MINISTRY OF PUBLIC WORKS
THE REPUBLIC OF LIBERIA

THE LIBERIA WATER AND SEWER CORPORATION

THE MASTER PLAN STUDY
ON
URBAN FACILITIES RESTORATION AND IMPROVEMENT IN MONROVIA IN THE REPUBLIC OF LIBERIA

OPERATION & MAINTENANCE AND MONITORING OF COMMUNITY-MANAGED SATELLITE WATER SUPPLY SYSTEM IN MTA COMMUNITY, GARDNERSVILLE

FINAL REPORT

March 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.
KATAHIRA & ENGINEERS INTERNATIONAL

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UNIT

A	: Ampere	LD or L$	: Liberian Dollar
hr or hrs	: Hour	m	: Meter
G	: U.S. Gallon (3.785 lit)	m^2	: Square Meter
GCD	: Gallon per Capita per Day	m^3	: Cubic Meter
ha	: Hectare	MGD	: Million Gallon per Day
Hz	: Hertz	min	: Minute
km	: Kilometer	%	: Percent
km^2	: Square Kilometer	rpm	: Revolutions per Minute
kVA	: Kilo Volt Ampere	sec	: Second
kW	: Kilo Watt	USD or US$	: U.S. (United State) Dollar
L or Lit	: Litter	W	: Watt
LCD	: Litter per Capita per Day		

EXCHANGE RATE

USD 1 = LD 70

ABBREVIATIONS

G.L.	: Ground Line
GS	: Galvanized Steel
HH or HHs	: Household
ICRC	: International Committee of the Red Cross
JICA	: Japan International Cooperation Agency
LHS	: Liberian Hydrological Services
LWSC	: Liberia Water and Sewer Corporation
MCC	: Monrovia City Corporation
MDGs	: Millennium Development Goals
MLGH	: Ministry of Land, Mines and Energy
MOU	: Minutes of Understanding
MPW	: Ministry of Public Works
MTA	: Monrovia Transit Authority
NGO	: Non Governmental Organization
NRW	: Non Revenue Water
O&M	: Operation & Maintenance
PEDW	: Project for Emergency Development of Water Supply System at Paynesville
PEWS	: Project for Expansion of Water Supply System at Paynesville
PRSP	: Poverty Reduction Strategy Programme
SETS	: Socio-Economic Transformation Strategy
UfW	: Uncounted for Water
uPVC	: Unplasticised Poly Vinyl Chloride
WATSAN	: Water and Sanitation
WMT	: Water Management Team

CHAPTER 1 INTRODUCTION

1.1 Background

As national policy and strategy in Liberia, the Poverty Reduction Strategy Programme (PRSP) shows the overall goals on water supply and sanitation sectors which are:

1. Improvement of water access rate from 25% to 50% by 2011
2. Sustainability on operation and maintenance of 90% of water supply facilities

For achievement of the sector's goals, the Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia, funded by Japan International Cooperation Agency (JICA), proposed the "Project for Emergency Development of Water Supply System at Paynesville in Greater Monrovia (PEDW)" as short-term plan and its expansion (PEWS) as medium-term plan.
The Study included drilling of observational deep wells for groundwater development, and furthermore implemented a pilot project of community-managed satellite water supply system utilizing the drilled well in MTA community of Gardnersville. The system has been operated and maintained by community organization since November 2009.

1.2 Objectives

In introduction of community-managed satellite water supply system in peri-urban Monrovia, pilot project was implemented and then the operation and maintenance was monitored in order to verify appropriateness and sustainability of the system and to clarify problems and issues on operation and maintenance. The results obtained from the monitoring can be useful for how to formulate future projects and also to ensure the functioning and sustainability of the system. This report is mainly composed of five (5) chapters.

Chapter 1	: Introduction
Chapter 2	: Water Supply in Peri-Urban Communities
Chapter 3	: Summary of Pilot Project
Chapter 4	: Results of Monitoring
Chapter 5	: Conclusion, Suggestions and Consideration

1.3 Present Condition of Water Supply Sector

1.3.1 Relevant Institutions for Water Supply Sector

The organizations concerned with water supply sector are "Liberia Water and Sewer Corporation (LWSC)" and "Liberian Hydrological Services (LHS)" of Ministry of Land, Mines and Energy (MLME).

LWSC, which was established in 1973 in accordance with the act of the government in order to supply safe water to the whole of Liberia, manages water supply and works especially for the center of Greater Monrovia and main towns of each county under the supervision of MLME. LWSC has the following vision and mission.

Vision

- Supply safe water and serve good hygiene at affordable cost to all nationals.

Mission

- Reduce the burden of water borne and other related diseases in Liberia
- Provide sustainable, effective and efficient services.
- Is accountable and responsible for beneficiaries who receive water supply and sanitation service.
- Has responsibility for cost recovery on water supply and sanitation sector.

In 2009, LWSC had 140 staffs (See the Table 1-1) and reformed its organization and established individual maintenance section in the technical service division (see the Figure 1-1).

On the other hand, LHS is engaged in the overall groundwater development, its technical support using basic hydrological data and responsible for designing water sources such as deep, shallow, and dug wells. Furthermore, MLME and LHS are responsible for land acquisition for any water supply facilities.

Table 1-1 Staff of LWSC

Category	Numbers of staff	%
Top Management	3	2
Professional	41	29
Supervisory	10	7
Skilled	39	28
Semi-Skilled	25	18
Unskilled	22	16
Total	140	100

Source: LWSC Annual Report 2008 (Draft)

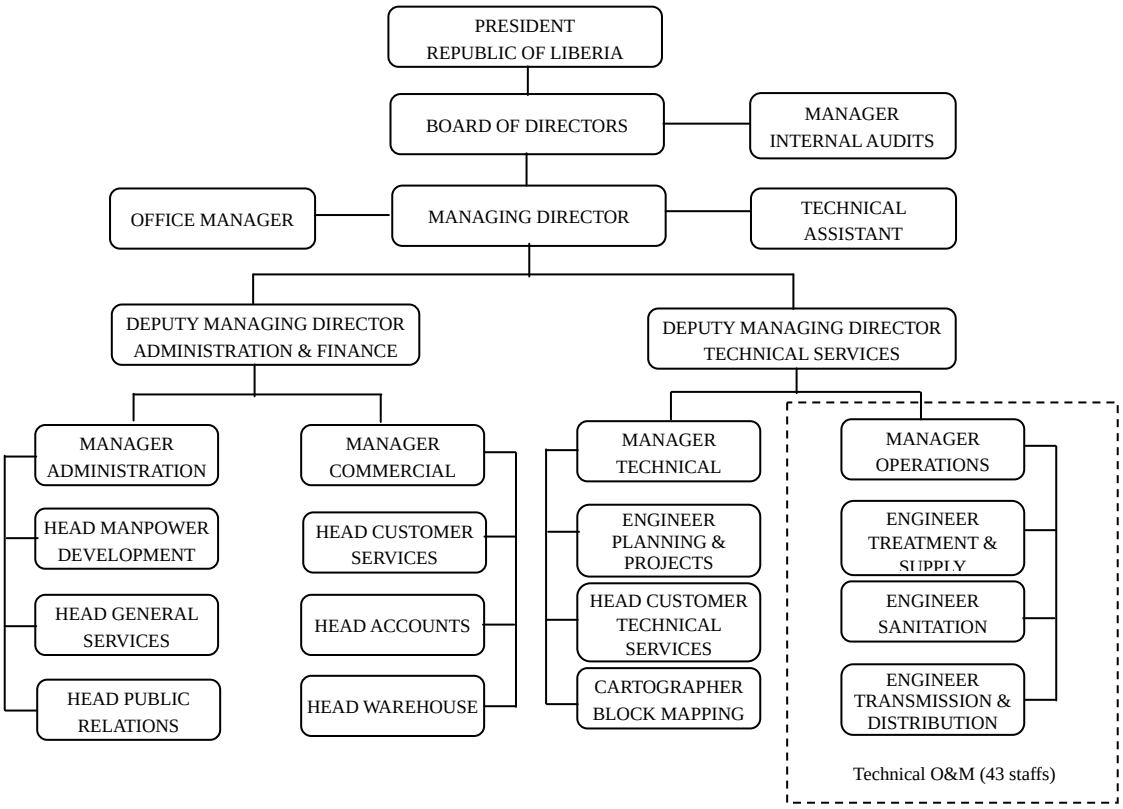


Figure 1-1 Organizational Chart of LWSC

1.3.2 Policy and Strategy

The National Poverty Reduction Strategy Program (PRSP) was finalized in April 2008. This contains not only an overall vision of the Liberian government and main national strategy but also implementation plans from 2008 to 2011 (four years), which focuses on the sustainable national growth and national development. In addition, PRSP is a process to the long term development plan of the Socio-Economic Transformation Strategy (SETS).

In terms of water supply sector, the water access rate[1] of 37% in 1990 was reduced to that of 17% in 2003. After the civil war, the water access rate reached 25% in 2004 as the rehabilitation project was been carried out. From this point of views, the PRSP focuses on the following goals.

Goals

- Improvement of Water Access Rate from 25% to 50% by 2011
- Operation and Maintenance Sustainability on 90% of water supply facilities

For the achievement of the above goals, a few countermeasures on community-managed water

[1] Water access rate is defined as ration that dwellers access any types of water supply facilities such as urban water supply facilities (house connection, tap-stands), shallow wells with hand pump and dug wells, etc.

supply in Monrovia were specified as follow:

- Rehabilitation of 90% of Stand Posts (including that of rural communities)
- Construction of Satellite Water Supply System with Water Source of Groundwater (Monrovia)

Furthermore, LWSC has goals and action plans to achieve the goals for the 3rd short term from 2008 to 2010 based on the PRSP and Millennium Development Goals (MDGs) in order to sustain safe drinking water supply and hygiene environment to improve the lives of communities.

Goals	Action Plans
- Reduction of "Unaccounted for Water" or "Non Revenue Water" - Capacity improvement of LWSC staff - Service improvement for users - A secure water supply service - Rationalization of salary system - Increase of LWSC annual revenue - Increase of the rate of water tariff collection - A secure operating profit - Improvement of water supply service in suburb of urban area and squatter area - Enhancement of purification process control and water quality monitoring - Capacity recovery of drainage system - Improvement of water and sewerage services in Monrovia city and main urban areas - Improvement of water supply service coverage	- Urgent rehabilitation of rising mains and distribution pipelines as well as purification plants - Replacement of distribution network - Evaluation of groundwater potential - Rehabilitation of sewer intermediate pump station - Procurement of vacuum trucks - Capacity building

1.3.3 Financial Structure and Budgeting of LWSC

LWSC manages the rehabilitation of water supply with national subsidy and donor's fund with the exception of disturbance periods of 2004 and 2005. In terms of operation and maintenance cost, LWSC has basically made earnest efforts to cover those cost with water revenue, but it is envisaged that the rehabilitation of water supply facilities needs much expenses because troubles such as damages of the deteriorated pipelines occur frequently. The Table 1-2 shows profit and loss statement (2004-2007) of LWSC. According to the Table, financial status in 2004 and 2005 shows a deficit of USD0.1-0.3Million. However, water revenue, which was downturn in 2004 and 2005, has changed to be increased since 2006 and the financial status of the management was in surplus. This is because not only that water revenue increased sharply but also the subsidy of the government and donor's fund of about USD 0.2Million were given.

For the future, in order to go on surplus financial status following water sale increase, improvement of the revenue water rate is one of the main issues for LWSC. Therefore, efforts of the LWSC are required to improve management furthermore.

Table 1-2 Profit and Loss Statement of LWSC (Unit : USD)

Items \ Year		2004	2005	2006	2007
Revenue	Water Sales	501,667	470,000	590,000	1,028,672
	Material sales and Sewerage	78,333	50,000	95,000	210,152
	Subsidy and other Grants	0	0	186,667	293,400
	Total	**580,000**	**520,000**	**871,667**	**1,532,224**
Expenses	Personnel	160,000	181,667	168,833	321,689
	Electric and Fuel	82,167	58,500	261,667	391,069
	Chemicals and Other Materials	260,167	186,667	123,333	196,667
	Contract out Service	81,667	31,667	45,000	51,667
	Others	100,000	200,000	116,667	127,322
	Company Overhead	20,000	6,667	18,333	204,441
	Total	**704,001**	**665,168**	**733,833**	**1,292,855**
Net Income		**▲ 124,001**	**▲ 145,168**	**137,834**	**239,369**

* Source: LWSC

1.4 Present Condition of Water Supply Services in Greater Monrovia

1.4.1 Water Consumption

Water production has been increasing steadily in the past five years. Revenue water is about 0.29 billion gallons in 2008 which is about 19% of the water production (1.56 billion gallons). The water consumption per capita per day is about 2 gallons, which is obtained by dividing the revenue water with the service population of 370,000. According to the report of "Water Demand and Market Study in Monrovia, Liberia" funded by the EC, the required water consumption per capita per day in Monrovia is assumed to be 13 gallons. The actual ratio of water consumption comes to about 16% (2 gallons per capita per day) of the required water consumption in Monrovia. This is because residential water such as washing, shower, etc. other than drinking water is taken from shallow wells, which were drilled for emergency purpose under the funds of international organizations or NGOs. However, theses wells depend on groundwater of shallow aquifer, which is easily affected by external contaminated sources. Therefore, LWSC needs establishment of the systematic water supply system focusing on the whole of Greater Monrovia.

1.4.2 Water Service Coverage

LWSC has operated and maintained the urban water supply system with the water source of the Saint Paul River and two (2) water supply systems with water source of groundwater (deep-wells), and provides water with a population of 370,000 through these systems. The purified water is pumped up from the White Plain purification plant to the center of Monrovia. As the rising pump operates for 12

hours a day, the water supply hours are maximized at 12 hours a day as well. However, the water supply hours are much shorter than 12 hours because the rising main pipelines are also used as distribution pipelines. So, water often does not reach to the service areas located downstream.

In addition, many dwellers, hotels and other bulk consumers have depended on water transported by water trucks and carts. Especially, most of the hotels and bulk consumers purchase water transported by water trucks several times a day.

Change of water service coverage ratio in the past five years is shown in the Table 1-3. The water service coverage ratio between 2004 and 2007 is calculated using service population which was provided by LWSC. Moreover, since the water service coverage ratio in 2008 was not available, it was assumed based on historical revenue water in 2008 and the estimated future service coverage ratio as shown in the Table 1-4. The Figure 1-2 shows water service coverage ratio in 2008 and the fact that service area where the water service coverage ratio is at least 50% concentrate at Bushrod Island which is an active commercial area and Mamba Point where many international organizations are located.

Table 1-3 Trends of Water Service Coverage Ratio in Greater Monrovia

Items	2004	2005	2006	2007	2008
Administrative Population (Million)	0.90	0.93	0.95	0.98	1.00
Service Population (Million)	0.10	0.10	0.35	0.35	0.37
Service Coverage Rate	11.1%	10.8%	36.8%	35.7%	37.0%

* Source: Population Census in 2008, Water Demand and Market Study in Monrovia, Liberia, and LWSC

Table 1-4 Water Service Coverage in 2008 (Estimated)

No.	Zone name	Pop. in 2004	Pop. in 2008	House Connections			Kiosks			Total		
				%	Service Pop.	Water Consumption (Gal/d)	%	Service Pop.	Water Consumption (Gal/d)	%	Service Pop.	Water Consumption (Gal/d)
1	New Kru Town	93,357	73,379	4	2,935	38,155	39	28,618	22,894	43	31,553	61,049
2	Logan Town	86,535	58,168	7	4,072	52,936	49	28,502	22,802	56	32,574	75,738
3	Clara Town	85,203	55,462	11	6,101	79,313	49	27,176	21,741	60	33,277	101,054
4	West Point	78,456	29,516	7	2,066	26,858	56	16,529	13,223	63	18,595	40,081
5	Central Monrovia A	62,422	42,139	25	10,535	136,955	42	17,698	14,158	67	28,233	151,113
6	Central Monrovia B	105,133	40,688	25	10,172	132,236	42	17,089	13,671	67	27,261	145,907
7	Sinkor	44,016	43,780	11	4,816	62,608	25	10,945	8,756	36	15,761	71,364
8	Lakpazee	35,813	42,045	7	2,943	38,259	21	8,829	7,063	28	11,772	45,322
9	Old Road	40,784	48,274	7	3,379	43,927	21	10,138	8,110	28	13,517	52,037
10	Congo Town	17,674	25,217	7	1,765	22,945	25	6,304	5,043	32	8,069	27,988
11	Paynesville	136,355	350,998	4	14,040	182,520	25	87,750	70,200	29	101,790	252,720
12	Gardnersville	57,922	80,397	4	3,216	41,808	21	16,883	13,506	25	20,099	55,314
13	New Georgia	41,296	54,188	4	2,168	28,184	21	11,379	9,103	25	13,547	37,287
14	Barnersville	30,390	35,224	4	1,409	18,317	21	7,397	5,918	25	8,806	24,235
15	Johnsonville	2,885	4,514	4	181	2,353	21	948	758	25	1,129	3,111
16	Caldwell	19,519	26,586	4	1,063	13,819	21	5,583	4,466	25	6,646	18,285
	Total	**937,760**	**1,010,575**		**70,861**	**921,193**		**301,768**	**241,412**		**372,629**	**1,162,605**

Source: Population Census in 2008 and Water Demand and Market Study in Monrovia, Liberia
Note: Current Service coverage was re-considered based on the above study report.

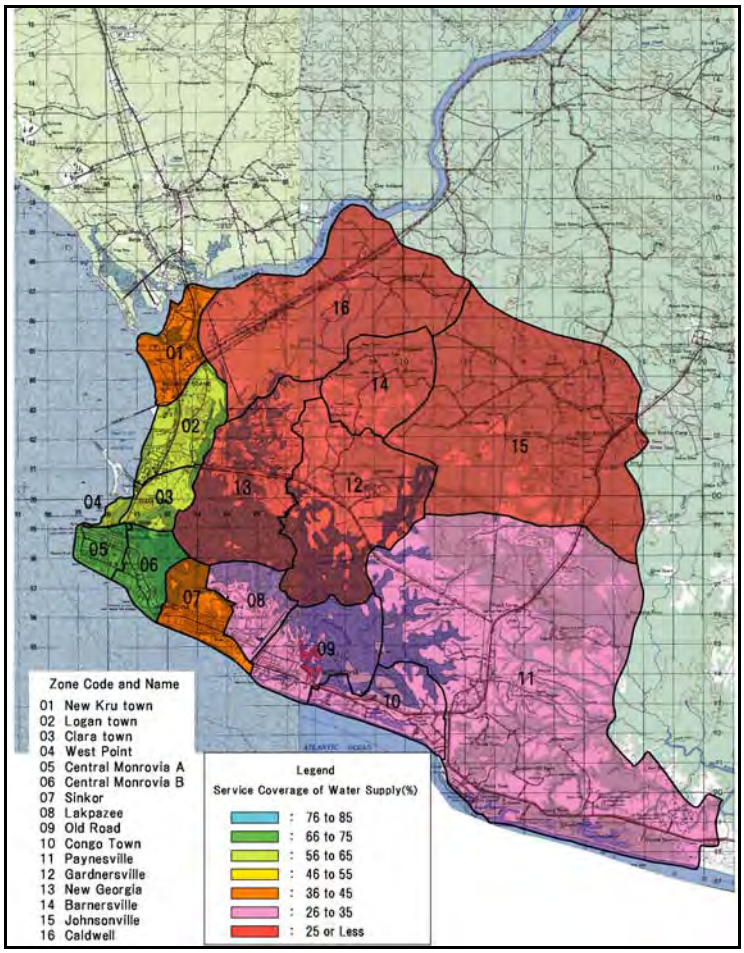


Figure 1-2 Outlines of Water Service Coverage Ratio in Greater Monrovia in 2008

1.5 Present Condition of Water Supply Facilities

Raw water pumped up from the Saint Paul River (Minimized flow: 1,140MGD) is treated in the White Plain Purification Plant (plant capacity: 16MGD), in which the intake point is located nearby. The purified water of about 4.3MGD (2008) is supplied to Greater Monrovia passing through the rising main pipelines systematized into two booster pump stations. Two rising main pipelines of cast iron (dia. of 12 and 16 inches) and three concrete pipes (dia. of 12, 24 and 36 inches) were laid 1950s to 1970s.

Two existing service reservoirs (Ducor Reservoir: 0.6MG and Mamba Reservoir: 1.0MG) were constructed for supplying water to the high elevated area in 1952 and 1960 respectively. However, the purified water has not reached to those service reservoirs due to the lack of capacity of the White Plain Purification Plant and rising pump, and fault of booster pumps, and the service reservoirs have not worked. Therefore, the purified water flown in the rising main pipes is directly distributed to recipient dwellers using individual house connections, tap-stands and water trucks. The Figure 1-3 shows current status of the existing water supply facilities.

1.6 Water Sources

LWSC's water sources in Greater Monrovia are composed of i) Saint Paul River (see Figure 2.5-5), ii) Paynesville Groundwater, iii) Airfield Groundwater (see Figure 2.5-6). In terms of ii), there are two wells (Well Depth: 30-50m) with water yield of about 0.02MGD and 0.05MGD respectively. However, groundwater of only 0.05MGD was pumped up due to a fault of the submersible pump of the other well in January 2009. The main users of groundwater pumped up from these wells are the Coca Cola factory as a major consumer and common dwellers using groundwater transported by carts and water tracks. Regarding iii), one well (well depth: about 10m) with water yield of 0.03MGD is located in the environs of the Airfield. Groundwater pumped up from the well is used for dwellers through tap-stands and water trucks. Small size pumps are used for pumping up water to water trucks.

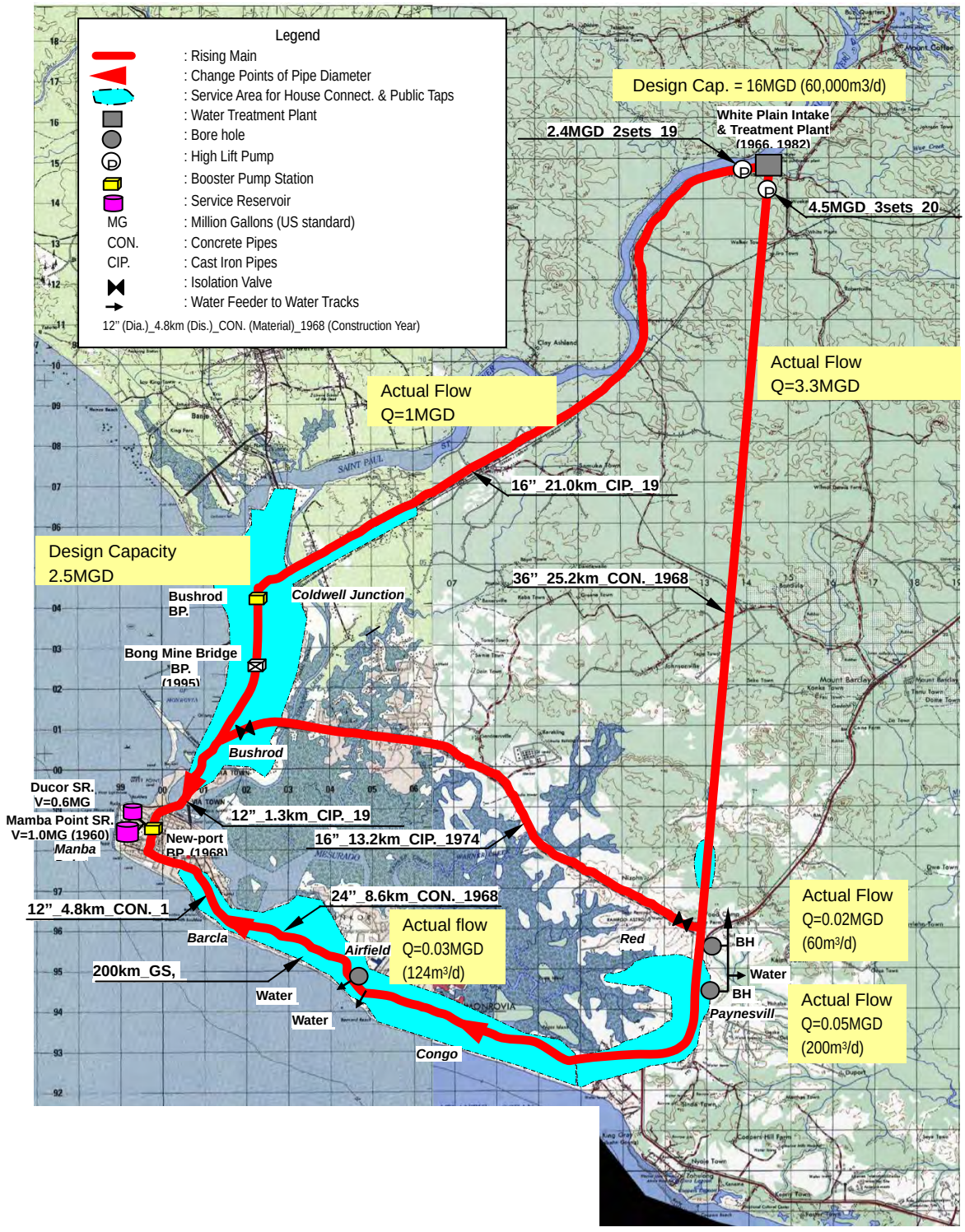


Figure 1-3 Outlines of the Overall Existing Urban Water Supply System

CHAPTER 2 WATER SUPPLY IN PERI-URBAN COMMUNITIES OF MONROVIA

2.1 General Situations of Water Supply in Peri-Urban Communities

Due to the conventional vulnerabilities of water infrastructures and its damages by the civil war, a number of peri-urban communities presently rely on communal tap-stands and hand-pump wells for drinking, and hand-dug wells for non-drinking as water sources.

A large number of hand-pump wells have been constructed by NGOs as an emergency water supply in the past 2 decades, and have contributed by the minimum water supply. However, as a matter of fact, hand-pump wells cannot boost water service coverage quantitatively as well as qualitatively in populated communities, since their capacity as a water supply facility is limited because of manual intake (e.g. 500 persons/day per well) and their water level fluctuates greatly with season or many wells dry up like most hand-dug wells, that is, they are not always safe and stable as sustainable water sources. Dwellers usually use hand-pump wells and hand-dug wells separately for drinking and non-drinking, sometimes with putting calcium hypochlorite.

On the other hand, community tap-stands connected directly with the existing urban water supply network have also been constructed as an emergency water supply by LWSC, NGOs and international organizations such as European Union and World Bank in some communities, which are located close to the existing urban network. However, this pipe-borne system is not always stable because of the capacity shortage of existing urban water supply system.

2.2 Hand-Dug Well

Some of community households have their own hand-dug wells in yard, which are generally unprotected and often shared by their neighbors. Due to poor water quality, water is usually used not for drinking but for non-drinking such as cooking, bathing, washing and so on. However, some communities or people rely on protected hand-dug wells for drinking too with/without putting calcium hypochlorite in case of no safer water sources for drinking nearby. Most of hand-dug wells get the water level down or dry up during the dry season.

Hand-Dug Well (Unprotected)

Private Hand-Dug Well (Protected)

2.3 Hand-Pump Well

NGOs have mostly constructed public hand-pump wells as water sources for drinking in peri-urban communities, often with social intervention including form of community WATSAN committee, hygiene promotion and other activities. Various types of hand-pump have been installed such as Afridev, India-Mark-II and Consallen. Although most of these hand-pump wells are protected by concrete cylinders and also covered, water is unstable and unsafe since water fluctuates seasonally and often dries up in the dry season, which means water source is shallow aquifer and accordingly will be possibly contaminated. In the community which has no WATSAN committee or equivalent, users sometimes argue due to queue jumping at a hand-pump-well.

However, especially a lot of hand-pump wells constructed during the civil war have played a crucial role as emergency water supply to make up for capacity shortage of urban water supply system.

Hand-Pump Well (less control)

Hand-Pump Well (long queue)

2. 4 Community-Managed Pipe-Borne Water Supply System

Due to its geographical advantage, tap-stands connected with urban network have been constructed in some peri-urban communities. These tap-stands have been operated and maintained with water fee collection by community organization namely "Water Management Team" commissioned by LWSC, or by community individuals employed by LWSC on a contractual basis. In this report, we focus on the former as community-managed pipe-borne water supply system, which were firstly introduced by an NGO "Concern" in 2006.

As a new approach, an NGO called "ICRC" started the improved system in 2009, which has a small-scale water supply station consisting of elevated water tank, kiosk building and public tap-stand and also being protected by fence and lockable gate. As main features, this system has mechanism to supply water stably by temporary water storage facility, in order to solve the unstable supply of water by existing tap-stands connected directly with urban water supply network. Eight (8) systems were constructed in 2009 and have been operated and maintained by the formed Water Management Team, and three (3) more will be constructed in 2010.

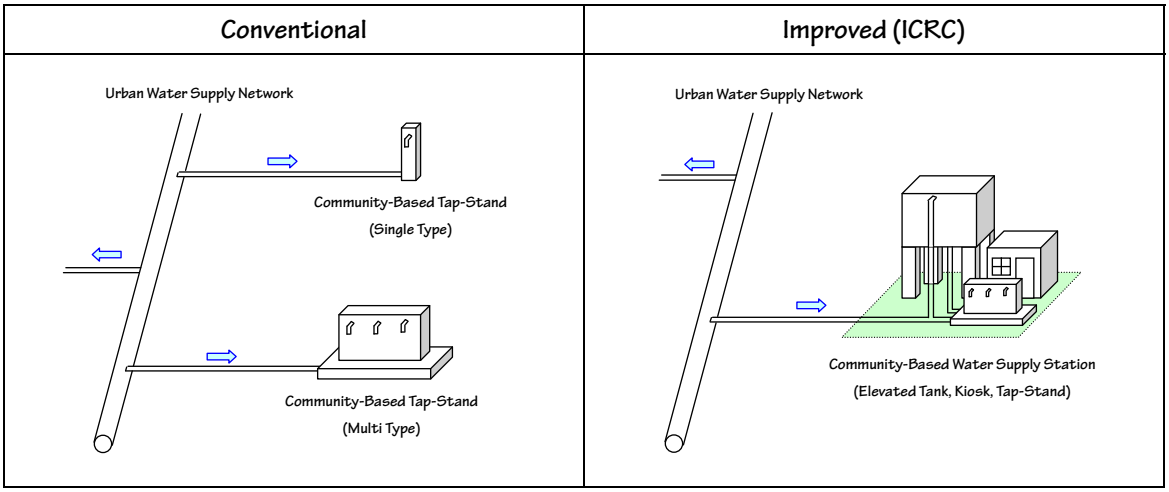


Figure 2-1 Conceptual Drawing of Community-Managed Pipe-Borne Water Supply System

Pipe-Borne System (Conventional/Single)

Pipe-Borne System (Improved)

Present Conditions - The system has contributed to supply clean water to communities with community empowerment by specific allocation of water sales to Water Management Team and with the reasonability of water tariff setting. In February 2010, totally 148 tap-stands were constructed in peri-urban communities from 1993 after the destruction of urban water supply facilities and network, as shown in the Table 2-1. 103 out of 148 tap-stands are functioning, and then 67 out of 103 active tap-stands have been operated and maintained by community Water Management Team.

However, this system has not been always successful. Water from tap-stands is not stable by irregular supply and low water pressure from urban network under rehabilitation and expansion. Presently, remaining 45 out of 148 tap-stands are not functioning because of the problems caused by technical failures (mainly lack of water pressure), leadership problems and jealousy within community dwellers and so on. This situation led to a renewed effort to enhance social mobilization by NGOs as an implementing body.

As for the system improved by NGO “ICRC”, unfortunately, most of the constructed facilities have such problems as ground subsidence under tank, inferiority (rusting, poor strength) of steel tank, low water pressure and systematic flaw of Water Management Team and so on.

In order to make the design concepts reflected in the facilities, implementing bodies and LWSC are required to strengthen their supervision and quality control on the construction work by local contractors and materials.

Table 2-1 Pipe-Borne Water Supply in Peri-Urban Communities

Zone	No	Community or Area	No. of Tap-stand	Function		Other Problems		Daily Managed by	
				Yes	No	M/F[*1]	S/C[*2]	WMT[*3]	LWSC[*4]
I	1	St.Paul Bridge	13	11	2	-	-	11	-
	2	Gbalasuah	4	4	-	-	-	4	-
	3	Caldwell Road	5	5	-	-	1	5	-
	4	Zone I Depot	1	-	1	-	1	-	-
	5	New Kru Town [*5]	17	-	17	-	3	-	-
	6	Bong Mines Bridge	1	1	-	-	-	1	-
	7	Logan Town	2	2	-	-	-	2	-
	8	Jamaica Rd./ Bassa T.	1	1	-	-	-	1	-
		Sub Total	**44**	**24**	**20**	**-**	**6**	**24**	**-**
II	9	S.K. Doe [*6]	17	5	12	1	-	-	5
	10	LPMC	2	2	-	-	-	-	2
	11	Clara Town	22	13	9	-	-	13	-
	12	Vai Town	1	1	-	-	-	-	1
		Sub-Total	**42**	**21**	**21**	**1**	**-**	**13**	**8**
III	13	Central Monrovia	18	16	2	2	1	3	13
		Sub-Total	**18**	**16**	**2**	**2**	**1**	**3**	**13**
IV	14	20th & 24th Streets	5	5	-	-	-	5	-
		Sub-Total	**5**	**5**	**-**	**-**	**-**	**5**	**-**
V	15	12th Street	1	1	-	1	-	-	1
	16	Fiamah	1	1	-	-	-	-	1
	17	Gbangaye Town	1	1	-	-	-	-	1
	18	Lakpazee	1	1	-	-	1	-	1
	19	Wroto Town	5	5	-	-	-	5	-
		Sub-Total	**9**	**9**	**-**	**1**	**1**	**5**	**4**
VI	20	Nippy Town	9	8	1	-	-	8	-
	21	Smith Road	1	-	1	-	-	-	-
	22	V.P. Road	1	1	-	-	-	1	-
	23	Tarr Town	1	1	-	-	-	1	-
	24	Congo Town	2	2	-	-	-	-	2
	25	White House	1	1	-	-	-	-	1
	26	TB Annex	2	2	-	-	-	-	2
		Sub-Total	**17**	**15**	**2**	**-**	**-**	**10**	**5**
VII	27	Joe Bar / Redlight	6	6	-	-	-	-	6
	28	Pipeline Road	4	4	-	-	-	4	-
	29	Pagos Island	1	1	-	-	-	1	-
	30	Block 12	1	1	-	-	-	1	-
	31	LBS	1	1	-	-	-	1	-
		Sub-Total	**13**	**13**	**-**	**-**	**-**	**7**	**6**
Grand Total			**148**	**103**	**45**	**4**	**8**	**67**	**36**

*1 M/F : Meter Faulty

*2 S/C : Straight Connection without Meter

*3 WMT : Water Management Team of community

*4 Community individuals employed directly by LWSC manage tap-stands on a contractual basis

*5 In New Kru Town, all tap-stands used to be managed by Water Management Team are not functioning due to little water pressure.

* In S.K. Doe community, all tap-stands were originally designed to be managed by Water Management Team, but have been downsized and managed directly by LWSC due to leadership problems.

2.5 Community-Managed Satellite Water Supply System

Alternatively, as a new challenge for the peri-urban communities not having stable and safe water supply, the community-managed satellite water supply system is the one firstly introduced in Liberia as a pilot project of the JICA Study. The system consists of deep well as a water source, pumping and generating equipment, generator house, elevated water tank, pipelines and tap-stands, and is physically independent from urban network.

Furthermore, the system is daily operated and maintained with water fee collection by community organization, namely "Water Management Team" commissioned by LWSC, in cooperation with community Water and Sanitation (WATSAN) committee. The major differences between the newly-introduced satellite system and existing pipe-borne system are accounting and the degree of community management. While the former is almost fully community-managed model on stand-alone basis, the latter is partially community-managed model as a part of urban water supply system.

Besides, NGO "Concern" also constructed a similar system in Topoe Village community in 2009, which consists of protected shallow well, pumping and generating equipment, generator house, elevated water tank, pipelines, tap-stands and additionally solar module. However, as of February 2010, the system has not been operated yet.

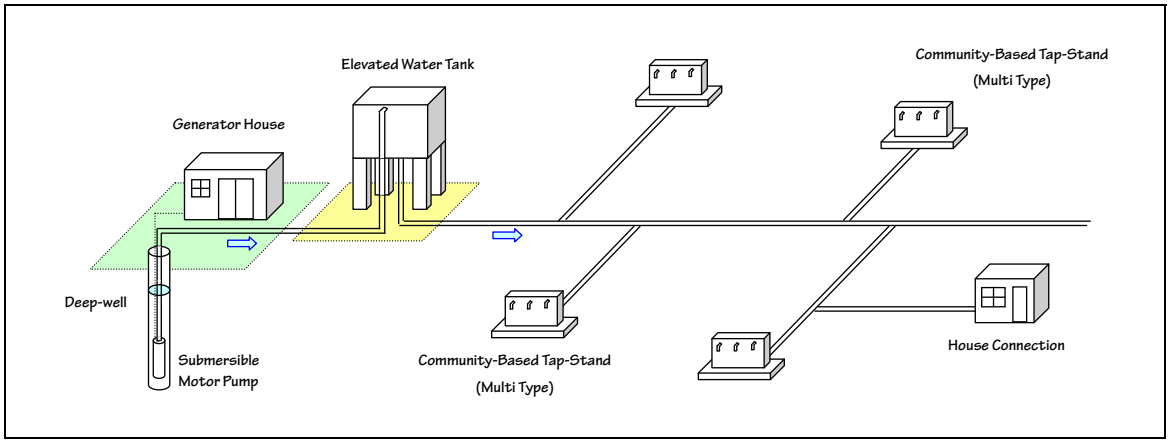


Figure 2-2 Conceptual Drawing of Community-Managed Satellite Water Supply System

Table 2-2 Community-Managed Water Supply in Peri-Urban Communities

Zone	No	Community or Area	No. of Tap-stand	Function		Other Problems		Daily Managed by	
				Yes	No	M/F	S/C	WMT	LWSC
New	1	MTA	5	5	-	-	-	5	-
	2	Topoe Village	6	(6)	-	-	-	(6)	-
		Sub-Total	**11**	**5**	-	-	-	**5**	-
Grand Total			**11**	**5**	**-**	**-**	**-**	**5**	**-**

* The system in Topoe Village has not yet functioned.

Satellite System in MTA (Tank & Gen. House)

Satellite System in MTA (Tap-Stands)

2.6 Transition of Community Water Supply in Greater Monrovia

Transition of water supply in peri-urban communities of Monrovia as shown-below illustrates the position of community-managed satellite water supply in this transition, and also represents that the approach is shifting from hand-pump wells and LWSC direct-managed water supply system to community-managed water supply system. That is, community water supply is recently being reviewed from both quantitative and qualitative aspects for the sustainability by partnership with community.

Table 2-3 Rough Transition of Water Supply in Peri-Urban Communities

	1980	1990	2000	2010
Social Background		Civil War	Transition	New Gov.
Hand-Dug Well		Have been constructed by individuals		
Hand-Pump Well	Not popular use except communities outside urban water supply network	Thousands of wells by NGOs, individuals		
Urban System (from White Plain, Deep Wells)	Constructed by LWSC, NGOs	Captured and damaged, and partial operation assisted by ICRC, Unicef, EU		Extended, Rehabilitated
Pipe-Borne Water Supply System LWSC Direct-Managed Community-Managed Community-Managed (Improved)	(Mostly destroyed)	Constructed by LWSC, EU	Constructed by Concern, WB	ICRC
Community-Managed Satellite Water Supply System				JICA, Concern

2.7 Comparative Review of Community Water Supply in Greater Monrovia

Features of the above-mentioned community water supply facilities or systems can be summarized briefly by comparison among them as follow.

Table 2-4 Comparative Table of Community Water Supply

Type		Safety	Stability	Convenience	Economics	Totality
Well	Hand-Dug	Bad	Bad	Marginal	-	Bad
	Hand-Pump	Marginal	Bad	Marginal	-	Marginal
Com.-Managed	Pipe-Borne	Good	Marginal	Good	Excellent	Good
	Improved	Good	Good	Good	Excellent	Excellent
	Satellite	Good	Excellent	Good	Good	Excellent

CHAPTER 3 PILOT PROJECT ON COMMUNITY-MANAGED SATELLITE WATER SUPPLY SYSTEM

3.1 Pilot Project in MTA community

The MTA community was selected for a pilot project on community-managed satellite water supply system, which is located along the Somalia Drive in Gardnersville zone. In addition, the Study team carried out baseline survey by questionnaire and field survey on water and sanitation in October 2009. Details of the survey results are shown in the *Appendix-1*.

3.2 Community Information

3.2.1 Basic Information

Most communities in the Greater Monrovia have several blocks or sub-communities under themselves, and the MTA community consists of three (3) blocks.

While the population of the whole community was 4,146 by census 2008, that is 5,623 by baseline survey. The number of households is 748, and average household's member is 7.5 persons. The average age of household heads is 37.8 years old and their sexuality is male of 57% and female 43%.

Table 3-1 Basic Information of MTA Community

Items	Census 2008	Baseline Survey 2009			
	Total	Block-A	Block-B	Block-C	Total
Population	4,146	699	893	4,056	5,648
Household	829*1	121	132	495	748
Household Size	5.0*2	5.8	6.8	8.2	7.6
Area(km^2)	0.467	0.186	0.123*3	0.218	0.527
Density per ha	88.8	37.6	72.6	186.1	107.2

*1 – Number of household is calculated from population and conventional household size of five (5).
*2 - Household size of five (5) is the conventional figure in Liberia.
*3 - Compound of Monrovia Transit Authority (0.051km^2) located in Block-B is not included.

3.2.2 Community Autonomous Structure and Water & Sanitation

Generally, community leaderships consist of chairman, block (sub-community) leaders and council members.

The following figure (See the Figure 3-1) shows the autonomous community structure of the MTA community and the relation between leaderships and WATSAN committee, Water Management Team in the community. General Chairman and other community leaderships participate in the

decision-making of WATSAN committee as advisors, but the committee is required to be neutral from the leaderships.

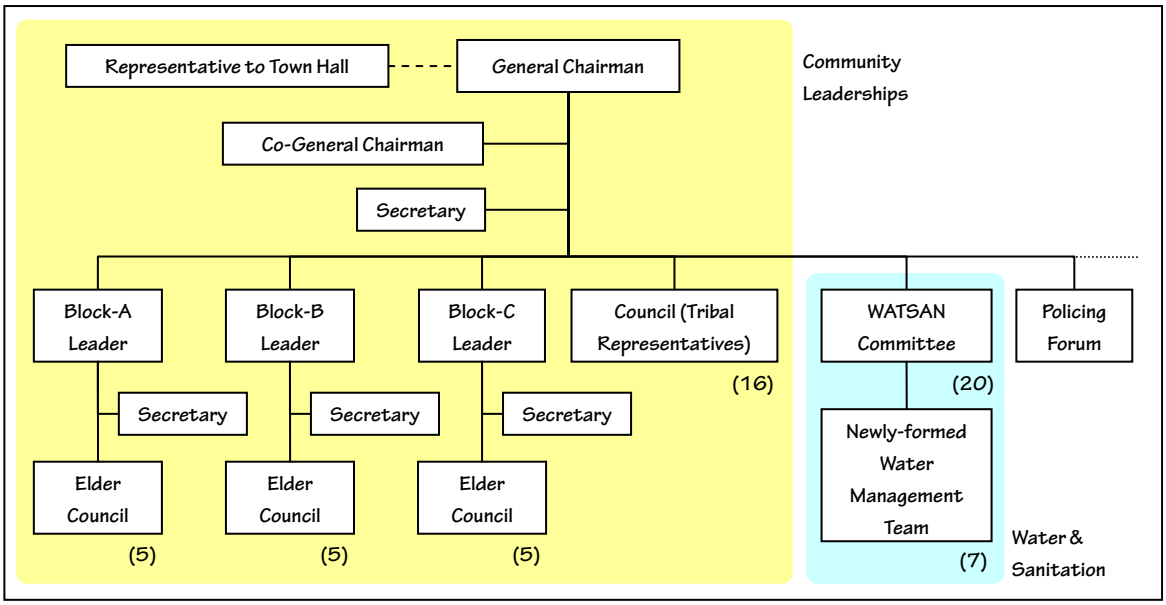


Figure 3-1 Community Autonomous Structure and Water & Sanitation Sector

3.2.3 Water Situation

While there are presently seven (7) public and four (4) private functioning hand-pump wells and eighty-three (83) private hand-dug wells in the community, other several hand-pump wells have not been functioned because water dried up completely. The public hand-pump wells were constructed by some NGOs, but they mostly become unavailable in dry season as well as hand-dug wells. Two (2) out of the seven (7) public hand-pump wells are available throughout the year. That is, all community dwellers are forced to rely on a few hand-pump wells as drinkable water sources, and also to take a fair amount of time and effort to fetch water due to long distance and queue.

3.2.4 Water Consumption

Generally, community dwellers use both hand-pump wells for drinking and hand-dug wells for non-drinking as the situation demands. So, we worked out average water consumption in both dry and rainy seasons separately, and the concluding difference between both seasons is 1.2 times which can be a factor for calculation of daily maximum water supply.

Meanwhile, according to the community leaderships and WATSAN committee, net average drinking water consumption from an empirical viewpoint is “2 jerry-cans per household per day” which is equivalent to 9 LCD in case of 5 person/HH.

Table 3-2 Daily Water Consumption of MTA Community

Items	Unit	Drinking		Non-Drinking		Total	
		Rainy	Dry	Rainy	Dry	Rain	Dry
Water Consumption	LCD	19.5[*1]	24.7[*2]	22.2[*3]	26.1[*4]	41.7[*5]	50.9[*8]
	GCD	5.1	6.5	5.9	6.9	11.0	13.4

*1 - 46.7 % of respondents consume less than 10 LCD, 73.2 % less than 20 LCD.
*2 - 38.4 % of respondents consume less than 10 LCD, 66.3 % less than 20 LCD.
*3 - 29.0 % of respondents consume less than 10 LCD, 63.9 % less than 20 LCD.
*4 - 23.2 % of respondents consume less than 10 LCD, 56.8 % less than 20 LCD.
*5 - 53.2 % of respondents consume less than 30 LCD, 77.7 % less than 50 LCD.
*6 - 70.8 % of respondents consume less than 30 LCD, 56.8 % less than 50 LCD.

3.2.5 Time required for Fetching Water

Same as water consumption, we also worked out average water time required for fetching water in both dry and rainy seasons separately, and the concluding difference between both seasons is 3 times.

Water is mostly fetched by women and children, which represents 85% of all households.

Furthermore, according to community awareness, most of respondents have a high tendency to accept walking distance of 10 minutes to public tap-stand to be constructed unless they have water source close-by for drinking.

Table 3-3 Time required for Fetching Water of MTA Community

Items	Unit	Drinking		Non-Drinking		Total	
		Rainy	Dry	Rainy	Dry	Rain	Dry
Time for Fetching	min.	33	90	10	29	43	119

3.2.6 Intention to Use and Willingness to Pay

Both the intention to use and the willingness to pay are very high. The reasons to use are mainly safety & clean, and the reasons to pay are safety & clean and sustainability of operation & maintenance.

3.2.7 Acceptable Unit Water Fees and Available Monthly Amount

As for the unit water fee, 83% of respondents accepted to pay more than 3 Liberian dollars (LD) per jerry-can container equivalent to 6 gallons. Monthly amount for water is averagely 164 LD per household.

3.2.8 Sanitation and Water-Borne Diseases

Almost half of the whole households own private latrines, which consists of 60% of pit latrine and 40% of latrine with septic tank. On the other hand, 17% of the whole households share public latrines which are not always in a good sanitary condition, and 43% relieve themselves by poor facilities or primitive ways

Although a causal relationship between water and diseases is not medically proven, more than 60% of the households perceived the existence of water-borne diseases in the community. 19% of them noted digestive system diseases (mainly cholera and diarrhea), and the remaining 81% noted skin diseases (mainly scabies). As for skin diseases, these may be caused by the fact that people use untreated water from hand-dug wells for their bathing.

3.2.9 Awareness of the Importance of Water

As a result of priority ranking of major development sectors in the community by baseline survey, water was selected as the first ranking. See the Table 3-3.

Table 3-4 Priority Ranking by Community Awareness

Ranking	1	2	3	4	5	6
Sector	Water	Health	Sanitation	Education	Drainage	Com. Road

3.3 Structural Arrangement of Operation & Maintenance

3.3.1 Relevant Organizations for Operation & Maintenance

Community-managed satellite water supply system in MTA community involved the following three (3) concerned organizations in the operation and maintenance in partnership. The roles and responsibilities are described below.

- The Liberia Water and Sewer Corporation (LWSC), as Water Service Authority
- Water and Sanitation (WATSAN) Committee of the Community
- Water Management Team (WMT) under WATSAN, as Water Service Provider

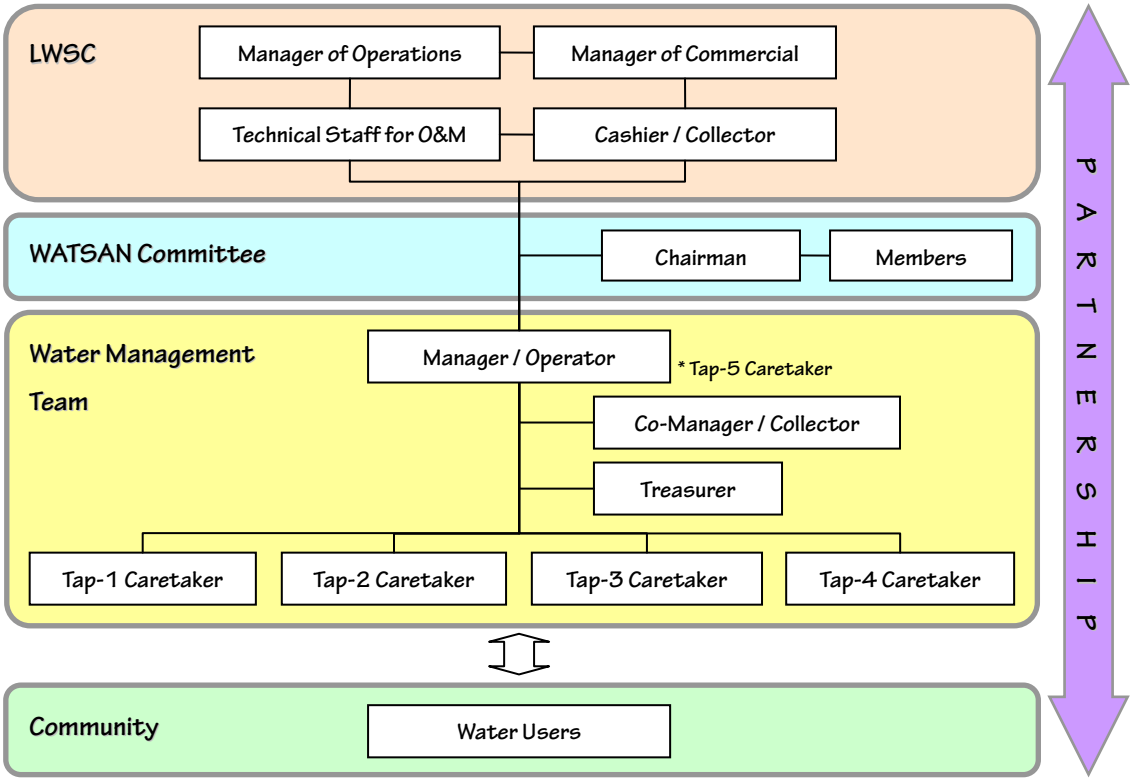


Figure 3-2 Structure for Operation & Maintenance

3.3.2 Liberia Water and Sewer Corporation (LWSC)

LWSC is the owner of the constructed water supply facilities, and is responsible for the sustainability and the overall operation and maintenance of the system. The Corporation supervises and monitors periodically the conditions of the system, finance, facilities and equipment as well as the operation and maintenance activities by the community, furthermore, advises WATSAN committee and Water Management Team for better operation and maintenance from technical and financial viewpoint. As necessary, the Corporation sends technician, electrician and plumber for major maintenance work.

Position	No	Role and Responsibility
Manager of Operations	1	Supervision of operation & maintenance by Water Management Team
Manager of Commercial	1	As Billing Supervisor, monthly detailed audit of Water Management Team for financial analysis and verification
Technical Staff for O&M (Engineer of Transmission & Distribution)	a few	- Groundwater level measuring - Water sampling for quality analysis - Periodical maintenance check (monthly) and advise - Repair work, if necessary
Cashier / Collector	1	- Monthly collection of service fee from water sales - Periodical meter reading to check water fees collection activity

* In addition, Water Meter Reader is responsible for reading meters only in every month end.

3.3.3 Water and Sanitation (WATSAN) Committee

WATSAN committee, which is a neutral organization in the community and composed of the following members, is responsible for the improvement of water and sanitation situations in the community, and also acts as a liaison body to external parties. Especially for the system, the committee shall utilize community opinions and needs on the operation and maintenance activities such as payment and collection method. In addition, they have authority on the personnel of Water Management Team and supervise their performance. Committee members are listed in the Manual, *Appendix-2*.

The Study team utilized existing WATSAN committee formed by NGO for public hand-pump well project in 2008, and then developed its capacity through workshops and other activities for this pilot project.

Position	No	Role and Responsibility
Chairperson	1	- Overall Service Supervision - Administration
Co-Chairperson	1	- Assistance to Chairperson - Administration - Acting Chairperson during Chairperson's absence
General Secretary	1	- Recording - Coordination
Treasurer	1	- Banker
Collector	2	- Collection of money and contribution from the Community
Chaplain	1	- Praying
Members	12	- Decision Vote - Hygiene Promotion - Hand-Pump Repair
Adviser	1	- Advice (by Community Leadership)

3.3.4 Water Management Team

Water Management Team, which is a paid organization and composed of the following members appointed by WATSAN committee, is responsible for the daily practical operation and maintenance of the system under the direct supervision of LWSC. Their roles and responsibilities are also as follows. Team members are listed in the Manual, *Appendix-2*.

Position	No	Role and Responsibility
Manager / Operator	1	- Supervision of all members - Daily operation of equipment - Routine maintenance check of equipment - Daily check of whole facility conditions - Maintenance log recording - Refueling of diesel-powered generator - Cleaning of site and generator house - Cleanup of inside water tank once in a half year - Report to LWSC and WATSAN Committee
Co-Manager / Collector	1	- Assistance to Manager's work - Daily collection of water fees from Kiosk Caretakers - Fuel procurement
Treasurer	1	- Daily collection of water sales from Collector - Examination and safekeeping of water sales - Keeping cashbook - Wage payment to Water Management Team Members - Weekly Bank Deposit and Withdrawal if necessary
Caretaker	4	- Cleaning of Kiosk - Check of faucets and water flow meter function, and leakage - Guiding users to minimize waiting time at queue - Control of water usage by user to reduce waste water from faucets - Collection of water fees from users per water container

* Chairman of WATSAN should be advisor.
* Change of members shall be approved by LWSC in advance.

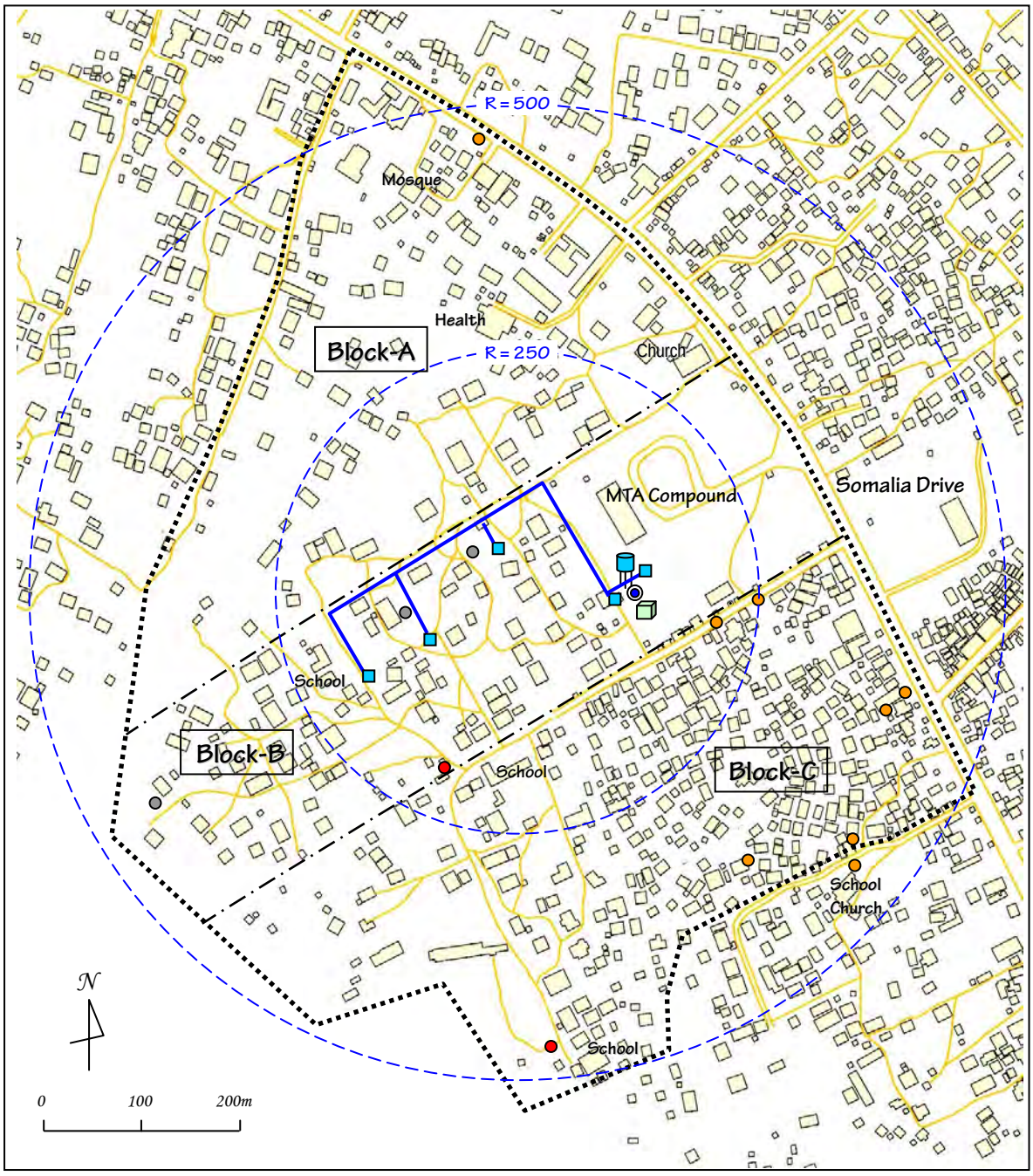
3.4 Technical Aspects

3.4.1 Scope of Project and Design Criteria

The Study Team amended the scope of pilot project and design criteria as follow, according to the results of baseline survey and interview to WATSAN committee and leaderships.

Table 3-5 Scope of Project and Design Criteria

Items	Original	Amended
Supply Area	Block-B	Whole Community
Beneficiaries	1,000	4,146
Household Size (average)	5	5
Target Households	200	829
Daily Consumption (LCD)	30	9 (charged drinking water)



- Project Deep-Well
- Generator House
- Elevated Water Tank (2,000gallon)
- Tap-stands, 4 (6 faucets each) in the Community, 1 (2 facucets) in MTA Compound
- Pipeline (PVC, D40, D50)
- Functioning Handpump Well
- Functioning Handpump Well (Rainy Season Only)
- Non-Functioning Handpump Well

* Public Functioning Handpump Well : 7
* Private Functioninig Handpump Well : 4
* Dugwell & Shallow Well : 83
(some of them are used for drinking)

Figure 3-3 Location Map of Water Supply Facilities in MTA Community

3.4.2 Summary of Newly-Constructed Water Supply Facilities

Owner : Liberia Water and Sewer Corporation (LWSC)

Design : Japan International Cooperation Agency (JICA) Study Team

Contractor : Bezaleel + Turnkey Contractors, Inc.

Table 3-6 Summary and Specification of Water Supply Facilities

	Items	Details
1	Water Source	Coordinates by UTM: 29 N 308194 699299 Diameter: 6 inch (150mm), Depth : 73 m Max-Yield: 120lit/min Optimum-Yield: 96lit/min
2	Lifting Pipe	Material: uPVC, Length: 50 m
3	Pumping Equipment	Specification: Q:0.09m3/min x H:55m, 2.2kW Submersible Motor Pump <*PEDROLLO, 4SR6/17*> Installation Depth: 45 m from G.L. Actual Pumping Rate (Q): 158 lit/min
4	Generator	Specification: 12.5kVA, 12kW, 380/220V, 19A, 50Hz, 1,500rpm, 3-Phase, Fuel-Tank: 40 lit (10 gallon) < Sets: JIMCO, Engine: *LISTER PETTER* >
5	Generator House	Reinforced Concrete: Basement, Pillars and Roof Concrete Block: Wall W:4,200mm x L:4,200mm x H:3,100mm
6	Water Storage	Elevated Water Tank with Steel Structure, 12.8m Height from G.L. Tank: Polyethylene, Size : 500 gallon <*Dura Plast*> Total Capacity: 2,000 gallon (4 tanks)
7	Pipelines	Material: PVC for the underground, GS for the exposed Rising Main: 40mm Dia. x 50m Length Distribution: 50mm Dia. x 430m Length, 40mm Dia. x 470m
8	Tap-Stands	Reinforced Concrete Number of Tap-Stands: 4 in community with 6 taps each and 1 in MTA compound with 2 taps
9	Water Flow Meter	Inlet to Water Tank: 2” Outlet from Water Tank: 2” Tap-Stands: 1-1/2”

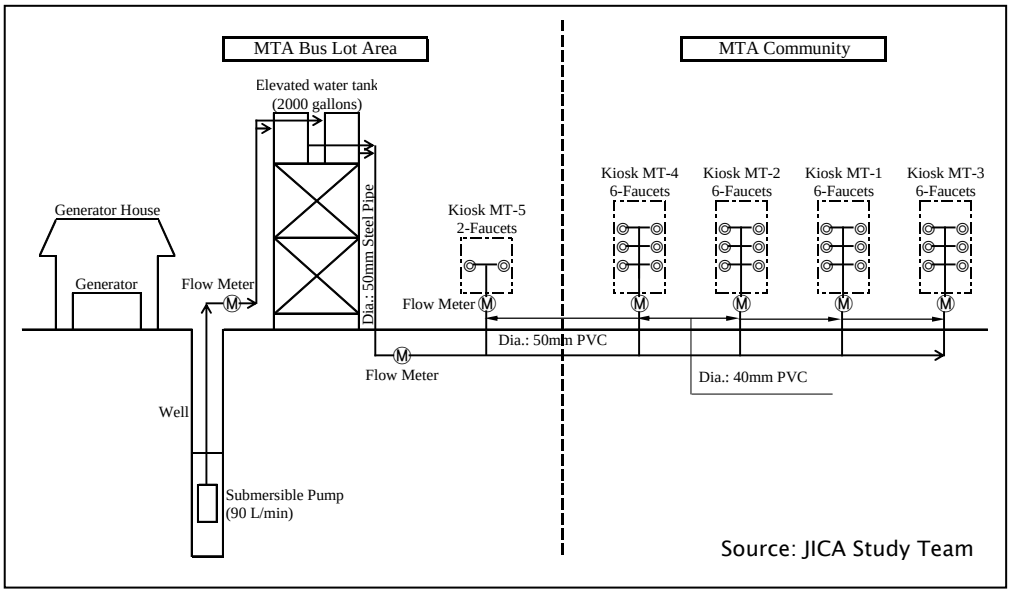


Figure 3-4 Conceptual System Drawing

3.4.3 Daily Water Consumption of Community

Daily consumption of water users was initially designed at 30lit/cap/day (8gallons/cap/day) including both drinking and non-drinking uses as conventional criteria in Liberia. However, in consequence of community baseline and questionnaire survey, it was expected that the users consume averagely much less than 30 lit (8 gallons) from tap-stands by paying because they have already had access to free water from existing hand-pump and hand-dug wells, and that some of the users will fetch minimum quantity of drinking water only from tap-stands.
Accordingly, daily water consumption from tap-stands was tentatively set as follows.

Daily Water Consumption per Household	2 Jerry-Cans (equivalent to 12gallons, 45.4lit)
Beneficial Individual Water Users	829 Households
Total Daily Water Consumption	37,653 lit (9948 gallons)

3.4.4 Daily Water Consumption of MTA Office

Deep-well, generator house and elevated water tank are located inside the compound of Monrovia Transit Authority (MTA) in Block-B, and water is supposed to be supplied to their office. According to their record, they have been purchasing water of 79,500 lit (21,000 gallons) per month from private water truck.

Daily Water Consumption of MTA Office	2,650 lit (700 gallons)

3.4.5 Water Supply Hours and Pump Running Hours

Water supply shall be strictly observed by valve control on outlet pipe, and the supply hours were initially set (see the Manual, *Appendix-2*). In the main time, pump running hours fluctuate according to water consumption trend, so the running hours can be fixed by operator himself through repeated periods of operation. The pump running hours were expected as follows: However, for conservation of limited water source, the daily total hours of pump running shall not exceed 8 hours.

Pump Running Hours For MTA Community	37,653 lit / 158 lit/min = 4.0 hrs/day
Pump Running Hours For MTA Office	2,650 lit / 158 lit/min = 0.3 hrs/day
Total	36,650 lit / 158 lit/min = 4.3 hrs /day

3.5 Financial Aspects

3.5.1 Cost Estimation

In case of ideal conditions for water supply in MTA community, an overall cost for operation 6 maintenance of water supply in MTA community was estimated as follow (See the Table 3-6).

Table 3-7 Monthly Overall Cost Estimation of O&M

Items			Unit (USD)	Quan.	Cost (USD)	Remarks	%
1	Power (Fuel)	Community	0.82	336	276	2.8lit/hr x 4.0hrs x 30days	28
		MTA Office		25.2	21	2.8lit/hr x 0.3hrs x 30days	
2	Chemicals		-	-	-	Not necessary	
3	Repairing		20.00	1	20		
4	Others		10.00	1	10		
5	Personnel	Operator	5.00	30	150	Desired wage	55
		Collector	2.50	30	75	Desired wage	
		Treasurer	2.00	30	60	Desired wage	
		Caretakers	3.00	120	360	Desired wage	
6	LWSC Service Fee		200.00	1	200	Incl. depreciation (10years)	17
Total					**1,172**		100

* Exchange Rate : US$1= L$70

3.5.2 Percentage-based Allocation of Water Sales

As for existing water services through tap-stands of community-managed pipe-borne water supply system, water sales collected by community Water Management Team have been allocated by the ratio fixed by LWSC and agreed by the team, 60% as general maintenance fees for LWSC and remaining 40% as commission and compensation for the team. This allocation model is likely based

on benefit principle and a means of realizing community empowerment.

At the inception of introduction of community-managed satellite water supply system in MTA community, we took on the percentage-based allocation model by initially 42% as major maintenance fees and depreciation for LWSC and 58% as commission and compensation including fuel cost, but finally amended as 17% for LWSC and 83% for the Team.

Table 3-8 Percentage-based Allocation of Water Sales

	LWSC	Water Management Team (Commission)	
		Personnel	Fuel, etc
Conventional Pip-Borne System	60 %	40 %	-
Satellite System in MTA (amended)	**17 %**	**55 %**	**28 %**

3.5.3 Water Tariff Setting

So far in Monrovia, water tariff for households has been composed of two systems. One is metered rate for users of direct connection managed by water meter reading, and another is container-based flat rate for users of public tap-stand managed by counting of water container (jerry-can).

For water tariff setting of community-managed satellite water supply system in MTA community, we also applied container-based flat rate system, but the tariff becomes relatively raised because of little advantage of scale. The water tariff was initially set at L$5 for 2 jerry-cans equivalent to L$0.42 per gallon for MTA community, which exceeds theoretical tariff of L$3.3 in consideration of usage rate. In addition, the water tariff L$5 for 2 jerry-cans is more suitable and simpler for manageable collection of water fees by caretakers, because the smallest change of Liberian Dollars is L$5 and the second is L$10.

Water Tariff for Community Water User's	L$5 for 2 jerry-cans (0.42 L$/gallon)

* US$1,172 / 829 HH / month= 1.41 US$/HH/month = 3.3 L$/HH/day for 2 jerry-cans

3.5.4 Financial Procedures

The following figure shows the financial procedures of operation and maintenance of community-managed satellite water supply in MTA community.

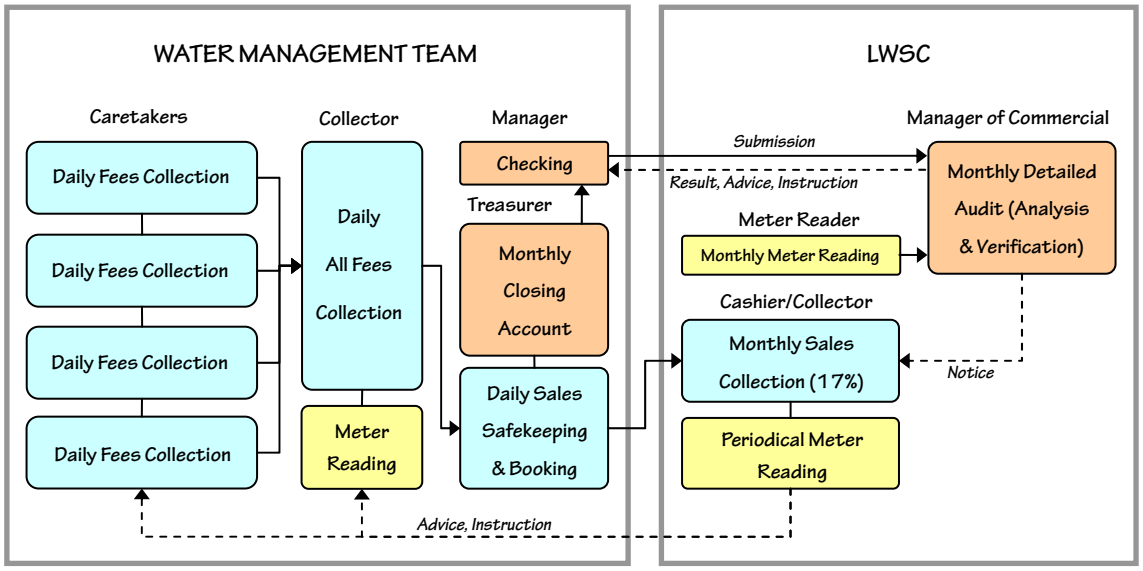


Figure 3-5 Flow Chart of Financial Procedures

3.5.5 Water Fee Collection by way of Cash-on-Delivery

The cash-on-delivery collection by caretakers has been adopted in the existing pipe-borne systems and also was adopted in the satellite system in MTA, which can reduce non revenue water and be easily accepted by Water Management Team and community dwellers, especially low-income households due to the intelligible and visible accounting, and payment to net water usage. Although there is a possibility that cash-on-delivery induces dishonesty such as embezzling by caretakers, scrutiny process by water sales recording and water meter reading can function as a prevention of dishonesty. In principle, all water fees paid to caretakers are daily collected by collector, then be delivered and deposited as daily water sales with treasurer. In this process, all transfer of money can be recorded accurately.

3.5.6 Cutoff Date of Water Management Team

Every month end, an account is closed by Treasurer, and then the result is submitted to Manager of Commercial of LWSC after checking by Team Manager and WATSAN Chairman.

3.5.7 Monthly Detailed Audit by LWSC through Water Flow Meter Reading

Every month end, the water flow meters is checked by LWSC Meter Reader. And then for financial analysis and verification, monthly water sales converted from metered water consumption at 0.42 L$/gallon is compared to total collected water sales by Manager of Commercial of LWSC as Billing Supervisor. The balance between the both is paid to LWSC in case of shortfall, or credited to Water Management Team in case of surplus. Furthermore, 5% of metered water consumption is given to

Water Meter Team as water wastage.

3.5.8 Monthly Collection of a part of Water Sales by LWSC

After the monthly detailed audit and verification by LWSC, 17% of water sales as a service fee including depreciation (10years) for pumping and generating equipment are collected by LWSC Cashier/Collector from Water Management Team.

3.5.9 Payment of Wage to Water Management Team

Also after the detailed audit and verification by LWSC, 55% of monthly water sales become wages to the members of Water Management Team to be tentatively determined by the following percentages, and wages should be paid monthly. Furthermore, the members should not be paid in advance, and also are not allowed to deduct their wages from collected water fees.
The following percentages can be modified by Water Management Team according to water sales and their work performance.

Table 3-9 Wage Allocation Ratio for Members of Water Management Team

No	Position	Percentage
1	Manager / Operator	23 %
2	Co-Manager / Collector	12 %
3	Treasurer	9 %
4	Caretaker 1	14 %
5	Caretaker 2	14 %
6	Caretaker 3	14 %
7	Caretaker 4	14 %
	Total	100 %

3.5.10 Reserve for Operational Costs

Remaining 28% of monthly water sales shall be put aside for fuel, repairing and others.

3.5.11 Bank Account of Water Management Team

A lot of cash deposits with Treasurer are not recommended due to security reasons. So, bank account is quite useful for the activities of the Water Management Team, also in terms of money transparency. Treasurer should deposit at the bank once a week at least.

3.5.12 Non Revenue Water

In principle, overall costs for operation and maintenance of community-managed satellite water

supply system shall be recovered by collected fees. So, non revenue water should be minimized by various efforts.

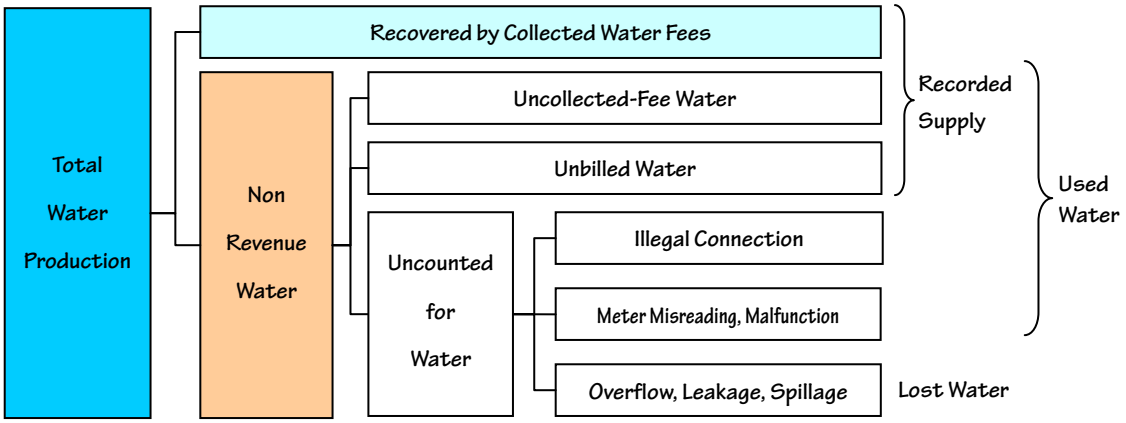


Figure 3-6 Relationship of the Non Revenue Water (NRW) to Total Water Production

Examples of Efforts

- Cash-On-Delivery sales at tap-stands to eliminate uncollected-fee water and unbilled water
- Check of the difference between water consumption estimated from collected water fees and flow meter reading at each tap-stand to check the accuracy of water fees collection activities
- Penalty on Water Management Team if the above difference exceeds 5%
- Appropriate time management of pump running to minimize overflowing from tank
- Examination of all flow meter readings to check the Uncounted-for-Water
- Rubber hoses for faucets to avoid water spillage
- Illegal connection shall be absolutely avoided.

3.6 Other Arrangements

3.6.1 O&M Log Recording

To appropriately monitor the operation and maintenance in both quantitative and qualitative terms, record forms were prepared for Water Management Team (see the Manual, *Appendix-2*).

Technical	Commercial
- Pump Running Record - Water Supply Hours Record - Refueling Record - Water Flow Meters Reading	- Records of Water Fees collected - Revenue and Expenditure - State of Accounts - Wage Payment Record - Bank Statement

3.6.2 Publicity Activities by WATSAN Committee

In order to make more water sales, WATSAN committee had publicity activities with the assistance of the Study Team in December 2009 and January 2010, such as distribution of promotion leaflets (see the *Appendix-3*) and promotional activity using megaphone, which had no small effect on boosting the sales.

CHAPTER 4 RESULTS OF MONITORING ON PILOT PROJECT

The Study team monitored the operation & maintenance of the community-managed satellite water system in MTA community since it started in November 2009 until February 2010, through community monitoring survey (sampling method, see the *Appendix-4*), check of log records, interviews to WATSAN committee and Water Management Team, and exchange of views with LWSC.

4.1 Disadvantageous Conditions of O&M in MTA community

4.1.1 Existing Water Supply Facilities

There are some existing hand-pumps for drinking use, which are available throughout the year, and it's free of charge to use. It means tap-stands and hand-pumps compete against each other as water supply facilities, and the degree of water distress is relatively not high in the community.

4.1.2 Lack of Social Mobilization

Due to limited activities in the Study, the pilot project was not able to be implemented by ideal procedures of social mobilization from the beginning, such as stakeholder meeting, community participation and involvement, assessment and analysis. Accordingly, the responsibility of the O&M by the community has not been secured properly, and it's not easy to urge people to convert their behavior of water usage in a short period.

4.1.3 Location of Tap-Stands

The whole community can not get the convenience of tap-stands, since they were originally designed to be concentrated in Block-B of the community. In fact, their location does not reflect the general will of the community, and they don't have the ability enough to pull in more water users from the whole community.

4.2 Water Management Team

Water Management Team has appropriately operated and maintained water supply facilities with self-reliant efforts and accurate reports with support from WATSAN committee and LWSC, which can be backed up by high degree (98%) of user's satisfaction on the grounds of good service and relationship.

However, a few young caretakers were replaced because of job separation caused by low water sales

in the first or second month. It is necessary to prepare arrangements for retention of members and financial supports to the Team as initial measures

4.3 Technical Aspect

Although some minor problems were found such as leaking from roof of generator house, all water supply facilities and equipment have functioned in general without vandalism and property loss.
However, as mentioned above, it's undeniable that location of a few tap-stands resulted in little growth in water sales.

4.3.1 Usage Situation of Tap-Stands

According to community monitoring survey, 63% of all respondents are using tap-stands in February 2010 because water is safer and more convenient than other existing water sources, and then 98% of water users who responded are willing to continue to use tap-stands as long as water is supplied stably.
In spite of the above-mentioned disadvantageous conditions, it is noteworthy that more than 60% of dwellers have shifted from free water to charged water in 4 months operation. Furthermore, not only safety and convenience but also publicity activities by WATSAN and dweller’s awareness of hygiene have provided some motivation for dwellers to use tap-stands.
On the other hand, 37% of all respondents as non water users stated mainly on far distance and existing hand-pump or shallow wells as the reason for not using tap-stands. However, 87% of them are interested in using water from tap-stands, that is, they can not be ignored as potential customers.

4.3.2 Water Consumption from Tap-Stands

Water users who responded consume 19 LCD (5 GCD) averagely for drinking by 49% of users and for both drinking and non-drinking by remaining 51%, and then pay averagely 15.3 L$ for 6.3 jerry-cans per household. The gap of water consumption between the estimated and the actual has more than triple, since more than half of users consume water for not only drinking but also non-drinking.

4.3.3 Time required for Fetching Water

86% of water users who responded realize that time for fetching water was reduced, and one third of them also realized that time were saved for business, school and rest.

4.4 Financial Aspect

4.4.1 Percentage-based Allocation of Water Sales

Water Management Team is commissioned by LWSC to operate and maintain the system which has financial mechanism for self cost recovery and profit-sharing between the Team as a service provider and LWSC as a service authority.

As a financial assistance to Water Management Team for the initial 3 months of operation, LWSC did not take service fees of 17% from water sales due to its expected inadequacy.

While this percentage-based allocation model has been widely adopted due to the understandability and acceptability by community and also to an incentive for work performance, all costs including personnel fluctuate according to water sales. This model can be suitable for the pipe-borne system once the community accepts, but may be sometimes unsuitable for the satellite system requiring not only personnel but also daily maintenance costs including fuel, unless a certain amount of water sales is secured throughout the year.

While the Team is required to do all kinds of things to promote water and reduce operational costs, it is necessary for LWSC to consider an exemption of service fees as a temporary special measure according to fluctuation in sales through further monitoring

4.4.2 Water Sales

Water sales have increased month by month since the operation started in November 2009, but still don’t reach to the target (see the Table 4-1). In spite of lack of community participation and also inconvenient location of tap-stands for all dwellers, it's noteworthy that a certain amount of water sales was secured after 4 months operation with limited inputs in the community which has not the custom to pay for water due to free water from existing hand-pump or shallow wells. It means an appropriate process of community participation and optimum designing are expected eventually to secure the target water sales.

Especially, tap-stands No.1 can generate high profits due to its geographical advantage. If location of other tap-stands had been designed optimally as a productive tap-stand No.1, water sales might have already reached the target.

It is also expected that the number of users will increase further in MTA community, and once users get used to using tap-stands, a certain level of steady water sales can be kept by better service even though the sales seesaw seasonally.

Although it seems possible that water sales from community users only do not reach the target in MTA community, the operation and maintenance can be sustained as long as a certain amount of

sales is secured and Water Management Team accepts the percentage-based allocation of sales. However, it becomes difficult for LWSC to keep depreciation as a part of service fees to be paid. Fortunately, MTA community has business and individual customers, and then they can contribute water sales. MTA office is supposed to consume approximately 2,650 lit (700 gallons) every day, which is equivalent to water sales L$ 11,760 (US$ 168) per month calculated by water tariff for business users 0.56 L$/G.

Table 4-1 Water Sales from November 2009 to February 2010 (Unit : L$)

	Nov. 2009	Dec. 2009	Jan. 2010	Feb. 2010	Cumulative
Tap-No.1	2,055	3,480	9,805	24,035	39,375
Tap-No.2	1,375	2,605	5,400	9,535	18,915
Tap-No.3	375	540	0	835	1,750
Tap-No.4	275	0	1,825	3,910	6,010
MTA Office (No.5)	-	-	-	(11,760)	(11,760)
House Connect. 1	-	-	-	(845)	(845)
Total	4,080	6,625	17,030	38,315	66,050
Total in US$	58.29	94.64	243.29	547.36	943.58

* Exchange Rate: US$1 = L$70
* Water users have been concentrated at tap-stands No.1 and 2 out of 4 in MTA community. This means other two (2) tap-stands are not located optimally.
* Accordingly, paucity of water sales contributed to job separation of caretakers of No.3 and 4. Then, replacements have been employed after the temporary suspension.
* Water has been supplied to office of Monrovia Transit Authority (MTA) through tap-stand No.5 and their newly-connected pipeline since January 2010, but water fee has been unbilled.
* Water has been supplied to an individual through his newly-connected pipeline since January 2010, but water fee has been unbilled.

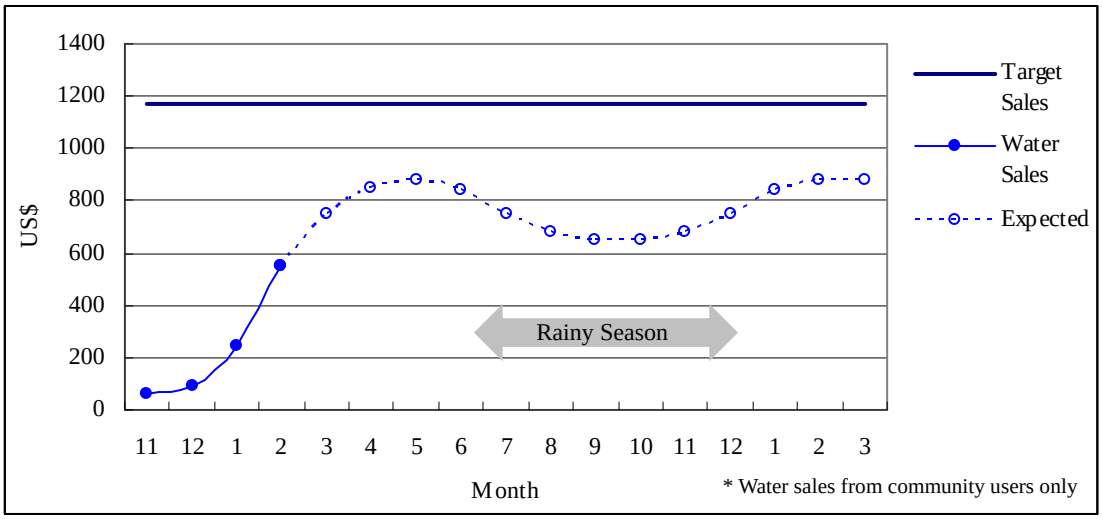


Figure 4-1 Expected Variation in Water Sales in each Month

4.4.3 Revenue and Expenditure

As special assistances, service fees for LWSC were not taken for initial three (3) months and fuel for generator and its maintenance service were provided for initial 4 (four) months. So, expenditures during this monitoring period are composed of mainly personnel costs.

Table 4-2 Revenue and Expenditure from November 2009 to February 2010 (Unit : L$)

Item		Nov. 2009	Dec. 2009	Jan. 2010	Feb. 2010	Cumulative
Income	Community	4,080	6,625	17,030	38,315	66,050
	MTA Office	-	-	-	(11,760)	(11,760)
	House Connection	-	-	-	(845)	(845)
	Total	4,080	6,625	17,030	38,315	66,050
Expenditure	Operational Cost	80	1,445	-	-	1,525
	- Fuel, Oil	Free provision as a financial assistance until Feb.				-
	- Other	80	1,445	-	-	1,525
	Personnel	3,300	3,085	13,625	21,075	41,085
	Service Fee	Exemption as a financial assistance until Jan.			6,510	6,510
	Total	3,380	4,530	13,625	27,585	49,120
Balance (Saving)		700	2,095	3,405	10,730	16,930
Balance in US$		10.00	29.93	48.64	153.29	241.86

4.4.4 Water Tariff Setting

Community monitoring survey shows that 83% of all respondents including non-users have regarded L$5 for 2 jerry-cans as reasonable water tariff. That is, the water tariff L$5 for 2 jerry-cans is mostly acceptable to pay routinely for peri-urban community and can be a design criteria of the system. However, it is predicated on ensuring convenience and easy access to water. Water tariffs and other prices for domestic users in Monrovia are enumerated in the Table 4-3.

Table 4-3 Water Tariff and other Prices for Domestic Users (Unit: L$/gallon)

LWSC Pipe-Borne Water Supply		
Direct Connection		Public Kiosk
Household (Category A)	Church, Mosque, Charities and etc.	(Category B)
0.10 (up to 2,250 gallons) **0.25** (> 2,250 gallons)	**0.10** (up to 2,250 gallons) **0.25** (> 2,250 gallons)	**0.17**
* Registration Fees : US$10.00 * Meter Installation Fees : 1/2"-US$35, 3/4"-US$50, 1"-US$100, 2"-US$200 * 2,250 gallons/month = 5 persons/HH x 15 gallon/c/d (56.8 lit/c/d) x 30 days		* L$5.00 per 5 jerry-cans
Community-Managed Satellite Water Supply (Provisional)		
Direct Connection (Category-A)		Public Kiosk
Household (Category A)	Church, Mosque, Charities and etc.	(Category B)
0.10 (up to 2,250 gallons) **0.25** (> 2,250 gallons)	**0.10** (up to 2,250 gallons) **0.25** (> 2,250 gallons)	**0.42**
* Registration Fees : US$10.00 * Meter Installation Fees : 1/2"-US$35, 3/4"-US$50, 1"-US$100, 2"-US$200 * 2,250 gallons/month = 5 persons/HH x 15 gallon/c/d (56.8 lit/c/d) x 30 days		* L$5.00 per 2 jerry-cans
Other Water (as reference)		**LWSC Bulk Carry**
Private Vendors (Push-Push)	Local Mineral Water	(by Water Truck)
3.33	**37.85**	**2.10**
* L$20.00 per jerry-can	* L$5.00 per 500ml (vinyl-packed)	* US$15.00 per 500 gallon * Outside of Monrovia incl. Paynesville, Gardnersville

4.4.5 Non Revenue Water

As a part of Non Revenue Water, Water Management Team had uncounted-for-water of 32.44 m^3 equivalent to 4.2% of water production for the last four (4) months between the inlet from well and the outlet from tank because of overflow from the tank and maybe water meter malfunctioning. Furthermore, the Team had also another uncounted-for-water of 20.19 m^3 equivalent to 2.7 % of between outlet from tank and all distributing taps because of water spillage at tap-stands and maybe water meter malfunctioning.

As of the beginning of March 2010, the Team has unbilled water for MTA office and an individual as a part of Non Revenue Water.

Table 4-4. Water Flow Volume by Meter Reading from November 2009 to February 2010

Meter Location	Flow Volume (m^3)
Inlet to from Well (A)	778.066
Outlet from Tank (B)	745.626
All 4 Community Tap-Stands (C)	590.008
MTA Office (D)	117.509
Individual House Connection 1 (E)	17.919
Balance (A-B)	32.440
Balance (B-C-D-E)	20.190

4.5 Impacts of the Pilot Project on Community

The project has impacted the community by the following outputs since the operation started in November 2009, and has totally contributed to community development.

1. 63% equivalent to 2,612 of community dwellers became users as beneficiaries of the project, and there is a high possibility that users increase further.
2. Accessibility to safe and stable water was increased, accordingly, the project has contributed to improve their health, living conditions and environment
3. WATSAN Committee and Water Management Team have been empowered technically and financially through workshops, survey, training and operation & maintenance.
4. Citizenship was exercised even though community participation was limited; accordingly, the project has contributed to develop the capacity of community.
5. Time and burden on fetching water by women and children were reduced for approximately 90% of users, accordingly, the project has contributed indirectly to improve educational and income generating activities

4.6 Issues on Sustainability of the System in MTA Community

Through the monitoring, the following issues on the sustainability of the system were known.

1. Competition with usage of existing water sources
2. Location of community tap-stands
3. Prospective seasonal fluctuation in water sales
4. Difficulty in depreciation
5. Community leadership issues, but was solved before operation & maintenance started.

4.7 Sustainability of the System in MTA Community

Although water sales have not yet reached the target, Water Management Team has operated and maintained the facilities with self-reliant efforts and financial assistances for the initial three (3) months, and then the members are getting satisfied with work conditions because of a certain amount of sales. That is, the operation & maintenance can be sustained even with paying for fuel by themselves if a certain amount of sales is kept on average throughout the year.

However, in order to achieve the target, both extension of pipeline and optimum relocation or addition of tap-stands to Block-A&C will be definitely very effective in increasing the sales as future measures. Furthermore, only partnership-based close communication can cope with the unexpected on the operation & maintenance.

CHAPTER 5 CONCLUSION, SUGGESTIONS AND CONSIDERATION

5.1 Conclusion

We conclude "there are potential and possibility of community-managed satellite water supply in peri-urban communities of Monrovia". The system can be sustainable through appropriate implementation with appropriate process, optimum planning & designing and social mobilization. The following figure shows the key factors affecting the sustainability of community-managed system.

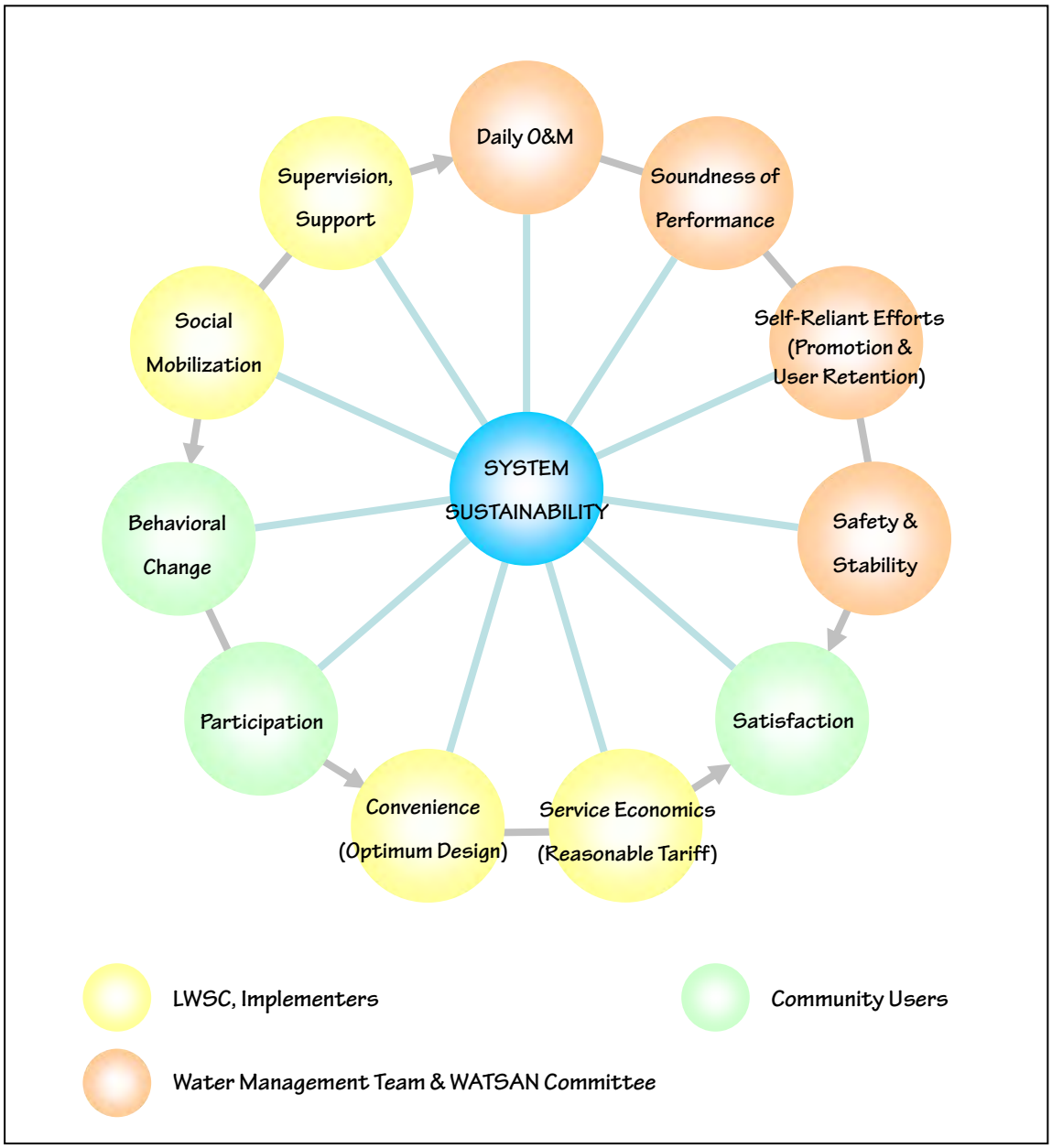


Figure 5-1 Key factors and their Interrelationship for the Sustainability of Community-Managed System

5.2 Suggestions

In order to make systems assuredly successful and effective, we make some suggestions as follow.

5.2.1 Proposed Principles on Community-Managed Satellite Water Supply System

1. Sustainable Safe and Stable Water Supply to Community
2. Partnership between LWSC and Community
3. Community Empowerment under Poverty Reduction Strategy
4. Community Management on Daily Operation and Maintenance
5. Community Participation in Process

5.2.2 Legal Framework

In case the community-managed satellite water supply system is developed extensively, LWSC should consider the formulation or strengthening of a legal framework to bind upon the concerned parties for ensuring the successful functioning and sustainability. That is, clearly-stated regularization and stipulation on the system are strongly necessary as legal force to prescribe implementation procedures, key actor's roles of responsibility and liability, beneficiaries-pay principle such as fund reserve by community. Furthermore, guideline and various manuals should be prepared as a complement.

5.2.3 Capacity Development of LWSC on Community Water Supply

In relation to community-managed pipe-borne water supply, LWSC has sections concerned for operation & maintenance (engineers, technicians, plumber and so on), and commercial (mainly collector), and also has the accumulated knowledge and experience which are applicable to community-managed satellite system. However, LWC has neither section nor human resources for social mobilization which contributes to the sustainability of system. In case of projects by NGOs, they usually mobilize communities from the beginning and monitor the operation & maintenance for a few months, but no follow-up activities are provided after their monitoring.

Therefore, we suggest LWSC to establish a division of community mobilization. Or if the community-managed system is widely developed and expanded in the future, it would be better off establishing a specialized section to consolidate the management of all types of community-managed systems including planning, designing, supervision, quality control, operation & maintenance, finance and social mobilization.

5.2.4 Study and Comprehensive Plan on Community Water Supply in Monrovia

A number of pipe-borne water supply projects have been implemented and operated as an emergency approach without comprehensive plan and reasonable design criteria for peri-urban communities of Monrovia. These existing systems and facilities should be studied technically and financially on the whole, and then the study results should be reflected into master plan on community water supply in Monrovia and also be utilized for design criteria, standardization and so on.

5.2.5 Collaboration with related Ministries and NGOs

In order to make project implementation successful with synergistic effects, it is more effective to take comprehensive approaches in closer collaboration with related Ministries such as Ministry of Health having dealt with community health, and NGOs having contributed to community water supply in Monrovia with experiences and knowledge such as community mobilization, formation of WATSAN committee, hygiene promotion and other social activities.

5.3 Consideration

5.3.1 Expected Stakeholders for Community-Managed Satellite Water Supply System

As stakeholders, the following organizations and also influential individuals of community, hand-pump owners or water vendors as necessary, should be involved in the process to ensure the function and sustainability of community-managed satellite water supply system with participation and partnership, and also in comprehensive control of community water and sanitation.

Table 5-1 Stakeholders for Community-Managed Satellite Water Supply System

	Organization	Description
1	LWSC	Water service authority and an implementing body
2	WATSAN Committee	Community voluntary group dealing with water and sanitation, elected by community
3	Water Management Team	Water service provider responsible for daily operation & maintenance of the system, supervised by LWSC and elected and supported by WATSAN committee
4	Community Leaderships	Community representatives and advisors to WATSAN committee
5	Water Users	Beneficiaries
6	Local Authority (Municipality)	Witness of understanding of communal operation & maintenance between LWSC and community

5.3.2 Diversity of Water Situation in Peri-Urban Monrovia

In varying degrees, it is expected that a diversity of water situation in communities makes water supply complicated. As for community-managed water supply to community, in particular, we need to consider how to deal with conventional water sources such as existing hand-pump and hand-dug wells.

From a viewpoint of public water service, we should examine closely whether LWSC officially aims at changeover of water usages from conventional water sources to sophisticated facilities or not. However, strict restriction on conventional water sources is not realistic and not acceptable for community because people own the sources and get water free of charge. So, it is essential to operate and maintain sustainably community-managed water supply with improvement of community practices on water and sanitation, and with normalization of water usages. The normalization is intended to make supply and demand balanced for supplying safe drinking water to beneficiaries as much as possible and also for keeping water sales constant for the sustainability.

5.3.3 Promotion of Normal Water Usages and Hygiene

There are some possibilities of water-borne diseases caused by conventional water usages and hygiene in a community. Though conventional water sources such as hand-pump and hand-dug wells cannot be disregarded at all, it is strongly necessary to promote safe and normal water usages of community for better health and living environment and for ensuring the sustainability with water sales. So in case LWSC or donors, NGOs implement pipe-borne or satellite water supply projects, efficient promotion on water and hygiene should be conducted systematically as a social mobilization activity to change community behavior on water and sanitation.

5.3.4 Importance of Optimization of the System

The number, positioning and layout of community tap-stands are quite important for the success of community-managed water supply system, because the realization of convenience and improved access to water can lead to high rate of utilization and water sales for the sustainable operation and maintenance. In order to make operation & maintenance optimized, the number, positioning and layout should be determined by service area, distribution of houses, distance, population, density, personnel cost for caretakers and so on.

5.3.5 Other Considerations on Implementation of the Project

In case of implementation of community-managed water supply projects, it is quite important to consider the followings.

1. Planning with the anticipated responses to various water usage and demands
2. System designing with convenience, stability and economics
3. Social approach by taking into account the characteristics of the community including leadership
4. Establishment of management system which can flexibly respond to seasonal fluctuation in water demands and sales
5. Initial financial assistances to Water Management Team

5.4 Necessity and Justification of Further Project Implementation

Peri-urban communities of Monrovia have been developed spontaneously as dormitory suburb for a large number of urban populations, and the inhabitable areas surely continue to spread and the population increases.

However, while the communities have had an increasing role in accommodating urban dwellers, they have suffered from a lack of infrastructure including water supply. Accordingly, a lot of communities outside urban water supply network rely on limited water sources such as hand-pump well and hand-dug well which are not always safe and stable. As an example, water situations of some communities outside urban network in Paynesville zone are described in the *Appendix-5*, which represents that dwellers are facing trouble getting safe and stable water.

Under the process of restoration and improvement of urban facilities in Monrovia after the civil war, limited budget and funds have been preferentially allocated to major urban infrastructures. As for the water sector, although White Plain water treatment plant and urban water supply network have been rehabilitated, urban water service remains in less-advanced situation.

On the other hand, efficient water supply with sustainable system is quite necessary for populated peri-urban communities in order to improve water services, and it is expected that community-managed satellite approach can be one of the alternatives from the result of this monitoring report and can boost water service coverage in the peri-urban communities which cannot benefit from urban network.

THE LIBERIA WATER AND SEWER CORPORATION
The Republic of LIBERIA

RESULTS OF COMMUNITY BASELINE SURVEY

ON

WATER AND SANITATION

in

MTA Community, Gardnersville

November 2009

Prepared by JICA Study Team
The Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia

JAPAN INTERNATIONAL COOPERATION AGENCY

Survey Period: October 2009

Survey Method: Complete Enumeration with Questionnaire

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Appendices

Figures

SUMMARY

Population, Household (HH), Average No. of HH Members

	Population	Household	Average No. of HH Members
Block-A	757	131	5.8
Block-B	875	132	6.6
Block-C	3,991	485	8.2
Total	5,623	748	7.5

Household Head

Male	Female	Average Age
57.1 %	42.9 %	37.8

Daily Unit Water Consumption (LCD) by Present Water Usage

	Drinking (Handpump)	Non-Drinking (Dugwells)	Total
Rainy Season	19.5	22.2	41.7
Dry Season	24.7	26.1	50.9

Daily Time (minutes) required for Fetching Water by Present Water Usage

	Drinking (Handpump)	Non-Drinking (Dugwells)	Total
Rainy Season	33	10	43
Dry Season	90	29	119

Water Fetching by Female and Children

Female (F)	Children (C)	F or C	Total
35 %	45 %	5%	85%

Wish to Use Kiosks and Willingness to Pay for Water

Wish to Use (Yes)	Willingness to Pay (Yes)
98.1 %	97.8 %

Acceptable Unit Water Fees and Available Amount for Water by Community Awareness

Unit Water Fees per JerryCan	Average Amount
More than 3 LD : 82.9 %	163.8 LD per month

Sanitation Facilities

Private Latrine		Public Latrine	Other
Pit Type	With Septic Tank	Pit Type	
28.0%	20.4%	16.9%	43.3%

Water-Borne Diseases (Direct or Indirect) by Community Awareness

Yes	Digestive System Diseases	Skin Diseases
62.1%	19.1%	80.9%

Priority Ranking by Community Awareness

	1	2	3	4	5	6
Sector	Water	Health	Sanitation	Education	Drainage	Road

1. Analysis on Community Basic Information

1-1. Population, Household (HH) and its Members

Adults and children under 18 years old and their sexes are equally distributed. The household members vary widely from 1 person to 39 persons, and the average is 7.5 persons per household.

	No. of HHs	Member Structure					Average of Members
		Male	Female	Boy	Girl	Sub-Total	
Block A	131	207	191	171	188	757	5.8
Block B	132	230	244	174	227	875	6.6
Block C	485	929	1,008	1,051	1,003	3,991	8.2
Total	**748**	1,366	1,443	1,396	1,418	**5,623**	**7.5**
%	-	24.3	25.7	24.8	25.2	100	-

Frequency Tabulations

Data Range	Frequency	%	Cumulative %
1	30	4.0%	4.0%
2-3	87	11.6%	15.6%
4-5	173	23.1%	38.8%
6-8	209	27.9%	66.7%
9-12	162	21.7%	88.4%
13-20	73	9.8%	98.1%
21-30	11	1.5%	99.6%
31-40	3	0.4%	100.0%
Total	748	100.0%	

Effectiveness	100%
Mean	**7.5**
Minimum	1
Maximum	39

Fig 1-1. No. of HH Members (Histogram)

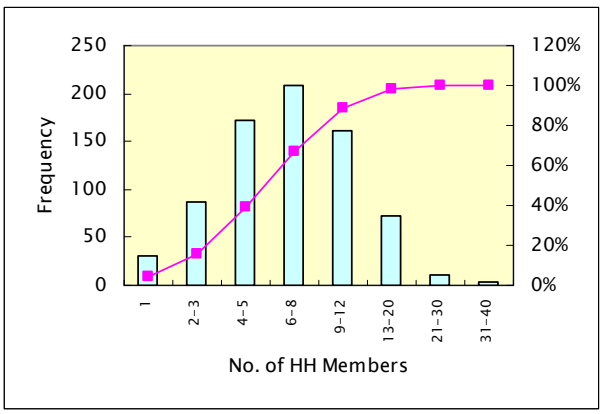
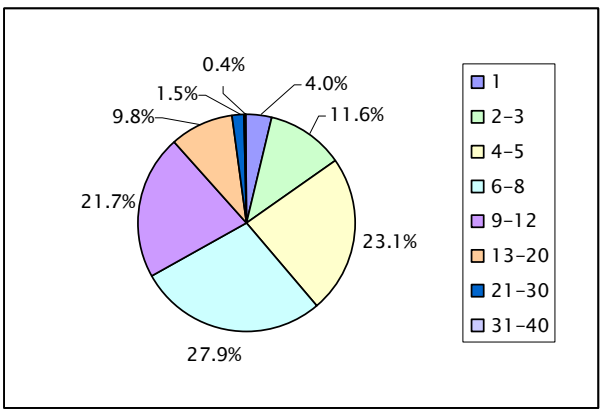


Fig 1-2. No. of HH Members (Graph)



1-2. Household (HH) Head

57% of household heads are males, and remaining 43% are females. The ages of household heads vary widely from 16 to 89 years old, and the average is 37.8 years old.

	No. of HHs	Sex of Head		Average Age
		Male	Female	
Block A	131	62	69	39.1
Block B	132	50	82	36.9
Block C	485	315	170	37.7
Total	748	427	321	**37.8**
%	-	57.1	42.9	-

Frequency Tabulations

Data Range	Frequency	%	Cumulative %
10s	29	4.0%	4.0%
20s	214	29.2%	33.2%
30s	234	31.9%	65.1%
40s	159	21.7%	86.8%
50s	67	9.1%	95.9%
60s	19	2.6%	98.5%
70s	8	1.1%	99.6%
80s	3	0.4%	100.0%
Total	733	100.0%	

Effectiveness	-
Mean	**37.8**
Minimum	16
Maximum	89

* Effective answer is 100% for sex of head, but 98% for age.

Fig 1-3. Household Head Age (Histogram)

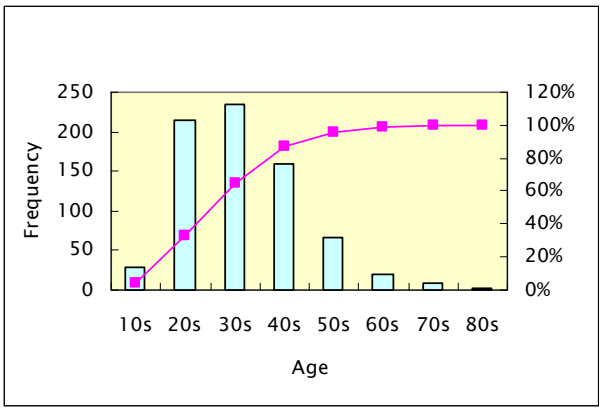
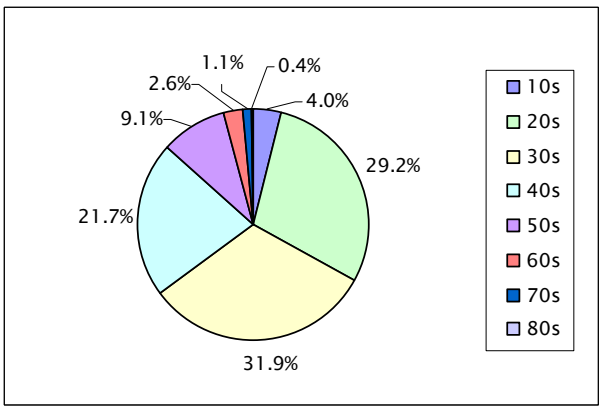


Fig 1-4. Household Head Age (Graph)



2. Analysis on Drinking Water Consumption

2-1. Present Daily Drinking Water Consumption from Existing Handpumps

On average, people get 19.5 liter/capita/day of drinking water from the existing handpumps during the rainy season, on the other hand 24.7 liter/capita/day during the dry season.

	Rainy Season		Dry Season	
	GCD	LCD	GCD	LCD
Block A	3.5	13.2	5.1	19.1
Block B	4.1	15.7	6.5	24.7
Block C	5.9	22.2	6.9	26.2
Average	5.1	**19.5**	6.5	**24.7**

	Rainy	Dry
Effectiveness	99.9%	99.9%
Mean	**19.5**	**24.7**
Minimum	0.9	1.1
Maximum	454.2	567.8

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<10	349	46.7%	46.7%	287	38.4%	38.4%
11-20	198	26.5%	73.2%	208	27.8%	66.3%
21-30	79	10.6%	83.8%	85	11.4%	77.6%
31-50	60	8.0%	91.8%	91	12.2%	89.8%
51-70	33	4.4%	96.3%	26	3.5%	93.3%
71-100	10	1.3%	97.6%	22	2.9%	96.3%
101-150	13	1.7%	99.3%	17	2.3%	98.5%
151-200	2	0.3%	99.6%	5	0.7%	99.2%
201-300	2	0.3%	99.9%	4	0.5%	99.7%
301-600	1	0.1%	100.0%	2	0.3%	100.0%
Total	747	100.0%		747	100.0%	

Fig 2-1. Unit Drinking W. Consumption (Rainy)

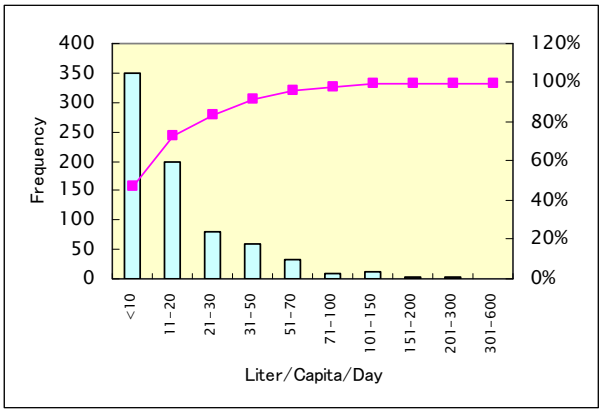
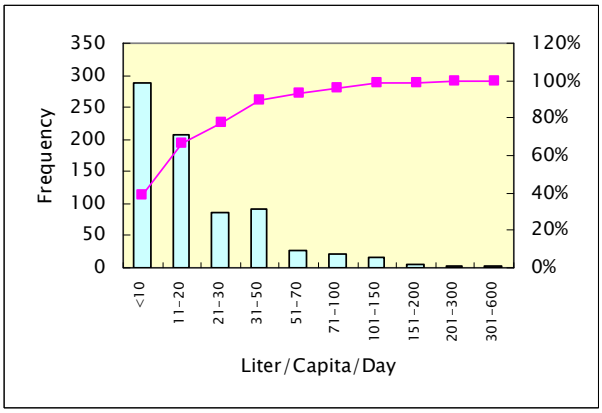


Fig 2-2. Unit Drinking W. Consumption (Dry)



2-2. Present Daily Non-Drinking Water Consumption from Existing Dugwells

On average, people get 22.2 liter/capita/day of non-drinking water for mainly washing, bathing and cooking from the existing dugwells during the rainy season, on the other hand 26.1 liter/capita/day during dry season.

	Rainy Season		Dry Season	
	GCD	LCD	GCD	LCD
Block A	7.4	28.1	8.1	30.7
Block B	6.4	24.2	9.1	34.5
Block C	5.3	20.1	6.0	22.6
Average	5.9	**22.2**	6.9	**26.1**

	Rainy	Dry
Effectiveness	99.6%	99.6%
Mean	**22.2**	**26.1**
Minimum	0.2	0.3
Maximum	227.1	272.5

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<10	216	29.0%	28.99%	173	23.2%	23.2%
11-20	260	34.9%	63.89%	250	33.6%	56.8%
21-30	132	17.7%	81.61%	133	17.9%	74.6%
31-50	77	10.3%	91.95%	114	15.3%	89.9%
51-70	31	4.2%	96.11%	33	4.4%	94.4%
71-100	12	1.6%	97.72%	19	2.6%	96.9%
101-150	14	1.9%	99.60%	16	2.1%	99.1%
151-200	1	0.1%	99.73%	3	0.4%	99.5%
201-300	2	0.3%	100.00%	4	0.5%	100.0%
-						
Total	745	100.0%		745	100.0%	

Fig 2-3. Unit Non-D. W. Consumption (Rainy)

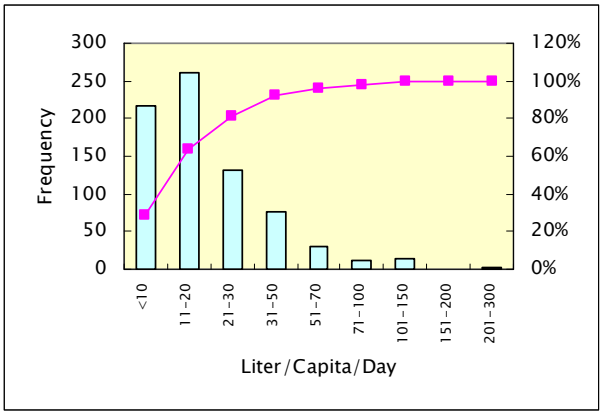
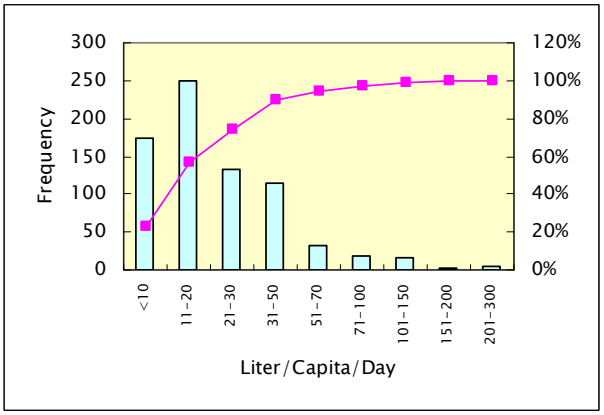


Fig 2-4. Unit Non-D. W. Consumption (Dry)



2-3. Present Daily Total Water Consumption from Existing Handpumps and Dugwells

On average, people get 41.7 liter/capita/day of water from the existing handpumps and dugwells during rainy season, on the other hand, 50.9 liter/capita/day during the dry season.

	Rainy Season		Dry Season	
	GCD	LCD	GCD	LCD
Block A	10.9	41.3	13.2	49.8
Block B	10.5	39.9	15.6	59.2
Block C	11.2	42.3	12.9	48.9
Average	11.0	**41.7**	13.4	**50.9**

	Rainy	Dry
Effectiveness	99.5%	99.5%
Mean	**41.7**	**50.9**
Minimum	4.1	4.5
Maximum	476.9	613.2

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<10	30	4.0%	4.0%	21	2.8%	2.8%
11-20	198	26.6%	30.6%	157	21.1%	23.9%
21-30	168	22.6%	53.2%	149	20.0%	44.0%
31-50	182	24.5%	77.7%	200	26.9%	70.8%
51-70	70	9.4%	87.1%	81	10.9%	81.7%
71-100	45	6.0%	93.1%	65	8.7%	90.5%
101-150	29	3.9%	97.0%	31	4.2%	94.6%
151-200	9	1.2%	98.3%	18	2.4%	97.0%
201-300	10	1.3%	99.6%	16	2.2%	99.2%
301-650	3	0.4%	100.0%	6	0.8%	100.0%
Total	744	100.0%		744	100.0%	

Fig 2-5. Unit Total Water Consumption (Rainy)

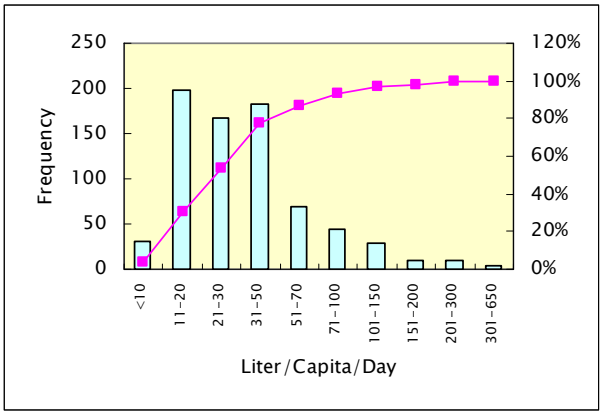
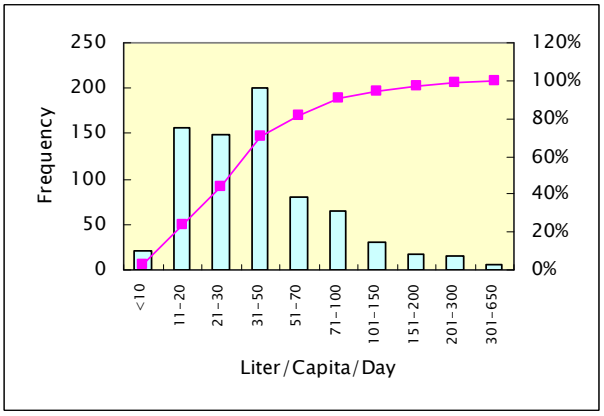


Fig 2-6. Unit Total Water Consumption (Dry)



3. Analysis on Present Time required for fetching Water

3-1. Present Time required for fetching Drinking Water from Existing Handpumps

On average, people take 33 minutes to fetch drinking water from the existing handpumps during the rainy season, on the other hand, 90 minutes during the dry season.

	Time (Minutes)	
	Rainy	Dry
Block A	30	95
Block B	33	96
Block C	22	57
Average	**33**	**90**

	Rainy	Dry
Effectiveness	99.7%	99.7%
Mean	**33**	**90**
Minimum	1	1.1
Maximum	270	480

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<5	57	7.6%	7.6%	36	4.8%	4.8%
6-10	110	14.7%	22.4%	46	6.2%	11.0%
11-15	73	9.8%	32.2%	26	3.5%	14.5%
16-30	176	23.6%	55.8%	57	7.6%	22.1%
31-45	132	17.7%	73.5%	43	5.8%	27.9%
46-60	115	15.4%	88.9%	58	7.8%	35.7%
61-120	71	9.5%	98.4%	212	28.4%	64.1%
121-180	9	1.2%	99.6%	188	25.2%	89.3%
181-240	2	0.3%	99.9%	64	8.6%	97.9%
241-480	1	0.1%	100.0%	16	2.1%	100.0%
Total	746	100.0%		746	100.0%	

Fig 3-1. Time for Drinking Water (Rainy)

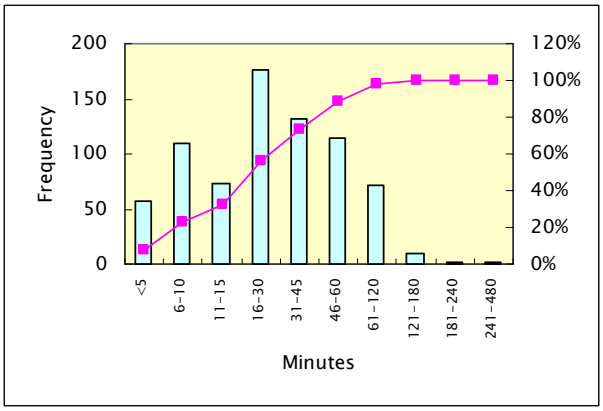
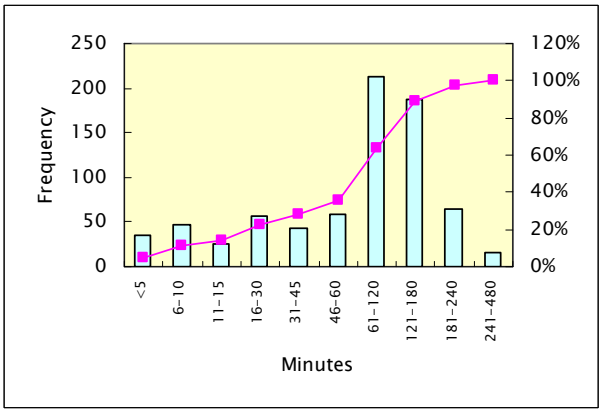


Fig 3-2. Time for Drinking Water (Dry)



3-2. Present Time required for fetching Non-Drinking Water from Existing Dugwells

On average, people take 10 minutes to fetch non-drinking water for mainly washing, bathing and cooking from the existing dugwells during the rainy season, on the other hand, 29 minutes during the dry season.

	Time (Minutes)	
	Rainy	Dry
Block A	7	29
Block B	11	70
Block C	7	11
Average	**10**	**29**

	Rainy	Dry
Effectiveness	99.6%	99.6%
Mean	**10**	**29**
Minimum	1	1
Maximum	130	420

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<5	345	46.3%	46.3%	233	31.3%	31.3%
6-10	175	23.5%	69.8%	169	22.7%	54.0%
11-15	87	11.7%	81.5%	82	11.0%	65.0%
16-30	91	12.2%	93.7%	92	12.3%	77.3%
31-45	32	4.3%	98.0%	40	5.4%	82.7%
46-60	7	0.9%	98.9%	12	1.6%	84.3%
61-120	7	0.9%	99.9%	65	8.7%	93.0%
121-180	1	0.1%	100.0%	33	4.4%	97.4%
181-240	0	0.0%	100.0%	13	1.7%	99.2%
241-480	0	0.0%	100.0%	6	0.8%	100.0%
Total	745	100.0%		745	100.0%	

Fig 3-3. Time for Non-Drinking Water (Rainy)

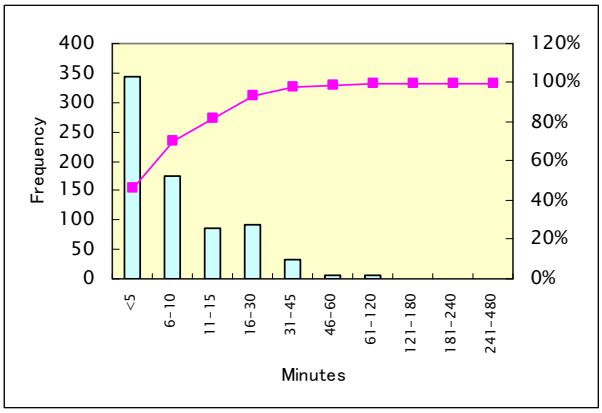
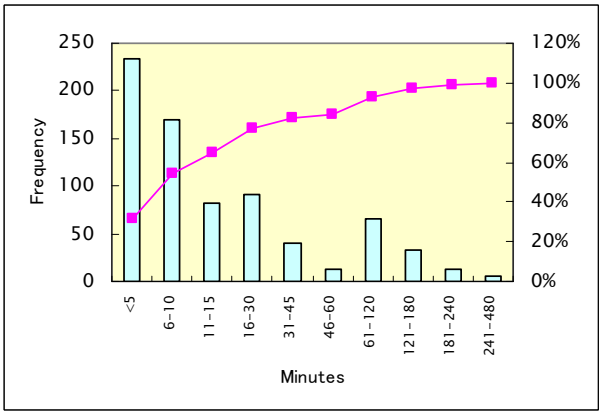


Fig 3-4. Time for Non-Drinking Water (Dry)



3-3. Present Time required for fetching All Water from Existing Handpumps and Dugwells

On average, people take 43 minutes to fetch water from the existing handpumps and dugwells during the rainy season, on the other hand, 119 minutes during dry season.

	Time (Minutes)	
	Rainy	Dry
Block A	37	124
Block B	43	166
Block C	45	105
Average	**43**	**119**

	Rainy	Dry
Effectiveness	99.3%	99.3%
Mean	**43**	**119**
Minimum	2	2
Maximum	272	840

Frequency Tabulations

Data Range	Rainy Season			Dry Season		
	Frequency	%	Cumulative %	Frequency	%	Cumulative %
<5	26	3.5%	3.5%	17	2.3%	2.3%
6-10	42	5.7%	9.2%	18	2.4%	4.7%
11-15	64	8.6%	17.8%	26	3.5%	8.2%
16-30	179	24.1%	41.9%	64	8.6%	16.8%
31-45	140	18.8%	60.7%	30	4.0%	20.9%
46-60	116	15.6%	76.3%	44	5.9%	26.8%
61-120	156	21.0%	97.3%	198	26.6%	53.4%
121-180	15	2.0%	99.3%	203	27.3%	80.8%
181-240	3	0.4%	99.7%	88	11.8%	92.6%
241-840	2	0.3%	100.0%	55	7.4%	100.0%
Total	743	100.0%		743	100.0%	

Fig 3-5. Time for All Water (Rainy)

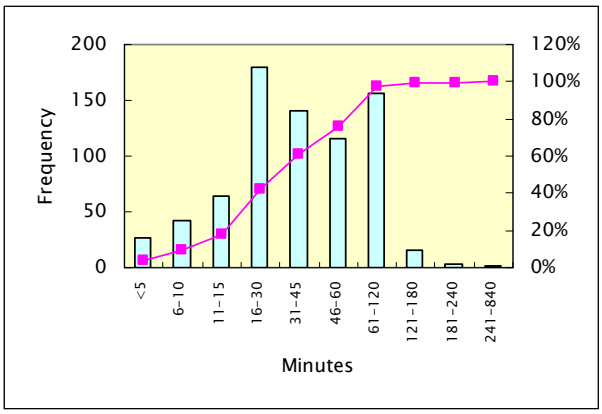
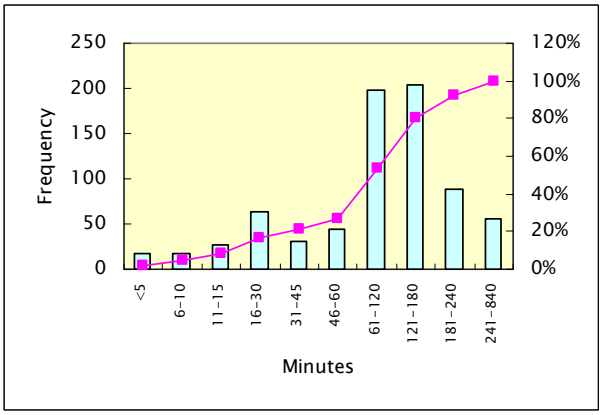


Fig 3-6. Time for All Water (Dry)



4. Other Analysis on Water Usage

4-1. Who fetches Water

For both drinking and non-drinking water, water is conventionally fetched by female and their children in most of the households, which is equivalent to 85% of them.

Fig 4-1. Fetching Drinking Water

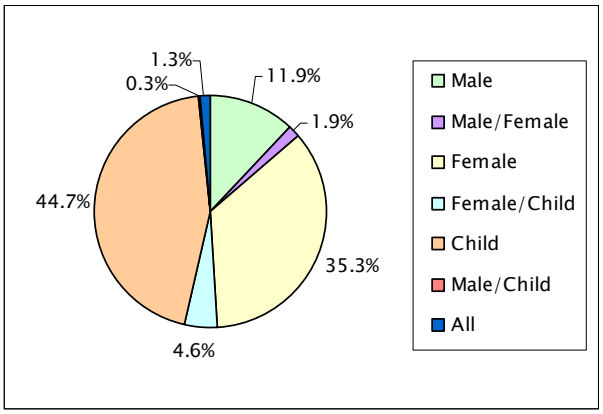
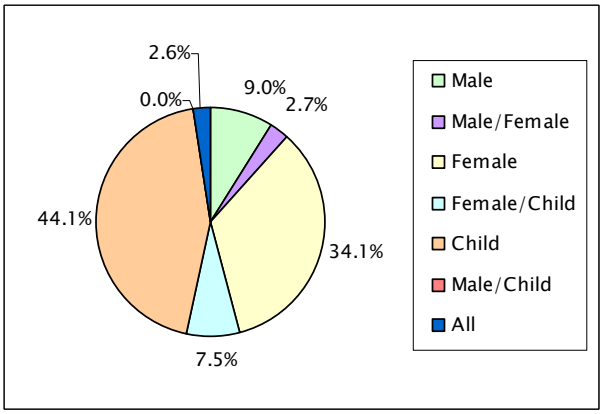


Fig 4-2. Fetching Non-Drinking Water



4-2. Daily Frequency of Water Fetching

For drinking water from the existing handpumps, 71% of the households fetch it once a day. On the other hand, for non-drinking water from the existing dugwells, the frequency increases relatively. This difference is because people are not always allowed to use handpumps but freely allowed to use dugwells located closed to their dwellings.

Fig 4-3. Frequency of Fetching Drinking Water

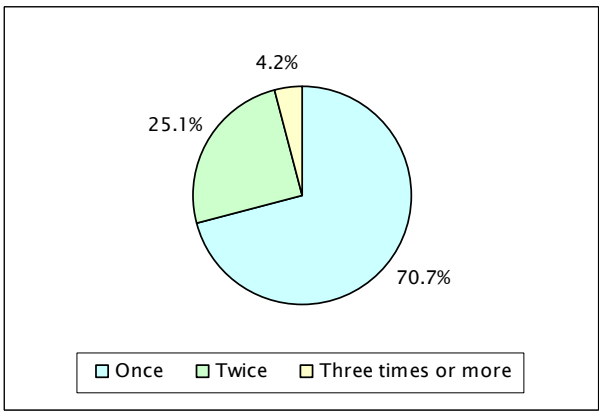
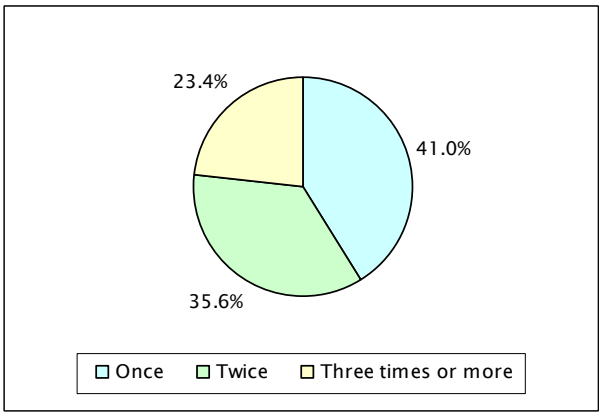


Fig 4-4. Freq. of Fetching Non-Drinking Water



4-3. When to fetch Water

For drinking water from the existing handpumps, 71% of the households fetch it once a day in the early morning or late afternoon. On the other hand, for non-drinking water from the existing dugwells, 59% of them fetch it throughout the day.

Fig 4-5. When to fetch Drinking Water

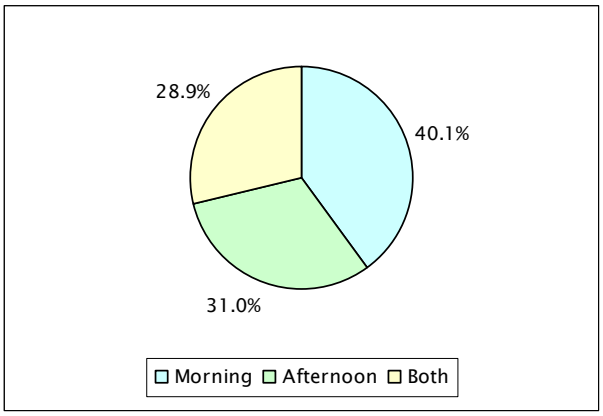
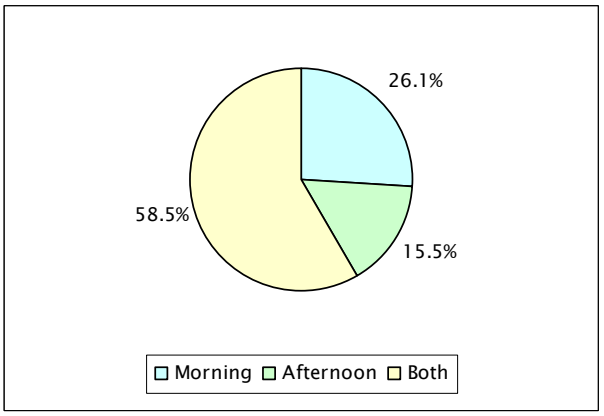


Fig 4-6. When to fetch Non-Drinking Water



4-4. Other Water Sources

34% of the households usually buy local mineral water (500ml, 5LD) for drinking from shops, and a half of them use rain water for non-drinking purposes.

5. Analysis on Water Usage from newly-constructed Kiosks

5-1. Wish to Use Kiosks for Drinking Water

People's wish to use kiosks is very high, and as a result 90% of the household said "Yes" and noted that the water is safe or clean for drinking. On the other hand, the main reason for "No" is the long distance from their houses to the kiosk.

Fig 5-1. Wish to Use Kiosks

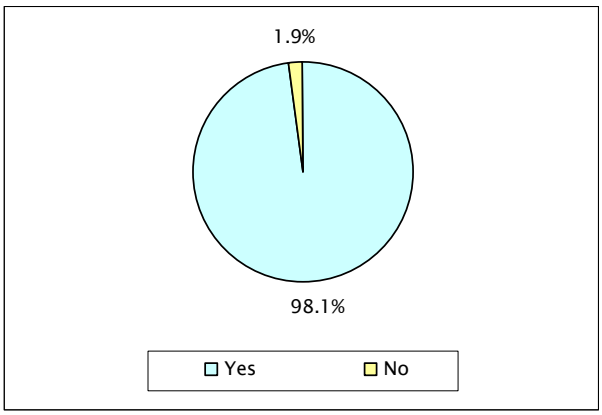
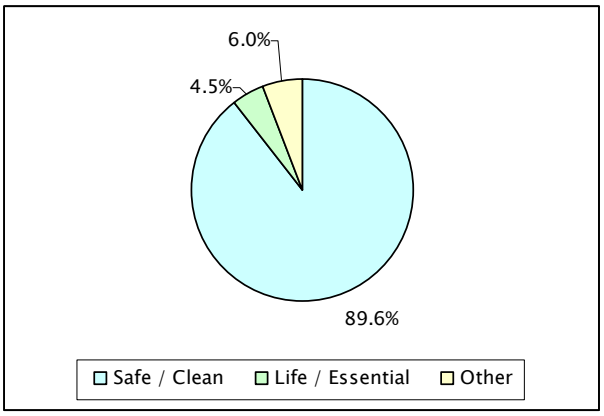


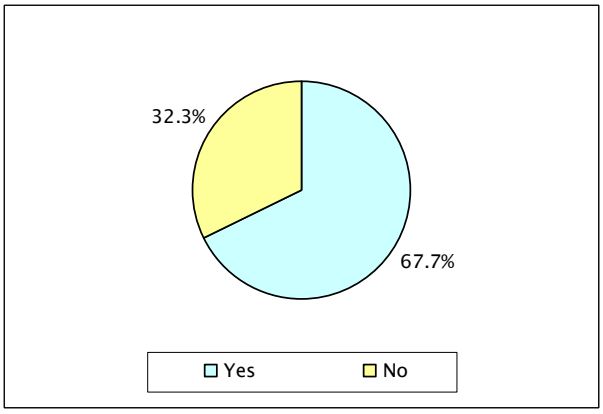
Fig 5-2. Reason to Use Kiosks



5-2. Wish to Use Kiosks for Non-Drinking Purposes

68% of the households wish to use water from kiosks not only for drinking but also for non-drinking purposes by paying fees, mostly because of the safety and cleanness of water. However, 32% do not wish mainly because of the existing dugwells closed to them.

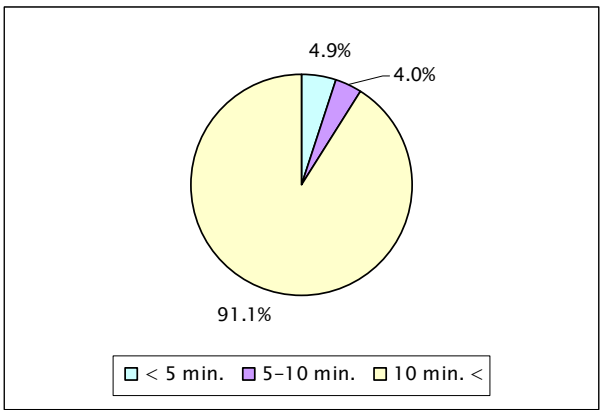
Fig 5-3. Wish to Use Kiosks (Non-Drinking)



5-3. Acceptable Walking Time to Kiosks

91% of the households accepted more than 10 minutes walking time to kiosks for fetching water.

Fig 5-4. Acceptable Walking Time to Kiosks



5-4. Willingness to Pay

People's willingness to pay for water is very high, and as a result 52% of the households said "Yes" and noted that the water is safe or clean, and also 21% noted that maintenance or regular supply is necessary. On the other hand, the main reasons for "No" are low household income and long distance from their dwellings to kiosk.

Fig 5-5. Willingness to Pay

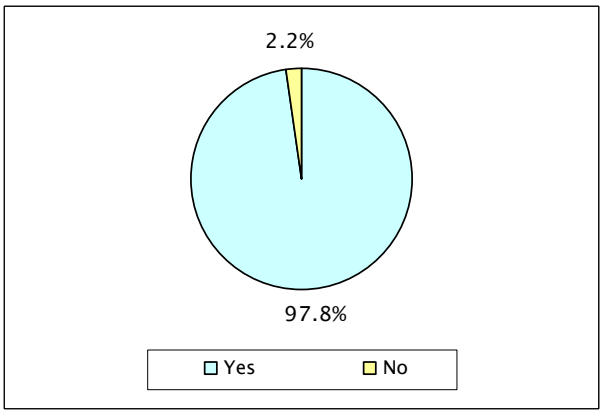
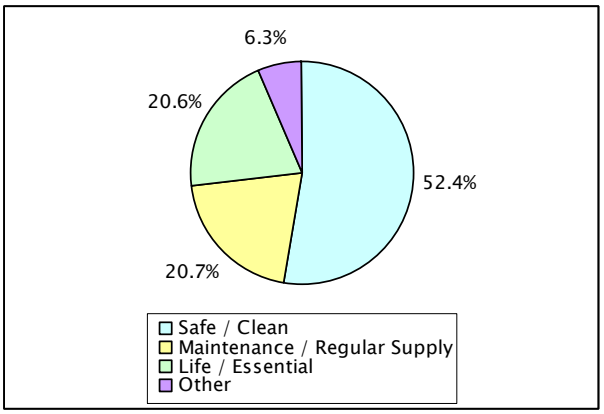


Fig 5-6. Reason to Pay



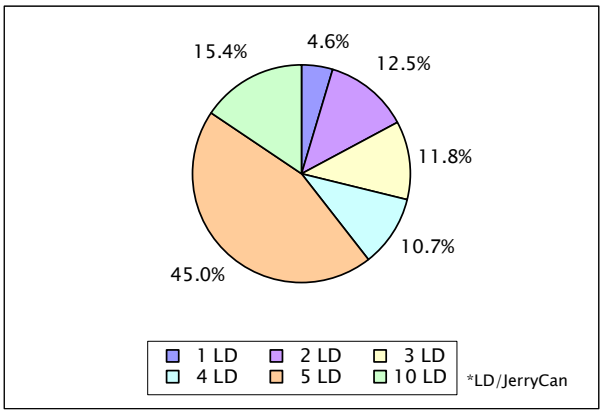
5-5. Acceptable Unit Water Fees by Community Awareness

As a unit water fees per container (jerry-can, 6 gallon), 83% of the households can accepted to pay more than 3 Liberian Dollars (LD).

	1 LD	2 LD	3 LD	4 LD	5 LD	10 LD	Total
Block A	6	12	18	3	9	72	120
	5.0%	10.0%	15.0%	2.5%	7.5%	60.0%	100%
Block B	17	13	8	5	72	11	126
	13.5%	10.3%	6.3%	4.0%	57.1%	8.7%	100%
Block C	10	64	58	68	240	27	467
	2.1%	13.7%	12.4%	14.6%	51.4%	5.8%	100%
Total	33	89	84	76	321	110	713
	4.6%	12.5%	11.8%	10.7%	45.0%	15.4%	100%

* Effective answer is 95.3%.

Fig 5-7. Acceptable Unit Water Fees



5-6. Monthly Available Amount for Water by Community Awareness

As an intention of the households, the monthly available amount for water varies widely from 5 LD to 1,500 LD, and the average is 163.8 LD per month which is equivalent to 5.5 LD per day.

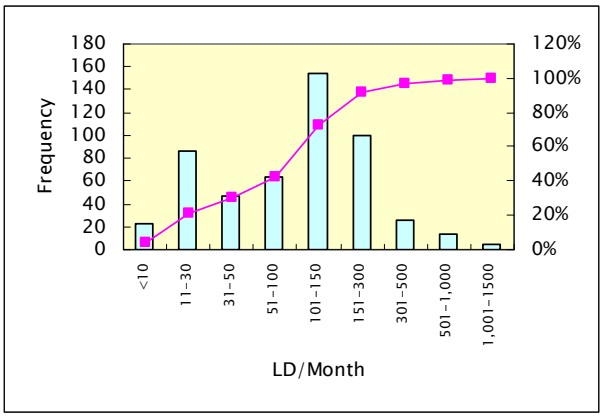
	LD/Month
Block A	152.0
Block B	77.1
Block C	221.5
Average	**163.8**

Effectiveness	68.9%
Mean	**163.8**
Minimum	5
Maximum	1,500

Frequency Tabulations

Data Range	Frequency	%	Cumulative %
<10	22	4.3%	4.3%
11-30	86	16.7%	21.0%
31-50	47	9.1%	30.1%
51-100	63	12.2%	42.3%
101-150	155	30.1%	72.4%
151-300	100	19.4%	91.8%
301-500	25	4.9%	96.7%
501-1,000	13	2.5%	99.2%
1,001-1500	4	0.8%	100.0%
Total	515	100.0%	

Fig 5-8. Available Amount for Water



6. Analysis on Sanitation and Health

6-1. Sanitation Facilities

Almost half of the households own private latrines, 60% of them have pit type and remaining 40% have latrine with septic tank. On the other hand, 17% of the households share public latrines which are not always in a good sanitary condition. And 43% of the households relieve themselves by poor facilities or primitive ways.

(Multiple Answers)

	Private Latrine		Public Latrine	Other	Effective
	Pit Type	With Septic Tank	Pit Type		Answer (HH)
Block A	32	37	45	18	130
	24.6%	28.5%	34.6%	13.8%	-
Block B	97	2	16	18	129
	75.2%	1.6%	12.4%	14.0%	-
Block C	60	99	53	257	417
	14.4%	23.7%	12.7%	61.6%	-
Total	189	138	114	293	676
	28.0%	**20.4%**	**16.9%**	**43.3%**	-

Effectiveness : 90.4 %

6-2. Water-Borne Diseases by Community Awareness

Although a causal relationship between water and diseases is not medically proven, more than 60% of the households perceived the existence of water-borne diseases in the community. 19% of them noted digestive system diseases (mainly cholera and diarrhea), and the remaining 81% noted skin diseases (mainly scabies). As for skin diseases, these may be caused by the fact that people use untreated dugwell water for their bathing.

Fig 6-1. Awareness on Water-Borne Diseases

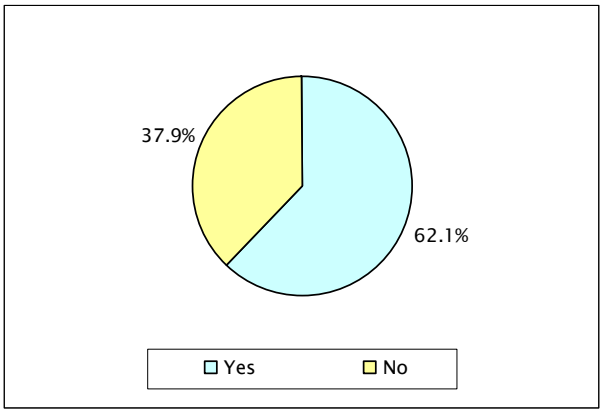
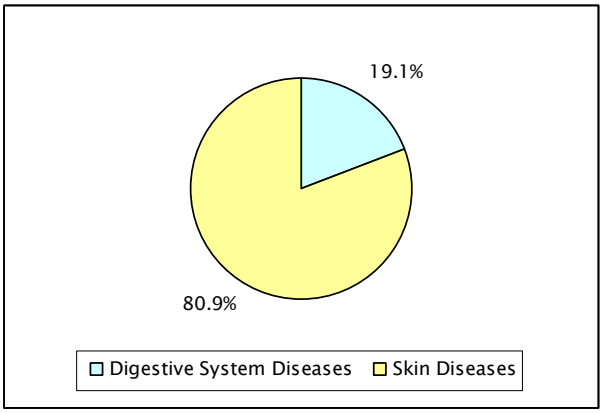


Fig 6-2. Type of Diseases

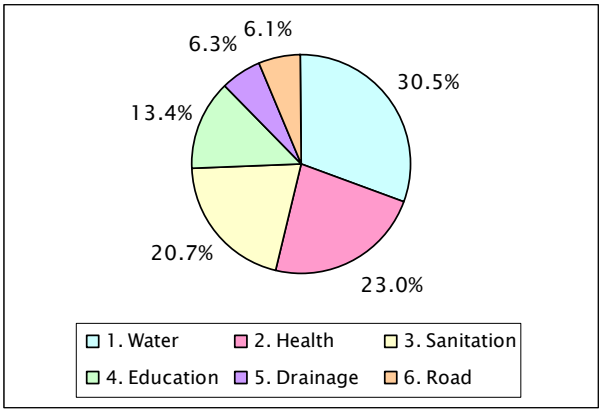


7. Other Analysis on the Community

7-1. Sector Priority Ranking by Community Awareness

The households prioritized 6 sectors including water, health, sanitation, education, drainage and communal road. The ranking is based on cross-multiplication of the priority number and the points. They gave the first priority on water, second on health, third on sanitation and others.

Fig 7-1. Sector Priority Ranking



Pointing

Priority-1 : 6 points

Priority-2 : 5 points

Priority-3 : 4 points

Priority-4 : 3 points

Priority-5 : 2 points

Priority-6 : 1 point

7-2. Tribal and Religious Distributions

There are totally 17 local tribal groups in Liberia, and the community has a large variety of 15 groups. And generally, the main religions are traditional one, Christian and Muslim, 88% are Christians and remaining 12% are Muslims in the community.

Fig 7-2. Tribal Distribution

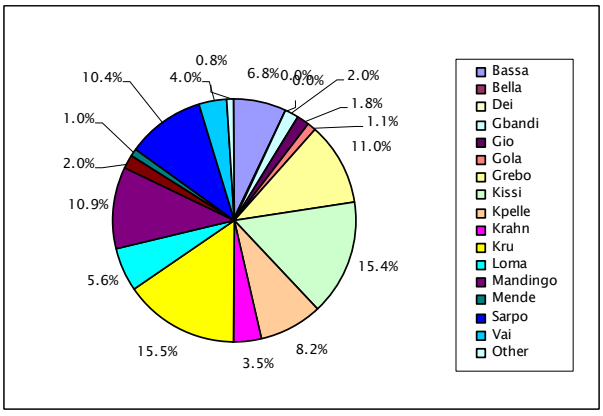
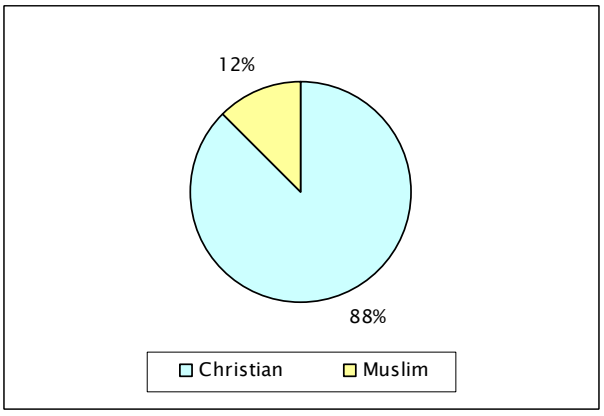


Fig 7-3. Religious Distribution



QUESTIONNAIRE

- SURVEY SHEET -

A

Zone: Gardnersville

Community: MTA

Surveyors: _____

Examiner: _____

The Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia, JICA Study Team

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
No	Household(HH) Head			HH Structure including Head				"Drinking" Water from Handpump Well										
	Name of Head and Interviewee's Signature	Sex	Age	Adult		Underage(<18)		Daily Consumption per HH			One-way Walking Time		Waiting Time at Queue		Frequency		Who fetches?	Used for
				Male	Female	Boy	Girl	Container	Rainy	Dry	Rainy	Dry	Rainy	Dry	Times/Day	When		
1	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
2	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
3	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
4	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
5	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
6	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
7	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
8	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
9	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,
10	Interviewee's Sig.	Male or Female						JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Drinking,

Date of Survey: October, 2009

A

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
No	"Non-Drinkable" Water from Shallow/Dug Well											Other Water Sources (Swamp, River, Truck, Rain-Water, Mineral-Water, etc)		Water-Borne Diseases in Household	
	Consumption per HH/Day			One-way Walking Time		Waiting Time at Queue		Frequency		Who	Used for			Yes	Type of Diesease
	Container	Rainy	Dry	Rainy	Dry	Rainy	Dry	Times/Day	When	fetches?		for Drinking	for Non-Drinking	No	(Diarrhea, Cholera, Scabbies, etc)
1	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
2	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
3	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
4	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
5	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
6	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
7	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
8	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
9	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	
10	JerryCan or ( )	pcs	pcs	min.	min.	min.	min.	Once Twice 3 Times <	am pm both	Male Female Child	Bathing, Washing,			Y or N	

A

No	34 Do you want to use safe water from Kiosk?	35	36 Desirable Drinking Water Consumption per HH/Day			39 "Willingness to Pay" for "Drinking" Water from Kiosk (Whole Year)	40	41	42	43	44	45	46	47	48	49	50	51	52
	Yes No	Reason why Yes or No	Container	Rainy	Dry	General	Reason why Yes or No	In case if one-way walking time is < 5 min.	5-10 min.	> 10 min.	Acceptability of Tariff per 1 JerryCan 1 LD	2 LD	3 LD	4 LD	5 LD	10LD	Available Amount for Safe Water per	Amount	Unit
1	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
2	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
3	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
4	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
5	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
6	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
7	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
8	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
9	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$
10	Y or N		JerryCan	pcs	pcs	Y or N		Y or N	Y or N	Y or N							Day or Month		US$ or L$

A

	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
No	Do you want to use safe water from Kiosk for washing, bathing etc by paying tariff?		Sanitation					Community PriorityRanking by Sector						Ethnic / Tribal Group	Religion
	Y/N	Reason why Yes or No	Public Toilet	Private Pit	Private Flush	Septic Tank	Other	Water	Sani-tation	Health	Edu-cation	Drai-nage	Road		
1	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
2	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
3	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
4	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
5	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
6	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
7	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
8	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
9	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others
10	Y or N		Y or N	Y or N	Y or N	Y or N	Y or N								Christian Muslim Others