, and Mambae. Additionally, a small section of the population is of Portuguese and Chinese decent, this group includes some of the most prominent leaders in East Timor.

East Timorese are approximately 90% Roman Catholic. The remaining 10% consists of Muslims, Protestants, Buddhists, and the native religion of Animism. The author's experience in East Timor finds that these statistics are accurate, although many people still believe strongly in the traditional beliefs such as local healers and black magic.

There are approximately 36 languages in East Timor with two official languages of Tetum and Portuguese. Although not official, Bahasa Indonesian is also widely spoken. Without a doubt, language remains a highly debated topic in East Timor. Schools often teach in Tetum; however, science and mathematics are taught in Bahasa Indonesian and both Portuguese and English language lessons are given to students. On the streets of East Timor a wide range of languages are used and are commonly mixed together. The other 33 languages in East Timor are local languages that range from only a single village to small regions. Some of the most widely used are Mambai, Makasae, and Tetum-terik.

East Timorese cuisine is similar to that of neighboring Indonesia, where the staple food is rice, although previously during at least the last 100 year it was maize. Most Timorese eat rice twice a day maintaining, that unless they have eaten rice, they have not eaten yet. Most other food groups are available in East Timor including meats, vegetables, and a range of subtropical fruits. Dairy, such as cheese and milk are not usually eaten by Timorese and are almost nonexistent from local sources.

2.4 Government and Politics

As one of the world's newest democracies East Timor is transitioning out of its independence movement. The East Timorese currently have an extreme shortage of leaders. For example, the election results of 2007 resulted in the prime minister becoming president and the president becoming the prime minister. During the first election in 2001 there was only one dominating party, *Frente Revolucionária de Timor-Leste Independente* (Revolutionary Front of Independent East Timor or Fretilin), which had approximately 80% support. For the most recent election in 2007 East Timor has come a long way with eight different parties represented in the Parliament. Although at least three parties held between 11–23% support each, Fretilin retained the highest percentage with 29%. Yet Fretilin was unable to establish a government because the remaining parties formed a coalition, thus securing a combined majority and the right to leadership of the East Timor Parliament.

The president of East Timor is the head of state and is elected to a five-year term. While the president has some legislative powers, it is mostly a figurehead position. However, the president is responsible for nominating the head of coalition party whom will become the prime minister and the head of the government. Administratively East Timor is

Figure 2: Map of East Timor divided into districts.
From : http://en.wikipedia.org/wiki/Image:Timor-Leste_districts_map.png#file
Licensed under Creative Commons.

divided into 13 districts, which are subdivided into 65 sub-districts, 443 Sucos, and 2,336 towns, villages and hamlets (Democratic Republic of Timor-Leste Ministry of State Administration, 2003).

In addition to the recent transformation of the parliament, the Government structure has also undergone changes during the government's six-year history. As of November 2007 there are twelve ministries including the Ministry of Infrastructure, which has three secretaries of state, (1) Water, (2) Electricity and (3) Urbanization. The ministries are still the one of the most difficult obstacles toward furthering democracy in East Timor as the positions are appointed and they often hold the largest amount of power in the government.

2.5 Economy

East Timor has a GDP of $471.7 million (2007) which comes from its main exports of coffee, oil and petroleum (Central Intelligence Agency, 2008). The largest export is petroleum removed from the Timor Gap, the region of ocean between East Timor, Indonesia and Australia. It is currently extracted from the Timor GAP and processed in Australia; providing Australian with a percentage of the profits and creating a point of tension between the two nations. Furthermore, East Timor has excellent areas for coffee farming and has started to take advantage of producing Fair Trade Organic Coffee for export to the developed world, especially the US where it is part of a blend sold at Starbucks. Unfortunately, these efforts have not had a significant impact in overcoming the misguided priorities from Portuguese colonization, Indonesian misadministration, and amount of infrastructure lost during the crisis of 1999. There is still a hungry season; unemployment is approximately 50% and other than coffee and petroleum exports, East Timor imports virtually everything including its main staple food, rice (Central Intelligence Agency, 2008).

Although economically East Timor has not been fortunate, the Timorese have been forward thinking and have decided to place the maximum profits from their main export, petroleum, in a US bank. Much of the current yearly fiscal budget comes from interest generated from these funds.

2.6 Water and Sanitation in East Timor

In East Timor the state of water and sanitation is very poor. The National Directorate of Water and Sanitation (DNSAS) estimates in East Timor for 2006 that approximately (Republica Democratica de Timor-Leste, 2006):

- 76% of rural households do not have access to safe water supplies;
- 82% of urban households in the capital, Dili, do not have household access to 24-hour safe water supplies;
- 96% of urban households outside of the capital do not have household access to 24-hour safe water supplies;
- 87% of rural households do not have access to adequate excreta disposal facilities;

- 24% of urban households in the capital, Dili, do not have access to household toilet facilities; and
- 40% of urban households outside the capital do not have access to household toilet facilities.

Much of the nation still uses traditional and simple technologies for the supply of water and sanitation. Rural populations use water from many undeveloped sources such as rivers, streams, springs, and from semi-developed/developed sources such as spring boxes, river catchments, shallow and deep wells, and rain water. Water systems in villages, towns, and hamlets use simple gravity flow or simple pumping systems. In a few district capitals, water treatment is also available with use of small sand filters and sedimentation tanks.

Dili, the urban and governmental capital, is the only location with any modern water treatment or septic systems in East Timor. Dili has multiple catchment systems from the main rivers and 13 deep bore wells that can provide sufficient water quantity to the population. Four modern water treatment plants contribute to a better water quality of the city system but only cover water supplied from river catchments and not bore wells that account for approximately half of production. Unfortunately a failing production and distribution system, including epidemic illegal connections and a largely unmaintained system, results in insufficient supply and water quality to most areas within the city. Additionally, many people use small tube wells for their water needs, which provide inadequate water quality.

There are no government sanitation or sewage systems anywhere in East Timor except for a sewage treatment facility on the outskirts of Dili (Figure 3) which uses three sedimentation and decomposition ponds that are located near the ocean in a secured non-development area. Where it applies, septic waste must be pumped out and delivered to the treatment facility. Consequently, the treatment facility is not used to capacity and is in poor condition due to neglect. In absence of city wide infrastructure all sanitation utilizes on-site applications. In the capital and around the country the most common latrine

models are constructed using a pit or septic tank. This of course contributes greatly to the groundwater quality within the city and around the country.

Figure 3: Sewage treatment pond facility serving Dili, East Timor.

2.6.1 Government and Policy Makers

The Department of Water and Sanitation (DNSAS) is part of the new Ministry of Infrastructure, and is responsible for all water and sanitation in East Timor. It directly manages the water supply systems in all urban centers as well as coordination for all rural areas. It currently has three sections, Dili, District, and Planning and Development. DNSAS has a central office in Dili as well as district offices in all remaining twelve districts of East Timor.

The government of East Timor has clearly declared that access to safe water and sanitation is a challenge, but a priority, in order to achieve the National Development Plan (and Millennium Development Goal targets). Therefore, investment and sector support will have to increase substantially in order to develop sustained projects in both rural and urban areas. Moreover, Water Law and Policy in East Timor is still in its

infancy. Created only recently, the National Water Policy (NWP) has been submitted to the East Timorese Council of Ministers but has yet to be ratified and put into Law. The policy surprisingly covers the water sector in generalities and is far from complete. East Timor does not yet have a sanitation policy or guidelines.

2.6.2 Beneficiaries

"Approximately 75-80% of the Timor-Leste population is located in rural areas. Based on the current estimates of access levels, and interim MDG targets, additional access to safe water must be provided to about 118,000 rural households by Year 2015, and adequate sanitation for an additional 135,000 households. To achieve the full National Development Plan (NDP) Year 2020 targets, the comparable figures are 138,000 for water and about 155,000 for sanitation" (Republica Democratica de Timor-Leste, 2006).

According to Republica Democratica de Timor-Leste the total population in urban centers, including Dili and the twelve district main towns, is approximately 206,000 (approximately 39,000 households). Yet not many of these households have water supply connections. In Dili, an estimated 45% of households have access to a piped water supply system, with only 30% having a house or yard connection. The remainder of the urban households uses shallow tube wells (boreholes), wells, springs, delivered water, or take water direct from rivers. Twenty-year planning for water infrastructure development has estimated the replacement value of the Government operated urban water supply infrastructure to be in the range of USD50 million. Existing coverage will also need to increase due to urban population growth of almost 250% by 2023.

The sanitation situation for East Timorese is poor. In urban centers, there is high population density, combined with poor on-site sanitation systems, high groundwater tables, an insufficient drainage system and limited solid waste management capacity. All of these contribute to a vulnerable environmental health situation. Only 47% of houses have water cisterns or pour flush toilets, while 24% had no toilet. Many of those households without toilets use shared toilets or use drains, rivers, fields or gardens.

"The sustained availability of safe and affordable water supplies depends on the continued existence of sufficient water resources of reasonable quality. The absence of a national policy that incorporates the key principles of Integrated Water Resource Management, coupled with a lack of water resources management capacity, poses a high risk that conflicting sub-sector strategies will emerge. Support to increase water resource management capacities within Government is needed" (Republica Democratica de Timor-Leste, 2006).

2.6.3 International Aid and NGO's

There have been over 700 NGOs, INGOs, and humanitarian organizations working in East Timor as well as most international aid organizations such as World Bank, Asian Development Bank, United States Agency for International Development (USAID), Australian Agency for International Development (AusAID), and the United Nations (UN). In 2008 alone, these organizations are forecasted to spend approximately USD98 million working in all sectors including USD22 million for water and sanitation (Ministry of Finance, Democratic Republic of Timor-Leste, 2008).

The organizations working in the water and sanitation sector of East Timor are, but not limited to, Oxfam Australia, Plan International, East Timor Red Cross, UNICEF, Triangle G.H., Belun, WaterAid Australia, TimorAid, Concern Worldwide and World Vision. DNSAS maintains a database of water and sanitation projects in East Timor that incorporates all organizations that coordinate with the government. Moreover, DNSAS engages these organizations with the government's prepared district investment plans and area priorities. Additionally DNSAS has created guidelines for technical recommendations and community mobilization that most NGOs follow during the implementation of their projects.

2.6.4 History of Access to Improved Water Sources and Sanitation in East Timor

It is generally understood in East Timor that before 1975 there was little development of water and sanitation systems. In fact, the only water and sanitation services were in the capitals Dili, Baucau, and Oecusse, where no formal system existed but local water sources were used. Certainly, the Indonesian occupation began an urbanization of the

populace, including the forced centralization of many parts of East Timor either by means of military might, or by providing services such as schools, roads, water systems, and agricultural irrigation systems. During this time, it is estimated that as many as 90% of the population had access to an improved water supply. Yet, in 1999 as Indonesia soldiers withdrew from East Timor, they burned the majority of buildings and destroyed most of the infrastructure. The loss of records and government property was immense. This included the almost complete loss of water and sanitation resources and records.

Since 2002 the government of East Timor, in addition to many NGOs and INGOs which work in urban and rural areas, have invested in water and sanitation infrastructure. However, access levels for water and sanitation remain low (see Section 2.6) as investment has been insufficient. Furthermore, poor investment and inexperience has meant that most of the infrastructure not destroyed in 1999 continues to lack proper maintenance and is falling into disrepair. Nevertheless, since the beginning of 2008, the current situation in East Timor has resulted in an increase in donor investment in the water and sanitation sector to as much as USD 22 million (see Section 2.6.3). These projects are beginning or are in the planning stages.

3.0 Case study: Project locations and objectives

This chapter describes the case study communities and the associated water and sanitation projects. This includes local and regional background information on the communities; a detailed description of all the construction works completed in each location; and information on the method of implementation, including staffing and the incentive project description.

3.1 Project Description

3.1.1 General

The project implemented by the international NGO Triangle G.H. (Hereafter referred to as Triangle) was completed in the Manatutu district of East Timor, Laleia sub-district, in the villages of Laleia, Cairui, and Samalai. The European Commission Humanitarian Office (ECHO) funded project had a total budget of €246,992(Euro) and the implementation took place over one year, November 2005 to November 2006

3.1.2 Triangle Generation Humanitaire

"Founded in 1994, Triangle Génération Humanitaire is a non-governmental organization (NGO) based in Lyons, France. Triangle has a mission to "provide concrete solutions to alleviate the suffering of populations living in unacceptable circumstances. It fights poverty and defends social integration. It offers support to victims of conflict, natural catastrophes and other events causing precarious living conditions. Triangle's action, integrating emergency and development, is characterized by a global, comprehensive approach to humanitarian assistance. Triangle Génération Humanitaire is an international solidarity organization that integrates emergency relief, rehabilitation, and development within comprehensive projects. Triangle designs and implements projects in collaboration with national partners and strives to identify and energize local skills and resources" (Triangle G.H., 2007).

Triangle has three areas of primary expertise; water and sanitation; rural development; and social-educational & psychosocial. Funding for Triangle's projects come from a

variety of sources including the European Union (ECHO). Since 1994, Triangle has operated over 150 projects in 15 countries (Triangle G.H., 2007). Triangle has been working in East Timor since 2005 when it began the project described in this report.

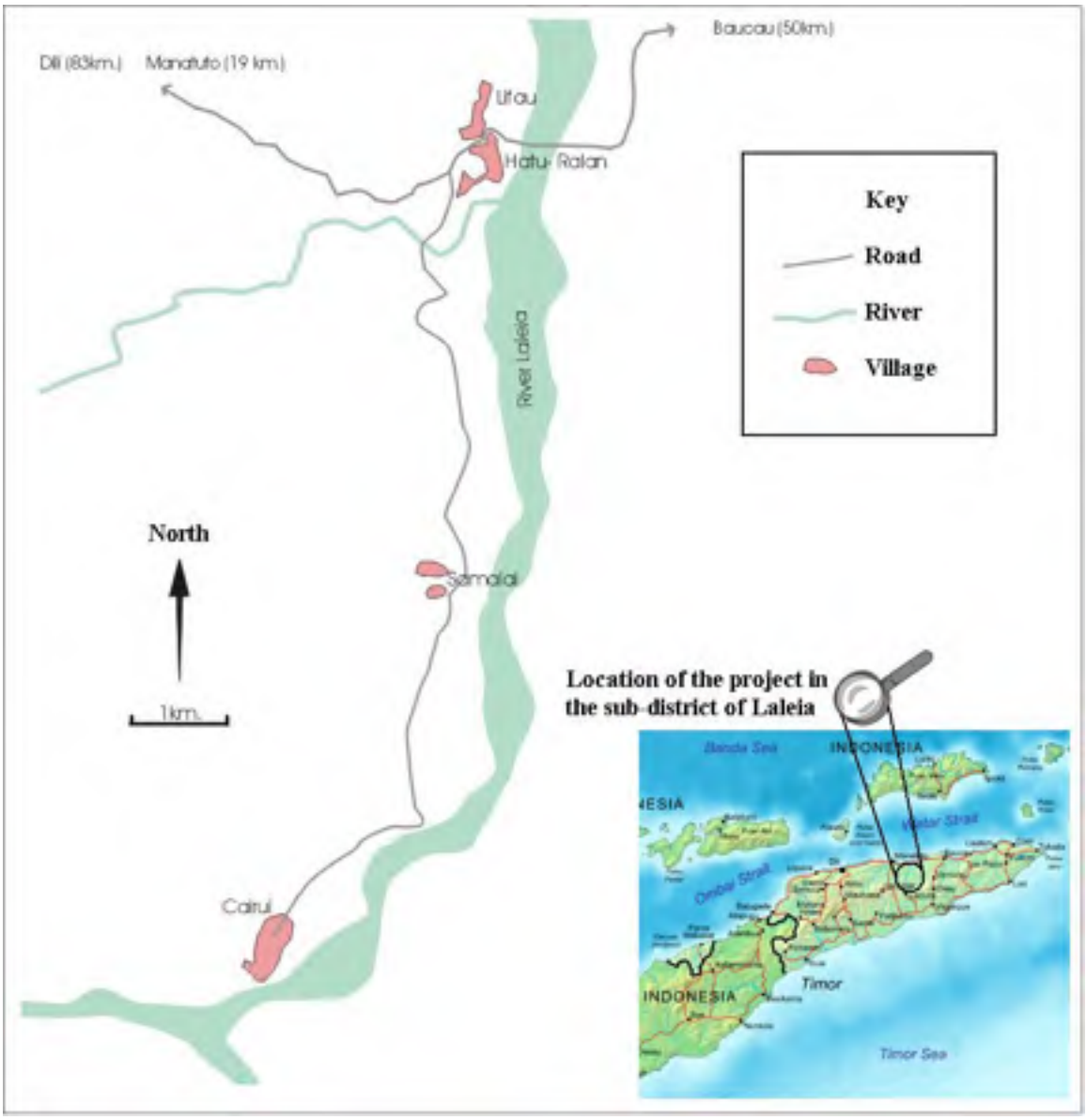


Figure 4: Map of Laleia sub-district with detail of villages Cairui, Samalai, and Laleia (Hatu Laran and Lifau).
Detail From : http://en.wikipedia.org/wiki/Image:East_Timor_map_mhn.jpg
Licensed by Wikimedia Commons.

3.1.3 Project Objective

The objective of the project was to provide access to sanitation and, good quality and sufficient water quantity for the population of Laleia sub district, in the villages of Cairui, Samalai, and Laleia through the implementation of adequate water supply and sanitation systems.

3.1.4 Activities

In order to achieve the objectives the following activities were undertaken:

- Community mobilization for construction of infrastructure by community members
- Drilling and construction of three deep wells
- Procurement and installation of three solar pumping stations
- Construction of three concrete water tanks
- Construction of 152 latrines (design in Appendix A)
- Procurement of hygiene kits
- Technical assistance, support and supervision of the community's work
- Procurement and oversight of three water networks including 32 public fountains (design in Appendix B)
- On-the-job training of key-persons in the community and in the formed water committees
- Water quality testing
- Coordination of all activities with the Department of Water and Sanitation (DNAS)
- Hygiene promotion (through a local NGO partner)
- Distribution of hygiene kits (through a local NGO partner)

3.1.5 Beneficiaries

A survey of the communities preformed in 2006 by Triangle with community leaders produced the beneficiary data. The number of people and families by each village is provided in Table 1.

Village Name	Number of People	Number of Families
Cairui	1,727	503
Samalai	230	75
Laleia	1,604 (by town: Hatu Ralan 752, Lifau 852)	463 (by town: Hatu Ralan 219, Lifau 244)
IDP in Laleia	378	
Total	3,939	1,041

Table 1: Beneficiaries in the sub-district of Laleia, disaggregated by village. The Internally Displaced People (IDP) population in the village of Laleia became beneficiaries mid-project due to East Timor's internal conflict in May of 2006.

Shown in Table 2 the population is detailed further by town, *aldeia*, partitioned by the number of men, women, infants, and households.

Village	Town	Houses	Men	Women	Infants	Total
Cairui	Rai Mian	136	201	217	615 (under 5 yrs old)	418
	Raibu	46	77	71		148
	Koro Hoko	65	106	104		210
	Hatu Sili	68	99	97		196
	Biabae	128	256	320		576
	Wai Nunu	60	94	85		179
	Samalai	75	124	106		230
Laleia - Hatu Laran	Umaluc	43	805	799		173
	Beboro	101				280
	Ralan	75				299
Laleia - Lifau	Uma Klalan	70				231
	Lenao	72				232
	Uma Rentau	102				389
Total		1041	1762	1799	615	3561

Table 2: Detail of Population in the Laleia Sub-district that were served by the project, disaggregated by number of houses, men, women, and infants. The IDP population is not included.

3.1.6 Water supply and Sanitation Systems

In Laleia, Samalai, and Cairui the water systems follow the same model. Water is supplied from bore wells drilled in the flood plain of the river and submersible pumps lift water from the bore wells to reservoir tanks located above each village. The reservoir tank volumes vary from 5,000 – 60,000 litres. Laleia and Samalai both have one bore well each whereas Cairui, with a larger population requires two. Laleia is powered by city electricity while Samalai and Cairui are powered by solar panel arrays. In all three villages the systems distribute water via gravity to household connections or public fountains.

The Triangle project also included sanitation support to Samalai and Cairui. The latrine project constructed 152 latrines in the two communities. Latrines where built within family groups where two latrines shared a common pit.

3.2 Water and Sanitation Community - Laleia

3.2.1 Political/demographic/social History

The town of Laleia was a settlement before, during, and after Indonesian occupation and is the capital of the sub-district of Laleia. It has a population of approximately 1,600 people and is situated roughly 10 km south of the shore, along the main road between Dili and Baucau, East Timor's two largest cities.

The district of Manatutu is considered a middle district, not necessarily aligned politically, socially, or geographically with the other areas of the country. This area is also significant because it is the birthplace of the first president of East Timor, Xanana Gusmao. The first president was also the chief of the military and continues to be seen by many as a god-like figure resulting from his leadership during the revolutions that lead to the end of the Indonesian occupation. He is currently the prime minister, after the election of 2007.

3.2.2 Water and Sanitation History

Traditionally residents of Laleia fetched water from the river that flows by the village. However, during Indonesian occupation, a formal water system was constructed. It consisted of a 6-inch bore well on the river's edge that pumped water to a tank above the town. The system also included a submersible pump that feeds a 20,000-liter reservoir tank at over 2 L/s. From the storage tank the town's water was supplied by gravity and the system distributed water to the population by galvanized iron (GI) pipe placed on the ground. Partial sections of the distribution system were buried under roads, dwellings, and convenient areas, although approximately 90% of the system sits above ground.

3.2.3 Project design

The Laleia water project was a system rehabilitation. The system included rehabilitation of all damaged pipelines, construction of a second 40,000-liter reinforced concrete reservoir, and installation of a 5,000-liter prefabricated zinc metal reservoir in trans-Laleia village (Figure 5: Water production and distribution system in Laleia, East Timor.).

The project also utilized the existing water committee from the community that consisted of two members, both plumbers. The project extended the water committee by making the plumbers project technicians and hiring a third person as a community mobilizer. The water committee with help of volunteers who mainly helped carry materials completed all piping rehabilitation. During reservoir construction, the entire community, which included the seven *aldeias*, hamlets, were mobilized and an agreed work schedule was followed.

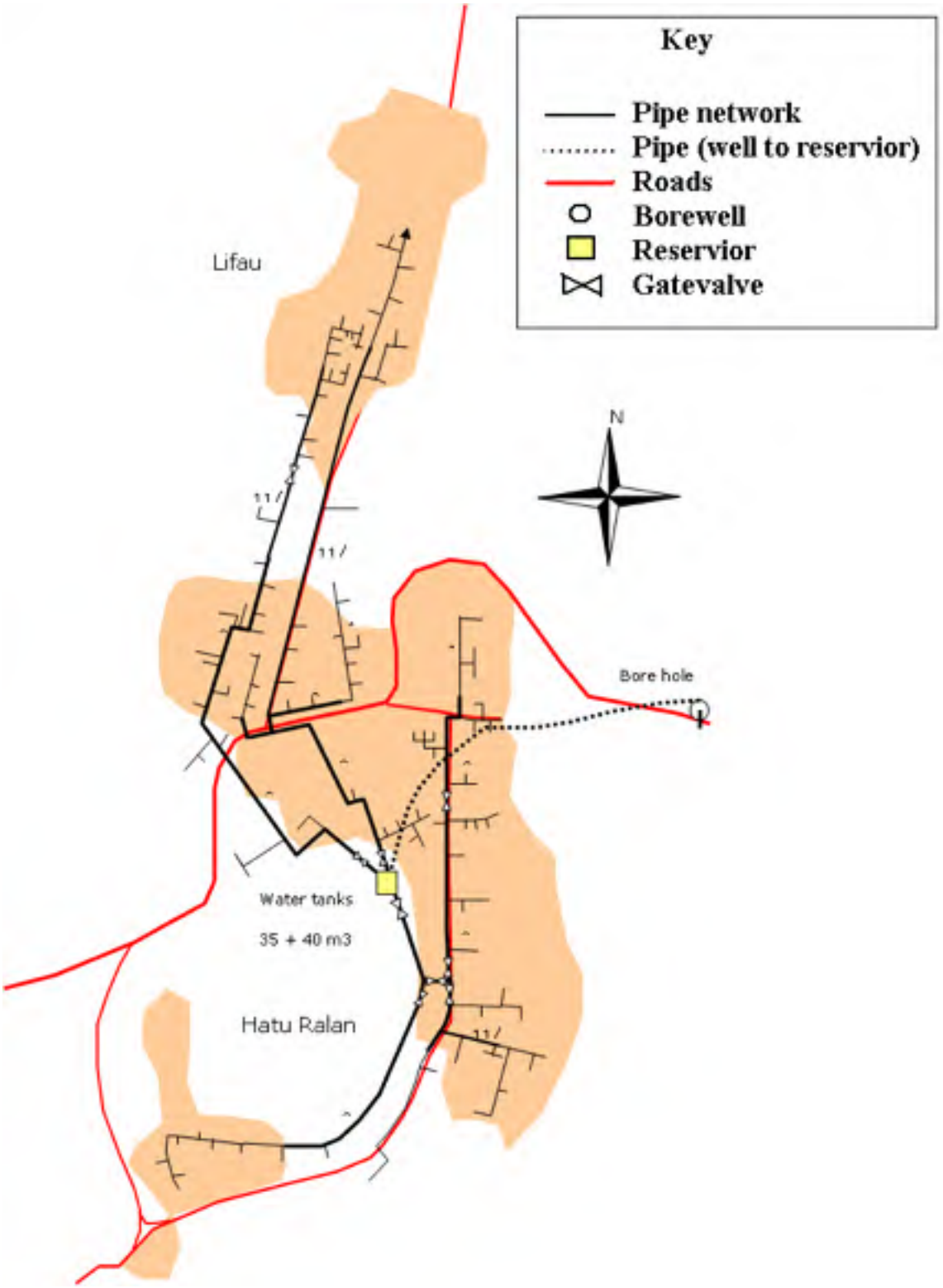


Figure 5: Water production and distribution system in Laleia, East Timor. System extending to Trans-Laleia not shown.

Figure 6: Laying pipe in Laleia, East Timor.

3.3 Water and Sanitation Community - Samalai

3.3.1 Political/demographic/social History

The village of Samalai is a product of the Indonesian occupation. Prior to 1975 there was no road, only a small collection of huts near the river where people subsisted on agriculture. During the Indonesian occupation however, the population was forced to further centralize there, near the river. Unfortunately, the road that comes from Laleia and continues on to Cairui was the only infrastructure constructed in Samalai prior to 1999.

3.3.2 Water and Sanitation History

Community members fetched their water from the river located next to the village. In time of drought, the residents would dig in the riverbeds for small amounts of water or would walk as far as 15 km to high mountain water sources or downstream to lower river flows.

3.3.3 Project design

In Samalai, the project integrated the construction of a new water and sanitation system with health promotion activities, implemented by a local NGO. The system included installation of all pipelines, construction of a 30,000-liter reinforced concrete reservoir, drilling of one 4-in bore well (Appendix F) with solar pumping system (Appendix G), installation of 13 public fountains, and construction of family latrines (Figure 7). The water distribution network is shown in Appendix C. The project involved the project staff and one community member as a technical supervisor and community mobilizer.

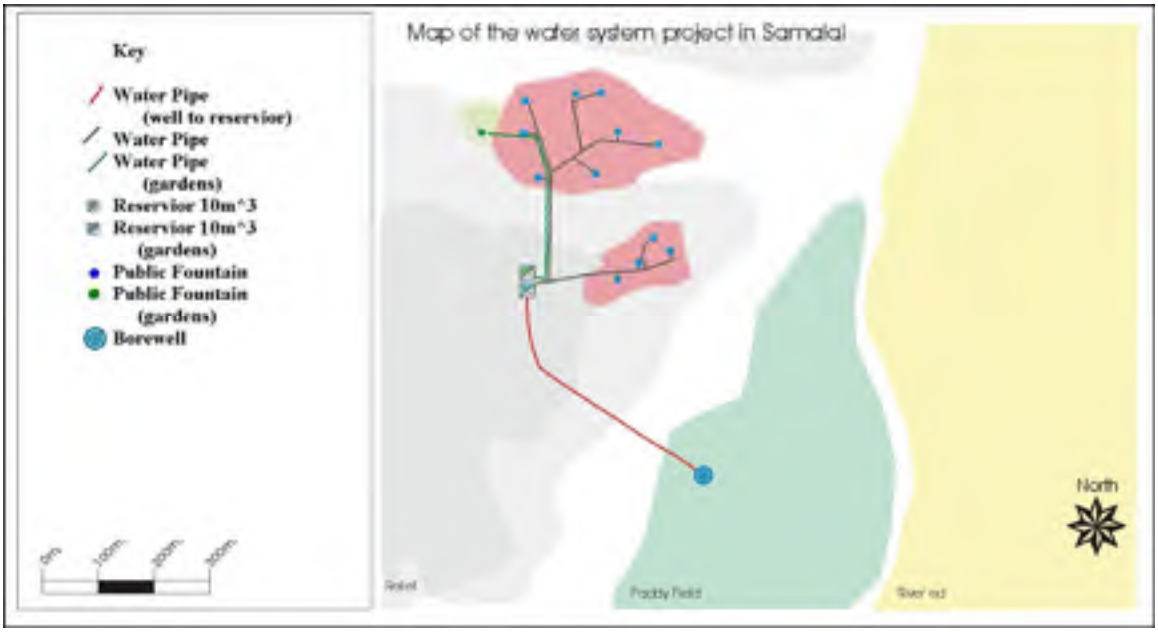


Figure 7: Water production and distribution system in Samalai, East Timor.

Family groups constructed latrines, pipelines, and public fountains on their own time, under the supervision and management of project staff. Moreover, community members, through the additional incentive-based compensation scheme built the reservoir and an external contractor completed the bore well construction, including installation of the pump. Project staff installed the solar array and system.

3.4 Water and Sanitation Community - Cairui

3.4.1 Political/demographic/social History

The village of Cairui is also a product of the Indonesian occupation. Prior to 1975, there was neither a road nor a town, only a small collection of huts near the river. In 1975, Indonesia cleared what was to be the town of Cairui and built a road from Laleia, a school, and a water system at no cost to the population. The plan was that the infrastructure would lure many out of the forest and if they did not come, the military would force them to. The population that migrated to Cairui, just as with many other places in Timor, had not previously known each other and indeed many had come from an existence in rural isolation where they never interacted in a social community larger than one family. The current population of Cairui is 1,500 people.

3.4.2 Water and Sanitation History

Under Indonesian rule every ten houses or so had access to a hand pump, but only upon malfunction were the neighbors called upon to contribute a bit of money to pay for repair (20 total hand pumps). There was no sense of communal upkeep and there were no usage fees. Once the pumps broke, the Indonesians collected a little money from each house and the money was given to Sr. Lorenzo, a local technician. After 1999 when the Indonesians withdrew, all the pumps except one slid into disrepair (Wright, 2005).

3.4.3 Project design

In Cairui the project integrated construction of a new water and sanitation system with health promotion activities, implemented by a local NGO The system included installation of a pipe network, construction of a 60,000-liter reinforced concrete reservoir (Appendix E), drilling of two 4-inch bore wells (Appendix F) with solar pumping systems (Figure 8: Water production and distribution system in Cairui, East Timor.), installation of 19 public fountains, and construction of family latrines. The water distribution network is shown in Appendix D. The project involved project staff, one community member as a technical supervisor, warehouse manager, and a block-making supervisor.

Family groups constructed latrines, pipelines, and public fountains, on their own time, under the supervision and management of the project staff. The reservoir was built by willing community members, using the incentive-based compensation scheme, described later in Chapter 4. An external contractor completed the bore well construction, including installation of the pumps and the project staff installed the solar arrays and systems.

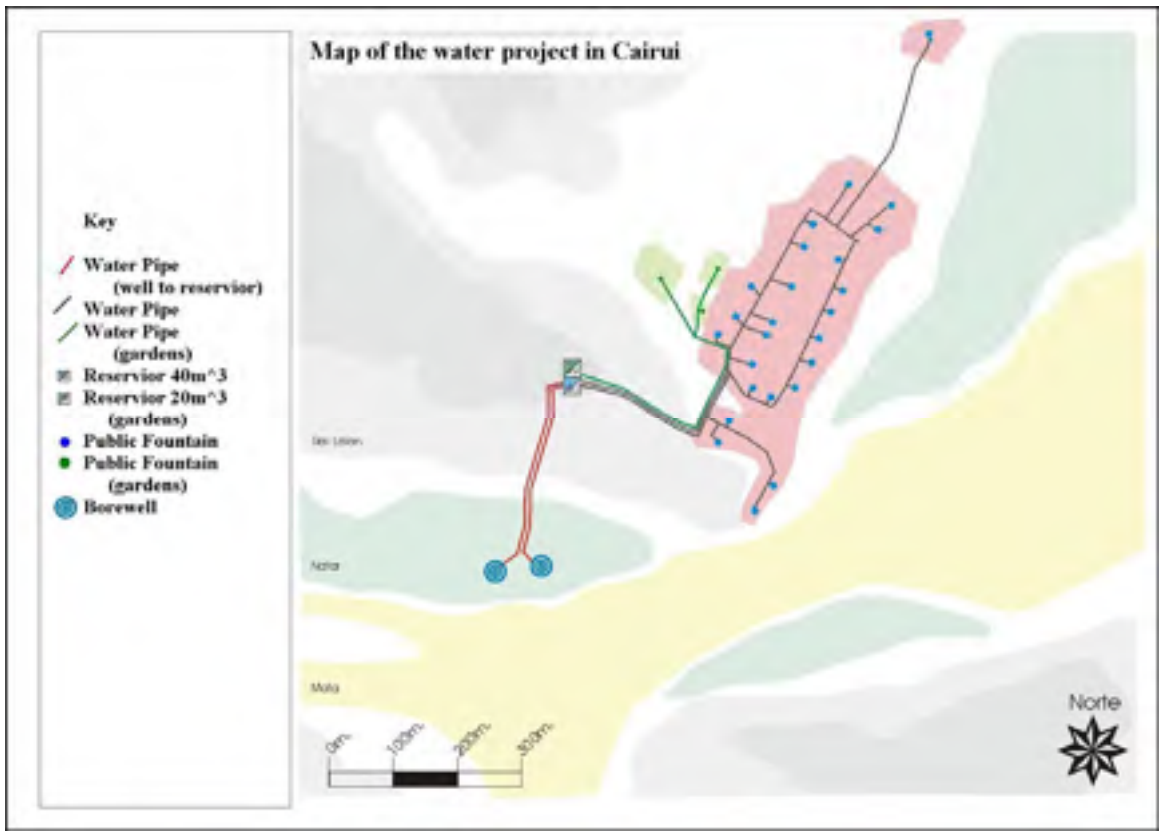


Figure 8: Water production and distribution system in Cairui, East Timor.

3.5 Project Implementation and Incentive Strategy

The project implementation strategy for the successful construction and implementation of the water and sanitation systems included three key pillars; staffing; timeline; and the beneficiary compensation scheme.

3.5.1 Staffing and Timeline

The staffing and timeline strategy differed in all three communities. Table 3 shows the complete staffing and timeline strategy for all three villages. The staffing positions are divided into sections by location of work. Positions 1-5 were general positions that existed within all three communities and staffing positions 6, located in the village of Laleia only, were a result of existing human resources that were in place prior to the project; they were a continuation of an existing water committee and were necessary for implementation within the urban context. Staffing positions 7, 8, and 9 worked only in Samalai and Cairui and were necessary as part of the sanitation project and due to the need to have a warehouse in Cairui, the largest village.

No	Position	Quantity	Duration (months)	Residence in
General				
1	Chief of Project	1	13	Laleia
2	Assistant to Chief of Project	1	13	Cairui
3	Chief of Mission	1	6	Dili
4	Intern Chief of Project	1	4	Laleia
5	Health Promotion Team	4	5	Cairui & Manatutu
Laleia Only				
6	Watsan Assistants	3	13	Laleia
Cairui and Samalai Only				
7	Latrine Manager	1	13	Cairui
8	Warehouse Manager	1	13	Cairui
9	Block Manager	1	6	Cairui

Table 3: Human Resource requirements during the duration of the project, disaggregated by village and including location of their residence.

3.5.2 Beneficiary Compensation Scheme

In all villages, there was an overwhelming unwillingness of the beneficiaries to volunteer or provide many of the local materials to the project, especially within the village of Laleia, the urban center for the sub-district. Consequently, the incentive project was

developed by applying the current social context of East Timor to initial investigative research done by NGO staff and community volunteers.

Initial contact with the beneficiary communities, community leaders, a PCV embedded in one of the communities, government ministries, and DNSAS, helped to shed light on the situation in Laleia sub-district. Factors for consideration included existence of a previous piped system (Laleia only), forced residence (lack of significant connection to the land), lack of formal social structures, lack of trust, and cultural norms during recent Indonesian occupation. Moreover, as described in Chapter 2, the current social context of East Timor is a culture of trauma and desperation. Most, if not all, of the population has experienced some level of serious trauma due to events related to independence and the Indonesian occupation. Since 1999, East Timor has taken significant steps towards democratizing and has continuously pushed ideas of self-determination and development to Timorese. These ideas compounded with current unemployment rates, health conditions, and lack of government involvement in the average Timorese's life creates a vulnerable and weak population engrossed in thinking of individualism and feelings of self-protection.

The resulting design of the beneficiary compensation scheme is presented in sections according to activity and location (Table 4). Across all three locations and activities, all non-local materials (Appendix H), project management, and technical supervision were supported by the donor organization. This part of the scheme provided no compensation to the beneficiaries for labor and is therefore classified as a voluntary compensation scheme (Section 4.1).

Additionally, a food incentive for motivational purposes was given to community individuals in all three villages for work relating to the reservoirs, this was classified as an incentive based compensation scheme, to be described in Chapter 4. Work carried out in the villages of Cairui and Samalai, other than the reservoir construction, was delegated to family groups and was built on a voluntary basis. In the village of Laleia, work was completed by salaried members of the village water committee.

Activity	Beneficiary Support	Incentive	Additional Incentive
General			
Reservoir	Community Individuals labor and local materials	All non-local materials, management, and technical supervision	Lunch + 2 noodles + 2 cans sardines/person
Cairui and Samalai ONLY			
Pipelines	Family group and local materials	All non-local materials, management, and technical supervision	None
Latrines			None
Public Fountains			None
Block making			None
Laleia ONLY			
Pipelines	Water committee	All materials, management, and technical supervision	Salary
Household connection			Salary

Table 4: Incentive Scheme presented according to activity and location.

4.0 Beneficiary compensation schemes

This chapter presents the predominant beneficiary compensation schemes by which rural developing communities are mobilized to construct infrastructure. There are three predominant schemes for beneficiary compensation; 1) voluntary, 2) cash, and 3) incentive-based.

4.1 Voluntary compensation scheme

A voluntary compensation scheme is defined as

> *one with no compensation given. The decision of the community member/s to participate is done with consideration, intention, free choice, and is agreeing in applying to something that is a natural outgrowth or natural expression arising from circumstances and conditions. The community members participate according to their own decision.*

Voluntary participation schemes are promoted by donor agencies and are the default scheme for most projects in poor and rural areas of the developing world. In fact, it is clear that voluntary schemes result in the highest sustainability, mostly due to the fact that they are demand driven. In other words voluntary schemes utilize the strong demand of the beneficiaries to implement the intervention. Since beneficiary demand directly relates to beneficiary ownership it results in high sustainability. There are many benefits and constraints to the scheme as shown in Table 5 (Heck, 2003).

Specifically voluntary participation schemes help the rural poor achieve their objectives through labor-based activities. The beneficiaries apply their voluntary labor to capital inputs (machines, tool, materials) provided from a donor agency to allow a project to achieve success in such a way as that minimizes costs and optimizes the quality of the resulting asset (Tajgman, 1998). Other benefits include potential for high production, self-reliance of the beneficiaries after construction, and capacity building of supporting institutions.

Benefits	Constraints
Coverage	The political/power conditions
Efficiency	Legislative obstacles
Effectiveness	Administrative obstacles
Adoption of innovations	Socio-cultural obstacles
High Production	Other (Educational, Health, isolation, freedom)
Successful results	Donor objectives
Self-reliance	Organization's structure
Supporting institutions	Community motivators

Table 5: Benefits and Constraints of voluntary beneficiary participation. Adapted from (Heck, 2003).

For example in Nepal there is a long history of voluntary beneficiary participation in community level activities. Community participation in the form of labor and local resources have commonly been used for construction of infrastructure. For example, Farmer Managed Irrigation Systems (FMIS) that comprise at least 75% of the total irrigated area (1.1 million hectares) in the country were constructed through voluntary beneficiary participation. The voluntary labor and materials initiatives built on the strengths of FMIS for success. These successes included that they are demand driven, were low cost, and utilized local resources. As they were locally managed "they have the ability to respond quickly to the maintenance needs" (Dr. Khem Raj Sharma, 2002).

Many limitations are present in voluntary schemes. Common obstacles include the donor's objectives, community or government structures, and legislative obstacles. Donor's objectives often interfere with local need and therefore restrict the voluntary process that is fundamentally rooted with the needs of the beneficiary. For example, the donor objective might be to improve sanitation to a level recognized by the MDGs such as the provision of a latrine for every household. However, beneficiaries may not want a latrine in every household but instead only public latrines on the edge of the village, far from most people, due to a local belief that latrines are smelly and cause sickness.

4.2 Cash compensation scheme

A cash compensation scheme is defined as

one where currency is given to the beneficiary(s) for labor and/or service.

Cash compensation is the preferred scheme by which most of the world trades labor. Although predominant to development and emergency response are cash compensation schemes, known as Cash-for-Work projects.

Cash-for-Work (CFW) refers to short-term temporary employment usually lasting no more than six months. CFW is often employed in infrastructure reconstruction or other similar temporary jobs such as harvesting, where laborers are paid in short-term intervals. The overall goal is to generate provisional employment rapidly and inject cash into the community (International Labor Organization, 2005). As presented in Table 6, the only disadvantage of a CFW project is it only has short-term applications. Benefits include cost efficiency, allowing strategic provision of services, supporting provisional employment, and injecting cash into the community.

Benefits	Limitations
Inject cash into community	Only short-term applications
Support provisional employment	
Strategic provision of services	
Cost efficient	

Table 6:Benefits and Limitations of Cash-for-work (CFW) projects. Adapted from (International Labor Organization, 2005).

CFW projects have been implemented around the world including East Timor where the International Labor Organization (ILO) implemented a project in 2007. The "Cash for Conflict Reduction and Meeting Basic Needs" helped to promote "peace and stability by providing short-term employment opportunities to IDPs and other vulnerable members of society." The project was motivated to provide employment and decrease unrest caused

by unoccupied youth and thus improved stability in the country (International Labor Organization, 2007).

UNDP also continues to support CFW projects such as the clearing of Tsunami debris from the worst affected areas of Banda Aceh where they cleared more than 40,800 m^3 of debris from 23 hectares of land. The project employed over 2,300 people throughout Banda Aceh and in Meulaboh. The activities were intended "to rehabilitate and improve access to public facilities, inject cash into IDP populations and ameliorate trauma among victims through the provision of work" (United Nations Development Programme, 2005).

4.3 Incentive compensation scheme

An incentive-based compensation scheme is defined as

> one that provides another form of incentive other than ones occurring out of the natural expression or done for cash payment. In other words, it is one that is neither voluntary nor has cash payment but is done for alternative incentive.

Many types of incentives are part of compensation schemes throughout the world although the prevailing incentive for poor and rural communities typically takes the form as materials and/or food. Material assets given, as incentive, to poor that do not have the means or ability to purchase materials has become a standard throughout the developing world. Food given as an incentive is also a common beneficiary compensation scheme, also described as a Food-for-Work (FFW) project.

In 2006 in Niger a FFW project used food to mobilize the community for a drought reduction program begun by the World Food Program (WFP). The community received food compensation for work during construction of crescent half moon rainwater irrigation ditches in the village of Karadji-Nord. "The food is not the only reason we are happy to do this work," explains 35 year-old Ismael Ibrahim, President of the village food-for-work committee. He also said, "We also do it because we know what it means for our future. With this kind of improvement to our land, we will be able to produce

much more food every year and look after our interests better." Most importantly the project states success on the ability to run a project where food is scarce and appreciated (World Food Program, 2007).

In fact, Ismael explains the two most important aspects of a FFW program. First, that the incentive, food, must be scarce or appreciated. In other words, the asset must be in demand by the beneficiaries. Second, the labor or construction must be toward assets the community demands or needs. In essence, a FFW requires killing two birds with one stone, filling a demand for infrastructure and a demand for food assets.

The U.S. Agency for International Development (USAID) has guidelines for a FFW project in which the primary objective is income transfer value of a food ration as a wage equivalent or incentive. The guidelines state that a FFW project can improve temporary household food security as long as projects continue supporting construction and rehabilitation activities that lead to longer-term solutions.

USAID has five program design steps included in their Commodities Reference Guide (USAID, 2007);

1. Program Design
2. Suitability of Food Commodities
3. Ration Specification
4. Ration Calculation
5. Ration Ranking and Selection

In 2004, in Kangemi, Kenya, a FFW project with support from the Mennonite Central Committee (MCC), Excellent Development and the Mukika Committee also found that providing food for work was sufficient replacement for work that normally required payment. The project, which helped to create a clean and plentiful water supply, timber production, food security and a fruit crop, choose to use FFW as an integrated approach to solve a secondary community problem of food insecurity and scarcity. It was common for local people to travel to neighboring areas in search of work and food. The project developed food resources that were used to supply lunches and provide food ration in

payment for work. "This stemmed the tide of local workers leaving for neighboring regions to search for food. Instead, they were able to remain in Kangemi and work on the project" (Excellent Development, 2005).

The example of Kenya reinforces the importance that incentive-based projects provide incentive that is needed by the beneficiaries. For example, distribution of food assets in a region with low food security as the MCC did in Kenya. This may be the single most important factor in planning and implementing a successful incentive-based beneficiary compensation project.

5.0 Information Methodology and Collection

This chapter explains the methodology and data collection for the beneficiary compensation scheme study. Specifically, it describes how indicators were developed and information was gathered.

5.1 Summary

The objective of the case study was to determine the success of the specific beneficiary compensation scheme. The success of the beneficiary compensation scheme is determined directly by the proper construction of the water and sanitation systems and is in fact, dependent upon the success of the scheme to properly motivate the community to work.

As described in Chapter 3 the construction of the water and sanitation systems used a basic input-output relationship (Figure 9). Triangle, the implementation agency, supported these three inputs for the infrastructure construction as part of the project including time, money, and human resources (HR in figure). The resulting output was the water and sanitation infrastructure.

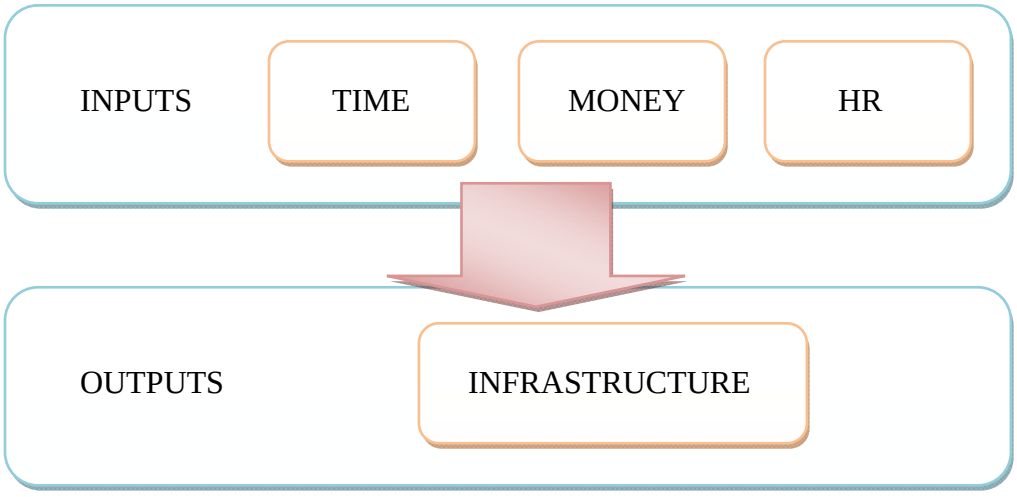


Figure 9: Project Input and Output relationship including inputs of Time, Money, and Human Resources resulting in infrastructure output.

Because these inputs and output directly determine the success of the construction, they are developed into the beneficiary compensation scheme indicators. The indicators are determined one by one from the project inputs and output shown in Figure 10.

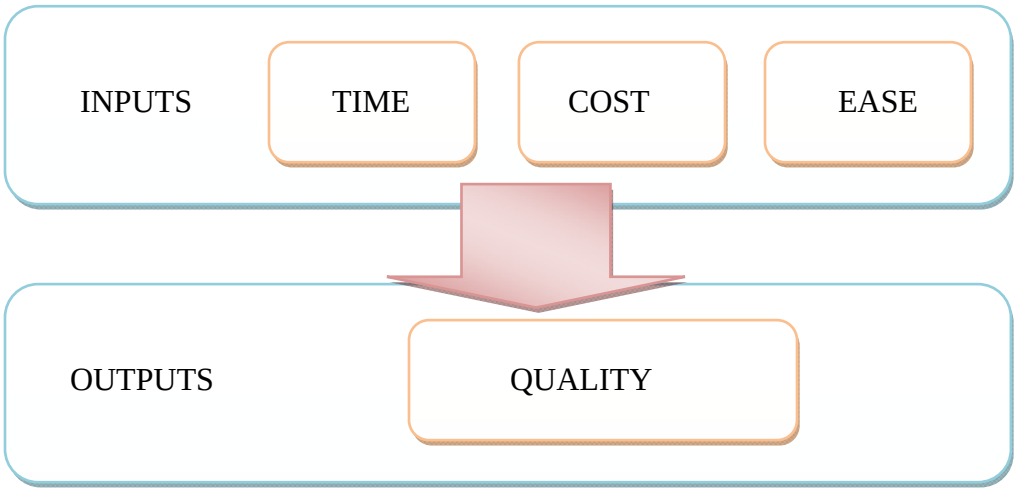


Figure 10: Project beneficiary compensation indicators including Time, Cost, Ease, and Quality.

The four resulting indicators are summarized in Table 7. The indicators provide a simple set of parameters by which to justify the success of the construction. Each Indicator is discussed in detail in the following sections; 5.2 quality, 5.3 ease, 5.4 time, 5.5 cost.

Indicator Name	Measurement Objective	Measure	Scale	Bias
Quality	Quality of the asset	Functionality and quality of finished construction	1 to 5	Judged and reported by author
Ease	Ease by which asset was completed	Amount of human resources and incentive required.	1 to 5	Judged and reported by author
Cost	Monetary cost of completed asset	Monetary cost of materials, transportation, and human resources.	USD	None
Time	Total construction time	Days, weeks, or months of construction	Days, weeks, months	Reported by author, project supervisor, and community members

Table 7: Summary of the indicators used to analyze a specific compensation scheme in Laleia, East Timor.

Finally, to simplify the study it was determined that the assets to be studied would include the reservoirs, public fountains, and latrines. As described in Chapter 3 and in Table 4, these assets provide examples for success or failure from both water and sanitation assets, both family group and community constructed assets, and small and large assets. Other assets such as the pipelines were not chosen due to the difficulty in recording the data and impracticality in the study, as pipelines require only a small amount of excavation and are abundant. The bore well constructions were also not considered in the study as the activities were subcontracted. The solar panel arrays and submersible pumps were also not considered because paid technical staff installed the assets, including the project manager and supervisor.

The development of the four indicators has been based on the idea that success of the compensation scheme is dependent upon success construction of the infrastructures. Although this may not necessary mean there is project success. In fact in order to determine success of the project it is necessary to include other aspects of the project including the health promotion, health improvement, and water committee success.

5.2 Quality Indicator

The first indicator is quality, the output, whose purpose was to determine the resulting quality of the asset. For this indicator a specific set of guidelines was developed on a scale from 1 to 5, 1 being bad and 5 being excellent, in order to rate each asset upon completion. The scale was developed by the author using his experience in residential construction and educational training. It is important to note that this may introduce some possible bias as each asset would later be judged and recorded by the author.

The scale that was developed determines the basic functionality and quality of the completed asset (Table 8). Creating the scale required choosing simple traits and flaws that would determine quality and if the asset was functioning. Specifically the asset quality was determined by how well the completed asset followed the technical design. This included the following of dimensions and practiced construction techniques. For example, how the concrete was mixed or if it was allowed proper time to cure. How the asset functioned was also taken into consideration such as missing or improperly installed features. A common example was improperly installed pipe works that reduce or eliminate proper water flow to public fountains or the water flush latrine plate is installed so that flow does not occur into the pit.

Quality	Rating	Description	Common Example
1	Bad	Is not useable and must be rebuilt	Weak or broken latrine pit roof
2	Poor	It has large flaws that require major or immediate repair before the asset is able to function	Missing concrete exposing metal reinforcement
3	Average	It has small flaws that prevent use and can be repaired easily or has characteristics that will cause issues during the life of the asset	Improperly mixed concrete
4	Good	It meets design criteria with small imperfections that do not affect how the asset functions	Improper public fountain height
5	Excellent	Follows technical design	100% complete

Table 8: Quality Indicator Scale

The quality indicator was judged and recorded by the author one week following the end of the Triangle project in the first week of December 2006. The author physically visited each asset and used the developed scale to classify each asset. Additionally every asset was photographed and catalogued.

5.3 Ease Indicator

For the purpose of this study ease is defined as

> Freedom from difficulty, hardship, or effort. (The American Heritage Dictionary of the English Language, Fourth Edition, 2000)

The ease indicator determines the human resource presence, one of the three project inputs, and amount of incentives used to motivate community labor for the construction of the water and sanitation assets. The ease indicator was developed by the author on an arbitrary scale between 1 and 5, 1 categorized as difficult and 5 categorized as easy. The

scale and its description are presented in Table 9 with some examples for each rating. Human resource requirements include supervision, management, and incentives which were shown in Table 3 and Table 4. Human resource requirements were determined based on the length and number of supervisor, managers, and incentives was determined from records whereas the staff's effort was based on consultations with them by the author and though the author's experience.

Ease	Rating	Description	Example
1	Maximum Resources (difficult)	Required maximum supervision and management and full incentive. Activity was carried by community member and supervisor with constant presence by manager.	Constant presence of staff required (approx 8 hrs/day) to insure technical aspects or to insure participation
2	Significant Resources	Required significant supervision and management and incentive. Activity was carried by community member and supervisor with support from manager.	Staff presence required at least half day (approx 5 hrs/day) to insure technical aspects and participation
3	Balanced Resources (average)	Required balanced quantity supervision and management or small incentive. Activity was carried out by community member with supervisor.	Staff presence required only during important technical moments or at start and end of the day (approx 2 hrs/day)
4	Minimal Resources	Required minimal supervision or management and no incentive. Activity was carried out almost completely by community member.	Staff presence required daily for short times (approx 0.5 hrs/day) to monitor activities
5	Nominal Resources (easy)	Required nominal supervision or management and no incentive. Activity was carried out completely by community member.	Staff monitoring visits occur when necessary

Table 9: Ease Indicator Scale

The ease indicator was judged and recorded by the author immediately after each asset was completed between August and December 2006. In some cases for assets completed before August 2006, the judgment by the author was based on a consultation with the asset supervisor and the project manager assistant who were present during construction.

5.4 Time Indicator

The time indicator is simply the actual time required for construction of each asset. This was from start to finish the real construction time from breaking ground to completion. For example, the time recorded would be the day, week, or month of first digging until the completion of the asset in its finished state.

The time data was collected by the latrine supervisor, a laborer, or the author and then recorded by the author. There are at least two possible biases and/or inaccuracies in the data. First, the author was not the sole collector of the data. Additionally rain delays, cultural inconveniences, and unexpected events sometimes caused delays, including half days, or weekends which are not considered. Data was often compared to parallel events to verify the true construction time. Furthermore, because data was recorded in units of days, weeks, and months the accuracy is severely limited, especially when some data was often rounded to the nearest week or month, depending on its scale.

5.5 Cost Indicator

The cost indicator determines the average cost of each asset to the project. This would include the total cost of all materials, human resources, and transportation. This cost was determined from data submitted as part of the final report to the donor agency, ECHO, after the project completion in December 2006.

For the study the cost of public fountains and latrines was determined as an average where the cost of every asset was the same. This was done for two reasons. First, it was impractical to separately track the costs of each latrine as it would require additional human resources to accomplish the task and the resulting value would be low. Secondly, construction of each latrine and public fountain required the same materials and transportation and only varied slightly on the amount of human resources required.

Determining the small variation in total cost that would result would not necessarily provide valuable information to show the success of the project or the construction of assets.

To determine the cost of the assets, the total expenses were divided into two categories including 1) material resources and 2) transport and human resources. Here material resources include a cost detail for each constructed asset (
Table 10).

	Activity	Direct Cost (€)	%	Transport & HR (€)	Totals (€)	# of latrines	# of public fountains
Materials	Pumps	15500	12%	$14,668	$30,168	152	32
	Pumping Station	37000	29%	$35,015	$72,015		
	Hydrolic Material	38800	31%	$36,718	$75,518		
	Latrine Materials	16000	13%	$15,142	$31,142	$ 205	
	Hygiene Kits	3200	3%	$3,028	$6,228		
	Outillage	1400	1%	$1,325	$2,725		
	Public fountains	7000	6%	$6,624	$13,624		$ 426
	Tank - Laleia 5kL	1300	1%	$1,230	$2,530		
	Tank - Laleia 40kL	2062	2%	$1,951	$4,013		
	Tank - Samalai 30kL	1546	1%	$1,463	$3,009		
	Tank - Cairui 60kL	3092	2%	$2,926	$6,019		
	SUB TOTAL	126900	100%	$ 120,092	$246,992		
Transport and HR	Transportation of materials to site	2000					
	Other (Triangle G.H, HR)	118092					
	SUB TOTAL	120092					
	GRAND TOTAL	246992					

Table 10: Calculating the average expenses for each asset of the study including latrines, public fountains, and reservoirs. Transport and HR costs are separated from material cost, then added evenly to determine the average total cost of each asset.

For each asset the average asset cost was determined by first calculating the percentage of total material cost the asset used. This percentage was used to average the human resource and transport costs back over the material costs for each asset. This total was then divided by the number of that specific asset. The result gave an average asset cost that includes human resource and transport costs (Equation 1). A detail of the calculation is shown as follows:

$$C = \frac{A(\frac{T}{M} + 1)}{N}$$ ***Equation 1***

where T = subtotal of transport and human resources, M = subtotal of the materials, A = total material cost of an asset, N = total number of an asset, and C = average cost of an asset.

6.0 Results

This chapter presents the results of the case study in the three project locations. Results are first summarized and then presented in more detail according to location.

6.1 Summary

The water and sanitation projects in the Laleia, Cairui, and Samalai East Timor were determined to be a success. All the key objectives were reached at the time of project completion, such as available water at all public fountains, available functioning latrines, functioning water management committees, and the budget of 246,992 € was fully implemented in the donor specified timeframe[1]. The specific objectives completed were:

- ✓ Community mobilization for construction of infrastructure by community members
- ✓ Drilling and construction of 3 deep wells
- ✓ Procurement and installation of 3 solar pumping stations
- ✓ Construction of 3 concrete water tanks
- ✓ Construction of 152 latrines
- ✓ Procurement of hygiene kits
- ✓ Technical assistance, support and supervision of the community's work
- ✓ Procurement and oversight of 3 water networks
- ✓ On the job-training of key-persons in community and within water committees
- ✓ Water quality testing
- ✓ Coordination of all activities with The Department of Water and Sanitation (DNSAS)
- ✓ Hygiene promotion (through local NGO partner)
- ✓ Distribution of hygiene kits (through local NGO partner)

Additionally the project was determined to be a success socially through the implementation of the beneficiary compensation scheme for construction of the water and

[1] Although planned for one year the project duration was 13 months after a 1-month delay due to the crisis of 2006.

sanitation system producing higher than average quality of infrastructure. The average infrastructure quality of construction was nearly 4.0 (Good), an above average rating.

Location	Quantity	Object	Average Quality	Average Ease	Average Time (days)	Average Time (days/Liter)	Average Cost (€)	Average Cost (€/Liter)
Cairui	1	Reservoir - concrete	4.0	1	63.0	0.0011	6019	0.10
	46	Latrine	3.9	3	37.9		205	
	19	Public fountain	3.9	3	2.8		426	
Laleia	1	Reservoir - concrete	3.0	1	35.0	0.0009	4013	0.10
	1	Reservoir - metal	5.0	3	3.0	0.0006	2530	0.51
Samalai	1	Reservoir - concrete	3.0	1	60.0	0.0020	3009	0.10
	16	Latrine	3.8	3	56.7		205	
	13	Public fountain	4.0	3	3.8		426	
	Mean		3.8	2.3		0.0011		0.20
	Median		3.9	3.0		0.0010		0.10

Table 11: Summary of results from project study

More importantly, the project was successful where other projects had already failed (ECHO, 2006). In fact, the project was so successful it has become an example in East Timor of how to plan other projects. The project has specifically been recognized by DNSAS and the donor agency, which includes Triangle winning the funding for a similar project in four villages in a neighboring sub-district. DNSAS has also requested Triangle to participate and complete a pilot study for the government involving all systems within the Manatutu District. For the pilot project, Triangle was among only two NGOs whom were chosen to complete a comprehensive survey and design for rehabilitation of an entire districts' water and sanitation systems.

6.2 Laleia

Laleia interventions where based on the rehabilitation of an existing urban system and required construction of only two new infrastructures (Table 11). The first was a 40,000-L reinforced concrete reservoir and the second was a locally prefabricated 5,000-L zinc metal sheet reservoir. Results of the study show a large difference in the two installations.

Analysis of the quality scores has shown a difference in average quality between the concrete and metal reservoirs of 2 points, 3.0 and 5.0 respectively. This difference may be explained by the difference in the ease indicator, showing 1.0 for the concrete reservoir and 3.0 for the metal reservoir. This clearly shows the difference in the two construction techniques where the metal reservoir required less human resources yet still resulted in a high quality score. It is believed this may be due to the prefabrication of the metal tank whereas the concrete tank was built with local labor and required significantly more human resources. This is supported by the results of the construction time where the concrete reservoir required 10 times the construction time.

These inputs and resulting output are clearly balanced by the cost of the two reservoirs. The concrete reservoir was less costly on per liter of storage basis and the prefabricated metal reservoir had a five times higher cost per liter of storage (**Error! Reference source not found.**).

6.3 Samalai

The Samalai interventions included the construction of a complete water and sanitation system. The project included construction of 1 30,000-L reinforced concrete reservoir, 16 latrine pairs, and 13 public fountains. Results of the study are shown in **Error! Reference source not found.**. The quality proved to be above average with scores above 3.0. The public fountains had an average quality score of 4.0, the latrines a score of 3.8, and the reservoir a score of 3.0. The ease scores showed that the public fountains and latrines had higher average scores compared to the reservoir. The difference in ease

scores display the large differential in resource requirements between the various constructions where reservoirs require a much larger number of resources. Additionally, time and cost numbers were within a reasonable level and the projects were finished in the allotted time and within the budget constraints.

6.4 Cairui

The Cairui intervention required the construction of a complete water and sanitation system. The project included construction of 1 60,000-L reinforced concrete reservoir, 46 Latrine pairs, and 19 public fountains. Results of the project are shown in **Error! Reference source not found.**1.

Results show the quality scores to all be approximately 4.0, a good rating. The ease scores showed that the public fountains and latrines rated higher than the reservoir. Again this shows a large differential between the three constructions where the reservoir required the maximum available resources. Additionally, time and cost numbers were within a reasonable level and all projects were finished in the allotted time and within the budget constraints.

7.0 Analysis, conclusions, and recommendations

This chapter reviews and analyzes the information and provides recommendations for further construction of water and sanitation systems in East Timor and around the world.

7.1 Summary

The results provided in Chapter 6 indicate that the water and sanitation projects in Laleia, Samalai, and Cairui were a success. The results show that all water and sanitation system assets, in all three villages, were functioning upon completion. Additionally all infrastructures averaged a mean quality score of 3.8. The systems were also completed within the given period and available budget. Although quality results show the project was a success and the beneficiary compensation scheme sufficiently mobilized the community, further examination of the data indicate that other conclusions can determined. These conclusions suggest some concrete recommendations for further studies and projects in East Timor and around the world.

7.2 Analysis and conclusions

As described in Sections 6.2 – 6.4 and discussed below, several trends emerge from the collected data from all three communities (Table 11). First, the quality scores range from 3.0 (average) to 5.0 (excellent) with a median and mean of 3.9 and 3.8 respectively, both approximately a good score. Further analysis shows that between the communities there was very little difference in the resulting quality of assets. For instance, the quality of produced public fountains in Cairui and Samalai were roughly the same at 3.9 and 4.0 respectively

The ease indicator provides a different pattern from the quality scores. Specifically the mean and average are lower at 2.3 and 3.0 respectively. Distant mean and median indicate that the spread of data is not symmetrical and therefore skewed to one side. Further analysis suggests that the difference between the mean and median is due to low ease scores obtained from the concrete reservoirs. All the remaining scores were 3, whereas the concrete reservoirs in all three villages had average ease scores of only 1.0.

All the assets constructed required an average amount of resources except for the concrete reservoirs, which required a maximum amount of resources.

The time and cost scores could not be averaged, as done with quality and ease scores, because they would naturally differ greatly between assets. Additionally, cost scores for the public fountains and latrines cannot be compared between communities as they are program-wide costs that are the same. However, comparing time scores between communities for like assets does show some significant differential. For instance in Cairui latrines required an average of 37.9 days whereas in Samalai it took 56.7 days, almost 50% longer. This trend appears again with the construction of public fountains where Cairui required an average of only 2.8 days whereas Samalai took another full day for a total of 3.8 days, almost 40% longer. The trend also appears with further examination of the construction of the reservoirs. Due to the different sizes of the reservoirs in each community, comparison between them is calculated by normalizing each time score over the storage capacity in liters. In Cairui, it cost 0.0011 days/L whereas Samalai required 0.0020 days/L, an increase of over 80%.

These differences, mainly the longer time required for constructing in Samalai vs Cairui, are due to many factors. The first and most likely reason for the inconsistencies is due to where staff resided (Table 3). As it is shown not a single staff resided in the community of Samalai. Most staff including positions 2, 7, 8, and 9, that were important to the construction, all resided in neighboring Cairui. Staffing position 1, the project manager also resided outside of Samalai but in the community of Laleia. Under this staffing scheme, supervision and management only occurred through a visit to the community whereas in Cairui staff were almost always present. This provided unplanned assistance to the constructions in Cairui, where regardless of the day's activities some supervision and management could be provided during the beginning and end of the workday as staff left or returned to the village.

Cairui also received additional assistance due to its size. As shown previously in Table 1 the populations between the communities differed quite a bit. Cairui's population was

the largest with 1,727 people followed by Laleia at 1,604 and Samalai at only 230. Most of the staff were focused on construction of the two new water and sanitation systems in Cairui and Samalai and not on the rehabilitation in Laleia where there was a dedicated water committee. Additionally, the staff would proportionally divide time between Samalai and Cairui based on the total workload, which was somewhat proportional to the populations where Cairui was much larger than Samalai.

Also the sequence of reservoir construction added a further factor to explain why the reservoir in Cairui was finished faster than in Samalai. This trend can be seen if data from the community of Laleia are evaluated. In Laleia, the concrete reservoir was built at an average rate of 0.0009 days/L where in Cairui it cost 0.0011 days/L and Samalai required 0.0020 days/L. The trend shows the longest construction time on a per storage basis in Samalai followed by Cairui and then Laleia. It turns out that this is the exact sequence of construction where the reservoir in Samalai was built first, then in Cairui, and finally in Laleia. It is clear that the staff became more efficient at constructing the reservoirs as time progressed.

Staffing issues also impact the pace of a project. For example, before the start of the project none of the staff including the project manager had any experience building a concrete reservoir. In fact only the project manager, an expat engineer, had a theoretic education in how to properly construct a reinforced concrete reservoir. This was the case throughout most of the construction of the first reservoir in Samalai until approximately 75% of the way through the construction the project manager was evacuated from the country due to a health problem. The replacement project manager, the author, immediately continued construction of the tank in Samalai. With the author's previous experience constructing reservoirs and his fluency in the local language the project progressed at an accelerated rate. Of course, this accelerated rate is only shown in the remaining reservoir data as each asset was analyzed as a package.

Continued analysis of the data for the reservoir revealed another trend. As described previously, the quality scores for the reinforced concrete reservoir construction in the

three villages where 3.0 in Samalai, 3.0 in Laleia, and 4.0 in Cairui. Also the ease scores for the three communities were a common 1 requiring maximum resources. As previously stated there was a trend for the increasing construction speed of each reservoir as well as a trend for increased quality. Yet the quality scores do not follow this trend ato the final construction in Laleia. In fact, for the construction in Laleia the quality score dropped back down to 3.0, the same as the Samalai construction.

A possible explanation may be found from the experience of the author and the ease data. The ease data indicates that the construction required the maximum resources for each construction. As reported by the project manager and assistant project manager, working with unskilled labor proved to be very difficult. In fact, many volunteers had very few skills including those whom had previously never used a hammer. Further analysis of how the volunteer labor was implemented shows that the average results in Laleia are due to large number of separate communities. As described in Chapter 3, Laleia and Cairui are administratively divided into six *aldeias* each, whereas Samalai consists of just one. In Cairui and Samalai, the communities selected for an incentive-based labor scheme where volunteers came to work at their own will. Laleia was different because the community decided that each day of the week, Monday – Saturday, would be allocated to one *aldeia*. This scheme required individuals to volunteer for labor only once per week resulting in new staff on site each day. In general, Cairui and Samalai volunteers were the same individuals every day of the week. This resulted in the average volunteer working at least five out of the six days of the week or thirty to sixty times over the course of the construction. In contrast, in Laleia the average individual worked only three to six times over the course of the construction.

This difference is most evident with examination of the resulting quality scores due to capacity building of individuals whom repeatedly came to work. Volunteers from Cairui and Samalai had their capacities significantly built over the course of the week whereas in Laleia a new individual, who worked slower and less efficiently, reported to work each day. Although the existence of low ease scores due to the schemes reflect poorly upon the success of the compensation scheme due to the resulting quality it doesn't necessary

suggest a project failure. Mobilizing the community in this manner lowers quality and increases the human resources and incentives required but may have another desired output, mainly the capacity development of the workers. As necessary to development, capacity building of locals is highly desired.

7.2.1 Incentive compensation

The incentive-based beneficiary compensation scheme appeared to be a success, achieving the desired objectives for construction of the water and sanitation systems in Laleia, Samalai, and Cairui. Although as discussed previously in Section 7.2, it was not the determining factor in the project's success. Other factors attributed to project success; the incentive scheme was only a small factor.

The small impact of the beneficiary compensation scheme also includes its relative financial impact. The cost of the incentives for beneficiary compensation was calculated from the reported financial expenditures of Triangle (Table 12). Table 17 includes a column describing the status of the project during each week of implementation. The status is explained because gaps existed in the records. These gaps were experienced during three separate periods and are marked in gray as shown. The gaps were due to unavoidable issues because there was an insufficient amount of staff available to report the expenditures. For the periods lacking records, an amount has been estimated based on the average of all weeks for which the project ran. Although this allows for some error, the results will show that it is ultimately of little effect on the results. The results show total incentive expenditures at less than 1% of the total project cost and about 1% of the total human resource and transport and materials cost.

Week of	Week	Cost	Status	Date	Week	Cost	Status
1/1/2006	1		ongoing	6/18/2006	25	88	ongoing
1/8/2006	2		ongoing	6/25/2006	26		evac
1/15/2006	3		ongoing	7/2/2006	27		evac
1/22/2006	4		ongoing	7/9/2006	28		evac
1/29/2006	5	4.5	ongoing	7/16/2006	29		evac
2/5/2006	6		ongoing	7/23/2006	30		evac
2/12/2006	7		ongoing	7/30/2006	31	42.3	evac
2/19/2006	8		ongoing	8/6/2006	32		evac
2/26/2006	9		ongoing	8/13/2006	33		evac
3/5/2006	10		ongoing	8/20/2006	34	72	ongoing
3/12/2006	11		ongoing	8/28/2006	35	13.5	ongoing
3/19/2006	12		ongoing	9/4/2006	36	88	ongoing
3/26/2006	13		ongoing	9/11/2006	37	35.1	ongoing
4/2/2006	14		ongoing	9/18/2006	38	145.3	ongoing
4/9/2006	15		ongoing	9/25/2006	39	10.1	ongoing
4/16/2006	16	26.5	ongoing	10/2/2006	40	60.6	ongoing
4/23/2006	17		ongoing	10/9/2006	41	90.5	ongoing
4/30/2006	18	75	ongoing	10/16/2006	42	100	ongoing
5/7/2006	19	72	ongoing	10/23/2006	43	106.9	ongoing
5/14/2006	20	15	ongoing	10/30/2006	44	70	ongoing
5/21/2006	21	107.5	ongoing	11/6/2006	45	72	ongoing
5/28/2006	22	134.5	ongoing	11/13/2006	46	72	ongoing
6/4/2006	23	65	ongoing	11/20/2006	47	72	ongoing
6/11/2006	24	56	ongoing				Currency
					Total	$ 1,694	USD
					0.732 Euro / $	$ 1,240	Euro
					Total Materials	$ 126,900	Euro
					Total HR and transport	$ 120,092	Euro
					Total Program Budget	$ 246,992	Euro
					% of materials	0.98%	
					% of HR and transport	1.03%	
					% of total	0.50%	

Table 12: Total Incentive expenditures for the length of the project.

Results show that the incentive cost only 0.5% of total project costs or about 1% of either total human resource and transport costs, or total cost of materials. Additional non-financial factors that affect the requirements include transport, procurement, and distribution or the incentive. These factors also prove to be of small consequence. For instance, the incentive was small and light, and in most cases fit into one of two small boxes for each day. Procurement was simple since staff were continuously purchasing

other materials on a weekly basis at the same businesses where the incentive could be purchased. Transport from the capital and to the project location was also easy as the incentive took up little space and was lightweight. Distribution was also easy and in fact became an additional motivational factor for beneficiaries to work until the end of the day, as an individual could not receive their incentive for the day without presence at the end of the workday.

7.3 Recommendations

Although all three projects were successful, the results for the three communities were not the same. Thorough analysis shows us there are many other factors that are important to the success of the project and the beneficiary compensation scheme. Some of these factors include differences between the staffing, specifically where the staff resided. Community characteristics also emerged important to success such as the technical capacity of the individuals and the size and geographic location of communities became limiting factors in success. Sequencing of constructed works and the timing when particular staff were present at the construction also became a clear issue in the success.

7.3.1 Incentive-based compensation scheme

The first recommendation of the author is

> *that incentive schemes should be recommended practice, along with alternative compensation schemes including cash based, where communities are unwilling to provide volunteer labor. Incentive schemes result in positive outputs for little investment.*

Analysis of the scheme suggests that the scheme required little investment of human resources, transport, time, or money but was a necessary input for community involvement in construction. The practice of incentive distributions should be a recommended practice to overcome the unwillingness of beneficiaries to volunteer. This scheme though is one of the many options available, including others such as cash based schemes.

7.3.2 Staffing

The second recommendation of the author is

> *that recruitment of staff is based on their capacity as not just a technical expert but as a person willing to do more than the standard job description, including relocation and most importantly relationship building. Staffing is of the highest importance.*

As described in Section 7.2 a trend emerged concerning where staff resided as an important factor to the project's success. Although, the importance of staffing did not end there, it also includes the capacity of those staff with technical, cultural, and lingual capacity. The character of certain key members of staffing, especially the assistant project manager made all the difference in the project. This positions largest key to success was unrelated to incentive, money, time, resources, or skill level. In fact, the key to his success and the success of the program was his character.

In only the short period of the project, he was able to befriend not only key community members but also the entire community. Understanding and relationships he built with the community made him family and figured into major motivations for community members to work toward the goals of the project. Just as with the Peace Corps objectives the author experienced during his service, this staff member moved to an unfamiliar community and took the time to become a member of the community before helping them to help themselves. The initiative the staff member took included activities not usually specified by intervention agencies but well understood by Returned Peace Corps Volunteers. The activities could best be described as "hanging out." The staff member took his time away from the project such as at night and on weekends to follow the members of the community through their daily routines. This often included just talking with them on their porches, joining in a cigarette, having coffee, or helping them carry a heavy load. This furthered an immeasurable bond with the community which later would reflect the support they provided while completing the project. The author believes the staff member's involvement is the most significant key to success for the project. In fact,

the key to success where others projects had failed was the initiative and characteristics of this staff member.

7.3.3 Sustainability

Lastly the author recommends that

> *water and sanitation projects are designed to include considerations of the construction, functionality and use. Design of water and sanitation systems considers more than just the resulting function.*

Specifically, as relevant to this project, design should include how the system would be constructed. For example, that construction of reinforced concrete reservoirs is not recommended, as it requires a high amount of human resources and is limited due to the technical capacity of the community. As described in Chapter 6 construction of the reinforced concrete water tanks required maximum resources of the NGO yet still resulted in an average quality score for the asset. In fact, much of this can be attributed to working with unskilled workers. Project design must focus on the entire lifecycle of the project including the construction and maintenance. Construction of the reservoirs was highly technical yet required construction by an unskilled workforce. This required an immense amount of supervision, management, capacity building by project staff which undoubtedly took away valuable time to oversee other constructions or general management.

Additionally the construction of reinforced concrete reservoir is not recommended as compared to prefabricated metal reservoir. Although the metal reservoir requires additionally monitory resources it resulted in a higher quality, lower installation time, and decreased effort of the NGO. Further analysis shows the metal reservoirs requiring only twice the funds or an additional 6% of total projects cost. This small increase in cost is minor in comparison to the overall benefits of choosing the metal reservoirs.

7.3.4 Application to future development work

As shown in this simple and small study there is much gained from analysis of beneficiary compensation schemes. Future work and research with compensation schemes is encouraged as well as the utilization of the indicators used for this study. It is important to note that as part of the central methodology of the indicator development was simplification to analyze only part of the infrastructure constructed. Additionally only infrastructure was analyzed while the social aspects such as water committee development, health promotion, and health behaviors were not. Further work should look to take advantage of opportunities to analyze these aspects of the project as well.

Additional work can also be done with the indicators. As discussed previously the development of the indicators introduced some bias and imprecision. The bias, mostly due to creation and the judgement being performed by the same individual, the author. This bias could be easily corrected if the improvement and further analysis is completed by separate people.

Also all the indicators besides, cost, had issues that limited precision. Quality and ease are both imprecise as they are mostly qualitative judgments of the infrastructure. Work on the indicator could be done to reduce this and increase the quantitative ability. For instance, the quality indicator could be improved through additional relation to specific features on each asset or could be broken down into sub indicators each measuring a different quality. Suggestions are sub indicators such as functionality, materials, or craftsmanship.

Efforts could also be made on the ease indicator. The indicator could be additionally quantified by relating it farther to actual amounts of incentive distributed or human resources presence required. Additional peer review of the indicators and analysis methodology will also increase their effectiveness and reduce the bias and imprecision. The time indicator can also be improved my increasing its accuracy as well as the rigorousness by which it is recorded.

References

Barker, A. (2006). *UN agrees to Timor investigation*. Retrieved 2008, from Lateline: http://www.abc.net.au/lateline/content/2006/s1661279.htm

Central Intelligence Agency. (2008, March 20). *East Timor*. Retrieved 2008, from CIA World Factbook: https://www.cia.gov/library/publications/the-world-factbook/geos/tt.html

Democratic Republic of Timor-Leste Ministry of State Administration. (2003). *On the establishment of the number of Sucos in the national territory.* Dili: Ministerial Order 6/2003 of 29 July.

Dr. Khem Raj Sharma, M. I. (2002). *A Study Report on Organisation, Negotiation and Contracting:Case Study of West Gandak and Marchawar Lift Irrigation Systems (Nepal).* Geneva: International Labour Organization.

Excellent Development. (2005). *Kangemi – Where There is No Food*. Retrieved December 1, 2007, from http://www.excellentdevelopment.com/news_detail.php?id=14

Heck, B. v. (2003). *Participatory Development: Guidelines on Beneficiary Participation in Agricultural and Rural Development.* Rome, Italy: Rural Institutions and Participation Service, Rural Development DivisionFood and Agriculture Organization of the United Nations.

International Labor Organization. (2007). East Timor. *Crisis Highlights* , 5.

International Labor Organization. (2005). *ILO Guide on Responses to Support the Recovery and Reconstruction Efforts in Crisis-Affected in Indonesia.* Turin: International Labor Organization.

Ministry of Finance, Democratic Republic of Timo-Leste . (2008). *General Budget of State 2008.* Dili: Ministry of Finance, Democratic Republic of Timo-Leste.

Republica Democratica de Timo-Leste. (2007). *Timor-Leste*. Retrieved 2007, from A Brief History of East Timor: http://www.timor-leste.gov.tl/

Republica Democratica de Timor-Leste. (2006). *Water Supply and Sanitation: Priorities and Proposed Sector Investment Program.* Dili: RDTL.

Swedberg, J. (2003). *Design of Infrastructure Projects.* Washington, DC: USAID Development Information Services.

Tajgman, D. (1998). *Food for thought: A Guide for moving from Food for Work (FFW) to Food for assets and sustainable employment (FASE).* Aarhus, Denmark: World Food Program (WFP) and the International Labour Office (ILO).

The American Heritage Dictionary of the English Language, Fourth Edition. (2000). *Dictionary.* Houghton Mifflin Company.

Triangle G.H. (2007). *About*. Retrieved 2007, from Triangle G.H.: http://www.trianglegh.org/English/

UNDP. (2006). *Human Development Report, Beyond scarcity:Power, poverty and the global water crisis.* UNDP.

United Nations Development Programme. (2005). *Update Report: Aceh Emergency Response and Transitional Recovery Programme.* Jakarta: United Nations Development Programme.

United Nations. (2002). *Report of the World Summit on Sustainable Development (Johannesburg, South Africa, 26 August-4 September 2002)*. Retrieved 2008, from Johannesburg Summit 2002: http://daccessdds.un.org/doc/UNDOC/GEN/N02/636/93/PDF/N0263693.pdf?OpenElement

United Nations. (2006). *The Millennium Development Goals Report.* New York: United Nations Department of Economics and Social Affairs.

USAID. (2007). *Commodities Reference Guide*. Retrieved 2007, from USAID: http://www.usaid.gov/our_work/humanitarian_assistance/ffp/crg/module2.html

World Food Program. (2007). *Food-for-work takes the strain out of Niger's lean season*. Retrieved 2007, from World Food Program: http://www.wfp.org/English/?ModuleID=137&Key=2066

Wright, J. (2005). A brief history of Kairui. Laleia, East Timor.

Appendix. Designs for Water and Sanitation Infrastructure

A. Latrine Design

The basic latrine design for the project is provided in

Figure 111. The design is for two water flush latrines with a shared pit. Each latrine was based on the standard acceptable latrine design in East Timor using appropriate technology for the specific region. As described in Chapter 3 the latrines were built by family groups on a voluntary basis. Triangle provided most materials on-site with technical supervision. Location map for Cairui with locations for constructed latrines is shown in Figure 12.

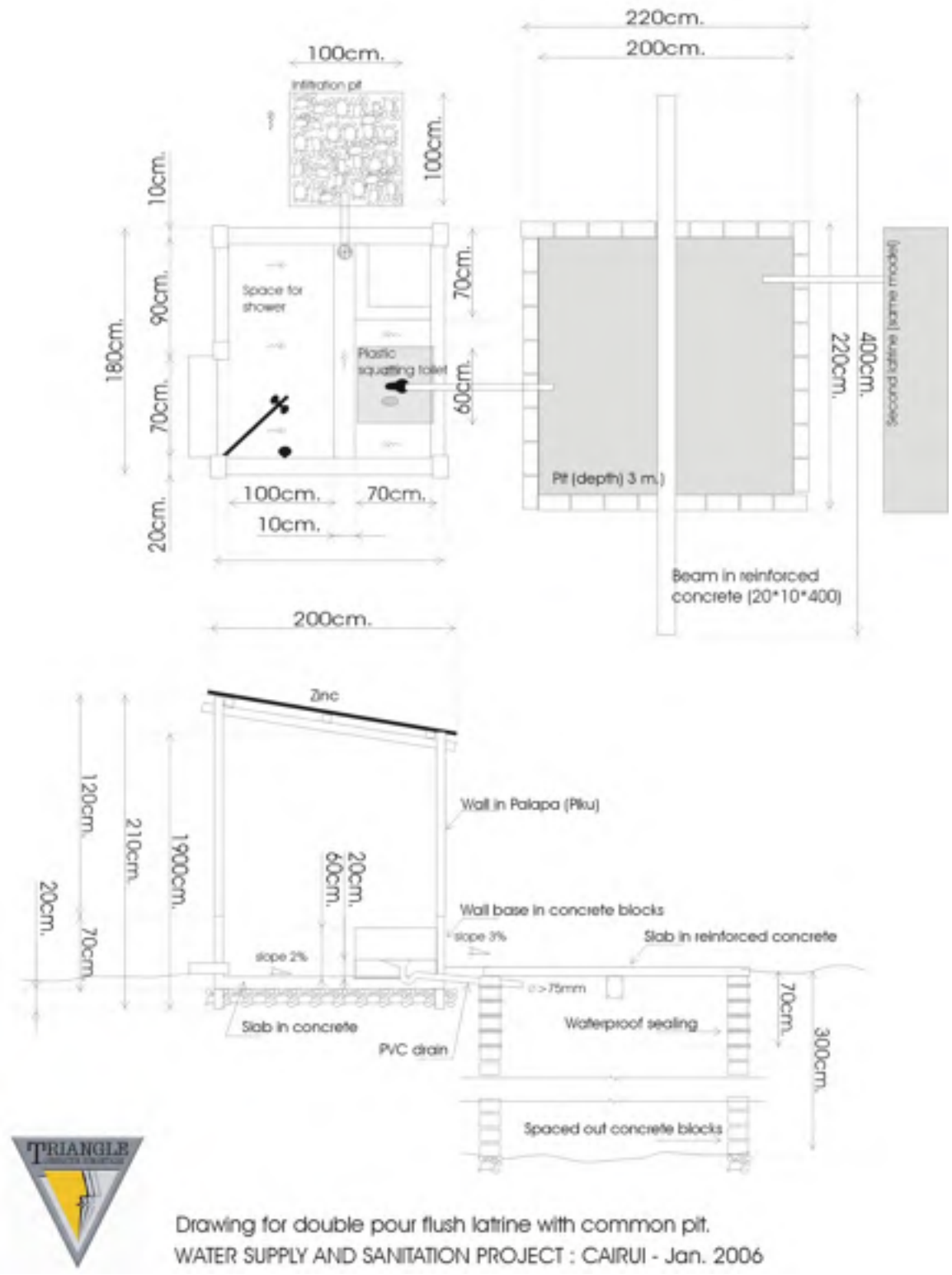


Figure 11: Latrine design for water and sanitation supply project Laleia, East Timor.

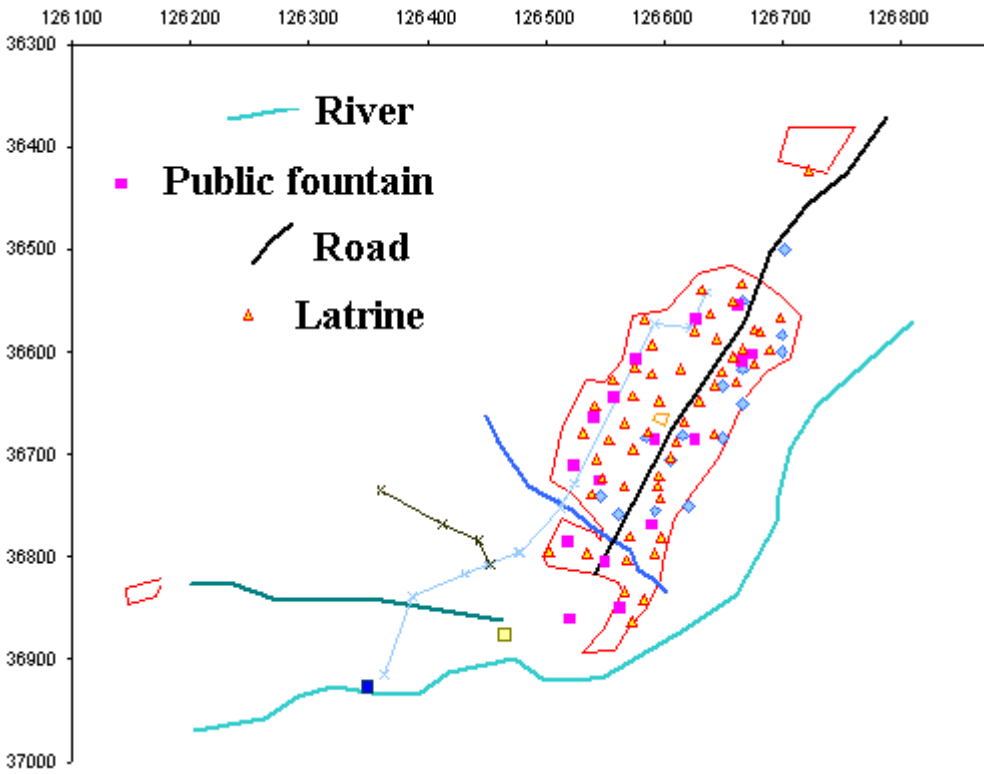
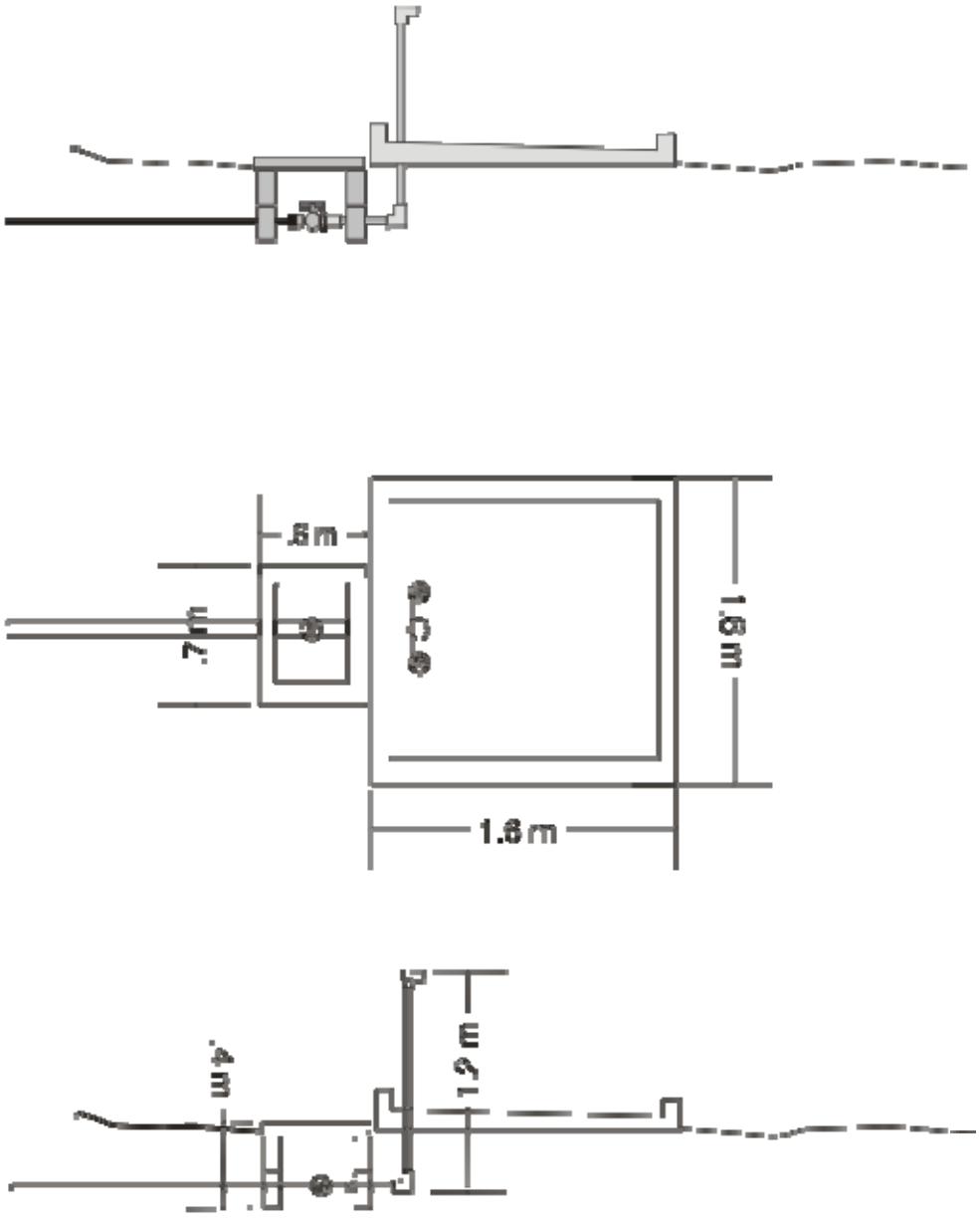


Figure 12: Map of constructed latrines Cairui, East Timor.

B. Public Fountain Design



Public Fountain
Triangle G.H. 2007

Figure 13: Public fountain design.

C. Samalai Pipe Network

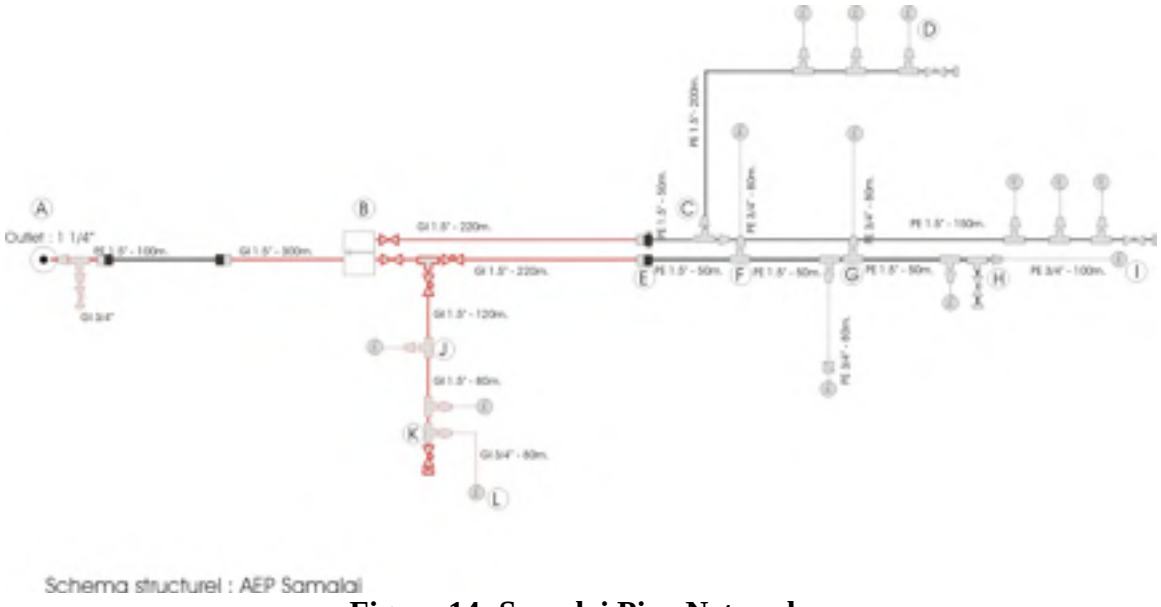


Figure 14: Samalai Pipe Network

D. Cairui Pipe Network

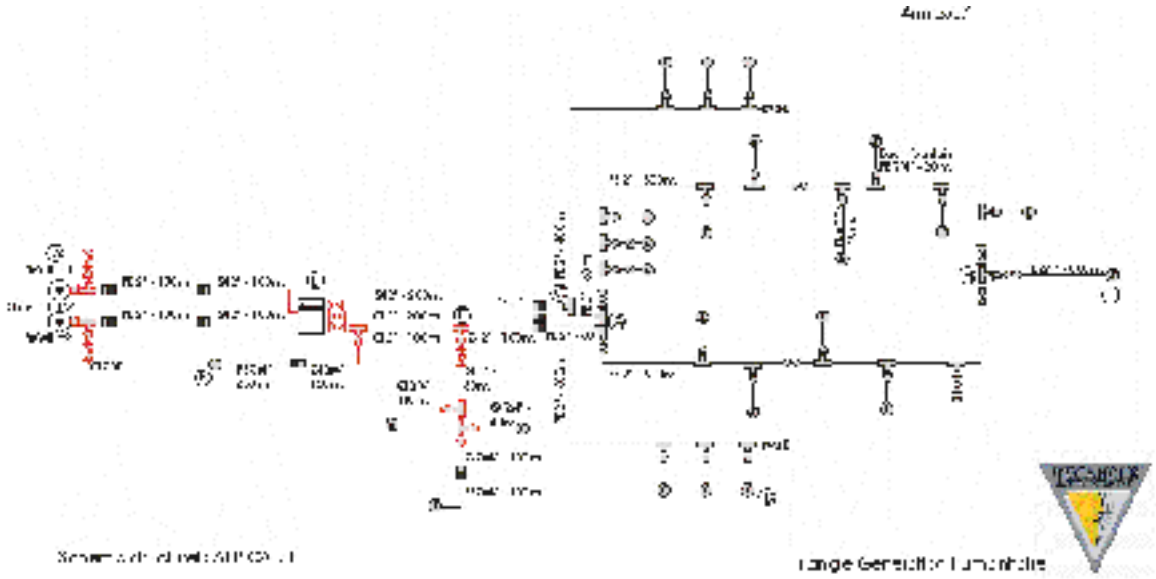


Figure 15: Pipe network drawing Cairui, East Timor.

E. Reservoir Design

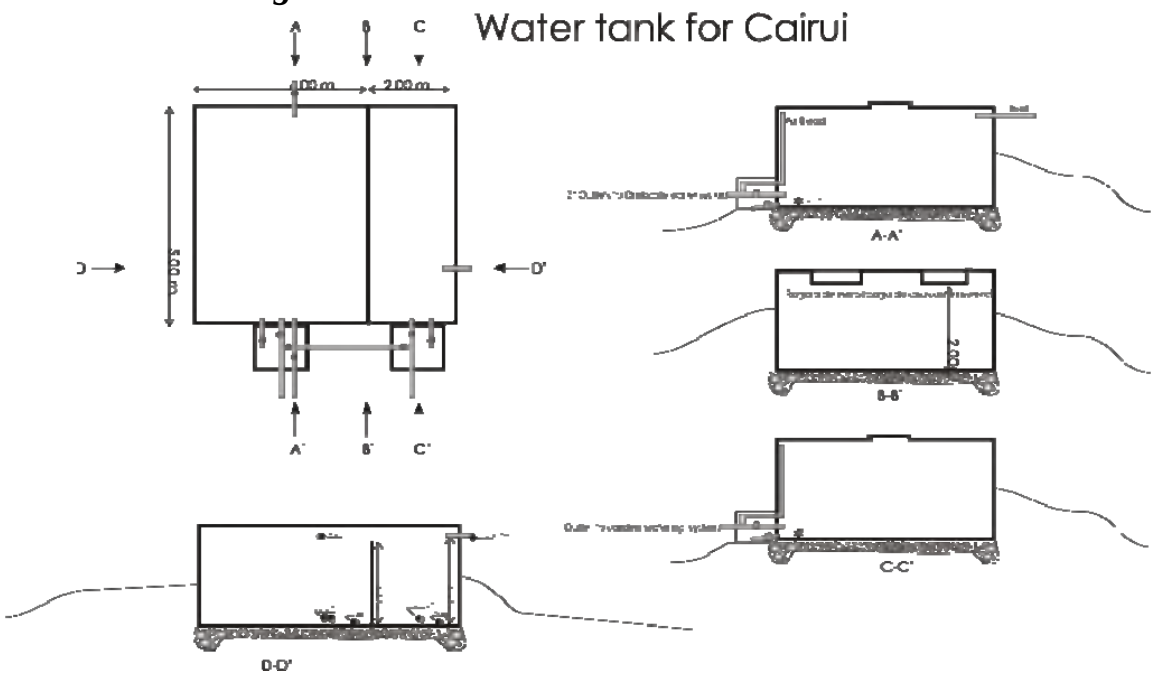


Figure 16: Reservoir design Cairui, East Timor.

F. Borewell Design

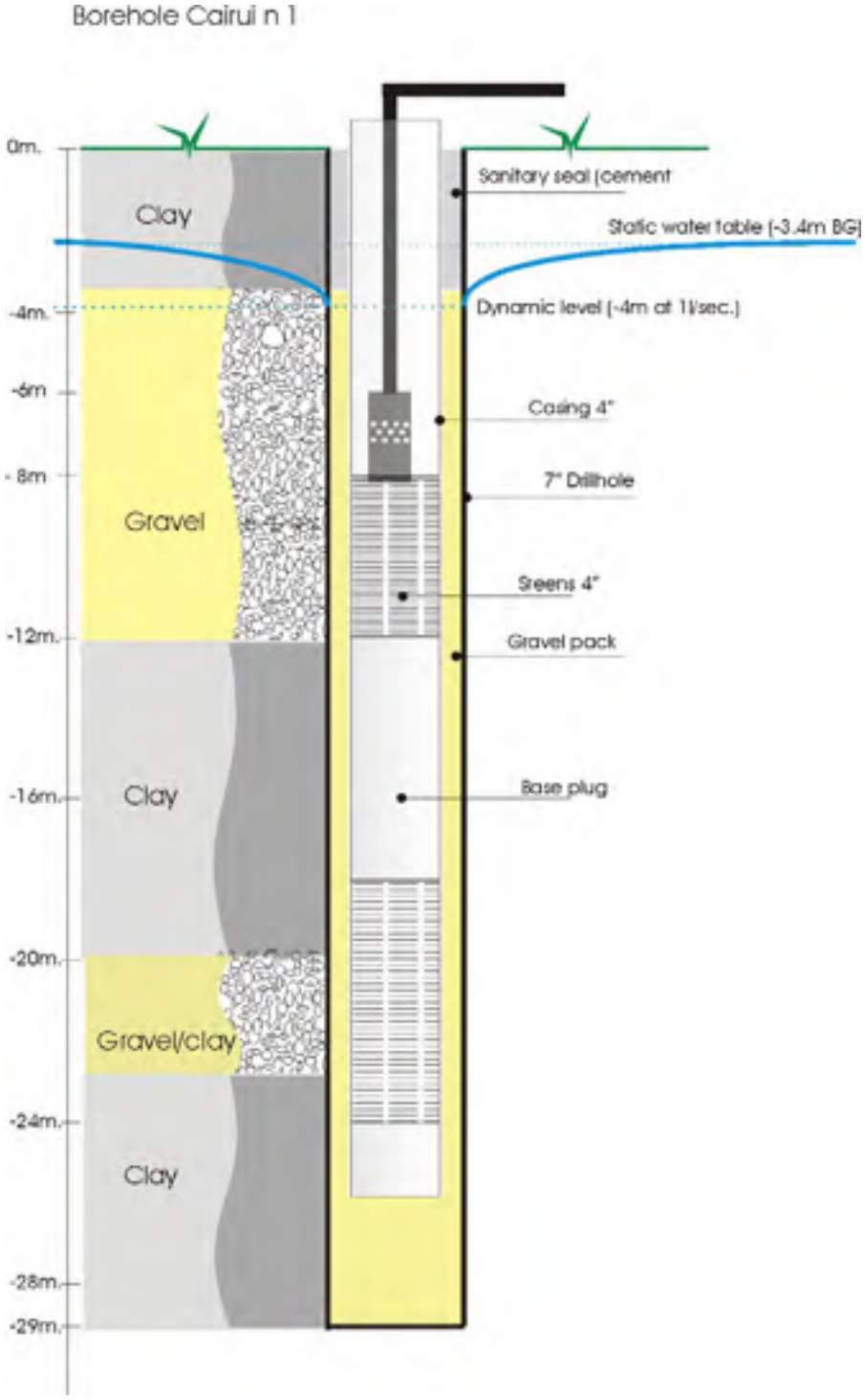


Figure 17: Borewell design Laleia, East Timor.

G. Solar Array and Bore wells

Figure 18: Installation of submersible bore well pump and solar array in Cairui, East Timor.

H. Non-local and local materials

Local Materials
Sand
Aggregate
Water
various wood (supports and forms)
palm stems (latrine siding).

Non-local Materials
Cement
piping (GI, HDPE, and PVC)
cut timber
zinc metal sheeting
water flush squat plates.