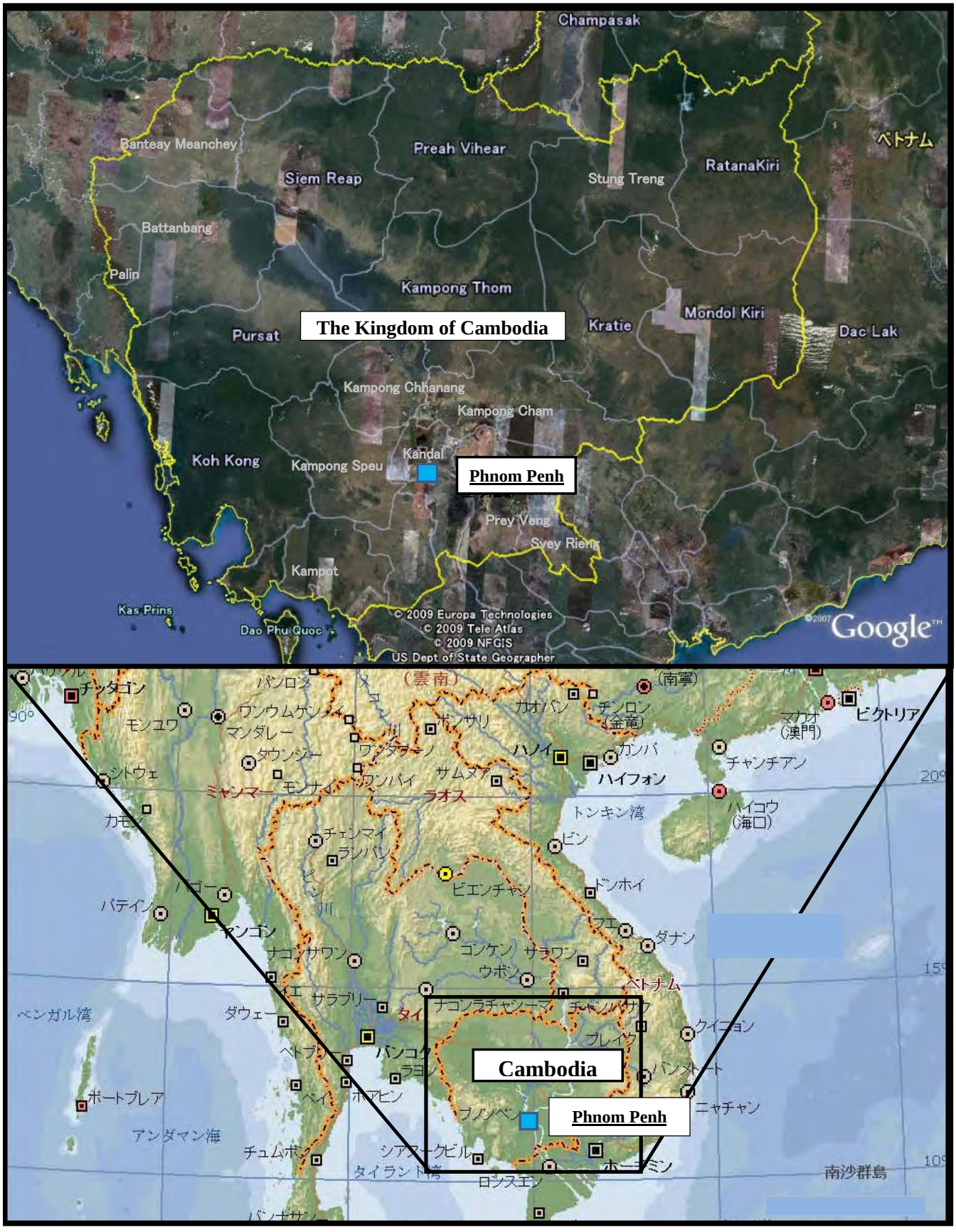
SURVEY
ON
THE WATER SUPPLY SECTOR
IN
THE KINGDOM OF CAMBODIA

FINAL REPORT

JUNE 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CONSULTANTS CO., LTD.
KOKUSAI KOGYO CO., LTD.



Location Map of the Study Area

EXECUTIVE SUMMARY

1. Background and Objective of the Study

For almost two decades now, much has been achieved in the water supply sector in the Kingdom of Cambodia. It has been drastically developed through financial and technical cooperation in both urban and rural areas by numerous donor agencies since the 1990's focusing mainly on Phnom Penh. However, the current access ratio to safe water in Cambodia is still low: 72% in urban areas and only 39.6% in rural areas. Hence, further efforts for improvements in physical infrastructure as well as in capacity and institutional development are needed to achieve the national target of an access ratio to safe water of 80% and 50% in urban areas and rural areas, respectively by 2015.

Since there is no available master plan covering the whole country's water supply sector, the target service area in each province is not clear; therefore the access ratio to the safe water has not improved in a more efficient or systematic manner.

In urban water supply, Japan (JICA) has been supporting urban water supply system development in Phnom Penh and Siem Reap through master plan (M/P) studies and financial assistance. It has also been providing technical cooperation for human resource development in water supply sector targeting Phnom Penh (PPWSA) and DIMEs in eight provincial capitals. As to rural water supply, Japan has been implementing cooperation for drilling deep wells through M/P studies and Grant Aid Assistance as well. These cooperation activities have significantly contributed to the improvement of access to the safe water in Cambodia.

Recognizing the importance of achieving the goal, JICA intends to continue cooperation in the water supply sector in Cambodia. However, in order to secure assistance to maximize benefits and efficiency, it is necessary to formulate strategies to attain sector targets covering urban and rural water supply based on mutual consultation with the concerned Cambodian ministries and donor agencies.

The following are the objectives of this study.

- Data collection and analysis on:
  - ✓ Current status and existing issues in urban and rural water supply sector in Cambodia
  - ✓ Approach to water supply sector by the Cambodian government, donor agencies, private sector and NGOs
- Examination of future assistance needs in urban and rural water supply sector

2. Target Study Area

The study area covers the entire Cambodia (24 provinces) as shown in Location Map.

3. Outline of Cambodia and Provinces

The Kingdom of Cambodia is located southwest of Indochinese Peninsula with a total area of 181,035 km^2. It is bordered by various countries; which are Thailand to the west and northwest, Laos to the north, and Vietnam to the east and southeast. To the south is Thailand Gulf with a coastline of 440 km. The national capital is Phnom Penh.

Cambodia belongs to Tropical Monsoon Climate and a year can be divided into Rainy Season and Dry Season. May to the middle of October is regarded as rainy season and the rest months are the dry season. Throughout a year, temperature and humidity is high and annual average temperature is 25℃. The coldest month is January, while the hottest is April.

According to the statistical yearbook, poverty ratio of 35% in 2004 was reduced to 30.1% in 2007. However this ratio is still high compared with other South-Asian countries. Meanwhile, the national population was rapidly increased from 9.3 million in 1993 to 13.4 million in 2008. Based on the statistical yearbook 2008, the working population in 2007 was 7.8 million. Ninety nine percent (99.3%) of the labor force population is working resulting to a very low unemployment rate of 0.7% (5.2 thousand). In Cambodia, the major industry is agriculture. The country is also rich in tourism resources, hence tourism industry has a great potential for development.

Cambodian GDP in 2009 was 10.8 billion US$ and unit GDP per person was 775 US$.

4. Current Status of Cambodian Water Supply Sector and Development Plan

4.1 Current Status of Urban Area Water Supply

Based on the information collected from MIME, water service rate in urban area was 56% in 2008. This service ratio includes piped water that are not properly disinfected and considered not safe. In some provinces, lake water or groundwater pumped from shallow wells has been supplied without any disinfection.

Table S.1 shows provincial water service rate managed by public or private operators. The service ratio shown in **Table S.1** looks rather larger than the actual one. Theses figures were reckoned by the MIME according to the following formula:

Service Ratio = Number of Connected Households/Total Household Number in Urban Area

Since the number of connected HH in the above formula includes shops, offices and factories, larger ratio was calculated.

The tariff system of public-managed urban water supply system differs by areas. Large-scale urban water system adopts volumetric tariff, while fixed rate is common in small-scaled system.

Table S.1 Current Status of Urban Water Supply by Province

Province		Urban Area *1		Average Number of Household	Number of Waterworks *2			Number of Water Connections *2			Estimated Served Population (person)	Water Service Ratio (%)
		Number of Households	Population (person)		Public	Private	Total	Public	Private	Total		
1	Banteay Meanchey	37,377	181,396	4.85	-	9	9	-	12,973	12,973	62,960	34.7
2	Battambang	36,104	180,853	5.01	1	10	11	8,582	4,701	13,283	66,538	36.8
3	Kampong Cham	25,540	118,242	4.63	1	7	8	4,172	4,408	8,580	39,723	33.6
4	Kampong Chhnang	8,411	43,130	5.13	1	1	2	1,114	-	1,114	5,712	13.2
5	Kampong Speu	10,636	54,505	5.12	-	10	10	-	5,009	5,009	25,669	47.1
6	Kampong Thom	6,760	31,871	4.71	3	1	4	4,033	912	4,945	23,314	73.2
7	Kampot	9,970	48,274	4.84	1	6	7	3,014	3,005	6,019	29,144	60.4
8	Kandal	38,362	195,898	5.11	-	21	21	-	14,329	14,329	73,172	37.4
9	Koh Kong	7,431	36,053	4.85	-	2	2	-	1,713	1,713	8,311	23.1
10	Kratie	7,542	35,964	4.77	1	4	5	1,710	973	2,683	12,794	35.6
11	Mondul Kiri	977	4,859	4.97	-	-	0	-	-	0	0	0.0
12	Phnom Penh	242,974	1,242,992	5.12	1	-	1	190,500	-	190,500	974,549	78.4
13	Preah Vihear	2,155	10,679	4.96	-	1	1	-	477	477	2,364	22.1
14	Prey Veng	7,137	33,079	4.63	1	1	2	1,588	3,247	4,835	22,410	67.7
15	Pursat	5,438	25,650	4.72	1	1	2	3,571	971	4,542	21,424	83.5
16	Ratanak Kiri	3,796	19,317	5.09	1	-	1	557	-	557	2,834	14.7
17	Siem Reap	34,717	174,265	5.02	1	4	5	4,540	1,051	5,591	28,065	16.1
18	Preah Sihanouk	18,775	89,447	4.76	1	3	4	3,458	1,231	4,689	22,339	25.0
19	Stung Treng	3,313	17,022	5.14	1	-	1	1,498	-	1,498	7,697	45.2
20	Svay Rieng	3,632	17,029	4.69	1	3	4	1,459	849	2,308	10,821	63.5
21	Takeo	2,738	14,456	5.28	-	9	9	-	3,823	3,823	20,185	139.6
22	Otdar Meanchey	3,665	18,694	5.10	-	1	1	-	183	183	933	5.0
23	Kep	970	4,678	4.82	-	1	1	-	-	0	0	0.0
24	Pailin	3,290	15,674	4.76	-	1	1	-	1,120	1,120	5,336	34.0
Total		521,710	2,614,027	5.01	16	96	112	229,796	60,975	290,771	1,466,291	56.1

Note: Number of Water Connection in Takeo Province include the number of households in rural area

Source: *1; General Population Census of Cambodia 2008

*2; Potable Water Supply Department, MIME

4.2 Current Status of Rural Water Supply and Sanitation

A new category of classifying "main source of drinking water" was applied in census 2008 for the purpose of differentiating "protected dug well" and "rain" from simple "dug well". The category of main source of drinking water in census 2008 consists of "piped water", "tube/pipe well", "protected dug well", "unprotected dug well", "rain", "spring and river etc.", "bought" and "other". Improved water source consists of pipe water, tube/pipe well, protected dug well and rain water defined by the Ministry of Planning based on the definitions of the Joint Monitoring Program of UNICEF and WHO. **Table S.2** presents the main source of drinking water for most Cambodian households in 1998 and 2008 conducted by the census survey.

Table S.2 Distribution of Households by Main Source of Drinking Water in Rural Areas

Main Source of Drinking Water	1998		2008	
	Number of Households	Percentage (%)	Number of Households	Percentage (%)
Piped Water	27,698	1.5%	102,306	4.4%
Tube/Pipe Well	277,657	15.4%	681,192	29.5%
Protected Dug Well	-	-	127,927	5.5%
Unprotected Dug Well	810,042	45.1%	559,016	24.2%
Rain	-	-	24,292	1.1%
Spring, River, etc	561,220	31.2%	618,579	26.8%
Bought	73,004	4.1%	164,511	7.1%
Other	47,884	2.7%	33,235	1.4%
Total	1,797,505	100.0%	2,311,058	100%

Source：Census 2008

The proportion of households using improved water sources has increased 24 percent compared to 1998, the breakdown of which is that dug well has decreased about 20 percent, and piped water and tube/pipe well have increased 14 and 3 percent respectively. However, said piped water and tube/pipe well are not always "protected water", still, 60% of households in rural areas are using unsafe water. Therefore, service ratio with water quality satisfying Cambodian drinking water standard is assumed to be further lower.

Access to improved sanitation in Cambodia is a mere 18%, which is the lowest of the five countries on the Indochinese Peninsula including Cambodia. A large percentage of its population still practiced open defecation at 75%. The type of toilet facility of the households was investigated in census 2008, the results were: 45% of the households used "septic tank", 28% "connected to sewerage", and 23% used a "pit latrine". Although the proportion of households using improved sanitation has increased by 17% (from 6 to 23.2%) still, the rate is extremely low. Households without toilet were at 77%.

According to the "National Health Statistics Report 2008" by the Ministry of Health, six out of the ten highest ranked diseases were water-borne diseases. This result can be correlated with an improved environment of water supply and sanitation. A close relation with the health sector can be deduced thus, it is important to work towards a solution of these issues with both

sectors involved. **Table S.3** shows the number of cases of water-born diseases.

Table S.3 Number of Cases of Water Born Disease

Diseases	Out-Patient			Inpatient					
				Cases			Deaths		
	No. of cases	Rate*1	Ranking	No. of cases	Rate*1	Ranking	No. of deaths	Rate*1	Ranking
Diarrhea	338,461	4.7%	3	22,688	3.50%	4	283	4.1%	9
Dysentery	253,583	3.5%	4	6,355	0.98%	12	43	0.6%	22
Typhoid	-	-	-	13,241	2.04%	6	223	3.2%	17
Dengue fever	47,748	0.7%	10	12,035	1.86%	7	110	1.6%	8
Malaria	127,347	1.8%	7	11,701	1.80%	8	42	0.6%	32
Cholera	-	-	-	72	0.01%	36	0	0.0%	32
Eyes diseases	126,149	1.8%	8	151	0.02%	33	0	0.0%	27
Skin infection	209,166	2.9%	5	-	-	-	-	-	-
Total	7,158,720			648,329			6922		
Total population	13,338,910								

*1 : This value show a rate in total cases.

Source: National Health Statistics Report 2008, Ministry of Health

4.3 Arsenic Contamination of Groundwater

The Ministry of Rural Development (MRD) has conducted water quality testing supported by UNICEF from 2003 to 2005 in approximately 16,000 tube wells in 16 provinces. As a result, an estimated 320,000 people in 1,607 villages located in 49 districts of 7 provinces: Kandal, Kompong Cham, Kompong Chhnang, Kompong Thom, Kratie, Phnom Penh (peri-urban area) and Prey Veng bordering the Mekong and the Bassac rivers were found to be at risk. In addition, tube well water for arsenic has identified the risk of arsenic contamination in Pailin, western Cambodia.

4.4 Current Status of Water Supply Sector

Work jurisdiction of central government agencies related to water supply sector is shown in **Table S.4**.

Table S.4 Agencies related to Water Supply Sector

Name of Agency	Roles and Functions
Ministry of Water Resources and Meteorology: MOWRAM	Water Resource Management
Ministry of Environment: MOE	Preparation of national environmental management plan and related policies Management of preservation areas and natural sources Environment observation and monitoring Review of EIA
Ministry of Industry, Mines and Energy: MIME	Water supply to urban area Management of hydraulic power station
Ministry of Rural Development: MRD	Water supply to rural area

The urban water supply service is under the jurisdiction of the Department of Potable Water Supply (DPWS) in MIME. The total staff number in MIME is 632 and 29 staffs in DPWS.

MRD was established in 1993 for improving living standards and alleviating rural poverty. The Department of Rural Water Supply (DRWS) and the Department of Health Care (DRHC) both belong to General Department for Technical Affairs of MRD. DRWS is responsible for rural water supply, whereas DRHC is in charge of rural sanitation and hygiene. The total numbers of staffs in DRWS and DRHC are 83 and 56, respectively.

4.5 Development Policy for Water Sector

4.5.1 National Development Policy

The Rectangular Strategy has been formulated as an integrated structure of interlocking rectangles at the first cabinet meeting of the third term in 2004. The four strategic "growth rectangles" are as follows.

- enhancement of the agricultural sector
- further rehabilitation and construction of physical infrastructure
- private sector development and employment
- capacity building and human resource development

In rectangle II "further rehabilitation and construction of physical infrastructure", the following strategies for water resources and irrigation system management are described.

- Cambodia should cooperate with the Cambodian Millennium Development Goals (CMDGs) to promote public access to clean water and sanitation, to ensure safe food and a better life and to endeavor in the conservation of the aquatic environment.
- Cambodia should promote the adequate development and management of irrigation systems and water supply systems by private sector.

(1) Rectangular Strategy for Growth, Employment, Equity and Efficiency Phase II, 26 September 2008

The components of the Rectangular Strategy are as follows:

(i) the core of the Rectangular Strategy is Good Governance, focused on four reform areas: a) fighting corruption; b) legal and judicial reform; c) public administration reform including de-centralization and de-concentration; and d) reform of the Royal Cambodian armed forces.

(ii) the environment for the implementation of the Rectangular Strategy consists of four elements: a) peace, political stability, security and social order; b) Cambodia's integration into the region and the world; c) partnership in development with all stakeholders, including the private sector, donor community and civil society; d) favorable macro-economic and financial environment.

(iii) the four strategic "growth rectangles" are to be referred to the above-mentioned itemizes.

In addition, the Rectangular Strategy phase II was announced by the Prime Minister at the Office of the Council of Ministries on 26 September 2008. It maintains the earlier structure and fine-tunes and prioritized policies of "Rectangular Strategy" of Phase I.

(2) National Strategic Development Plan (NSDP), 2009-2013, November 2009
NSDP 2006-2010 was organized using the Rectangular Strategy framework and supported by CMDGs. Currently, NSDP was extended to 2013 when the new government came into power in July 2008.

(3) Cambodian Millennium Development Goals (CMDGs), November 2003
Cambodia Millennium Development Goals set the following indicators for the water and sanitation sector.

Table S.5 CMDGs Targets for Water and Sanitation Sector

Indicators	1998 (Benchmarks)	2005 (Targets)	2010 (Targets)	2015 (Targets)
Proportion of urban population with access to safe water source (%)	60	68	74	80
Proportion of rural population with access to safe water source (%)	24	30	40	50
Proportion of urban population with access to improved sanitation (%)	49	59	67	74
Proportion of rural population with access to improved sanitation (%)	8.6	12	20	30

4.5.2 Upper Level Plan and Policy for the Water Sector

Table S.6 shows the upper level plan and policies on water sector.

Table S.6 Upper Level Plan and Policies on Water Sector

Name	Outline
Water and Sanitation Sector Financing Strategy for Cambodia, National Water and Sanitation Sector Financing Strategy for Cambodia, Draft Final, March 2010	This strategy's purpose is: (i) to ensure that strategic development plans take into account the whole Water Supply Sector including Rural Water Supply Sector, (ii) to ensure that such plans are financially sustainable and affordable to the population by 2028, and (iii) to ensure increased and more harmonized International Finance Institutions (IFI) and donor assistance.
National Policy on Water Supply and Sanitation、9th June 2000 and 7th February 2003	This policy is comprised of three parts: Part I Urban Water Supply Policy, Part II Urban Sanitation Policy, Part III Rural Water Supply and Sanitation Policy. "Part I Urban Water Supply Policy" has its contents: (i) water supply approaches, (ii) private sector participation, (iii) water tariff, (iv) protecting the poor and subsidies, (v) the autonomy of public utilities, (vi) the water supply regulatory body. "Part III Rural Water Supply and Sanitation Policy" has its sector vision to sustain access to safe water supply and sanitation services and lives in a hygienic environment for every person in rural communities by 2025. Moreover, this part is stipulated role and duty among central and provincial level, Water and Sanitation User Group, private and donors.

4.6 Assistance by the Other Donor Agencies and NGO on the Water Sector

4.6.1 Urban Area Water Supply

Japan (JICA), WB, WSP (Water and Sanitation Program), ADB, UN-HABITAT, AFD are the major assistant country and agencies. Target assistance has been rendered to technical and "soft" component of water supply. As to assistance targeting low income group in urban area, UN-HABITAT and WB have provided assistance to subsidize house connection fees.

4.6.2 Rural Water Supply and Sanitation

Japan (JICA), UNICEF, ADB, IMF are the major assistant country and agencies. UNICEF has been a long term partner in rural water supply and sanitation and hygiene sector in Cambodia since MRD's inception in 1993. It has been conducting a Five Year Country Action Programme named "Seth Koma Programme (2006-2010)" which means community action for child rights. This program is divided into two parts: (i) Local Governance for Child Rights (LGCR) Project, and (ii) Water, Sanitation and Hygiene Project. As the Programme will be completed in June 2010, UNICEF is preparing a next five-year programme (2011-2015), which will support implementation of the strategy for rural water supply, sanitation and hygiene (2010-2025).

ADB has implemented rural water and sanitation projects in 5 provinces around Tonle Sap Lake. Although the initial plan was continued up to 2011 from 2006, the project ended by February 2010 due to inflationary cost increases. ADB has a new assistance plan titled "Second Rural Water Supply and Sanitation Sector Project" which will cover 6 provinces around Tonle Sap Lake and will continue up to 2015.

4.7 Law and Standard

4.7.1 Summary for Legislation

Laws and regulations in the water and sanitation sector in Cambodia are summarized as follows.

(1) Water Legislation

- Draft Water and Sanitation Law of the Kingdom of Cambodia
- Sub-Decree on Water Pollution Control
- Sub-Decree on Solid Waste Management
- Law on Environmental Protection and Natural Rescore Management
- Sub-Decree on Environmental Impact Assessment Process
- Law on Water Resources Management of the Kingdom of Cambodia

(2) Organizational Legislation

- Law on Administrative Management of Capital, Provinces, Municipalities, Districts and Khans (Organic Law)
- Law on Khan/Sangkat Administrative Management

(3) Private Sector Legislation

- Law of Concession

(4) Regulation

- Drinking Water Quality Standards

5. Current Status of Water Supply Sector by Province

As described above, Cambodia has 24 provinces (including Phnom Penh), and each province is different in management form of urban water supply and rural water supply, water conditions, operating conditions of existing facilities, organizational structure and current status regarding donor supports.

The present situation of urban water supply and rural water supply and sanitation are shown in **Table S.7** and **Table S.8**, respectively.

6. Issues in the Water Supply Sector and Development Policy

6.1 National Level Issues

6.1.1 Urban Water Supply

At first, national level issues in urban water supply are extracted and examined. Aside from national level governance issues in water sector and absence of relevant laws and regulations, development of organizational structure for technical level upgrading and maintenance of activity base station is the crucial point for future water supply sector improvement. **Table S.9** shows the summary of national level issues.

Table S.9 Summary of National Level Issues

Categories of Subjects	Detail Description of Subject
A1. National policy, adjustment between related agencies	A1-1. Incompleteness of Master Plan A1-2. Lack of communication between MIME and DIME A1-3. Authorization delegation A1-4. Jurisdiction conflict between MIME and MRD on small-scaled piped water supply A1-5. Lack of governance by the Ministry of Water Resource and Meteorology (MOWRAM) in water source development A1-6. Insufficient coordination among Donor Agencies
A2. Laws and regulations	A2-1. Legislation of water related laws and regulations A2-2. Expiration of water quality standard and fragile water quality inspection structure A2-3. Streamline of license system A2-4. Undeveloped accountant system and obscure accounting
A3. National level technology standard	A3-1. Water quality aggravation in Tonle Sap River Basin A3-2. Limited opportunity for communication and technical training for water supply engineers A3-3. Optimizing of water treatment methods

Table S.7 Present Situation of Urban Water Supply by Province

No.	Province	Capital	Public/Provate	Water Resources	Construction	Capacity (m3/day)	Connection (No. of HH)	Supply Time (hr/day)	Leakage (%)
1	Banteay Meanchey	Sprei Sihpan	Private	River	1998	3,200	5,621	-	20 - 30
2	Battambang	Battambang	Public	River	1963	7,000	8,000	21 - 22	30
3	Kampong Cham	Kampong Cham	Public	Ground Water	2006	4,200	4,205	24	14.2
4	Kampong Chhnang	Kampong Chhnang	Public	River	1939	700	1,119	20 - 24	14
5	Kampong Speu	Chbar Mon	Private	River	1979	1,150	1,447	-	-
6	Kampong Thom	Stung Sen	Public	River	1946	2,000	-	24	-
7	Kampot	Kampot	Public	Lake/Dam	1953	2,447	3,331	18 - 20	-
8	Kandal	Kandal	PPWSA	River	-	-	-	-	-
9	Koh Kong	Koh Kong	Private	Lake/Dam	2000	2,200	1,313	24	-
10	Kratie	Kracheh	Public	Ground Water	1960	-	1,712	15 - 17	29
11	Mondul Kiri	Saen Monouromdeha	No Urban Water Supply System						
12	Phnom Penh	Phnom Penh	PPWSA	River	1959	300,000	-	24	6
13	Preah Vihear	Tobay Meanchey	Private	River	2006	1,920	503	24	-
14	Prey Veng	Kampong Leav	Public	Ground Water	1954	1,300	1,620	20 - 25	16 - 18
15	Pursat	Pursat	Public	River	1994	2,850	3,912	24	21 - 23
16	Ratanak Kiri	Banlung	Public	Lake+G. Water	1995	500	570	12 - 15	19
17	Siem Reap	Siem Reap	SRWSA	Ground Water	1995	9,000	4,500	24	12
18	Preah Sihanouk	Sihanoukville	Public	Lake/Dam	1958	6,551	3,845	24	19
19	Stung Treng	Stung Treng	Public	River	1960	1,200	1,498	12 - 14	26
20	Svay Rieng	Svay Rieng	Public	Ground Water	1995	1,343	1,325	24	19
21	Takeo	Roka Khnong	Private	Lake/Dam	1997	1,300	-	23	20
22	Otdar Meanchey	Samraong	No Urban Water Supply System						
23	Kep	Kep	No Urban Water Supply System						
24	Pailin	Pailin	Private	River	2008	2,800	720	-	-

Source: Questionnaire results conducted by the Study Team

Table S.8 Present Situation of Rural Water Supply and Sanitation by Province

No.	Province	Water Resources (%)					Protected Well (%)	Water Quality Issue	Own Toilet Ratio (%)
		Spring/River	Tubu Well	Dug Well	Bought	Piped Water			
1	Banteay Meanchey	63.3	11.0	10.7			20.2	Arsenic	21.8
2	Battambang	35.5	18.9	23.4			30.2	Iron	36.5
3	Kampong Cham		23.8	39.5	13.9		36.2	Arsenic	22.9
4	Kampong Chhnang	19.8	32.1	35.8			40.2	Arsenic	14.6
5	Kampong Speu	40.9	27.4	14.3			37.5	Arsenic	14.7
6	Kampong Thom	14.9	9.2	62.0			20.8	Arsenic	25.3
7	Kampot	45.9	10.6	30.8			20.9	Iron, Salt	22.8
8	Kandal	41.4	20.6		18.7		33.5	Arsenic,iron,hardnes	40.1
9	Koh Kong			47.6	15.9	11.4	28.7	No data	27.1
10	Kratie	25.3	17.4	25.6			33.4	Arsenic	21.8
11	Mondul Kiri	38.6	23.3	18.3			41.4	Hardness	11.2
12	Phnom Penh	14.4	20.5		39.9		41.6	Arsenic	67.1
13	Preah Vihear	21.4	37.4	31.1			44.5	Arsenic	7.2
14	Prey Veng	8.7	78.8			4.3	85.5	Arsenic,iron,manganese	15.1
15	Pursat	38.7	9.5	33.9			20.9	Arsenic	14.9
16	Ratanak Kiri	53.5	17.3	15.5			27.9	Iron	11.3
17	Siem Reap	12.0	30.9	40.8			43.1	Iron	15.9
18	Preah Sihanouk			54.2		12.0	37.1	Iron	28.8
19	Stung Treng	69.7	18.0	5.2			23.4	Arsenic	26.6
20	Svay Rieng		86.6	3.2		3.8	93.0	Arsenic	19.1
21	Takeo	41.1	25.3	19.6			35.6	Arsenic	23.1
22	Otdar Meanchey	36.5	28.8	13.8			41.7	Arsenic	20.1
23	Kep	40.6	9.3	36.9			20.1	Iron, hardness	25.1
24	Pailin	44.2	10.5		27.3		21.3	Arsenic	34.2

Source: Questionnaire results conducted by the Study Team

6.1.2 Rural Water Supply and Sanitation

Issues in rural water supply and sanitation sector are classified into four groups: (i) policy, system and finance; (ii) organization and human resource development; (iii) project implementation plans and systems; and (iv) locally specific issues. **Table S.10** shows issues in the entire sector and **Table S.11** shows regional specific issues.

Table S.10 List of Issues in the Entire Sector

Classification	Issues
A1. Issues related to policy, system and finance	A1-1: Sustainable implementation of operation and maintenance procedures A1-2: Establishment of supply chains A1-3: Creation of awareness of ownership among villagers A1-4: Development of technical manuals A1-5: Poor availability of sanitation facilities A1-6: Measures to promote devolution A1-7: Review of the water quality management system A1-8: Integration of service level A1-9: Improvement in quality control A1-10: Insufficient sector budget A1-11: Establishment of procedures for the management of Maintenance Fund A1-12: Division of duties in the piped water supply
A2. Issues related to organization and human resource development	A2-1: Capacity development of personnel in the water supply and sanitation sector A2-2: Human resource development in the water supply and sanitation sector A2-3: Clarification of duty division among governmental ministries in the water supply and sanitation sector A2-4: Establishment of multi-sector cooperation for the achievement of CMDGs
A3. Issues related to project implementation plans and systems	A3-1: Construction of an efficient and sustainable information management system A3-2: Verification of the actual proportions of people with access to safe water and improved sanitation A3-3: Opportunities to improve capacity of Provincial Department of Rural Development (PDRD) staff A3-4: Active participation of the private sector A3-5: Nationwide rural water supply master plan A3-6: Increase service ratio by protected water source A3-7: Unsanitary privately-owned wells

Table S.11 List of Issues (Locally specific Issues)

Classification	Regional relevance (Regional characteristics)	Issues
B1. Locally specific issues	B1-1 Developing areas （6 provinces: Preah Vihear, Stung Treng, Ratanak Kiri, Kratie, Mondol Kiri, Kon Kong）	B1-1-1: Prioritizing order of the water supply and sanitation facility development
	B1-2 Areas of poor-quality groundwater (13 provinces: Kratie, Kampong Thom, Kampong Cham, Kampong Chhnang, Prey Veng, Kandal, Pailin, Kep, Takeo, Kampot, Siem Reap and Preah Sihanouk)	B1-2-1: Diffusion of appropriate technology and securing of safe water sources
	B1-3 Areas highly dependent on shallow groundwater (tube wells) (2 provinces: Prey Veng and Svay Rieng)	B1-3-1: Securing of safe water sources
	B1-4 Areas covered by the urban water supply network (1 province: Phnom Penh)	B1-4-1: Provision of water supply facilities to poverty groups
		B1-4-2: Improvement of sanitary environment

6.2 Provincial Level Issues

6.2.1 Urban Water Supply

Issues in urban water supply at provincial level can be roughly categorized into following two items:

- Reduction of un-served area
- Control/supervision of low quality private water supply system

Table S.12 tabulates the technical/managerial subjects of public/private urban water supply system in each province.

6.2.2 Rural Water Supply and Sanitation

The issues at provincial level rural water supply and sanitation sector are included in those at the national level mentioned above. The current state in the 23 provinces, excluding the capital, Phnom Penh, is more or less the same in principle. Even though some issues which were not included in the explanation of PDRDs, provincial level issues have been deduced from available data and provided data. **Table S.13** shows the issues found in each province.

Table S.12 Provincial Level Issues in the Urban Water Supply

Issues in large Category	Issues in detailed Category	Name of Proivinces																							No. of Provinces	Page to be referred
		1 Banteay Meanchey	2 Battambang	3 Kampong Cham	4 Kampong Chhnang	5 Kampong Speu	6 Kampong Thom	7 Kampot	8 Kandal	9 Koh Kong	10 Kratie	11 Mondul Kiri	12 Phnom Penh	13 Preah Vihear	14 Prey Veng	15 Pursat	16 Ratanak Kiri	17 Siem Reap	18 Preah Sihanouk	19 Stung Treng	20 Svay Rieng	21 Takeo	22 Otdar Meanchey	23 Kep	24 Pailin		
B1. Issues in Urban Water Supply System Development	B1-1-1 : Un-served areas in urban water supply area												No remarkable issues were recognized													9	p5-14
	B1-1-2 : Virtually non-existent un-served area treduction																									3	p5-14
	B2-1-1 : Obscure authority of DIME for private WSS																									3	p5-14
B2 : Issues on Private System Management	B2-1-2 : Supervisory capacity shortage in private system																									8	p5-15
	B2-1-3 : Technical capacity shortage																									15	p5-15
	B2-2-1 : Vague contract contents/items																									4	p5-15
C1 : Issues on Public System Management	C1-1-1 : Improper procurement and inventory control of equipment and																									2	p5-16
	C1-1-2 : Technical capacity shortage of staff																									4	p5-16
	C1-2-1 : Shortage of management capacity																									1	p5-16
	C1-2-2 : Imbalanced investment to WTP and distribution system																									2	p5-16, 17
	C1-2-3 : Undeveloped fund procurement system																									1	p5-17
	C1-2-4 : Need for improvement in water sales income																									3	p5-17
C2 : Issues on Suppled Water Quality	C2-1-1 : Functional issues of WTP																									6	p5-17
	C2-2-1 : Insufficient water source capacity and water quality deterioration																									4	p5-18
	C2-2-2 : Imprudent development in upstream area of water source																									3	p5-18
C3 : Issues on Water Supply Amount	C3-1-1 : Shortage of distribution network capacity																									8	p5-18, 19
	C3-2-1 : Water leakage from deteriorated pipes																									5	p5-19
	C3-2-2 : Water leakage caused by inferior construction																									2	p5-19
	To be improved	2	1	2	2	3	3	4	1	2	3	1	0	3	4	2	**3**	0	3	1	2	2	1	1	1		47
	Serious Issues	1	4	2	5	0	1	3	1	2	2	0	0	1	2	3	1	0	1	2	2	1	1	0	1		36
	Page to be referred	p4-3	p4-13	p4-24	p4-35	p4-49	p4-59	p4-71	p4-84	p4-92	p4-101	p4-114	p4-122	p4-133	p4-142	p4-152	p4-167	p4-176	p4-188	p4-202	p4-212	p4-225	p4-235	p4-243	p4-251		

Legend To be improved **Serious Issues**

Table S.13 Provincial Level Issues in the Rural Water Supply and Sanitation

Classification	Issues	Province																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Banteay Meanchey	Battambang	Kampong Cham	Kampong Chhnang	Kampong Speu	Kampong Thom	Kampot	Kandal	Koh Kong	Kratie	Mondul Kiri	Phnom Penh	Preah Vihear	Prey Veng	Pursat	Ratanak Kiri	Siem Reap	Preah Sihanouk	Stung Treng	Svay Rieng	Takeo	Otdar Meanchey	Kep	Pailin
Promotion of rural water supply and sanitation	A: Existence of areas with no rural water supply system	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■		■	■	■	■
	B: Insufficient of measures to solve the problems of lack of rural water supply									■	■	■					■			■					
	C: Existence of areas with no rural sanitation facilities	■		■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	
	D: Insufficient measures to solve the problem of lack of the rural sanitation			■				■	■	■	■	■		■			■		■			■		■	■
Water sources	A: Existence of areas with risk of arsenic contamination at groundwater sources			■	■		■		■		■		■		■										■
	B: Existence of areas with poor quality ground water sources	■	■					■										■	■			■		■	
	C: Unknown ground water potencial	■	■				■	■		■	■	■		■		■	■	■	■	■			■	■	■
	D: Dependence on unsanitary surface water	■				■		■	■								■			■		■		■	■
	E: Dependence on private owned wells			■											■						■				
	F: Water sources located far from houses	■				■		■		■	■	■	■	■		■	■	■	■	■		■	■	■	■
System and technology for rural water supply maintenance and administration	refer to the Section 5.2.2, (2), 3) in the Main Report	The current state in the 23 provinces, excluding Phnom Penh, is more or less the same issues																							
Total number of provinces having issues		**4**	**3**	**5**	**3**	**4**	**4**	**7**	**5**	**6**	**7**	**5**	**3**	**4**	**3**	**4**	**6**	**5**	**6**	**5**	**2**	**6**	**3**	**6**	**6**
Number of serious issue(s)		**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**

Legend: ■: Issue ■: Serious issue

6.3 Urban and Rural Water Supply System Development

6.3.1 Current Water Demand and Future Demand Projection

(1) Current water demand

Cambodian water demand has been increasing owing to its urbanization and population growth and current water demand is larger than water supply amount. As a result, temporal water supply is popular in urban water supply and in case of rural water supply, they use unsanitary water not suitable for potable use, such as river water and pond water, when regular water source, represented by groundwater is not available.

(2) Future water demand projection

Future water demand is anticipated to increase due to development of national socio-economic activities and population growth. Setting target year in 2025, future water demand was projected for urban and rural water supply system. Water demand projection was carried out based on the unit water consumption rate and estimated population of urban and rural area in 2025.

1) Unit water consumption rate setting

Unit water consumption rates of 120L/capita/day and 40L/ capita/day are applied to urban water supply and rural water supply, respectively.

2) Future water demand projection

Urban and rural population projections in 2025 were estimated based on the annual average population growth rate of national census in 2008. **Table S.14** shows the calculation results of province-wise urban and rural water demand projections.

6.3.2 Urban and Rural Water Supply System Development and Expansion

Examination on orientation on urban and rural water supply system development is carried out based on the following policies:

(1) Policy in classification of urban area and rural area

Although there are three criteria to identify whether the target area is an urban area or rural area, established by the Ministry of Planning based on the 2008 national census, one criterion that "Percentage of male agricultural worker is less than 50%" was excluded and the following two criteria were chosen for this purpose.

① Commune population density exceeds 200 person/km^2

② Total commune population surpasses 2,000 persons

(2) Policy in selection of applicable water supply system types

The following six types of water supply systems (refer to **Table S.15**) are recommendable for safe water supply:

Table S.14 Water Demand Projection

		Water Demand (m3.day)								
		Present			Projection		Breakdown			
		Urban 120 lpcd	Rural 40 lpcd	Total	Urban (a) 120 lpcd	Rural (b+c) 40 lpcd	Urban --> Urban (a) 120 lpcd	Rural --> Urban (b) 40 lpcd	Rural --> Rural (c) 40 lpcd	Total (a+b+c)
		2008	2008	2008	2025	2025	2025	2025	2025	2025
1	Banteay Meanchey	21,768	19,859	41,627	35,506	23,918	35,506	4,483	19,435	59,425
2	Battambang	21,702	33,773	55,475	22,490	53,803	22,490	23,575	30,228	76,293
3	Kampong Cham	14,189	62,470	76,659	14,310	67,539	14,310	40,037	27,502	81,849
4	Kampong Chhnang	5,176	17,168	22,344	5,474	21,456	5,474	7,425	14,031	26,930
5	Kampong Speu	6,541	26,498	33,038	8,092	36,126	8,092	27,333	8,793	44,218
6	Kampong Thorn	3,825	23,982	27,806	3,923	28,786	3,923	6,629	22,157	32,710
7	Karnpot	5,793	21,503	27,296	6,930	25,724	6,930	16,498	9,227	32,655
8	Kandal	23,508	42,775	66,283	38,408	54,180	38,408	50,803	3,377	92,588
9	Koh Kong	4,326	3,257	7,583	3,358	3,806	3,358	0	3,806	7,164
10	Kratie	4,316	11,330	15,646	4,243	16,457	4,243	1,482	14,975	20,700
11	Mondul Kiri	583	2,250	2,833	1,062	4,534	1,062	0	4,534	5,597
12	Phnorn Penh	149,159	3,385	152,544	233,835	8,236	233,835	8,236	0	242,071
13	Preah Vihear	1,281	6,418	7,700	2,153	11,787	2,153	115	11,672	13,940
14	Prey Veng	3,969	36,572	40,541	3,553	36,759	3,553	20,895	15,863	40,311
15	Purs at	3,078	14,860	17,938	2,793	16,988	2,793	3,915	13,073	19,780
16	Ratanak Kiri	2,318	5,246	7,564	5,207	10,302	5,207	191	10,110	15,508
17	Siern Reap	20,912	28,887	49,799	50,150	40,180	50,150	14,879	25,301	90,330
18	Preah Sihanouk	10,734	5,278	16,012	19,417	7,743	19,417	1,860	5,883	27,160
19	Stung Treng	2,043	3,786	5,829	2,489	6,918	2,489	0	6,918	9,408
20	Svay Rieng	2,043	18,630	20,674	2,050	18,917	2,050	8,613	10,304	20,968
21	Takeo	1,735	33,218	34,953	1,908	37,211	1,908	30,182	7,029	39,119
22	Otdar Meanchey	2,243	6,685	8,928	2,175	14,140	2,175	785	13,355	16,316
23	Kep	561	1,243	1,804	726	1,833	726	1,833	0	2,558
24	Pailin	1,881	2,192	4,073	1,437	5,160	1,437	1,837	3,323	6,597
Total		313,683	431,266	744,949	471,689	552,504	471,689	271,606	280,898	1,024,194

Table S.15 Recommended Water Supply System Types

Category	Type	System Composition and Explanation
Urban Water Supply	U-I Type	Mainly served by private system. Support is offered to upgrade the service level
	U-II Type	Direct assistance on public system. Expand the service area by system improvement and expansion, water source development and water leakage reduction
	U-III Type	To be adopted in areas where water supply service is still not fully developed in spite of sufficient target service population. F/S for urban water supply system is needed.
Village Water Supply	R-I Type	Small piped water supply facilities operated by community
	R-II Type	Tube well operated by community
	R-III Type	Rain season: Rainwater collection tank, Dry season: Community pond, surface water and water treatment equipment at household level

(3) Design service area plan

Provincial-wise design service area plans are prepared based on the aforementioned conditions. As a result, breakdown of commune water supply system in target year of 2025 is shown in **Table S.16**.

Table S.16 Number of Communes by recommended Water Supply System（2025）

Number of Communes in 2008		Number of Communes in 2025	
Urban Area	162	Urban（Existing Urban Areas）	162
		Urban（Areas in transition to urban）	651
		Urban Total	813
Rural Area	1,459	R-I Type	63
		R-II Type	607
		R-III Type	138
		Rural Total	808
Urban＋Rural Total	1,621	Urban＋Rural Grand Total	1,621

6.3.3 Issues in Water Supply System Development

(1) Identify the areas where future water service stress generation is anticipated

In Cambodia, public system has been developed only specific areas such as provincial capital and important cities with high economical efficiency and other surrounding areas and small-scaled towns have been served by private system. Needless to mention, private system is one of the foundation for safe water supply but they apt to eager on promotion in service area and water sales expansion, instead of service quality upgrading. Aggressive support and proper regulation shall be applied to such private utility to let them voluntarily improve their supply water quality.

Many rural areas which are in transition to urban but not yet served by water supply system were found during this survey. These areas are supposed to face water service stress in the near future. As it usually takes 10 years to develop urban water supply system, field surveys need to be conducted as soon as possible to grasp the current situation for designing the optimum system.

(2) Evaluation of surface water intake

Surface water is introduced to most of urban water supply system and water level degradation, water quality deterioration and supply amount shortage due to water demand increase are universal issues during dry season. Further, if deregulated water source development in upstream of water source is added, whole urban system functions might be ceased.

Water source securement is the most serious external risk beyond control. Though water source development is one of the countermeasures to solve water source shortage, confirmation of water use in whole catchment area and preparation of stake adjustment scheme to maintain water intake function is the top priority item. If water source shortage is unavoidable, water leakage reduction program shall be conducted in parallel to mitigate the adverse effect on water supply service.

(3) Elucidation of Nationwide Groundwater Development Potential

Groundwater development potential database gives the information on the location and the potential groundwater yield of groundwater development areas. Therefore, it is quite important to promote efficient and effective water supply development program.

(4) Diffusion of appropriate technology in the areas where groundwater development is difficult

In the following areas, groundwater development is difficult due to arsenic contamination and saline water intrusion:

- Areas along with Mekong and Tonle Sap River
- Some areas in southern provinces
- Coastal areas

Therefore residents must rely on the surface water but it shall be properly treated. Although household filter water treatment device is common in rural areas in Cambodia, it is not applicable to the processing of raw water in large volume due to its low treatment capacity.

Application and diffusion of the suitable level of water treatment technology according to the locality, in other words, application and diffusion of the water treatment devices from household level to community level is desirable for stable and sustainable water supply.

7. Examination on Assistance Needs

7.1 Examination in Priority Order

7.1.1 Criteria Setting

Upon setting of priority project selection criteria, extracted iuues in water supply sector shall be examined to ensure a steady water service rate increase in urban and rural water supply. Criteria shall be settled for urban and rural system, respectively.

(1) Urban Water Supply

The following items are proposed as national-wide criteria for the selection of prioritized urban water supply projects to accelerate the service ratio:

① Size of served population in 2008
② Size of un-served population in 2025
③ Possibility in urbanization, namely development in infrastructure, industrial estate and tourism resource
④ Urgency in water supply system development

(2) Rural Water Supply

Criteria for prioritization of rural water supply facilities at provincial level are set up as described below in consideration with “Part 3: Rural Water Supply and Sanitation Policy, National Policy on Water Supply and Sanitation” which prioritizes “poor, underserved communities and/or areas where there is high prevalence of water and sanitation-related disease”.

① Poverty score
② Un-served population by protected water source
③ Mortality rate by diarrhea

7.1.2 Examination on Priority Order

Priority order is determined by the total points based on the points weighted by criteria.

(1) Urban Water Supply

Based on the grading points, urban water supply development priority order was determined. **Table S.17** shows the priority order and **Figure S.1** illustrates the location of provinces colored by priority orders.

Table S.17 Urban System Development Priority Order

Priority Order		Province Name
First Priority Group (7 provinces)	First Priority 4 Provinces	Battambang, Kampong Cham, Preah Sihanouk, Banteay Meanchey
	Project is on-going 3 provinces	Phnom Penh, Kandal, Siem Reap
Second Priority Group (8 provinces)	First Priority 6 Provinces	Kampong Chhnang, Kampong Speu, Kampong Thom, Kampot, Pursat, Prey Veng
	Project is on-going 2 provinces	Mondul Kiri, Ratanak Kiri
Third Priority Group (6 provinces)		Koh Kong, Kratie, Stung Treng, Svay Rieng, Takeo, Pailin
Fourth Priority Group (3 provinces)		Otdar Meanchey, Kep, Preah Vihear

(2) Rural Water Supply

Based on the grading points, rural water supply development priority order was determined. **Table S.18** shows the priority order and **Figure S.2** illustrates the location of provinces colored by priority orders.

Table S.18 Prioritizations for Rural Water Supply Facilities

Priorities	Province
First priorities group	7 provinces : Kampong Cham, Mondul Kiri, Kratie, Preah Vihear, Ratanak Kiri, Stung Treng, Takeo
Second priorities group	12 provinces : Banteay Meanchey, Battambang, Kampong Chhnang, Kampong Speu, Kampong Thom, Kampot, Kandal, Prey Veng, Pursat, Siem Reap, Otdar Meanchey, Kep
Third priorities group	4 provinces：Koh Kong, Preah Sihanouk, Svay Rieng, Pailin
Fourth priorities group	1 province：Phnom Penh

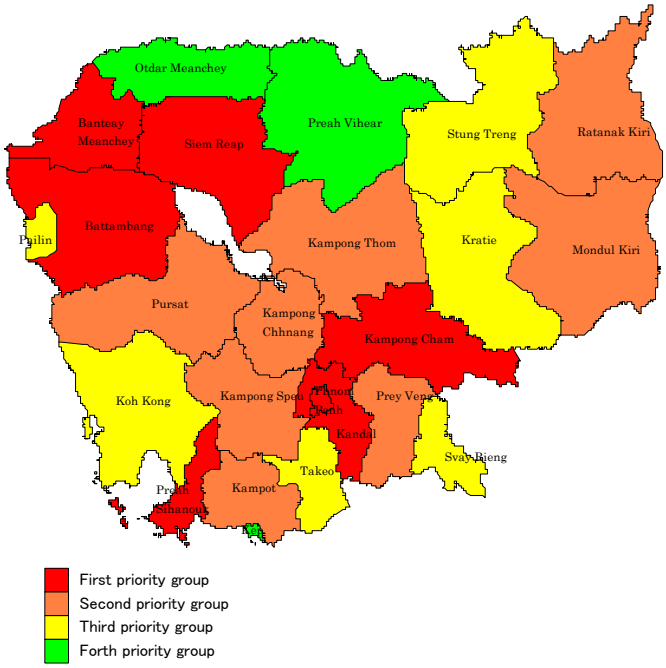
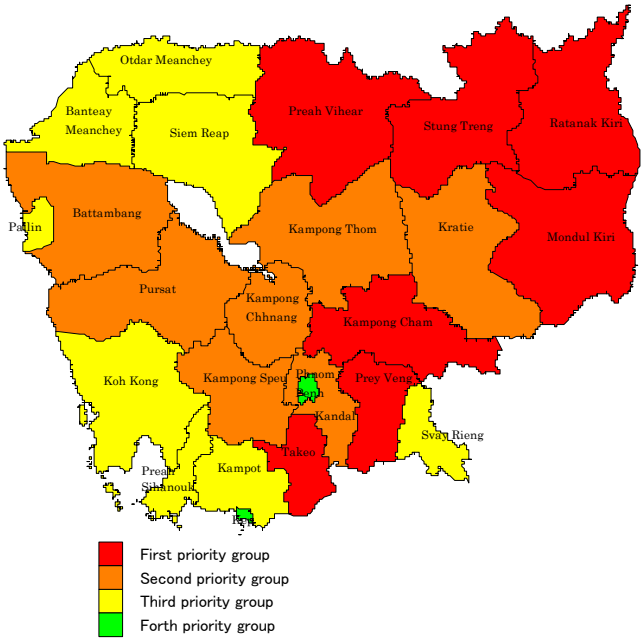


Figure S.1 Urban System Development Priority Order by Province



FigureS.2 Rural System Development Priority Order by Province

7.2 Potentials of PPP Application to Water Supply Projects

(1) PPP Application Policy in Cambodia

BOT method has been applied in relatively large-scaled urban water supply projects. The

capital of Takeo province was implemented by the same method. The action plan of MIME for the period of 2009 to 2013 specifies the policy of project promotion by private sector, through an application of BOT, DBL or OBA methods. The followings are the proposed PPP application policy in this study:

- Newly building or expansion of urban system: BOT/DBL method
- House connection aid for low income group: OBA method（Loan or Grant）

(2) Proposed PPP Application Method

1) Applicable projects

In case of urban system, target water utilities are public water utility as stable management is dully expected. Other utilities which have management policies similar to those of public utilities are also eligible. Further, low income group areas are applicable as these areas have great possibility in contributing to water service ratio improvement.

2) Proposed PPP methods and projects

As to project execution methods for new urban water supply system development or system expansion project, excluding those utilizing the central government's fund, application of BOT method, DBL method and OBA method which have been applied in several projects is deemed to be effective.

Aside from assistance by PPP, Two Step Loan in which the private sector can bestow the fund offered by donor agencies through the central government is another option. This method is applicable as fund procurement measure on project execution by private sector in second or third-scaled local cities.

(3) Provinces having Potentials in PPP Application

① Provinces served by less matured public system

As to five or six provinces including Battambang, Pursat and Kampot, which are evaluated as first priority group, private fund investment by allocation of part of fund to management right or to stock of Government Corporation is possible.

② Provinces served by non self-sustaining private system

Provinces such as Banteay Meacnhey, Kampong Speu and south-east provinces have high population density and many small-scaled private systems.

③ Provinces have needs for water supply service but not yet served

Provinces located near to the national border of Thailand such as Preah Vihear, Otdar Meanchey and north Siem Reap, have many communes where urban system has not been developed even if the needs for water supply service is high.

7.3 Study on Comprehensive Priority

7.3.1 Human Resource Development and Organizational Strengthening for Urban System

Proposed implementation time frame of the assistance needs, implementation for human resource development and organizational strengthening for urban water supply system management are classified into short, medium and long term as shown in **Table S.19**.

Table S.19 Time Frame for Implementation of Assistance Needs (Urban)

Assistance Needs Classification	Short Term	Medium Term	Long Term
Assistance needs-1: Organization strengthening program for sustainable management	O	O	
Assistance needs-2: Formulation of water source management database		O	O
Assistance needs-3: Capacity building program for water quality monitoring and water quality analysis		O	O
Assistance needs-4: Program for urban water supply system master plan establishment	O		
Assistance needs-5: Private water supply system promotion program	O	O	O
Assistance needs-6: Program for appropriate technology introduction and engineering manual preparation	O	O	

7.3.2 Human Resource Development and Organizational Strengthening for Rural Water Supply

Proposed implementation time scale of the assistance needs, implementation for human resource development and organizational strengthening for in rural water supply system management are classified into short, medium and long term as shown in **Table S.20**.

Table S.20 Time Frame for Implementation of Assistance Needs (Rural)

Assistance needs	Short term	Middle term	Long term
Needs-1：Program for enhancement of sustainable operation and maintenance (O&M) system	O		
Needs-2：Program for establishment of data base for groundwater management	O	O	
Needs-3：Program for enhancement in capability of the local administration staff		O	O
Needs-4：Program for building of water quality monitoring and an observation system		O	O
Needs-5：Development of appropriate technology and technical manuals	O		
Needs-6：Capacity building of water supply and sanitation		O	O
Needs-7：Program for development of nationwide rural water supply master plan	O	O	
Needs-8：Program for improvement of hygiene awareness and environment	O		

7.4 Conclusion and Recommendations

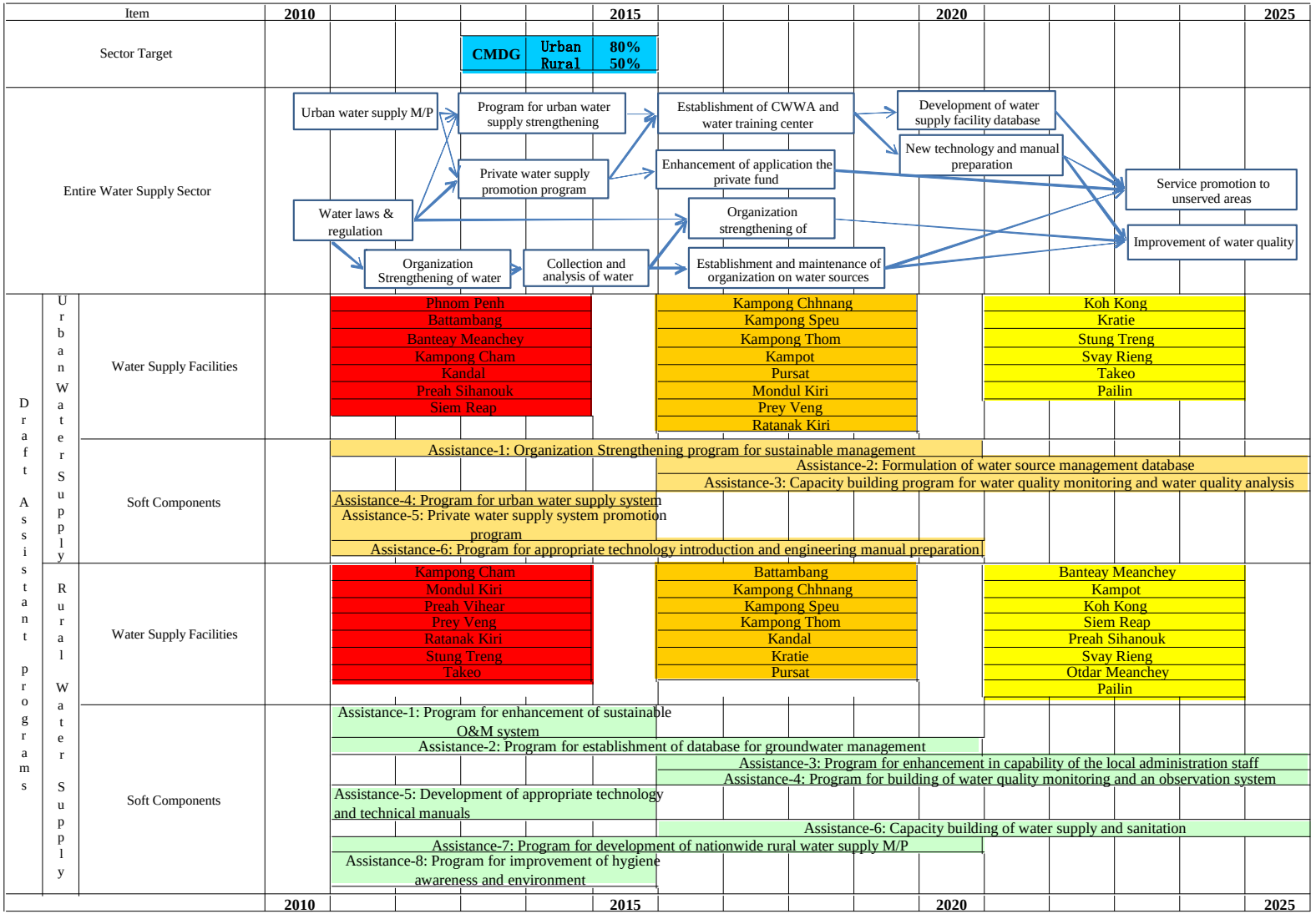
Consolidating the draft assistance needs by urban/rural water supply system development and soft component, a draft road map shown in **Table S.21** is prepared. Though actual project/ program implementation period differs according to their scale and contents, a uniform period of four years is adopted herein. Based on the draft road map, the followings are proposed as applicable assistance option by donor agencies:

- Assistance program on technology transfer or human resource development for urban and rural water supply system in single province
- Assistance program on technology transfer or human resource development for urban and rural water supply system in plural provinces contained in one package
- Assistance program on technology transfer and human resource development for urban or rural water supply system in single province

The followings are the temporally goal suggested by this study:

- Utilizing this draft road map, promote the water supply system development supported by donor agencies
- Achieve the water supply and sanitation facility service ratio specified in Millennium Development Target
- Maintain appropriate and sustainable system development to serve safe and stable water to citizens as much as possible

Table S.21 Road Map of Assistance Needs Program by Urban and Rural Water Supply Sector (Draft)



FINAL REPORT

Study Area
Executive Summary
Table of Contents
List of Tables
List of Figures
Abbreviations

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOES

ABBREVIATIONS

ADB	:	Asian Development Bank
AFD	:	Agency of France for Development
BOT	:	Build Operate Transfer
CMDG	:	Cambodian Millennium Development Goals
CWWA	:	Cambodian Waterworks Association
D&D	:	Decentralization and Deconcentration
DBO	:	Design Build Operate
DIME	:	Department of Industry, Mines and Energy
DRHC	:	Department of Rural Health Care
DRWS	:	Department of Rural Water Supply
EIA	:	Environmental Impact Assessment
F/S	:	Feasibility Study
GDP	:	Gross Domestic Products
IEIA	:	Initial Environmental Impact Assessment
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
JMP	:	Joint Monitoring Program
MIME	:	Ministry of Industry, Mines and Energy
MOE	:	Ministry of Environment
MOH	:	Ministry of Health
MOI	:	Ministry of Interior
MOWRAM	:	Ministry of Water Resources and Meteorology
MRD	:	Ministry of Rural Development
MEF	:	Ministry of Economic and Finance
NTU	:	Nephelometric Turbidity Unit
NSDP	:	National Strategic Development Plan
OBA	:	Output Based Aid
O&M	:	Operation and Maintenance
PDA	:	Provincial Department of Agriculture
PDRD	:	Provincial Department of Rural Development
PE Pipe	:	Polyethylene Pipe
PIF	:	Provincial Investment Fund
PPP	:	Public-Private-Partnership
PPWSA	:	Phnom Penh Water Supply Authority
PRDC	:	Provincial Rural Development Committees
PVC	:	Polyvinyl Chloride Pipe
RO	:	Reverse Osmosis
SRWSA	:	Siem Reap Water Supply Authority

UNDP	:	United Nations for Development Program
UNICEF	:	United Nations Children's Fund
WB	:	World Bank
WHO	:	World Health Organization
WSP	:	Water and Sanitation Program
WSUGs	:	Water and Sanitation User Groups
WTP	:	Water Treatment Plant

Chapter 1
Background and Outline of the Study

Chapter 1 Background and Outline of the Study

1.1 Background

For almost two decades now, much has been achieved in the water supply sector in the Kingdom of Cambodia. It has been drastically developed through financial and technical cooperation in both urban and rural areas by numerous donor agencies since the 1990's focusing mainly on Phnom Penh. However, the current access ratio to safe water in Cambodia is still low: 72% in urban areas and only 39.6% in rural areas. Hence, further efforts for improvements in physical infrastructure as well as in capacity and institutional development are needed to achieve the national target of an access ratio to safe water of 80% and 50% in urban areas and rural areas, respectively by 2015.

In water supply, the Ministry of Industry, Mines and Energy (MIME) is responsible for water supply for piped network and the Ministry of Rural Development (MRD) for non-piped network, respectively (A system managed by a commune is under the jurisdiction of MRD). Actual services are undertaken by two corporations, 15 MIME's provincial offices and about 300 private service providers (80 out of 300 are vested the license by MIME) and Department of Rural Water Supply (DRWS) of MRD. However, there is no development plan covering the whole of water supply sector and the jurisdictions of individual water supply systems are not clear. Therefore, the access ratio to safe water is not improved in a planned manner and efficiently as a result.

In the urban water supply, Japan has been supporting urban water supply development in Phnom Penh and Siem Reap through development studies and financial assistance and also providing technical cooperation for human resource development in the water supply sector targeting Phnom Penh and eight provincial capitals. As to rural water supply, Japan (JICA) has been implementing deep well development through development studies and grant aid assistance as well.

Although JICA will provide technical cooperation aggressively in future towards the improvement of an access to safe water through the cooperation program of "Improvement of Access to Water", it is necessary to implement cooperation systematically by clarifying the development issues in the whole of water sector and their priorities to upgrade the cooperative impact and efficiency.

1.2 Objectives of the Study

The objectives of the Study are as follows:

- Current situation analysis of urban and rural water supply in Cambodia and identification of their problems.
- Collection and analysis of information on the Cambodian Government, donor agencies, private sectors and NGOs involved in the water supply
- Study on the future cooperation needs for the whole water supply sector including both urban and rural water supply

1.3 Target Study Area

The study area covers the entire Cambodia (24 provinces).

1.4 Study and Personnel Schedule

The manning schedule and the Study Team is shown in **Table 1.4.1**.

Table 1.4.1 Manning Schedule

	Position	Name	Organization	2010 1	2	3	4	5
Field Survey	**Chief Consultant/Water Supply Planning 1**	**Hirofumi SANO**	NJS	2/2	65(2.17)		4/7	
	Water Supply management/Capacity Building	**Takeshi NAKANO**	KKC	2/2	65(2.17)		4/7	
	Water Supply Planning 2	**Takeo YAMAGUCHI**	NJS	2/2	65(2.17)		4/7	
	Rural Water Supply Planning	**Takeshi YOSHIKAWA**	KKC	2/2	65(2.17)		4/7	
Work in Japan	**Chief Consultant/Water Supply Planning 1**	**Hirofumi SANO**	NJS	7(0.23)			21(0.70)	
	Water Supply management/Capacity Building	**Takeshi NAKANO**	KKC				20(0.67)	
	Water Supply Planning 2	**Takeo YAMAGUCHI**	NJS	7(0.23)			15(0.50)	
	Rural Water Supply Planning	**Takeshi YOSHIKAWA**	KKC				15(0.50)	
Report				IC/R			DF/R	F/R

1.5 Visiting Schedule to All Provinces of Cambodia

The study area is the entire Cambodia and the Study Team carried out the field survey to all the twenty-four (24) provinces of the country to collect the information on the current situation of urban and rural water supply sectors and to identify their problems in the following manner.

Conduct interviews with some representatives of the villages. Two study team members were each assigned to take charge of the urban and rural water supply system. Field survey was conducted as shown in the following approach.

- Field survey was conducted by the two teams covering the eastern and western areas, separately.
- Each team was composed of urban and rural water supply experts.
- Each province was visited twice with the following purposes.

  First: Explanation on the objectives of the Study, confirmation of the current situation and request for the questionnaire survey and preparation of the relevant information; and

  Second: Collection of the information requested and confirmation of additional information

In relation to the study on the urban and rural water supply, it is necessary to define “Urban

Area" and "Rural Area" first. According to MIME, the following are the definition of an Urban Area, which is the same as those used in 2008 Census, and the rest are considered as a Rural Area.

＜Definition of Urban Area＞

- Population Density: More than 200 person/km^2
- Population in a Service Area: More than 2,000 persons
- Male Working Rate in Agriculture: less than 50%

Table 1.5.1 shows the field survey schedule in Cambodia.

Table 1.5.1 Visiting Schedule to All Provinces in Cambodia

No.	Date		Activities	
			Team A	Team B
1	2-Feb	tue	Travel (Japan to Phnom Penh)	
2	3-Feb	wed	Meeting, courtesy call at JICA/MIME	
3	4-Feb	thu	Explanation and discussion on IC/R	
4	5-Feb	fri	Meeting and data collection at MIME, MRD, etc.	
5	6-Feb	sat	Meeting and data collection at MIME, MRD, etc.	
6	7-Feb	sun	Travel (Phnom Penh to Prear Vihear)	Travel (Phnom Penh to KG Chhnang)
7	8-Feb	mon	Field survey at Prear Vihear	Field survey at KG Chhnang
8	9-Feb	tue	Field survey at Prear Vihear, travel to Stung Treng	Field survey at KG Chhnang, travel to Pursat
9	10-Feb	wed	Field survey at Stung Treng	Field survey at Pursat
10	11-Feb	thu	Field survey at Stung Treng, travel to Ratanakiri	Travel to Pailin, field survey at Pailin
11	12-Feb	fri	Field survey at Ratanakiri	Field survey at Pailin
12	13-Feb	sat	Travel to Kratie	Field survey at Pailin, travel to Battambang
13	14-Feb	sun	Collected data analysis	Collected data analysis
14	15-Feb	mon	Field survey at Kratie	Field survey at Battambang
15	16-Feb	tue	Field survey at Kratie, travel to Mondulkiri	Field survey at Battambang
16	17-Feb	wed	Field survey at Mondulkiri	Travel to B. Meanchey, field survey at B. Meanchey
17	18-Feb	thu	Field survey at Mondulkiri, travel to KG Cham	Field survey at B. Meanchey, travel to O. Meanchey
18	19-Feb	fri	Field survey at KG Cham	Field survey at O. Meanchey
19	20-Feb	sat	Field survey at KG Cham, travel to Phnom Penh	Field survey at O. Meanchey, travel to Siemriep
20	21-Feb	sun	Travel to Svay Rieng	Collected data analysis
21	22-Feb	mon	Field survey at Svay Rieng, travel to Prey Veng	Field survey at Siemriep, travel to KG Thom
22	23-Feb	tue	Field survey at Prey Veng, travel to Phnom Penh	Field survey at KG Thom
23	24-Feb	wed	Travel to Kep, field survey at Kep	Field survey at KG Thom, travel to KG Spue
24	25-Feb	thu	Field survey at Kep, travel to Takeo	Field survey at KG Spue
25	26-Feb	fri	Field survey at Takeo, travel to Phnom Penh	Field survey at KG Spue and Koh Kong
26	27-Feb	sat	Collected data analysis	Field survey at Koh Kong, travel to Sihanouk
27	28-Feb	sun	Collected data analysis	Collected data analysis
28	1-Mar	mon	Meeting with UNICEF, WB, etc.	Field survey at Sihanouk
29	2-Mar	tue	Field survey at Kandal	Field survey at Sihanouk and Kampot
30	3-Mar	wed	Field survey at Phnom Penh	Field survey at Kampot, travel to Phnom Penh
31	4-Mar	thu	Meeting with JICA	Meeting with JICA
32	5-Mar	fri	Meeting with MIME	Internal meeting and meeting with MRD
33	6-Mar	sat	Internal meeting, collected data analysis	Internal meeting, collected data analysis
34	7-Mar	sun	Internal meeting, collected data analysis	Internal meeting, collected data analysis
35	8-Mar	mon	Internal meeting, collected data analysis	Internal meeting, collected data analysis
36	9-Mar	tue	Meeting with JICA, PPSWA	Travel to KG Chhnang
37	10-Mar	wed	Trip to Preah Vihear	Data collection at KG Chhnang, travel to Pursat
38	11-Mar	thu	Data collection at Preah Vihear, travel to KG Cham	Data collection at Pursat, travel to Pailin
39	12-Mar	fri	Travel to Ratanakiri, data collection at Ratanakiri	Data collection at Pailin, travel to Battambang
40	13-Mar	sat	Travel to Stung Treng	Collected data analysis
41	14-Mar	sun	Collected data analysis	Collected data analysis
42	15-Mar	mon	Data collection at Stung Treng, travel to Kratie	Data collection at Battambang and B. Meanchey
43	16-Mar	tue	Data collection at Kratie, travel to Mondulkiri	Data collection at O. Meanchey, travel to Siemriep
44	17-Mar	wed	Data collection at Mondulkiri, travel to KG Cham	Collected data analysis
45	18-Mar	thu	Data collection at KG Cham and Prey Veng	Data collection at Siemriep and KG Thom
46	19-Mar	fri	Data collection at Svay Rieng, travel to Phnom Penh	Data collection at KG Spue
47	20-Mar	sat	Internal meeting, collected data analysis	Internal meeting, collected data analysis
48	21-Mar	sun	Internal meeting, collected data analysis	Internal meeting, collected data analysis
49	22-Mar	mon	Data collection at Takeo	Travel to Koh Hong, data collection at Koh Kong
50	23-Mar	tue	Data collection at Kandal	Data collection at Sihanouk, travel to Kampot
51	24-Mar	wed	Work at Phnom Penh	Data collection at kampot and Kep, travel to P. P.
52	25-Mar	thu	Work at Phnom Penh	
53	26-Mar	fri	Meeting with WSP and JICA Study Team	Meeting with WSP and JICA Study Team
54	27-Mar	sat	Work at Phnom Penh	
55	28-Mar	sun	Work at Phnom Penh	
56	29-Mar	mon	Work at Phnom Penh	
57	30-Mar	tue	Work at Phnom Penh, meeting with MRD	
58	31-Mar	wed	Work at Phnom Penh, meeting with MIME	
59	1-Apr	thu	Work at Phnom Penh	
60	2-Apr	fri	Work at Phnom Penh	
61	3-Apr	sat	Work at Phnom Penh	
62	4-Apr	sun	Internal Meeting	
63	5-Apr	mon	Work at Phnom Penh	
64	6-Apr	tue	Meeting with JICA and relevant agencies, travel to Bangkok	
65	7-Apr	wed	Travel (Bangkok to Japan)	

Chapter 2
Outline of Province and Provincial Capital

Chapter 2 Outline of the Provinces and the Provincial Capital

2.1 Location and Area

The Kingdom of Cambodia is located southwest of Indochinese Peninsula with a total area of 181,035 km^2. It is bordered by various countries; namely, Thailand to the west and northwest, Laos to the north, and Vietnam to the east and southeast. To the south is Thailand Gulf with a coastline of 440 km. The national capital is Phnom Penh.

Cambodia is comprised of 24 provinces including Phnom Penh. The area and population by province is shown in **Table 2.1.1**.

Table 2.1.1 Area and Population by Province

No.	Province	Area (km^2)	Population in 2008	
			Number of Households	Population (person)
1	Banteay Meanchey	6,679	145,219	677,872
2	Battambang	11,702	210,853	1,025,174
3	Kampong Cham	9,799	369,458	1,679,992
4	Kampong Chhnang	5,521	101,260	472,341
5	Kampong Speu	7,017	149,753	716,944
6	Kampong Thom	13,814	134,546	631,409
7	Kampot	4,873	130,084	585,850
8	Kandal	3,564	258,393	1,265,280
9	Koh Kong	10,090	24,311	117,481
10	Kratie	11,094	65,778	319,217
11	Mondul Kiri	14,288	12,407	61,107
12	Phnom Penh	294	260,468	1,327,615
13	Preah Vihear	13,788	33,402	171,139
14	Prey Veng	4,883	227,137	947,372
15	Pursat	12,692	83,745	397,161
16	Ratanak Kiri	10,782	27,596	150,466
17	Siem Reap	10,299	180,743	896,443
18	Preah Sihanouk	1,938	45,237	221,396
19	Stung Treng	11,092	21,204	111,671
20	Svay Rieng	2,966	115,253	482,788
21	Takeo	3,563	184,215	844,906
22	Otdar Meanchey	6,158	38,853	185,819
23	Kep	336	7,236	35,753
24	Pailin	803	14,746	70,486
Sub-Total		178,035	2,841,897	13,395,682
Tonle Sap Lake		3,000	-	-
Total		181,035	2,841,897	13,395,682

Source: General Population Census of Cambodia, 2008

2.2 Natural Conditions

In the central plain of Cambodia, there are two distinct geographical features: Mekong River, located in the east and flows in a north to south direction; and Tonle Sap Lake, located in the

west. Topographic features can be roughly categorized into four; namely Central Plain Area, Tonle Sap Area, Coastal Area and Mountainous Area.

Cambodia belongs to Tropical Monsoon Climate with two distinct seasons in a year: rainy season and dry season. May to the middle of October is regarded as rainy season and the rest of the months as dry season. Throughout the year, temperature and humidity are high and the average annual temperature is 25℃. The coldest month is January, while the hottest month is April. **Table 2.2.1** shows the annual precipitation in four typical areas, **Figure 2.2.1** indicates the rainfall distribution during 1981 to 2004, and **Table 2.2.2** reflects the temperature fluctuation in three typical areas.

Table2.2.1 Annual Precipitation in Four Typical Areas

(unit: mm)

Province	Year					
	2001	2002	2003	2004	2005	2006
Koh Kong	3,358.8	2,310.0	2,952.8	3,548.1	3,939.0	5,855.9
Phnom Penh	1,486.7	1,221.5	1,326.5	1,221.9	1,386.4	1,188.5
Ratanak Kiri	-	-	2,351.9	2,119.8	2,500.0	3,189.4
Takeo	1,525.6	1,107.7	1,378.5	1,088.7	1,201.7	1,042.7
Average in Cambodia	1,710.7	1,405.6	1,574.1	1,449.4	1,625.2	1,920.4

Source: Statistical Yearbook 2008

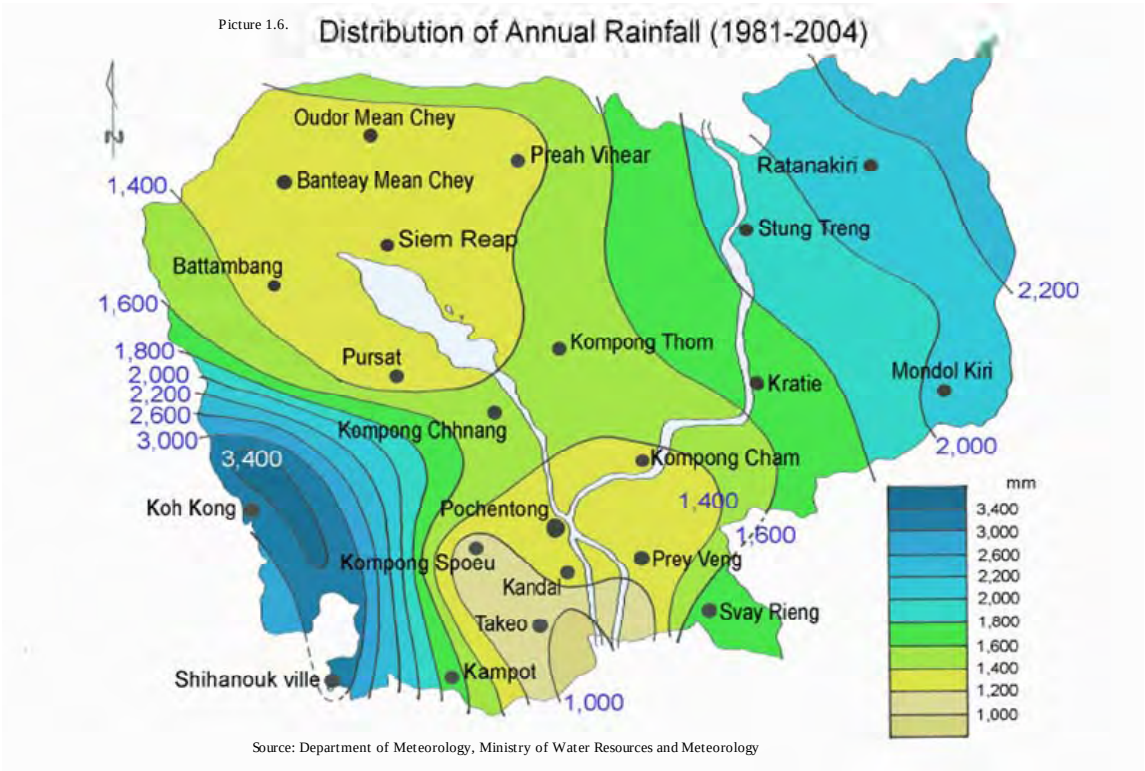


Figure2.2.1 Rainfall Distribution during 1981 to 2004

Table2.2.2 Temperature Fluctuation in Three Typical Areas

Province	Maximum Temperature (°C)					Minimum Temperature (°C)				
	Year				Average in 4 years	Year				Average in 4 years
	2003	2004	2005	2006		2003	2004	2005	2006	
Koh Kong	34.2	34.5	31.5	31.6	32.9	21.6	21.8	25.1	24.4	23.2
Phnom Penh	35.6	35.5	33.8	33.5	34.6	22.2	21.8	24.5	24.8	23.3
Ratana Kiri	37.2	38.8	34.7	34.7	36.4	18.5	19.4	22.6	21.5	20.5
Average in Cambodia	35.2	34.0	32.9	32.7	33.8	21.2	21.2	24.0	23.7	22.5

Source: Statistical Yearbook 2008

2.3 Population

From the general population census in 2008, the national population was approximately 13.4 million with an annual growth rate of 1.54% (1998 to 2008). National average population density was 75 persons/km^2. **Table 2.3.1** shows the population distribution by province, and by urban area and rural area. Based on this data, the population in the national capital of Phnom Penh and its surroundings, Battambang and Siem Reap provinces has the highest, while the population in the provinces adjacent to the borders of other countries; namely, Ratanak Kiri, Mondul Kiri, Stung Treng and Koh Kong province is the lowest. A great number of the population resides in rural areas with a population ratio of 19.5% and 80.5%, for urban and rural areas, respectively.

Table2.3.1 Population Distribution by Province, Urban and Rural Area

No.	Province	Population in 2008				
		Urban (person)	Rural (person)	Total (person)	Urban (%)	Rural (%)
1	Banteay Meanchey	181,396	496,476	677,872	26.8	73.2
2	Battambang	180,853	844,321	1,025,174	17.6	82.4
3	Kampong Cham	118,242	1,561,750	1,679,992	7.0	93.0
4	Kampong Chhnang	43,130	429,211	472,341	9.1	90.9
5	Kampong Speu	54,505	662,439	716,944	7.6	92.4
6	Kampong Thom	31,871	599,538	631,409	5.0	95.0
7	Kampot	48,274	537,576	585,850	8.2	91.8
8	Kandal	195,898	1,069,382	1,265,280	15.5	84.5
9	Koh Kong	36,053	81,428	117,481	30.7	69.3
10	Kratie	35,964	283,253	319,217	11.3	88.7
11	Mondul Kiri	4,859	56,248	61,107	8.0	92.0
12	Phnom Penh	1,242,992	84,623	1,327,615	93.6	6.4
13	Preah Vihear	10,679	160,460	171,139	6.2	93.8
14	Prey Veng	33,079	914,293	947,372	3.5	96.5
15	Pursat	25,650	371,511	397,161	6.5	93.5
16	Ratanak Kiri	19,317	131,149	150,466	12.8	87.2
17	Siem Reap	174,265	722,178	896,443	19.4	80.6
18	Preah Sihanouk	89,447	131,949	221,396	40.4	59.6
19	Stung Treng	17,022	94,649	111,671	15.2	84.8
20	Svay Rieng	17,029	465,759	482,788	3.5	96.5
21	Takeo	14,456	830,450	844,906	1.7	98.3
22	Otdar Meanchey	18,694	167,125	185,819	10.1	89.9
23	Kep	4,678	31,075	35,753	13.1	86.9
24	Pailin	15,674	54,812	70,486	22.2	77.8
Total		2,614,027	10,781,655	13,395,682	19.5	80.5

Source: General Population Census of Cambodia, 2008

2.4 Administrative Organizations

2.4.1 Governmental Policy towards Decentralization

In 2002, the Cambodian Government aimed to pursue participative development, democracy strengthening, delivery of sustainable services, and poverty reduction. It established Commune Council selected through provincial election as a first step towards decentralization. To achieve such objective, a national program, the Seila Program[1] was developed and executed in 1996.

In 2005, the Government formulated a political strategy towards acceleration of Decentralization and Deconcentration (D&D) with the following objectives:

- Democracy popularization and strengthening in provinces; and
- Facilitation in provincial development and poverty reduction.

Based on the said strategy, the provincial and district governor appointment system by the central government will be continued, while the establishment of a new council selected by indirect election is scheduled in 2013. The above-mentioned decentralization is currently practiced in only two pilot provinces: Battambang and Siem Reap and therefore, further expansion is needed.

2.4.2 Current Status of Provincial Administration

Figure 2.4.1 shows the provincial administrative organization.

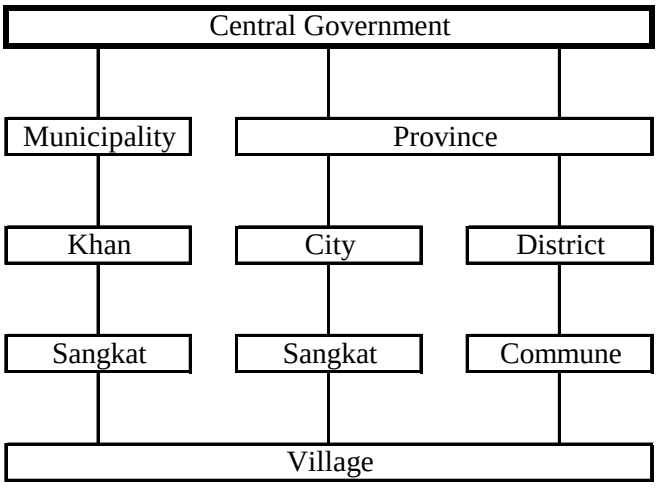


Figure2.4.1 Provincial Administrative Organization

[1] Seila means "Foundation" in Khmer. Seila Program is a 10 year-term assistance project executed through the initiative of UNDP and completed in January of 2007. Through the program, budget allocation and management for Commune/Sangkat has been carried out.

While the Commune/Sangkat has a council selected by direct election, the Province/District has a branch sector office. The provincial and district governors are to be appointed by the Central Government.

As stated earlier, Cambodia is comprised of 24 provinces including Phnom Penh and each province has Commune/Sangkat. It controls the following tasks:

- Preparation and management of family register;
- Permission and licensing on business activities and construction works;
- Vehicle registration;
- Police administration;
- Land registration;
- Environment administration;
- Preservation of cultural assets; and
- Urban infrastructure development including water supply service.

At the provincial level, there are two agencies in the water supply sector. Urban area water supply is governed by DIME (Department of Industry, Mines and Energy), while the rural area water supply is controlled by PDRD (Provincial Department of Rural Development). Both have district sector office. The provincial organizational chart of DIME and PDRD is presented in Chapter 4.

2.4.3 Provincial Budget

The provincial budget consists of budget allocation from the central government, budget distributed by MOI (Ministry of Interior), and PIF (Provincial Investment Fund) donated by donor agencies. Budgetary flow in water supply sector is indicated in **Figure 2.4.2**.

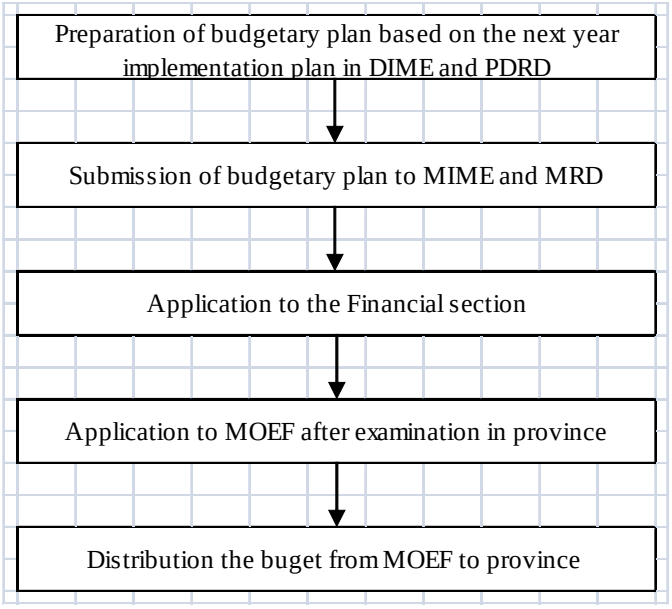


Figure2.4.2 Budgetary Flow in Water Supply Sector in Cambodia

2.5 Socio-Economic Status

According to the statistical yearbook, poverty ratio of 35% in 2004 was reduced to 30.1% in 2007. However, this ratio is still high compared with other South-Asian countries. Meanwhile, the national population rapidly increased from 9.3 million in 1993 to 13.4 million in 2008.

The trend of the major industry type working population from 1998 to 2004 is shown in **Table 2.5.1.** Slight movement from agricultural and fishery sector to industrial sector was observed but the difference was not significant, while the trend from 2004 to 2007 showed rapid movement from agricultural and fishery sector and industrial sector to commercial sector and public service.

Table 2.5.1 Working Population by Major Industry Type

Sector	1998	2004	2007
Agricultural and Fishery Sector	77.5%	74.2%	60.4%
Industrial Sector	4.3%	7.0%	14.0%
Commercial Sector and Public Service	18.2%	18.8%	25.6%
Total	100.0%	100.0%	100.0%

Source：Statistical Yearbook 2008

Based on the statistical yearbook 2008, the working population in 2007 was 7.8 million. Ninety nine percent (99.3%) of the labor force population is working, resulting to a very low unemployment rate of 0.7% (5.2 thousand).

In Cambodia, the major industry is agriculture. The country is also rich in tourism resources, hence tourism industry has a great potential for development. **Table 2.5.2** shows the trend in the number of foreign tourists. The number drastically increased after 2000 with Siem Reap as the major destination.

Table2.5.2 Historical Trend in Tourist Number

Item	1995	1998	2000	2002	2004	2007
Tourist Number	219,680	286,524	466,365	786,524	1,055,202	2,015,128
	(-)	(-)	(-)	(453,148)	(560,947)	(1,120,586)

Source: Statistical Yearbook 2008
Note: ( ) means the number of tourist visiting Siem Reap

The scale of the Cambodian economic activity is small with a national GDP of 5.3 billion US$. Per capita GDP was taken at 392 US$ in 2005, while in 2007, it increased at 575 US$. **Table 2.5.3** and **Figure 2.5.1** reflect the per capita GDP transition.

Table2.5.3 Historical Trend in Per Capita GDP (2000 – 2009)

(US$)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Per capita GDP	288	309	326	349	392	454	513	648	825	775

Source: Statistical Yearbook 2008

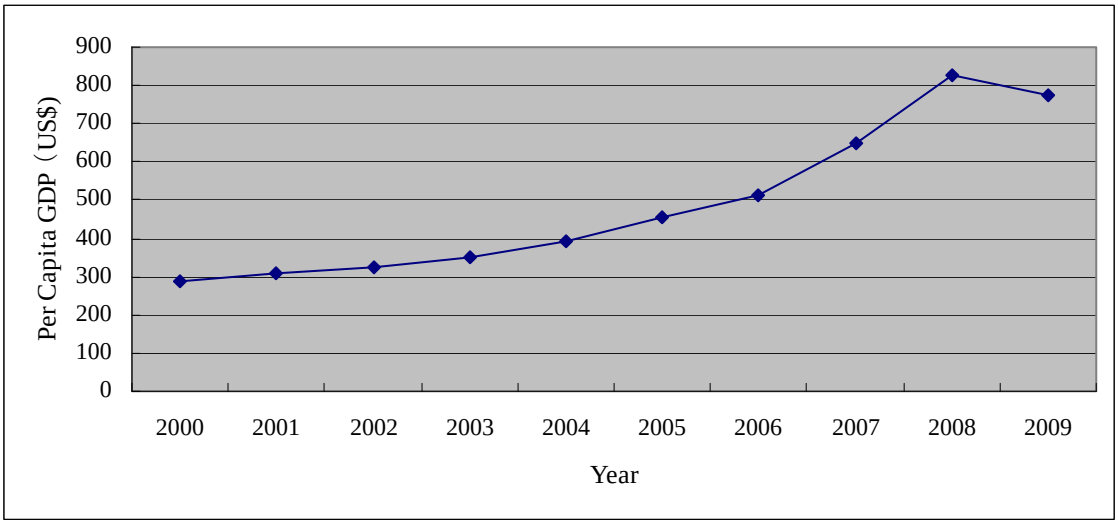


Figure2.5.1 Historical Trend in Per Capita GDP (2000 – 2009)

The occupation ratio by major industry type in 2008 was as follows:

- Agricultural and Fishery Sector 31.7%
- Industrial Sector 23.8%, mainly Mining
- Commercial Sector and Public Service 37.5%, mainly Tourism

2.6 Status of Urban Area and Development Plan

In this Study, the system plan for future water sector is formulated. Therefore, urban infrastructure development status and urban development plan shall be taken into account. As priority project is to be proposed in this study, the degree of urbanization and progress of major national road development to secure easy access to provincial towns shall be considered during prioritization.

Based on this design policy, major national road development plan described in "Follow-Up Study on the Road Network Development Master Plan, 2009" established by the Ministry of Public Works and Transport (MPWT) is presented in this chapter. On the other hand, urban

development plan was not available in the Ministry of Land Management, Urban Planning and Construction, thus, it is not described in this Study.

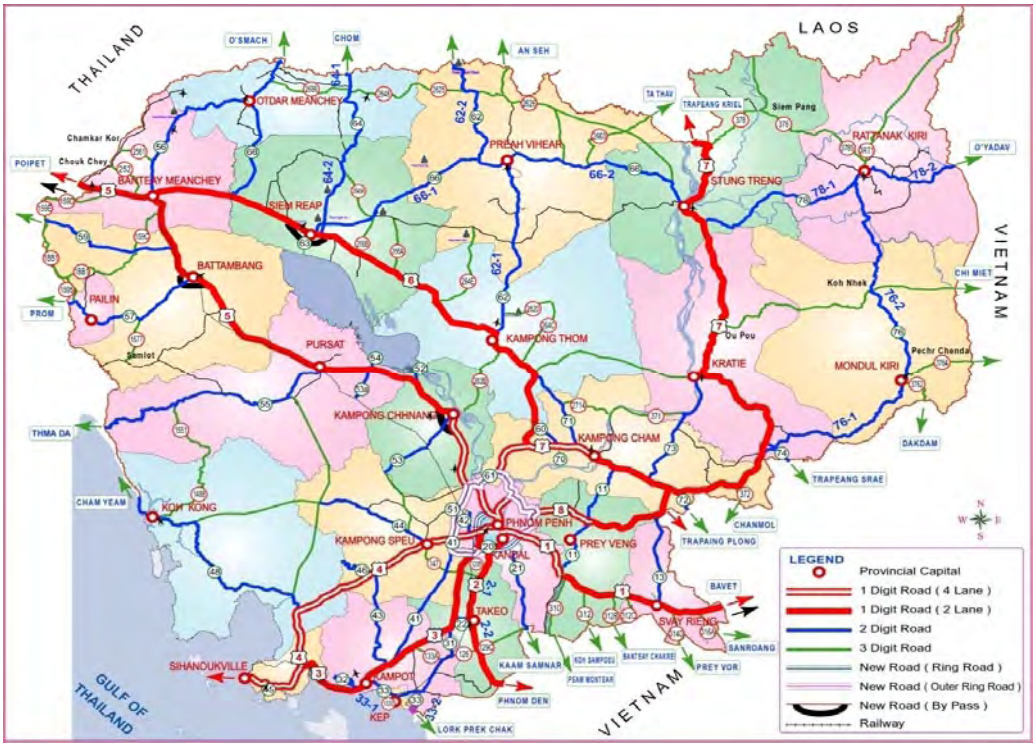
2.6.1 Road Development

The breakdown of the existing road network is as follows:

- National Road/International Road 5,068 km
- Provincial Road 6,169 km
- Rural Area Road 28,000 km

According to the aforementioned MPWT report, new development and rehabilitation of major national road No.1 to No.8 was proposed. Total road length is 2,100 km and the work is scheduled to be completed by 2020. During the field survey, road width expansion work and pavement work were observed in several routes. As to general roads, development plan was also proposed and the work schedule is planned along with those of national roads.

Based on this plan, major cities and towns in 24 provinces, the Study target, are to be connected to the nearest national road until 2020. This will provide easy access from the central area to the provincial cities and towns. It is expected that with the plan, rapid development in these areas will take place. **Figure 2.6.1** shows the road development plan which is scheduled to be completed by 2020.



Source: Follow Up Study on the Road Network Development Master Plan, 2009

Figure2.6.1 Road Development Plan in 2020

Chapter 3
Current Status of Cambodian Water Supply Sector and Development Plan

Chapter 3 Current Status of Cambodian Water Supply Sector and Development Plan

3.1 Current Status of Water Supply Sector

3.1.1 Urban Area Water Supply

(1) Current Status of Urban Area Water Supply

Based on the information collected from MIME, water service rate in urban area was 56% in 2008. This service ratio includes piped water that are not properly disinfected and considered not safe. In some provinces, lake water or groundwater pumped from shallow wells has been supplied without any disinfection. Current urban water supply status is to be explained in detail in Chapter 4.

Table 3.1.1 shows the provincial water service rate managed by public or private operators. **Table 3.1.2** illustrates the urban water supply conditions in the provincial capital.

There are 86 urban water supply projects managed by private operators and licensed by MIME and another 11, also managed by private operators with the assistance of World Bank.

Service ratio shown in **Table 3.1.1** looks rather larger than the actual one. These figures were reckoned by the MIME according to the following formula:

Service Ratio = Number of Connected Households/Total Household Number in Urban Area

Since the number of connected HH in the above formula includes shops, offices and factories, larger ratio was calculated.

Table 3.1.1 Provincial Water Service Rate

Province		Urban Area *1		Average Number of Household	Number of Waterworks *2			Number of Water Connections *2			Estimated Served Population (person)	Water Service Ratio (%)
		Number of Households	Population (person)		Public	Private	Total	Public	Private	Total		
1	Banteay Meanchey	37,377	181,396	4.85	-	9	9	-	12,973	12,973	62,960	34.7
2	Battambang	36,104	180,853	5.01	1	10	11	8,582	4,701	13,283	66,538	36.8
3	Kampong Cham	25,540	118,242	4.63	1	7	8	4,172	4,408	8,580	39,723	33.6
4	Kampong Chhnang	8,411	43,130	5.13	1	1	2	1,114	-	1,114	5,712	13.2
5	Kampong Speu	10,636	54,505	5.12	-	10	10	-	5,009	5,009	25,669	47.1
6	Kampong Thom	6,760	31,871	4.71	3	1	4	4,033	912	4,945	23,314	73.2
7	Kampot	9,970	48,274	4.84	1	6	7	3,014	3,005	6,019	29,144	60.4
8	Kandal	38,362	195,898	5.11	-	21	21	-	14,329	14,329	73,172	37.4
9	Koh Kong	7,431	36,053	4.85	-	2	2	-	1,713	1,713	8,311	23.1
10	Kratie	7,542	35,964	4.77	1	4	5	1,710	973	2,683	12,794	35.6
11	Mondul Kiri	977	4,859	4.97	-	-	0	-	-	0	0	0.0
12	Phnom Penh	242,974	1,242,992	5.12	1	-	1	190,500	-	190,500	974,549	78.4
13	Preah Vihear	2,155	10,679	4.96	-	1	1	-	477	477	2,364	22.1
14	Prey Veng	7,137	33,079	4.63	1	1	2	1,588	3,247	4,835	22,410	67.7
15	Pursat	5,438	25,650	4.72	1	1	2	3,571	971	4,542	21,424	83.5
16	Ratanak Kiri	3,796	19,317	5.09	1	-	1	557	-	557	2,834	14.7
17	Siem Reap	34,717	174,265	5.02	1	4	5	4,540	1,051	5,591	28,065	16.1
18	Preah Sihanouk	18,775	89,447	4.76	1	3	4	3,458	1,231	4,689	22,339	25.0
19	Stung Treng	3,313	17,022	5.14	1	-	1	1,498	-	1,498	7,697	45.2
20	Svay Rieng	3,632	17,029	4.69	1	3	4	1,459	849	2,308	10,821	63.5
21	Takeo	2,738	14,456	5.28	-	9	9	-	3,823	3,823	20,185	139.6
22	Otdar Meanchey	3,665	18,694	5.10	-	1	1	-	183	183	933	5.0
23	Kep	970	4,678	4.82	-	1	1	-	-	0	0	0.0
24	Pailin	3,290	15,674	4.76	-	1	1	-	1,120	1,120	5,336	34.0
Total		521,710	2,614,027	5.01	16	96	112	229,796	60,975	290,771	1,466,291	56.1

Note: Number of Water Connection in Takeo Province include the number of households in rural area

Source: *1; General Population Census of Cambodia 2008

*2; Potable Water Supply Department, MIME

Table 3.1.2 Urban Water Supply Conditions in the Provincial Capital

No.	Province	Status	Remarks
1	Banteay Meanchey	Private	
2	Battambang	Public Utility	
3	Kampong Cham	Public Utility	
4	Kampong Chhnang	Private and Public Utility	Private (50%), Public (50%)
5	Kampong Speu	Private	
6	Kampong Thom	Public Utility	
7	Kampot	Public Utility	
8	Kandal	Public Utility	Under PPWSA
9	Koh Kong	Private	BOT
10	Kratie	Public Utility	
11	Mondul Kiri	No Water Supply System	Developing Triangle Project by Japanese Government
12	Phnom Penh	Public Utility	Autonomous
13	Preah Vihear	Private	
14	Prey Veng	Public Utility	
15	Pursat	Public Utility	
16	Ratana Kiri	Public Utility	Improving under Triangle Project by Japanese Government
17	Siemreap	Public Utility	Autonomous
18	Sihanoukville	Public Utility	
19	Stung Treng	Public Utility	
20	Svay Rieng	Public Utility	
21	Takeo	Private	
22	Kep	Private	Under Construction
23	Pailin	Private	
24	Oddar Meanchey	No Water Supply System	

Source: Potable Water Supply Department, MIME

(2) Water Tariff

Tariff of public-managed urban water supply system differs by areas. Large-scale urban water supply system adopts volumetric tariff, while fixed rate is common in small-scale system. As compared, tariff of public-managed system is cheaper than the private-managed system. **Table 3.1.3** indicates the tariff of public-managed systems collected from MIME.

Table3.1.3 Water Tariff of Public-managed System

Province	Category	Water tariff Riel/m^3
Battambang		1,500
Kampong Cham	Domestic	
	0-10m^3	550
	Over 11m^3	900
	Business	900
	Institution, Banks	1,500
Kampong Chhnang		1,300
Kampong Thom		1,500
Kampot		1,400
Kratie		1,400
Phnom Penh	Domestic	
	0-7m^3	550
	8-15m^3	770
	16-50m^3	1,010
	Over 51m^3	1,270
	Institution, Community	1,030
	Industry	
	0-100m^3	950
	101-200m^3	1,150
	201-500m^3	1,350
	Over 501m^3	1,450
Prey Veng		1,200
Pursat		1,300
Ratanak Kiri		1,500
Siem Reap	0-7m^3	1,100
	8-15m^3	1,500
	16-30m^3	1,800
	Over 31m^3	2,000
Preah Sihanouk	0-7m^3	1,500
	8-15m^3	1,800
	Over 16m^3	2,000
Stung Treng		1,500
Svay Rieng		1,200

Source : Potable Water Supply Department

(3) Expenditure of MIME

Eighty percent (80%) of the annual project budget comes from the assistance of foreign donor

agencies. **Table 3.1.4** shows the annual expenditure by MIME during the years 2003 to 2007. Expenditure drastically increased in 2006.

Table 3.1.4 Transition in Annual Expenditure of MIME

Unit: Million Riel

Year	2003	2004	2005	2006	2007
Expenditure	7,000	6,200	7,400	31,000	38,300

Source: Statistical Yearbook 2008

As to the annual budget of MIME and Water Supply Department in 2010, only the total amount was available. There was no breakdown provided.[1] **Table 3.1.5** shows the annual budget for 2010. The expenditure is equivalent to that of 2005.

Compared with total income, total expenditure is only 50%. Some planning or project implementation budget is supposed to be excluded from the total budget.

Table 3.1.5 Annual Budget of MIME and Water Supply Department in 2010

Unit: Million Riel

Cost Items	Amount	Remarks
1. Total budget of MIME	14,432	
1.1 Total budget of WSD	2,162	15 % of total budget
2. Total expenditure of MIME	7,327	
2.1 Total expenditure of WSD	1,087	

3.1.2 Current Status of Rural Water Supply and Sanitation

(1) Access to Improved Drinking Water

1) Comparison between Neighboring Counties

Access to improved drinking water and sanitation facilities under the Joint Monitoring Programme (JMP) for Water Supply and Sanitation by WHO and UNICEF was assessed in both urban and rural areas in over 200 countries around the world.

Access to improved drinking water in rural areas in five countries on the Indochinese Peninsula, including Cambodia, is shown in the table below.

[1] Information was provided through interview

Table 3.1.6 Access to Improved Drinking Water in Rural Areas in Neighboring Countries

Country	Year	Population (thousand)	Percentage Urban Population (%)	Use of Drinking Water Sources (Percentage of Population)			
				Improved			Unimproved
				Piped	Other Improved	Total Improved	
Cambodia	1990	9,690	13	0	33	33	67
	2000	12,760	17	2	40	42	58
	2008	14,562	22	5	51	56	44
Thailand	1990	56,673	29	14	75	89	11
	2000	62,347	31	29	66	95	5
	2008	67,386	33	39	59	98	2
Viet Nam	1990	66,247	20	0	51	51	49
	2000	78,663	24	5	69	74	26
	2008	87,096	28	9	83	92	8
Lao People's Democratic Republic	1990	4,207	15	-	-	-	-
	2000	5,403	22	5	35	40	60
	2008	6,205	31	4	47	51	49
Myanmar	1990	40,844	25	1	46	47	53
	2000	46,610	28	2	58	60	40
	2008	49,563	33	2	67	69	31

Source：WHO/UNICEF Joint Monitoring Programme for Water and Sanitation ISBN978 92 4 156395 6

Access to improved drinking water in Cambodia is the second lowest in the Indochinese Peninsula, the lowest of which is the Lao People's Democratic Republic where almost half (44%) of the residents are still using unsafe water. Improved drinking water source as defined by JMP is shown in the table below.

Table 3.1.7 Definition of Improved Drinking Water by JMP

Improved drinking water	Unimproved drinking water
・ Piped water into dwelling yard or plot ・ Public tap or standpipe ・ Tubewell or borehole ・ Protected dug well ・ Protected spring ・ Rainwater collection	・ Unprotected spring ・ Unprotected dug well ・ Cart with small tank/drum ・ Tanker-truck ・ Surface water (river, dam, lake, pond, stream, canal irrigation channel) ・ Bottled water

Source：JMP Website http://www.wssinfo.org/

2) Differences in Data of Access to Drinking Water

Drinking water access rates were measured by various surveys in Cambodia as shown in the table below. However, the rates differed in each result due to the absence of a clear and common definition of "access to an improved water source". Hence, reliability of data is a big issue.

Table 3.1.8 Differences in Data of Access to Drinking Water

Survey Name	Access Tate to Drinking Water (%)	Remark
Cambodia Inter-censal Population Survey 2004 (CIPS 2004)	35.30	
Cambodia Socio-Economic Survey 2004 (CSES 2004)	52.70	
Cambodia Demographic and Health Survey 2005 (CDHS 2005)	53.70	
Cambodia Socio-Economic Survey 2007 (CSES 2007)	55.10	
Census 2008	40.49	Adoption value by MRD
Joint Monitoring Programme for Water and Sanitation 2008 (JMP 2008)	56.00	

MRD has expressed that it adopts the access rate to drinking water in the 2008 census figures as an official value. However, it was pointed out by the Water and Sanitation Working Group last October that the biggest difference in the access rate to drinking water is between the rainy and dry seasons. A new estimation method for access to drinking water is being proposed to consider the results in both the rainy and dry seasons. Moreover, water quality of the "improved water source" sometimes does not meet the Cambodian drinking water quality standards. As a result, it is necessary to re-confirm the definition of “safe drinking water” with related agencies.

(2) Main Source of Drinking Water

A new category of classifying “main source of drinking water” was applied in census 2008 for the purpose of differentiating “protected dug well” and “rain” from simple “dug well”. The category of main source of drinking water in census 2008 consists of “piped water”, “tube/pipe well”, “protected dug well”, “unprotected dug well”, “rain”, “spring and river etc.”, “bought” and “other”. Improved water source consists of pipe water, tube/pipe well, protected dug well and rain water as defined by the Ministry of Planning based on the definitions of the Joint Monitoring Program of UNICEF and WHO.

Table 3.1.9 and **Figure 3.1.1** present the main source of drinking water for most Cambodian households in 1998 and 2008 conducted by census survey.

Table 3.1.9 Distribution of Households by Main Source of Drinking Water in Rural Areas in 1998 and 2008

Main Source of Drinking Water	1998		2008	
	Number of Households	Percentage (%)	Number of Households	Percentage (%)
Piped Water	27,698	1.5%	102,306	4.4%
Tube/Pipe Well	277,657	15.4%	681,192	29.5%
Protected Dug Well	-	-	127,927	5.5%
Unprotected Dug Well	810,042	45.1%	559,016	24.2%
Rain	-	-	24,292	1.1%
Spring, River, etc	561,220	31.2%	618,579	26.8%
Bought	73,004	4.1%	164,511	7.1%
Other	47,884	2.7%	33,235	1.4%
Total	1,797,505	100.0%	2,311,058	100%

Source：Census 2008

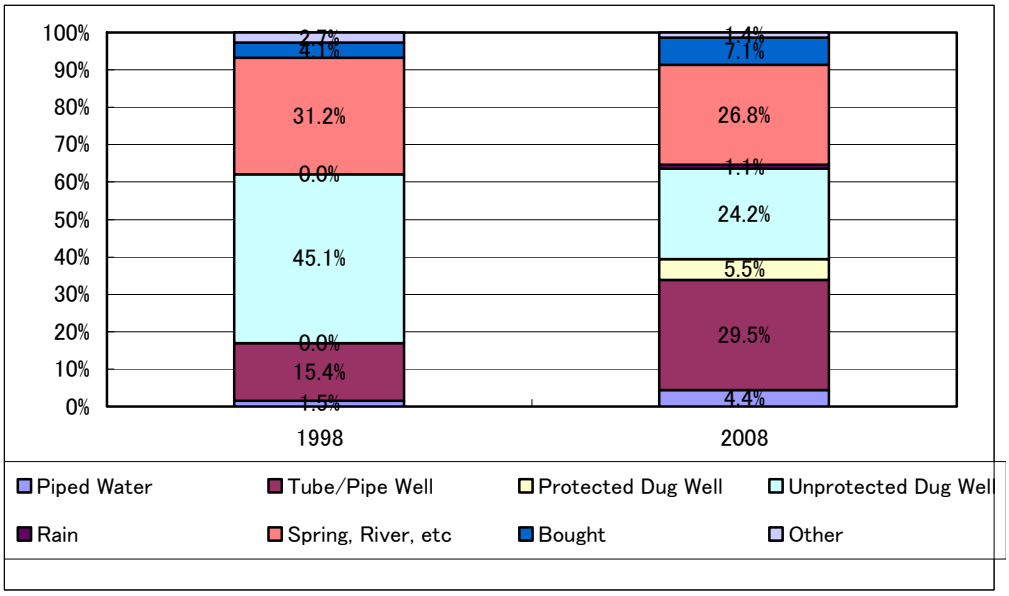


Figure 3.1.1 Main Source of Drinking Water in Rural Areas in 1998 and 2008

The proportion of households using improved water sources has increased by 24% compared to 1998, the breakdown of which is that dug well has decreased about 20%, and piped water and tube/pipe well have increased 14 and 3% respectively. However, said piped water and tube/pipe well are not always “protected water”, and 60% of households in rural areas are still using unsafe water. Therefore, service ratio with water quality satisfying Cambodian drinking water standard is assumed to be further lower.

(3) Location of Main Source of Drinking Water

Location of water source is a new question applied in the 2008 census. Three categories were prepared for this question. Those are “within the premises”, “near the premises” which means

within five minutes walk of the water source, and "away" which means more than five minutes walk to the water source. The results are shown in the table below. About 36% of the households in rural areas fetched water "away" from their premises and about 13% of the households were using unsafe surface water such as river and springs "away" from their premises.

Table 3.1.10 Location of Water Source by Main Source of Drinking Water in Rural Areas, 2008

Water source \ Location		Within the Premises	Near the Premises (within 5 min. of walk to the water source)	Away (more than 5 min. of walk to the water source)	Total
Piped Water	Number of Households	61,739	21,811	18,756	102,306
	Percentage	60.3%	21.3%	18.3%	100.0%
Tube/Pipe well	Number of Households	316,116	244,193	120,883	681,192
	Percentage	46.4%	35.8%	17.7%	100.0%
Protected Dug well	Number of Households	47,631	44,492	35,804	127,927
	Percentage	37.2%	34.8%	28.0%	100.0%
Unprotected Dug well	Number of Households	166,330	192,916	199,770	559,016
	Percentage	29.8%	34.5%	35.7%	100.0%
Rain	Number of Households	10,871	5,371	8,050	24,292
	Percentage	44.8%	22.1%	33.1%	100.0%
Spring, River, etc.	Number of Households	53,582	242,893	322,104	618,579
	Percentage	8.7%	39.3%	52.1%	100.0%
Bought	Number of Households	18,812	32,870	112,829	164,511
	Percentage	11.4%	20.0%	68.6%	100.0%
Other	Number of Households	3,254	10,957	19,024	33,235
	Percentage	9.8%	33.0%	57.2%	100.0%
Total	Number of Households	678,335	795,503	837,220	2,311,058
	Percentage	29.4%	34.4%	36.2%	100.0%

Source：Census 2008

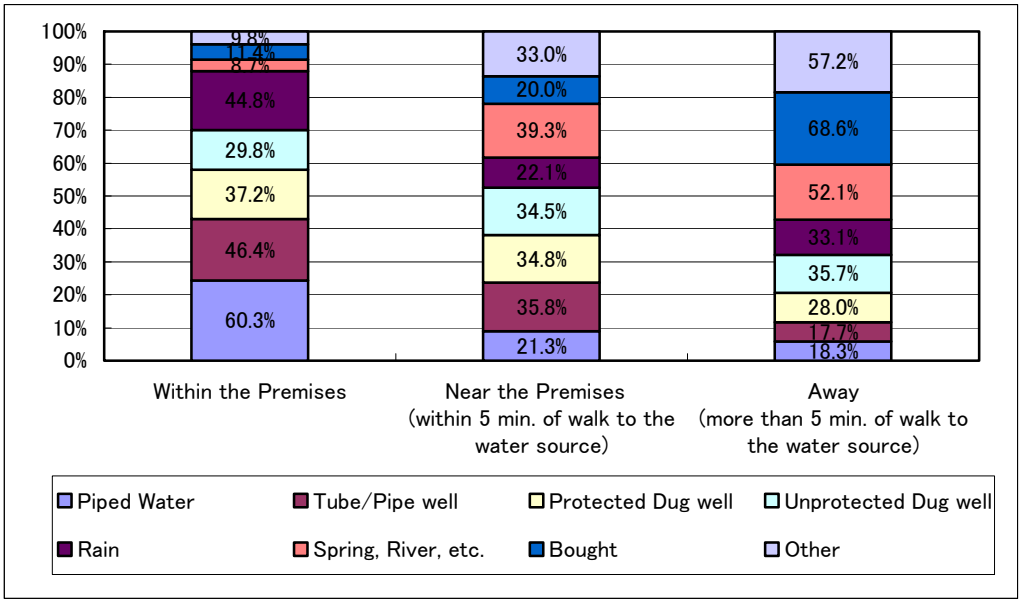


Figure 3.1.2 Location of Water Source by Main Source of Drinking Water in Rural Areas, 2008

(4) Access to Improved Sanitation

1) Comparison between Neighboring Counties

Access to improved sanitation in rural areas in five countries on the Indochinese Peninsula including Cambodia was also surveyed by JMP as shown in the table below.

Table 3.1.11 Access to Improved Sanitation in Rural Areas in Neighboring Countries

Country	Year	Population (thousand)	Percentage Urban Population (%)	Use of Sanitation Facilities (Percentage of Population)			
				Improved	Unimproved		
					Shared	Unimproved Facilities	Open Defecation
Cambodia	1990	9,690	13	5	1	5	89
	2000	12,760	17	10	2	6	82
	2008	14,562	22	18	4	3	75
Thailand	1990	56,673	29	74	3	0	23
	2000	62,347	31	92	4	0	4
	2008	67,386	33	96	4	0	0
Viet Nam	1990	66,247	20	29	2	23	46
	2000	78,663	24	50	3	22	25
	2008	87,096	28	67	4	21	8
Lao People's Democratic Republic	1990	4,207	15	-	-	-	-
	2000	5,403	22	16	1	8	75
	2008	6,205	31	38	2	8	52
Myanmar	1990	40,844	25	-	-	-	-
	2000	46,610	28	59	8	19	14
	2008	49,563	33	79	11	9	1

Source：WHO/UNICEF Joint Monitoring Programme for Water and Sanitation ISBN978 92 4 156395 6

Access to improved sanitation in Cambodia is a mere 18%, which is the lowest of the five countries. A large percentage of its population still practiced open defecation at 75%. Definition of improved sanitation by JMP is shown in the table below.

Table 3.1.12 Definition of Access to Sanitation

Improved Sanitation	Unimproved Sanitation
・ Flush toilet ・Piped sewer system ・Septic tank ・Flush/pour flush to pit latrine ・ Ventilated improved pit latrine ・ Pit latrine with slab ・ Composting toilet	・ Flush/pour flush to elsewhere ・ Pit latrine without slab ・ Bucket ・ Hanging toilet / hanging latrine ・ No facilities / bush / field)

Source：JMP Website http://www.wssinfo.org/

2) Differences in Data of Access to Improved Sanitation

As in drinking water, access rates to improved sanitation were measured by various surveys in Cambodia. The difference of each result as shown in **Table 3.1.13** was due to the absence of a

definition of improved sanitation, although the gap is smaller than the drinking water access rate. MRD has adopted the 2008 census figures as the official value for the access rate to improved sanitation.

Table 3.1.13 Differences in Data of Access to Improved Sanitation

Survey Name	Access Rate to Sanitation Facility（%）	Remark
Cambodia Inter-censal Population Survey 2004 (CIPS 2004)	16.4	
Cambodia Socio-Economic Survey 2004 (CSES 2004)	15.0	
Cambodia Demographic and Health Survey 2005 (CDHS 2005)	15.7	
Cambodia Socio-Economic Survey 2007 (CSES 2007)	20.0	
Census 2008	23.0	Adoption value by MRD
Joint Monitoring Programme for Water and Sanitation 2008 (JMP 2008)	18.0	

(5) Toilet Facility

The type of toilet facility of the households was investigated in census 2008. The results were: 45% of the households used “septic tank”, 28% “connected to sewerage”, and 23% used a “pit latrine”. Although the proportion of households using improved sanitation has increased by 17% (from 6 to 23.2%), the rate is still extremely low. Households without toilet were at 77%.

Table 3.1.14 Distribution of Households by Availability and Type of Toilet Facility in Rural Areas, 1998 and 2008

Toilet Facility	1998		2008	
	Number of Households	Percentage (%)	Number of Households	Percentage (%)
Total	1,797,505	100.0%	2,311,058	100.0%
Households without Toilet	1,689,151	94.0%	1,774,042	76.8%
Households with Toilet	108,354	6.0%	537,016	23.2%
Connected to sewerage	-	-	148,832	27.7%
Septic tank	-	-	241,264	44.9%
Pit latrine	-	-	125,562	23.4%
Other	-	-	21,358	4.0%

Source：Census 2008

(6) Health Impacts

1) Summary of Health Impacts

Poor sanitation and hygiene coupled with lack of safe drinking water remain a significant health problem causing morbidity and deaths. Although the mortality rate for infants and under 5 year olds has been decreasing every year according to “World Health Statistics 2009” by WHO in five

neighboring counties, the rate in Cambodia was the second highest among these countries.

According to the "National Health Statistics Report 2008" by the Ministry of Health, six out of the ten highest ranked diseases were water-borne diseases. This result can be correlated with an improved environment of water supply and sanitation. A close relation with the health sector can be deduced. Therefore, it is important to work towards a solution of these issues with both sectors involved.

Table 3.1.15 Mortality Rate of Infants and Under 5 Year Olds in Five Countries

Country	Malaria Mortality Rate *1	Infant Mortality Rate *2			Under 5 year Mortality Rate *3			Distribution of Causes of Death Among Children Aged <5 years (%)		Number of Reported Cases	
								Diarrhea	Malaria	Cholera	Malaria
	2006	1990	2000	2007	1990	2000	2007	2004		2007	
Cambodia	4	87	80	70	119	107	91	20.3	0.5	-	59,848
Thailand	< 1	26	11	6	31	13	7	20.6	1.1	1428	-
Viet Nam	< 1	40	23	13	56	30	15	13.9	0.2	1946	-
Lao PDR	1	120	77	56	163	101	70	16.9	0.2	169	-
Myanmar	19	91	78	79	130	110	113	21.4	3.3	-	-

*1: per 100,000 population

*2: probability of dying between birth and age 1 per 1000 live births, *3：per 1000 live births

Source：World Health Statistics 2009 by World Health Organization

Table 3.1.16 Number of Cases of Water-Borne Disease

Diseases	Out-Patient			Inpatient					
				Cases			Deaths		
	No. of cases	Rate*1	Ranking	No. of cases	Rate*1	Ranking	No. of deaths	Rate*1	Ranking
Diarrhea	338,461	4.7%	3	22,688	3.50%	4	283	4.1%	9
Dysentery	253,583	3.5%	4	6,355	0.98%	12	43	0.6%	22
Typhoid	-	-	-	13,241	2.04%	6	223	3.2%	17
Dengue fever	47,748	0.7%	10	12,035	1.86%	7	110	1.6%	8
Malaria	127,347	1.8%	7	11,701	1.80%	8	42	0.6%	32
Cholera	-	-	-	72	0.01%	36	0	0.0%	32
Eyes diseases	126,149	1.8%	8	151	0.02%	33	0	0.0%	27
Skin infection	209,166	2.9%	5	-	-	-	-	-	-
Total	7,158,720			648,329			6922		
Total population	13,338,910								

*1：This value show a rate in total cases.

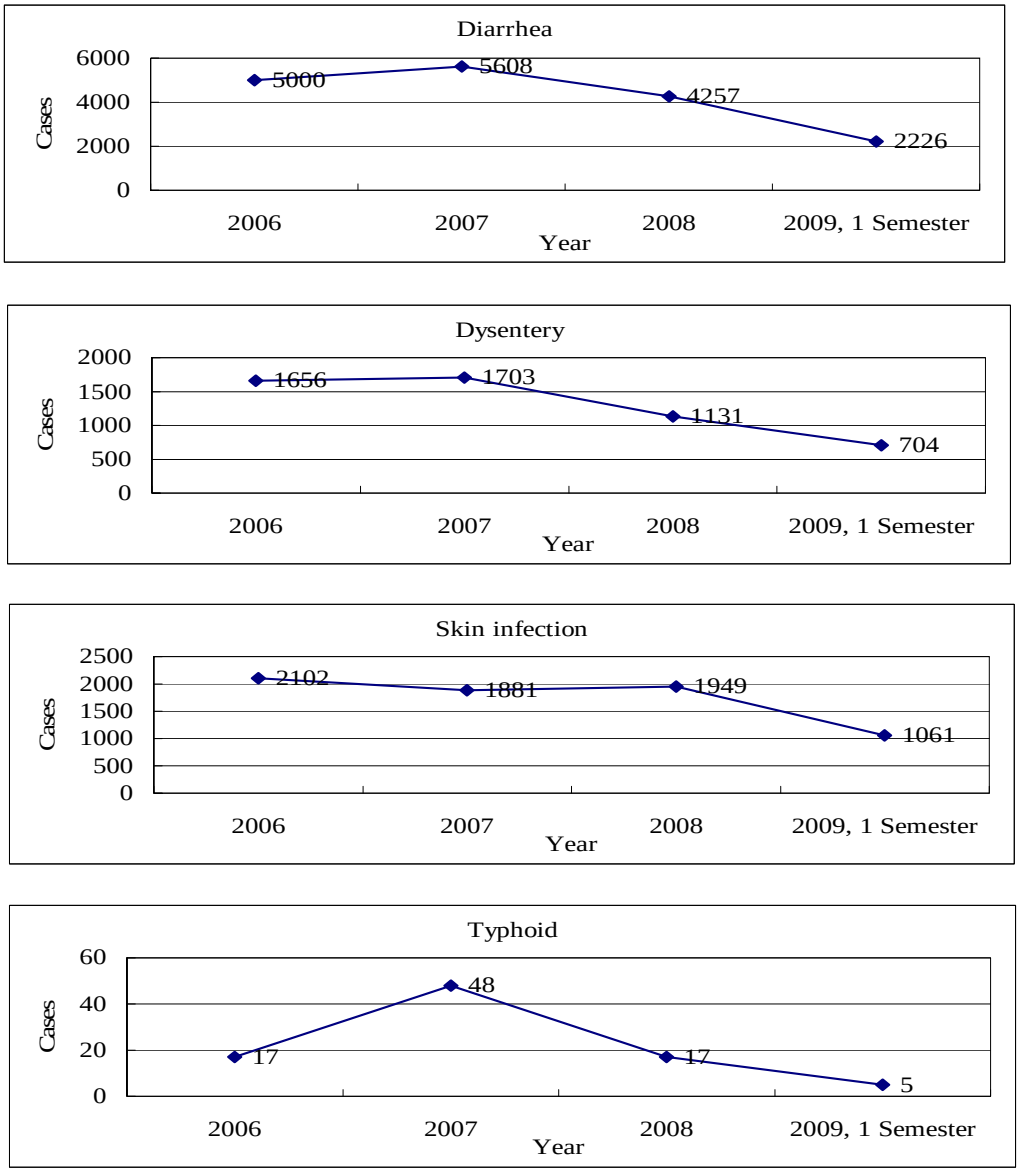
Source：National Health Statistics Report 2008, Ministry of Health

2) Correlation between Improvement of Water Supply, Hygiene Environment and Water-borne Disease

In the "Project for Rural Drinking Water Supply in Kampong Cham Province" under a Japanese grant aid conducted in 2006-2008, a total of 355 boreholes with hand pumps were constructed in 115 villages in 4 districts in the eastern part of Kampong Cham Province. This was augmented with "soft" component activities for hygiene education that were carried out in the same target

villages. As a result, water supply and hygiene environment in these target areas has improved significantly.

One year after the completion of this project, the Health Office in Memot district compiled the effectiveness of tube wells in reducing diseases. **Figure 3.1.3** shows the trend of the cases of water-borne diseases such as diarrhea, dysentery, skin disease and typhoid fever from 2006 to 2009. Based on this, the number of cases is decreasing every year and it is assumed that this is due to the positive impact of the project.



Source : Effectiveness of Reduction of Disease through Consumption of Pumped Well Water by Health Office of Memot Operational District, Kompong Cham Province Department Health, July 2009

Figure 3.1.3 Comparison of the Rate of Water-Borne Diseases Between 2006 and 2009

(7) Situation of Private Contractor

Under the "National Policy on Water and Sanitation" approved in 2003, a policy for the promotion of private sector participation is being pursued. Construction is currently carried out by private contractors selected by tender. However, the technical level of drilling contractors in Cambodia is still low and the cases of well failure are not decreasing due to the current poor state of quality control (refer to Chapter 4 for further details).

According to the evaluation for machines, equipment and capacity of drilling contractors carried out by UNICEF and MRD last year, 33 local contractors owned a rig which can drill through rock layers and 25 contractors with a rig capable of drilling deeper than 100 m. However, in the event of severe drilling conditions such as hard rock layers or deeper drilling depth, it is observed that most contractors cannot provide the specified quality/requirement.

Table 3.1.17 Evaluation for Machines, Equipment and Capacity of Drilling Contractors

Grade	Qualification of own drilling rig		Local Contractor	
	Depth	Geological condition	No. of contractor	Rate
2A	Drill from 0 m to 30m	Soil layer zone	2	4%
2B	Drill from 0 m to 50m	Soil layer zone	10	22%
3A	Drill from 0 m to 70m	Soil and rock layer zone	9	20%
3B	Drill from 0 m to 120m	Soil and rock layer zone	20	43%
3C	Drill from 0 m to 180m	Soil and rock layer zone	5	11%
Total			46	100%

Source : UNICEF

(8) Finance – Budget

1) NSDP (2006-2010) Allocation to the Water and Sanitation Sector

Figure 3.1.18 shows NSDP (2006-2010) allocation. Based on this figure, urban water supply is classified under water and sanitation in infrastructure and 5% is allocated in all sub-sectors. On the other hand, rural water supply and sanitation is classified under rural development in economic sectors and 10% is allocated in all sub-sectors. However, the bulk of the budget for rural development is mostly appropriated to rural road development judging from the annual budget for MRD. Consequently, it is assumed that allocation for rural water and sanitation is a low priority.

2) Development Cooperation Disbursements

Table 3.1.19 shows the development cooperation disbursements by sector for years 2005 to 2008. From the table, development cooperation disbursements in the rural development sector including rural water and sanitation in 2008, have become nearly flat (approx. 8%) as compared with 2005 (the year before the NSDP commenced), and since then, disbursements for water and sanitation sector have started to decrease (from 4% to 3%).

Table 3.1.18 NSDP Allocation, 2006-2010

Unit: USD millions

Sector	2006 NSDP	2006 % allocation	2008 MTR*1 revision	2008 % allocation	2006-2008 % change
Social Sectors					
Education (basic=60%)	550	15.71%	670	15.95%	22%
Health	600	17.14%	720	17.14%	20%
Sub-Total	1,150	32.86%	1,390	33.10%	21%
Economic Sectors					
Agriculture & Land Mgmt: other than crops	150	4.29%	200	4.76%	33%
Seasonal crops: rice etc	200	5.71%	370	8.81%	85%
Rural Development *2	350	10.00%	420	10.00%	20%
Manufacturing, Mining & Trade	80	2.29%	100	2.38%	25%
Sub-Total	780	22.29%	1,090	25.95%	40%
Infrastructure					
Transportation (Primary & Secondary Roads)	550	15.71%	690	16.43%	25%
Water and Sanitation (excluding rural) *3	150	4.29%	180	4.29%	20%
Power & Electricity	120	3.43%	160	3.81%	33%
Post & Telecommunications	60	1.71%	75	1.79%	25%
Sub-Total	880	25.14%	1,105	26.31%	26%
Services & Cross Spectral Programmes					
Gender Mainstreaming	30	0.86%	40	0.95%	33%
Tourism	30	0.86%	45	1.07%	50%
Environment and Conservation	100	2.86%	120	2.86%	20%
Community and Social Services	80	2.29%	100	2.38%	25%
Culture & Arts	30	0.86%	40	0.95%	33%
Governance & Administration	220	6.29%	270	6.43%	23%
Sub-Total	490	14.00%	615	14.64%	26%
Unallocated	200	5.71%			
Grand Total:	3,500	100.00%	4,200	100.00%	20%

*1: MTR:Mid-Term-Review

*2: Land Management and Planning, Land Mine Clear, Rural Roads, Rural Sector Policy and Administration, Rural Water & Sanitation

*3: Education and Training, River Development, Sector Policy and Planning, Waste Management, Urban Water Supply and Sanitation

Source：The Cambodia Aid Effectiveness Report 2008 by the Cambodia Rehabilitation and Development Board of the Council for the Development of Cambodia, November 2008

Table 3.1.19 Development Cooperation Disbursements by Sector 2005-2008

Unit: USD millions

Sector	2005		2006		2007 (prov)		2008 (est)	
	USD	%	USD	%	USD	%	USD	%
Social sectors								
Education	69.3	11.4	79.7	11.2	88.2	11.2	67.9	7.6
Health	110.3	18.1	109.0	15.3	111.2	14.1	106.0	11.9
HIV/AIDS	25.4	4.2	35.4	5	41.0	5.2	44.2	5.0
sub-total	205.0	33.7	224.1	31.5	240.4	30.5	218.1	24.6
Economic sectors								
Agriculture	33.8	5.5	123.5	17.3	43.3	5.5	53.6	6.0
Rural Development	**50.0**	**8.2**	**49.9**	**7.0**	**71.0**	**9.0**	**71.4**	**8.0**
Manufacturing, Mining & Trade	10.0	1.6	24.2	3.4	15.7	2.0	29.2	3.3
Urban Planning & Management	3.9	0.6	0.9	0.1	2.0	0.2	4.2	0.5
Banking and Business Services	12.7	2.1	9.7	1.4	15.6	2.0	11.5	1.3
sub-total	110.4	18.0	208.2	29.2	147.6	18.7	169.9	19.1
Infrastructure								
Transportation	73.9	12.1	54.8	7.7	99.2	12.5	170.5	19.2
Water and Sanitation (urban)	**24.5**	**4.0**	**18.2**	**2.6**	**17.4**	**2.2**	**26.6**	**3.0**
Energy, Power & Electricity	15.6	2.6	13.7	1.9	12.6	1.6	31.0	3.5
Information and Communications	0.9	0.1	9.9	1.4	31.3	4.0	1.8	0.2
sub-total	114.9	18.8	96.6	13.6	160.5	20.3	229.9	25.9
Services & cross-sectoral								
Gender	2.6	0.4	3.8	0.5	6.4	0.8	7.0	0.8
Tourism	1.2	0.2	2.5	0.4	3.0	0.4	6.1	0.7
Environment & Conservation	12.3	2.0	14.6	2.0	8.9	1.1	7.1	0.8
Community and Social Welfare	35.3	5.8	38.5	5.4	52.2	6.6	14.9	1.7
Culture & Arts	4.8	0.8	14.1	2.0	7.2	0.9	5.8	0.7
Governance & Administration	67.3	11.0	96.8	13.6	109.9	13.9	137.0	15.4
Budget & BoP Support	11.1	1.8	0.0	0.0	29.1	3.7	22.3	2.5
sub-total	134.6	22.0	170.3	23.9	216.7	27.4	200.2	22.5
Emergency & Food Aid	3.0	0.5	0.4	0.1	2.1	0.3	10.4	1.2
Other	42.0	6.9	13.4	1.9	23.3	2.9	59.5	6.7
Total Disbursements	610.0	100	713.2	100	790.4	100	887.9	100

Source：The Cambodia Aid Effectiveness Report 2008 by the Cambodia Rehabilitation and Development Board of the Council for the Development of Cambodia, November 2008

3) Budget of MRD

About 80% of revenues of Cambodia is appropriated for the current budget, and highly dependent on foreign assistance for about 80% of its development budget. For this reason, the financial base of the Department of Rural Water Supply (DRWS), which is responsible for rural water supply, and the Department of Rural Health Care (DRHC), which is responsible for rural sanitation and hygiene, are weak and most projects for rural water and sanitation have depended on the assistance from international organizations, such as ADB and UNICEF, or bilateral aid of the foreign governments.

Budgets for MRD, DRWS and DRHC from 2006 to 2010 are shown in **Table 3.1.20**. As reflected, although the total program budget for MRD, DRWS and DRHC have increased dramatically, the proportion of program budget to the total for DRWS and DRHC is about 11 and 4% respectively, revealing again the low priority for rural water and sanitation sector.

Table 3.1.20 Budgetary Allocation for MRD / DRWS / DRHC

Unit : Million Riel

	2006	2007	2008	2009	2010
MRD total	20,837	22,960	31,532	43,756	57,580
Program budget	n.a	13,530	16,290	24,003	34,634
Without program budget	n.a	7,302	6,670	7,529	9,122
-DRWS total	n.a	500	1,816	3,214	3,685
Program budget	n.a	500	1,816	3,214	3,685
Proportion to total MRD program budgets	n.a	3.7%	11.1%	13.4%	10.6%
-DRHC total	n.a	120	715	1,087	1,188
Program budget	n.a	120	715	1,087	1,188
Proportion to total MRD program budgets	n.a	0.9%	4.4%	4.5%	3.4%

Unit : Thousand USD

	2006	2007	2008	2009	2010
MRD total	5,209	5,740	7,883	10,939	14,395
Program budget	n.a	3,383	4,073	6,001	8,659
Without program budget	n.a	1,826	1,668	1,882	2,281
-DRWS total	n.a	125	454	804	921
Program budget	n.a	125	454	804	921
Proportion to total MRD program budgets	n.a	3.7%	11.1%	13.4%	10.6%
-DRHC total	n.a	30	179	272	297
Program budget	n.a	30	179	272	297
Proportion to total MRD program budgets	n.a	0.9%	4.4%	4.5%	3.4%

Exchange rate: 1USD=4000R

Source : MRD

3.1.3 Arsenic Contamination of Groundwater

(1) Extent of Arsenic Contamination

High levels of arsenic in tube-wells were first detected in Cambodia in 2001 during the National Drinking Water Quality Assessment Program supported by WHO, and conducted jointly by MRD and MIME in 1999 and 2000. This program screened about 100 urban and rural drinking water sources for toxic chemicals, and found arsenic in at least 11% of water samples from 13 provinces along the major rivers of the country; namely, the Mekong, Bassac and Tonle Sap rivers.

As a result, the Government set up the Arsenic Inter Ministerial Sub-Committee (AISC) on 2002 to respond and develop a Government policy, and initiated an emergency Arsenic Mitigation Program. Further, an arsenic information center has already been set up at MRD, the secretariat for the AISC, with the active involvement of the five related ministries. The database is centrally managed by the MRD and it is now stationed at the Arsenic Information Centre. Also, a five year Strategic Action Plan, the latest version of which is Ver.10, summarized in the table below, was developed in 2006 by the Royal Government of Cambodia supported by UNICEF and WSP.

Table 3.1.21 Summary of Strategic Action Plan 2006

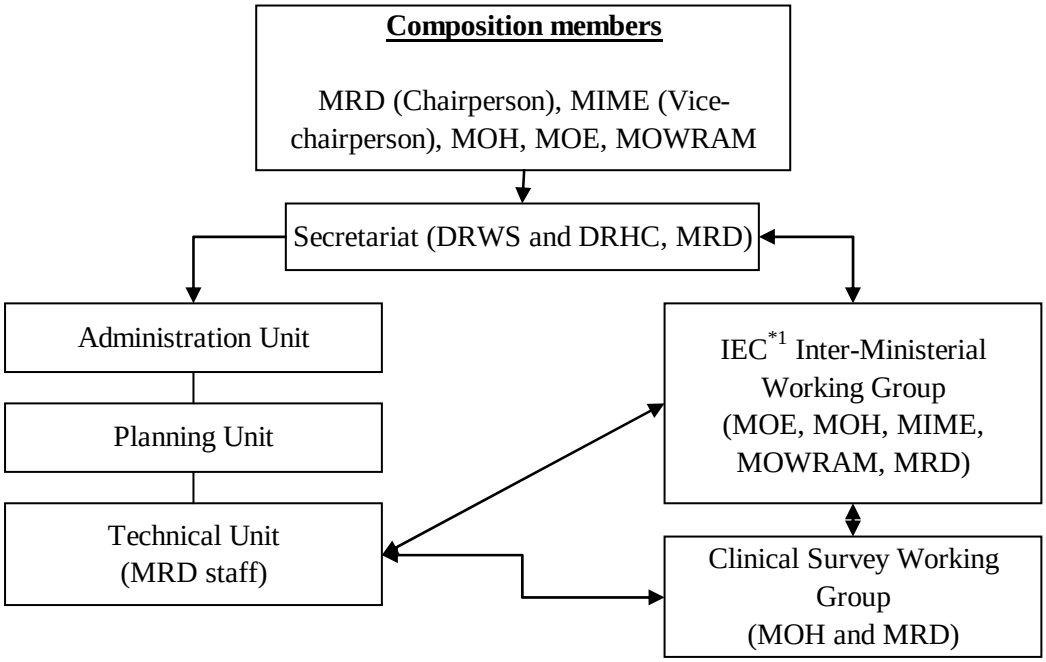
Objective	1. To ensure at least a 75% reduction in the number of people consuming arsenic contaminated water in the high risk areas of Cambodia by the year of 2011. 2. To understand the scale and extent of the arsenic contamination problem, exposure of the population, incidence of arsenicosis in the population, and effectiveness of the arsenic mitigation programs so that the Royal Government of Cambodia can plan and effectively respond to the situation. 3. To ensure that within 5 years, there will be a case detection, management and surveillance system that ensures that all people with arsenic related health problems living in high risk areas receive treatment.
Strategy	1.1 Well screening and marking of wells to identify contaminated wells 1.2 Community IEC for behaviour change: to stop people drinking from contaminated wells 1.3 Advocacy at all levels of government for them to recognize to play an active role and appropriately prioritize the arsenic contamination issue 1.4 Control the construction of shallow-tube wells in arsenic affected areas 1.5 Development of an institutional environment that enables that provisions of alternative safe water in arsenic affected areas 1.6 Provision of alternative safe water in key areas 2.1 Collate, manage and interpret data collected by arsenic screening , IEC and public health 2.2 Undertake specific investigations of groundwater contamination, consumption, IEC, incidence of arsenicosis, and treatment (case management) 2.3 Manage and disseminate knowledge 3.1 Target and Self-Referral Case Detection system 3-2 Case Confirmation / Referral System 3-3 Case Management 3-4 Case Surveillance to monitor the trend of arsenicosis or to follow up patients for clinical management

Source：Arsenic Contamination of Groundwater in Cambodia, Strategic Action Plan 2006, Version 10

(2) Arsenic Inter Ministerial Sub-Committee: AISC

As mentioned earlier, AISC was established in 2002 and it includes members from MRD, MIME, MOH, MOE and MOWRAM, as shown in **Figure 3.1.4.** The AISC has the following roles and responsibilities:

- Data collection and analysis of drinking water in rural areas
- Mapping high arsenic areas
- Operational research on arsenic in drinking water
- Develop strategic plans and action plans for mitigation of arsenic in drinking water
- Develop arsenic information, education and communication materials
- Undertake and coordinate education and information campaigns in the arsenic affected communities

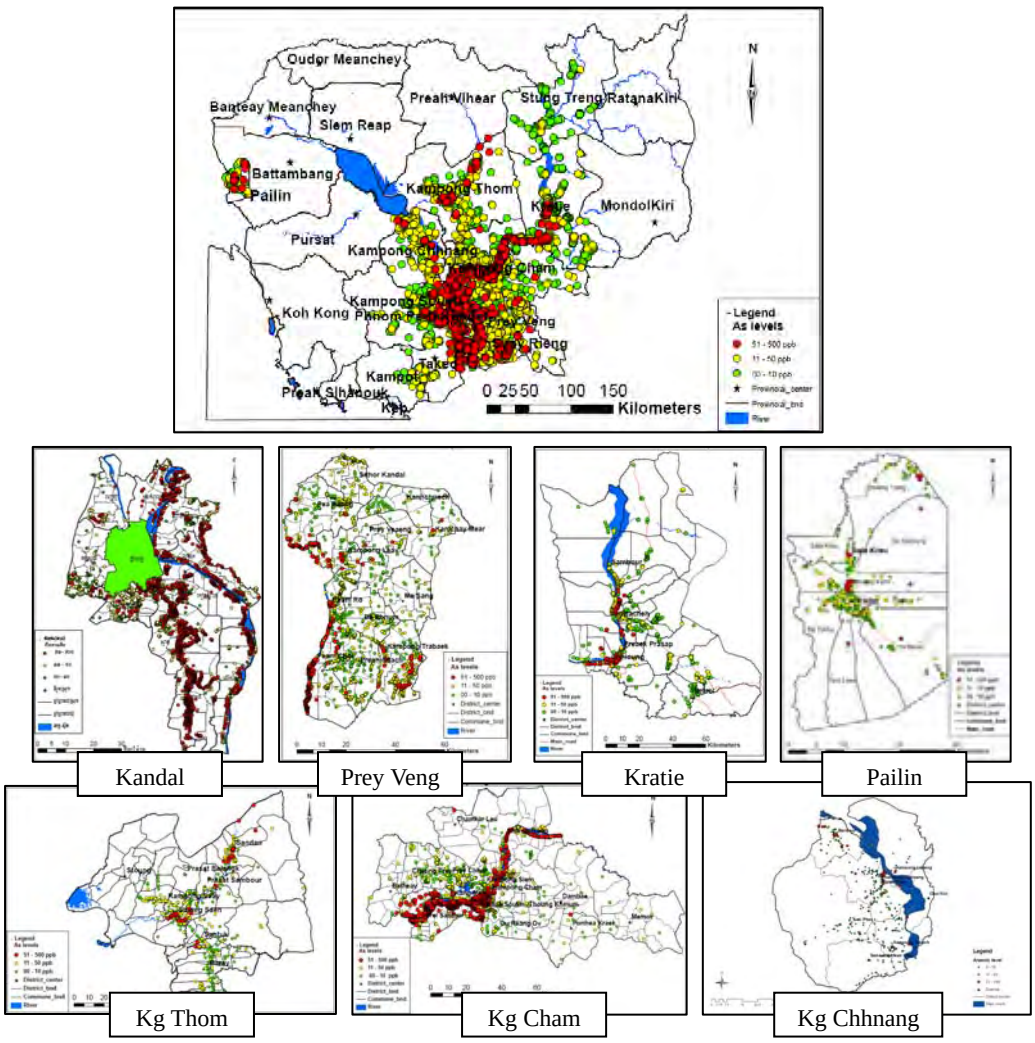


*1: Information, Education and Communication

Figure 3.1.4 Organization Chart of AISC

(3) Arsenic Risk Map

MRD has conducted water quality testing supported by UNICEF from 2003 to 2005 in approximately 16,000 tube wells in 16 provinces. As a result, an estimated 320,000 people in 1,607 villages located in 49 districts of 7 provinces: Kandal, Kompong Cham, Kompong Chhnang, Kompong Thom, Kratie, Phnom Penh (peri-urban area) and Prey Veng - bordering the Mekong and the Bassac rivers were found to be at risk. Alarmingly, arsenic concentrations as high as 1,300 ppb were measured in the Mekong delta south of the capital, Phnom Penh, far in excess of the national standard of 50ppb. In addition, tube well water for arsenic has identified the risk of arsenic contamination in Pailin, western Cambodia. Arsenic risk maps of the whole of Cambodia and of the 7 provinces which were identified as arsenic risk areas are shown in **Figure 3.1.5**.



Source：Annual Report 2009, prepared for the Arsenic Inter-Ministerial Sub-Committee, Arsenic Secretariat, MRD

Figure 3.1.5 Arsenic Risk Maps for the Whole of Cambodia and 7 Provinces

(4) Key Activities Completed for Awareness Raising

The following key activities related to arsenic mitigation have successfully been implemented and described in the Final Report of Evaluation of Arsenic Mitigation in Four Countries of the Greater Mekong Region by UNICEF–AusAID, December 2008.

- The formation of the AISC to coordinate the government's response
- Development of the national Strategic Action Plan for arsenic mitigation activities, established clear lines of responsibility and set goals and targets to effectively monitor the program's progress
- A Knowledge Attitudes and Practices (KAP) survey was conducted to evaluate the progress and effectiveness of the arsenic mitigation activities.
- 37,200 water samples have been tested.
- Blanket testing has been completed in 1,607 high risk villages.

- IEC materials were revised and a moderate message has been adopted instead of focusing on negative health impacts of consuming arsenic contaminated water.
- Active involvement of research institutions to carry out different studies to make arsenic mitigation activities sustainable
- The arsenicosis patient management guideline was adopted from the existing WHO guidelines for use in Cambodia, and accordingly, the patient management initiative was started in Cambodia.
- Public-private partnerships have been initiated to ensure more rapid safe water coverage
- As a result of the Alternative Safe Water Options activities, 12,000 people have gained access to safe water
- Identified arsenicosis patients have been provided alternative safe water options and are no longer consuming arsenic contaminated water
- A National Arsenic Centre has been established for better coordination of arsenic mitigation activities.

Moreover, community-based education in 2008 through the Arsenic Mitigation Program implemented by MRD and supported by UNICEF is shown in **Table 3.1.22**.

Table 3.1.22 Summary Results of Community Based Education (2008)

Province	District	Commune	Village	Village facilitator	Community Participation		
					M	F	Total
Kandal	3	23	122	539	18768	28235	47003
Kampong Cham	1	5	44	140	2035	4298	6333
Prey Veng	5	10	45	253	4109	5897	10006
Total	**9**	**38**	**211**	**932**	**24912**	**38430**	**63342**

Source：Annual Report 2009, prepared for the Arsenic Inter-Ministerial Sub-Committee, Arsenic Secretariat, MRD

(5) Provision of Safe Water Alternatives

There are various alternative water sources in arsenic affected groundwater areas. Common options for an alternative source are shown in **Table 3.1.24.** Alternative source selected by informed choice method of beneficiaries in 2008 are shown in **Table 3.1.23**.

Table 3.1.23 Alternative Source Selected by Beneficiaries using the Informed Choice Method in 2008

Province	Ceramic Filter	Protected Dug Well	Rainwater Jar	Simple Water Treatment for Family	Rainwater Tank for School
Kandal	-	12	-	158	22
Kratie	65	-	-	65	-
Prey Veng	600	-	220	820	-
Total	665	12	220	665	22

Source：Annual Report 2009, prepared for the Arsenic Inter-Ministerial Sub-Committee, Arsenic Secretariat, MRD

6）Arsenic Mitigation Program (2010)

The outline of Arsenic Mitigation Program in 2010 implemented by MRD and supported by UNICEF is shown in **Table 3.1.25**.

Table 3.1.24 Common Alternative Water Source

Type	Small-piped Water Supply Facility	RainwaterTank and Container	Protected Dug Well	Individual Use (surface water + simple water filter)
Photo	 Small treatment plant	 Rainwater tank (V: 7m3)  Rainwater tank (V: 35m3)  Ring tank  Rain water jar  Water jar	 Protected dug well with hand pump	 Simple filter  Ceramic filter  Bio-sand filter  Boil water
Setting Location	**Location**：5 places, Kaoh Thom & S'ang district, Kandal province **Facility**：a. water source is river water, b. water treatment plant (capacity: 9m^3/hr, 11m^3/hr), Reservoir tank, Distribution network **Operator**：Local private entrepreneurs supervised by commune council **Construction Budget**：own budget of private and financial support from GRET and UNICEF	(i) 16 rainwater tanks with 4m^3 capacity subsidized to families; 120 rainwater jars provided to families; and 100 families supported to improve traditional rainwater jars in Prey Veng. (ii) 30 rainwater collection systems with 35m^3 capacity provided to primary schools and health centers- 12 Kampong Thom, 8 Kampong Cham, and 10 Prey Veng. (iii) 665 ceramic filters were subsidized to families and 22 schools in Kandal, Kratie and Prey Veng.	12 dug wells equipped with hand pump subsidized to 158 families in Lvea Thong village, Kandal province.	After the training, 5 communes with a total of 24 villages in Kratie, Kampong Chhnang, Kampong Cham and Pailin were selected to promote this new approach. 343 community facilitators trained to be the village leaders to work with their community to discuss, identified and take action. Of those, 36 were proactive after the campaign, and it was observed that 153 families bought ceramic filters, 31 families made bio-sand filters and around 80% of families participated in the campaign reported to regularly boil water.

Source：Annual Report 2009, prepared for the Arsenic Inter-Ministerial Sub-Committee, Arsenic Secretariat, MRD

Table 3.1.25 Arsenic Mitigation Program (2010) by MRD

CP output	Annual target	Activities	Budget (US$)
-	-	AISC coordination meeting	6,480.00
		Monitoring activities by national staff	6,320,00
		Capacity building at MRD and PDRD on water quality and arsenic mitigation management ・ Refresher training on water safety plan ・ Training water quality management and hygiene in schools ・ Capacity building to local government and private investor on simple water safety plan to enable them to monitor and to supply water with enough quantity and good quality in the selected provinces	10,510.00
		Monitoring and Evaluation ・ Data management ・ Assess their knowledge of arsenic, what actions they've taken in their respective region, and what support they've received from organizations and higher government (in terms of education and tools to find solutions) ・ Development of an institutional environment that enables the provision of alternative safe water in arsenic affected areas: assessment capacity of local private water supply.	18,000.00
50 percent of families living in arsenic high risk areas are informed of arsenic contamination and 30 percent used alternative arsenic free water supply facilities.	Approximately 50% of local authorities (Commune Councils) in the at risk areas reached by advocacy on arsenic mitigation.	Families living in high risk areas are informed of arsenic contamination and use of the household arsenic mitigation system. (i) Review and print IEC materials for advocacy forum (supplied by UNICEF) (ii) Advocacy forum organized at the district and commune (150 communes will organize meetings to inform about arsenic issues, to discuss arsenic related activities and to advocate arsenic issue into the commune development plan)	23,000.00
	In the At Risk areas the percentage of families having tube wells with arsenic content higher than 50 ppb will increase alternative water supply from 19 % in 2009 to 30 %.	Families living in high risk areas targeted; approximately 22,000 families use alternative free water supply ・ Provision of alternative safe water technology ・ Rainwater collection system ・ Ceramic filter In selected villages, school and health centre	50,000.00
-	-	Water quality improvement review Implementation in 2009, pilot activity in school, health center, and pagoda in collaboration with ITC and NGOs	31,000.00
-	-	Operation	15,442.00

3.2 Current Status of Water Supply Sector Implementation Structure

3.2.1 Urban Area Water Supply

Work jurisdiction of central government agencies related to water supply sector is shown in **Table 3.2.1**.

Table 3.2.1 Agencies Related to Water Supply Sector

Name of Agency	Roles and Functions
Ministry of Water Resources and Meteorology: MOWRAM	Water Resource Management
Ministry of Environment: MOE	Preparation of national environmental management plan and related policies Management of preservation areas and natural resources Environment observation and monitoring Review of EIA
Ministry of Industry, Mines and Energy: MIME	Water supply to urban area Management of hydraulic power station
Ministry of Rural Development: MRD	Water supply to rural area

As shown in the above table, there are two executing agencies related to water supply service:

- MINE: For Urban Water Supply; and
- MRD: For Rural Water Supply

These two agencies exchanged notice regarding piped water supply service on February 2005. The "Notice on Water Supply Service" translated from Khmer language to English is attached as an **Appendix A 1.3**.

Jurisdiction of MIME：
- Piped water supply service in urban area, including public and private management projects
- Small-scale rural piped water supply service operated by private management as a profit-making project

Jurisdiction of MRD：
- Small-scale rural piped water supply service which is managed by a Commune/Sangkat as a non-profit-making project

As aforementioned, urban water supply service is under the jurisdiction of the Department of Potable Water Supply (DPWS) in MIME. The organization chart of DPWS and MIME is illustrated in **Figure 3.2.1** and **Figure 3.2.2**, respectively.

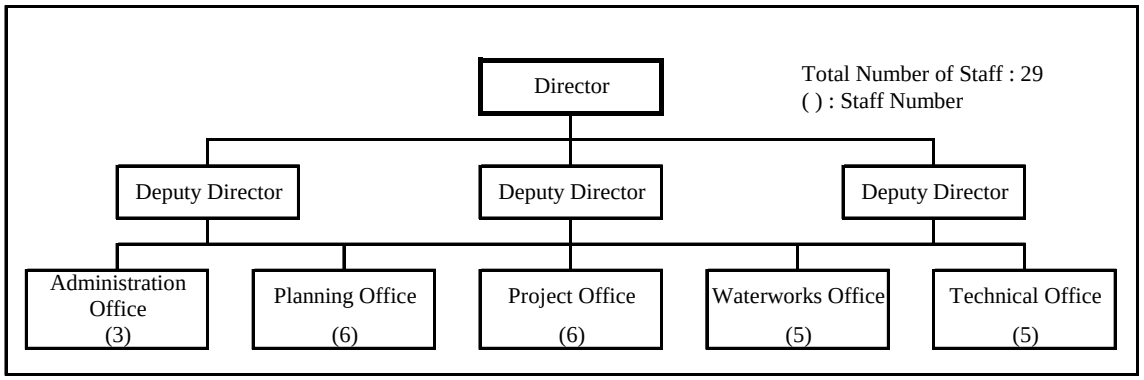


Figure 3.2.1 Organization Chart of DPWS in DPWS

Urban water supply service has been managed by public and private sector. These water supply projects in 22 provinces excluding projects in Phnom Penh and Kandal province are directly managed by the Department of Industry, Mines and Energy (DIME), the branch office of MIME. Provincial-wise current status of urban water supply and organizational structure of DIME is detailed in Chapter 4.

Provincial DIME office conducts O&M of public managed urban water supply projects. Further, it also undertakes the following activities for private managed urban water supply projects planned and operated within the province.

- Water analysis every three months – water samples sent to the laboratory of MIME
- Non-regular observation on operational status of water supply facilities to give instructions
- Application of water tariff increase
- Application of license related to new project

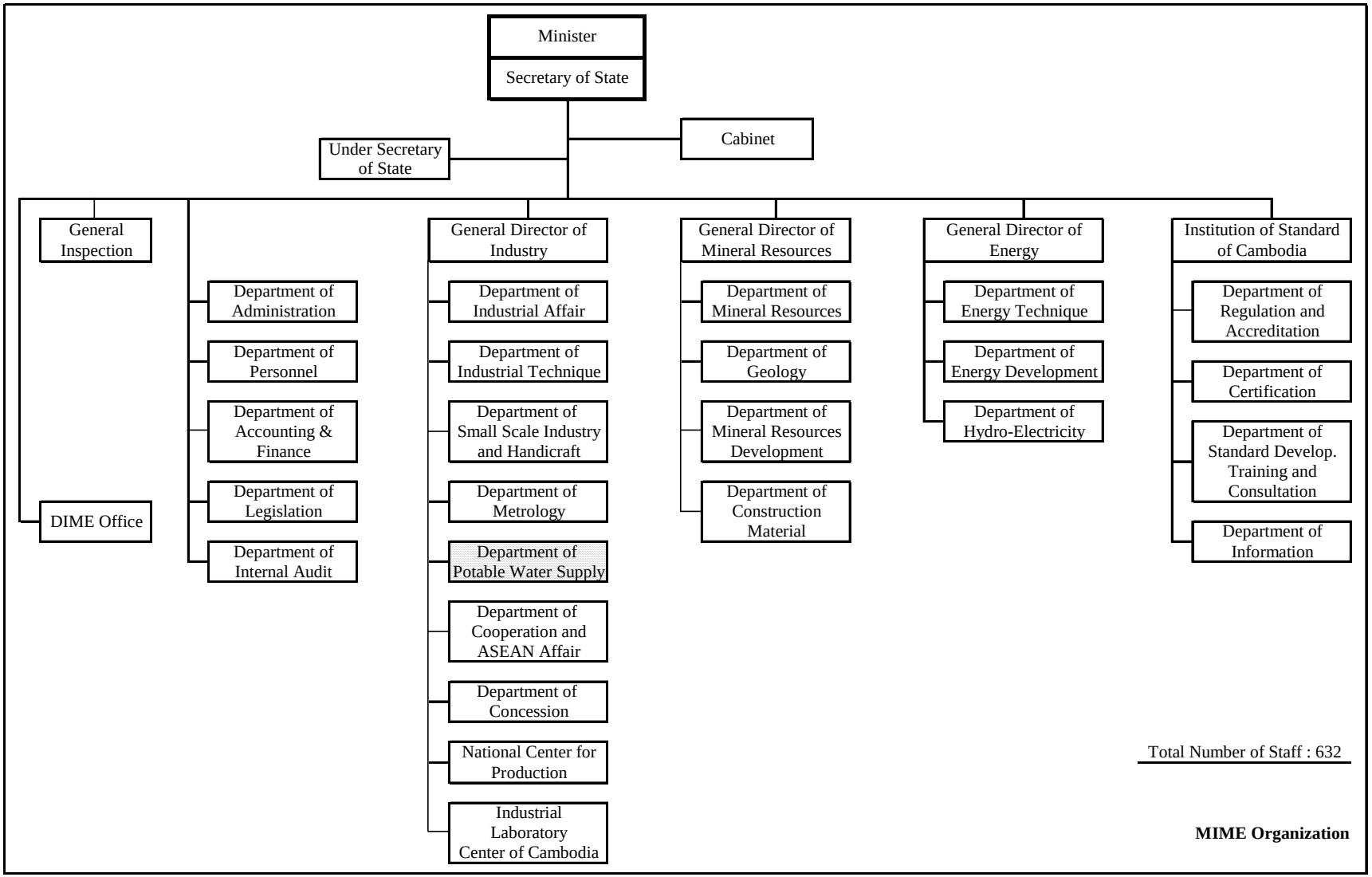


Figure 3.2.2 Organization Chart of MIME

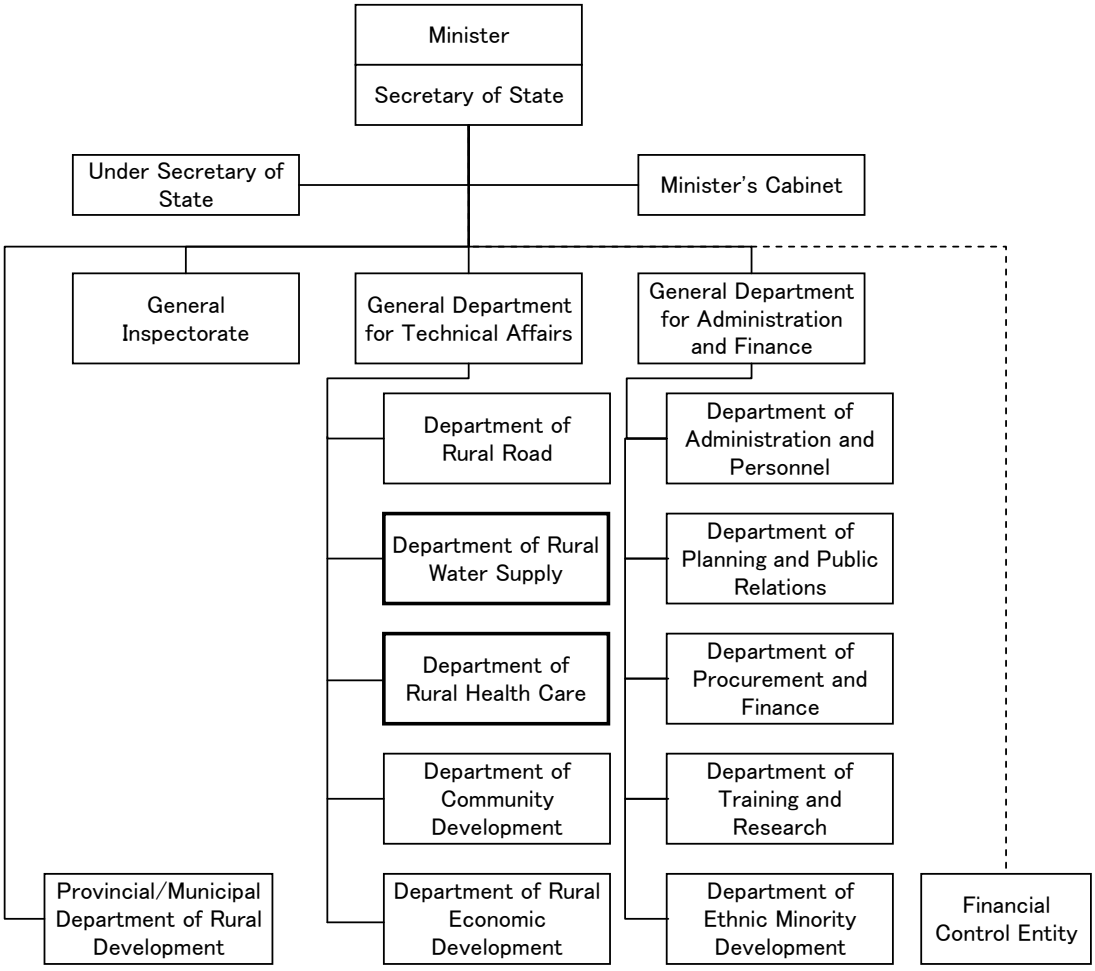
3.2.2 Rural Water Supply and Sanitation

(1) Central Government Level

1) Ministry of Rural Development

The Ministry of Rural Development (MRD) was established in 1993 for improving living standards and alleviating rural poverty and is organized as shown in **Figure 3.2.3.**

DRWS and DRHC, which both belong to General Department for Technical Affairs, is responsible for rural water supply, and rural sanitation and hygiene, respectively.



Source : MRD

Figure 3.2.3 Organization Chart of MRD

2) DRWS

DRWS is responsible for rural water supply and its duty is stipulated as follows in National Policy.

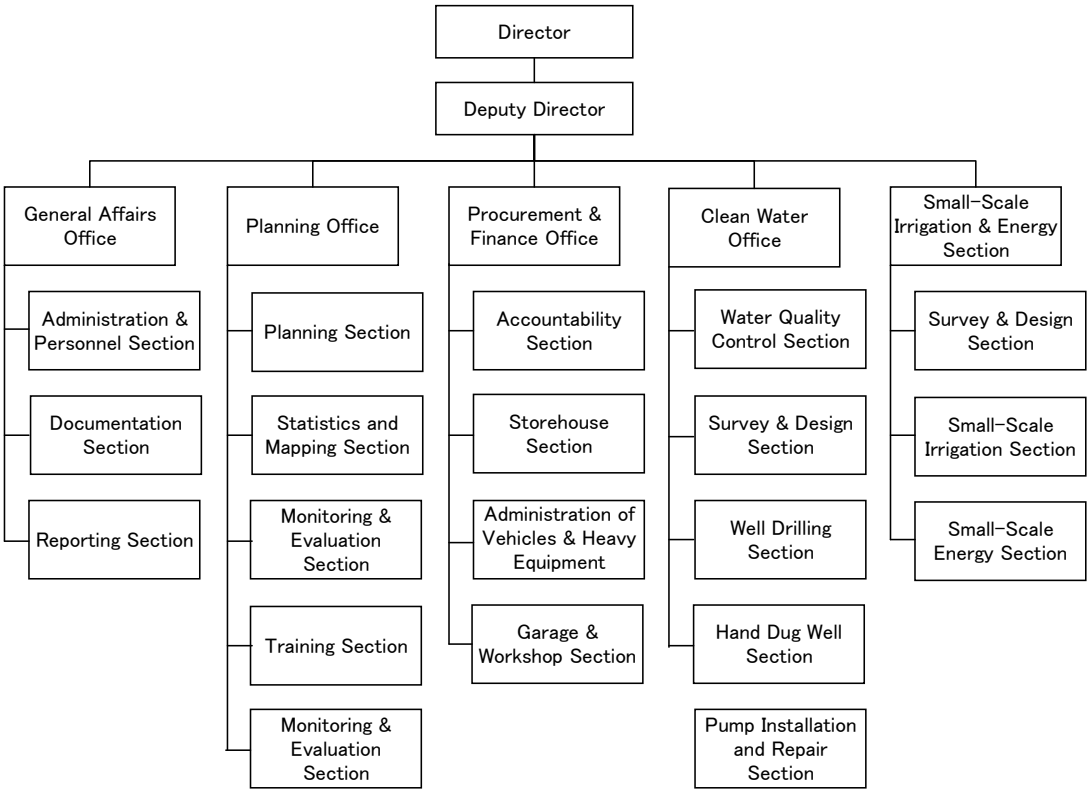
- Establish an independent regulatory body to facilitate active participation by communities and service providers in sector-related interventions

- Secure financing for the sector
- Formulate, disseminate, and implement RWSS policies, regulations, and strategies
- Prepare plans for putting the policy into practice
- Coordinate internal and external assistance, and sector interventions
- Develop and promote technical assistance in the field of human resource development, research, and community education programmes
- Develop and strengthen mechanisms or systems for monitoring and evaluating the performance of the sector to ensure that progress towards the sector vision is on target
- Establish drinking water quality standards, and monitor and assess the quality of drinking water sources

National Policy sets the role of DRWS/MRD as a facilitator of the sector and rural water supply projects are not directly implemented by DRWS. However, the Policy was amended in the Cabinet Meeting on 17 September 2004. The Government adopted the following amendments submitted by MRD.

(The contents of the amendment)
The central government will act as an initiator to ensure the provision of rural water supply and sanitation services in the country and the step-wise approach in promoting private sector participation as well as strengthening their capacity. The government must provide rural water supply services to poor communities in an emergency case and in any area where the private sector is not able to supply.

The organization chart of DRWS is shown in **Figure 3.2.4** which consists of 5 departments: General Affairs Office, Planning Office, Procurement & Finance Office, Clean Water Office and Small-Scale Irrigation & Energy Section. It has a total staff of 83 as shown in **Table 3.2.2**.



Source：MRD

Figure 3.2.4 Organization Chart of DRWS

Table 3.2.2 Number of Staff, DRWS

Department	No. of Staff
Director	1
Deputy Director	11
General Affairs Office	20
Planning Office	4
Procurement & Finance Office	13
Clean Water Office	29
Small-Scale Irrigation & Energy Section	5
Total	83

Source：MRD

3) DRHC

DRHC is one of the technical departments, which has a mission to participate in improving the health and well-being of rural residents and is responsible for the following duties:

- To prepare short/medium/long-term plans for primary health care in community;

- To provide training in skills and knowledge of primary health care and sanitation to MRD staff and village volunteer health workers;
- To give health education and advice to the community about nutrition, women and children's health support, mental health care and disease prevention; and
- To actively improve rural environmental sanitation by promoting the construction of public and household sanitation latrines and educating villagers to keep their surroundings clean. The importance of only drinking water known to be clean must be constantly emphasized to families.

In addition, the main activities of DRHC are described below:

- Community-based HIV/AIDS awareness on prevention, care and support PLWHA (People Living with HIV/AIDS)
- Water Use and Hygiene Education (WUHE)
- Rural Sanitation, including latrine construction, in both households and public places and cleaning house compounds
- Primary Mental Health, both adults and children
- Primary Health Care activities
- Eye care activities
- Community training and refresher training to VHVs

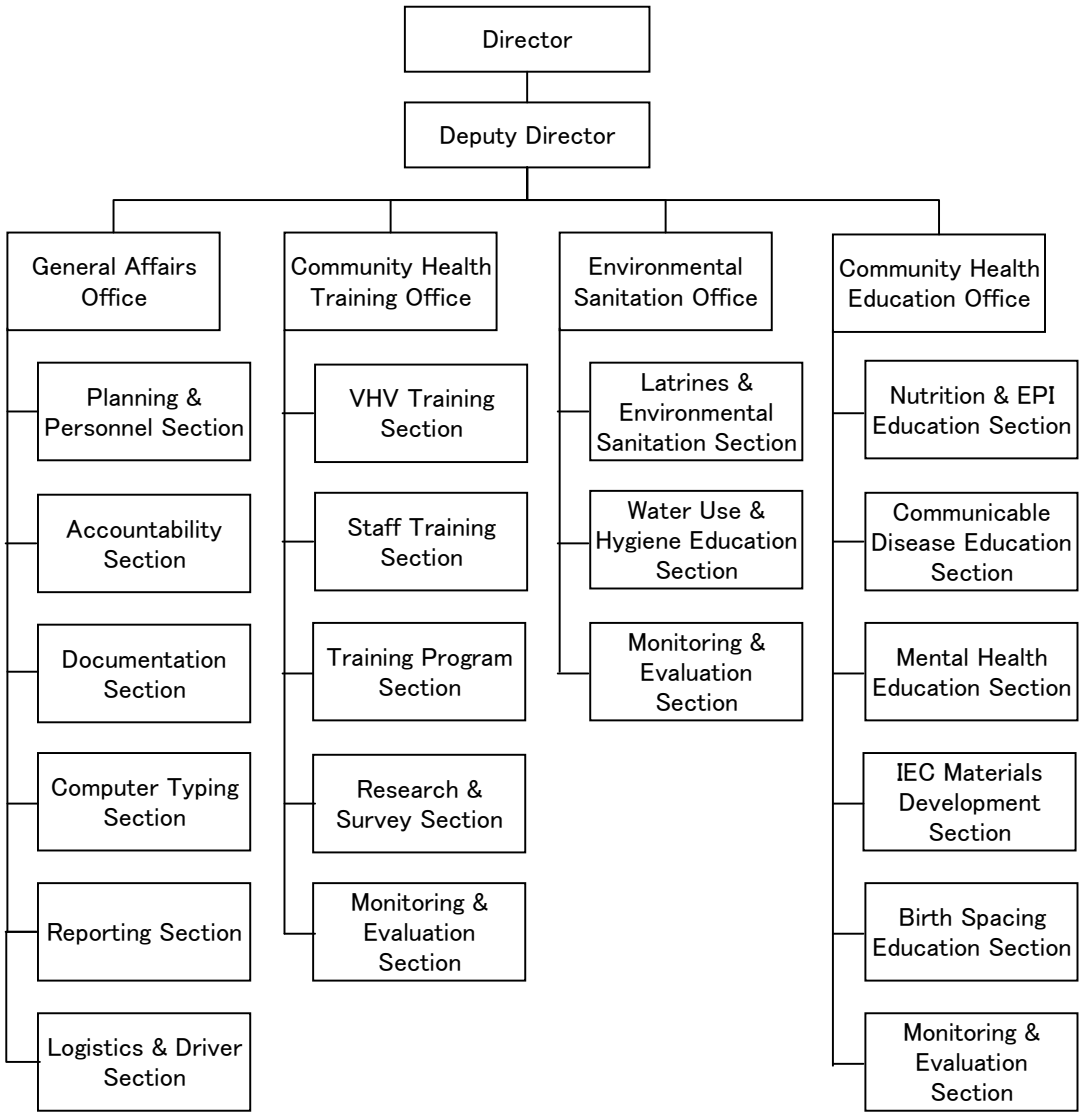
As mentioned above, particularly in the rural sanitation and hygiene sector, DRHC has adopted three methods for improved rural sanitation and hygiene behavior as shown in **Table 3.2.3.**

Table 3.2.3 Improved Sanitation and Hygiene Practice by DRHC

Method	Outline
Community-Led Total Sanitation: (CLTS)	CLTS takes a community-based approach to achieving 100% sanitation coverage. It adopts the principle that the community has the resources and ability to address sanitation problems if it comprehends the nature of the associated health and environmental problems of open defecation. It originates from Kamal Kar's evaluation of WaterAid Bangladesh and their local partner organization – VERC's (Village Education Resource Centre is a local NGO) traditional water and sanitation programme and his subsequent work in Bangladesh in late 1999 and into 2000. This led to the discovery of the CLTS approach in which use of PRA methods enables local communities to analyze their sanitation conditions and collectively internalise the terrible impact of open defecation on public health and on the entire neighborhood environment. In Cambodia, CLTS was introduced through a water supply and sanitation project by UNICEF and Plan International (NGO) in 2006. CLTS has spread to other organizations in Bangladesh and to other countries in South and South East Asia, Africa, Latin America and the

	Middle East. Committed champions in organisations have played a crucial part. To date, CLTS has taken hold most in Bangladesh, India, Cambodia, Indonesia and Pakistan. It has also been introduced through these trainings with varying degrees of take up in China, Mongolia, and Nepal. More recently it has been sparked off with promising starts in Ethiopia, Kenya, Zambia and other countries in Africa, in Bolivia in South America, and Yemen in the Middle East.
Participatory Hygiene and Sanitation Transformation: (PHAST)	PHAST is an innovative approach to promoting hygiene, sanitation and community management of water and sanitation facilities. It is an adaptation of the Self-esteem, Associative strengths, Resourcefulness, Action-planning, and Responsibility (SARAR) methodology of participatory learning, which builds on people's innate ability to address and resolve their own problems. It aims to empower communities to manage their water and to control sanitation-related diseases, and it does so by promoting health awareness and understanding which, in turn, lead to environmental and behavioural improvements. PHAST method mainly consists of 7 steps: (i) problem identification, (ii) problem analysis, (iii) planning for solutions, (iv) selecting options, (v) planning for new facilities and behaviour change, (vi) planning for monitoring and evaluation, (vii) participatory evaluation. DRHC has developed PHAST kits supported by UNICEF and has actively promoted use of it for water supply and sanitation projects by the ADB and UNICEF.
School and Community Water, Sanitation and Hygiene: (SC WASH)	School and Community WASH is an approach to achieve no open defecation practices and ensure use of latrine by all with the initiation from school and its surrounding communities. The main objective of SC WASH is to bring about a synergistic effect at both schools and its catchment communities by elimination of open defecation practices through the construction and use of latrines and enhancing children's behavior change on sanitation and hygiene practices. Currently, this approach is adopted by water and sanitation projects supported by UNICEF and has been reported to be effective.

The organization chart of DRHC is shown in **Figure 3.2.5** which consists of four departments. These are the General Affairs Office, Planning Office, Community Health Training Office, Environmental Sanitation Office, and Community Health Education Office with a total staff of 56.



Source : MRD

Figure 3.2.5 Organization Chart for DRHC

4) Water and Sanitation (WATSAN) Working Group

Water and Sanitation Working Group was established in 1994 and aims at making policy and giving advice on the water and sanitation sector in Cambodia. It includes members from MRD, MOH, MOWRAM, MIME, WSP, UNICEF, WHO and NGOs, and is chaired by the director of DRW. The Group has monthly meetings to disuses initiatives in the WSS sector.

In this working group, there are three sub-committees such as WUHE (Water Use and Hygiene Education) Committee, Drinking Water Quality Working Group and Rural Sanitation. However, since it is a non-regional organization and the chairman is the director of DRWS, it is mainly concerned with information for rural water and sanitation by among MRD, donors

and NGOs, and is not functioning as an organization for the water and sanitation sector for the whole of Cambodia.

5) Technical Working Group for Rural Water Supply, Sanitation and Hygiene (TWG-RWSSH)

The TWG-RWSSH, established in 2007, is an inter-ministerial working group comprising senior representatives from government agencies and development partners active in the sector and its members are mainly made up from MRD、MIME、MOWRAM、ADB、UNICEF、WSP and chaired by MRD Minister. Currently, the Group is preparing "Rural Water Supply, Sanitation and Hygiene Strategy (2010-2025)" supported by ADB, UNICEF and World Bank's Water and Sanitation Program and is due for approval by June 2010.

(2) Provincial Government Level

1) Provincial Rural Development Committees (PRDC)

The Provincial Rural Development Committee (PRDC) is responsible for rural development planning at the provincial level by national policy on water supply and sanitation. This role includes the following responsibilities:

- Collect necessary planning data and information
- Prepare provincial development plans and related budgets
- Facilitate, monitor and evaluate all rural development programmes and projects
- Provide support to inter-department cooperation and coordination in the field of RWSS services at the provincial level
- Provide support to the development of the private sector, especially the development of RWSS sector
- Establish commune Rural Development Committees
- Certify Village Development Committees (VDCs)
- Provide rural water supply services to poor communities in an emergency case and in any area where the private sector does not have possible to supply

PRDCs are chaired by the provincial governor and comprise the directors of seven provincial line agencies: MOH, MOWA, MRD, MOAFF, MOWRAM, MOP and MOI.

2) Provincial Department of Rural Development (PDRD)

Provincial Departments of Rural Development (PDRD) are line agencies at the sub-national level for MRD and are responsible for implementing and coordinating all MRD-supported activities within each province. PDRDs are mainly comprised of six sections. These are rural water supply, rural health care, rural credit, rural roads, rural community development, and administration and finance.

3) District Office of Rural Development (DORD)

District Offices of Rural Development (DORD) are line agencies at the sub-national level for MRD and are responsible for implementing and coordinating all MRD-supported activities at the district level.

4) Commune Councils

Commune councils are responsible for the planning, implementation, and financing of rural infrastructure in accordance with the Law on Khum/Sangkat Administration Management (2001) legislated under de-centralization and de-concentration (D&D) strategy framework. The Councils prepare, prioritize and formulate their needs and annual plans and submit it to PRDC or its equivalent.

5) Village

The village is the minimum administration units in Cambodia. A village chief appointed by the Ministry of Interior is nominally in charge of village affairs. Village development committees (VDCs) established under Seila Program supported by UNDP are responsible for a range of rural development.

6) Water and Sanitation User Groups (WSUGs)

Water and sanitation user groups (WSUGs) are responsible for managing, operating, and maintaining communal RWSS facilities in order to ensure the sustainability and transparency of RWSS service at the community level defined by national policy on water supply and sanitation. MRD set “Guideline on WSUG” and has specified establishment method, organization and role of members.

3.3 Development Policy for Water Sector

3.3.1 National Development Policy

(1) Fundamental Plans

In 2004, Prime Minister Samdech Hun Sen declared “Rectangular Strategy” as a national development policy. The strategy prioritized areas of concern to be addressed by the Government.

I. Enhancement of the agriculture sector
II. Further rehabilitation and construction of physical infrastructure
III. Private sector development and employment
IV. Capacity building and human resource development

Under the second area of concern, the strategy on water resource and irrigation system management is described as follows:

- The Cambodian government will facilitate accessibility to clean water supply system to secure safe food and better life in line with the Cambodia Millennium Development Goals (CMDG). The Government will also preserve aqua-environment.
- The Cambodia government will accelerate privatization in the development and management of irrigation system and water supply system.

1) Rectangular Strategy for Growth, Employment, Equity and Efficiency Phase II, 26 September 2008

The Rectangular Strategy has been formulated as an integrated structure of interlocking rectangles at the first cabinet meeting of the third term in 2004. To summarize, the components of the Rectangular Strategy are as follows:

(i) the core of the Rectangular Strategy is Good Governance, focused on four reform areas: (1) fighting corruption; (2) legal and judicial reform; (3) public administration reform including decentralization and deconcentration; and (4) reform of the Royal Cambodian armed forces.

(ii) the environment for the implementation of the Rectangular Strategy consists of four elements: (1) peace, political stability, security and social order; (2) Cambodia's integration into the region and the world; (3) partnership in development with all stakeholders, including the private sector, donor community and civil society; and (4) favorable macro-economic and financial environment.

(iii) the four strategic "growth rectangles" are: (1) enhancement of the agricultural sector; (2) further rehabilitation and construction of physical infrastructure; (3) private sector development and employment; and (4) capacity building and human resource development.

The water and sanitation sector is classified in “Side 2: Water Resources and Irrigation System

Management, Rectangle II: Further Rehabilitation and Construction of the Physical Infrastructure" and it focuses on: (i) providing all citizens with clean and safe water; (ii) protecting all citizens from water-related diseases; (iii) providing adequate water supply to ensure food security, economic activities and appropriate living standards; and (iv) ensuring water resources and an environment free from toxic elements, while enabling supportive fisheries and ecological system in the next 20 years.

In addition, Rectangular Strategy Phase II was announced by the Prime Minister at the Office of the Council of Ministries on 26 September 2008. It maintains the earlier structure and fine-tunes the prioritized policies of "Rectangular Strategy" of Phase I.

2) National Strategic Development Plan (NSDP), 2009-2013, November 2009

In Cambodia, the Country Development Plan has been formulated based on the two principal plans which are: the second Socio-Economic Development Plan (SEDP II), 2001-2005, and the National Poverty Reduction Strategy (NPRS), 2003-2005.

The Third Five-Year Development Plan for 2006-2010 was formulated to be the single, overarching, guiding**,** and reference national policy document for pursuing prioritized goals, targets and actions for the next five years. The new plan was renamed to be the National Strategic Development Plan (NSDP) 2006-2010. NSDP 2006-2010 was organized using the Rectangular Strategy framework and supported by the CMDGs. Currently, NSDP was extended to 2013 when the new government came into power in July 2008. In the extended NSDP, the sector goals for urban and rural water supply are set as shown in **Table 3.3.2** and **3.3.1**, respectively.

Table 3.3.1 Target of Rural Water and Sanitation Sector by NSDP

Indicators	2008 (Act.)	2009 (Est.)	2010 (Est.)	2011 (Est.)	2012 (Est.)	2013 (Est.)	2015 (CMDGs)
Access to improved drinking water - % of rural population	40.49	41.99	43.49	44.99	46.49	47.69	50.09
Access to sanitation - % of rural population	16.00	23.24	25.00	27.00	29.00	31.00	33.00

Source: ODA Country Book 2008 Cambodia by the Ministry of Foreign Affairs of Japan and National Strategic Development Plan, November 2009

3) Cambodian Millennium Development Goals (CMDGs), November 2003

The Cambodia Millennium Development Goals set the following indicators for the water and sanitation sector.

Table 3.3.2 CMDGs Targets for Water and Sanitation Sector

Indicators	1998 (Benchmarks)	2005 (Targets)	2010 (Targets)	2015 (Targets)
Proportion of urban population with access to safe water source (%)	60	68	74	80
Proportion of rural population with access to safe water source (%)	24	30	40	50
Proportion of urban population with access to improved sanitation (%)	49	59	67	74
Proportion of rural population with access to improved sanitation (%)	8.6	12	20	30

3.3.2 Upper Level Plan and Policy for Water Sector

(1) Water Sector in both urban and rural areas

Name	Outline
Water and Sanitation Sector Financing Strategy for Cambodia, National Water and Sanitation Sector Financing Strategy for Cambodia, Draft Final, March 2010	This strategy's purpose is: (i) to ensure that strategic development plans take into account the whole WSS sector incuding RWSS, (ii) to ensure that such plans are financially sustainable and affordable to the population by 2028, and (iii) to ensure increased and more harmonized International Finance Institution (IFI) and donor assistance.
National Policy on Water Supply and Sanitation. 9th June 2000 and 7th February 2003	This policy is comprised of three parts: Part I Urban Water Supply Policy; Part II Urban Sanitation Policy; and Part III Rural Water Supply and Sanitation Policy. Part I Urban Water Supply Policy contains : (i) water supply approaches; (ii) private sector participation; (iii) water tariff; (iv) protecting the poor and subsidies; (v) the autonomy of public utilities; and (vi) the water supply regulatory body. Part III Rural Water Supply and Sanitation Policy has its sector vision to sustain access to safe water supply and sanitation services and lives in a hygienic environment for every person in rural communities by 2025. Moreover, this part stipulates the roles and duties of central and provincial levels, WSUG, private sector and donors.

(2) Urban Area Water Supply

1) Cambodia Millennium Development Goals (CMDG)

At present, the lone target of MIME is to achieve the development goal described in CMDG to be completed in 2015 and so far no future development plan has been drawn up. CMDG aims at 80% accessibility to safe water until 2015 as explained in relation to the Rectangular Strategy.

MIME also prepared an action plan for the years 2009 to 2013 based on the National Strategic Development Plan. In Rectangular Strategy Phase II, four major items were raised for the water supply sector.

- Facilitation in employment of private sectors
- Renewal and rehabilitation of existing water supply facilities
- Support in access to safe water for low income group
- Dissemination of environment preservation and sanitary practice

The action plan proposes the following:

1. Regulations and Establishment of Partnership with Private Sector

- Prepare guidebook on the procedure and principles for investment in water supply sector
- Prepare the guidelines on the operation, production and distribution of water supply
- Review and study the cost policy of the private service providers
- Strengthen the regulatory capacity of the regulators of MIME and DIME
- Conduct the consultative meeting with the sub-national administration to delineate roles and responsibilities in regulating the water supply sector
- Prepare the necessary procedure and regulations for encouraging private investment in water supply sector
- Monitor and strengthen the contract implementation (DBL＆OBA) with operators in the 11 urban areas
- Promote the development and contract implementation of BOT with KTC (Korean private company) on the Project for expansion of Water Supply in Siem Reap
- Provide training and technical capacity building, basic management and bookkeeping to private service providers in cooperation with WSP
- Implement the small and medium enterprises development project on water supply sector in cooperation with USAID
- Promote the implementation of the public forum between government and private sector on water supply and sanitation

2. Reform and Management of the Public Waterworks

- Review and study the factors for improving and strengthening of the business efficiency, and governance of the waterworks
- Review and follow-up the progress of the implementation of the operation of the waterworks
- Monitor and study to determine the cost of water supply of the waterworks except the autonomous authorities
- Implement the project on capacity building for water supply system of the eight waterworks in cooperation with JICA
- Facilitate the establishment of the Cambodian Waterworks Association (CWWA）
- Implement the project on water supply expansion and sanitation to the four urban poor communities in cooperation with UN-HABITAT
- Study and prepare the water supply expansion and sanitation to the five urban poor communities with UN-HABITAT
- Study and prepare the project for the rehabilitation of Kratie and Stung Treng Waterworks in cooperation with ADB
- Implement the project for the rehabilitation and development of water supply in Triangular Area of Ratanak Kiri and Mondul Kiri under the Japanese Grant Aid
- Study and prepare the Siem Reap water supply expansion project in cooperation with JICA
- Implement the project for rehabilitation of old pipe network in Kampot in cooperation with GRET
- Implement the expansion of water supply and sanitation in Kampot in cooperation with UN-HABITAT
- Prepare and implement the project on old pipe replacement, new pipe expansion of water supply in the four provincial towns in cooperation with JICA
- Prepare and implement the capacity expansion project of water supply in Battambang in

cooperation with JICA ➢ Prepare and implement the capacity expansion project of water supply in Kampong Cham in cooperation with JICA ➢ Prepare and implement the capacity expansion project of water supply in Kampot in cooperation with JICA
3. Environment and Sanitation ➢ Promote and educate the communities on water supply and sanitation ➢ Lead and facilitate the preparation of integrated plan on environmental management and sanitation in five towns ➢ Implement the study on the institutional framework on environmental management and sanitation in cooperation with WB ➢ Implement the study on the financing strategies of environment, sanitation and water supply in cooperation with WSP

2) Action Plan in 2010

According to MIME, the following four items are proposed as action plan of the urban water supply sector in 2010:

1. Institutional Strengthening and Good Governance ➢ Review and reorganize the roles and responsibilities of water supply department and other departments in MIME ➢ Prepare job descriptions and standard operation procedure of each task of departments in MIME ➢ Review, re-assign the duties and strengthen the duty implementation and responsibilities of departments in MIME ➢ Continue strengthening and building the capacity of staff in administration and technical division ➢ Review the roles and responsibilities of provincial department, DIME
2. Improvement and Strengthening Regulations ➢ Prepare the procedure and guideline for the investment in water supply sector ➢ Develop the water tariff policy ➢ Prepare the policy on subsidy of the water connection for the poor ➢ Review and update the permit on the production business of water supply ➢ Strengthen the implementation of the permit on the production business of water supply ➢ Prepare the technical regulations and guidelines on the water quality improvement and production business of water supply ➢ Strengthen the enforcement of licensing of the private sector
3. Strengthening of Public Waterworks ➢ Strengthening and improving the efficiency of business and governance of the water works ➢ Continue administrating and follow -up the progress of waterworks ➢ Continue building the human resources in management and technology ➢ Establishment of Cambodia Water Works Association
4. Cooperation with Donor Agencies ➢ Continue the implementation of water supply system development projects with donor agencies ➢ Continue the submission of the development project proposals ➢ Enhance the public promotion on the benefits of clean water use ➢ Continue and intensify the capacity development of the private water supply operators

(3) Rural Water Supply Sector

Plans and Policies	Outline
Rural Water Supply and Sanitation Sector, Sector Investment Plan (2010-2025), June 2009	This plan is a sector investment plan which identifies the rural water supply and sanitation sector financing requirements in order to achieve the sector goals in 2025. Of the total $53.49 million of investment required to attain the 2015 RWSS CMDG, an estimated $41.70 million has been committed or is planned for investment in the sector from 2008 to 2015 by ADB and IMF. The funding gap for investment necessary to meet the 2015 CMDG targets for RWSS is estimated at $11.79 million. In addition, in order to attain the 2025 RWSS sector goals, $527.51 million (2015-2025) is estimated.
Rural Water Supply, Sanitation and Hygiene Strategy (2010-2025)	This strategy is under preparation and is due for approval by June 2010. It is supported by ADB, UNICEF and World Bank's Water and Sanitation Program through the Technical Working Group for Rural Water Supply, Sanitation and Hygiene. This strategy follows the "Water and Sanitation Sector Financing Strategy for Cambodia" and "Rural Water Supply and Sanitation Sector, Sector Investment Plan (2010-2025)" and is comprised of nine chapters: (i) definitions; (ii) scope; (iii) principles; (iv) situation analysis; (v) strategic objectives; (vi) strategic framework; (vii) strategic components; (viii) financing; and (ix) time frame.
National Hygiene Promotion Guideline	The main purpose of this guideline is to provide practical guidance for sub-national levels including PDRD, DORD, commune rural development committees (CDRC), village development committees (VDCs), health centre management committees (HCMC), commune communities for women and children, village facilitators, and non-governmental sector such as NGOs/CBOs (community-based organization)/FBOs (faith-based organizations), and private sector to jointly promote behavior change on safe hygiene practice regarding the three risk behaviors: (i) open defecation, (ii) not washing hands with soap before eating and preparing food, and after defecating, and (iii) drinking unsafe water. This guideline is under preparation and is due for approval by May 2010 and can be disseminated and promoted to all relevant sectors such as MRD, MOH, MOEYS, MOWA, MOI so that their respective sub-national level structures can use the guideline to promote safe hygiene practices in the community.
Guideline on Water and Sanitation User Group (WSUG), August 21, 2004)	Based on the Part III Rural Water Supply and Sanitation Policy, National Policy on Water Supply and Sanitation, MRD set this guideline which contains the objective of the organization, membership, criteria for selection, regular duties and responsibilities.

(4) Budget Strategic Plan

The Budget Strategic Plan and its budget requirement are reflected in **Table 3.3.3** and **3.3.4,** respectively.

The financial gap, when comparing the required budget to achieve this strategic development plan with the government budget in 2009, has increased 4.6 times for rural water supply and 3 times for rural sanitation. With these requirements, it would be difficult to achieve this development plan with only the government budget available.

Table 3.3.3 Budget Strategic Plan 2010-2012 for the MRD

Priority strategy of programme	Indicator of objective			
	Total	2010	2011	2012
Increase Rural Water Supply Facilities				
To construct new tubewells in rural areas	To construct 600 new wells in remote areas in 10 provinces	Construction of 180 tubewells	Construction of 240 tubewells	Construction of 180 tubewells
To maintain the un-functioning wells	To improve well rehabilitation for un-functioning wells which is 9,000 wells in 20 provinces	Rehabilitation of 3,000 tubewells	Rehabilitation of 3,000 tubewells	Rehabilitation of 3,000 tubewells
To repair hand dug wells	To repair 1,000 hand dug wells in 4 provinces	To repair 400 hand dug wells in 4 provinces	To repair 350 hand dug wells in 4 provinces	To repair 200 hand dug wells in 4 provinces
To upgrade community ponds	To construct 60 community ponds in 5 provinces	To construct 30 community ponds	To construct 15 community ponds	To construct 15 community ponds
To construct filter tanks	To construct 2,000 filter tanks in 5 provinces	To construct 700 filter tanks	To construct 600 filter tanks	To construct 700 filter tanks
To construct rain water collection tanks	To construct rain water collection tanks for 600 communities in 4 provinces	To construct rain water collection tanks for 300 communities	To construct rain water collection tanks for 150 communities	To construct rain water collection tanks for 30150 communities
Rural Hygiene and Sanitation Promotions				
To increase sanitation facility in 210 target villages in 21 provinces	Awareness promotion for construction and use of community HH latrine in 21 target provinces	Beneficiaries in 70 target villages will receive 3,654 HH latrines from Awareness promotion program financed by Royal Government of Cambodia and they understand and change their habit from open defecation, hygiene, drinking potable water and store water in a safe manner.	Beneficiaries in 70 target villages will receive 5,117 HH latrines from Awareness promotion program financed by Royal Government of Cambodia and they understand and change their habit from open defecation, hygiene, drinking potable water and store water in a safe manner.	Beneficiaries in 70 target villages will receive 7,168 HH latrines from Awareness promotion program financed by Royal Government of Cambodia and they understand and change their habit from open defecation, hygiene, drinking potable water and store water in a safe manner.
To create networks and capacity building for village volunteers in 210 target villages and PDRD staff in 21 provinces	To create networks and capacity building for 840 village volunteers, who will become a core person to disseminate sanitation promotion in their community	To create networks and capacity building for 280 village volunteers, who will become a core person to disseminate sanitation promotion in their community in 7 provinces: Pailin, Takeo, Kandal, Siem Reap, Kep, Stung Treng and Kratie	To create networks and capacity building for 280 village volunteers, who will become a core person to disseminate sanitation promotion in their community in 7 provinces: Ratanak Kiri, Mondol Kiri, Preah Vihear, Otdar Meanchey, Siem Reap, Kandal and Preah Sihanouk	To create networks and capacity building for 280 village volunteers, who will become a core person to disseminate sanitation promotion in their community in 7 provinces: Kampong Speu, Kampot, Otdar Meanchey, Svay Rieng, Prey Veng, Kok Konh and Preah Sihanouk

Source：Budget Strategic Plan 2010-2012 for the Ministry of Rural Development

Table 3.3.4 Program or Priority Strategy and Assistance Needs for MRD (2010-2012)

Program or Priority Strategy	Duration (Year)	Total Finances	Implemented Financials 2009	Financial Projection		
				Proposed Finances for 2010	Proposed Finances for 2011	Proposed Finances for 2012
Increase Rural Water Supply	3	38,965	3,214	12,781	14,789	11,395
To construct new tubwells in rural areas	3	6,150	864	1,845	2,460	1,845
To maintain un-functioning tubewells	3	7,840	1,950	2,744	2,744	2,352
To rehabiritate hand dug wells	3	2,350	0	750	800	800
To upgrade community ponds	3	5,350	150	2,194	2,556	600
To construct filter tanks	3	750	0	250	250	250
To construct rain water collection tanks	3	1,200	110	400	400	400
To prepare small pipe water supply systems in community	3	5,513	140	1,654	1,654	2,205
To repair small scale irrigation	3	9,812	0	2,944	3,925	2,943
Rural Hygiene and Sanitation Promotion	3	7,791	1,087	1,927	2,624	3,240
To provide materials, equipment, electronics for program implementati	3	13	0	13	0	0
Sanitation Awareness Program	3	253	73	84	85	84
To create networks and capacity building for village volunteers	3	7,525	1,014	1,830	2,539	3,156

Source：Budget Strategic Plan 2010-2012 for the Ministry of Rural Development

3.4 Past Experiences, Present Status and Future Plans of Other Donor Agencies and NGOs

3.4.1 Urban Area Water Supply

As described in **Table 3.4.1**, JICA, Japanese Government, WB, WSP (Water and Sanitation Program), ADB, UN-HABITAT, AFD are the major donor countries and agencies. Target assistance has been provided to technical and “soft” component of water supply. As to assistance targeting low income group in urban area, UN-HABITAT and WB have been hampered with house connection fees.

Table 3.4.1 On-going Water Supply Projects under the Jurisdiction of MIME

No.	Project Title	Scheme	Counterpart Organization	Budget in Million USD	Status	Remarks
1	The Project on Capacity Building for Water Supply System in Cambodia Phase-2	TCP	MIME/8 Provincial Utilities/JICA	4.60	On-going	
2	Niroth Water Supply Project	Yen Loan	PPWSA/JICA/AFD	35.13	On-going	Co-finance with AFD (13.32), PPWSA (16.88)
3	Siem Reap Water Treatment Plant Expansion Project	Yen Loan	SRWSA/JICA	-	F/S	
4	Triangle Project: Water Supply in Mondul Kiri and Ratanak Kiri	Grant	MIME/Japan Government	2.19	On-going	
5	Expansion Water Supply in Kratie and Stung Treng	Technical Assistance	MIME/ADB	1.50	On-going	For three countries - Laos, Cambodia and Vietnam
6	Cambodia MSME Project	Grant Aid	MIME/USAID/ Private	1.20	On-going	
7	Capacity Building for Small Scale Private Operators-Pilot Project	Grant Aid	MIME/WSP	-	On-going	
8	Pipe Replacement in Kampot	Grant Aid	MIME/GRET/Utility	0.026	On-going	Co-finance with Kampot Utility (6,000$)
9	Project on Extension Water Supply and Sanitation in Kampot Province	Grant Aid	MIME/ UNHABITAT/Utility	0.294	On-going	Co-finance with kampot Utility (53,500$) and Community (26,000$)
10	Project on Extension Water Supply in 4 Provinces - Kampong Thom, Kampong Cham, Pursat and Svay Rieng	Grant Aid	MIME/ UNHABITAT/4 Utility	1.652	MOU Discussion	Co-finance with 4 Utilities (371,000$) and Community (26,000$)
11	Project on Additional New Water Treatment Plant, Serious Old Pipe Replacement, New Pipe Expansion with Leakage Reduction System and Supply 1 Set of Pipe Installation Equipment for Battambang Water Works	Grant Aid	MIME/JICA	19.70	Not yet Consider	Requested by MIME as future plan
12	Project on Additional New Water Treatment Plant, Serious Old Pipe Replacement, New Pipe Expansion with Leakage Reduction System and Supply 1 Set of Pipe Installation Equipment for Kampong Cham Water Works	Grant Aid	MIME/JICA	12.41	Not yet Consider	Requested by MIME as future plan
13	Project on Additional New Water Treatment Plant, Serious Old Pipe Replacement, New Pipe Expansion with Leakage Reduction System and Supply 1 Set of Pipe Installation Equipment for Kampot Water Works	Grant Aid	MIME/JICA	14.05	Not yet Consider	Requested by MIME as future plan
14	Project on Serious Old Pipe Replacement, New Pipe Expansion with Leakage Reduction System and Supply 7 Sets of Pipe Installation Equipment for Battambang, Pursat, Kampong Thom, Svay Rieng, Kampong Cham, Kampot and Sihanouk Ville Water Works	Grant Aid	MIME/JICA	-	Not yet Consider	Requested by MIME as future plan and resubmit Project in stead of request Project for 4 Utilities
15	Project on Regulatory Reform and Enforcement	Grant Aid	MIME/ADB	-	Negotiation	
16	Water and Sanitation Financing Strategy		MIME/WSP			
17	Grid-connected Photovoltaic Power Generation System for Phum Prek Water treatment Plant in Phnom Penh	B/D	MIME/PPWSA/JICA	7.2	On-going	

Source: Potable Water Supply Department, MIME

(1) Japan (JICA)

Japanese assistance in urban water supply was started by the water supply master plan in Phnom Penh in 1993 and up to the present, numerous assistances have been provided in technical cooperation, Grant Aid and ODA Loan projects. Details of the Japan (JICA)-assisted projects are shown in **Table 3.4.2.**

Table 3.4.2 JICA-assisted Projects in Water Sector

Project Title	Project Period		Remarks
	Start	End	
"The Study on Master Plan of Phnom Penh Water Supply System" (TC)	Feb. 1993	Nov. 1993	M/P + F/S
"Project for Water Supply System Development in Phnom Penh" Phase 1 and Phase 2 (GA)	1996	2004	
"The Study on Master Plan of Siem Reap Water Supply System" (TC)	2000		M/P + F/S
"Project for Expansion of Phum Prek Water Treatmrent Plant" (GA)	2001		
"The Study on Master Plan of Groundwater Development in Southern Provinces" (TC)	2002		
"Project for Rural Water Supply System Development in Peri-Urban Area" (GA)	2002		
"The Study on Master Plan of Groundwater Development in Central Provinces" (TC)	2002		
"Project for Water Supply System Development in Siem Reap" (GA)	2003		
"The Project on Capacity Building for Water Supply System" Phase 1 (TC)	Oct. 2003	Oct. 2006	
"Project for Water Supply System Development in Kompong Cham Province" (GA)	2005		
"The Study on Phnom Penh Water Supply System Expansion Project" Phase 2 (TC)	2006		
"The Project on Capacity Building for Water Supply System" Phase 2 (TC)	May 2007	Apr. 2011	On-going
"Project for Expansion of Niroth Water Treatmrent Plant" (Loan)	Mar. 2009	2013	Bidding stage (Loan)
"The Preparatory Study on the Siem Reap Water Supply Expansion Project (PS)	Jun. 2009	2017	F/S → Loan
Grid-connected Photovaltaic Power Generation System for Phum Prek Water Treatment Plant (GA)	Dec. 2009	Oct. 2012	B/D
Project on Replacement and Expansion of Water Distribution System for Provincial Capitals (PS)	2010	2014	in preparation
The Project on Capacity Building for Water Supply System (Phase 3)	-	-	as a future plan

Source: Potable Water Supply Department, MIME

Note: GA = Grant Aid, PS = Preparatory Study
TC = Technical Cooperation

(2) WB and WSP

"Provincial and Peri-urban Water and Sanitation Project" (2003 to 2006) can be raised as typical urban water supply improvement project implemented by the World Bank. This project financed sustainable water supply and sanitation investments targeting rapidly growing provincial towns and peri-urban communities that express demand for improved services. As a part of project preparation, the project assisted pilot innovative financing mechanisms through which low income communities could participate as full-fledged piped water supply systems. The project supported and strengthened existing entrepreneurship in the water sector and encourages Cambodian and international firms to bid for design, build and operate water supply systems. This project was terminated in 2006.

WB has two budgetary assistance systems: namely, OBA (Output Base Aid) and DBL (Design Build and Lease). OBA is a grant aid assistance and DBL is a loan assistance. Target of OBA is for the low income group and hampered by just a 50% house connection fee. Target households are identified according to the selection criteria set forth and are programmed to apply house connection by WB grant aid.

One of the conditions in applying DBL is that more than 51% of the residents living in urban area with more than 1,000 household must be "willing-to-pay". Ten percent of the capital cost is shared by a private company and the executing agency, and the remaining 90% is supported by WB loan. Out of the total household (HH), connection fee of up to 500 HH is supported by WB and the rest is covered by the budget of the private company.

At present, these assistance programs were completed and there are no on-going projects.

WSP proposed the following three programs as the working plan of 2010:

(1) Support on participation by small-scale private sector for small-scale system
(2) Assistance in capacity building of middle to small-scale private sector for dissemination and improvement of sanitation facilities
(3) Support and adjustment to water supply sector and program management

WSP is also planning to open a training course in Cambodia University or other nearby universities for human resource development.

(3) ADB

ADB conducted a water supply system upgrading project in six provinces: namely, Battambang; Pursat; Kampong Thom; Kampong Cham; Svey Rieng and Kampot province. It was called "Provincial Towns Improvement Project" and completed by the end of 2006.

One project is now under planning stage and the target areas are the two provinces of Kratie and Stung Trang located along the Mekong River. Although this project also involves sanitary facility development, the following description is limited to the outline of the proposed part regarding water supply.

1) Kratie

- A new water treatment plant with a capacity of 8,800 m^3/day is planned at the upstream of Mekong River 8 km away from the town center. Intake facility and pumping station are also planned.
- Distribution pipelines with total length of 30 km, water meters, valves and connection pipes
- Estimated project cost is 4.1 million US$.
- Human resource development for MIME and DIME: O&M of water supply facilities; and water quality analysis and observation

2) Stung Treng

- New water treatment plant with a capacity of 5,760 m^3/day is planned at the

downstream of Mekong River 7 km away from the town center. Intake facility and pumping station are also planned.

- Distribution pipelines with a total length of 50 km, water meters, valves and connection pipes
- Estimated project cost is 4.8 million US$.
- Human resource development for MIME and DIME: O&M of water supply facilities; and water quality analysis and observation.

(4) UN-HABITAT

UN-HABITAT is currently implementing a water supply pipeline expansion project in four provinces: Kampong Thom, Kanpomg Thom, Pursat and Svey Rieng. The project for water supply pipeline expansion and sanitary facility development in Kampot is now on-going.

3.4.2 Rural Water Supply and Sanitation

(1) Assistance Record by Japan

Assistance record for rural water supply and sanitation sector by Japan is shown below.

Table 3.4.3 Assistance Record for Rural Water Supply and Sanitation Sector by Japan

Year	Project	Scheme	Outline
1996～2001	The Study on Groundwater Development in Southern Cambodia	Development Study	The objectives of the study were: (i) to evaluate the potential for the development of ground water resources; (ii) to select and prioritize the villages to be developed; and (iii) to formulate the groundwater development plan and water supply plan for the selected villages. The Study area covered five provinces (Kandal, Kompong Speu, Takeo, Prey Veng, Svay Rieng) in southern Cambodia and Peri-Urban areas of Phnom Penh.
2000～2002	The Study on Groundwater Development in Central Cambodia	Development Study	The objectives of the study were: (i) to evaluate the potential for the development of ground water resources; (ii) to select and prioritize the villages to be developed; and (iii) to formulate the groundwater development plan and water supply plan for the selected villages. The Study area covered two provinces (Kompong Cham, Kampong Chhnang) in central Cambodia.
2001	The Project for Rural Drinking Water Supply in Phnom Penh Peri-Urban	Basic Design Study	This study targeted 60 villages in 3 districts was done in order to draw up an implementation plan for Japanese Grant-aid. The contents of this study were as follows: (i) construction of deep wells with handpumps; and (ii) procurement of equipment and machinery for drilling.
2002	The Project for Rural Drinking Water Supply in Phnom Penh Peri-Urban (1/2)	Grant	The project was comprised of 3 works: (i) construction of 91 deep wells with hand pumps in 35 villages; (ii) procurement of one set of equipment and machinery for well drilling; and (iii) soft components for operation and maintenance for water supply facilities.

Year	Project	Scheme	Outline
2003	The Project for Rural Drinking Water Supply in Phnom Penh Peri-Urban (2/2)	Grant	The project was comprised of 3 works: (i) construction of 74 deep wells with hand pumps in 25 villages; (ii) procurement of one set of equipment and machinery for well drilling; and (iii) soft components for operation and maintenance for water supply facilities.
2005	The Project for Rural Drinking Water Supply in Kampong Cham	Basic Design Study	This study targeted 115 villages in 4 districts and was conducted in order to draw up an implementation plan for Japanese Grant-aid. The contents of this study were as follows: (i) construction of deep wells with handpumps; and (ii) procurement of equipment for investigation of drilling and maintenance of facilities.
2005	The Project for Rural Drinking Water Supply in Kampong Cham (1/2)	Grant	The project consisted of 2 works: (i) construction of 161 deep wells with hand pumps in 55 villages; and (ii) soft components for sustainable operation and maintenance for water supply facilities.
2006	The Project for Rural Drinking Water Supply in Kampong Cham (2/2)	Grant	The project consisted of 2 works: (i) construction of 194 deep wells with hand pumps in 59 villages; and (ii) soft components for sustainable operation and maintenance for water supply facilities.
2009	The Project for Rural Drinking Water Supply in Memot District of Kampong Cham	Basic Design Study	This study targeted 52 villages in Memot district and was conducted in order to draw up implementation plan for Japanese Grant aid. The content of this study is construction of deep well with handpump.
2009	The Project for Rural Drinking Water Supply in Memot District of Kampong Cham	Grant	The project is comprised of 2 works: (i) construction of 136 deep wells with hand pumps in 52 villages; and (ii) soft components for sustainable operation and maintenance for water supply facilities.

(2) Trend of Assistance by Other Donors

1) UNICEF

a. On-going Project

UNICEF has been a long term partner in rural water supply and sanitation and hygiene sector in Cambodia since MRD's inception in 1993. It has been conducting a Five Year Country Action Programme which is named "Seth Koma Programme (2006-2010)" which means community action for child rights. This program is divided into two parts: (i) Local Governance for Child Rights (LGCR) Project; and (ii) Water, Sanitation and Hygiene Project with a total budget of about US$17 million. Of this, about US$9.9 million was distributed to "Water, Sanitation and Hygiene Project", whose outline is shown in **Table 3.4.5**:

Table 3.4.4 Outline of Water, Sanitation and Hygiene Project under Seth Koma Programme

Name of Project	Target Area (Province)	Duration	Beneficiaries (person)	Contents	Budget (US$)
Water, Sanitation and Hygiene Project	6 provinces (Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng)	2006-2010	1,460,000	(i) CLTS Project (ii) Arsenic Mitigation Programme (iii) HWTS Project (iv) S-C WASH Project (v) Community Water Supply Project (vi) School Water Supply and Sanitation Project	9,887,972.30

Source：UNICEF

Summary for each 6 projects is descried below.

Table 3.4.5 Outline of each Six Projects under Water, Sanitation and Hygiene Project

Name of Project	Target Area (Province)	Duration	Beneficiaries (person)	Contents
CLTS（Community-Led Total Sanitation） Project	6 provinces (Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng)	2006-2010	800,000 (800 villages x 200 households x 5 people)	・ Training of trainer (Provincial and District levels) ・ Training for commune committees for women and children, second deputy chiefs commune, village chiefs ・ Ignition activities at village ・ Selection of village focal points ・ Training for village focal points
Arsenic Mitigation Programme	6 provinces (Kandal, Kratie, Kampong Cham, Prey Veng, Kampong Thom, Phnom Penh Peri-Urban）: 48 districts, 318 communes, 1607 villages	2006-2010		・ Training on arsenic testing (Provincial and District levels) ・ Training on bacteria testing (Provincial and District levels) ・ Testing of arsenic ・ Education on arsenic contamination ・ Arsenic mitigation
HWTS（Household Water Treatment and Safe Storage） Project	6 provinces (Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng)	2009-2010	573 WSUGs	・ Training of trainer for provincial and district level ・ Training on bacteria testing (included in province and district level training) ・ Dissemination for water and sanitation user groups (WSUGs), village focal points and village chiefs ・ Baseline assessment ・ Development of water safety plan by WSUG ・ Follow-up assessment

Name of Project	Target Area (Province)	Duration	Beneficiaries (person)	Contents
S-C WASH Project	6 provinces （Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng）	2009-2010	184 schools	・Training of trainer for provincial and district level ・Training on bacteria testing (included in province and district level training) ・Training for cluster school directors, school directors, school support committees, student councils, teacher focal points for health and sanitation, village chiefs, commune committees for women and children, second deputy chiefs of commune, and village focal points (included bacteria testing demonstration) ・Ignition activities in school using CLTS approach ・Ignition activities in community using CLTS approach
Community Water Supply Project (Construction of Water Facilities)	6 provinces （Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng）	2006-2010	73,085	・Construction of 503 community wells ・Renovation of 453 community wells ・177 household rainwater tanks ・100 rainwater jar connection system ・O & M training ・Water Use and Hygiene Education（WUHE） training
School Water Supply and Sanitation Project (Construction of Water and Sanitation Facilities)	6 provinces （Kampong Thom, Kampong Speu, Stung Treng, Otdar Meanchey, Prey Veng, Svay Rieng）	2006-2010		・Construction of 360 school wells ・Renovation of 138 school wells ・Construction of 142 school rainwater tanks（35m^3） ・Construction of 437 school latrines ・O & M training ・WUHE training

Source：UNICEF

b. New Assistance Plan

As mentioned before, Seth Koma Programme will be completed in June 2010. Therefore, UNICEF is preparing the next five-year programme (2011-2015) which will support the strategy for rural water supply, sanitation and hygiene (2010-2025). It aims to promote sustainable access to and use of safe water, sanitation and hygiene with emphasis on reaching the unreached among rural communities. It will operate within government schemes and seek to leverage these and other resources to scale-up decentralized approaches to water supply and sanitation. MRD is the key implementing ministry, with partners particularly members of the TWG-RWSSH including MOH and MOEYS.

Table 3.4.6 WASH Programme under the Next Five-Year Country Programme (2011-2015)

Target Area (Province)	Contents	Output
24 provinces	a. Promotion of three key hygiene practices, building upon experience and lessons learned from the CLTS and participatory hygiene approaches and advocacy with commune committee for women and children b. Promotion of water safety planning, particularly in arsenic at-risk areas, community-based water quality monitoring and maintenance and household water treatment c. Improvement of access to water, sanitation and hygiene facilities for schools and health centers particularly those utilized by vulnerable groups as well as settlements in remote and disaster-prone areas d. Supporting capacity development including risk assessments e. Advocacy for increased resources for WASH programmes	a. Community practice key hygiene behaviors (hand-washing with soap at critical times, using toilet and drinking safe water) b. Communities, schools and health centers have access to sustainable technologies for safe water, sanitation and hygiene c. MRD and concerned sub-national agencies able to lead, coordinate, facilitate and monitor and evaluate the RWSSH

Source：UNICEF

2) ADB

a. Assistance Record

ADB has implemented a rural water and sanitation project in 5 provinces around Lake Tonle Sap. Although the initial plan was continued up to 2011 from 2006, the project ended by February 2010 from lack of budget due to inflationary cost increases. A project outline is shown in **Table 3.4.7**.

b. New Assistance Plan

ADB has a new assistance plan which is named the “Second Rural Water Supply and Sanitation Sector Project” covering 6 provinces around Lake Tonle Sap and will continue up

to 2015. A project outline is shown in **Table 3.4.8**.

Table 3.4.7 Summary of Tonle Sap Rural Water Supply and Sanitation Sector Project（Phase I）

Project Name	Target Area (Province)	Duration	Beneficiaries (person)*1	Contents *2	Budget （US$）
Tonle Sap Rural Water Supply and Sanitation Sector Project	5 provinces (Kampong Thom, Kompong Chhnang, Pursat, Battambang, Siem Reap)： 18 districts、 135 communes、 862 villages	2008-2010	Approx. 493,600 for water supply facilities, Approx. 225,100 for sanitation facilities	1.Construction of water supply facilities a. Drill well：3169 b. Combined well：1087 c. Hand dug well：221 d. Rehabilitation well：257 e. Community pond：27 f. Pipe-water supply：5 g. Rainwater Tank：1163 h. Bio-Sand filter：982 i. Iron Reduction Plant：218 2. Construction of household latrine：45046 3. Improved community health and hygiene practices 4. Human resource development	24 million US$ (Breakdown： ADB Grant: 18 million US$、 Cambodia Government: 2.06 million US$、 Beneficiaries: 3.94 million US$)

*1、2: TSRWSSP consultant, other: ADB RRP:CAM34382

Table 3.4.8 Summary of Tonle Sap Rural Water Supply and Sanitation Sector Project（Phase II）

Project Name	Target Area (Province)	Duration	Beneficiaries (person)*1	Contents *2	Budget （US$）
Second Rural Water Supply and Sanitation Sector Project	6 provinces Banteay Meanchey, Battambang, Kampong chhnang, Kampong Thom, Pursat, Siem Reap)： 16 districts、 40 communes、 400 villages	2010-2015	377,000 for water supply facilities, 290,000 for sanitation facilities	a. Improved community health and hygiene practices b. Rehabilitated upgraded and developed water facilities c. Improved public and household sanitation d. Strengthened sector planning and development e. Improved capacity for project implementation	25.8 million US$ (Breakdown： ADB Grant: 21 million US$, Cambodia Government: 1.8 million US$, Beneficiaries: 3.0 million US$)

Source：ADB Project Number:38560, August 2009

3) IMF

The amount of debt relief granted to Cambodia was US$82 million, which became effective on January 2006, wherein, $18.6 million will be utilized for the implementation of the Rural Water Supply and Sanitation Project. In this regard, the Rural Water Supply and Sanitation Project will be implemented that will provide water and sanitation infrastructure to the vulnerable population in the rural communities using a participatory approach. The Project will utilize a contracting arrangement strategy between the Project Management Unit (PMU) at the MRD and the Provincial Implementation Units (PIU) based at PDRD in each of the 13

targeted provinces in designing and implementing sub-projects aimed at changing behaviour on rural water supply and sanitation in the impoverished communities. The summary of the project is described below.

Table 3.4.9 Summary of Rural Water Supply and Sanitation Project financed by IMF

Project Name	Target Area (Province)	Duration	Beneficiaries (person)*1	Contents *2	Budget (US$)
Rural Water Supply and Sanitation Project (IMF-MRD)	13 provinces (Kratie, Stung Treng, Ratank Kiri, Mondul Kiri, Kampong Cham, Prey Veng, Svay Rieng, Kandal, Takeo, Kampot, Kampong Speu, Odtor Meanchey)	2008-2011	Cover about 13% of villages in target provinces	a. improve access to safe water supply through construction of infrastructure facilities b. expand access to sanitation facilities by providing appropriate systems to individual households, rural public schools/pagodas and other public facilities where sanitation and hygiene are in the poor conditions c. strengthen capacity of the communities and local institutions to plan, implement, manage, and maintain such facilities d. enhance implementation capacity and quality of relevant Government agencies and local communities through provision of project management services	18.6 million US$

Source：MRD Website

3.5 Laws and Standards

3.5.1 Summary of Laws

Laws and regulation relevant to water and sanitation sector in Cambodia are summarized in the table below:

Table 3.5.1 Principal Laws and Regulation Relevant to Water and Sanitation Sector

Name	Establishment Year	Outline
A Laws		
A1 Water Laws		
A1-1 Draft Water and Sanitation Law of the Kingdom of Cambodia	2004 (Draft)	This law, whose draft work was prepared by MIME supported by WB, mainly covers the following: a) framework of water supply and sanitation services; b) establishment of the water and sanitation authority; c) type of licenses; and d) tariffs. However, legislation of this bill suffered a setback due to the discontinuance of the "Provincial & Peri-Urban Water & Sanitation Project" by WB in 2006.
A1-2 Sub-Decree on Water Pollution Control	1996	The Sub-Decree was established in compliance with Article 13 of the Law on Environmental Protection,

Name	Establishment Year	Outline
		and Natural Resources Management in 1996. The Sub-Decree focuses on the protection and conservation of water quality at public water areas, as well as the monitoring and controlling of any types of wastewater discharged from various pollution sources that do not have harmful impacts on water environment and aquatic life. In addition, the licensed owner/manager of factory and/or pollution source where his/her effluents were properly treated, and vice versa, he/she will be fined or punished if he/she has violated the Sub-Decree.
A1-3 Sub-Decree on Solid Waste Management	1999	The Sub-Decree was established in compliance with Article 13 of the Law on Environmental Protection and Natural Resources Management. The Sub-decree is comprised of six chapters: (i) general provision; (ii) household waste management; (iii) hazardous waste management; (iv) monitoring and inspection of hazardous waste management; (v) penalty; and (vi) final provision.
A1-4 Law on Environmental Protection and Natural Resoure Management	1996	This law was established as the basic law on environment in Cambodia. T he purpose of this Law is: (i) to protect and promote environmental quality and public health through the prevention, reduction, and control of pollution; (ii) to assess the environmental impact of all proposed projects prior to the issuance of a decision by the Royal Government; (iii) to ensure the rational and sustainable conservation, development, management, and use of the natural resources of the Kingdom of Cambodia; and (iv) to encourage and enable the public to participate in environmental protection and natural resource management; and (v) to suppress any acts that cause harm to the environment.
A1-5 Sub-Decree on Environmental Impact Assessment Process	1999	This Sub-Decree shall be applied on every project and activity, private or public, and shall be reviewed by the Ministry of Environment before being submitted to the Royal Government for a decision. In the water sector, if water supply users are more than 10,000 and wastewater treatment plant (any size) is constructed, an initial environmental impact assessment (IEIA) or an environmental impact assessment (EIA) shall be required.
A1-6 Law on Water Resources Management of the Kingdom of Cambodia	2007	This law aims to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people. This law shall determine the following: (i) the rights and obligations of water users; (ii) the fundamental principles of water resources management; and (iii) the participation of water users association in the sustainable development of water resources.
A2 Organizational Laws		

Name	Establishment Year	Outline
A2-1 Law on Administrative Management of Capital, Provinces, Municipalities, Districts and Khans (Organic Law)	2008	This law aims to define administrative management of the Capital, Provinces, Municipalities, Districts and Khans based on the decentralization and deconcentration (D&D) strategy framework in 2005.
A2-2 Law on Khum/Sangkat Administrative Management	2001	This law aims to establish administrative management of all Khum/Sangkat in the Kingdom of Cambodia in order to follow a policy of decentralization.
A3 Private Sector Laws		
A3-1 Law of Concession	2007	This Law aims to promote and facilitate the implementation of privately financed concessions in the Kingdom of Cambodia in order to ensure the public interest and the fulfillment of the national economic and social objectives. A Concession Contract may provide by means of the following : - Build, operate and transfer - Build, lease and transfer - Build, transfer and operate - Build, own and operate - Build, own operate and transfer - Build, cooperate and transfer - Expand, operate and transfer - Modernise, operate and transfer - Modernise, own and operate. - Lease and operate manage or management arrangements or any variant thereof or similar arrangement, including joint public-private implementation of Infrastructure Facilities.
B Regulation		
Drinking Water Quality Standards	2004	This standard was based on the World Health Organization (WHO) drinking water quality guidelines (2003). Parameters for drinking water quality set five categories: (i) bacteriological quality; and (ii) inorganic constituents of health significance, organic constituents of health significance and physical and chemical quality. Moreover, minimum sampling frequencies, methods of sampling, analytical methods and sanitary surveys are also set in it. In addition, although it is specified in the general clause that the guideline shall be reviewed every five years, re-examination work is not done at the present day.

3.5.2 Potable Water Quality Standard

Although potable water quality standard was established by MIME with the assistance of WHO, its validity period has already expired. According to the advice of JICA human resource development expert, some of the water quality indices must be reviewed. Detailed potable water quality standard is presented in **Appendix A1.2**.

Table 3.5.2 shows the standard values on major water quality indices, while **Table 3.5.3**

presents the standard for small-scale water supply system.

Table 3.5.2 Major Potable Water Quality Standard

Water Quality Indices	Unit	Standard Value
pH	-	6.5 – 8.5
Color	TCU	5
Turbidity	NTU	5
Residual Chlorine	mg/l	0.2 – 0.5
Ammonia	mg/l	1.5
Chloride	mg/l	250
Hardness	mg/l	300
Iron	mg/l	0.3
Manganese	mg/l	0.1
Sodium	mg/l	200
Total Dissolved Solids	mg/l	800

Table 3.5.3 Potable Water Quality Standard for Small-scaled System

Water Quality Indices	Unit	Standard Value
pH	-	6.5 – 8.5
Turbidity	NTU	5
Arsenic	mg/l	0.05
Iron	mg/l	0.3
Total Dissolved Solids	mg/l	800
Thermotolerant Coliforms	-	0 per 100mL

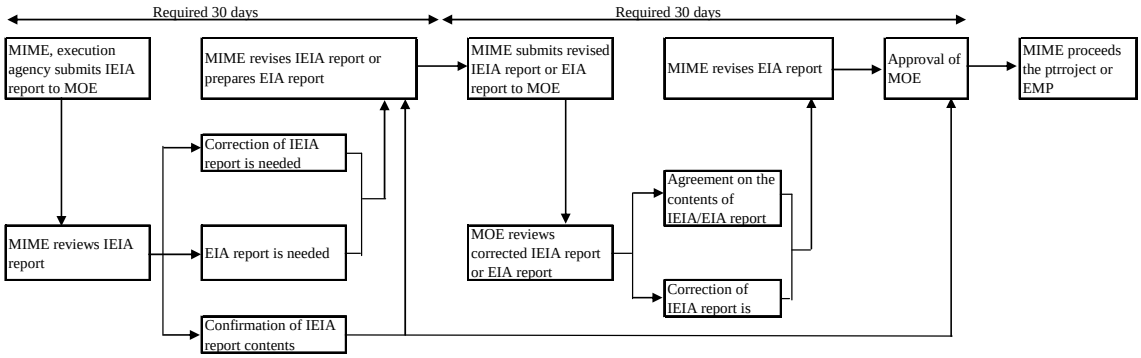
3.5.3 EIA Procedures

Upon formulation of a new project for water supply sector, if the project beneficiaries exceed 10,000 persons, Initial Environmental Impact Assessment (IEIA) or Environmental Impact Assessment (EIA) or both shall be conducted following the instruction of MOE. Draft EIA Guideline was issued by MOE in 2000 but until now it is still being finalized. The contents conform to JICA EIA standard. If project beneficiaries exceed 10,000 persons for expansion or rehabilitation project on existing system, EIA is not needed. During EIA survey, MOE staff must visit the site to confirm the assessment method. Cost incurred for site visit shall be shouldered by the project executing agency.

Further, if the project area is located in Community Forest, Community Fishery or Protected Area, approval shall be obtained in advance from related agencies. An example of this is the surrounding areas of Tonle Sap Lake that have been strictly regulated by the Fishery Bureau of the Ministry of Agriculture in 1968 where careful consultation with MOE and MOA was needed.

Other than these, cultural assets preservation area called APSARA that were delineated by UNESCO, Far East University, and Sidney University must be fully taken into account during planning.

Figure 3.5.1 presents the EIA procedures.



Legend : EEA (Environment Examination Application)
IEIA (Initial Environment Impact Assessment)
EIA (Environment Impact Assessment)
EMP (Environment Management Plan)

Figure 3.5.1 Procedures for Environmental Impact Assessment

Chapter 4
Current Status of Water Supply Sector by Province

Chapter 4 Current Status of Water Supply Sector by Province

4.0 Outline of Provincial Water Supply Sector

As aforementioned, Cambodia is comprised of 24 provinces and current situation of water supply sector defers by each province. The typical topics are as follows:

- Management structure of urban and rural water supply system
- Water supply condition
- Operational status of the existing facilities
- Organizational structure
- Assistance offered by donor agencies
- Subjects to be tackled

In the following section, results of field survey on current status of urban and rural water supply system are to be described. Outline of urban water supply system in each province is summarized in Table 4.0.1. As to rural water supply system, refer to each section because their situations vary largely by province.

Table 4.0.1 Outline of Urban Water Supply System in each Province

No.	Name of Province	Provincial Capital	Public/Private	Water Source	Completion Year	Capacity (m^3/day)	House Connection (No. of HH)	Supply Hours (hr/day)	NRW Rate (%)
1	Banteay Meanchey	Sprei Sihpan	Private	River	1998	3,200	5,621	-	20 - 30
2	Battambang	Battambang	Public	River	1963	7,000	8,000	21 - 22	30
3	Kampong Cham	Kampong Cham	Public	Groundwater	2006	4,200	4,205	24	14.2
4	Kampong Chhnang	Kampong Chhnang	Public	River	1939	700	1,119	20 - 24	14
5	Kampong Speu	Chbar Mon	Private	River	1979	1,150	1,447	-	-
6	Kampong Thom	Stung Sen	Public	River	1946	2,000	-	24	-
7	Kampot	Kampot	Public	Pond	1953	2,447	3,331	18 - 20	-
8	Kandal	Kandal	PPWSA	River	-	-	-	-	-
9	Koh Kong	Koh Kong	Private	Pond	2000	2,200	1,313	24	-
10	Kratie	Kracheh	Public	Groundwater	1960	-	1,712	15 - 17	29
11	Mondul Kiri	Saen Monouromdeha	No Uran Water Supply System is available						
12	Phnom Penh	Phnom Penh	PPWSA	River	1959	300,000	-	24	6
13	Preah Vihear	Tobay Meanchey	Private	River	2006	1,920	503	24	-
14	Prey Veng	Kampong Leav	Public	Groundwater	1954	1,300	1,620	20 - 25	16 - 18
15	Pursat	Pursat	Public	River	1994	2,850	3,912	24	21 - 23
16	Ratanak Kiri	Banlung	Public	Pond+GW	1995	500	570	12 - 15	19
17	Siem Reap	Siem Reap	SRWSA	Groundwater	1995	9,000	4,500	24	12
18	Preah Sihanouk	Sihanoukville	Public	Pond	1958	6,551	3,845	24	19
19	Stung Treng	Stung Treng	Public	River	1960	1,200	1,498	12 - 14	26
20	Svay Rieng	Svay Rieng	Public	Groundwater	1995	1,343	1,325	24	19
21	Takeo	Roka Khnong	Private	Pond	1997	1,300	-	23	20
22	Otdar Meanchey	Samraong	No Uran Water Supply System is available						
23	Kep	Kep	No Uran Water Supply System is available						
24	Pailin	Pailin	Private	River	2008	2,800	720	-	-

Source) Results of Questrionnaire Survey

4.1 Banteay Meanchey Province

4.1.1 Brief Description of the Province

The Banteay Meanchey province has total area of 6,679 km^2. It is comprised of 9 districts, 64 communes and 640 villages. According to 2008 Census, the registered urban population was at 181,396 (37,174 HH) and the recorded rural population was at 496,476 (107,484 HH). The provincial population growth rate was 1.56 %, while in the urban and rural areas were 2.92% and 1.10 %, respectively.

4.1.2 Current Status of Urban Water Supply

(1) Description of provincial water supply

1) Status of provincial urban water supply

There is no public-managed water supply service in the province. Including the provincial capital of Sprei Sihpan, many towns are served by private-managed water supply service. Development of private-managed water supply service is also recommended for Ou Chirou, a key town located nearby the border. Such privately-managed water supply systems were facililitated by the the WB.

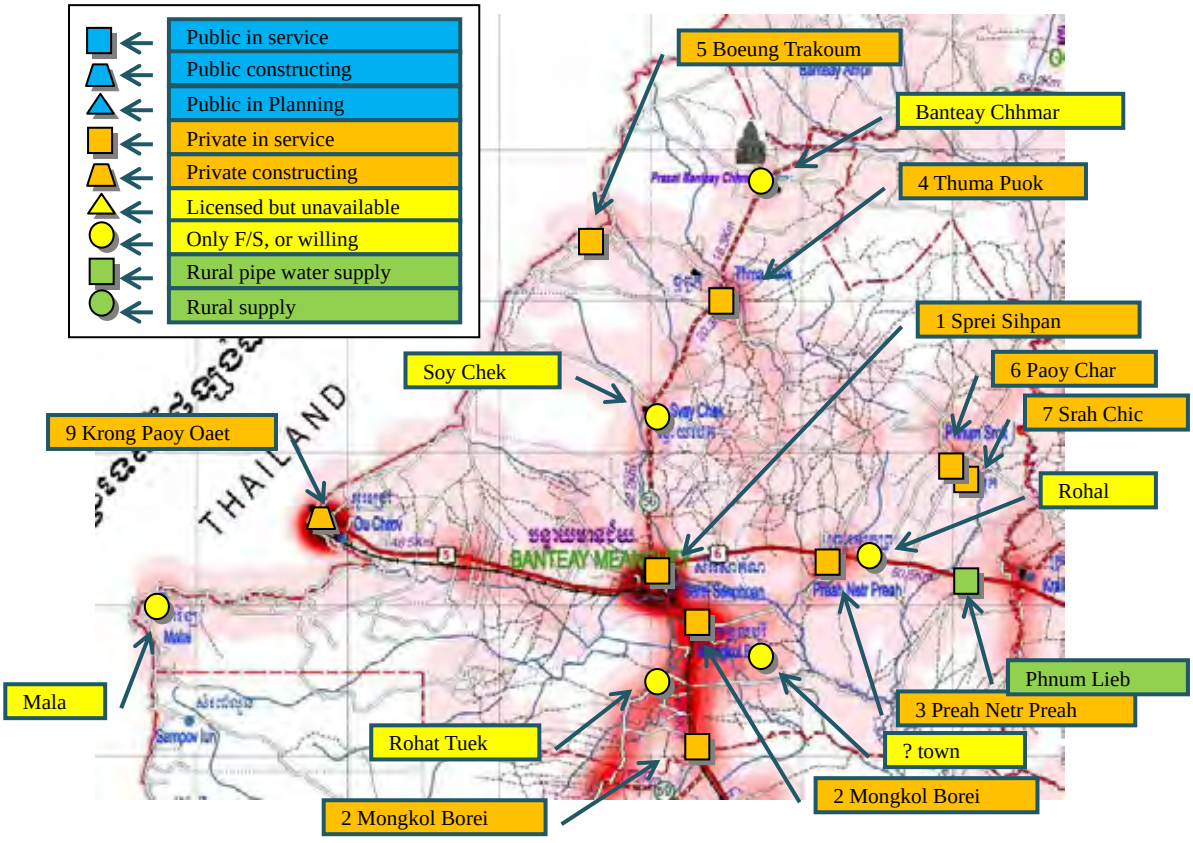


Figure 4.1.1 Existing Urban Water Supply System in Banteay Meanchey Province

Table 4.1.1 Current Status of Urban Water Supply in Banteay Meanchey Province

No	Name of Town	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Notes
1	Sprei Sihpan	Pri	1998	26,045	5,621	3,200	River	100,000	1,600	
2	Mongkol Borei	Pri	2000		1,560	260		210,000	2,000	*1
3	Preah Netr Preah	Pri	2007	7,350	1,338	360	well	210,000	2,000	*1
4	Thuma Puok, Thuma Puok	Pri			1,297	210		210,000	2,000	*1
5	Thuma Puok, Boeung Trakoum	Pri			460	70		210,000	2,000	*1
6	Phnom Srok, Paoy Char	Pri	2002		982	96	4 Wells	220,000	2,000	*1
7	Phnom Srok, Srah Chic	Pri	2002		888	124	2 Wells	200,000	2,000	*1
8	Phnom Thom,& Phnom Touch	Pri	2007	8,803	1,572	370	Well		2,000	*1
9	Krong Paoy Oaet	Pri	2011	Not operated yet (under construction)						

*1 Projects implemented by WB's BOT scheme. Blank column means N/A.

2) Historical development of urban and public water supply systems

1998 Private-managed water supply service was started in Sprei Sihpan, the provincial capital.

2000 Private-managed water supply service was started in Mongkol Borei

2002 to 2004 WB conducted F/S in 12 towns with 6 towns to be served by water supply system developed by BOT scheme (6 town were found not feasible).

2008 Service was started in 6 towns.

2011（Plan） Ou Chirou is scheduled to be served by private-managed water supply system.

3) Support from donor agencies

The WB conducted a basic survey from year 2002 to 2004 and evaluated the possibility of town water supply in Banteay Meanchey Province. In Mongkol Borei, where the survey was unterdataken in advance, the WB introduced private-led water supply development through BOT scheme in 6 towns, which started operation in 2008. The WB focused on private sector participation in water supply development considering the need of the government to undergo rigid capacity building programs in order to provide good water supply service.

If a town is considered for BOT project, it will be evaluated through the DIME. Currently, two agencies are involved in the evaluation as follows:

- Less than 500 HH: PDRD
- More than 500 HH: DIME

Based on the above arrangement, some towns may not satisfy the condition to be evaluated under the DIME, but may suit in the near future as the population increases. In general,

water supply built under BOT is classified as public system but developed through the private sectors. Most public-managed systems have deteriorated with the absence of proper O&M. To solve this problem, the government contracts out the O&M to private sector. In such case, a system is regarded as "private-managed" even if it is managed by the MIME.

According to DIME, there is no other donor than the WB. As to the 6 towns found not viable by the WB, DIME is recognizing the necessity to serve them soon since at present no water supply service is available in these areas.

(2) Urban water supply system management structure

1) Organizational structure of DIME and public water utility

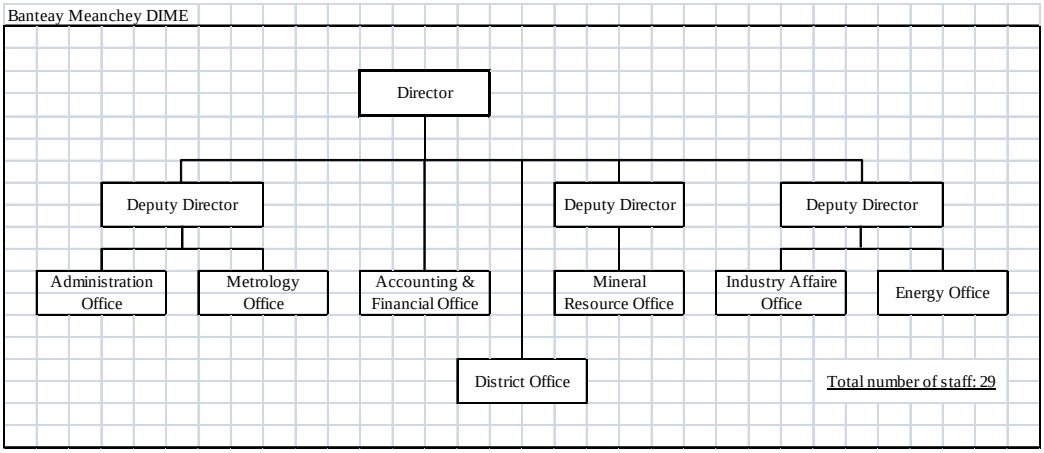


Figure 4.1.2 Organization Chart of DIME in Banteay Meanchey Province

The above is the organization structure of DIME. Currently, the agency has 29 staffs.

- Status of private-managed water supply system

  Currently, DIME is intensively undertaking supervisory work for private-managed water supply system. Although all questionnaires regarding private-managed system were not collected, detailed information including drawings were obtained for the 5 projects.

  Upon application for license, private-managd system is examined by MIME in coordination with DIME. If a proposed tariff increase rate exceeds 15%, approval of MIME is needed. In case of BOT, there is collection of charge for the system operation. O&M contract period is 15 years and if the performances are excellent, the contract of the private operator is extended for another 15 years. This is the original scheme of Banteay Meanchey province.

  Apparently, O&M of private-managed system in the province is outstanding. Even if the facilities are simple with limited treatment capacity, because of budgetary restraint,

staffs are trying to produce potable water.

Water supply systems developed by the WB are good with respect to water source, water treatment and operation.

Further, NGO "1001 Fountains" operates small-scale village water supply with simplified facility, consisting of RO membrane and UV disinfection. It produces bottled water to provide additional investment funds for water supply system. This scheme is worthy.

2) Capacity development for staffs

The staff pointed out that they attended general training held by MIME in 2005. However, since they do not have public-managed water supply system until now, MIME's training have not been conducted continuousely.

(3) Visited water supply facilities

1) Serei Saophan Water Treatment Plant: Private managed

- Brief description of the system

  Private-managed system covers water supply service of Serei Saophan, the provincial capital.
- Water supply facilities

  Raw water is directly diverted from river source to receiving well through PVC pipe. The raw water is treated employing the conventional method consisting of coagulation, sedimentation and rapid sand filtration. Dissolved coagulant is injected to the rapid chemical mixing channel then to the slow mixing flocculation basin prior to the upflow type sedimentation basin. As sand filter is shallow, there are a number of filters in the system. There are two separate filters from the main plant. These are mechanical filters intended for excessive turbidity in raw water. A staff told that a stainless turbidity removal tank is installed just upstream of sand filters.

  Reservoir is constructed at elevated site. Clearwater transmission pump is exposed.

  Introduction of mechanical equipment (mostly Chinese made) is minimized. The design of existing pipeline neither considers the occasional pipe removal/replacement nor pressure generated by flowing water.
- Operational status

  Although coagulation is insufficient, floc formation occurs. Treatment efficiency can be relatively improved by amendment in the coagulation process.

  Chemicals used are alum as coagulants and chlorine as oxidant. Chlorine agent is dissolved and injected in form of liquid. Storage of these chemicals was not elaborated.

Water quality analysis is conducted twice every week and results are recorded accordingly. The results of the analyses reflect the actual plant efficiency.

Although the overall technical capacity is not so high, the staff is able to deal with the high raw water turbidity. The insufficient coagulation is compensated by a number of sand filters. Such system is commendable.

The map of the service area posted on the wall of control room is quite effective for O&M purposes. However, leakage ratio is still at 20～30％, which is quite high.

2) Private-managed Mongkol Borei Water Treatment Plant

- Brief description of the system
  The private-managed water supply system is located adjacent to Serei Saophan City
- Water supply facilities
  The design of the system is totally the same as that of Serei SaophanWTP. Raw water is obtained from river and conveyed directly into a receiving well through PVC pipe. Water treatment is carried out by coagulation, sedimentation and rapid sand filtration. Chemical is injected into a mixing channel and the agitated effluent flows into sedimentation basin. The sand filters are small and the filter number is not enough. Since effluent trough is not installed, backwashed effluent is overflowing from the filtration basin.

  No reservoir was constructed and water is supplied directly from the plant. Pressure gauge is installed on distribution main just nearby the plant. Target pressure is 20m aq. All mechanical equipment is made in China.
- Operational status
  This plant is managed by the private company managing the Serei SaophanWTP.
  Alum and chlorine are the chemicals applied. Chlorine agent is dissolved and injected in liquid form. Although coagulation is insufficient, floc formation takes place. Further, no storage facility exists.

3) Phnom Thom & Phnom Touch Area Water Treatment Plant: BOT

- Brief description of the system
  The WTP was built through BOT scheme, which was assisted by the WB. Technical operation is quite high and faciliy design is also remarkable. According to a staff, other plants built by BOT scheme have the same conditions.
- Water supply facilities
  Source of raw water is groundwater. It contains some iron but in concentration within acceptable limit. The raw water is pumped from two intake wells equipped with air

valves and water meters.

Raw water flows into contact oxidation tank with cobble medium to accelerate oxidation. Treated effluent flows into sedimentation basin, clear water tank and pumped to the service area.

- Operational status

  According to a staff, chemical applied is chlorine compound. It is dissolved and injected by a feed pump. Operation of feed pump is quite an advance technique in Cambodia.

4.1.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “springs, rivers and other surface water sources” (63.3%), “tubed/pipe wells” (11.0%) and “unprotected dug wells” (10.7%). The access rate to improved water is 20.2%. About 55.1% of households in the province depend on water sources distanct from the service area.

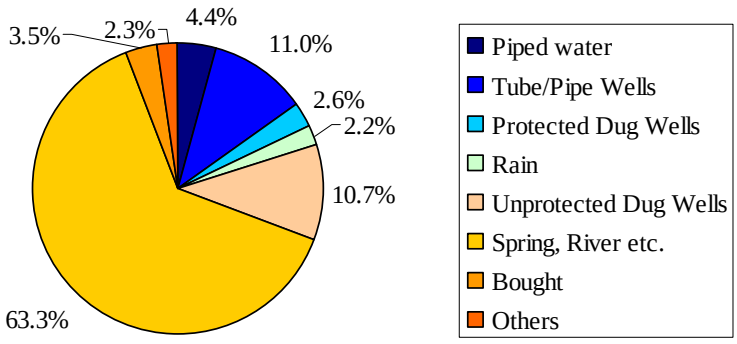


Figure 4.1.3 Type of Water Sources (Banteay Meanchey Province)

2) Condition of Water Supply Facilities

The functional ratio of all the water supply facilities in this province is 84.2% according to the results of monitoring by PDRD. Based on past experience, PDRD assumes that the causes of breakdowns of 742 tube/pipe wells include hand pump problems at about 80% and well problems (broken screen pipes, lack of cleaning, etc.) at about 20%.

Table 4.1.2 Monitoring Results by PDRD (Banteay Meanchey Province)

Items	Total	Function		Broken	
	No.	No.	Ratio	No.	Ratio
Boreholes	4,354	3,612	83.0%	742	17.0%
Open wells	2,406	1,765	73.4%	641	26.6%
Community ponds	969	631	65.1%	338	34.9%
Private ponds	5,514	5,143	93.3%	371	6.7%
Total	13,243	11,151	84.2%	2,092	15.8%

Source: PDRD in Banteay Meanchey (2010)

3) Hand pumps

Afridev hand pumps are common in this province, but cheaper pumps made in Thailand are also used. Spare parts for Afridev hand pumps are readily available in the locality. However, as the villagers do not know what spare parts are needed or how to repair the hand pumps, many wells remain dilapidated.

4) Water Quality for Groundwater

Arsenic beyond the standard MRD value is detected at Poipet town. Calcium and manganese can be detected by visual observation after boiling water from some wells, which appear as sclaes. However, PDRD has never carried out water quality sampling and analysis despite such situation because they have no water quality analyzing equipment. MRD was instructed to analyze the water quality instead of PDRD, but it has not accomplished such directive.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province consists of 52 staff members, with 4 members under the Office of Rural Water Supply and 3 under the Office of Primary Health.

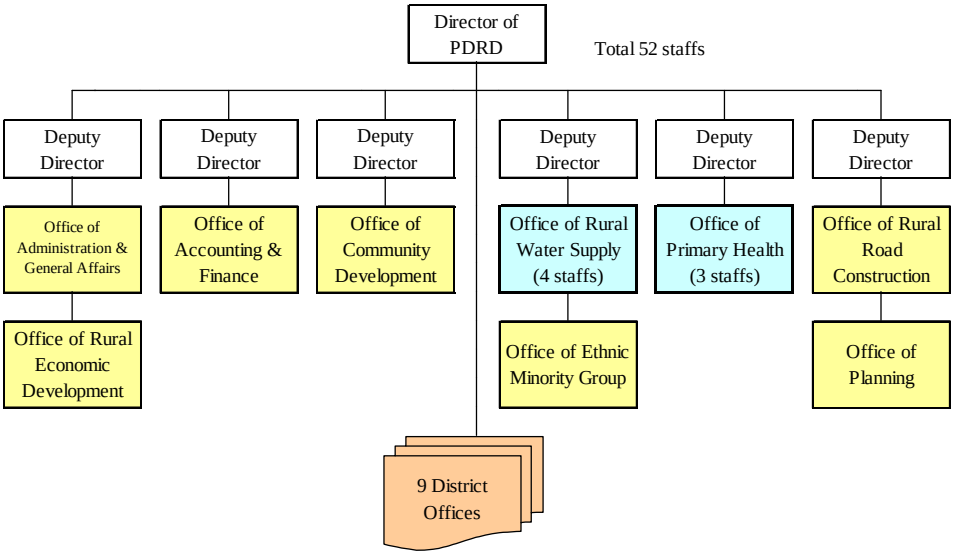


Figure 4.1.4 PDRD Organization Chart (Banteay Meanchey Province)

2) Budget

"Other external expenses for services" and "personal expenses" account for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects. On the other hand, 188.9 million Riel was allocated in 2009 as a MRD budget, which was mainly used for rehabilitation of existing facilities.

Table 4.1.3 PDRD Budget (Banteay Meanchey Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	223.0	29.9%	221.0	28.8%
	External charges for services	76.0	10.2%	76.0	9.9%
	Other external charges for services	240.0	32.2%	240.0	31.3%
	Personal expenses	205.0	27.5%	227.6	29.7%
	Taxes and similar services	1.7	0.2%	1.7	0.2%
	Total	745.7		766.3	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	188.9	10	under preparation by MRD	
	Well rehabilitation		70		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		80		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

The PDRD monitors the water supply facilities. Hence, it is aware of the condition of the facilities. The agency also plans for new development projects and reports to the donors (NGOs and aid

agencies) and to MRD. However, PDRD does not monitor the village water systems because of budget shortage.

PDRD used to have a drilling rig, and it bored about 200 wells (average depth is 45m). It still has some drilling staffs. However, as the budget for the water sector and the number of staff members are insufficient, it is impossible for PDRD to develop new water sources.

(3) Other donors in the water supply sector

1) Existing Project

There were other donors for the water supply sector. These include Oxfam（UK） in 1991; Concern, CARE and UNDP in; UNDP, CARE, Concern, SAWA, ACF（French）, Social Fund, CAA, NPA and etc., from 1994 to 2000 for rural water and sanitation sector in the province. However PDRD was not a partner for some projects, particularly those from NGOs. Thus, PDRD has no information and records that could be used for future undertakings.

In addition, the Provincial Department of Agriculture (PDA) has an implemented rural water supply project in this province before PDRD was established in 1994. Also, PDA has technical knowledge on drilling. It had directly implemented drilling works. But after the reorganization in 1994, PDA was disbanded. Currently, data from PDA are not available.

2) New Assistance Plan

a. Second Rural Water Supply and Sanitation Project by ADB

ADB has new assistance plan that is almost the same as the Tonle Sap Rural Water and Sanitation Project (2006-2010), which will commence on July 1, 2010. Ten priority communes, which have poor water supply and sanitation condition, were targeted and a 100% water supply coverage is envisaged for this project.

(4) Current Hygiene Condition

Households with toilets account for 21.8% (23,441 households) in rural areas. Of these households, 43.6% use septic tanks and 41.8% are connected to sewerage system.

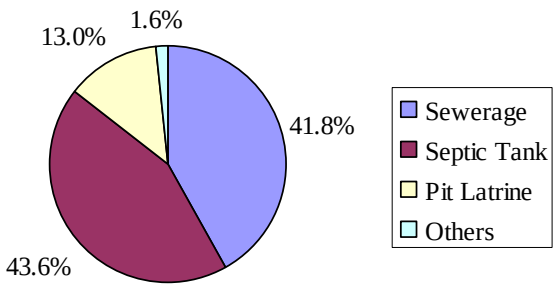


Figure 4.1.5 Type of Toilet (Banteay Meanchey Province)

4.1.4 Safe Water Supply Area

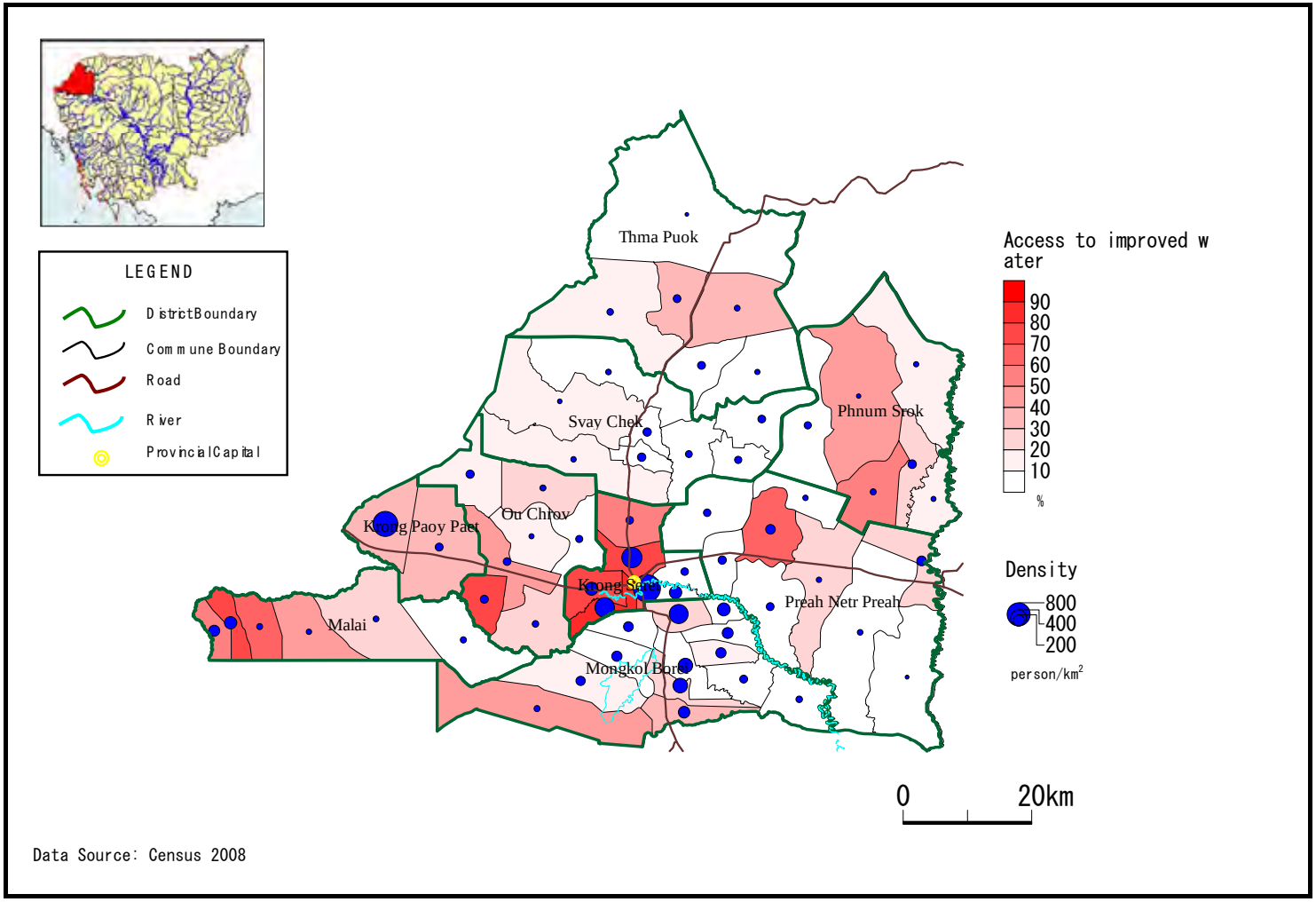
Based on the data on water source usage by household in each community from the 2008 census, 11 of the total 64 communes in this province have more than 50% access to "improved water"[1] as shown in the table below.

Table 4.1.4 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Banteay Meanchey Province)

Urban	Rural	Total
4/6 communes	7/58 communes	11/64 communes

Note: The denominator in the table is the number of communes/Sangkat

[1] "Improved Water" means "Piped water", "Tube/Pipe wells", "Protected dug wells" and "Rain" defined in the 2008 census by the Ministry of Rural Development and Ministry of Planning.



Unit : %, Source : 2008 Census

Figure 4.1.6 Service Area of Safe Water (Banteay Meanchey Province)

4.2 Battambang Province

4.2.1 Brief Description of the Province

The Battambang province has area of 11,702 km^2, comprised of 14 districts, 96 communes and 787 villages. Based on the 2008 Census, urban population was recorded at 1,803,853 persons（35,671 HH）, while rural population reached 844,321 persons (174,031 HH）. Population growth rate was 0.21% in urban area, 2.78 % in rural area and 2.56 % for the whole province.

4.2.2 Current Status of Urban Water Supply

(1) Description of provincial water supply

1) Status of provincial urban water supply

Battambang City, the provincial capital, is served by public managed water supply system. This system supplies 7,900 m^3/day of water in daily average to a served population of 42,051 or 8,582 house connections.(2009)

Aside from Battambang City, 12 other districts are served by private-managed system, excluding the newly formed Rokha Kiri District. Of these water systems, two had not undergone the usual planning process to set appropriate facility capacity.

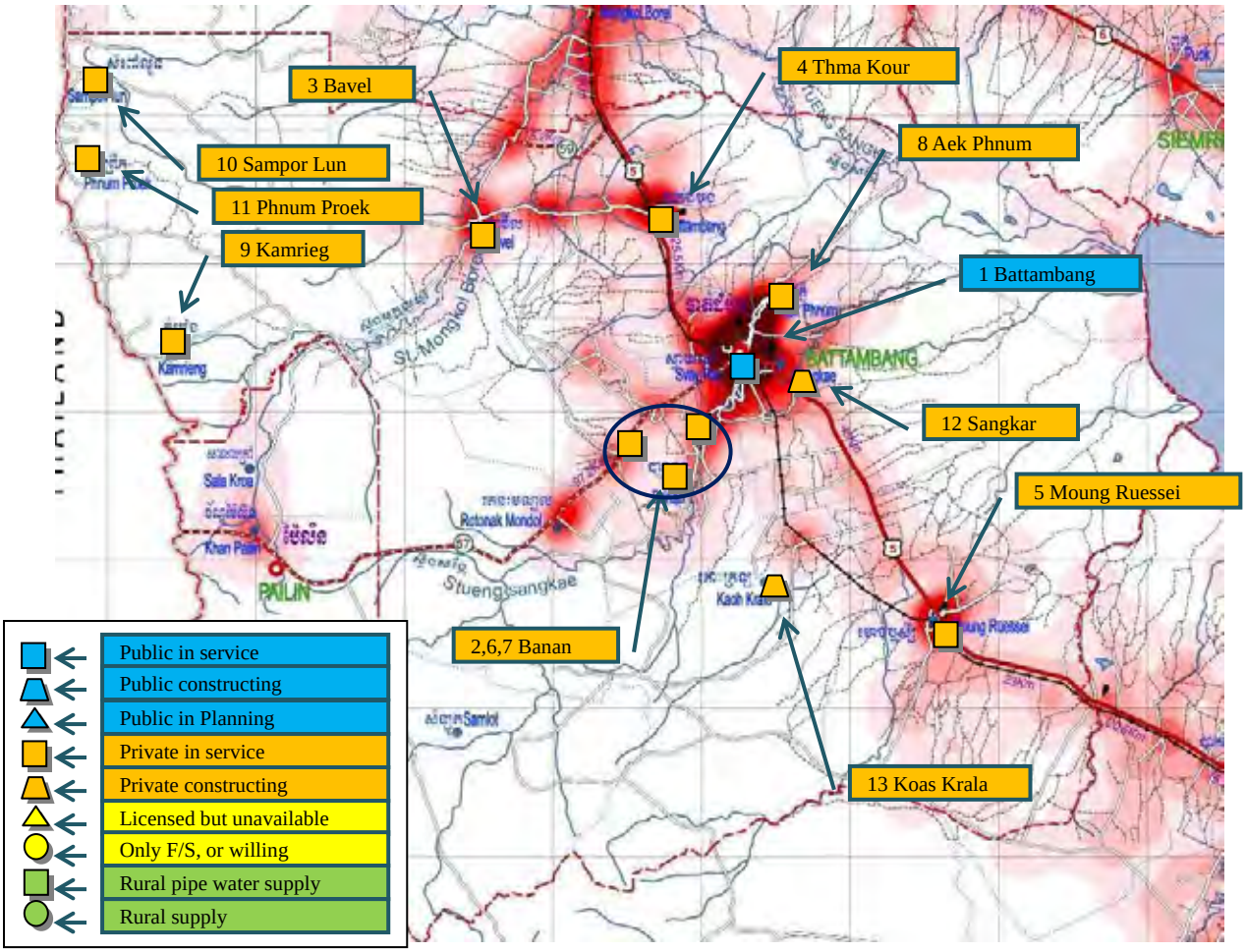


Figure 4.2.1 Existing Urban Water Supply System in Battambang Province

Table 4.2.1 Current Status of Urban Water Supply System in Battambang Province (2009)

No	Name of Town	Ownership	Year Established	Service Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Remarks
1	Battambang	Pub	1963	40,000	8,000	7,000	River	240,000	1,500	
	Battambang	Pub	1923	42,051	8,582	7,903				
2	Banan	Pri			275	38		130,000	2,000	
3	Bavel	Pri			476	150		100,000	2,500	
4	Thma Kour	Pri			675	150		100,000	2,200	
5	Moung Ruessei	Pri			852	150		100,000	2,000	
6	Banan (Doit Tolich)	Pri			203	25		50,000	2,000	
7	Banan (Khoal Bunheat)	Pri			650	33		58,000	2,000	
8	Aek Phnum	Pri			610	96		120,000	2,000	
9	Kamrieg	Pri			340	50		400,000	2,000	
10	Sampor Lun	Pri			312	10		400,000	2,000	
11	Phnum Proek	Pri			310	25		60,000	2,000	
12	Sangkar ?	pri	Not operated yet (under construction)							*1
13	Koas Krala ?	pri	Not operated yet (under construction)							*1

*1 Detail location is unknown. Blank means N/A.

2) Historical development of urban and public water supply systems

1923 Battambang public-managed water supply service was commissioned under the French regime.

1999 Rehabilitation project started through ADB loan assistance.

2005 Completion of the ADB-assisted rehabilitation of the existing WTP

Battambang City public-managed water supply service started its operation in 1923 under the French regime. In 1999, the system rehabilitation project was undertaken through a loan from the ADB. The rehabilitation of the WTP was completed in 2005. Compared with other provinces, Battambang province has more public-managed water supply system. This attributed to DIME's directives. As the first public-managed system became successful, this scheme was replicated to other districts.

3) Support from donor agencies

Since the rehabilitation of the Battambang public-managed water supply system through an ADB loan, which was managed mainly by the MIME, DIME has no information kept in its custody.

Currently, construction of a dam is on-going through Chinese assistance. It is a countermeasure for water source capacity shortage. Another dam is on the planning stage. The total construction cost is 61 million USD, of which 48 million USD is to be financed by a Chinese grant. The remainder is to be covered by loan. According to other information, the proposed dam is for irrigation use and there is no improvement plan to increase capacity in case of raw water shortage.

Presently, DIME, which has been engaged in the program of JICA, has no future plan for support from other donor agencies.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

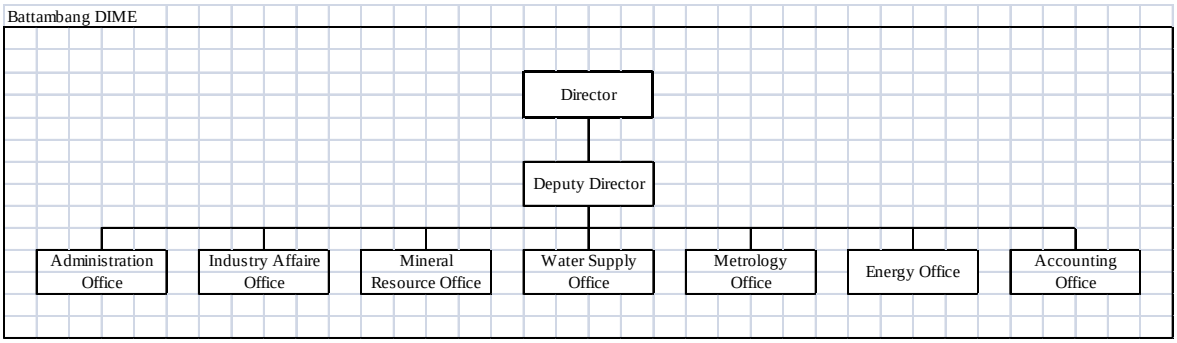


Figure 4.2.2 Organization Chart of Battambang Province

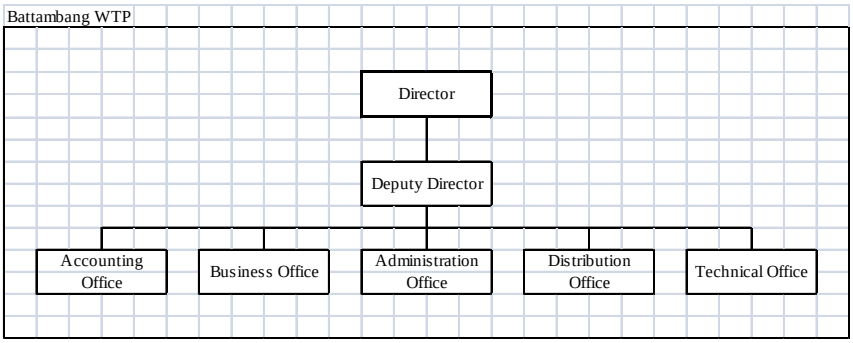


Figure 4.2.3 Organization Chart of Battambang WTP

Presently, DIME has 50 staff. Forty of which are involved in water supply operation and maintenance.

As benefit from JICA technical project, DIME is now operating the related projects properly. As an example, it was able to save the annual cost by shifting from low voltage to high voltage power and utilizes the saved amount to distribution pipeline installation.

Currently, the pipe network has high leakage rate, which needs a comprehensive reduction countermeasures.

- Operational status of private-managed water system
  DIME needs to establish water quality analysis procedure for standardization and capacity building for overseeing private-managed systems. Since MIME directs private-managed water system, DIME simply accepts the service level of existing facilities.

2) Capacity development for staffs

Since Battambang City public-managed water supply agency got technical assistance by JICA, DIME staffs participated three to four times in the training conducted in Japan.

For private-managed water supply service providers in each district, MIME offers technical assistance. It requires these service providers to submit a report every three months to verify plant production only. No monitoring on water quality is being made.

(3) Public managed water supply system and their operation

1) Capacity and function of raw water intake facility

The most serious issue in water supply projects in this province is water supply shortage. The raw water source is Sankar River, which flows from south to north of the city. The intake could not be observed because of high turbidity. At present, river water depth is low. If the irrigation dam upstream is implemented, the raw water for water supply will be substantially reduced to critical level.

JICA technical project is now examining the alternatives of intake infiltrated water in upstream and intake from other raw water source located 20 km away. KOICA once proposed raw water dam development. The plan was cancelled because it will require relocation of several residents.

2) Capacity and operation of WTP

The WTP was constructed with the assistance of ADB. Water treatment method employed is conventional where raw water is coagulated prior to sedimentation and filtration.

The raw water flows from the intake to grit chamber. It flows into another chamber where coagulant is combined through a mechanical flash mixer and then the water is diverted in horizontal flow flocculator at higher detention time at low velocity before reaching to the sedimentation basin. At present, the conditions of the baffle wall and trough are satisfactory.

Though sand filter has apparently sufficient depth, it cannot be concluded that this is appropriate since detailed drawings are not available.

There are two existing large capacity elevated reservoirs provided for the system. These are old and new storage facilities.

Generally, the WTP is well-designed considering that the piping system generates low friction loss. To avoid the risk caused by machinery malfunctioning, installation of mechanical equipment is minimized. Most of mechanical equipment used came from China.

3) Capacity and function of water distribution system

As loan contract was signed by MIME, all related drawings and documents are in its possession.

Thus, DIME has no related files on hand.

Reported water leakage is 30%, which is quite high.(28%, 2009) Since necessary measures will take time and huge budget, DIME should start leakage reduction program as soon as possible. A lot of PVC and/or GI pipes were used by ADB program and it may be a problem from the view point of leakage. Large leakage is expected in private-installed/contracted-out pipes considering that the pipes used are thin.

The JICA expert team reported that DIME understood the importance of leakage reduction and started to take measures. For example, they saved money by changing power receiving facility to high voltage and they used it for taking leakage measures and extention of distribution lines.

4) Operation and management of WTP

The study team could conduct field investigation only by site observation in this study. According to the JICA expert, the WTP staff is doing the necessary works to improve the facilities.

Although the technical capability of the staff still needs further development, they are able to keep the turbidity level of the treated water less than 5 NTU as apparently observed. Since algae are noted in sedimentation basin, concentration of nutrients in raw water is seemingly high. WTP staff explained that the sedimentation basin is cleaned and sediments are removed every three months.

Chemicals applied in the water treatment include alum and slaked lime. Alum is dissolved in chemical mixing tank and dosed in the system. Chlorine gas is employed for disinfection. Apparently, chemical procurement, supply and management are excellent.

5) Water quality control and supplied water quality

Water quality parameters were set by the JICA. The existing laboratory is equipped with general test kit and advanced measurement equipment such as electric conductivity meter and absorbent meter. However, only one staff can operate the equipment. When the WTP was formally commissioned, water samples were taken frequently and analysed by Chinese-made jar tester. But recently, jar tester is used only when turbidity in raw water is substantially high.

Table 4.2.2 Results of WTP Water Quality Analysis

Coagulation Management	Unit	Target	Raw Water	Sedimentation	Distribution
Temperature	degree	—	28 – 29	28 - 29	28 - 29
pH	—	7.0	7.9	7.4	7.5 - 8.0
Turbidity	NTU	Sed<10 Dis<1.0	105 – 110	5.5 – 6.0	0.93 – 0.98
Free Chlorine	mg/L	AF>0.1 Dist=1.0		0.12 - 0.13	1.03
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	300		310
Color	TCU	Sed<20 Dis<5	120 – 125	18 - 19	1.5 – 1.8
Alkalinity [mg/L]	mg/L	>10	136		12.0

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800	175.5	180.5
Total Hardness	mg/L	< 250	41	41
Total Organic Carbon	mg/L		19.53	11.48
Ammonia (NH_3+)	mg/L	< 1.5	0.11	0
Iron (Fe_2+)	mg/L	< 1.5	0.31	0.12
Manganese(Mn_2+)	mg/L	< 0.3	<0.2	0.2
Arsenic (As)	µg/L	< 50		
Chlorine (Cl-)	mg/L		17.38	20.52

Testing Status	
Testing Lab	WTP
Daily Record	OK
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	N/A
Latest test in	2010
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	N/A

The data in red is taken in March 2010, the data hilighted was taken in April 2010.

Analysis for required water quality parameters is conducted regularly and the results are recorded. Based on the recordings, the raw water has high turbidity and color. Turbidity of treated water is kept less than 1 NTU. Results of water quality tests are not available.

(4) Water supply status of public system

1) Water tariff, service area coverage and number of house connections

Table 4.2.3 Water Supply Status by Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population				180,853			
Population in supply area		135,539	151,627	157,009	162,340	100,000	
Service population		24,985	39,475	40,120	42,910	40,000	
Service connection or household		4,997	7,895		8,582	8,000	
Water supply (intake or treat)		4,587	7,452	7,412	7,903		
Water supply (distribution)		3,139	4,823	5,197	5,721	7,000	

Note） Results of interview

The capacity of the existing urban water supply system is 11,520 m^3/day. This served 42,910 of urban population and number of contract of water supply was 8,582 (2009). Fluctuation of water

consumption data was not available. According to the JICA expert team, present total water demand is 30,000 m^3/day, while the current possible water supply capacity is 15,000 m^3/day counting leakage deduction program.

2) Water tariff

The existing water tariff is 1,500 R/m^3, while house connection fee is 240,000Riel. Water charge is collected monthly and the customers have to pay in the WTP office.

3) Extent of water supply service

The extent of current water service lasts 21 to 22 hours per day. This cannot be extended to 24 hours unless leakage is substantially reduced. In this aspect, DIME is keen to conduct leakage reduction program as well as to extend the service area coverage with the recovered water from leaks.

(5) Financial status of public-managed water supply systems

Since no financial statements were provided, the current financial status of the water systems cannot be assessed.

4.2.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “springs, rivers and other surface water sources” (35.5%), “unprotected dug wells” (23.4%) and “tubed/pipe wells” (18.9%). The access rate to improved water is 30.2%. About 37.2% of the households in the province depend on remote water sources.

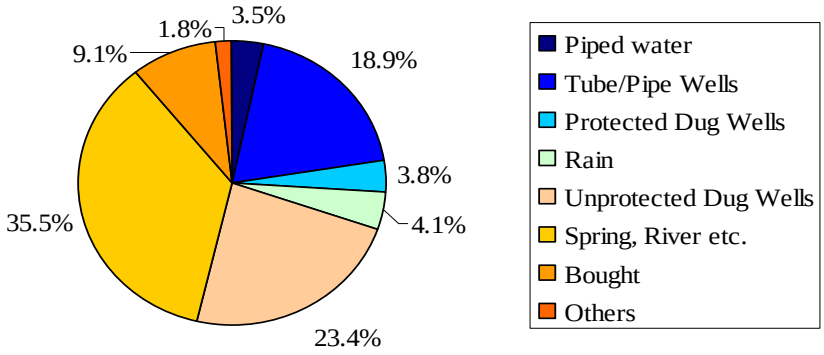


Figure 4.2.4 Type of Water Sources (Battambang Province)

2) Condition of Water Supply Facilities

The functional ratio of all the water supply facilities in this province is 88.9% according to the results of monitoring by PDRD. As shown in this monitoring, non-functional rate for VN6 pump, which is easy to procure in this province, is high.

Table 4.2.4 Monitoring Results by PDRD (Battambang Province)

Items	Total	Function		Broken	
	No.	No.	Ratio	No.	Ratio
Open wells	2,880	2,617	90.9%	263	9.1%
VN6	889	713	80.2%	176	19.8%
Afridev	1,393	1,247	89.5%	146	10.5%
Others	3,289	2,935	89.2%	354	10.8%
Total	8,451	7,512	88.9%	939	11.1%

Source: PDRD in Battambang (2010)

3) Hand pumps

Afridev hand pumps are common in this province, but availability of spare parts is difficult in the area. Also, VN6 pumps are used, whose spare parts are locally available. When pumps breakdown, the villagers directly procure the spare parts and make necessary repairs without any support of PDRD.

4) Water Quality of Groundwater

Arsenic is below the standard limit of MRD in this province. Iron is detected in 20 wells among the existing 1,056 wells. Since water quality equipments are not owned by PDRD, it has not performed water quality analysis even once.

(2) Organization and Structure of Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 92 staff, 3 of which are under the Office of Rural Water Supply and 7 under the Office of Primary Health.

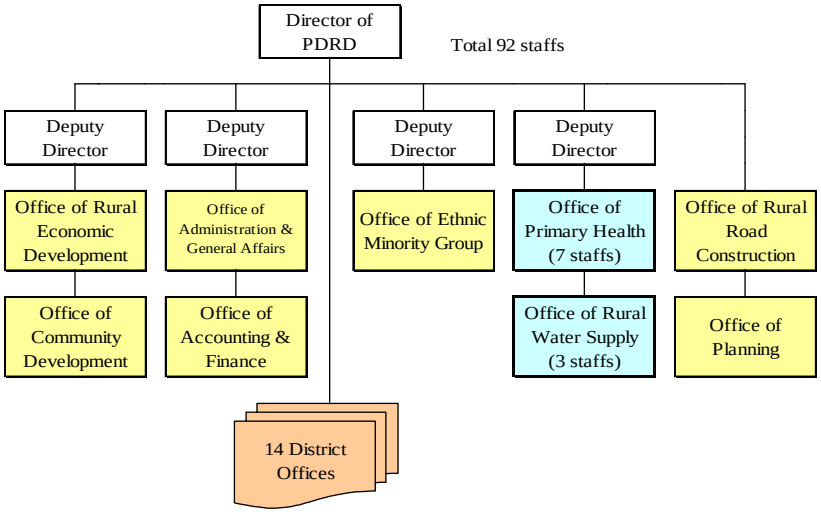


Figure 4.2.5 PDRD Organization Chart (Battambang Province)

2) Budget

"External expenses for services" accounts for a high percentage share of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 181.5 million Riel was allocated in 2009 for MRD budget, which was mainly used for rehabilitation of existing facilities.

Table 4.2.5 PDRD Budget (Battambang Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	136.0	11.1%	169.0	11.5%
	External charges for services	749.0	61.0%	806.0	54.7%
	Other external charges for services	85.0	6.9%	189.2	12.8%
	Personal expenses	255.0	20.8%	306.0	20.8%
	Taxes and similar services	2.0	0.2%	3.0	0.2%
	Total	1,227.0		1,473.2	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	181.5	7	under preparation by MRD	
	Well rehabilitation		150		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		157		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD is not actively carrying out the monitoring of water supply facilities. It has no knowledge of the present conditions of water supply facilities unless WSUGs report to PDRD, particularly in cases of failure of the facilities. PDRD understands that motoring is important in order to prevent major breakdown of the facilities. But because of budget limitation, it cannot perform what are necessary procedures. However, in ADB-assisted projects, budgets were allocated. Hence, PDRD was able to carry out monitoring programs.

(3) Assistance by Other Donors

1) Existing Project

a. Tonle Sap Water Supply and Sanitation Project by ADB

ADB has conducted Tonle Sap Water and Sanitation Project from 2006 to 2010. Three districts, Moang Reasey, Sangke and Thnar Koal district, where poor households are dominant and wells can be easily drilled, were considered in this project. The project constructed wells, toilets, bio-sand filters, community ponds, pipe water supplies and rainwater tanks. With this project, water supply coverage for target village improved to 51%. One drilled well provides water from 25 to 30 households. Also, toilet facilities coverage improved to 28%.

2) New Assistance Plan

a. Second Rural Water Supply and Sanitation Project by ADB

ADB has a new assistance plan which is almost the same as the Tonle Sap Rural Water and Sanitation Project (2006-1010), which commenced on July 1, 2010. Eight priority communes, 70 villages and 100 percent for water supply coverage are targeted by this project.

(4) Current Condition of Hygiene

Households with toilets account for 36.5% (63,512 households) in the rural areas. Of these households, 42.2% use septic tanks and 33.2% are connected to sewerage system.

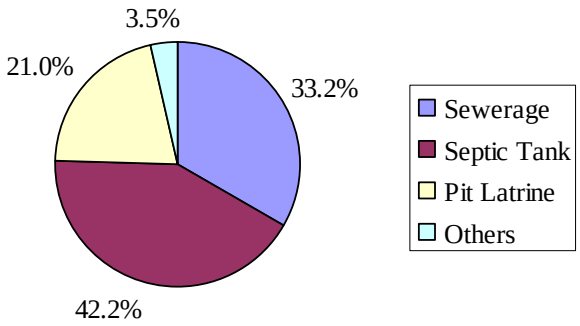


Figure 4.2.6 Type of Toilet (Battambang Province)

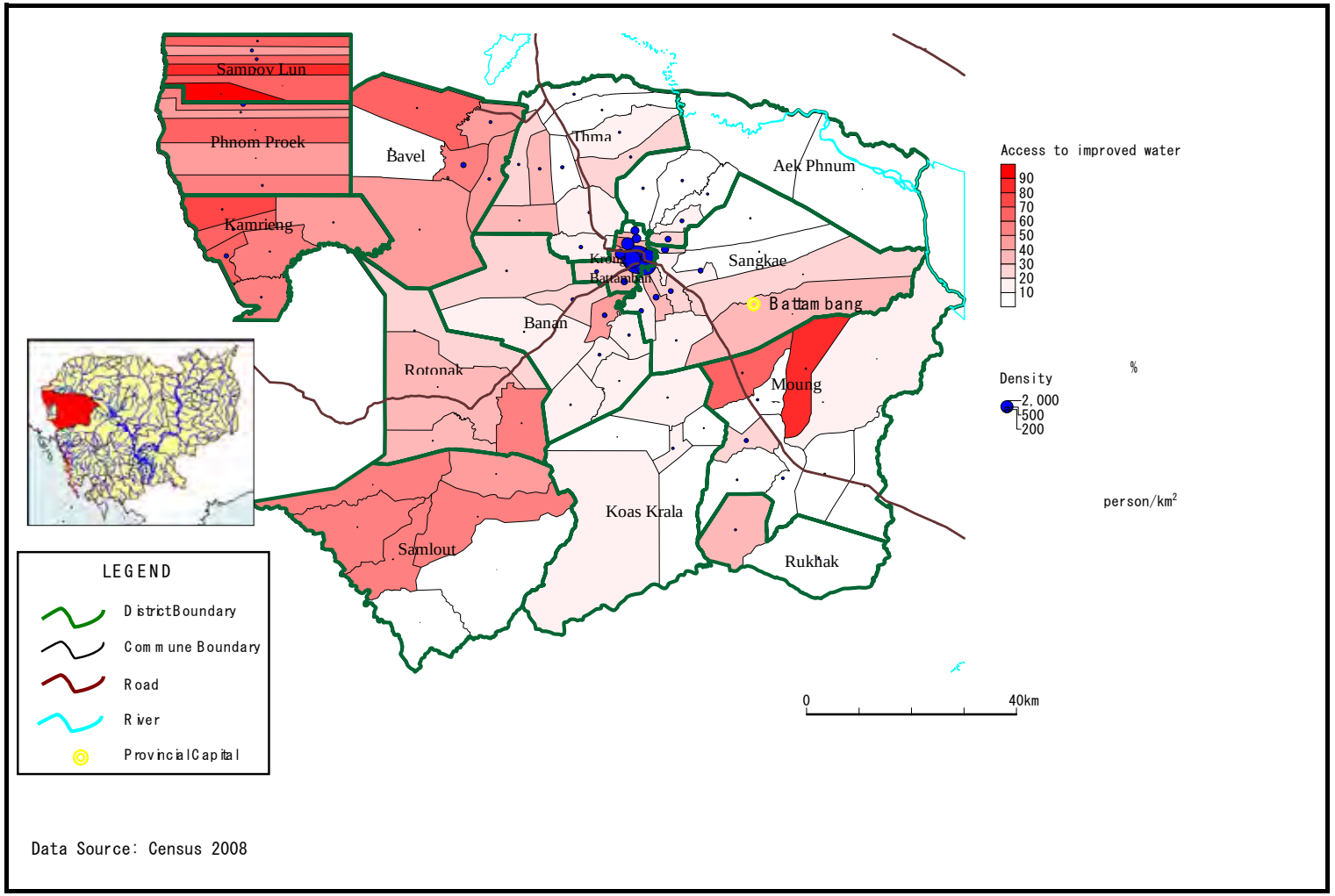
4.2.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 26 of the total 96 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.2.6 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Battambang Province)

Urban	Rural	Total
4/13 communes	22/83 communes	26/96 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.2.7 Service Area of Safe Water (Battambang Province)

4.3 Kampong Cham Province

4.3.1 Brief Description of the Province

The Kampong Cham province has an area of 9,799 km^2, which is comprised of 17 districts, 173 communes and 1,759 villages. According to 2008 Census, urban population was recorded at 118,242 persons（25,056 HH）and rural population reached 1,561,750 persons (343,058 HH）. Population growth rate was 0.50% in urban area, 0.46 % in rural area and 0.43 % in the whole province.

4.3.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of urban water supply

As to urban area water supply, only the provincial capital of Kampong Cham is public-managed and others are private-managed. Towns and villages not served by water supply system obtain water from groundwater wells.

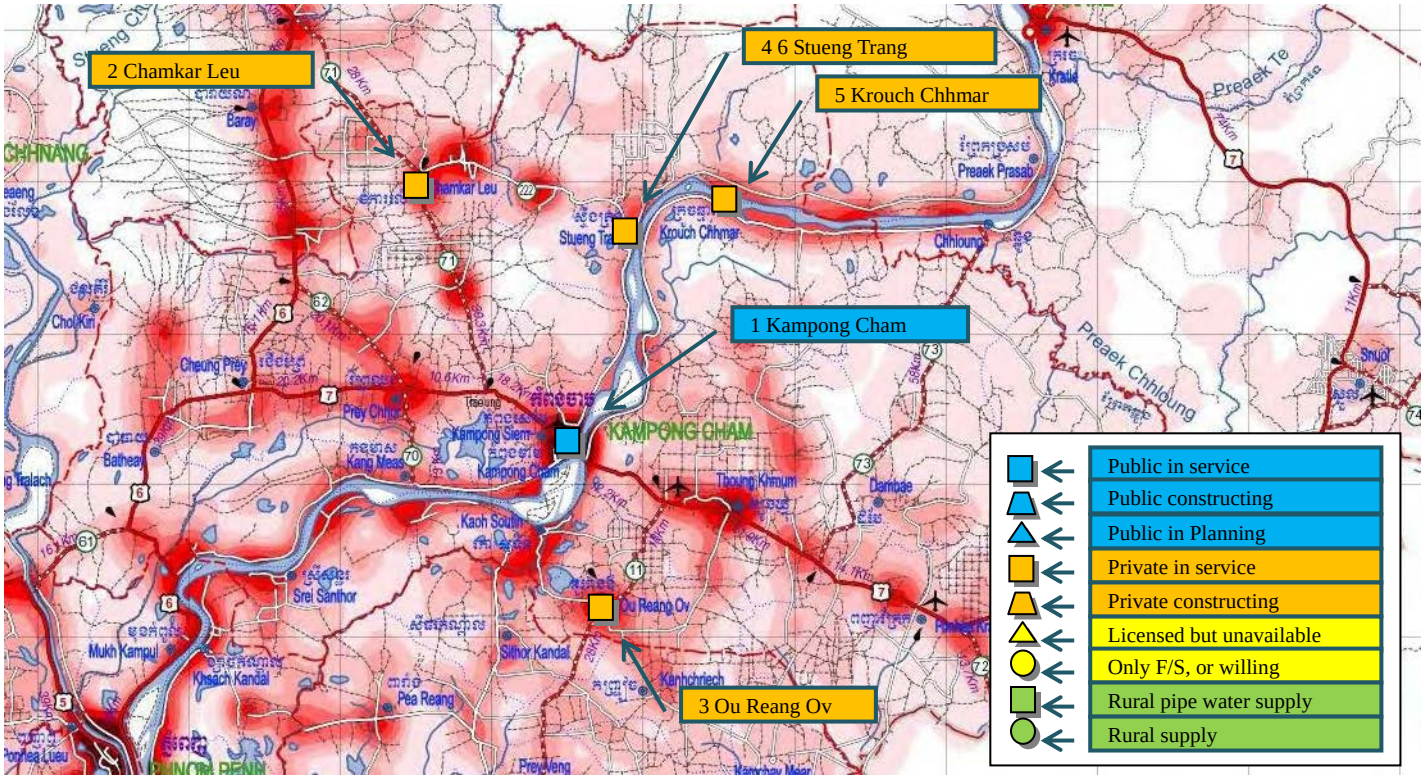


Figure 4.3.1 Existing Urban Water Supply System in Kampong Cham Province

Table 4.3.1 Current Status of Urban Water Supply System in Kampong Cham Province (2009)

No	Name of Town	Ownership	Year Established	Service Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Notes
1	Kampong Cham	Pub	1942	23,000	4,180	4,148	Well		900	
2	Chamkar Leu	Pri			299	67		120,000	2,700	*1
3	Ou Reang Ov	Pri			684	110		120,000	2,500	*1
4	Stueng Trang	Pri			307	80		80,000	2,500	*1
5	Krouch Chhmar	Pri								*1
6	Stueng Trang	Pri			740	120		free	2,500	*1

*1: According to DIME, additional project exists. Blank means N/A

2) Historical development of urban and public water supply systems

The provincial capital urban water supply system was improved through ADB assistance. The components of the assistance are as follows:

- Construction of reservoir, WTP building
- Installation of groundwater pumping facility
- Installation of distribution pipeline

Additional well construction was not included.

Some major urban areas are now served by private-managed system financed by WB and some are in planning stage.

Since the existing wells are old and capacity is not sufficient, DIME has to secure other water sources, additional wells and surface water at Mekong River. But any donor's supports are not presently available. Although study on alternative water sources was prepared by JICA basic study in 1992, there is no undertaking so far.

Capacity development project (Phase2) for the staffs of DIME has been undertaken aiming at improvement of management capacity of local governments for the water supply facilities.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

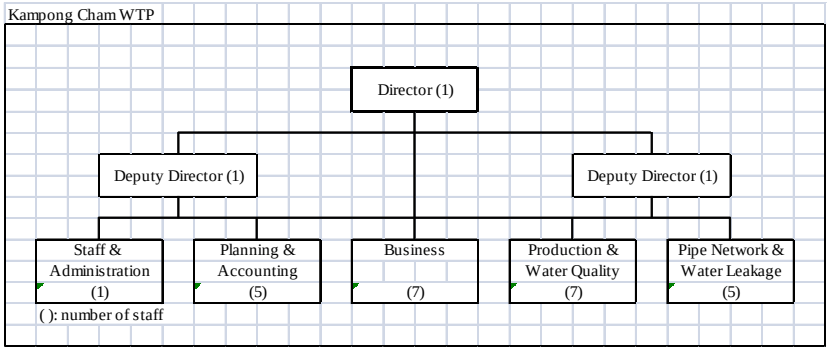


Figure 4.3.2 Organization Chart of Kampong Cham WTP

Staff number assigned to system O&M is as follows:

- WTP 6 persons
- Pipeline, meter reading and charge collection 10 persons
- System management 13 persons

In total, there are 29 persons manning the water system. As to private-managed system, no data are available.

2) Capacity development for staffs

DIME indicated that capacity building for staff has been executed, including technical cooperation rendered by JICA technical cooperation project. The director of WTP sent a request for the construction of training center within the premises of WTP for various capacity development activities.

(3) Facilities and operation of public-managed system

1) Capacity and operation of water source

Groundwater through is the primary source of supply of the water system. The existing tube wells were constructed in 1938. One of the wells is equipped with pump installed under the ADB assisted project in 2006. The pump head is 200m. Two other wells are also available.

Since groundwater table is remarkably deep during dry season, additional water source should be explored. DIME proposed the construction of additional wells or raw water intake at Mekong River.

During field survey, groundwater table was observed substantially lowered to 0.36 m above well bottom, limiting pump operation. If supply from groundwater is not available or very limited, WTP ceases operation. In such case, users have no other options other than using water from the Mekong River.

2) Capacity and operation of WTP

Water supply system has a capacity of 9,600m^3/day.

There are two existing elevated tanks with the following descriptions:

Elevated Tank	Year Constructed	Dimension	Application	Remarks
Lower elevated tank	1938	V = 175 m^3, H =30 m	Supply water for hydrant	
Higher elevated tank	2006	V = 500 m^3, H =39 m	Supply potable water	ADB assisted

The inside of the tanks is checked on weekly basis.

3) Capacity and function of water distribution facilities

Because of budgetary constraint, water service is limited to only 52% of the service area. If sufficient budget is allocated, DIME is planning to expand the service area

Valves are installed in key points of the distribution network for pipe maintenance and repairs. Thus, during maintenance and repair works water service interruption will be limited to small part of the service area.

Water loss attributed to leakage was accounted at 4.19% in 2009.

The diameter of the distribution main is 400 mm, which suited the WTP capacity.

4) Operation and management of water supply system

Available materials for O&M activities are inadequate. There are no stock of major supplies and tools, only few pipe fittings are available.

DIME posts the number of house connection on monthly basis. Also, the WTP operation status is placed on bulletin board to provide information on the plant's performance and provide early warning on impending problems to the staff as proposed by the JICA expert team.

5) Operation/management of WTP

Chlorine is injected into the system for disinfection before pumping to elevated tanks.

The premise of WTP is regularly cleaned and well-maintained.

6) Water quality and control

The WTP has own laboratory and several water quality parameters are analyzed regularly as indicated in the table below.

Table 4.3.2 Results of WTP Water Quality Analysis

Source	Date	Turbidity	pH	Total Dissolved Solids	Iron (Fe)	Total Hardness	Arsenic (As)	Chloride (Cl^-)
Standard		< 5 NTU	6.5 - 8.5	< 800 mg/l	< 0.3 mg/l	< 300 mg/l	< 50 µg/l	< 250 mg/l
Raw Water								
Potable Water	2009/08/31	1 NTU	6.64	225	0.05	-	0	-
		1 NTU	7.15	231	0.03	-	0	-

Note: Blank means N/A

(4) Water supply status of public system

1) Water supply capacity and service coverage

The table below shows a brief summary of the capacity and service coverage of the water system of Kampong Cham Province.

Table 4.3.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		42,302	43,549	43,726	43,981		
Population in supply area				47,300	44,085		
Service population		16,099	18,359	20,708	23,000		
Service connection or household		2,927	3,338	3,765	4,180	4,205	
Water supply (intake or treat)		1,778	2,999	3,519	4,219		
Water supply (distribution)		1,368	2,401	2,930	3,560		

Note: Blank means N/A

2) Water tariff

Water tariff is categorized by water use and type based on consumption as follows:

- Less than 10 m^3 550 Riel/m^3
- More than 10m^3 900 Riel/m^3
- Commercial use 900 Riel/m^3
- Public offices 1,500 Riel/m3

The water sales as of January 2010 are as follows:

House Connection No.	4,205	
Meter reading, bill collection HH	4,093	Collection Rate = 97%
Water production (m^3)	146,952	
Charged water amount (m^3)	126,635	Loss = 13.85%
Income (Riel/Month)	113,930,450	
Average charged water amount per connection	0.97	m^3/day/connection
Average water sale (Riel/m^3)	899.68	

3) Extent of water supply service

Water service is available 24 hours daily. Major complaints include malfunctioning of water

meters and water quality. Water charges are less in this water system.

4.3.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "unprotected dug wells" (39.5%), "tubed/pipe wells" (23.8%) and "water vendors" (13.9%). The access rate to improved water is 36.2%. About 30.6% of the households in the province depend on water sources distant from the service area.

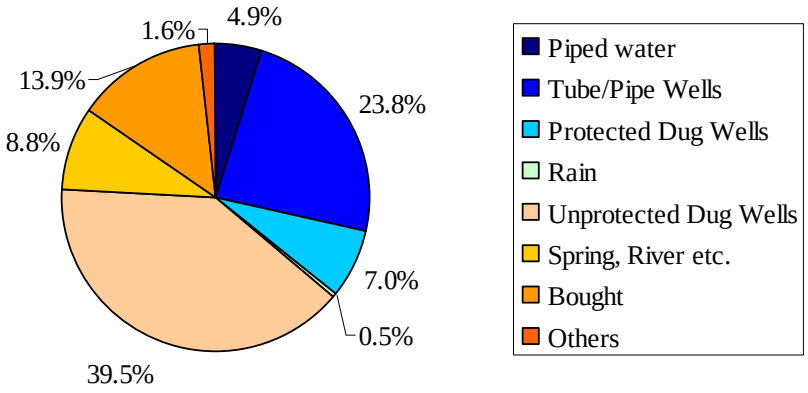


Figure 4.3.3 Type of Water Sources (Kampong Cham Province)

2) Condition of Water Supply Facilities

Since PDRD has not carried out regular monitoring, it is not aware of the present conditions of water supply facilities in the villages.

Table 4.3.4 Monitoring Results by PDRD (Kampong Cham Province)

Items	Total	Tube well	Hand dug Well	Combined well	Water jar	Rain water collection tank	Community pond
No. of facilities	6,756	3,905	1,705	469	616	26	35

Source: PDRD in Kampong Cham (2009)

Meanwhile, according to District Data Book (2008) of UNDP, the percentage of tube wells available year-round is 88.6%, while non-functional tube wells account for 7.7% (please refer to the table below).

Table 4.3.5: Functional / Non-functional Conditions of Water Supply Facilities (Kampong Cham Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	57,435	***
Year-round usable pumped or mixed wells	50,873	88.6%
Dry season unusable pump or mixed wells	6,562	11.4%
Pump or mixed wells needing repair/rehabilitation	4,405	7.7%
Total number of ring wells	57,710	***
Year-round usable ring wells	49,476	85.7%
Dry season unusable ring wells	8,234	14.3%
Ring wells needing repair/rehabilitation	5,423	9.4%
Total number of un-protected dug wells	28,187	***
Year-round usable un-protected dug wells	24,249	86.0%
Dry season unusable un-protected dug wells	3,938	14.0%

Source: District Book (2008)

3) Hand pumps

The hand pumps used in this province currently totals 60 with Afridev pumps installed in deep groundwater level areas, VN6 pumps account for 25%, and TARA pumps installed in shallow groundwater level areas comprising 15% of the total wells. Though spare parts for VN6 pumps can be procured easily in this province, spare parts for Afridev and TARA can only be procured from Phnom Penh. Procurement made by residents are as follows: (i) one set of standards spare parts are provided in case of donor projects, (ii) PDRD provide consumables such as O-ring and U-seal, which are stocked by PDRD to villagers, (iii) villagers direct purchase in Phnom Penh.

4) Water Quality of Groundwater

According to result of water quality analysis by arsenic center, 19.4 percent out of 1576 groundwater samples were detected more than 10ppb of arsenic and this province was identified as a high risk area of arsenic.

Table 4.3.6: Result of Arsenic Testing (Kampong Cham Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
1,576	218	13.8%	88	5.6%	1,270	80.6%

Source: Arsenic Center (2005-2007)

(2) Organizational Structure and Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 130 staff with 8 members under the Office of Rural Water

Supply and another 8 under to the Office of Primary Health.

The Office of Rural Water Supply has three main functions; construction of platform, installation of hand pump and soft component.

2) Budget

"External expenses for services" accounts for a high percentage share of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 664.9 million Riel was allocated in 2009 as a MRD budget, which was mainly used for rehabilitation of existing facilities.

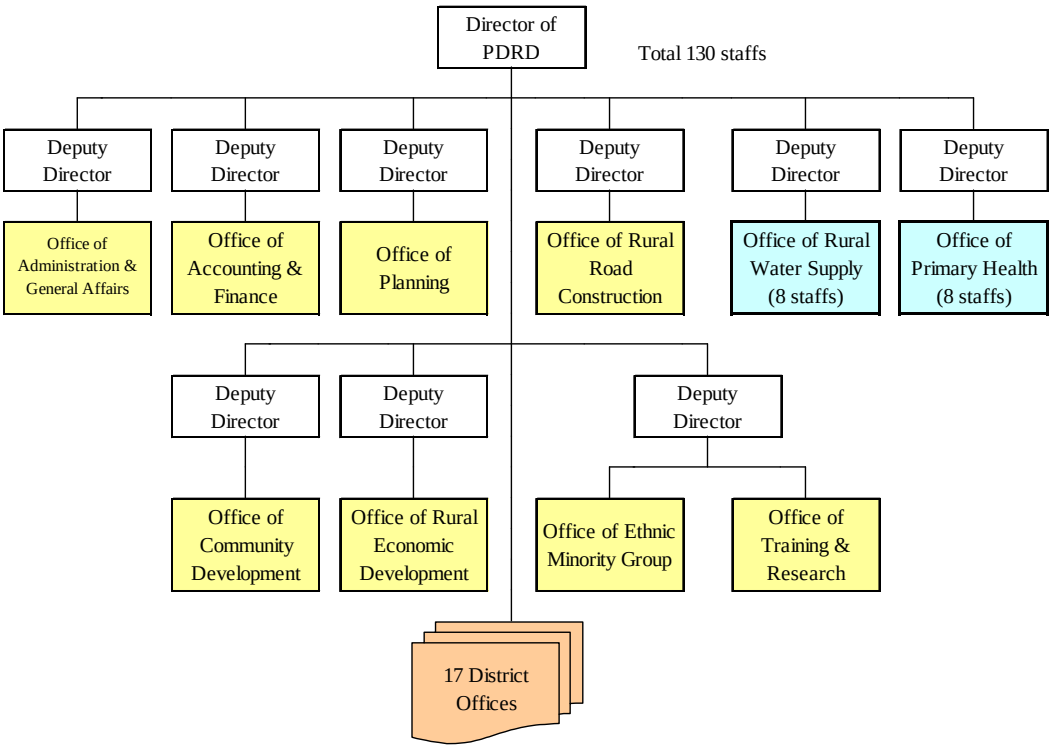


Figure 4.3.4 PDRD Organization Chart (Kampong Cham Province)

Table 4.3.7 PDRD Budget (Kampong Cham Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	183.0	18.7%	183.0	10.4%
	External charges for services	297.0	30.3%	997.0	56.9%
	Other external charges for services	170.0	17.3%	170.0	9.7%
	Personal expenses	330.0	33.7%	403.0	23.0%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	980.0		1,753.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	664.9	14	under preparation by MRD	
	Well rehabilitation		173		
	Upgrading Community Pond		3		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		3		
	Total		193		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has own drilling rigs, which are rented to PDRD in Kampong Chhnan at the present. These were procured by PRASAC project and are capable of constructing tube wells. But according to the National Policy, this construction is entrusted private entities.

(3) Assistance by Other Donors

1) Existing Project

Project Name	Description
a. Rural Water Supply and Sanitation Project financed by IMF	(i) Target sites: 25 communes {5districts (Batheay, Kaof Soutin, Krouch Chhmar, Memot and Tboung Khmum district), 5communes pre 1 district, however, it is not covered all villages in commune.} (ii) Contents: Construction of tubewell: 126, Construction of household toilet: 339, Installation of rainwater tank: 300 (iii) Period: From 2010 to 2012
b. The Project for Rural Drinking Water Supply in Memot district by Japanese Grant Aid	(i) Target site: Memot district (i) Contents: Construction of 135 wells with hand pumps, Soft components activities (formation of WSUG, hygiene education, instruction of operation & maintenance) (ii) Period: From January 2010 to March 2011
c. Rural Water Supply and Sanitation Project by Plan International	(i) Target site: 2 districts (Dambae and Ponhea Kraek) (ii) Contents: Construction of tubewell, Construction of tubewell and toilet to school, Hygiene education
d. CLTS Project by UNICEF	Sanitation campaign
e. Arsenic Mitigation Program by MRD supported by UNICEF	Water qualities testing in arsenic risk area were carried out in 2009. IEC activities to focal villagers will be carried out in 2010.
f. Rehabilitation Project for Rural Water Supply	(i) Contents: Rehabilitation for existing tubewell: 147, Construction of new tubewell: 14, Construction of new community pond: 3 (ii) Budget: 396 Million Riel (financed by MRD) (iii) Period: 2009

2) Issues of existing Project

- Inventory data of tube well constructed by donors and NGOs has not been shared between PDRD and supporting agencies, PDRD has not understood the well conditions.
- Lack of capacity building of PDRD and DORD such as technical know-how and computer skills for well database
- No provision for rehabilitation of machine and equipment such as compressor and truck with crane

3) New Assistance Plan

a. Rural Water Supply Project financed by MRD

Budget: 536 Million Riel (budgetary request in 2010)

Situation: Project plan was submitted by PDRD to MRD and Ministry of Finance and Economy in December 2009 but not yet approval.

Contents: Rehabilitation of existing tube wells, 110; Construction of new tubewell, 16; Replacement of existing hand pump, 25; Well developing of existing wells, 4; Construction of new community pond, 1; Construction of rainwater tank for school ($35m^3$), 5; Construction of rainwater tank for household ($4m^3$), 13; Construction of irrigation pond, 1; Construction of canal for irrigation, L=250m; and Construction of culvert, 1.

(4) Current Hygiene Condition

Households with toilets account for 22.9% (78,509 households) in the rural areas. Of these households, 52.0% use septic tanks and 25.7% use pit latrines.

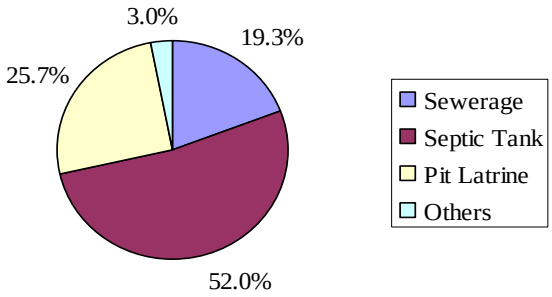


Figure 4.3.5 Type of Toilet (Kampong Cham Province)

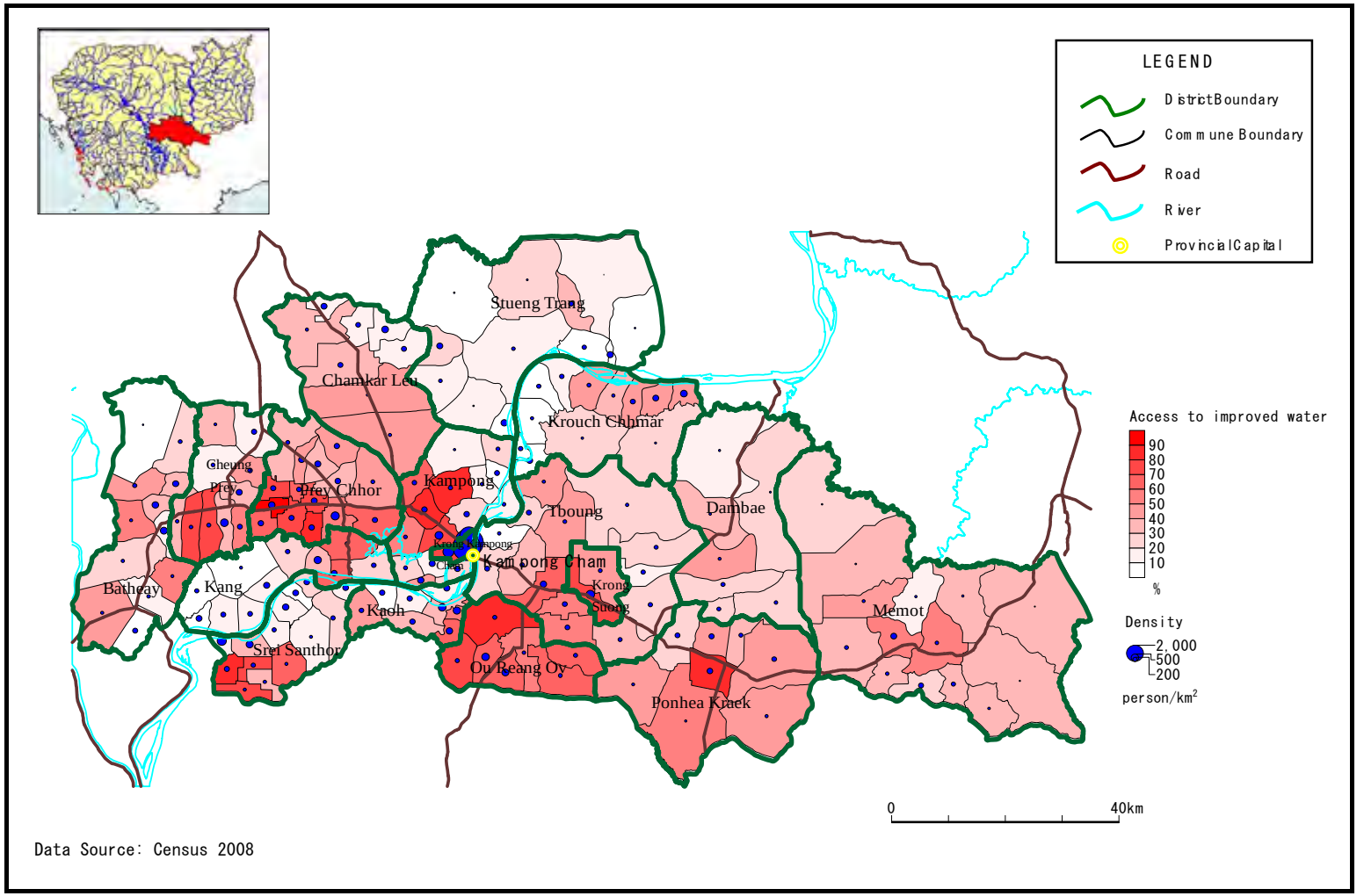
4.3.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 46 of the total 173 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.3.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kampong Cham Province)

Urban	Rural	Total
7/8 communes	39/165 communes	46/173 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.3.6 Service Area of Safe Water (Kampong Cham Province)

4.4 Kampong Chhnang Province

4.4.1 Brief Descrition of the Province

The Banteay Meanchey province has an area of 5,521 km^2, comprised of 8 districts, 69 communes and 568 villages. Based on 2008 Census, urban population was 43,130（8,294 HH）and rural population was 429,211 (92,507 HH）. Population growth rate was 1.22 % for the whole province, 0.33% in urban area and 1.32 % in rural area.

4.4.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

The Provincial capital of Kampong Chhnang is served by public-managed water supply system. In the southern district, a private-managed water supply system operates. There are also two private-managed systems developed, but currently not operational. In general, urban water supply service neither improved nor expanded. Therefore, these systems should be improved to have more beneficiaries.

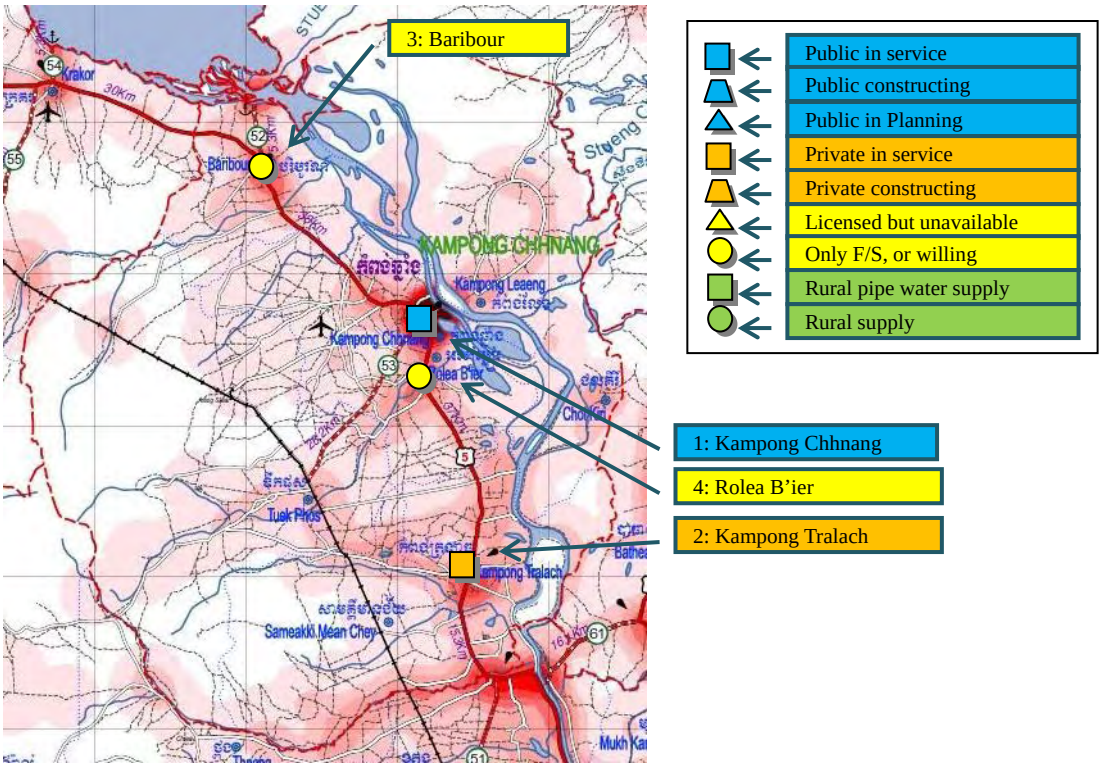


Figure 4.4.1 Existing Urban Water Supply Sytem in Kampong Chhnang Province

Table 4.4.1 Current Status of Urban Water Supply Sytem in Kampong Chhnang Province

No	Name of Town	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Notes
1	Kampong Chhnang	Pub	1939	9,972	1,119	700	River	1,300		
2	Kampong Tralach	Pri	2009	N/A	284	20	Well	1,750		
3	Baribour	Pri	Not operated yet (only license)							
4	Rolea B'ier	Pri	Not operated yet (only license)							

Note: Blank column means N/A

2) Historical development of urban and public water supply systems

1939 Water service was established in provincial capital under French regime.

1975 to 1976 Pol Pot group destroyed the water supply system.

1981 to 1982 Vietnam assisted WTP repair, expansion, technical cooperation and material and equipment procurement. The system is then managed by public sector but WTP capacity is still insufficient.

1996 to 1992 Through the support of Netherlands, SAWA, NGO and local consultant, donated 500 thousand US$ to the province of Kampong Chhnang and Kratie as budget for transmission and distribution pipe installation. Dilapidated pipes were replaced by PVC pipe.

1997 The WTP was developed to the existing capacity and operation.

1998 DIME requested Social Fund (NGO) budget allocation for water supply capacity augmentation. Utilizing the budget of 130,000 US$, the project was completed. Service population has increased from 17 - 18% to 23 - 24% of the urban population.

The WB conducted F/S on three towns located along the national road and their viability were confirmed. In one of the towns, Kampong Tralach located in south of the province, private-managed system is now operating. Raw water is obtained from groundwater through tube well constructed by the WB in 2009. Distribution pipelines were installed in the service area measuring 6 km west to east and 4 km north to south directions. It was financed by residents lending from bank. Further expansion is planned through loan from banks.

For the other two towns, tendering of contract was made in 2006 but contractor has not started the construction work. The water supply projects for both towns were suspended. DIME has no information whether the contractor got construction license or not.

DIME's short-term goal is to develop urban water supply system in four areas including the provincial capital to supply affordable water supply complying with the national potable water standards.

3) Support from donor agencies

Though DIME presently has no future plans for development of water supply facilities, it intends to expand the distribution pipelines and increase WTP capacity to reduce the gap between water supply and water demand when budget becomes available.

MIME and JICA sent technical team to DIME to examine the possibility of the agency's assistance. So far, DIME has not received any assistance.

Requirements of the provincial capital water supply system are as follows:

- Rectification of the problem of water intake pump
- Improvement and incease capacity of the water treatment facilities
- Expansion of distribution network
- Rehabilitation of dilapidated office

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

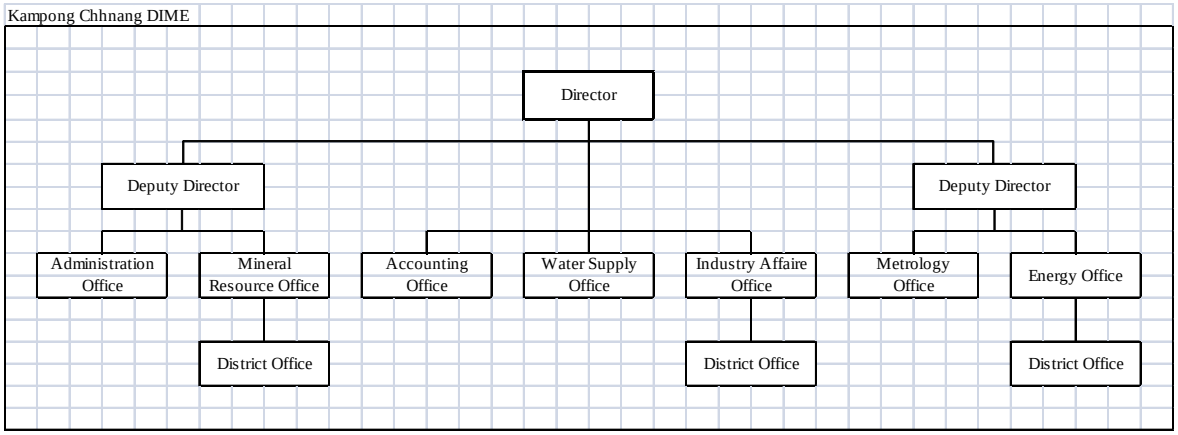


Figure 4.4.2 Organization Chart of DIME in Kampong Chhnang Province

Based on the accomplished questionnaires, DIME has nine staffs. Five of which are regular staffs and the remaining four are contractual staff. Salary is paid from the Royal Government.

- Management of private system

One completed system of the three located in the south of the province is under private contract.

2) Capacity development for staffs

DIME dispatches their staff to the short-term seminar on accounting and water quality analysis conducted by MIME. Technical capacity is fair. Last year, there was only one participant because of budgetary problem of MIME.

The needs on capacity development are as follows:

- Technical Aspect
  - General knowledge
  - Design criteria and procedure for related facilities from raw water intake to water treatment
  - Distribution pipe installation method
  - Operation of mechanical equipment
  - Water quality anlysis
- Managerial Aspect
  - General knowledge
  - Accounting
  - Human resource management
  - Computer operation
  - Supply water tariff adjustment and record keeping

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Water source is withdrawn from surface water of Tonle Sap River. There is a port nearby the intake point. As many residents are living around the port, river water is contaminated by domestic wastes.

Intake capacity is 900 m^3/day, while the WTP capacity is 700 m^3/day. The distribution pipe network can accomodate 850 m^3/day.

Raw water is taken from intake tower installed within Tonle Sap River. During rainy season, water quality is good, but during dry season water becomes troublesome because of increased dust and domestic wastewater.

2) Capacity and operation of WTP

Primitive rapid coagulation and sedimentation method, a French technology, is employed in the water supply system. Coagulant is mixed at receiving well utilizing the remaining water head. No flocculator was observed. After the up-flow rapid sedimentation, the water is further treated by sand filter.

Clear water is pumped to elevated reservoir and then distributed to the service area by gravity. Since capacity of the existing pump is insufficient, it should be replaced by higher capacity pump.

CI pipe is used at exposed portion connecting the treatment facility. This pipeline is in satisfactory condition. PVC with TS connection is used in other pipelines.

There is water supply facility that serves large volume of water to tanker trucks. It is for festival use.

Water production and consumption is monitored through water meter at the intake and service connections.

3) Capacity and function of distribution system

According to water service area plan, the existing main piping is trunk water pipe and the total length of lateral water pipe is too short. Against water intake facility capacity of 900 m^3/day and water supply capacity of 700 m^3/day, daily maximum water supply amount is 642 m^3/day and hourly maximum water supply amount is 1,920m^3/day.

Since intake water amount and supply water amount is monitored by water meter, abovementioned figure is reliable.

The leakage of the distribution system is about 14%, which is within acceptable level. The amount of leakage is calculated based on meter reading and leakage information from users.

House connections are tapped to the lateral pipes. A fee is collected for every connection made.

Figure 4.4.3 Urban Water Supply System Layout Plan of Kampong Chhnang Province

4) Water supply O&M status

DIME does not manage water supply projects and entrusted its O&M to water supply authority.

5) WTP O&M status

The present coagulation process made is not adequate, specifically if turbidity is high. Further modification is necessary to cope with the demand. For coagulation, crushed alum is used. Other chemicals are used to improve turbidity reduction, but this is found ineffective. For disinfection, powder hypochlorite (bleaching agent) is utilized.

6) Water quality and control

The only available water quality data is the results of the survey conducted in 2004. Both raw water and treated water were analyzed. Ammonia was found in raw water, but not in treated water. Based on the above survey, turbidity of treated water was 2.7NTU. Also, fishy smell and bubbles were observed at the receiving well, which suggest raw water contamination.

The Provincial Department of Water Resource and Methodology is the agency that keeps gage height data of the source as well as water quality data.

Table 4.4.2 Results of WTP Water Quality Analysis

Coagulation Management	Unit	Target	Raw Water	Sedimentation	Distribution
Temperature	degree	―			
pH	―	7.0	5.2		7.25
Turbidity	NTU	Sed<10 Dis<1.0	64.7		2.7
Free Chlorine	mg/L	AF>0.1 Dist=1.0			
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	149.7		80.4
Color	TCU	Sed<20 Dis<5			
Alkalinity [mg/L]	mg/L	>10			

Water Quality	Unit	Standard	Raw Water	Potable Water
Total Dissolved Solids	mg/L	< 800	71	37.8
Total Hardness	mg/L	< 250	19	18.8
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5	4.64	0.18
Iron (Fe2+)	mg/L	< 0.3	0.08	0.05
Manganese(Mn2+)	mg/L	< 0.3	0.0	0.0
Arsenic (As)	μg/L	< 50		
Chlorine (Cl-)	mg/L	< 250		
Fluorine (F-)	mg/L	< 1.0	0.14	0.10
Nitrate (NO2-)	mg/L	< 50	2.6	2.8

Testing Status	
Testing Lab	DPWS
Daily Record	N/A
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	N/A
Latest test in	2004
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	OK

Note: Blank means N/A

Considering the presence of ammonia, the degree of organic contamination of the raw water is relatively high. Ocasionally, nitrogen as nitrate is tested on the raw water. However, this has to be performed on regular basis.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.4.3 Water Supply Status of Public System

	Plan	2006	2007	2008	2009	2010	Future
Total population of urban area		37,144	37,827	38,988	39,220	41,181	45,300
Population in supply area		21,100	21,100	21,100	21,100	21,100	36,200
Service population		8,959	9,391	9,671	9,972	10,472	21,700
Service connection or household					1,119	1,130	
Water supply (intake or treat)		1,340	1,400	1,450	1,500	1,600	3,250
Water supply (distribution)		750	856	800	855	930	-

Note: Calculated by 5 to 6 persons/HH, Urban area population in 2008 was 38,988 persons in 5,569 HH, Blank column means N/A

The supply rate of the system is 700m^3/day, which is nearly the same as the daily maximum water demand of 642m^3/day. The hourly maximum water demand, as earlier mentioned is 1,920m^3/day. This necessitates provision of reservoir to meet the hourly maximum water requirement.

2) Water tariff

The existing water tariff is 1,300 R/m^3. The water fee is collected by MIME, through its collectors, on monthly basis. Billing is still made manual. Current collection efficiency is almost 100%, which is considerably high. Collection from higher income group is relatively difficult.

3) Extent of water supply service

Basically, the water service is available 24 hours daily. But there are occasions when water supply last for only 20 hours. There is an outstanding request from residents to expand the system as there are considerable potential users beyond the main roads where the distribution pipelines are installed.

(5) Financial status of public system

1) Current financial status

Based on the income statement in 2008, 2009 and balance sheet in 2009 on public-managed water supply project, cost item composition is analyzed. Financial statement was immediately submitted upon request. Compared with project management, financial management seemed satisfactory.

Table 4.4.4 Financial Status of DIME in Kampong Chhnang Province

Kampong Chhinung	1,000 Riel
Aasets	**361,618**
Current Aasets	**19,411**
Cash	817
Current Receivable	15,566
Materials	3,028
Fixed Assets	**342,207**
Land	58,654
Buildings net	33,605
Machineries net	246,497
Other Equipments net	3,451

Liabilities & Equity	**361,618**
Liabilities	**193,720**
Current Liabilities	193,456
Long term Liabilities	264
Equity	**167,898**
Capital	529,797
Retained Earnings	-361,899

Fixed Assets Ratio	203.8%
Fixed Assets to Fixed Liability Ratio	203.5%
Equity Ratio	46.4%
Suppy per Assets	1,415 Riel/m3

1,000 Riel

	2009	2008	Retio
Revenue	**349,611**	**312,410**	**100.0%**
Water revenue	302,299	266,551	85.3%
Others	47,312	45,859	14.7%
Expense	**332,246**	**375,635**	**100.0%**
Operating Expense	**329,222**	**372,969**	**99.3%**
Electricity Cost	0	0	0.0%
Chemicals	43,320	27,800	7.4%
Fuel	222,265	282,214	75.1%
Spairparts	6,033	6,543	1.7%
Labor & Temp. staff	460	5,451	1.5%
Salary & Allowance	5,871	12,473	3.3%
Depreciation	32,655	33,915	9.0%
Others	18,618	4,573	1.2%
Operating Expense	**3,024**	**2,666**	**0.7%**
Administrative & Tax	3,024	2,666	0.7%
Net income	17,365	-63,225	-16.8%

Amout of Water Supply	700	m3/day
Unit price of Water Supply	1,223	Riel/m3
Energy Cost per Water	1,213	Riel/m3
Material Cost per Water	26	Riel/m3
Labor Cost per Water	70	Riel/m3

2) Potentials for sustainable management by water charge income

Income from water sales accounts for 85.3% of the total income, which is fair. However, there was an instance that negative income was incurred.

3) Composition of Expenditures

The major disbursements or outflows of public-manage water system consist of fuels (may include electricity), chemical cost and depreciation.

4) Financial capacity

The financial capacity of rural water system is weak due to annual operation loss attributed to substantial reduction of equity capital and net worth of the water system.

Although the equity capital ratio is within reasonable range of 46%, the long-term liability ratio is quite high at 203% due to heavy debt.

5) Fund investment effects

Considering the annual investment amount and the annual volume of water supplied, the unit investment was only 1,415 Riel/m^3. This is quite low and it shows that no substantial investment has been made for several years. Additional budget allocation is necessary for the water system.

(6) Relevant facilties

1) Private system（Trakach district）

- Outline of the system

  The "Water Supply and Sanitation for Urban Area in Trakach District" project serves 284 HH out of the total 1,800 HH. In 2009, water treatment facilities were constructed through a loan. Water tariff was set at 1,750 R/m^3. The personnel overseeing the system need capacity development on financial management and technical aspect of operation.

- Water supply facilities

  Groundwater is the primary source of supply. It is pumped from deep well and directly distributed to the consumers. In 2009, the WB constructed a well with depth of 93 m. However, no distribution pipes were installed. To utilize the well, distribution pipes have to be installed to the school which was originally planned along the roads, 2 km north, 4 km south and 4 km west reckoning from the well. Construction of elevated tank is now on-going and scheduled to be completed in June 2010.

- Operational status

  No water quality data is available.

4.4.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "unprotected dug wells" (35.8%), "tube/pipe wells" (32.1%) and "spring, river etc." (19.8%). Access rate to improved water is 40.2%. About 30.4% of households in this province depend on remote water sources.

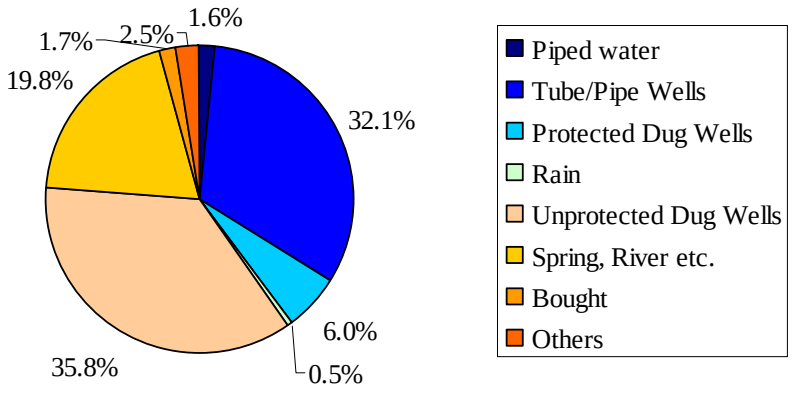


Figure 4.4.4 Type of Water Sources (Kampong Chhnang Province)

2) Condition of Water Supply Facilities

The functional ratio of all the water supply facilities in this province is 57.3% for the whole year and a mere 26.7% during rainy season. This is based on the results of monitoring made by PDRD. Water level and water quality data shows that most of the well sources have

varying period of operation, i.e. a function of season change.

Table 4.4.5 Monitoring Results by PDRD (Kampong Chhnang Province)

Items	No. of facilities	Ratio
Pumps or mixed wells	19,958	
Usable year-round	13,415	67.2%
Usable only rainy season	3,730	18.7%
Broken (not function)	2,813	14.1%
Open wells	18,097	
Usable year-round	8,537	47.2%
Usable only rainy season	6,400	35.4%
Broken (not function)	3,160	17.5%
Water ponds	379	
Usable year-round	59	15.6%
Usable only rainy season	135	35.6%
Broken (not function)	185	48.8%
Total	38,434	
Usable year-round	22,011	57.3%
Usable only rainy season	10,265	26.7%
Broken (not function)	6,158	16.0%

Source: PDRD in Kampong Chhnang (2008)

3) Hand pumps

Afridev hand pumps are used in areas where groundwater level is deep. On the orher hand, VN6 pumps are utilized in areas where groundwater occurs at shallow depth. Spare parts for Afridev hand pumps are not readily available in the province. If WSUG needs spare parts for Afidev hand pumps, it has to order from the PDRD. The spare parts are procured in Phnom Penh.

4) Water Quality of Groundwater

The result of water quality analyis made by the Arsenic Center shows that 10.4% of the 662 groundwater samples collected and analyzed were detected for arsenic at concentration level of more than 10ppb but not more than 50ppb. Hence, this province was identified as high risk area of arsenic.

Table 4.4.6 Result of Arsenic testing（Kampong Chhnang Province）

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
662	24	3.6%	69	10.4%	569	86.0%

Source: Arsenic Center (2005-2007)

Moreover, iron was detected in some areas surveyed. Iron removal equipment are installed in 20 tube wells. However, PDRD is not carrying out water quality testing since no equipment is provided.

(2) Organizational Structure

1) Organizational Structure

The PDRD in this province is comprised of 66 staff, 7 of which are detailed in the Office of Rural Water Supply and another 7 under the Office of Primary Health.

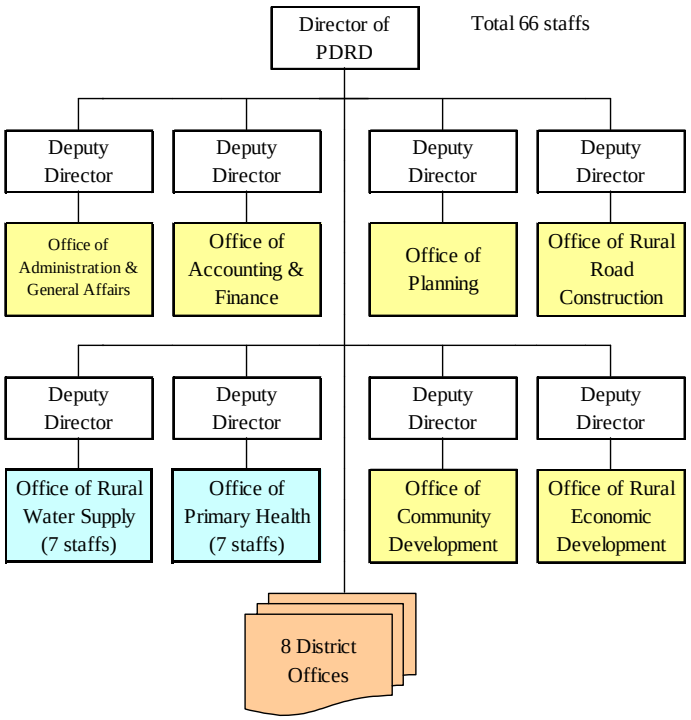


Figure 4.4.5 PDRD Organization Chart (Kampong Chhnang Province)

2) Budget

"External expenses for services" and "personal expenses" account for substantial percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

Table 4.4.7 PDRD Budget (Kampong Chhnang Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	212.0	26.7%	210.0	24.7%
	External charges for services	226.0	28.5%	276.0	32.5%
	Other external charges for services	89.0	11.2%	89.0	10.5%
	Personal expenses	266.4	33.6%	273.6	32.2%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	793.4		848.6	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Since PDRD is not active in monitoring the water supply facilities, it has no first hand information on the present conditions of the water system, unless the WSUG reports to PDRD, such as in case of facility breakdowns. PDRD is aware that monitoring is is vital in maintaing the facilities to prevent major service interruptions. However, because of insufficient budget, monitoring works are considered low priority.

In addition, although PDRD owns drilling rig, it cannot develope more wells to augment current supply and expand the system. Again, this is attributed to inadequate budget allocation for the agency.

PDRD understood that rural residents (i) prefer the use of surface water for adequate supply, (ii) are not used to have toilet for proper sanitation, (iii) cannot easily change their lifestyle, and (iv) do not participates in projects. In order that the rural residents change their attitudes towards water supply and sanitation, information, education and communication (IEC) is necessary. With constricted budget, PDRD cannot carry out public awareness programs.

(3) Assistance by Other donors

1) Existing Project

a. Tonle Sap Water Supply and Sanitation Project by ADB

ADB has started Tonle Sap Water and Sanitation Project commencing in 2006 and will be completed in 2010. Three districts, the Kampong Tralach, Rolea B'ier and Kampong Leaeng, where poor households concentrate, will have water supply and sanitation projects.

2) New Assistance Plan

a. Second Rural Water Supply and Sanitation Project by ADB

ADB has a new assistance plan which is almost the same endeavors as the Tonle Sap Rural Water and Sanitation Project (2006-2010), which will commence on July 1, 2010. Five priority districts, Kampong Tralach, Rolea B'ier, Kampong Leaeng, Samaki Meanchey and Teuk Phos, are targeted in this project.

b. Tonle Sap Lowlands Rural Development Project by ADB

The Tonle Sap Lowlands Rural Development Project will support 40 communes. It includes development and upgrading of rural infrastructures such as road, school, health center, irrigation facility, and water supply and sanitation facilities in the provinces of Kampong Chhang, Kampong Thom, and Pursat in the Tonle Sap basin. The implementation will involve the target communities to assist the government agencies. MOWRAM is the executing agency and several government agencies will be directly engaged in the implementation, including the Ministry of Rural Development (MRD), Ministry of Agriculture, Forestry and Fisheries (MAFF), and Ministry of Interior (MOI).

Feasibility study was already done and construction will commence in June or July 2010. However, PDRD has no other details.

(4) Current Condition of Hygiene

Households with toilets account for 14.6% (13,476 households) in the rural areas. Of these households, 45.7% use septic tanks and 30.5% are connected to sewerage system.

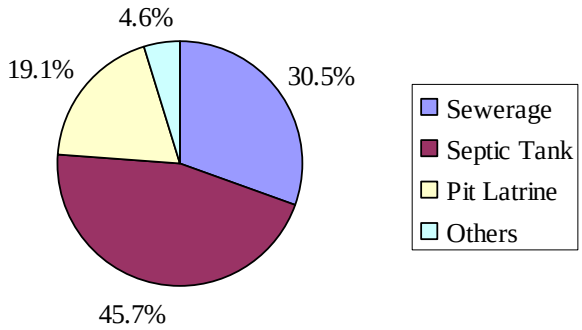


Figure 4.4.6 Type of Toilet (Kampong Chhnang Province)

4.4.4 Safe Water Supply Area

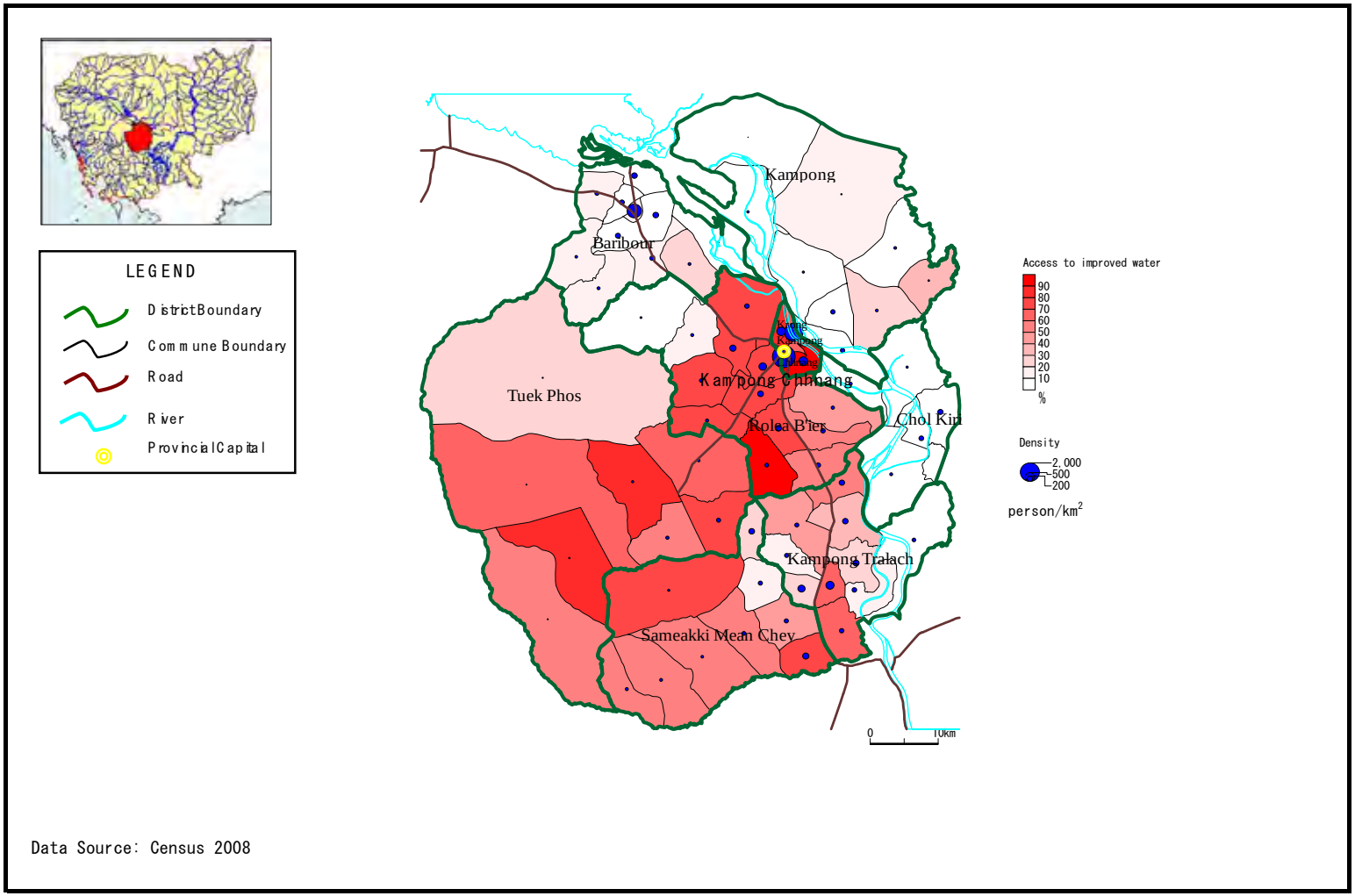
Based on the data on water source usage by household in each community from the 2008 census, 30 of the total 69 communes in this province have more than 50% access to "improved water" as shown in the table below.

Table 4.4.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kampong Chhnang Province)

Urban	Rural	Total
4/4 communes	26/65 communes	30/69 communes

Note: The denominator in the table is the number of communes/Sangkat

.



Unit: %, Source: 2008 Census

Figure 4.4.7 Service Area of Safe Water (Kampong Chhnang Province)

4.5 Kampong Speu Province

4.5.1 Brief Description of the Province

The Kampong Speu province has total area of 7,017 km^2, comprised of 8 districts, 87 communes, and 1,359 villages. According to 2008 Census, urban population was 54,505 persons (10,564HH）, and rural population was 662,439 persons (138,706 HH）. Population growth rate was 1.26% in urban area, 1.84 % in rural area and 1.79 % in whole province.

4.5.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

While the provincial capital water supply system is classified as private-managed system, about 30% of the facilities came from public fund. There are 13 private-managed systems in the province. One of which has just started the construction work.

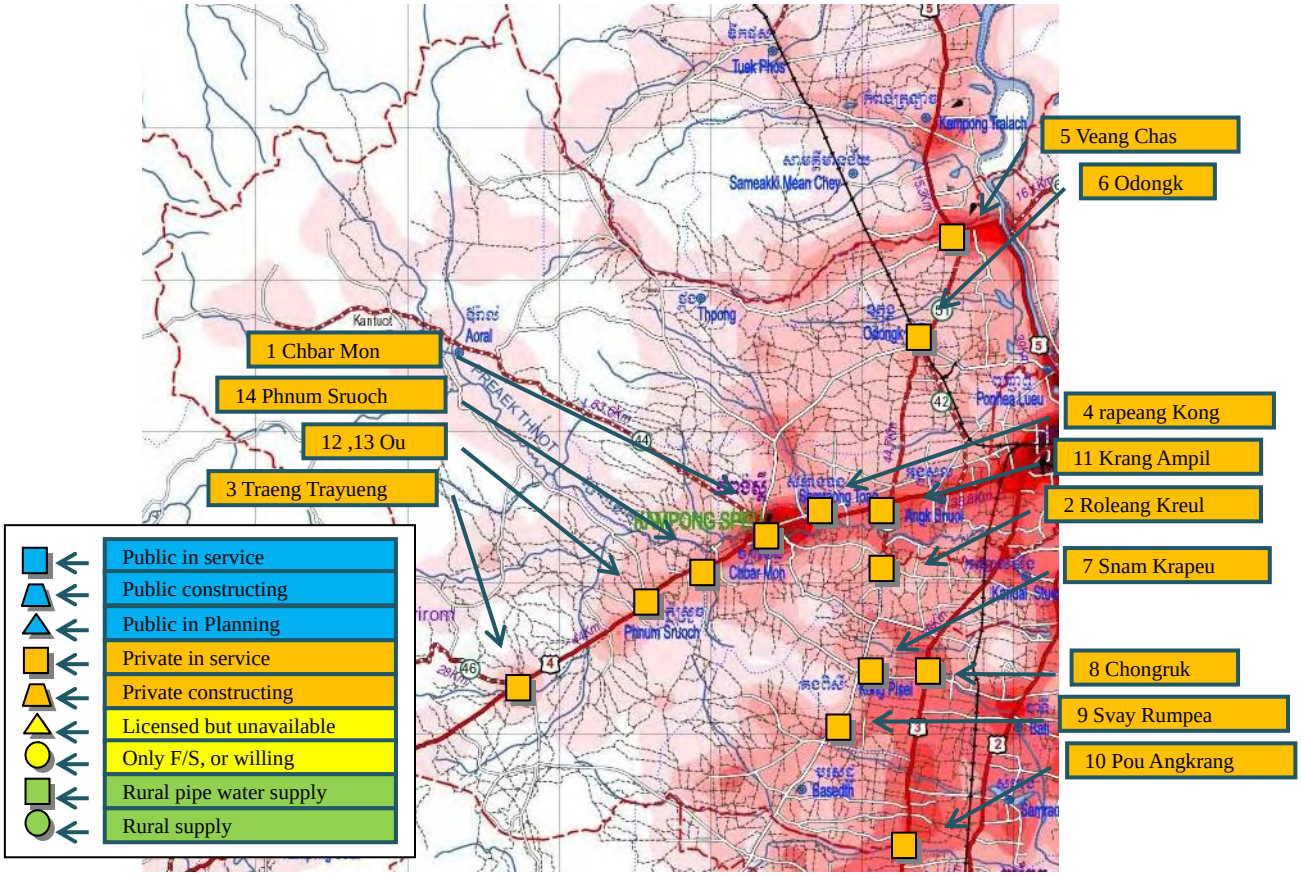


Figure 4.5.1 Existing Urban Water Supply System in Kampong Speu Province

Table 4.5.1 Current Status of Urban Water Supply System in Kampong Speu Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Notes
1	Chbar Mon	Pri	1979		1,447	1,150	Surface	200,000	1,650	
2	Roleang Kreul	Pri			205	47	Surface	100,000	2,500	
3	Traeng Trayueng	Pri			238	66	Well		2,000	
4	Trapeang Kong	Pri			147	30	Surface	100,000	2,500	
5	Veang Chas	Pri			1,020	290	Pond	200,000	1,500	
6	Odongk	Pri			320	87	Pond	120,000	2,000	
7	Snam Krapeu, Kong Pisei	Pri			97	16	Pond	80,000	2,500	
8	Chongruk, Kong Pisei	Pri			66	31	Pond	100,000	2,500	
9	Svay Rumpea, Basedth	Pri			152	40	Pond	120,000	3,000	
10	Pou Angkrang, Basedth	Pri			14	11	Pond	20,000	2,500	
11	Krang Ampil	Pri			311	130	Surface		2,500	
12	Ou	Pri			265	43	Well		3,000	
13	Ou	Pri			97	10	Well		3,000	
14	Phnum Sruoch	Pri			238	66		120,000	2,000	

Note: Blank column means N/A

2) Histrical development of urban and public watrer supply system

1979 Provincial water supply system was established through French assistance.

1994 to 1995 The system was converted into private-managed entity due to budget shortage.

The water supply system in the provincial capital was constructed in 1979 by the assistance of French Government and has been a sole water supply system in the province. In 1994 to 1995, MIME announced the water supply project implementation by the private sector and they issued license to the applied private sector. DIME invested the fund corresponding to 30 % of the total construction cost.

3) Support from donor agencies

Assistance is needed to prevent water supply shortage in the city center. As private sector is holding the license, support from donor agencies is not easy to recieve and service area can not be expanded because of budgetary limitation. DIME prefers the system to converted back to public organization.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

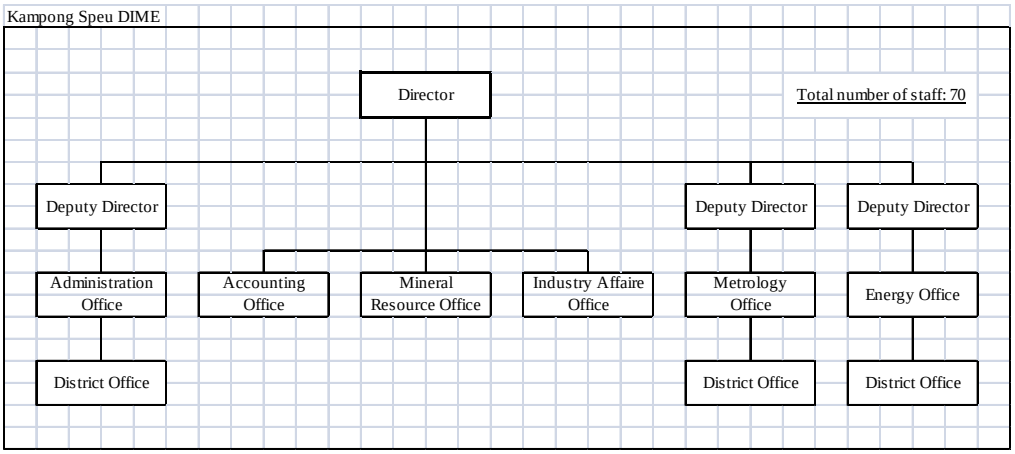


Figure 4.5.2 Organization Chart of DIME in Kampong Speu Province

DIME has 70 staffs. Since it does not manage the water supply project directly, it regulates privated-managed water supply system. The control over privately managed system as well as communication is satisfactory. Periodical joint meeting is held among the private service providers and the DIME.
Water quality analysis is undertaken every three months.

2) Capacity development for staff
DIME staff has not participated in any seminar on water supply technology, and operation and management of the system.
DIME is contemplating on having water quality laboratory to conduct analysis by itself. This is to ensure potability and reliability of private-managed water system. Other than water quality testing equipment, the agency needs capacity development training on efficient system management and monitoring.

(3) Relevant facilities
Chbar Mon Water Treatment Plant
●Outline of the system
Water supply system covers the provincial capital. Originally, the system was publicly managed. When private funds were utilized to repair the facilities destroyed during Khmer Rouge regime, the system was turned over to private entity. Although the facilities are old, treated water quality is satisfactory.

●Water supply facilities
Raw water is withdrawn directly from river by pumping through a suction pipe installed at the river. During daytime, raw watrer is pumped by engine-driven pump. Because of the noise generated using engine-driven pump, water is withdrawn by electric motor-driven pump with power supplied from generator during night time. Two receiving wells were constructed for this

system.

Similar to Banteay Meanchey, conventional water treatment process is employed. This involves coagulation (rapid mixing), flocculation (slow mixing), sedimentation and filtration. From the treatment plant, the clear water is pumped to elevated tank.

All mechanical equipment is Chinese made. PVC valves are used and PE pipes are stored.

●Operational status

Sufficient coagulation and flocculation are effected by using granular alum which is dissolved and injected in liquid form. Bleaching powder is used for disinfection. All chemials are well stored.

No water quality problem has been reported for the present raw water source.

4.5.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (40.9%), “Tube/Pipe Wells” (27.4%) and “Unprotected Dug Wells” (14.3%), and the access rate to improved water are 37.5%. About 53.1% of households in this province depend on remote water sources.

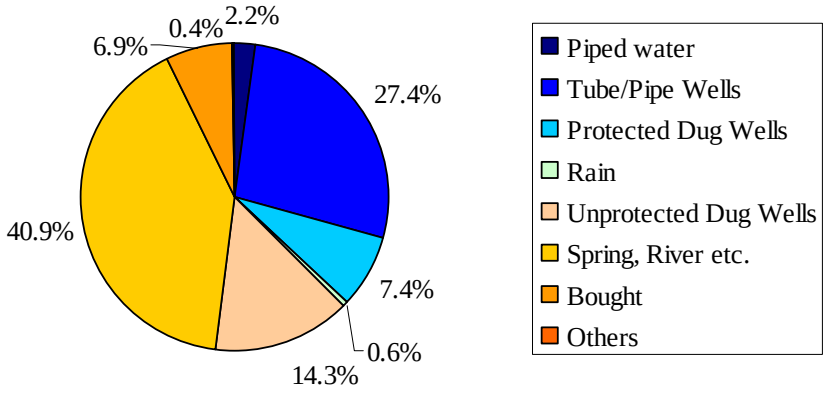


Figure 4.5.3 Type of Water Sources (Kampong Speu Province)

2) Condition of Water Supply Facilities

The monitoring of existing water facilities in the province by PDRD is shown in Table 4.5.2. The functional rate of bored well is 66.9%. Although monitoring for water supply facilities are carried out by district staff of rural development by each commune, the PDRD does not fully share information among district staff.

Table 4.5.2 Monitoring Results by PDRD (Kampong Speu Province)

Items	Total	Function		Broken	
	No.	No.	Ratio	No.	Ratio
Boreholes	7,001	4,685	66.9%	2,316	33.1%
Open wells	4,882	N/A	**	N/A	**
Ponds	1,288	N/A	**	N/A	**
Total	13,171				

Source: PDRD in Kampong Spue (2008)

3) Hand pumps

Afridev hand pumps are used in areas where groundwater level is deep. On the orher hand, VN6 pumps are utilized in areas where groundwater occurs at shallow depth. Spare parts for Afridev hand pumps are not readily available in the province. If WSUG needs spare parts for Afidev hand pumps, it has to order from the PDRD. The spare parts are procured in Phnom Penh. PDRD considers that the main cause of tube well failures is hand pump.

4) Water Quality of Groundwater

Based on the result of water quality analysis made by the Arsenic Center, 3.2% of the 529 groundwater samples collected had concentration of more than 10ppb but not exceeding 50ppb arsenic.

Table 4.5.3 Result of Arsenic testing (Kampong Speu)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
529	0	0.0%	17	3.2%	512	96.8%

Source: Arsenic Center (2005-2007)

Iron was also detected in 30% of tube wells in this province. Iron removal devices are installed in high iron concentration areas. In other areas, to ensure that the water use is safe, the PDRD instructed rural residents to boil the water.

(2) Organization and Structure/Operation and Maintenance

1) Organization and Structure

The PDRD in this province is comprised of 92 staff, 10 of which are detailed in the Office of Rural Water Supply and 15 are under the Office of Primary Health.

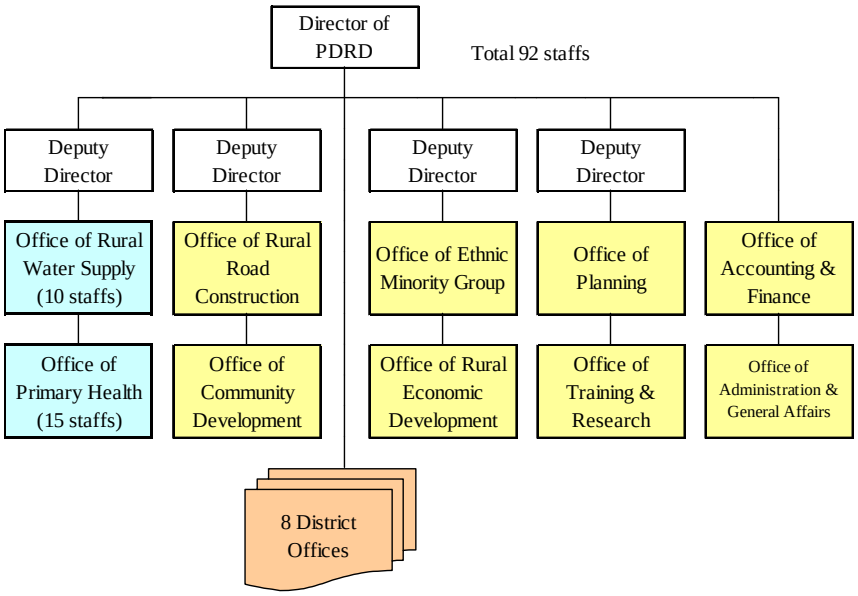


Figure 4.5.4 PDRD Organization Chart (Kampong Speu Province)

2) Budget

"External expenses for services" and "personal expenses" account for substantial percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

There was a 300.6 million Riel allocation in 2009 for MRD, which was aimed for the rehabilitation for existing water supply facilities.

Table 4.5.4 PDRD Budget (Kampong Speu Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	100.0	12.6%	100.0	9.9%
	External charges for services	380.0	47.7%	580.0	57.6%
	Other external charges for services	50.0	6.3%	50.0	5.0%
	Personal expenses	266.2	33.4%	276.8	27.5%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	796.2		1,006.8	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	300.6	0	under preparation by MRD	
	Well rehabilitation		190		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		190		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Since PDRD is not active in undertaking monitoring program for the water supply facilities, it has no first hand information on the present conditions of the water systems, unless the WSUG reports to PDRD, such as in case of facility breakdowns. PDRD is aware that monitoring is is vital in maintaing the facilities to prevent major service interruptions. However, because of insufficient budget, monitoring works are considered low priority.

In addition, although PDRD owns drilling rig, it cannot develope more wells to augment current supply and expand the system. Again, this is attributed to inadequate budget allocation for the agency.

(3) Assistance by Other Donors

1) Existing Project

a. Background

Rural water supply project in the province only started in 1979 through the UNICEF, LWS (NGO) and Social Fund. Simultaneous with the water supply project are construction of school and irrigation. In 1996, the rural agriculture project of PRASAC (NGO), which was financed by EU, constructed tubewells, rainwater tanks and community ponds. Then, 100 tube wells with hand pumps were constructed by China. There are also some wells constructed by the SEILA program.

Rural water supply project carried out by World Vision and local NGOs were not coordinated to PDRD. Hence, it has no information about the project.

b. UNICEF Project

UNICEF has implemented rural water supply project since 1979 and constructed more than 1,300 tube wells up to year 2009. However, more than 50% of tube wells are presently non-functional because of water quality, which was not considered at beginning of the projects. In addition, UNICEF has new assistance planned for 2010. This only includes operation and maintenance training without construction of any water supply facilities.

c. Rehabilitation Project for existing tube wells financed by MRD

Rehabilitation project of 500 non-functional tube wells in 7 districts has been implemented by PDRD using MRD fund.

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

Rural water supply and sanitation project has been commenced implementer by MRD and financed by IMF since 2008. It covers 100 villages, 20 communes, and 4 districts. Currently,

bidding for selection of contractor is under preparation by MRD.

b. UNICEF Project

UNICEF is preparing a five-year programme (2011-2015) for water and sanitation sector. According to PDRD, this province will be included in the new UNICEF program. However, details are not available.

c. MRD Project

Construction of 80 tube wells with hand pumps are being planned by MRD and NGO.

(4) Current Condition of Hygiene

Households with toilets account for 14.7% (20,337 households) in the rural areas. Of these households, 42.3% use septic tanks and 39.2% are connected to sewerage system.

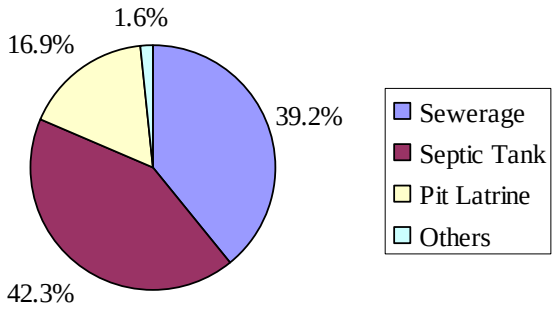


Figure 4.5.5 Type of Toilet (Kampong Speu Province)

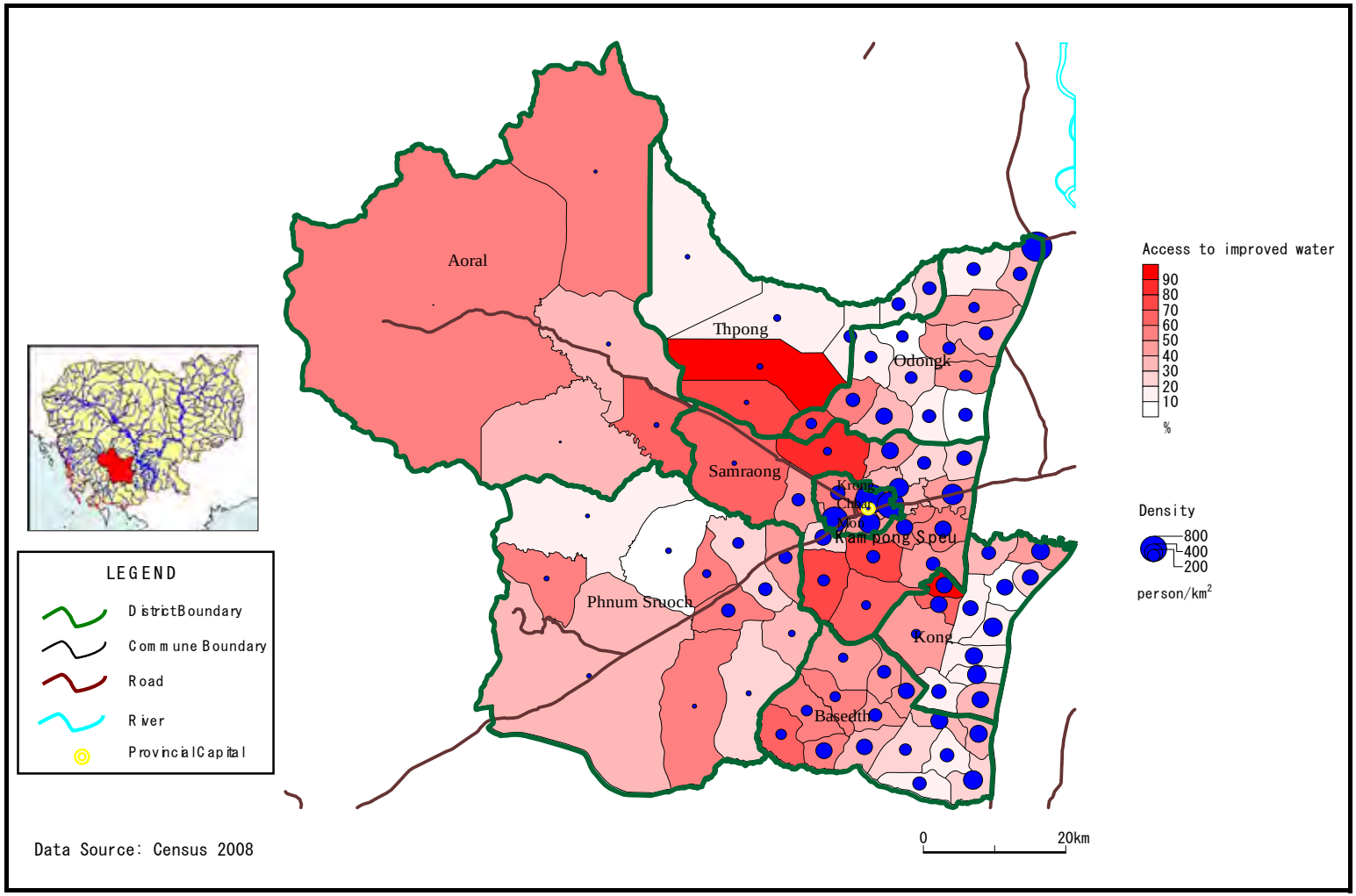
4.5.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 27 of the total 87 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.5.5 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kampong Speu Province)

Urban	Rural	Total
3/6 communes	24/81 communes	27/87 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.5.6 Service Area of Safe Water (Kampong Speu Province)

4.6 Kampong Thom Province

4.6.1 Brief Description of the Province

The Kampong Thom province has an area of 13,814 km^2, comprised of 8 districts, 81 communes, and 767 villages. According to 2008 Census, urban population was 31,871 persons （6,677 HH）, and rural population was 599,538 persons (127,201 HH）. Population growth rate was 0.15% in urban area, 1.08 % in rural area and 1.03 % in whole province.

4.6.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban watrer supply

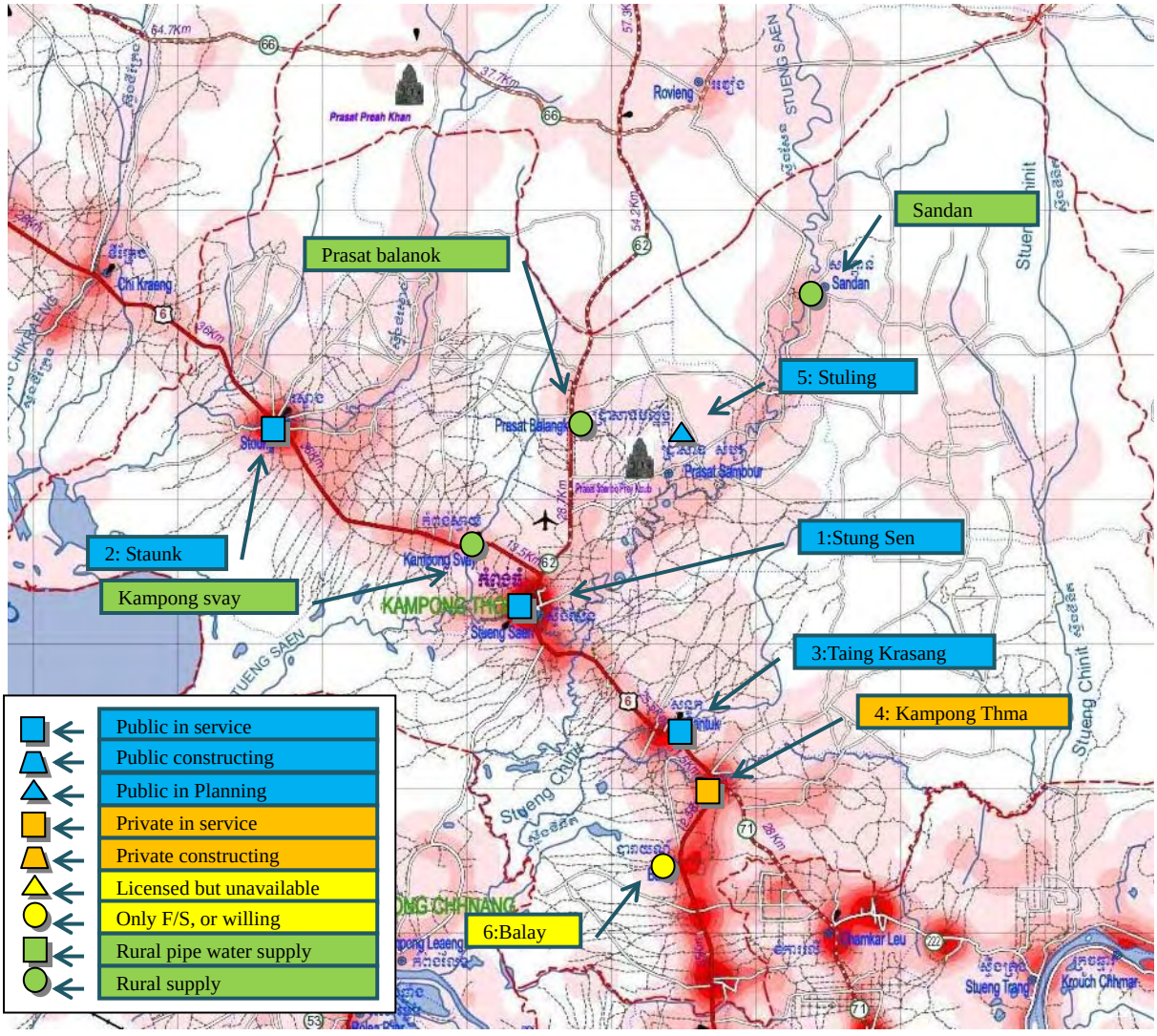


Figure 4.6.1 Existing Urban Water Supply System in Kampong Thom Province

Table 4.6.1 Current Status of Urban Water Supply System in Kampong Thom Province (2009)

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Stung Sen	Pub	1946	10,600	2,080	1,877	River		1,500	*1
2	Staunk(Stanug)	Pub	2005	13,934	2,615	500	Surf	150,000	2,000	*2
3	Taing Krasang	Pub	2008	10,139	1,793	120	River		1,500	*2
4	Kampong Thma	Pri								
5	Stuling	Pub	Not operated yet (F/S)							
6	Baray	Pri	Not operated yet (only license)							

*1: Design Water Supply Amoun (m^3/day): Stung Sen=5,700; Staung=1,000; Taing Krasang=800

*2: Information discrepancy between MIME and DIME Blank column means N/A

There is one public-managed water supply system that serves the Stung Sen City, the provincial capital, and two others that recently operate. Further, a private-managed water supply system is currently operating in the area. Threre are some towns where the WB conducted F/S but found not viable. Rural water supply projects are currently in progress in villages located along with the national road.

2) Histrical development of urban and public water supply system

1946 Water supply service was established in the provincial capital Stung Sen during French regime.

1962 Reconstruction of system after destruction by Khmer Rouge

2003 Public managed Stung Sen water supply system was rehabilitated by ADB assistance.

2005 Stung public managed water supply system was completed with the support of the Italian government.

2006 Rehabilitation of Stung Sen water supply system was completed through the assistance of ADB.

2008 Taing Krasang public managed water supply system was completed with the support of the Italian government.

Water supply system development in Stung Sen has been executed in three phases:

1st Pahse Establishment in 1946 during French regime

2nd Phase Reconstruction in 1962

3rd Phase System expansion under ADB assistance that started in 2003

The Italian government initiated the preparation of F/S for Stung Sen. However, the F/S was not completed. It was the ADB that rehabilitated the Stung Sen water system in 2003. The Italian government later completed the 1,000 m^3/day Stung Sen public-managed water system. At present, a total of three public-managed systems are in service. Currently, the Italian government is conducting F/S in one of the towns.

3) Support from donor agencies

Currently, ther is no donor agency in Stung Sen City other than the Italian government, who is executing F/S preparation in one of the towns. Rural water supply projects are on-going in the villages located along with the national road.

Water distribution network development in Stung Sen city is a top priority. The UN-HABITAT approved a grant aid assistance program, but the implementation schedule is not yet fixed. The existing WTP is still new and not yet fully operational. Thus, no immediate work is necessary.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

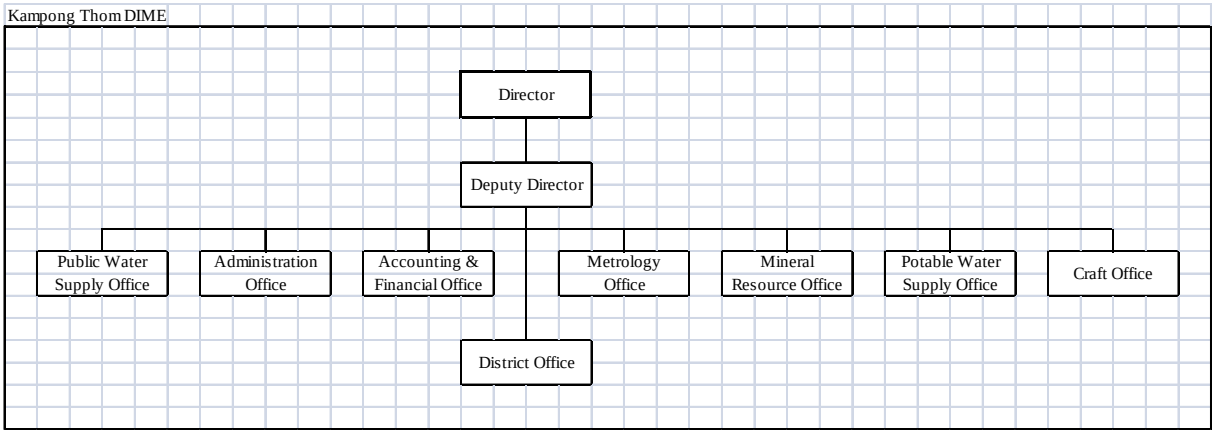


Figure 4.6.2 Organization Chart of DIME in Kampong Thom Province

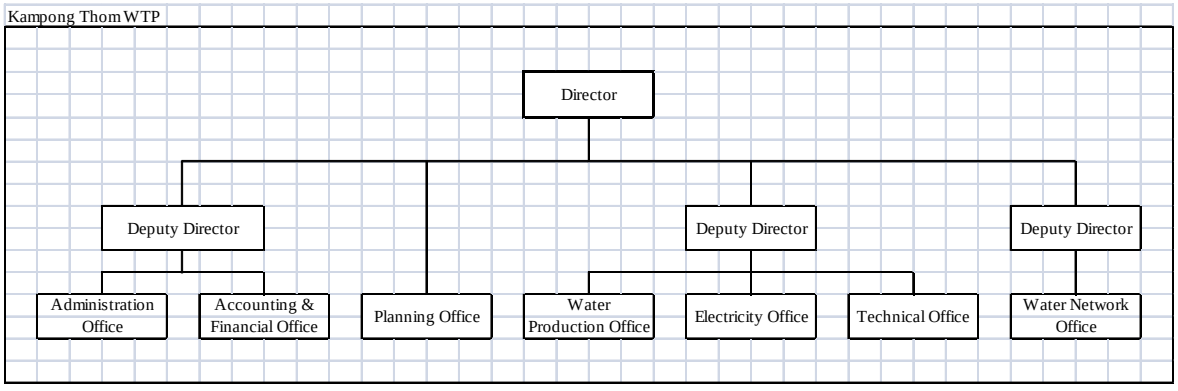


Figure 4.6.3 Organization Chart of WTP in Kampomg Thom Province

Out of the 45 DIME staff, 31 are assigned to water supply system. Three public-managed water supply systems are operated by separate organization. The one managing the Stung Sen city is equivalent to a division in DIME. The others are organizations under the WSA, which is the decision-making agency for water supply system.

2) Capacity development for staff

Technical seminars were conducted by PPWSA, MIME and JICA. Seminars managed by

JICA are the most frequent, five to six are scheduled. Each seminar takes two days.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Raw water for Stung Sen water supply system is obtained from a river. The amount abstracted is 2,000m^3/day. The raw water is directly pumped from the river using two USA-made pumps. The river water has normally high turbidity and the flow is almost stagnant. There are residents located nearby the intake point, which pollute the river water. During dry season, withdrawal of water from the river becomes difficult due to lowering of water level. Thus, the Stang public-managed water supply system can not supply water during dry season. For other systems like the Taing Krasang, no remarkable issue on supply capacity is currently experienced.

2) Capacity and operation ofWTP

The Stung Sen WTP is comprised of grit chamber, flash mixer, horizontal flow shaft type flocculator, horizontal flow sedimentation tank and sand filter. The filter has fair depth and of gravity type. The Stung Sen WTP has a capacity of 5,700m^3/day. Potable water is supplied from two elevated tank by gravity. Two tanks have large storage capacity.

3) Capacity and operation of distribution system

The present demand of the service area is far below the Stung Sen WTP capacity of 5,700m^3/day. This is attaributed to the limited extent of the existing distribution pipe network. Distribution network was not covered by the previous ADB project. Expansion of the dfistribution system has not been accelerated. At present it only supplies 1,900m^3/day to 2,080HH, equivalent to 10,400 to 10,500 served population. There is a planned expansion to be implemented through internally generated fund, mainly from water sales income.

The main distribution pipe from the WTP is 400mm ϕ which is appropriate for the designed WTP capacity.

4) Water supply O&M status

Basic information on public-managed system is not coordinated to Stung Sen management office but communication to each management office is made. Diagram of the Stung Sen system distribution network is posted on the wall of control room and director's room for appreciation of the staff.

5) WTP O&M status

The Stung Sen system WTP utilizes alum, slaked lime and chlorine gas. These chemicals are well kept in the storage room with sufficient stocks. Necessary precautions are marked in places such as the chlorine storage room, which has "Danger" mark on the door. Floc formation in the clarifier is satisfactory. Net is placed over the tank to prevent leaves from falling. In general, the WTP is well maintained.

6) Water quality control and supply water quality

Stung Sen system management conducts daily water quality analysis. Based on the results of analysis, no remarkable water quality problem is identified.

Table 4.6.2 Results of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	—	27 - 28	27 - 28	27 - 28
pH	—	7.0	6.7	6.0	6.8 - 6.9
Turbidity	NTU	Sed<10 Dis<1.0	58 - 80	4 - 5	1.00 - 1.05
Free Chlorine	mg/L	AF>0.1 Dist=1.0		0.15 - 0.18	0.46 - 0.90
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	51 – 55		78 - 87
Color	TCU	Sed<20 Dis<5	101 - 156	4.7 – 5.0	4.8 – 5.0
Alkalinity [mg/L]	mg/L	>10	19 - 27		19 - 20

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800		
Total Hardness	mg/L	< 250		
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5		
Iron (Fe2+)	mg/L	< 0.3		
Manganese(Mn2+)	mg/L	< 0.3		
Arsenic (As)	μg/L	< 50		
Chlorine (Cl-)	mg/L	< 250		

Testing Status	
Testing Lab	WTP
Daily Record	N/A
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	N/A
Latest test in	210
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	OK

Note: Blank column means N/A

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.6.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population	-	33,880	34,550	34,641	34,434	34,434	
Population in supply area	-			29,838	23,833	23,833	
Service population		7,168	8,642	9,569	10,601	10,601	
Service connection or household		1,459	1,683	1,880	2,080	2,080	
Water supply (intake or treat)	5,700	1,174	1,379	1,633	1,877		
Water supply (consumption)	5,700	844	1,023	1,217	1,418	1,900	

2) Water tariff

The present water tariff is 1500 R/m^3. All the three public-managed systems adopt the same tariff. Billing statement preparation is already computerized. Fee is collected on monthly basis.

3) Extent of waster supply service

Since WTP has enough capacity, a 24 hours service is realized. As rain water is used during rainy season, water demand decreases. No remarkable issue was observed.

(5) Financial status of public system

1) Current financial status

Financial statements are submitted regularly and well accomplished. There is still uncertainty with regard to financial management.

2) Potentials in self-reliance management by water sales income

Recent account settlement shows large loss. As loss cannot be cancelled out by depreciation deduction, fund assistance is apparently needed for sustainable accountant.

Occupation rate of water charge income in total income was 90% in 2009, which is relatively good.

3) Composition of expenditure

Cost items for operation and maintenance are not appropriately categorized. Record are confusing. Hence, no assessment was made.

4) Finance stability

As no balance sheet is available, no evaluation was executed.

5) Fund investment

As no balance sheet is available, cannot be analyzed.

Table 4.6.4 Financial Statements of DIME in Kampong Thom Province

1,000 Riel

	2008	2009	Retio
Revenue	**833,434**	**860,559**	**100.0%**
Water revenue	694,533	776,387	90.2%
Others	138,901	84,172	9.8%
Expense	**1,136,487**	**1,200,843**	**100.0%**
Operating Expense	**1,128,939**	**1,191,929**	**99.3%**
Electricity Cost	8,025	7,950	0.7%
Chemicals	64,645	127,546	10.6%
Fuel	328,385	224,679	18.7%
Spairparts	87,217	67,869	5.7%
Labor & Temp. staff	10,408	1,306	0.1%
Salary & Allowance	62,790	88,689	7.4%
Depreciation	119,812	125,447	10.4%
Others	447,657	548,443	45.7%
Operating Expense	**7,548**	**8,914**	**0.7%**
Administrative & Tax	7,548	8,914	0.7%
Net income	-303,053	-340,284	-28.3%

Amout of Water Supply	2,000	m3/day
Unit price of Water Supply	1,179	Riel/m3
Energy Cost per Water	493	Riel/m3
Material Cost per Water	93	Riel/m3
Labor Cost per Water	123	Riel/m3

4.6.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Unprotected Dug Wells” (62.0%), “Spring, River etc.” (14.9%) and “Tube/Pipe Wells” (9.2%), and the access rate to improved water is 20.8%. About 29.3% of households in this province depend on remote water sources.

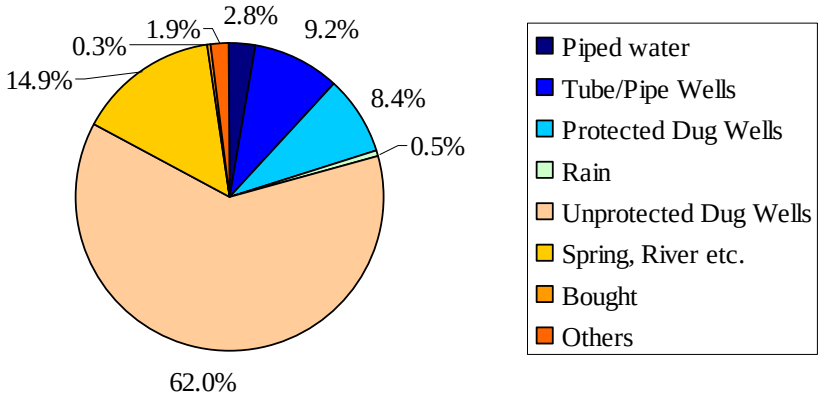


Figure 4.6.4 Type of Water Sources (Kampong Thom Province)

2) Condition of Water Supply Facilities

Since PDRD does not carry out regular monitoring and data management, it is not aware of the present conditions of water supply facilities in the villages.

According to District Data Book (2008) prepared by UNDP, 76.4% of the tubewells can be used throughout the year. The percentage of non-functional is at 21.2%.

Table 4.6.5: Functioning/Un-functioning Conditions of Water Supply Facilities (Kampong Thom Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	12,364	
Year-round usable pumped or mixed wells	9,448	76.4%
Dry season unusable pump or mixed wells	2,916	23.6%
Pump or mixed wells needing repair/rehabilitation	2,622	21.2%
Total number of ring wells	23,657	
Year-round usable ring wells	17,554	74.2%
Dry season unusable ring wells	6,103	25.8%
Ring wells needing repair/rehabilitation	4,849	20.5%
Total number of un-protected dug wells	13,370	
Year-round usable un-protected dug wells	9,797	73.3%
Dry season unusable un-protected dug wells	3,573	26.7%

Source: District Book (2008)

3) Hand pumps

Afridev hand pumps are used in areas where groundwater level is deep. On the orher hand, VN6 pumps are utilized in areas where groundwater occurs at shallow depth. Spare parts for Afridev hand pumps are not readily available in the province. A set of spare parts is usually provided for each hand pump installed for the past projects. If WSUG needs spare parts for Afidev hand pumps, it has to order from the PDRD. The spare parts are procured in Phnom Penh by the PDRD.

According to PDRD, WSUG collects operation and maintenance fee from users, which is 1,000 Riel for most of the residents and 500 Riel for less priviledged people. The users have to pay for the expenses on spare parts and repair of the facilities.

4) Water Quality of Groundwater

Elevated arsenic concentration in groundwater of the province was noted in 2% of the tube wells. The concentration exceeded the national standard of 50ppb. As a warning, red paint is painted to hand pumps where high arsenic concentration were detected.

Based on the result of water quality analysis made by the Arsenic Center, 10.7% of the 828 groundwater samples collected had concentration of more than 10ppb but not exceeding 50ppb arsenic. The province is identified as high risk area for arsenic.

Table 4.6.6 Result of Arsenic Testing (Kampong Thom Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
828	15	1.8%	89	10.7%	724	87.4%

Source: Arsenic Center (2005-2007)

In addition, iron contaminations at high level were detected from 10 percent of tube wells in this province and iron removal devices were installed according to the survey by UNICEF. However, PDRD don't know details such as affected place of iron contamination and water qualities result.

Although PDRD carries out water quality monitoring in some areas on regular basis (mostly monthly or every other month), precautions on the utilization of water (specifically those with water quality exceeding the national standard) from PDRD is not obvious.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is consisted of 70 staff, 4 members under the Office of Rural Water Supply and 6 members under the Office of Primary Health.

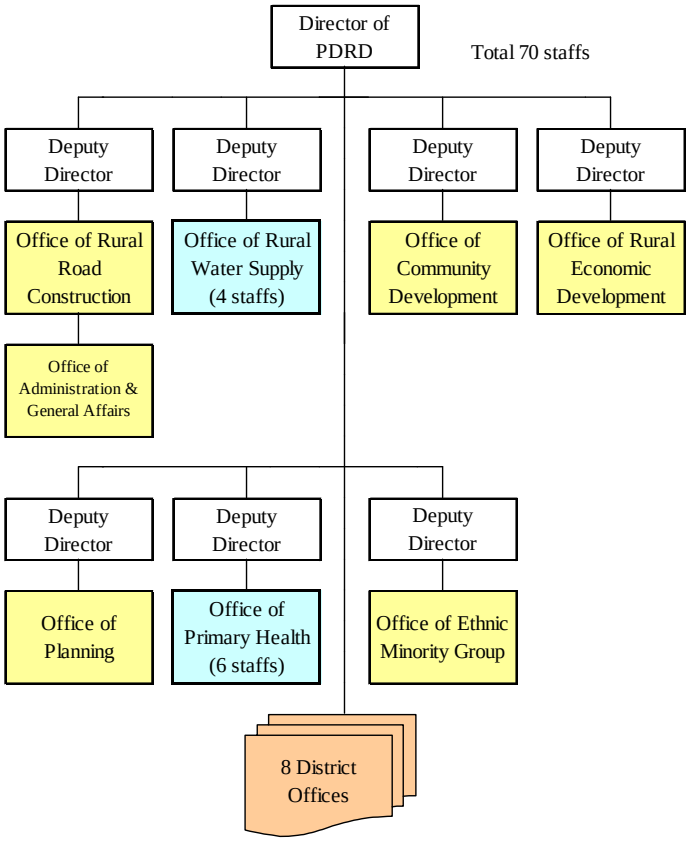


Figure 4.6.5 PDRD Organization Chart (Kampong Thom Province)

2) Budget

"External expenses for services" and "personal expenses" account for substantial percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

Table 4.6.7 PDRD Budget (Kampong Thom Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	191.0	18.9%	191.0	18.0%
	External charges for services	452.0	44.8%	452.0	42.7%
	Other external charges for services	135.0	13.4%	135.0	12.7%
	Personal expenses	232.0	23.0%	278.0	26.3%
	Taxes and similar services	0.0	0.0%	3.0	0.3%
	Total	1,010.0		1,059.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Since PDRD is not active in undertaking monitoring program for the water supply facilities, it has no first hand information on the present conditions of the water systems, unless the MRD request to do so.

Although PDRD has no equipment for maintenance, some of the staff was involved in the supervisory works for the construction of water supply facilities. The staff can provide assistance in the operation and maintenance. However, in case of major breakdowns in the system, when heavy or specialized equipment are necessary, the PDRD cannot provide support.

(3) Assistance from Other Donors

1) Existing Project

a. Tonle Sap Water Supply and Sanitation Project by ADB

(i) Target site: 4 districts (Kampong Swai, Storng, Prasat Balan and Prasat Sambour)

(ii) Components: Construction of tubewells, toilets, community ponds and piped water supply facilities, installation of iron removal equipment

(iii) Period: From 2006 to 2010

b. Rehabilitation Project for Rural Water Supply financed by MRD

If major breakdowns could not be covered by the O and M fee from concerned users, PDRD provides the necessary fund support for repair of facilities using MRD budget. Yearly, PDRD

requests from MRD allocation for each province.

2) New Assistance Plan

a. Second Rural Water Supply and Sanitation Project by ADB

ADB has new assistance plan which is the same as the Tonle Sap Rural Water and Sanitation Project (2006-2010). Three priority districts are considered, namely; Storng, Barai and Sandan. Currently, ADB consultant and MRD staff have conducted monitoring and evaluation of Phase I project.

b. Tonle Sap Lowlands Rural Development Project by ADB

The Tonle Sap Lowlands Rural Development Project will cover 3 districts, the Storng, Kampong Swai and Barai, in this province for the development and upgrading of rural infrastructures such as rural roads, schools, health centers, irrigation facilities, and water supply and sanitation facilities. This will be implemented with community participation. This also includes government -implemented infrastructure development in the provinces of Kampong Chhang, Kampong Thom, and Pursat in the Tonle Sap basin.

MOWRAM is the executing agency and several government agencies will be directly engaged in the implementation, including the Ministry of Rural Development (MRD), Ministry of Agriculture, Forestry and Fisheries (MAFF), and Ministry of Interior (MOI). Feasibility study was already done and construction will commence in June or July 2010.

(4) Current Condition of Hygiene

Households with toilets account for 25.3% (32,173 households) in the rural areas. Of these households, 51.0% use pit latrines and 29.0% use septic tanks.

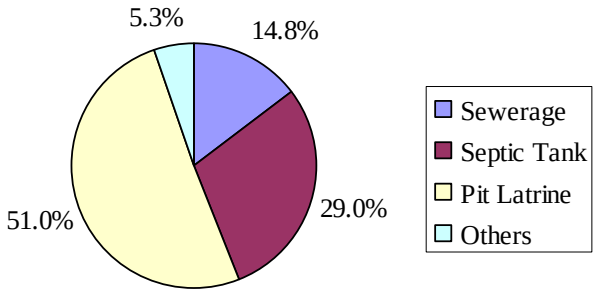


Figure 4.6.6 Type of Toilet (Kampong Thom Province)

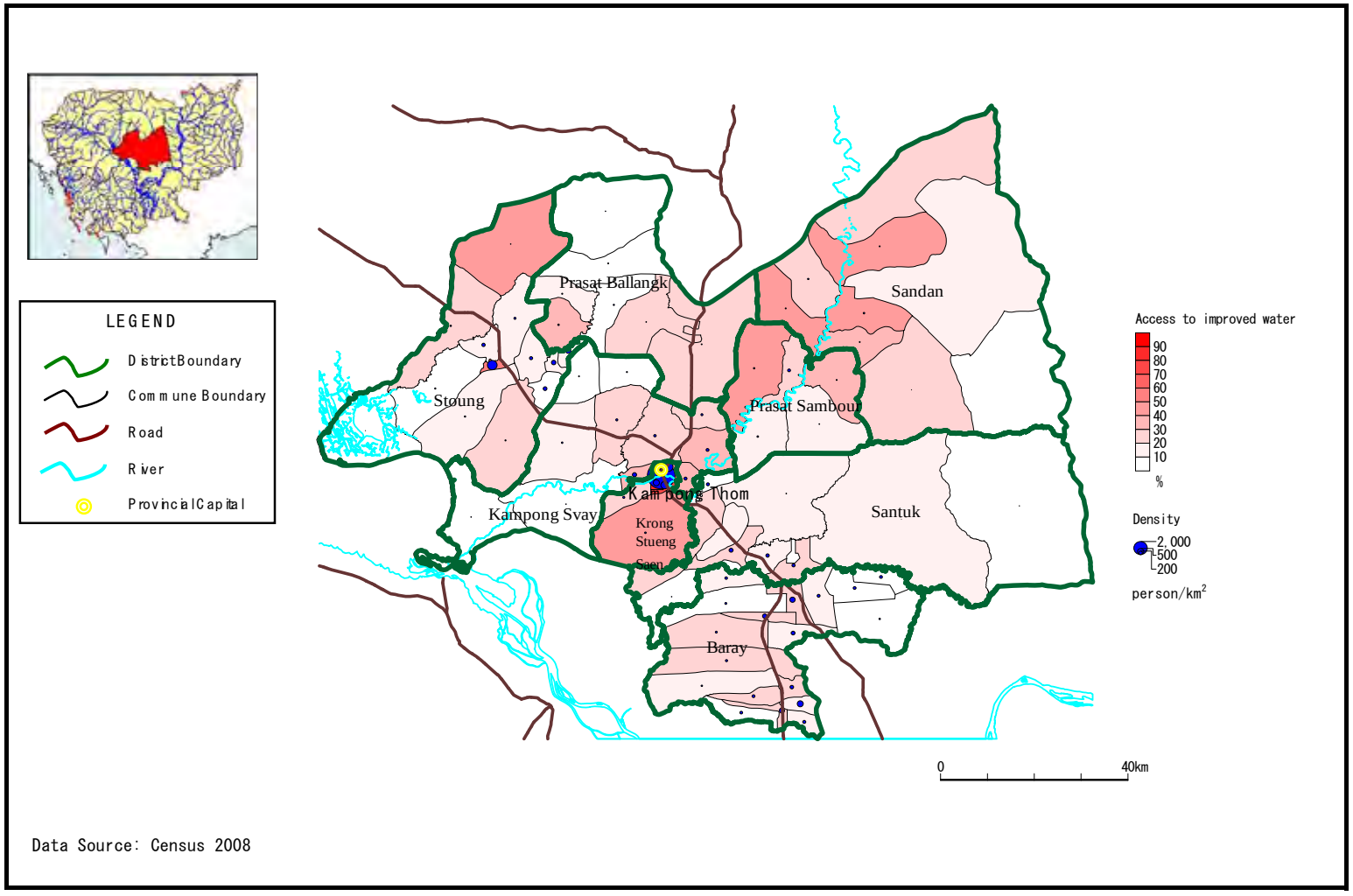
4.6.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, only 5 of the total 81 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.6.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kampong Thom Province)

Urban	Rural	Total
4/6 communes	1/75 communes	5/81communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.6.7 Service Area of Safe Water (Kampong Thom Province)

4.7 Kampot Province

4.7.1 Brief Description of the Province

The Kampot province has an area of 4,873 km^2, comprised of 8 districts, 92 communes, and 482 villages. According to 2008 Census, urban population was 48,274 persons（9,816 HH）, and rural population was 537,576 persons (119,830 HH）. Population growth rate was 0.64% in urban area, 1.06 % in rural area and 1.03 % in whole province.

4.7.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Provincial capital is served by public managed water supply system. Several private managed water supply systems are also in service.

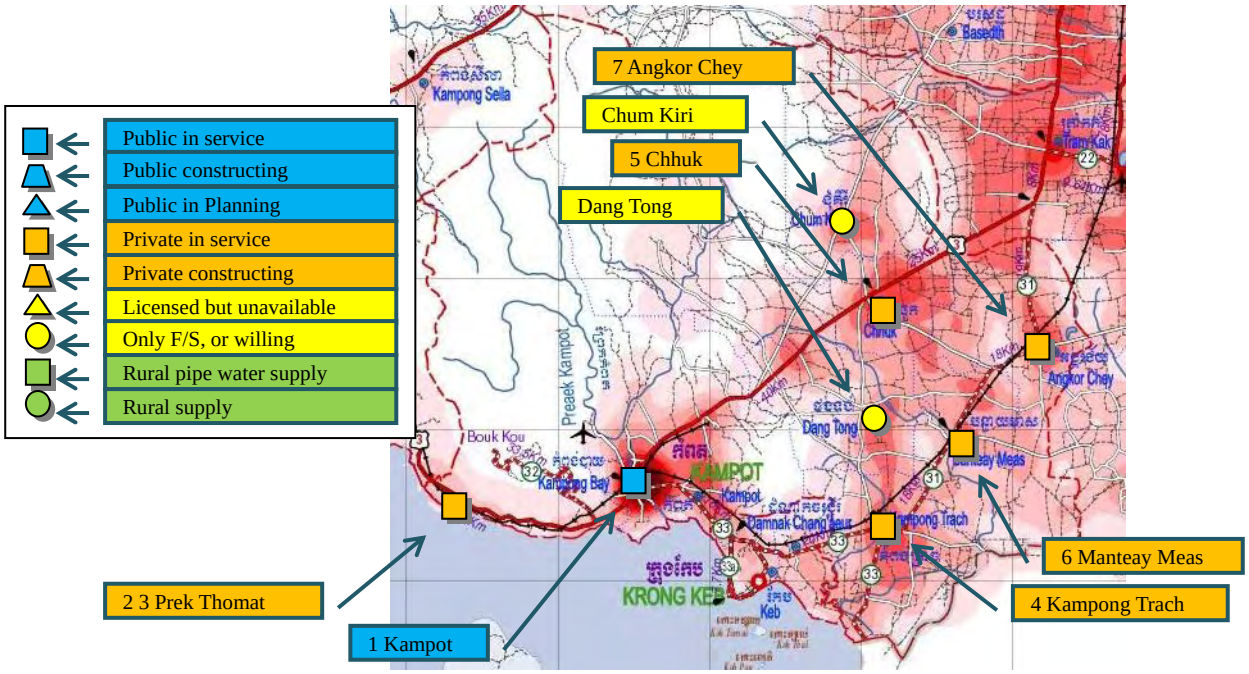


Figure 4.7.1 Existing Urban Water Supply System in Kampot Province

Table 4.7.1 Current Status of Urban Water Supply in Kampot Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Kampot	Pub	1953	16,665	3,331	2,447	River		1,400	
2	Prek Thnoat, Kampot	Pri			310	380	Pond	50,000	2,500	
3	Prek Thnoat, Kampot	Pri			180	380	Pond	41,000	2,500	
4	Kampong Trach, Kampot	Pri			613	480	Pond	102,500	2,000	
5	Sat Pong, Chhouk	Pri			300	290	Surface	123,000	2,500	
6	Banteay Meas	Pri			340	340	Surface	61,500	1,800	
7	Angkor Chey	Pri			510	550	Pond	61,500	2,000	

*1 Houseconnection charge: 1USD=4,100Riel、Blank means N/A.

2) Histrical development of urban and public water supply system

1953	The provincial capital water supply system was constructed under French regime.
1975 to 1979	Pol Pot group destroyed the water supply system.
1979	System rehabilitation was started through the assistance of SAWA（a NGO from Netherlands).
2000 to 2006	System rehabilitation was executed out of ADB loan.

The provincial capital water supply is a public-managed system under the auspices of the DIME. It was originally constructed by French government in 1953 and operated until 1975, but it was destroyed during the Khmer Rouge reign from 1975 to 1979.
In 1979, the water supply system was rehabilitated with the assistance of SAWA（NGO from Netherlands）. From 2000 to 2006, the rehabilitation of WTP was implemented with a loan from the ADB. The original sand filter and elevated tank are still utilized at present.

3) Support from donor agencies
Since 2008, the following assistances have been implemented:

UN habitat	Expansion of distribution network and installation of sanitary facilities with total budget of 210,000 US$
AIMF (French NGO)	Expansion of distribution network

No assistance has been provided to DIME. Supports given to WSA are as follows:

- Expansion of distribution pipeline
- Leakage reduction
- Training on water quality analysis

They requested the following two items:

a. Replacement of dilapidated pipes and expansion of the service area (request for JICA)
b. Mitigating measure on the negative effect of dam construction for power generation on water quality, and prevention of raise of salinity during dry season as a result of intrusion of salty water (may involve development of new water source)

The Project on Capacity Building for Water Supply System Phase 2 by JICA provides training for DIME staff to improve their capacity to manage water supply service.

(2) Urban water supply system management structure
1) Organizational structure of DIME and public water utility

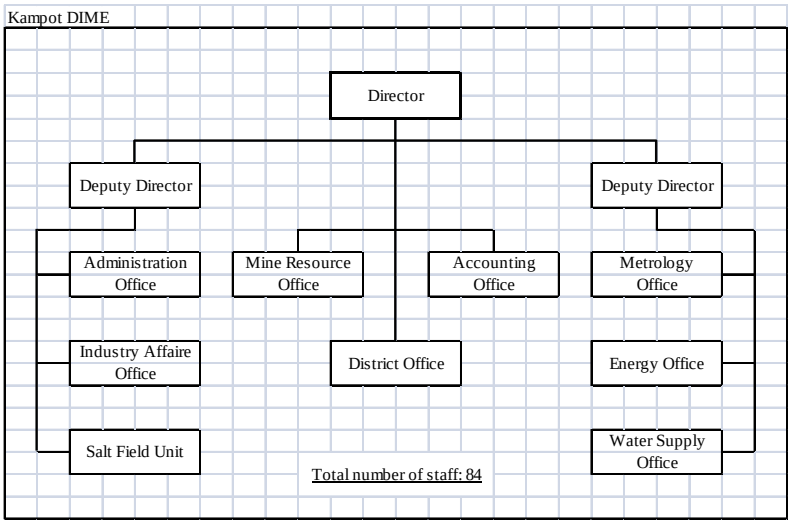


Figure 4.7.2 Organization Chart of DIME in Kampot Province

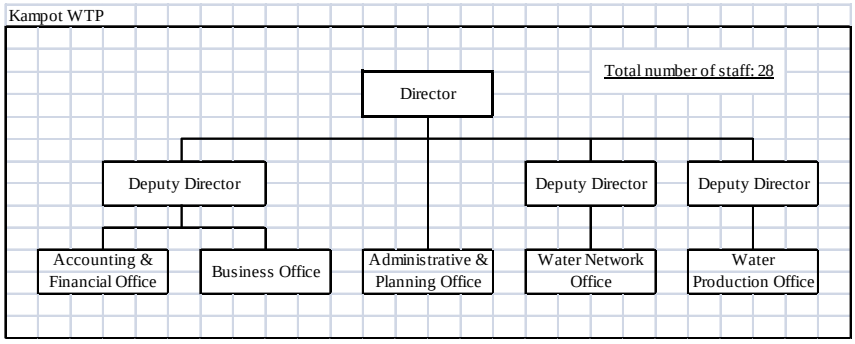


Figure 4.7.3 Organization Chart of WTP in Kampot Province

Basically water supply projects are delegated to WSA. Twenty eight of the WSA staff is assigned to WTP.

2) Capacity development for staff

WSA staff detailed for water supply underwent technical seminar on distribution network development, leakage reduction and water quality analysis.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

The intake for the public system is located 8 km downstream of the WTP at a point of lake-like configuration in the stream. The location for the intake was decided in the detail design to avoid the saline intrusion from the downstream to raw water as well as to secure a condition for easy construction keeping clear of boulderly soil condition that were found at the upper reach.

Rehabilitation of the WTP was conducted as one of the new construction project in 2003 to achieve increase of the intake capacity from 800 m^3/day to 5,760m^3/day.

Construction of a dam for hydroelectric power upstream scheduled to finish in 2011 has been a concern for the raw water quality. Water pollution of high turbidity, chemicals and wastes by the construction work has been observed after the work started. MIME has been discussing the

issue with the contractor for countermeasures. Seasonal factors for the pollution were not found according to the presentation by MIME.

2) Capacity and function of WTP
Typical ADB style WTP and treatment process is as follows:

Raw water intake→Chemical injection→Agitation by flush mixer→Coagulated sedimentation in horizontal detour type flocculator→gravity filtration tank

Painting work for elevated tank was observed during the field survey.

3) Capacity and opretion of distribution system
The major concern on distribution system is service area expansion. Currently, the water supply service covers 36% HH in the provincial capital. Because the WTP capacity is less than the demand, the duration of water service is limited to 18 to 20 hours only. Leakage ratio is also high.（25%, 2009） Distribution network development has been undertaken every year.

・In 2009 PE×9,550m

4) Water supply O&M status
DIME director delegated water supply operation to WSA. Diagrams of water system and distribution network are visibly posted in the control room of the WTP for easy reference.

Photo 4.7.1 Flocculator and Sedimentation Basin

5) WTP O&M status
During the field survey, the flash mixer was malfunctioning and coagulant was injected manually. With this procedure, coagulation and sedimentation are not sufficient.
Cleaning and operation of WTP is generally satisfactory. Stocks, such as chlorine gas, are safely stored with sufficient inventory.

6) Water quality control and supply water quality

The laboratory and equipment utilized are similar to other public-managed water supply systems in the country. Likewise, water quality analyses are undertaken locally using the existing equipment.

Table 4.7.2 Result of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	—			
pH	—	7.0	7.5 – 8.6	6.5 – 7.4	6.7 – 7.2
Turbidity	NTU	Sed<10 Dis<1.0	44 – 563	3 – 16	0.33 - 1.00
Free Chlorine	mg/L	AF>0.1 Dist=1.0		0.17 – 1.10	0.8 – 1.9
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	45 - 77		71 – 99
Color	TCU	Sed<20 Dis<5	278 – 622	16 48	1 – 3
Alkalinity [mg/L]	mg/L	>10	21 – 43	18 – 40	20 - 39

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800	31	46.5
Total Hardness	mg/L	< 250	39	41
Total Organic Carbon	mg/L		4.02	2.58
Ammonia (NH3+)	mg/L	< 1.5	<0.01	0.00
Iron (Fe2+)	mg/L	< 0.3	0.468	0.162
Manganese(Mn2+)	mg/L	< 0.3	0.00	<0.2
Arsenic (As)	µg/L	< 50		
Chlorine (Cl-)	mg/L	< 250	3	8

Testing Status	
Testing Lab	WTP
Daily Record	OK
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	N/A
Latest test in	2010
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	OK

*1 The data in red was taken in March 2010. The data highlighted in red was taken in April 2010 and in Blue in May 2010.

The support from JICA was able to improve the operation and management of the WTP to a satisfactory level. The record of water quality analysis suggests that the treatment efficiency of the WTP is good.

(4) Water supply stastus of public system

1) Water supply amount, service ratio and house connection rate

Table 4.7.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		38,958	45,306	47,756	48,066		
Population in supply area					50,074		
Service population		11,760	13,000	14,280	16,655		
Service connection or household		2,352	2,600	2,856	3,331		
Water supply (intake or treat)		3,092	3,371	3,221	3,278		
Water supply (distribution)		1,711	2,277	2,233	2,448		

*1Blank means N/A.

2) Water tariff

The present water tariff is 1,400 R/m^3.

(5) Financial status of public system

1) Current financial status

The table below summarized the financial condition of public-managed water system.

Table 4.7.4 Financial Statements of DIME in Kampot Province

Kamot	1,000 Riel
Aasets	**13,228,197**
Current Aasets	**962,883**
Cash	290,528
Current Receivable	249,760
Materials	422,595
Fixed Assets	**12,265,314**
Land	3,041,619
Buildings net	2,941,408
Machineries net	5,881,056
Other Equipments net	401,231

Liabilities & Equity	**13,228,197**
Liabilities	**163,751**
Current Liabilities	246
Long term Liabilities	163,505
Equity	**13,064,446**
Capital	13,103,562
Retained Earnings	-39,116

Fixed Assets Ratio		93.9%
Fixed Assets to Fixed Liability Ratio		92.7%
Equity Ratio		98.8%
Suppy per Assets	14,811	Riel/m3

1,000 Riel

	2009	2008	Retio
Revenue	**1,280,350**	**1,264,813**	**100.0%**
Water revenue	1,250,924	1,141,137	90.2%
Others	29,426	123,676	9.8%
Expense	**1,656,941**	**1,680,059**	**100.0%**
Operating Expense	**1,644,387**	**1,668,559**	**99.3%**
Electricity Cost	512,119	374,736	22.3%
Chemicals	157,604	97,441	5.8%
Fuel	56,769	207,215	12.3%
Spairparts	81,866	145,937	8.7%
Labor & Temp. staff	13,088	22,290	1.3%
Salary & Allowance	108,990	143,921	8.6%
Depreciation	641,621	608,050	36.2%
Others	72,330	68,969	4.1%
Operating Expense	**12,554**	**11,500**	**0.7%**
Administrative & Tax	12,554	11,500	0.7%
Net income	-376,591	-415,246	-24.7%

Amout of Water Supply	2,447	m3/day
Unit price of Water Supply	1,416	Riel/m3
Energy Cost per Water	761	Riel/m3
Material Cost per Water	163	Riel/m3
Labor Cost per Water	186	Riel/m3

Fanincial statement was stored in control room of WTP.

2) Potential in self-reliance management by water sales income

Income statement shows significant loss. Revenue generation is largely affected by huge operation and maintenance cost. Income from water sales comprised 90% of the total revenue, which is relatively good.

3) Composition of expenditure

Major expenditures were depreciation, electricity and fuel. Also, expenses for chemical, fuel and other materials fluctuate appreciably within a year. No annual budget is prepared. Hence, stocks and equipment are procured based on actual need.

4) Financial stability

The capital structure is weak due to annual operation loss attributing to substantially reducing equity's capital and net worth. Although the equity capital ratio is in a reasonable range at 99%, the long-term liability ratio is 94%,which suggests it totally depends on the fund offered by donor agencies.

5) Fund investment

Considering the annual investment amount and the annual volume of water supplied, the unit investment was 14,811 Riel/m^3. Compared to other projects, this figure is extremely high. It

shows that water sales income is far below the investment cost for the system.

(6) Relevant facilities

1) Kampot provincial private managed system（Chhuk）

●Description of the system

As observed during the site visit, the WTP of the Chhuk private-managed water supply system is in troublesome condition. The treated water cannot be regarded as safe water considering the dismal performance of the WTP. Improvement of the existing private-managed system is an interim work to be prioritized.

●Water supply facilities

Raw water is drawn from nearby river by engine-drivem pump. The weir used to divert water is damaged. The raw water has very high turbidity. However, no coagulation is administered as no rapid mixing device was found. Only flocculator with baffle and shallow filter are available. The treated water is pumped to an elevated tank by an engine-driven pump.

With regard to the distribution facilities, most of the PVC pipes with TS socket are exposed, particularly those installed along with roads. This is prone to accidental crush by automobile.

●Operation Status

No coagulant is employed as can be observed. The sedimentation tank was filled with sediments. Empty chemical bags were indiscriminately disposed into receiving well. Filter surface was coverd with scum. No disnfection was conducted as stock ran out. In general, the WTP is in disorder and treatment is not effective to provide potable water to the consumers.

Photo 4.7.2 Baffling Type Flocculator and Sedimentation Basin

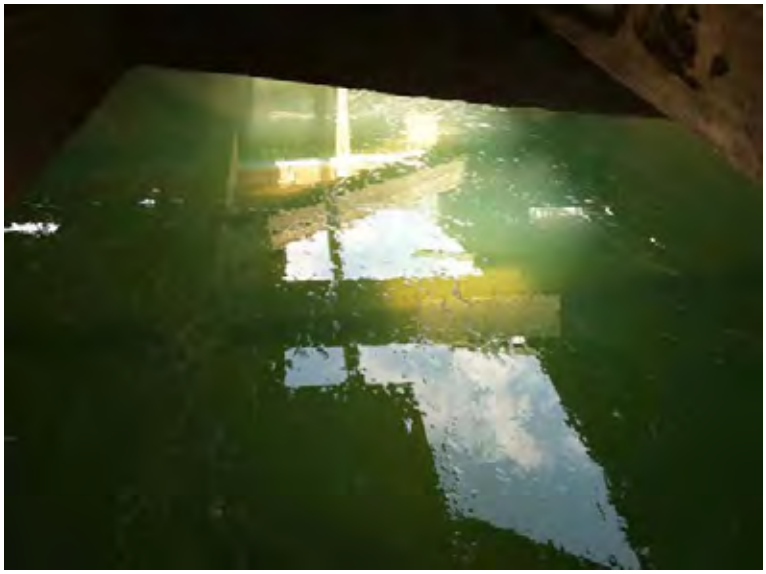


Photo 4.7.3 Bubbled Surface of Sedimentation Basin

4.7.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (45.9%), “Unprotected Dug Wells” (30.8%) and “Tube/Pipe Wells” (10.6%), and the access rate to improved water are 20.9%. About 48.1% of households in this province depend on remote water sources.

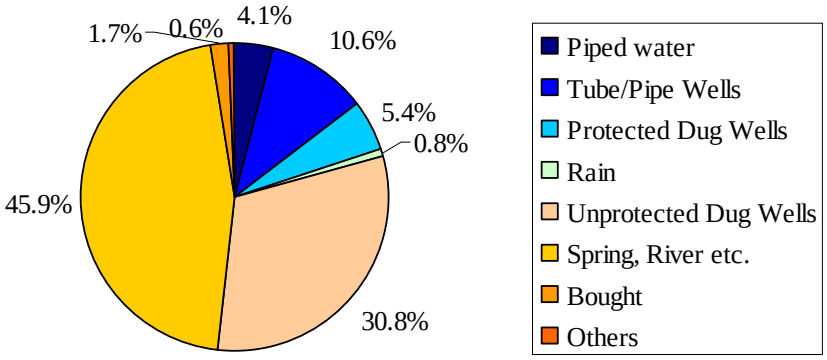


Figure 4.7.4 Type of Water Sources (Kampot Province)

2) Condition of Water Supply Facilities

The monitoring of existing water facilities in the province by PDRD is shown in Table 4.7.5. The functional rate of bored well is 71.2%.

Meanwhile, unprotected wells mostly are supposed to un-function due to failures of parts.

Table 4.7.5 Monitoring Results by PDRD (Kampot Province)

Items	Total	Function		Broken	
	No.	No.	Ratio	No.	Ratio
Afridev	512	403	78.7%	109	21.3%
India Mark II	394	276	70.1%	118	29.9%
VN6	1,796	1,246	69.4%	550	30.6%
Total	2,702	1,925	71.2%	777	28.8%

Source: PDRD in Kampot (2010)

3) Hand pumps

Afridev hand pumps are used in areas where groundwater level is deep. On the orher hand, VN6 pumps are utilized in areas where groundwater occurs at shallow depth. Spare parts for Afridev hand pumps are not readily available in the province. A set of spare parts is usually provided for each hand pump installed for the past projects. If WSUG needs spare parts for Afidev hand pumps, it has to order from the PDRD. The spare parts are procured in Phnom Penh by the PDRD.

4) Water Quality for Groundwater

There is no reported high arsenic concentration in groundwater in this province. However, elevated iron and salt concentration in groundwater were detected in some communes in Kampot Town, Kampong Trach, Tack Chou and Bantey Means. In shallow wells, high salt concentration reders the water tastes sour. Iron and salts in elevated concentration is mostly found in deep wells Therefore, groundwater development in the area is not simple.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is comprised of 83 staff, 8 of which are under the Office of Rural Water Supply and 7 are under the Office of Primary Health.

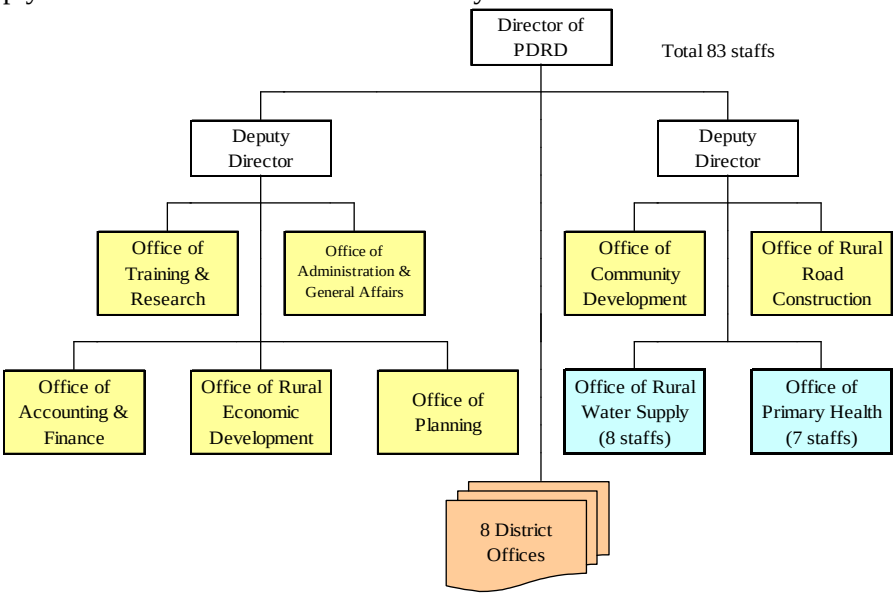


Figure 4.7.5 PDRD Organization Chart (Kampot Province)

2) Budget

"Personal expenses" accounts for the bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

In 2009, 261.2 million Riel was allocated for MRD, mainly used for the rehabilitation of existing facilities

Table 4.7.6 PDRD Budget (Kampot Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	155.0	24.4%	155.0	22.2%
	External charges for services	122.0	19.2%	162.0	23.2%
	Other external charges for services	113.0	17.8%	113.0	16.2%
	Personal expenses	243.0	38.2%	264.7	37.9%
	Taxes and similar services	3.0	0.5%	3.0	0.4%
	Total	636.0		697.7	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	261.2	16	under preparation by MRD	
	Well rehabilitation		115		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		131		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Since PDRD is active in undertaking monitoring program for the water supply facilities in this province for preparation of rehabilitation plan for submission to MRD for funding. The PDRD owns drilling rig. However, this is already in dilapidated condition. Thus, PDRD cannot developed more wells to augment current supply. There is also inadequate budget allocation for the agency to implement projects.

(3) Assistance from Donor Agencies

1) Existing Project

In 1996, IFAD (NGO) carried out a project that includes construction of open wells and tube wells with hand pump in Chum Kiri, Angkor Chey, Kampong Trach and Dong Tong. CIDSE (NGO) also implemented construction of open well in Chum Kiri District. During the period 2006 - 2007, Demark Red Cross carried out construction of tubewells with hand pumps and simple toilets made of concrete. In 2008, KOICA constructed 500 open wells. In 2009, PDRD carried out rehabilitation of 115 tube wells with hand pumps and construction of 16 new tube wells with hand pumps from the funds of MRD.

2) New Assistance Project

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Target sites: 2 districts (Kampong Trach, Teck Chhou)

(ii) Components: Construction of tubewell with hand pump, community pond and toilet

b. Rehabilitation Project for Rural Water Supply financed by MRD

Rehabilitation of 185 existing tube wells with hand pumps are planed for 2010.

(4) Current Condition of Hygiene

Households with toilets account for 22.8% (27,315 households) in the rural areas. Of these households, 41.8% use pit latrines and 33.5% use septic tanks.

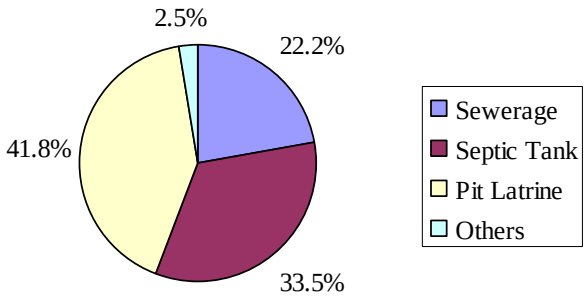


Figure 4.7.6 Type of Toilet (Kampot Province)

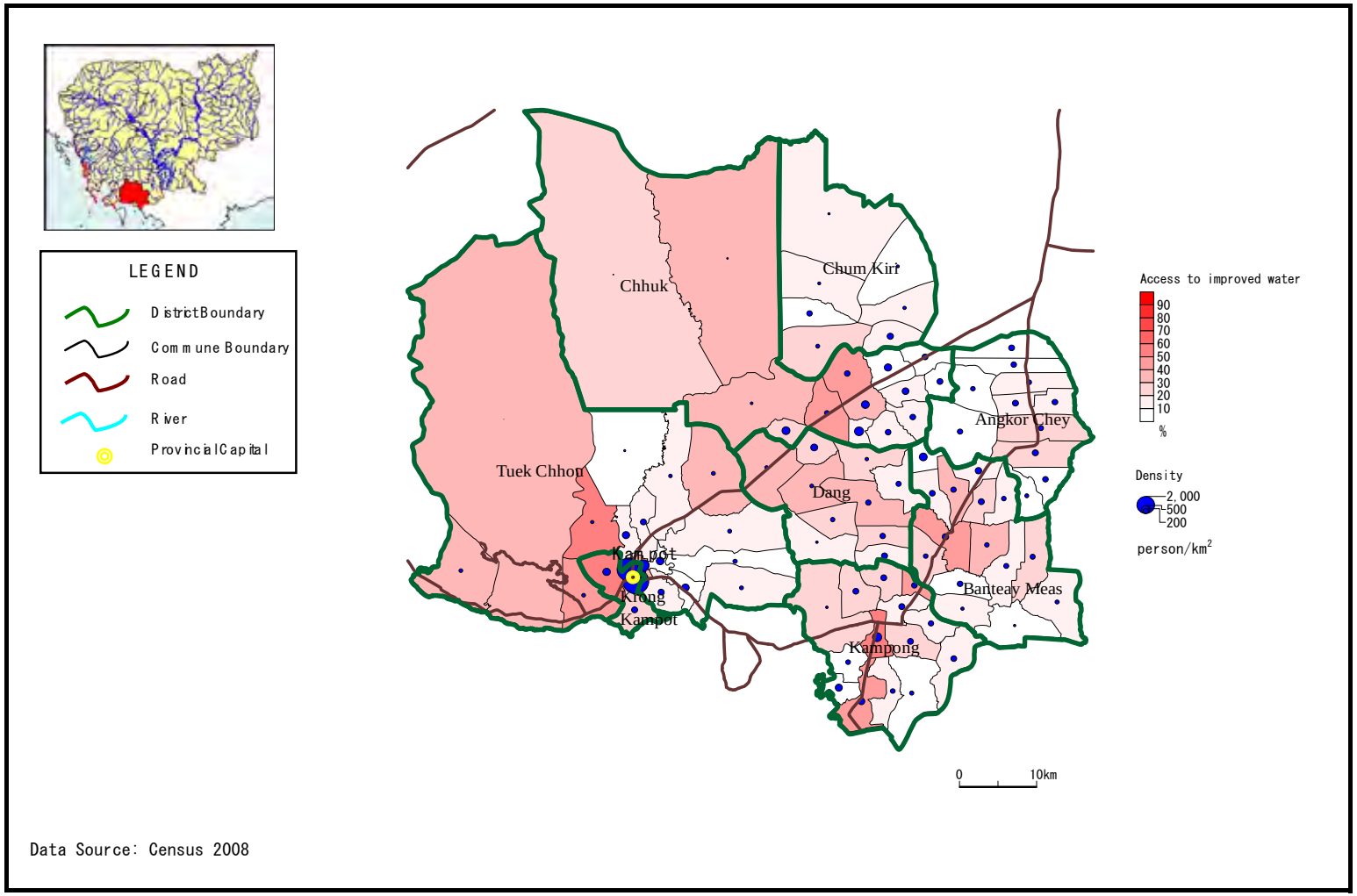
4.7.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, only 6 of the total 92 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.7.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kampot Province)

Urban	Rural	Total
5/7 communes	1/85 communes	6/92 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.7.7 Service Area of Safe Water (Kampot Province)

4.8 Kandal Province

4.8.1 Brief Description of the Province

The Kandal province has an area of 3,564 km^2, comprised of 11 districts, 147 communes, and 1,083 villages. According to 2008 Census, urban population was 195,898 persons（36,329 HH）, and rural population was 1,069,382 persons (218,700 HH）. Population growth rate was 2.93% in urban area, 1.40 % in rural area and 1.62 % in whole province.

4.8.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

The Public-managed system for the provincial capital supplies water from the PPWSA. In addition, several private-managed water supply systems operate within the province. There are 15 MIME licensed privated-managed urban water supply systems as well as 30 small-scaled systems.

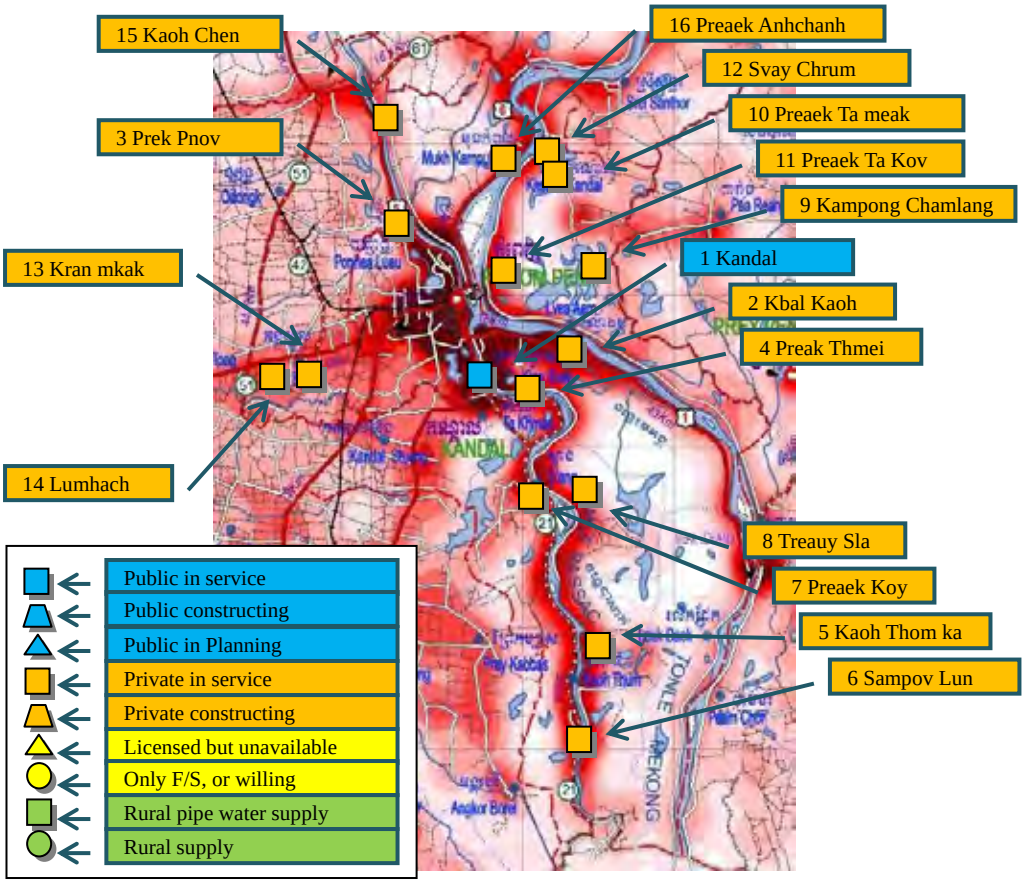


Figure 4.8.1 Existing Urban Water Supply System in Kandal Province

Table 4.8.1 Current Status of Urban Water Supply in Kandal Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Kandal （PPSWA）	Pub	Water Supply by PPWSA							
2	Kbal Kaoh, Kien Svay	Pri			3,819	2,700		200,000	1,700	
3	Prek Pnov, Popnhea Lueu	Pri			1,270	130		160,000	1,800	
4	Preak Thmei, Kien Svay	Pri			2,400				1,800	
5	Kaoh Thom ka, Kaoh Thom	Pri			770	130		80,000	1,700	
6	Sampov Lun, Kaoh Thom	Pri			1,466	510		240,000	2,000	
7	Preaek Koy, S'ang	Pri			1,195	700		240,000	1,850	
8	Treauy Sla, S'ang	Pri			1,100	290		80,000	1,700	
9	Kampong Chamlang, Khsach Kandal	Pri								
10	Preaek Ta meak, Khsach Kandal	Pri			287	40		90,000	2,000	
11	Preaek Ta Kov, Khsach Kandal	Pri			1,062	180		140,000	2,500	
12	Svay Chrum, Khsach Kandal	Pri			404	50		200,000	2,000	
13	Kran mkak, Angk Snoul	Pri			1,165	460		150,000	2,800	
14	Lumhach, Angk Snoul	Pri			337	120		150,000	2,500	
15	Kaoh Chen, Popnhea lueu	Pri			104	330		200,000	2,500	
16	Preaek Anhchanh, Mukh Kampul	Pri			270				1,900	

*1 Blank means N/A.

2) Histrical development of urban and public water supply system

A public-managed WTP was newly constructed in Phom Penh in 2009 and transferred to PPWSA. PPWSA also undertakes O&M activities. Treated water is pumped to the elevated tank located near to DIME office and distributed by gravity.

3) Support from donor agencies

Several staff attended technical seminar on private managed water supply O&M presented by Kosan（NGO）and JICA. No aid is currently obtained from donor agencies. No urban water supply system development plan is being prepared at the moment.

4) Difficulty in assistance structure building

Kandal provinve is the second industrial province in Cambodia with textile as the major industry. To operate a factory, license is required from the following offices:

- Factory scale>2 million US$ License from MIME
- Factory scale<2 million US$ License from the province

Since Kandal is located adjacent to Phom Penh, necessary materials and equipment can be easily procured. A number of hotels suited for long-term stay are available.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

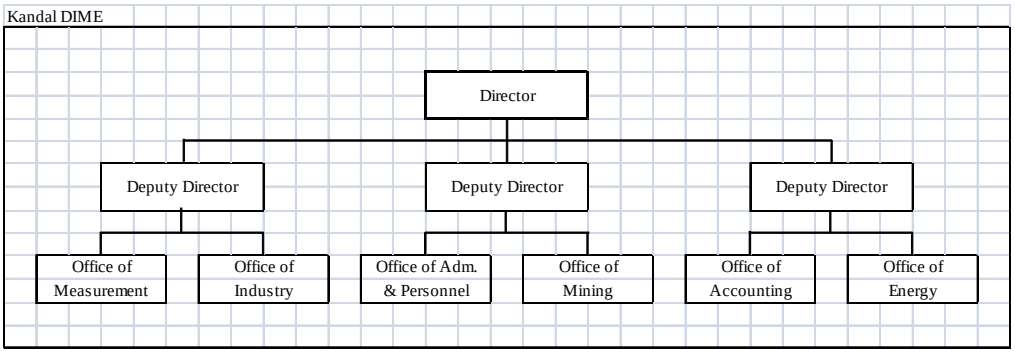


Figure 4.8.2 Organization Chart of DIME in Kandal Province

As mentioned aboved, the operation and management of the water system is under the PPWSA. Three out of the 70 staff of DIME are assigned to urban water supply system. The DIME has no direct involment on the O and M of the water supply system.

●Management status of private system

The responsibility of three DIME staff assigned to the urban water supply system is to supervise the private-managed water systems. With regard to regulation of water supply system, MIME makes inspection every three months.

For the 30 unlicensed small-scaled urban water supply systems, upgrading of facilities is needed. But according to the current law system, MIME cannot compel these water systems to make necessary upgrading. MIME is examining the law for revision.

It was reported that other small-scaled systems out of jurisdiction of the MIME set higher water tariff and supplied water in inferior quality. In some occassions, untreated river water is directly supplied without disinfection.

Since private sector's financial capability is weak, assistance from funding agencies is needed. Further, water meter reading figures are not reliable.

(3) Relevant facilities

1) Preaek Phnov public managed system

●Outline of the system

The urban water system licensed by MIME and located in Preaek Phnov Commune in Popnhea Luev District has WTP capacity of 1,000 m^3/day to 1,500 m^3/day

●Water supply facilities

Treatment process is as follows:

Coagulation→Sedimentation Basin→Rapid Sand Filter→Clear water reservoir→Elevated tank

Chroline is injected in clear water reservoir.

●Operational status

There are 18 persons assigned in O and M section that oversee the system with total house connections of 1,270. To ensure quality of the water distributed to consumers, samples are taken monthly and send to MIME for water quality analysis. The WTP facilities are operated by power generator.

4.8.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Springs, Rivers, etc." (41.1%), "Tube/Pipe Wells" (20.6%) and "Bought" (18.7%), and the access rate to improved water are 33.5%. About 33.1% of households in this province depend on remote water sources.

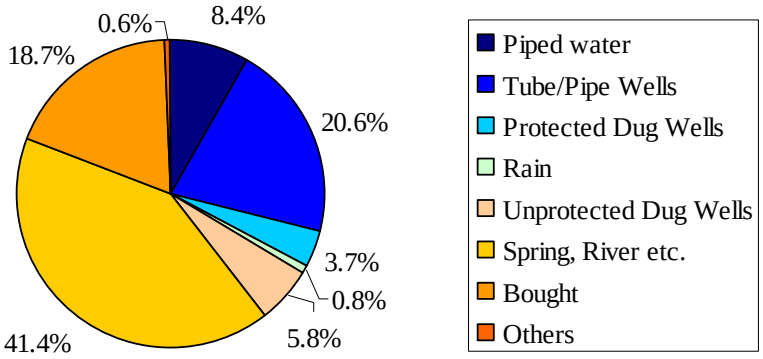


Figure 4.8.3 Type of Water Sources (Kandal Province)

2) Condition of Water Supply Facilities

The water sources used in this province consist of "springs, rivers and other water sources" (41.1%), "tubed/pipe wells" (20.6%) and "water vendor" (18.7%). The access rate to improved water is 33.5%. About 33.1% of the households in the province depend on remote water sources.

Table 4.8.2 Monitoring Results by PDRD (Kandal Province)

Items		Total	Function		Broken	
		No.	No.	Ratio	No.	Ratio
Hand-dug well	Community	2,037	1,254	61.6%	783	38.4%
	Private	5,771	N/A	**	N/A	**
	Total	7,808	N/A	**	N/A	**
Tube well	Community	4,772	2,934	61.5%	1,838	38.5%
	Private	20,995	N/A	**	N/A	**
	Total	25,767	N/A	**	N/A	**

Source: PDRD in Kandal (2008)

3) Hand pumps

VN6 pumps are utilized in 60% of the rural wells, mostly in areas where groundwater occurs at shallow depth. On the orher hand, Afridev hand pumps account for 40% of the wells, which are used largely in areas where groundwater level is deep. India-maid Mark III hand pumps are also used sparingly. Spare parts for VN6 can be procured easily in the province. For Afridev hand pumps the parts are not readily available in the province and for India-made Mark III extra parts are not available in Cambodia. If WSUG needs spare parts for Afidev hand pumps, it has to to be procured in Phnom Penh by the PDRD.

4) Water Quality of Groundwater

Elevated levels of arsenic were remarkably detected in tube wells along the Bacsak River. Based on the result of the water quality analysis, 57.8% of the 4,779 groundwater samples were detected with more than 10ppb of arsenic. This province is considered high risk area for arsenic. Groundwater is an alternative source for small pipe water system in the western part of the Bacsak River considering the government budget constraint.

Table 4.8.3: Result of Arsenic Testing (Kandal Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
4,779	2,260	47.3%	503	10.5%	2,016	42.2%

Source: Arsenic Center (2005-2007)

Moreover, iron concentrations and hardness are generally excessive in the province. With the water quality problem of groundwater in the area, the residents have no other option but to use polluted surface water.

PDRD indicated that groundwater development in Kandal Stueng, Ampov Prey, Tbaeng and Trapeang Veaeng commune is difficult.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is comprised of 92 staff, 8 of which are under the Office of Rural Water Supply and 5 are under the Office of Primary Health.

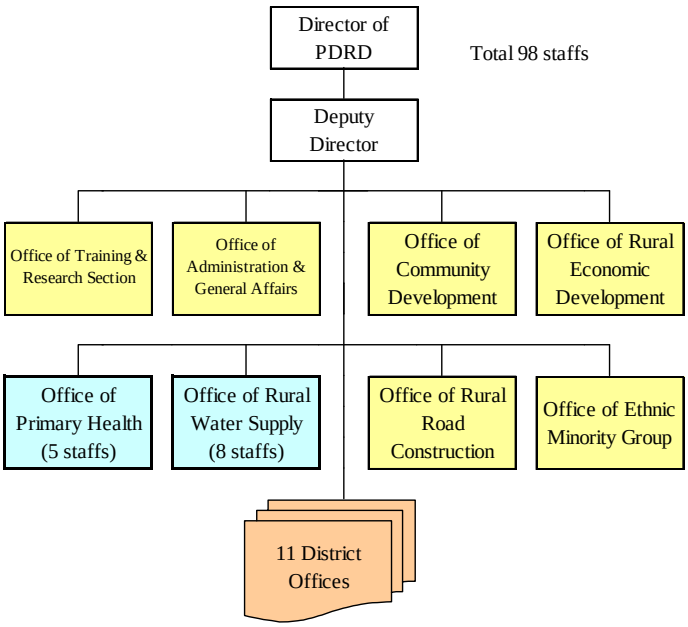


Figure 4.8.4 PDRD Organization Chart (Kandal Province)

2) Budget

"Personal expenses" accounts for the bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects, and also MRD financial package budget in 2009.

Table 4.8.4 PDRD Budget (Kandal Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	222.8	36.8%	222.8	35.2%
	External charges for services	90.0	14.9%	90.0	14.2%
	Other external charges for services	30.0	5.0%	30.0	4.7%
	Personal expenses	260.0	42.9%	287.0	45.4%
	Taxes and similar services	3.0	0.5%	3.0	0.5%
	Total	605.8		632.8	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

If hand pump is broken, repair is contracted out to private entity without PDRD assistance.

(3) Assistance by Other Donors

1) Existing Project

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Base line survey was already done.

(ii) Target sites: 5 districts (5 communes per one district)

(iii) Components: Construction of tubewell, school toilet and community pond

b. CLTS Project by World Vision

(i) Target sites: 6 villages (2 villages in 2009, 6 villages in 2010)

(ii) Components: Construction of tube well and hygiene education

c. Arsenic Mitigation Program by MRD/PDRD financed by UNICEF

(i) Period: From 2004 to 2010 (plan preparation in 2010)

(ii) Components: KAP survey, testing and marking tubewell in the At Risk areas, IEC intervention and provision of alternative safe water

(4) Current Condition of Hygiene

Households with toilets account for 40.1% (87,672 households) in the rural areas. Of these households, 56.9% use septic tanks and 25.4% are connected to sewerage system.

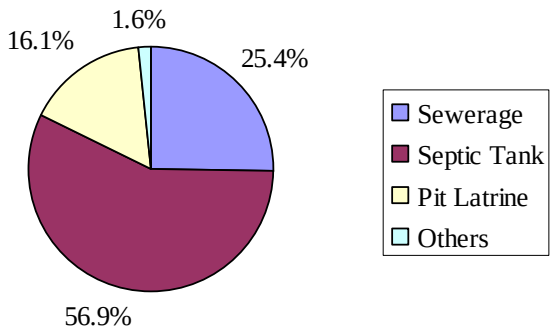


Figure 4.8.5 Type of Toilet (Kandal Province)

According to PDRD, incidence of diarrhea in children is high in this province. The average medical expenditure per child for one year is from 60,000 to 100,000 Riel (15-25 US$) as of last year. This is susbtantial for rural residents.

Moreover, hygiene education and awareness are not aggressive in the area. The PDRD consider that public awareness campaign program be implemented to improved hygiene in the locality. In 4 villages, PDRD observed improvement hygiene of residents with the awareness program of Word Vision.

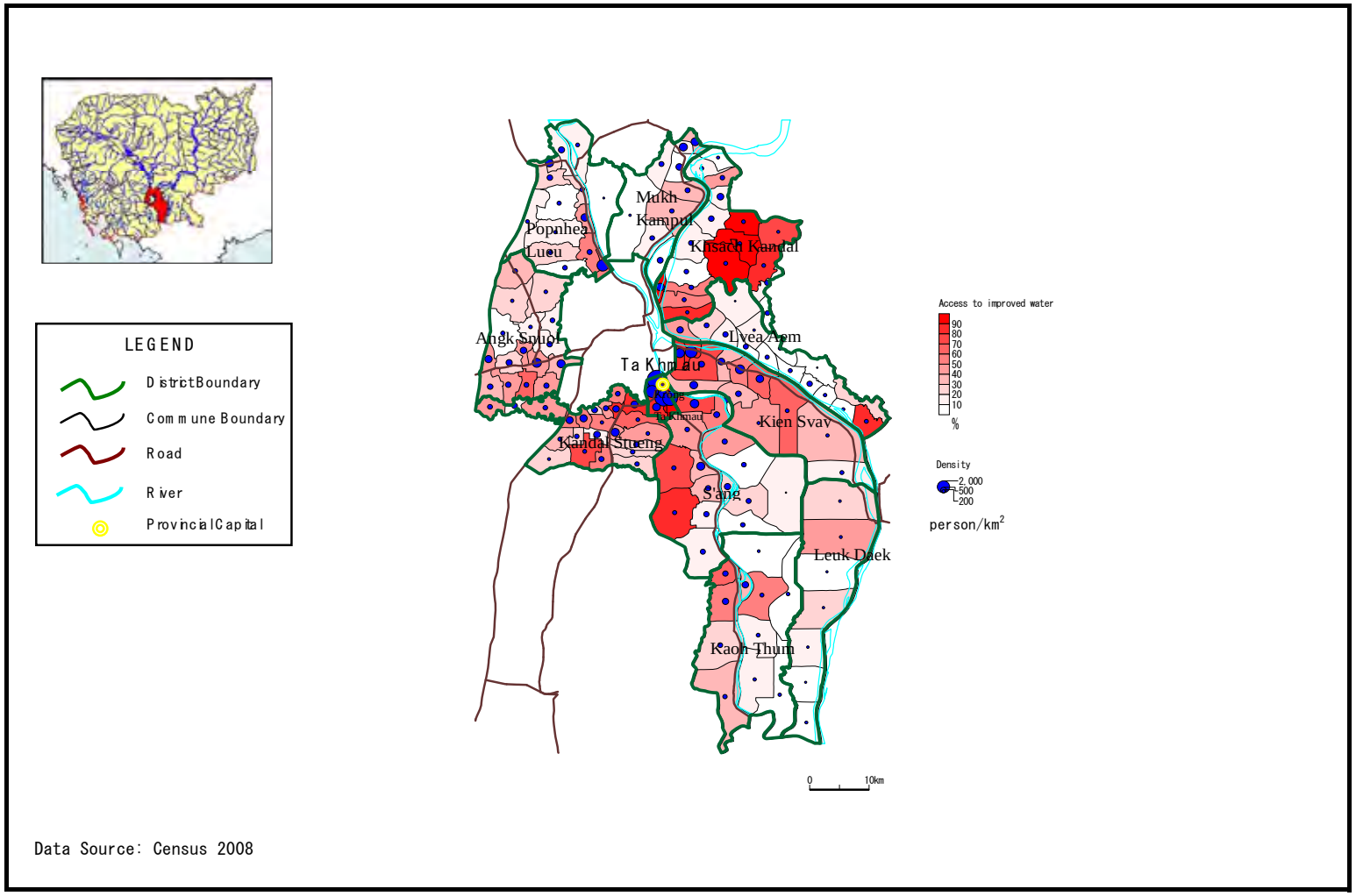
4.8.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, only 41 of the total 147 communes in this province have more than 50% access to "improved water" as shown in the table below.

Table 4.8.5 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kandal Province)

Urban	Rural	Total
12/15 communes	29/132 communes	41/147 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.8.6 Service Area of Safe Water (Kandal Province)

4.9 Koh Kong Province

4.9.1 Brief Description of the Province

The Koh Kong province has an area of 10,090 km^2, comprised of 7 districts, 29 communes, and 119 villages. According to 2008 Census, urban population was 36,053 persons（7,395 HH）, and rural population was 81,428 persons (16,771 HH）. Population growth rate was -1.48% in urban area, 0.92 % in rural area and 0.12 % in whole province.

4.9.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

The water supply in Koh Kong capital is provided by large-scale private-managed system built in Mondul Seima, which is located on the opposite river bank. There are three other private-managed water systems in the province.

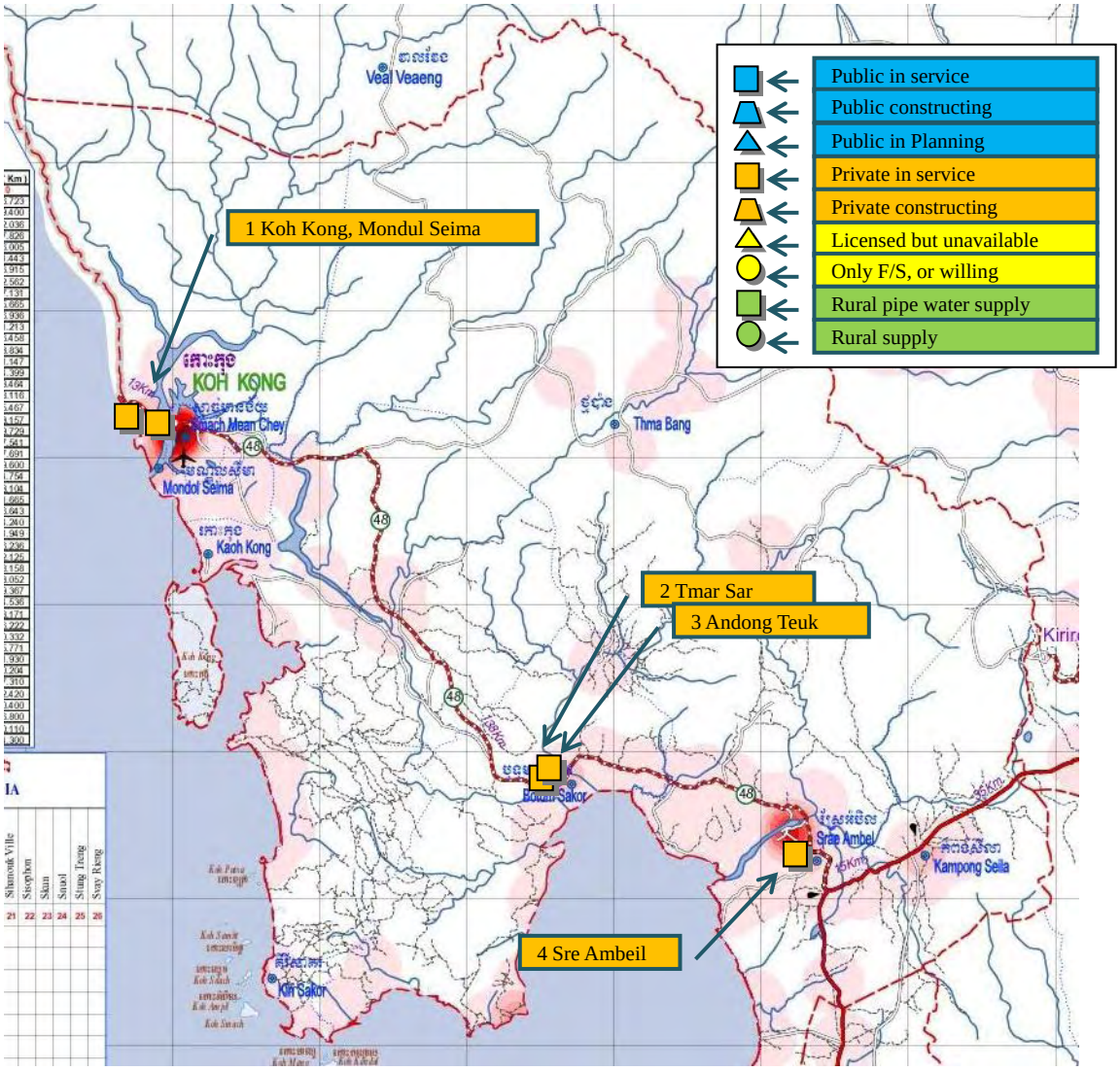


Figure 4.9.1 Existing Urban Water Supply System in Koh Kong Province

Table 4.9.1 Current Status of Urban Water Supply in Koh Kong Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Koh Kong, Mondul Seima	Pri	2000 ?		1,313	2,200	Pond	350,000	1,800	*1
2	Tmar Sar, Batum Sarkor	Pri	2003	450		20 - 60	Pond		4,000	
3	Andong Teuk, Batum Sarkor	Pri	2009	20		7	Pond		4,000	
4	Sre Ambeil	Pri	2002	515		300	Pond	20,000	2,000	

*1 Source: Information by MIME. Blank means N/A.

2) Historical development of urban and public water supply system

Aprox.2000 Several private managed water supply providers started system construction.

Early 2000's Private managed system construction was completed.

Operation of Mondul Seima system was supposed to start in early 2000's. Current operational status of WTP is satisfactory and staff has high motivation.

Two small-scaled piped systems in Batum Sarkor were built by village budget to improve local sanitation ondition. These systems seldom operate during rainy season.

Established in 2000 as private sector-led system, Sre Ambeil water supply system started operation in 2002. It has five staff. Although some facilities are slightly deteriorated, treatment performance is still satisfactory. The service provider is contemplating on expanding the service area through income from water sales.

3) Support from donor agencies

DIME insists to develop the public managed water supply system in the provincial capital. Although they consider that the existing water supply capacity is not coping with water demand, they cannot participate in this undertaking.

(2) Urban water supply system management structure

1) Organizational structure of DIME and public water utility

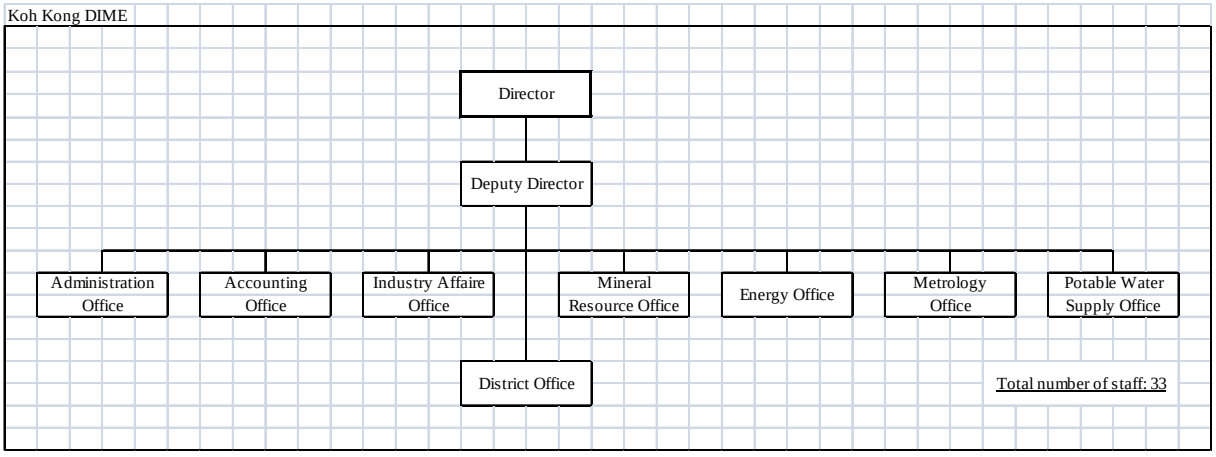


Figure 4.9.2 Organizational Chart of DIME in Koh Kong Province

DIME has total 33 staffs and Potable Water Supply Office is managing water supply system.

2) Capacity development for staff
No technical seminar has been held as DIME is not directly managing water supply projects.

(3) Relevant facilities
1) Mondul Seima private-managed water supply system
●Description of the system
The private-managed water provider played important part in the development of Koh Kong City. Water tariff for the system is 2,000 R/m^3. The system operates sustainably and can support service area expension.
The WTP of the system is located at the opposite side of the river that runs through the city (facing to the provincial capital and water transmission pipe of another system). Installation of the 200 to 250 diameter PE pipe crossing the Koh Kong brige is on-going at present. Distribution pipeline installation works continuously expand in city area to increase service area. As private-managed system, no public fund has been received, but the service area has been expanding using the income from water sales.

●Water supply facilities
The source of raw water is a lake. A WTP is provided and has operated for eight years. The WTP has two separate units. Unit No.1 is located near to raw water source and is typical of Cambodia treatment process, which is comprised of horizontal flow clarifier as the core facility. Unit No.2 has different setup from other unit. This unit was designed by a Thai engineer. The treatment process is composed by rapid mixing chamber, shaft-type flocculator, sedimentation basin and filtration tank. A small-capacity elevated tank is utilized as backwashing tank. CIP and PE pipes are used for piping.

●Operational status
Suffiucient chemical coagulation and flocculation were observed. Coagulation performance is satisfactory.
Alum is used as coagulantion agent. For pH adjustment, soda ash is utilized, while for disinfection, chlorine, in the form of bleaching powder is used.
A 24-hour water supply service is normlly achieved. However, supply capacity becomes less during dry season.

(4) Financial status of public system
As no public-managed system is operated in this province, no financial statement is available.

4.9.3 Rural Water Supply
(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Unprotected Dug Wells" (47.6%), "Bought" (15.90%) and "Piped water" (11.4%), and the access rate to improved water is 28.7%. About 45.7% of households in this province depend on remote water sources.

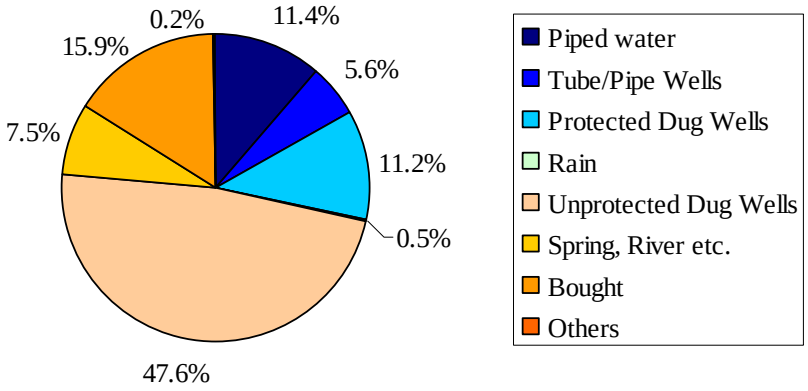


Figure 4.9.3 Type of Water Sources (Koh Kong Province)

2) Condition of Water Supply Facilities

Since PDRD does not carry out regular monitoring and data management, it has no present knowledge of the conditions of existing water supply facilities in the villages.

Meanwhile, according to the District Data Book (2008) of UNDP, the proportion of tubed well which can be used in throughout the year is 74.3%, while the ratio of non-functional tubed well is 24.1%.

Table 4.9.2 Functioning/Un-functioning Conditions of Water Supply Facilities (Koh Kong Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	1,177	
Year-round usable pumped or mixed wells	874	74.3%
Dry season unusable pump or mixed wells	303	25.7%
Pump or mixed wells needing repair/rehabilitation	284	24.1%
Total number of ring wells	1,450	
Year-round usable ring wells	1,154	79.6%
Dry season unusable ring wells	296	20.4%
Ring wells needing repair/rehabilitation	229	15.8%
Total number of un-protected dug wells	2,106	
Year-round usable un-protected dug wells	1,387	65.9%
Dry season unusable un-protected dug wells	719	34.1%

Source: District Book (2008)

3) Hand pumps

Afridev and Indian-made hand pumps are common in the area, which are cheap but not of good quality. Spare parts of Afridev hand pumps are not easy to find in this province.

Although PDRD can receive requests, which are mostly repair of hand pumps and replacement of parts, PDRD can not make implementation due to lack of budget.

4) Water Quality of Groundwater

PDRD does not carry out water quality testing eversince, although it is aware of the groundwater quality in this province.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is comprised of 27 staff, 2 of which are under the Office of Rural Water Supply and another 2 are under the Office of Primary Health.

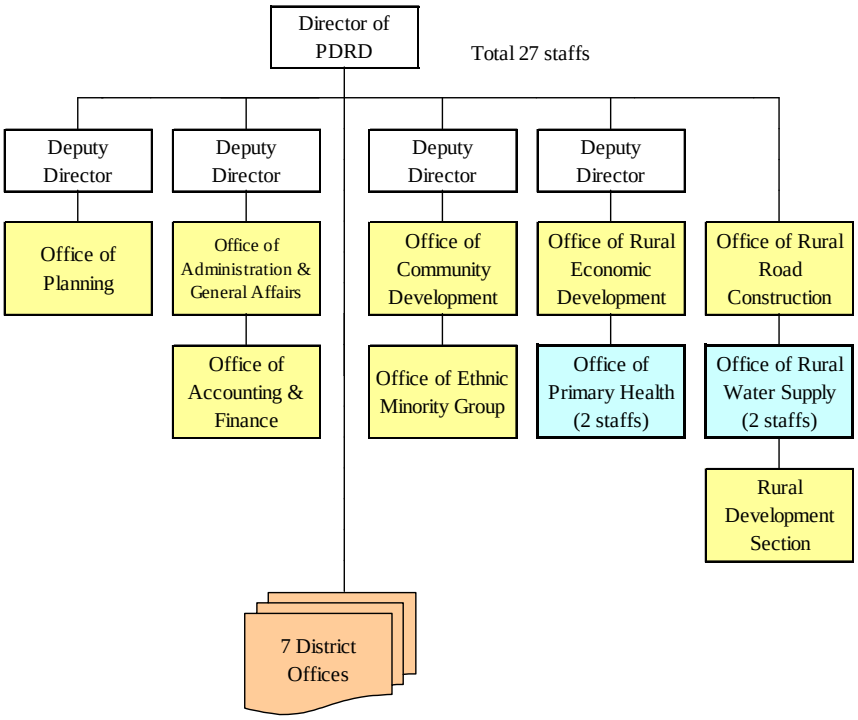


Figure 4.9.4 PDRD Organization Chart (Koh Kong Province)

2) Budget

"External expenses for services" and "Personal expenses" account for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

A budget of 147.1 million Riel was allocated in 2009 to MRD mainly for rehabilitation of existing facilities.

Table 4.9.3 PDRD Budget (Koh Kong Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	58.0	17.2%	58.0	16.4%
	External charges for services	107.0	31.8%	107.0	30.3%
	Other external charges for services	67.0	19.9%	67.0	19.0%
	Personal expenses	105.0	31.2%	121.0	34.3%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	337.0		353.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	147.1	30	under preparation by MRD	
	Well rehabilitation		80		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		110		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

(3) Assistance from Other Donors

1) Existing Project

MRD constructed the open wells and tube wells with hand pumps from 1979 to 1998. During this period, there are no related program coming from donors and NGOs. CAREECO provided assistance for the construction of the open wells, tubed wells with hand pumps and local infrastructure such as rural road during the period 1999 to 2000. MRD also constructed the open wells and tubed wells with hand pumps from 2002 to 2007. SCW (Save Cambodia Wildlife, an NGO) supported the construction of 92 toilets in Thmar Boing districts in 2008 and planned to construct 6 tubed wells in 2009. Other donor is the SEILA.

2) New Assistance Plan

a. Rehabilitation Project for Rural Water Supply financed by MRD

PDRD has a plan to rehabilitate 50 tubed wells with hand pumps and 20 open wells in 2010, which will be financed by MRD.

(4) Current Condition of Hygiene

Households with toilets account for 27.1% (4,553 households) in the rural areas. Of these households, 40.2% use septic tanks and 29.9% are connected to sewerage system.

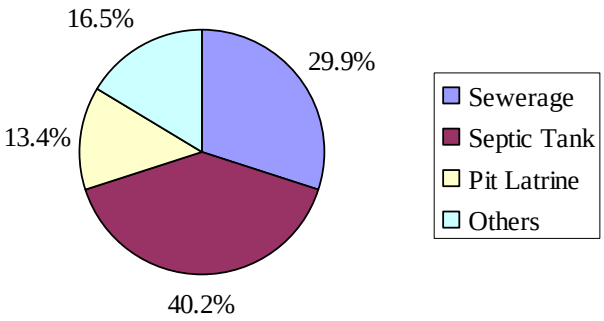


Figure 4.9.5 Type of Toilet (Koh Kong Province)

(5) Characteristic of this province

This province has few projects from donors as compared with other provinces because of the following reason:

(i) Accessibility

Travel time to the capital town was 12 hours by the boat from Phnom Penh. It had limited access, which is passable only during dry season until the national road was built in 1997 to 1998. Public transport was very poor until buses ply the route Phnom Penh-Koh Kong and vice versa in 2008. At present, it is still impossible to access overland to and from Kiri Sakor District.

(ii) Laborers' wages

There are many laborer of fishing or forest in this province, and its wage level is high compared with a farmer. It is a disincentive of the project implementation by NGOs not to ensure manpower with low wage.

(iii) Natural condition

Prolong rainy season, from March to October, hampers project implementation.

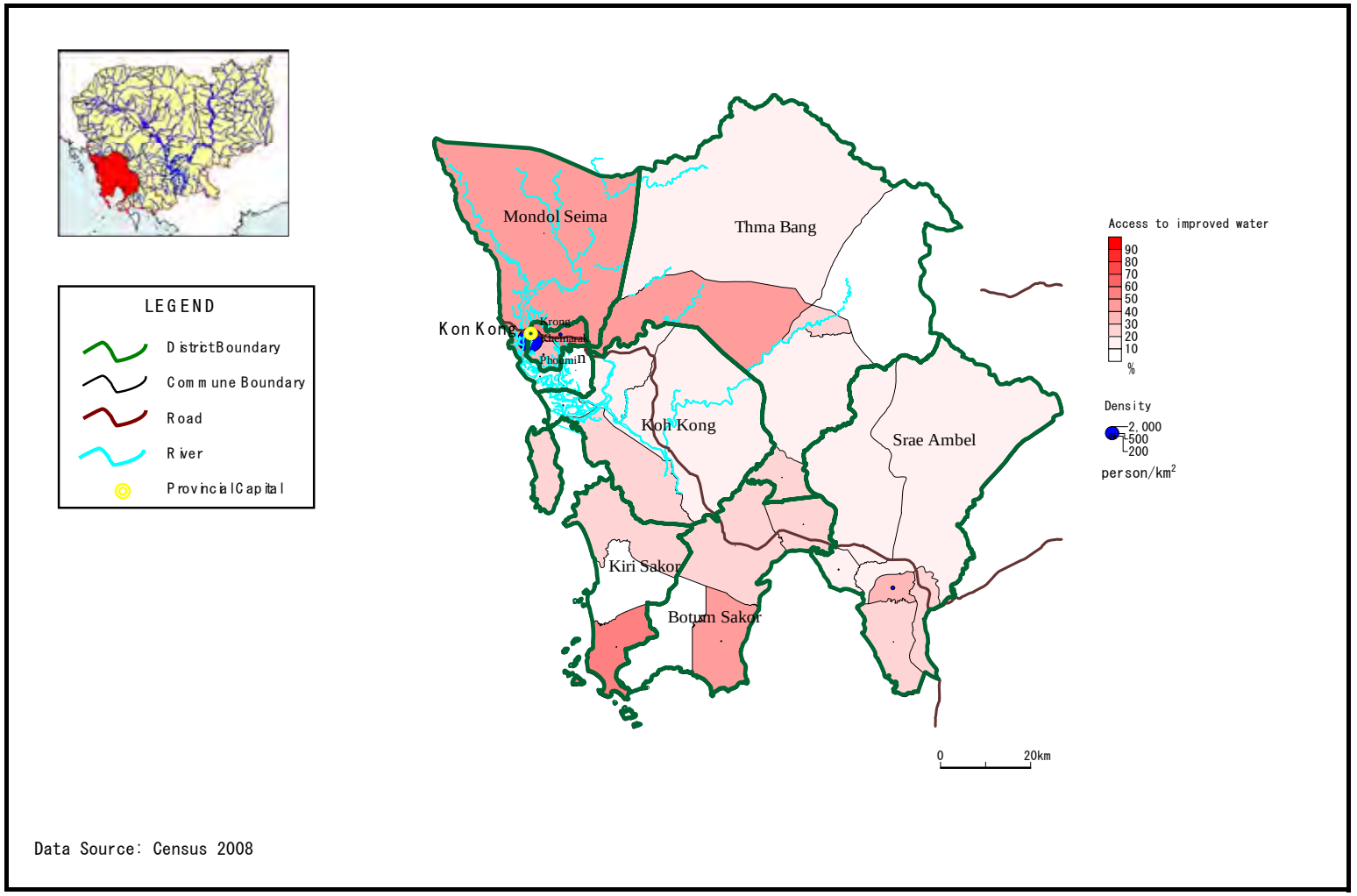
4.9.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, only 3 of the total 29 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.9.4 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Koh Kong)

Urban	Rural	Total
2/3 communes	1/26 communes	3/29 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.9.6 Service Area of Safe Water (Koh Kong Province)

4.10 Kratie Province

4.10.1 Brief Description of the Province

The Kratie province has an area of 11,094 km^2, comprised of 6 districts, 46 communes, and 260 villages. According to 2008 Census, urban population was 35,964 persons（7,439 HH）, and rural population was 283,253 persons (57,884 HH）. Population growth rate was -0.10% in urban area, 2.22 % in rural area and 1.93 % in whole province.

4.10.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Only public managed water supply system is available in Kracheh, the provincial capital, serving 4,524 HH and house connection of 1,712 units as of 2009. Further five private managed systems are in service and contruction of one more sysyem is now on-going.

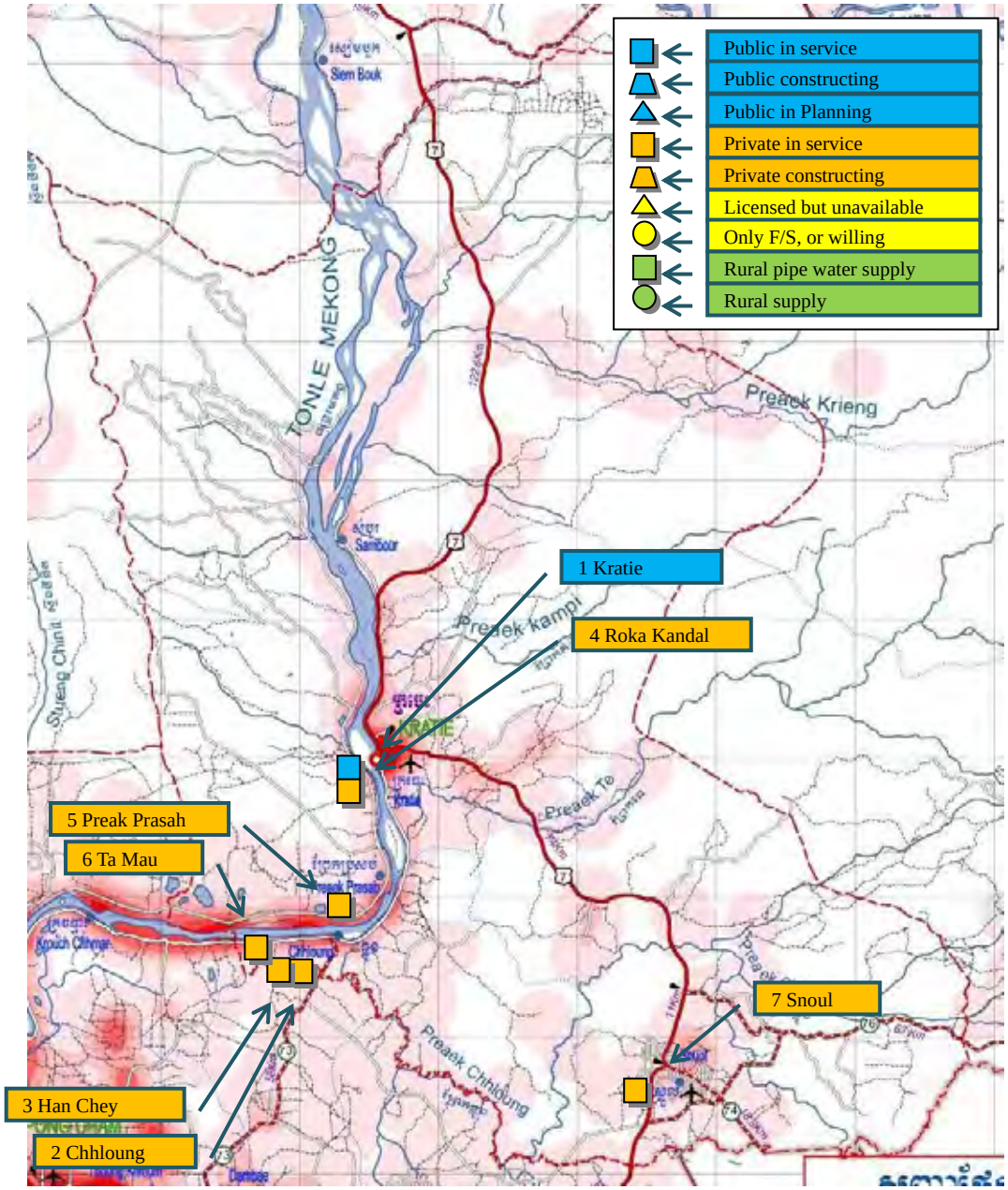


Figure 4.10.1 Existing Urban Water Supply in Kratie Province

Table 4.10.1 Current Status of Urban Water Supply in Kratie Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Kracheh	Pub	1960		1,712				1,400	
2	Chhloung	Pri								
3	Han Chey	Pri								
4	Roka Kandal	Pri								
5	Preaek Prasab	Pri			335	47		60,000	2,000	
6	Ta Mau	Pri								
7	Snuol	Pri			394	230		100,000	2,500	

*1 Blank means N/A.

2) Historical development of urban and public water supply system

1952	Water supply system, which was served by untreated from Mekong River was established.
1962	Groundwater intake system was developed through the assistance by USAID and structure as water supply system was formed.
2005	Current water supply system was formed.

The original water supply system constructed in 1952 directly supplied untreated water from Mekong River to consumers. The water supply sustem which distributes underground water through tubed well and elevated tank was built in 1962 and is still operated. Current water supply system was formed by construction of the WTP in 2005 using the budget of MIME.

3) Support from donor agencies

As to Kracheh city, ADB conducted the basic study together with Stung Traeng province. The scope of work of the study was as follows:

1. Construction of new WTP located north of the existing WTP, upstream of Mekong River
2. Rehabilitation and expansion of distribution network
3. Development of urban sewerage system and inbstallation of latrine

English presentation material was collected and presented in the "Data collected by the Study Team" Kr-7.

(2) Urban water supply system management structure

1) Organizational structure of DIME and public water utility

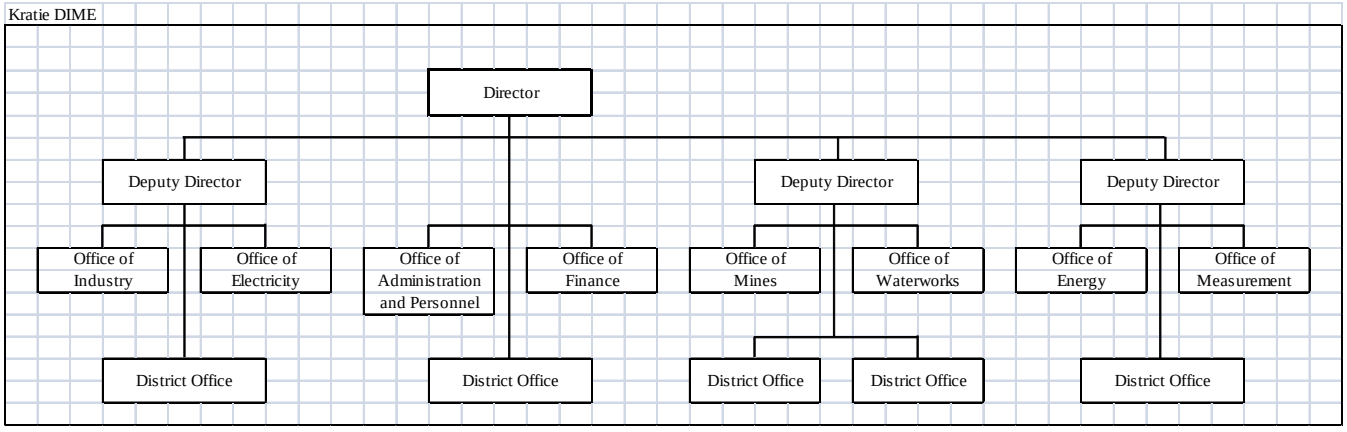


Figure 4.10.2 Organizational Chart of DIME in Kratie Province

The DIME has 18 staffs for the province.

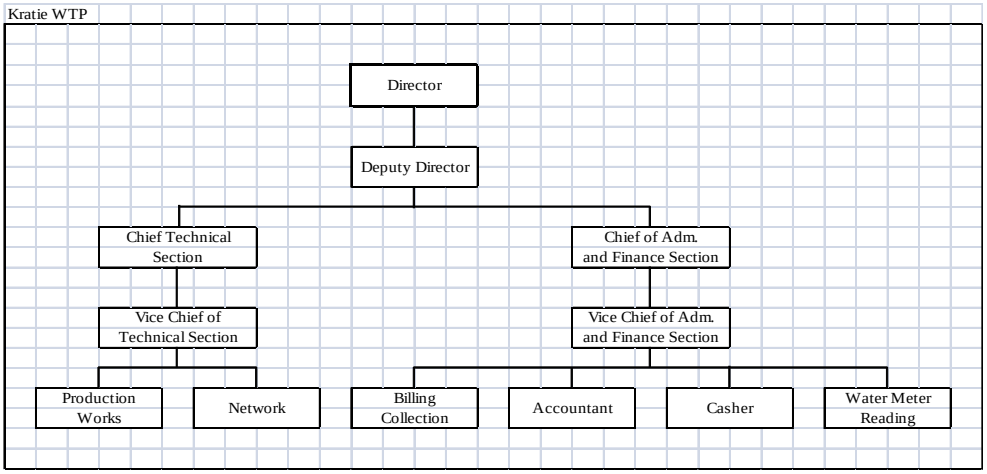


Figure 4.10.3 Organizational Chart of WTP in Kratie Province

2) Capacity development for staff

According to the questionnaire results, almost all the staff has not attended any related seminar for capacity development.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

The WTP has two units; one is taking raw water from Mekong River and the other is pumping groundwater through tubed wells constructed within the WTP premise. In 1962, USAID drilled tubed wells at depth of 209m and 100m near the river. However, the 100m deep well dried up in 1996. On the same year, SAWA, an NGO from Netherlands, drilled a 96m deep well, and it dried up in 2002.

Currently, the groundwater through the 209 m deep well source augments the surface water production from 50m^3/day to a total of 100m^3/day. During dry season, groundwater level drastically lowers but is not drained. The river water source can secure sufficient amount of water.

2) Capacity and operation of WTP

The water from river source is treated as follows:

Raw water storage tank→Coagulation tank→Shallow filter→Clear water reservoir (150 m^3)

Groundwater is pumped directly to the reservoir without treatment.

The WTP started operation in 2005. Additional capacity is needed to cope with the water demand. The filter is too shallow and has no drain channel installed, sometime sand spilled off. Therefore, surface water treatment is intermittent. Moreover, as it is located in the city area, no land is available for expansion. Chlorine gas is injected at clear water reservoir for disinfection. The elevated reservoir aws built in 1960's, which has capacity of 50 m^3 and height of 18.5 m.

3) Capacity and function of distribution system

Two distributrion lines are installed. One is direct distribution line and the other is through the elevated tank. Normally, the direct distribution line is used. The diameter of the distribution mains is 300 mm, which is relatively large compared with the water supply capacity of 100m^3/day. Leakage of the pipe network is 29%. Further reduction of the water loss is envisioned, but no program is available.

4) Water supply project O&M status

O&M tools and equipment for WTP and distribution network are dilapidated and lacking. No budget is available for water supply system expansion and repair tools and equipment. Tools are purchased based on immediate needs. Reportedly, 10% of Thailand made water meter are not functioning.

5) WTP O&M status

Upon the field survey, operation of all facilities were suspended for cleaning. During cleaning works, groundwater is directly supplied. Coagulation tank and sedimentation basin are cleaned every month and filter is back-washed every week. Every year filter media are replaced.

6) Water quality control and supply water quality

Since there is no loboratory available, water samples are sent to MIME every three months for water quality analysis.

Table 4.10.2 Result of WTP Water Quality Analysis

	Parameter	Turbidity	pH	Total Dissolved Solids	Iron (Fe)	Total Hardness	Arsenic (As)	Chloride (Cl^-)
Standard		< 5 NTU	6.5 - 8.5	< 800 mg/l	< 0.3 mg/l	< 300 mg/l	< 50 µg/l	< 250 mg/l
Raw Water								
Potable Water	2003/01/17	0.2 NTU	7.39	206	0.52	120	0	1.44

*1 Blank means N/A.

(4) Water supply stastus of public system

1) Water supply amount, service ratio and house connection rate

Table 4.10.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		4,039	4,160	4,524			4,659
Population in supply area		1,314	1,369	1,480	1,710	1,730	4,000
Service population		2,725	2,791	3,044	2,814	2,794	
Service connection or household						1,626	
Water supply (intake or treat)		1,125	1,258	1,410	1,400	1,400	3,000
Water supply (distribution)		736	837	964	1,074	1,200	2,700

*1 Blank means N/A.

2) Water tariff

Current water tariff is 1,400 Riel/m^3.

3) Extent of water supply service

Current water service hour is 15 to 17 hours/day. The consumers are requesting continuous water service. Because of low pressure, water is not available at the end of distribution network.

(5) Financial status of public system

1) Current financial status

Financial statememt was included in project report documents.

2) Potential in self-reliance management by water sales income

Income statement shows negligible loss. Income from water sales comprised 94% of the total revenue, which is relatively good. Considerable decrease in water sales largely affects sustainability of the water system.

Table 4.10.4 Financial Statements of DIME in Kratie Province

Kratie	1,000 Riel
Aasets	**1,228,048**
Current Aasets	**291,766**
Cash	49,540
Current Receivable	224,315
Materials	17,911
Fixed Assets	**936,282**
Land	199,875
Buildings net	315,245
Machineries net	411,964
Other Equipments net	9,198

Liabilities & Equity	**1,228,048**
Liabilities	**225,614**
Current Liabilities	225,614
Long term Liabilities	0
Equity	**1,002,434**
Capital	1,209,618
Retained Earnings	-207,184

Fixed Assets Ratio	93.4%
Fixed Assets to Fixed Liability Ratio	93.4%
Equity Ratio	81.6%
Suppy per Assets	2,804 Riel/m3

1,000 Riel

	2009	2008	Retio
Revenue	**577,194**	**512,659**	**100.0%**
Water revenue	549,042	483,713	94.4%
Others	28,152	28,946	5.6%
Expense	**536,316**	**561,435**	**100.0%**
Operating Expense	**536,316**	**561,435**	**100.0%**
Electricity Cost	169,176	383,181	68.3%
Chemicals	34,164	42,373	7.5%
Fuel	190,629	33,359	5.9%
Spairparts	39,562	11,472	2.0%
Labor & Temp. staff	32,068	19,579	3.5%
Salary & Allowance	22,491	31,020	5.5%
Depreciation	28,152	19,804	3.5%
Others	20,074	20,647	3.7%
Operating Expense	**0**	**0**	**0.0%**
Administrative & Tax	0	0	0.0%
Net income	40,878	-48,776	-8.7%

Amout of Water Supply	1,200	m3/day
Unit price of Water Supply	1,170	Riel/m3
Energy Cost per Water	1,048	Riel/m3
Material Cost per Water	26	Riel/m3
Labor Cost per Water	116	Riel/m3

3) Composition of expenditures

Major disbursements were power and bad account. Expenses for salary and wages are considered small and there is a possibility that the amount paid under this item was not allocated from the internally generated fund. Also, expenses for fuel should be included in the O&M cost as price fluctuates erratically in 2009.

4) Financial stability

The capital structure is weak due to annual operation loss attributing to substantially reducing equity's capital and net worth. Although the equity-debt ratio is 18%, the long-term liability ratio is 93%. In general, the water supply system is totally depending on external sources, i.e., from donor agencies.

5) Fund investment

Considering the annual investment amount and the annual volume of water supplied, the unit investment was 2,804Riel/m^3. Compared to other projects, this figure is small compared with those well-managed projects. Entry of accounts should be reviewed as depreciation cost was observed to be small.

4.10.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Unprotected Dug Wells" (25.6%), "Springs,

Rivers, etc." (25.3%) and "Tube/Pipe Wells" (17.4%), and the access rate to improved water is 33.4%. About 43.4% of households in this province depend on remote water sources.

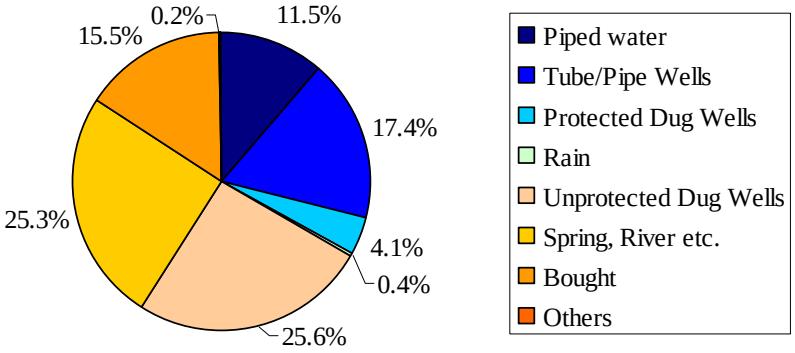


Figure 4.10.4 Type of Water Sources (Kratie Province)

2) Condition of Water Supply Facilities

Since PDRD does not carry out regular monitoring and data management, it has no present knowledge of the conditions of existing water supply facilities in the villages.

Table 4.10.5 Monitoring Results by PDRD (Kratie Province)

Items	Total	Tube well	Hand-dug well with platform	Hand-dug well without platform	Small irrgation	Community pond
No. of facilities	2,203	886	643	563	89	22

Source: PDRD in Kratie (2010)

Meanwhile, according to the District Data Book (2008) of UNDP, the proportion of tubed well which can be used in throughout the year is 86.2%, while the ratio of non-functional tubed well is 16.3%.

Table 4.10.6 Functioning/Un-functioning Conditions of Water Supply Facilities (Kratie Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	2,579	
Year-round usable pumped or mixed wells	2,223	86.2%
Dry season unusable pump or mixed wells	356	13.8%
Pump or mixed wells needing repair/rehabilitation	420	16.3%
Total number of ring wells	2,033	
Year-round usable ring wells	1,605	78.9%
Dry season unusable ring wells	428	21.1%
Ring wells needing repair/rehabilitation	353	17.4%
Total number of un-protected dug wells	1,930	
Year-round usable un-protected dug wells	1,568	81.2%
Dry season unusable un-protected dug wells	362	18.8%

Source: District Book (2008)

3) Hand pumps

About 95% of the hand pumps installed in this province are Afridev, which is normally installed in deep groundwater areas. The remaining 5% are VN6 and TARS hand pumps, which are commonly installed in shallow groundwater areas. Spare parts for Afridev hand pumps are not locally available in the province. If WSUG need the spare parts for Afridev hand pumps, the following are usually done:

(i) PDRD requests the rehabilitation of well to MRD, then PDRD will rehabilitate 100 tubed wells in 2010 using the MRD allocated budget; and

(ii) WSUG order required spare parts to PDRD and PDRD procure it with actual charge in Phnom Penh instead of WSUG.

4) Water Quality

Based on the Arsenic Mitigation Program of MRD, which is financed by UNICEF, elevated arsenic concentration were founded in Kracheh and Preaek Prasab districts along Mekong River. Considering to the result of water quality analysis by the Arsenic Center, 16.8% of 1,248 groundwater samples were detected with more than 10ppb of arsenic. This province is also identified as a high risk area for arsenic.

Table 4.10.7 Result of Arsenic Testing (Kratie Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
1,248	94	7.5%	116	9.3%	1,038	83.2%

Source: Arsenic Center (2005-2007)

Moreover, since groundwater in the area is hard, notable in almost 60% of province, PDRD has instructed residents to boil water.

(2) Organization and Structure/Operation and Maintenance

1) Organization and Structure

The PDRD in this province is comprised of 31 staff, 6 of which are under the Office of Rural Water Supply and 4 are under the Office of Primary Health.

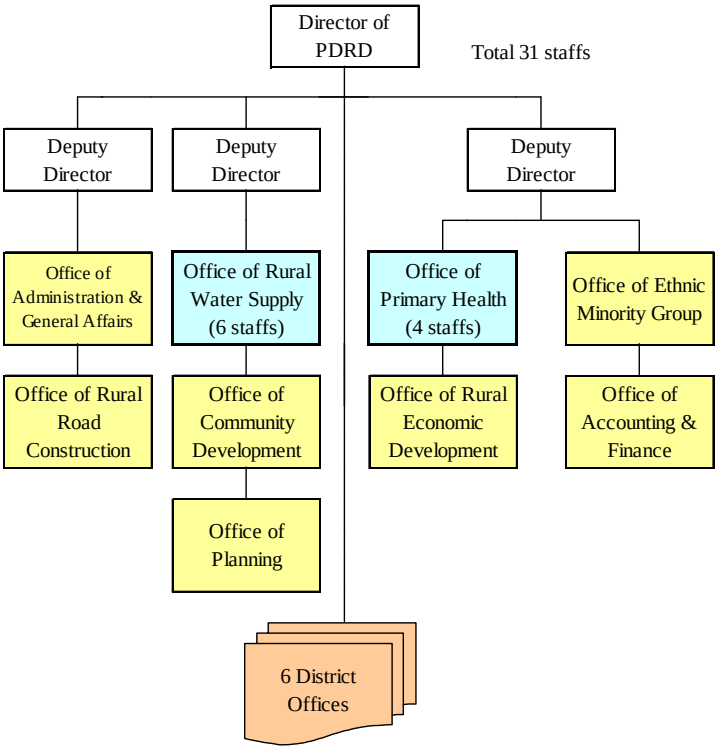


Figure 4.10.5 PDRD Organization Chart (Kratie Province)

2) Budget

"External charges for services" accounts as for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

A budget of 40.3 million Riel for MRD was allocated in 2009 mainly for rehabilitation for existing facilities.

Table 4.10.8 PDRD Budget (Kratie Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	57.0	6.7%	57.0	4.5%
	External charges for services	605.8	71.3%	1,006.0	78.7%
	Other external charges for services	98.0	11.5%	97.8	7.6%
	Personal expenses	88.0	10.4%	116.9	9.1%
	Taxes and similar services	1.3	0.2%	1.3	0.1%
	Total	850.1		1,279.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	40.3	5	under preparation by MRD	
	Well rehabilitation		0		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		5		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

(3) Assistance from Other Donors

1) Existing Project

a. Arsenic Mitigation Program

(i) Target sites: 124 villages

(ii) Component: Arsenic testing, IEC activities and provision of alternative safe water such as rainwater jar and hand dug well

b. Rural Water Supply Project by USAID

(i) Period: From 1994 to 2000

(ii) Component: Construction of 630 tube wells with hand pumps

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation.

(ii) Target sites: 4 districts (Krong Kracheh and Sambour district are selected in 2010 as a pilot site)

(iii) Component: Construction of tube well, rainwater collection and public toilet and hygiene education

b. CLTS Project by UNICEF

(i) Target sites: 10 villages

(ii) Period: From July 2009 to 2010

(iii) Component: Hygiene education include sanitation campaign

(4) Current Condition of Hygiene

Households with toilets account for 21.8% (12,590 households) in the rural areas. Of these households, 49.8% use septic tanks and 28.6% use pit latrines.

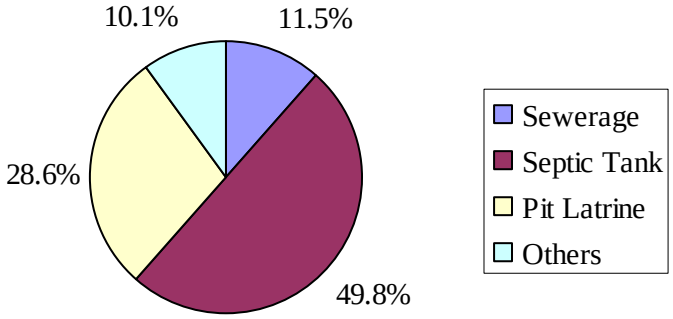


Figure 4.10.6 Type of Toilet (Kratie Province)

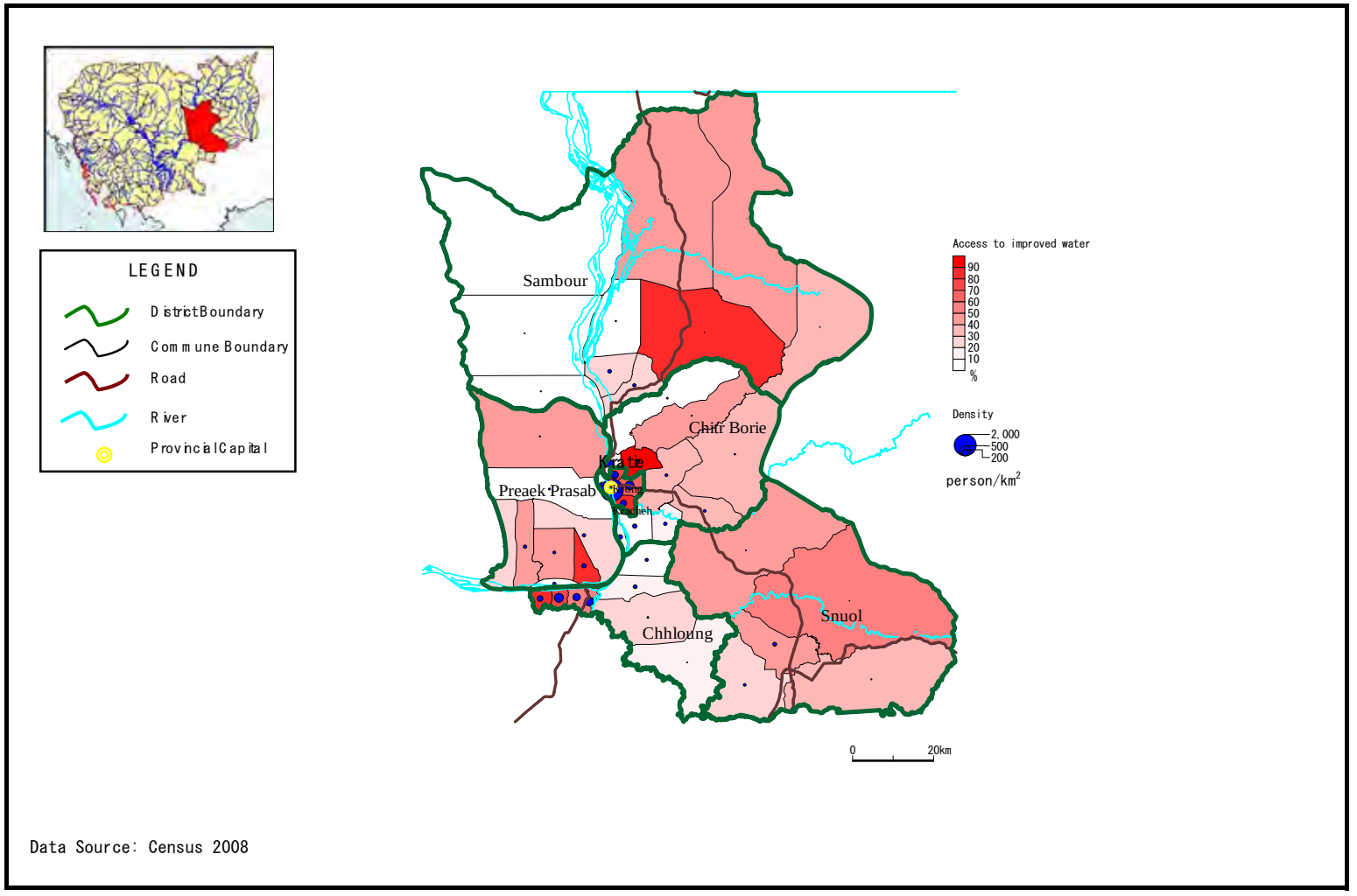
4.10.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 12 of the total 46 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.10.9 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kratie Province)

Urban	Rural	Total
5/5 communes	7/41 communes	12/46 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.10.7 Service Area of Safe Water (Kratie Province)

4.11 Mondul Kiri Province

4.11.1 Brief Description of the Province

The Mondul Kiri province has an area of 14,288 km^2, comprised of 5 districts, 21 communes, and 99 villages. According to 2008 Census, urban population was 4,859 persons（938 HH）, and rural population was 56,248 persons (11,332 HH）. Population growth rate was 5.76% in urban area, 6.39 % in rural area and 6.34 % in whole province.

4.11.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

At present, no urban water supply system exists in the province. In provincial capital of Saen Monouromdeha, groundwater is the primary source of water. It neither belonged to the PDRD nor to DIME. No large-scaled private managed water system exists in the province.

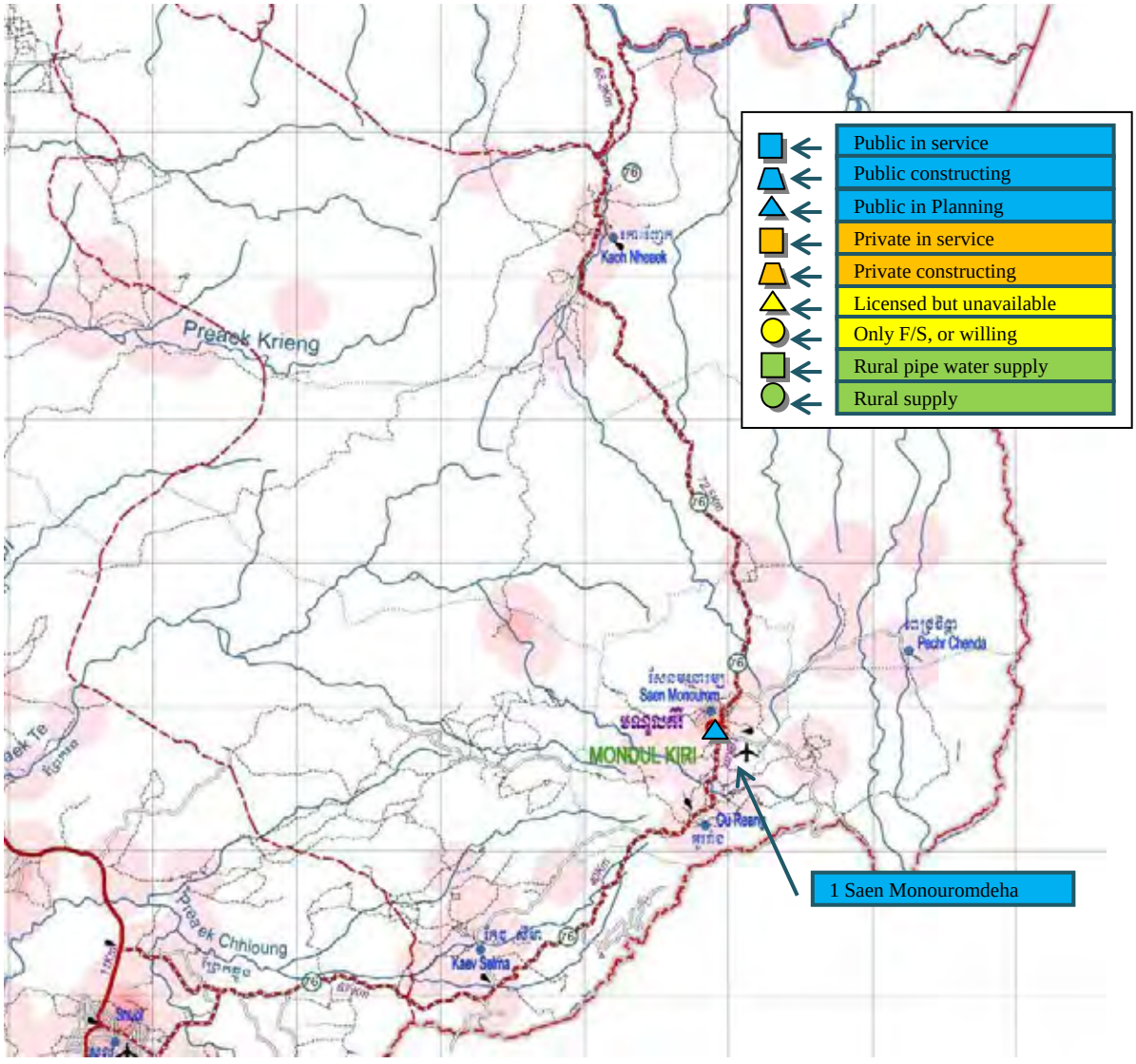


Figure 4.11.1 Existing Urban Water Supply in Mondul Kiri Province

Table 4.11.1 Current Status of Urban Water Supply in Mondul Kiri Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection fee	Tariff (R/m^3)	Note
1	Saen Monouromdeha	Pub	Not operated yet (Now on F/S)							

In Kaev Seima District, potable water is sold to 10 households by tanker trucks. The sold water is sourced from tubed wells built by private sector. No license is given by MIME to this water vendor.

2) Historical development of urban and public water supply system

Water supply system is not yet developed. According to Yearly Development Plan, the following basic study has been prepared. Estimated project cost does not include electrical quipment.

1. Basic Study on Koh Nhek District Water Supply System — Estimated Project Cost: 2,500,000 USD
2. Basic Study on Pich Chrada District Water Supply System — Estimated Project Cost: 1,500,000 USD
3. Basic Study on Keo Seyma District Water Supply System — Estimated Project Cost: 1,000,000 USD
4. Basic Study on O Reing district District Water Supply System — Estimated Project Cost: 1,000,000 USD

3) Support from donor agencies

As a part of Triangle Program assisted by the Japanese government, a study on WTP, distribution network and project implementation is now being prepared for two communes in provincial capital. The study is composed of two stages. The DIME prepared a report for Stage 1 and MIME worked on the Stage 2. Current status of the study is preparation of basic design.

The proposed raw water source is one of two existing ponds in city. Although arsenic was found present in pond water, concentration was below the maximum limit. The other pond exceeded the arsenic standard; hence the pond is not recommended as future source of supply. Land acquisition for WTP site was already completed. At present, no other donor agencies are interested.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

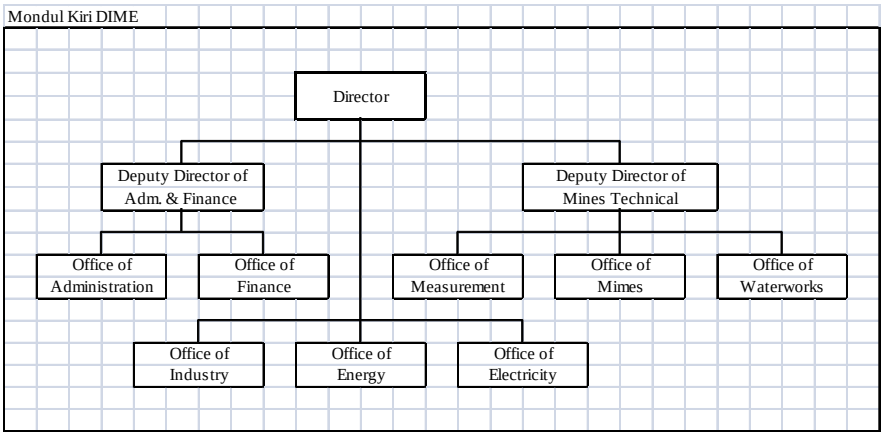


Figure 4.11.2 Organizational Chart of DIME in Mondul Kiri Province

DIME's current existence in the province is mainly for power supply.

(3) Relevant facilities

1) Candidate site for WTP and location of intake

The ground level of the proposed WTP site is +780 m, while the GL of surrouding area of raw water pond is +680 m or a difference of 100m. Short trees are scattered in WTP site. Access road is definitely needed. As the water depth of the target pond is only 4 to 5 m, fluctuation of water level must be carefully examined.

4.11.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Springs, Rivers, etc." (38.6%), "Tube/Pipe Wells" (23.3%) and "Unprotected Dug Wells" (18.3%), and the access rate to improved water are 41.4%. About 57.3% of households in this province depend on remote water sources.

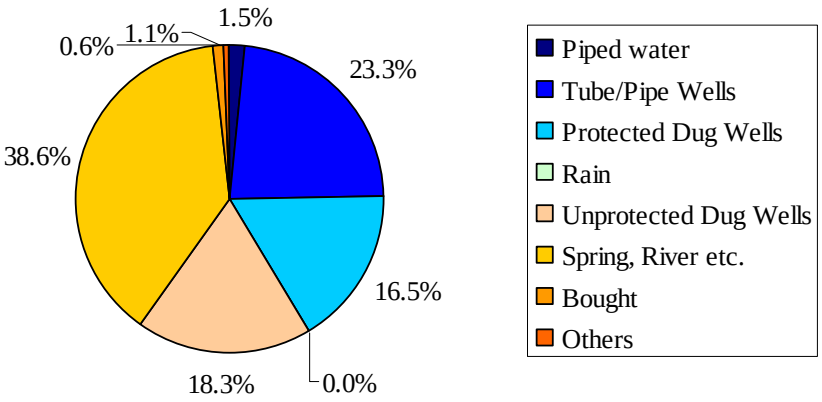


Figure 4.11.3 Type of Water Sources (Mondul Kiri Province)

2) Condition of Water Supply Facilities

Since PDRD does not carry out regular monitoring and data management, it has no present knowledge of the conditions of existing water supply facilities in the villages.

Meanwhile, according to the District Data Book (2008) of UNDP, the proportion of tubed well which can be used in throughout the year is 82.1%, while the ratio of non-functional tubed well is 16.8%.

Table 4.11.2 Functioning/Un-functioning Conditions of Water Supply Facilities (Mondul Kiri Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	463	
Year-round usable pumped or mixed wells	380	82.1%
Dry season unusable pump or mixed wells	83	17.9%
Pump or mixed wells needing repair/rehabilitation	78	16.8%
Total number of ring wells	206	
Year-round usable ring wells	185	89.8%
Dry season unusable ring wells	21	10.2%
Ring wells needing repair/rehabilitation	33	16.0%
Total number of un-protected dug wells	1,127	
Year-round usable un-protected dug wells	976	86.6%
Dry season unusable un-protected dug wells	151	13.4%

Source: District Book (2008)

3) Hand pumps

Afridev hand pumps are common in this province. Although spare parts for Afridev hand pumps are not available in this province, PDRD can provide some parts. Thus, if WSUG needs spare parts or repair of facilities, the PDRD is sought for the service with corresponding charges to WSUG.

Moreover, in blighted areas, PDRD provides supports. PDRD recommends WSUG to collect 100 Riel as water fee per month for every household.

4) Water Quality for Groundwater

Hardness is high in the groundwater of the province. Likewise, groundwater potential for development is low according to PDRD, particularly in Sokh Dom, Spean Mean Chey commune, Krong Sean Monoyrom districts.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is comprised of 24 staff, 2 of which are under the Office of Rural Water Supply and 1 under the Office of Primary Health.

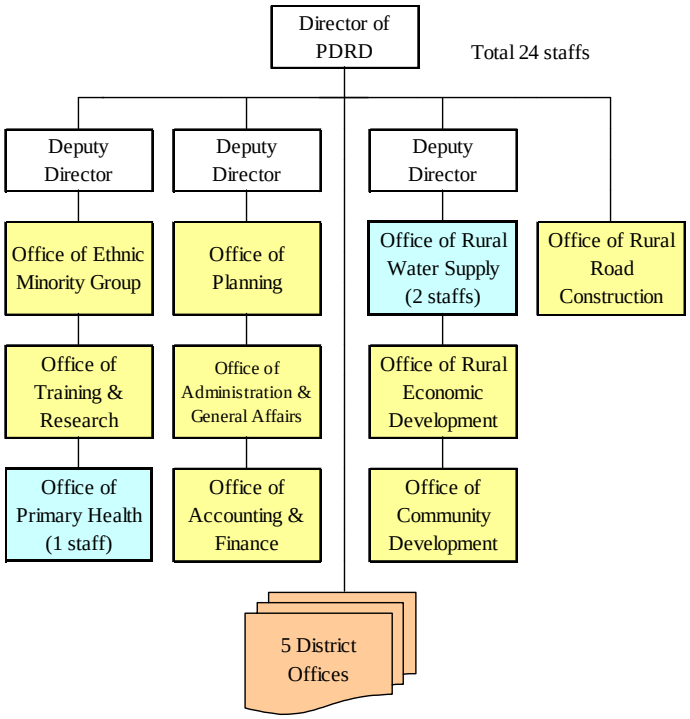


Figure 4.11.4 PDRD Organization Chart (Mondul Kiri Province)

2) Budget

"External charges for services" accounts for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects, and also MRD financial package budget in 2009.

Table 4.11.3 PDRD Budget (Mondul Kiri Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	145.0	12.3%	383.0	26.8%
	External charges for services	750.0	63.4%	709.0	49.5%
	Other external charges for services	177.6	15.0%	177.6	12.4%
	Personal expenses	110.0	9.3%	158.9	11.1%
	Taxes and similar services	1.0	0.1%	3.0	0.2%
	Total	1,183.6		1,431.5	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has requested to rehabilitate 30 existing tubed wells every year using the MRD budget for well rehabilitation. However, PDRD has not received any response. Although PDRD prepared 5 year, 3 year and annual development plan according to ministerial decree by province, no budget for rural water supply and sanitation sector is allocated.

(3) Assistance Record by Other Donors

1) Existing Project

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation.

(ii) Target sites: 2 districts (Ou Reang district: 2 communes, Krong Saen Monourom district: 4communes)

(iii) Component: Construction of 66 tube wells and 2 community ponds (No components for sanitation and hygiene)

b. Rural Water Supply and Sanitation Project by CRC (Cambodian Red Cross)

(i) Target sites: 15 villages in 3 districts (Ou Reang, Pech Chreada and Krong Saen Monouromdistrict)

(ii) Component: Construction of tube well, hand dug well and household toilet

c. Rural Water Supply Project by Oxfam (Australia

(i) Target sites: 2 villages in Krang The commune, Pech Chreada district

(ii) Period: January 20

(iii) Component: Construction of new hand dug wells and rehabilitation of existing wells

(4) Current Condition of Hygiene

Households with toilets account for 11.2% (1,268 households) in the rural areas. Of these households, 43.3% use septic tanks and 36.0% use pit latrines.

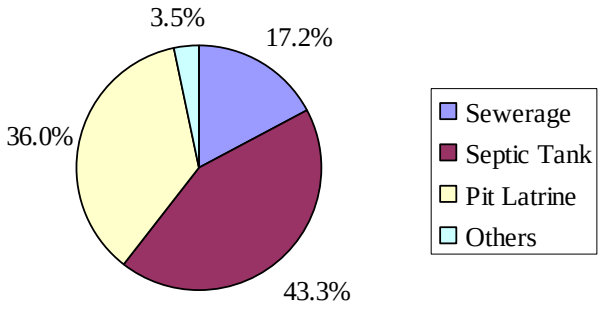


Figure 4.11.5 Type of Toilet (Mondul Kiri Province)

(5) Characteristic of this Province

Many ethnic minorities (nine ethnic minorities) exist in this province with low population density. Although the tubed well service coverage of 20 to 25 households by MRD, less than 15 households are validated by PDRD. Thus, MRD tends to set tubed well every 150 m and each well would serve only 2 to 4 households.

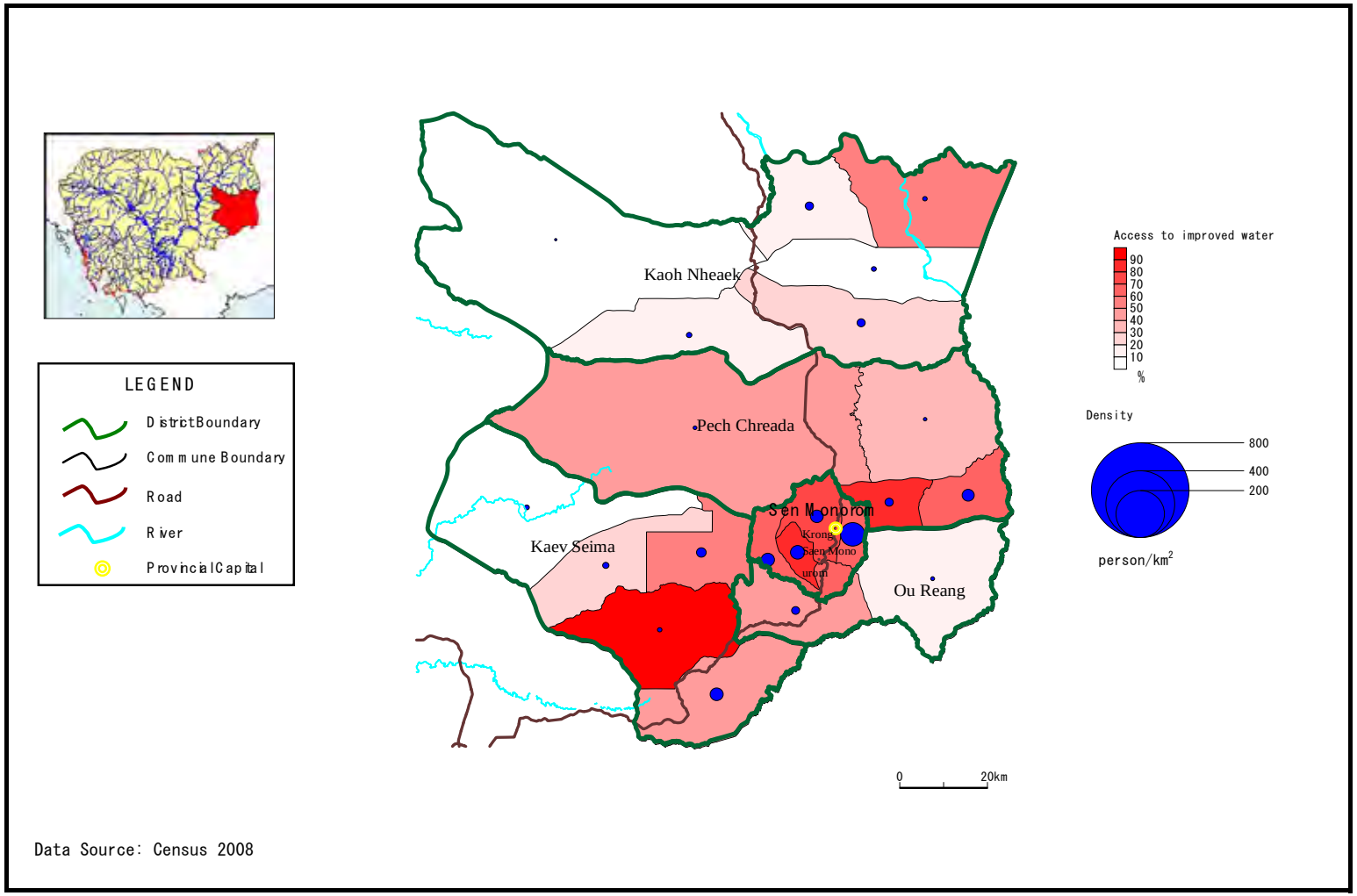
4.11.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 9 of the total 21 communes in this province have more than 50% access to "improved water" as shown in the table below.

Table 4.11.4 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Mondul Kiri Province)

Urban	Rural	Total
1/1 communes	8/20 communes	9/21 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit : %, Source : 2008 Census

Figure 4.11.6 Service Area of Safe Water (Mondul Kiri Province)

4.12 Phnom Penh

4.12.1 Brief Description of the Province

Phnom Penh has an area of 294 km^2, comprised of 8 districts, 76 communes, and 694 villages. According to 2008 Census, urban population was 1,242,992 persons（233,218 HH）, and rural population was 84,623 persons (17,379 HH）. Population growth rate was 2.68% in urban area, 5.37 % in rural area and 2.83 % in whole province.

4.12.2 Current Status of Urban Water Supply

(1) Descriptrion of provincial water supply project

1) Status of provincial urban water supply

Whole Phnom Penh and adjoining Kandal province are served by PPWSA. There is no private managed water supply system.

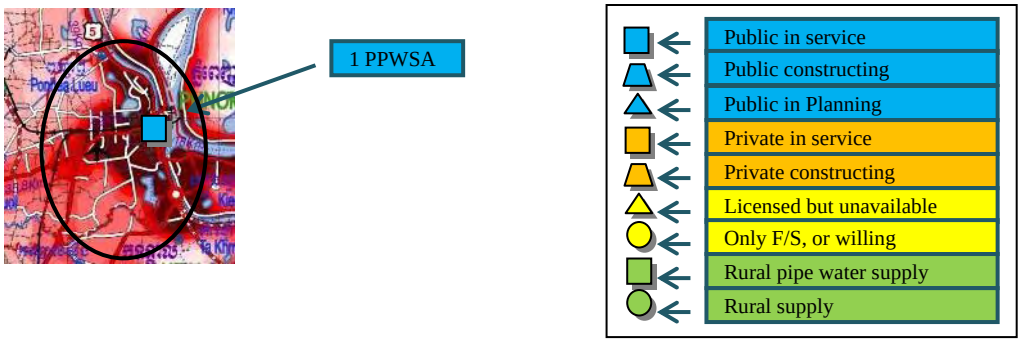


Figure 4.12.1 Existing Urban Water Supply in Phnom Penh Province

Table 4.12.1 Current Status of Urban Water Supply in Phnom Penh Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Note
1	Phnom Penh (PPWSA)	Pub	1959	1,528,880		232,212	River		770	

*1 Blank means N/A.

2) Historical development of urban and public water supply system

1895 Water supply service was started.

1990 WTP rehabilitation was started after the termination of Civil War.

Phnom Penh water supply system was established in 1895. With several expansion, three WTP were completed in 1970's. During civil war, water supply system was destructed. In 1990's civilwar was over and numerous large-scaled assistances were offered from many donor countries. Based on water supply system master plan prepared in 1993 by the assistance of the Japanese government, each donor agency cooperated for efficient system development. As a result, 24 hours water supply, drastic leakage rate reduction and technical level upgrading were achieved. Then, rehabilitation works for each WTP were accelerated.

At present, construction work of 4th WTP, Niroth WTP is in progress to cope with water demand and the target year of stage 1 work was set in 2013.

3) Support from donor agencies

To deal with the increasing water demand, construction of new Niroth WTP is now on-going by loan from AFD and JICA. Raw water source is Mekong River.

JICA has rendered its assistance for capacity development of PPWSA staff through "The Project on Capacity Building for Water Supply System" Phase 1 and 2. JICA also extended its assistance on "The Study on Phnom Penh Water Supply System Expansion Project" Phase 1 and 2 by technical cooperation and on "Project for Expansion of Phum Prek Water Treatment Plant" by grant aid.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

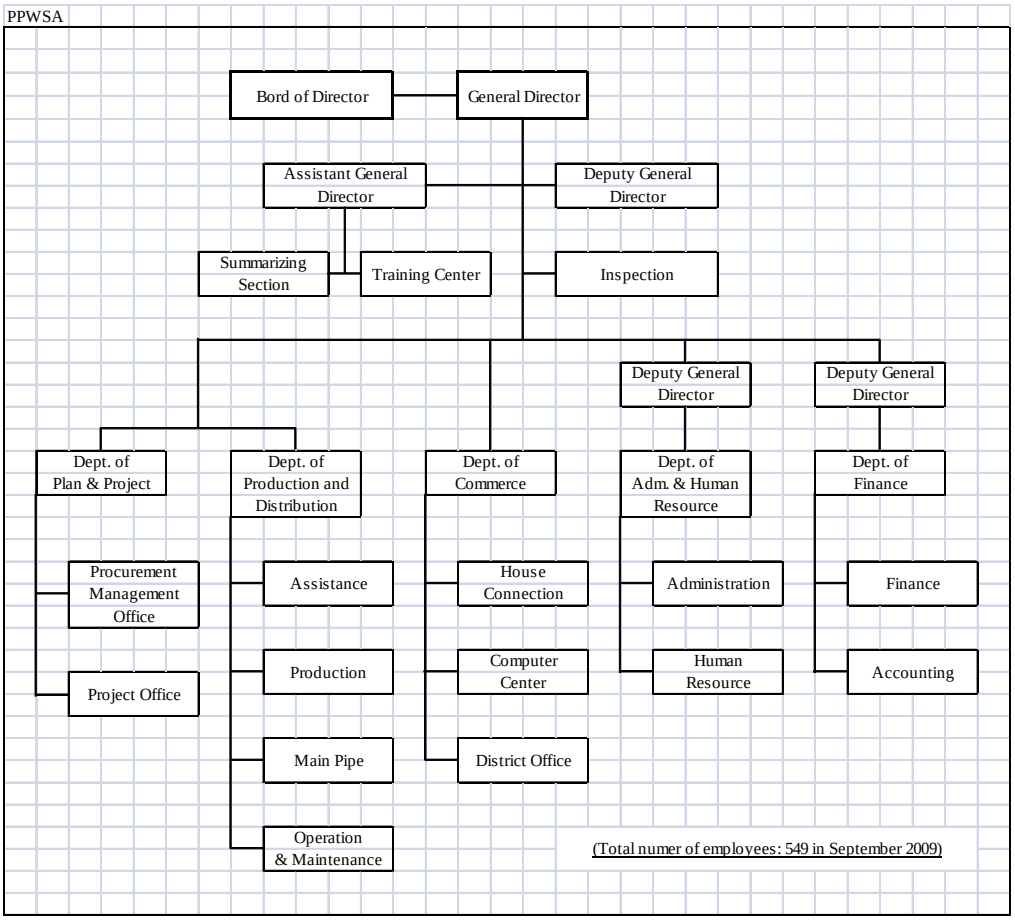


Figure 4.12.2 Organization Chart of PPWSA

As water supply service in this province is provided to all districts by PPWSA, DIME does not operate any urban water supply projects and therefore no water supply division is assigned in the structure of DIME for the province.

Decision making in PPWSA management is discussed among the Board of Directors in meeting presented by PPWSA, MEF, and MIME. The meeting is held every three months.

2) Capacity development for staff

Capacity building of staff is undertaken by themselves. Further, PPWSA renders multiple technical supports in facility design, system planning and accountant for urban water supply projects in other provinces.

(3) Water supply facilities and management of public system

1) Capacity and function of intake facility

The followings are the existing WTP:

Name of WTP	WTP Capacity	Raw Water Source
Phum Prek WTP	150,000 m^3/day	Tonle Sap River
Chamkar Mon WTP	20,000 m^3/day	Tributary of Tonle Sap River
Chrouy Changva WTP	130,000 m^3/day	Mekong River
Total WTP Capacity	300,000 m^3/day	

According to the future plan, water demend was estimated as 500,000 m^3/day in 2020. Now the construction of Niroth WTP（130,000 m^3/day） is on-going and capacity of 65,000 m^3/day , corresponding to half of total capacity is to be developed in stage-1 project.

2) Capacity and operation of WTP

Water treatment flow is basically rapid filtration method. Flush mixer and flocculator is vertical shaft mechanical type. Compared with other WTPs, more machinery is applied. The latest monitor system is intalled in control room.

3) Capacity and operation of distribution system

Non revenue water rate in PPSWA is 6%, which is quite low. This is the results of deteriorated pipe replacement, water leakage detection, analysis on leakage area and strategic NRW reduction plan. NWR reduction structure is quivalent to the most adnanced water supply projects in Japan. Further, they provided financial incentive for its staff to maintain their motivation.

The distribution network at 2006 covers 90 % and its total length is 1,371 km comparing to the coverage of 25 % and the length of 282 km at 1993. Besides, service pressure improved from 0.2 bar (0.02 MPa) at 1993 to 2.5 bar (0.25 Mpa) now.

4) Water supply O&M status

Director General explained that the water supply system has been developed based on the master plan.

5) WTP O&M status

No issues were observed in WTP operation in this study. However as to 1st WTP taking raw water from Tonle Sap River, the effect of raw water quality aggravation seemed noteworthy. If

river water quality becomes worse, unusual smell and taste might be detected from supplied water.

WTP O&M procredures are compiled in manual. Chemical dosage rates are set in detail, alum 17 g, slaked lime 0.6 g, choroline 2.1 g per 1 m^3 of incoming water.

6) Water quality control and supply water quality

PPWSA owns water quality laboratory with technical level higher than that belongs to MIME. Four WTP are properly operated and treated water quality is stable. However as to 1st WTP taking raw water from Tonle Sap River, there is possibility in generation of unusual smell and taste due to river water quality aggravation.

Table 4.12.2 Result of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	－			
pH	－	7.0			6.7
Turbidity	NTU	Sed<10 Dis<1.0			1.94
Free Chlorine	mg/L	AF>0.1 Dist=1.0			
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500			
Color	TCU	Sed<20 Dis<5			
Alkalinity [mg/L]	mg/L	>10			

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800		44
Total Hardness	mg/L	< 250		44
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5		
Iron (Fe2+)	mg/L	< 0.3		0.06
Manganese(Mn2+)	mg/L	< 0.3		
Arsenic (As)	μg/L	< 50		
Chlorine (Cl-)	mg/L	< 250		20

Testing Status	
Testing Lab	WTP
Daily Record	OK
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	OK
Latest test in	2010
Coliform Test	OK
Facal Coli Test	OK
Dosing Control	OK

*1 Blank means N/A.

(4) Water supply stastus of public system

1) Water supply amount, service ratio and house connection rate

Table 4.12.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population							
Population in supply area							
Service population		1,213,792	1,296,496	1,425,432	1,528,880	1,606,400	
Service connection or household		151,724	162,151	178,200	191,092		
Water supply (intake or treat)		193,488	217,534	233,936	246,864	271,928	
Water supply (distribution)		179,199	203,970	219,466	232,212	254,797	

*1 Blank means N/A.

Phnom Penh is a megalopolice which has about 50% of the total national urban population and 10% of the total national population. At 2002, water service ratio was only 20％ but it has exceeded 90％ in 2008. Population of Phnom Penh is 1.33 million but as PPWSA served water to adjoining Kandal city, service population exceeds this population.

2) Water tariff

Up to 1979, water was supplied free of charge. In 1984, water rate of 166 Riel/m^3 set up and water rate system for commercial use was formulated in 1993. Rate system revision was conducted several times, namely in the year of 1996, 1997, 2001 and resulted in the current rate system shown as follows. Upon revision in 2001, domestic rate was decreased while commercial/industrial rate was raised. Charge billing system was computerized and Oracle software was employed.

Domestic Use	0～7 m^3/month	550 Riel/m^3
	8～15	770 Riel/m^3
	16～50	1,010 Riel/m^3
	50～	1,270 Riel/m^3
Official/Public Use		1,030 Riel/m^3
Commercial/	～100	950 Riel/m^3
Insustrail Use	101～200	1,150 Riel/m^3
	201～500	1,150 Riel/m^3
	500～	1,450 Riel/m^3

Basic house connection fee is set at 90 US$ but several subsidies are provided.

3) Extent of water supply service

The system operates 24 hours. Water meter replacement is conducted actively and now 100 % of costomers connect water meter, while only 12 % of customers connected in 1993. Remarkably high water charge collection rate of 99.9% was achieved by broad campaign. They also strives for bribe eradication.

(5) Financial status of public system

1) Current financial status

Though financial statements were attched to the report but as balance sheet was written in Khmer language and no code number was indicated, finamcial status was analyzed based on the profit and loss statement as of 2009 and 2010.

Table 4.12.4 Financial Statements of PPWSA

1,000 Riel

	2009	2010(Budget)	Retio
Revenue	**104,435,880**	**108,195,635**	**100.0%**
Water revenue	84,735,219	92,210,186	85.2%
Others	19,700,661	15,985,449	14.8%
Expense	**89,068,879**	**95,446,461**	**100.0%**
Operating Expense	**58,070,914**	**66,251,697**	**69.4%**
Electricity Cost	14,892,733	16,817,076	17.6%
Chemicals	4,388,490	6,510,810	6.8%
Fuel	705,290	840,007	0.9%
Spairparts	1,443,417	1,526,399	1.6%
Labor & Temp. staff	0	0	0.0%
Salary & Allowance	13,164,940	13,586,512	14.2%
Depreciation	20,354,108	20,659,879	21.6%
Others	3,121,936	6,311,014	6.6%
Operating Expense	**30,997,965**	**29,194,764**	**30.6%**
Administrative & Tax	30,997,965	29,194,764	30.6%
Net income	8,222,779	8,020,649	8.4%

Amout of Water Supply	232,212	m3/day
Unit price of Water Supply	1,232	Riel/m3
Energy Cost per Water	236	Riel/m3
Material Cost per Water	17	Riel/m3
Labor Cost per Water	155	Riel/m3

2) Potential in self-reliance management by water sales income

Water sales income occupies 85% of total income. Other income is also at certain level. Compared with domestic water rate of 770 Riel/m^3, average water sales income was 12,320 Riel/m^3. Income from large consumers and commercial users contributes to this average income.

As water sales income far exceeds the disbursement amount, water supply project can be dully self-reliable.

3) Composition of expenditures

Major disbursement items are depreciation, power cost and labor cost. Excluding the large weight of power cost, disbursement composition is equivalent to the water supply projects in advanced country. Fluctuation in cost items is small and stable. Advanced management of PPWSA was proven by the financial status.

Water supply efficiency is also remarkably high; staffs per connection, which was 22 staffs per thousand connections in 1993, has improved to 4 staffs per thousand connections in 2006.

4) Public listing plan

The Cambodian government is preparing for the establishment of a stock market and PPSWA was nominated as a company to be listed.

4.12.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Bought" (39.9%), "Tube/Pipe Wells" (20.5%) and "Springs, Rivers, etc." (14.4%), and the access rate to improved water is 41.6%. About 43.2% of households in this province depend on remote water sources.

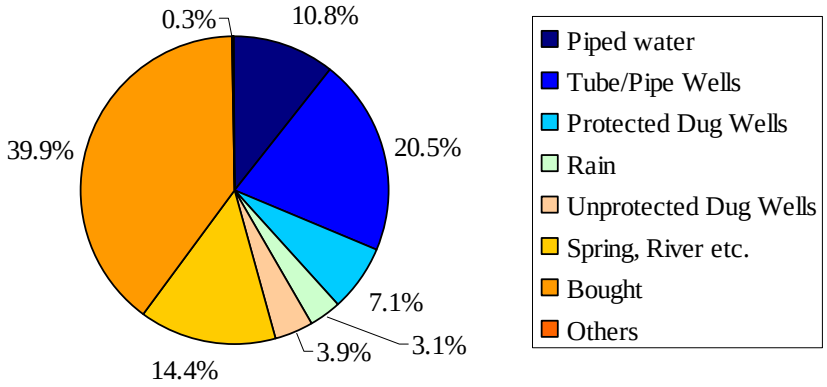


Figure 4.12.3 Type of Water Sources (Phnom Penh Province)

2) Condition of Water Supply Facilities

Since PDRD does not carry out regular monitoring and data management, it has no present knowledge of the conditions of existing water supply facilities in the villages.

3) Hand pumps

VN6 hand pumps are used about 70 percent, which is mostly adopted in shallow areas of groundwater, and Afridev hand pumps are used about 30 percent, which is mostly adopted in deep areas of groundwater and also Indian Mark III hand pumps were used by UNCEF Project in 1993. However, spare parts for Indian Mark III cannot be procured even in Phnom Penh. Although tube wells with Indian Mark III are still used as a dirking water purpose in poorest areas, it still remains un-functioning due to no support for repairing if facilities were broken down.

4) Water Quality for Groundwater

According to the result of water quality analysis by arsenic center, 23.2 percent out of 612 groundwater samples were detected more than 10ppb of arsenic and this province was identified as a high risk area of arsenic.

Table 4.12.5 Result of Arsenic Testing (Phnom Penh Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
612	33	5.4%	109	17.8%	470	76.8%

Source: Arsenic Center (2005-2007)

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

The PDRD in this province is comprised of 51 staff, 5 of which are under the Office of Rural Water Supply and another 5 under the Office of Primary Health.

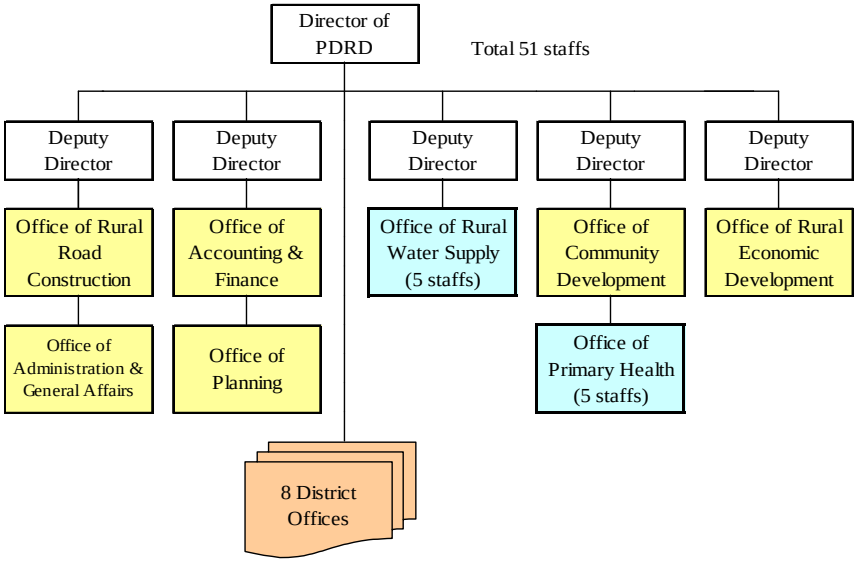


Figure 4.12.4 PDRD Organization Chart (Phnom Penh Province)

2) Budget

"Purchase" and "Personal expenses" account for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects, and also MRD financial package budget in 2009.

Table 4.12.6 PDRD Budget (Phnom Penh Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	224.0	38.8%	224.0	36.5%
	External charges for services	107.0	18.5%	107.0	17.5%
	Other external charges for services	86.0	14.9%	86.0	14.0%
	Personal expenses	161.0	27.9%	196.0	32.0%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	578.0		613.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

(3) Assistance Record by Other Donors

1) New Assistance Plan

a. PSDD Program (Project to Support Democratic Development through De-centralization and De-concentration) by MOI and Provincial Rural Committee

In this program, PDRD has proposed and reached approval for rural sanitation activities such as construction of 105 household toilets and construction of rural roads to Provincial Rural Committee in 2009.

(4) Current Condition of Hygiene

Households with toilets account for 67.1% (11,663 households) in the rural areas. Of these housegolds, 73.5% use septic tanks and 24.4% are connected to sewerage system.

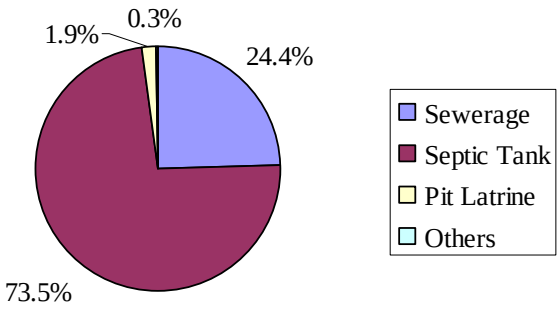


Figure 4.12.5 Type of Toilet (Phnom Penh Province)

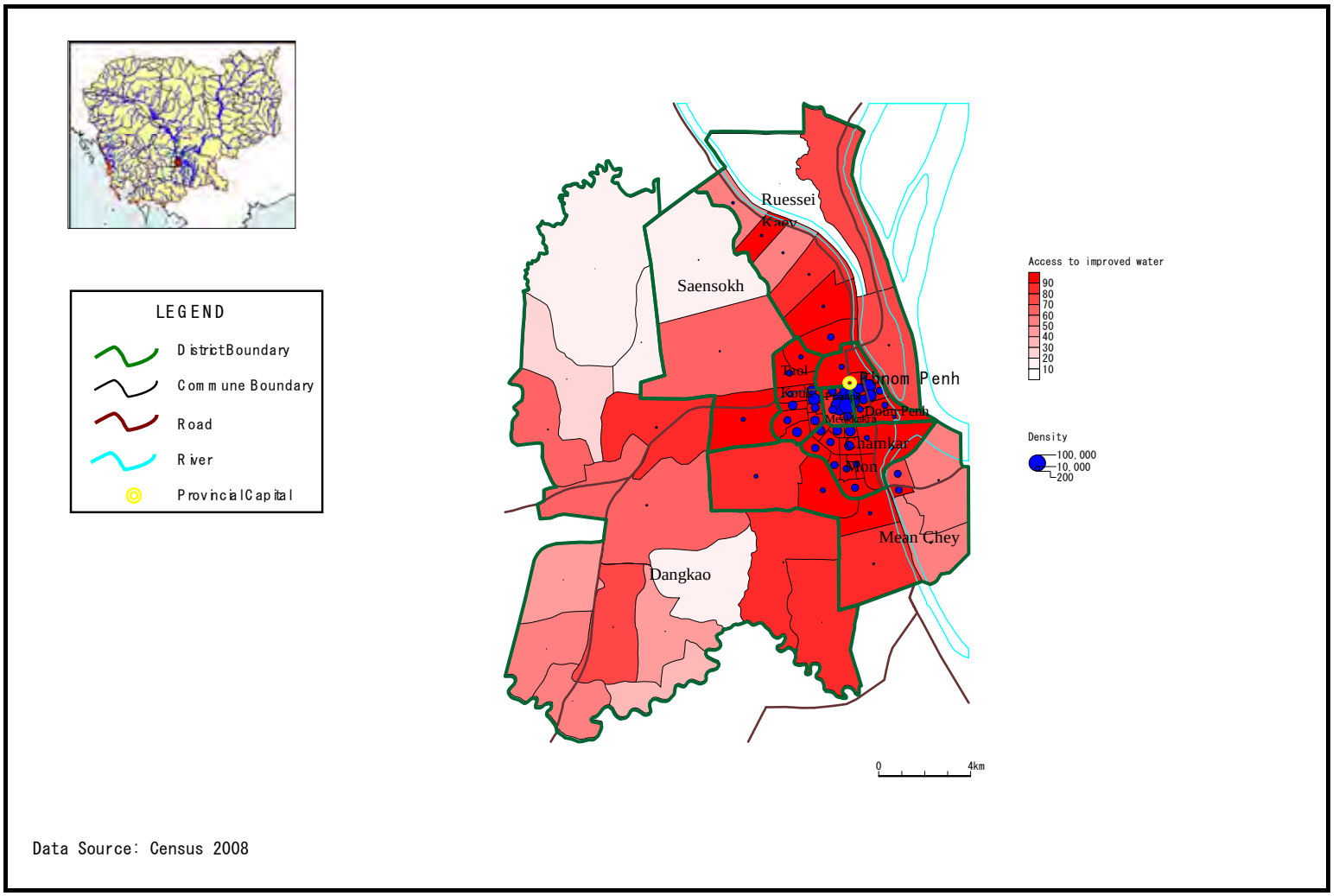
4.12.4 Safe Water Supply Area

Based on the data on water source usage by household in each community from the 2008 census, 67 of the total 76 communes in this province have more than 50% access to “improved water” as shown in the table below.

Table 4.12.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Phnom Penh)

Urban	Rural	Total
61/63 communes	5/13 communes	67/76 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.12.6 Service Area of Safe Water (Phnom Penh Province)

4.13 Preah Vihear Province

4.13.1 Brief Description of the Province

The Preah Vihear province has an area of 13,788 km^2, comprised of 8 districts, 49 communes, and 212 villages. According to 2008 Census, urban population was 10,679 persons（2,061 HH) and rural population was 160,460 persons (31,054 HH）. Population growth rate was 3.61 % for the whole province, 3.10% in urban area and 3.64 % in rural area.

4.13.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Urban water supply system is only available in Tobay Meanchey, the provincial capital. Other towns are served by groundwater. Operation of the system is by a private company, thus it is classified by MIME as private-managed.

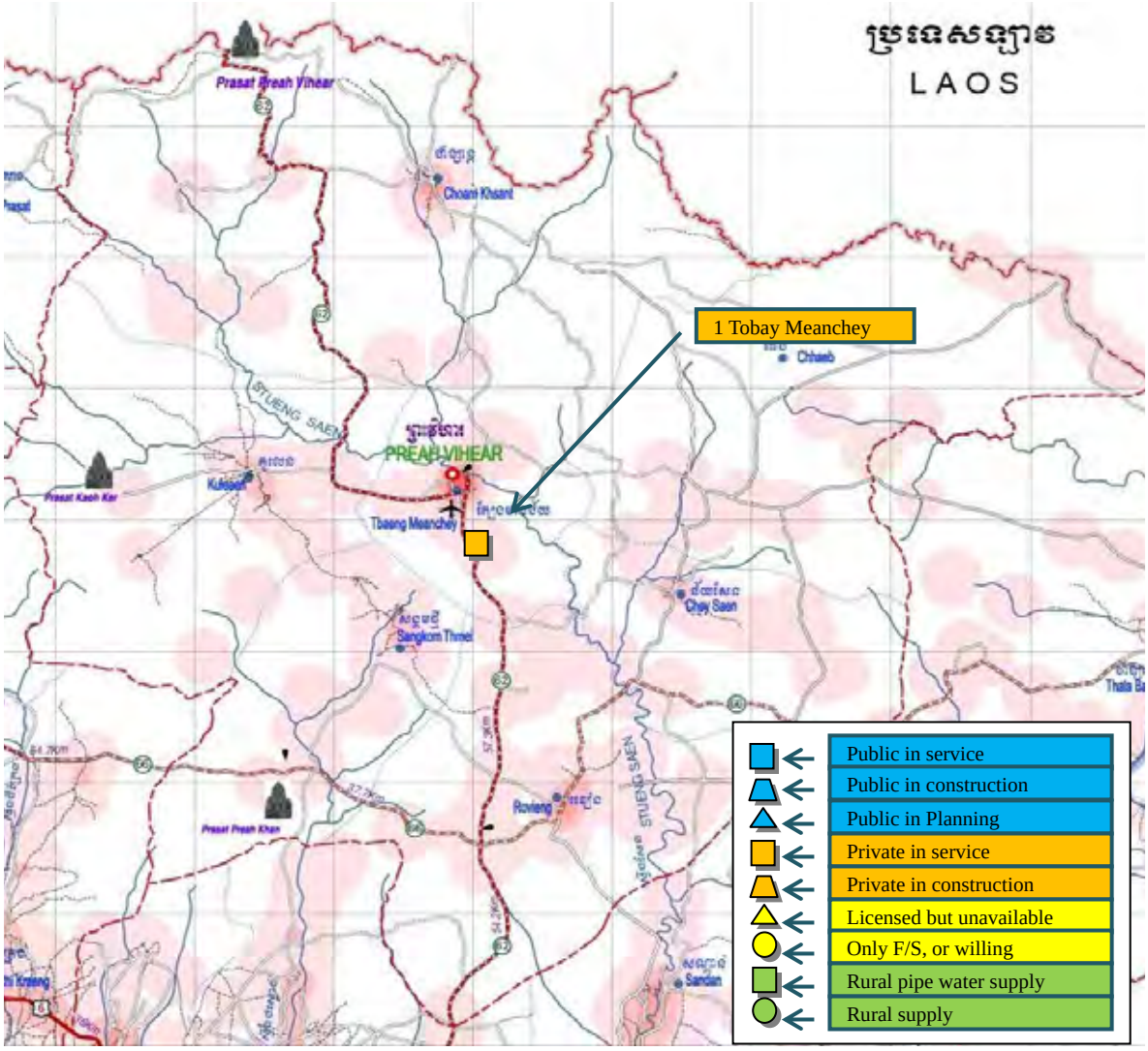


Figure 4.13.1 Existing Urban Water Supply System in Preah Vihear Province

Table 4.13.1 Current Status of Urban Water Supply System in Preah Vihear Province

No.	Name of Town	Ownership	Year Established	Population	No. of Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Remarks
1	Tobay Meanchey	Pri	2006	1,520	503	1,920	River	240,000	1,800	

2) Historical development of urban and public water supply system

Operation of WTP was started in 2006. Since then, no new water supply system was added, hence people has to depend on groundwater and river water.

3) Support from donor agencies

MIME prepares the Three-year Plan on water supply system development. Based on the plan, the following are the strategies:

- Construction of urban water supply system;
- Compliance to water quality standard;
- Stable water supply; and
- Upgrading of water service for low income group

According to the Director of DIME, even in a relatively large-scale town, if population density is not high enough, urban water supply system is not feasible. Since it is located far from the national capital and provincial economic activities are insufficient, no assistance from donor agencies has been offered.

(2) Urban water supply system management structure

1) Organizational structure of DIME and public water utility

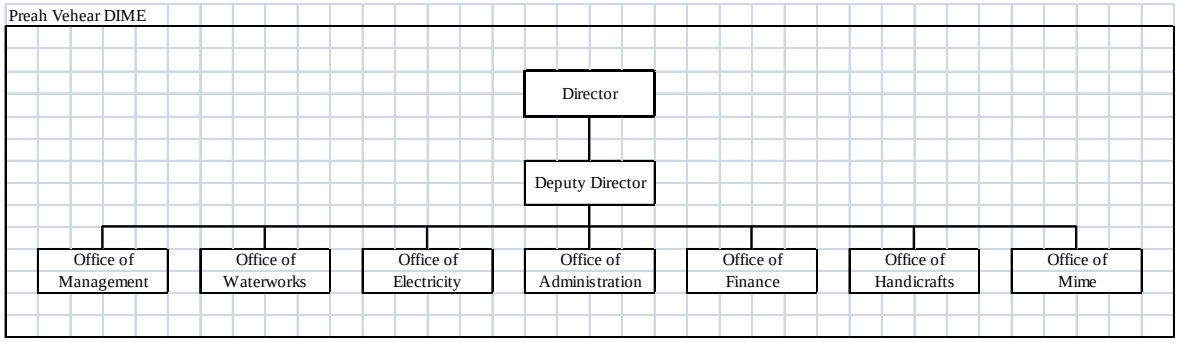


Figure 4.13.2 Organization Chart of DIME in Preah Vihear Province

Two site operation staffs are assigned. Since the urban water supply service has just started and the system operation was assigned to private sector, DIME has no executing structure for water supply project. The staff could not reply to any technical items listed in the Questionnaire.

2) Capacity development for staff

The staff seeks advice on system O&M from PPWSA.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Intake capacity is 1,400 m^3/day. Raw water source is river water. Volume of river water is abundant even during dry season but as water level fluctuates largely, a floating intake devise was employed.

2) Capacity and operation of WTP

WTP capacity is 80 m^3/hr. Treatment method is coagulation and sedimentation. Capacity of elevated tank is 150 m^3.

3) Capacity and operation of distribution system

Trunk distribution pipe is PE pipe ϕ 100 × 550 m and branch distribution pipe is PE pipe ϕ 60 × 75 m. with a distribution network capacity of 1,200 m^3/day. Capacity of WTP is 1,920m^3/day. NRW rate is monitored by supplied water amount and water meter reading.

4) Water supply O&M status

Urban water service to Tobay Meanchey city is managed by a private company. However, service area is limited to specific area in one commune. Other areas are still served by groundwater. System operation is considered satisfactory but improvement is still needed.

5) WTP O&M status

Applied chemicals are alum, slaked lime and liquid chroline. Dosing rates are adjusted depending on the raw water quality. Quality of raw water exhibited high turbidity levels.

6) Water quality and control

Water samples are taken to PPWSA every three months for water quality analysis.

Table 4.13.2 Results of WTP Water Quality Analysis

Coagulation Management	Unit	Target	Raw Water	Sedimentation	Distribution
Temperature	degree	—			
pH	—	7.0			7.3
Turbidity	NTU	Sed<10 Dis<1.0			7
Free Chlorine	mg/L	AF>0.1 Dist=1.0			
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500			
Color	TCU	Sed<20 Dis<5			
Alkalinity [mg/L]	mg/L	>10			

Water Quality	Unit	Standard	Raw Water	Potable Water
Total Dissolved Solids	mg/L	< 800		49
Total Hardness	mg/L	< 250		108
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5		0.37
Iron (Fe2+)	mg/L	< 0.3		0.23
Manganese(Mn2+)	mg/L	< 0.3		

Testing Status	
Testing Lab	PPWSA
Daily Record	N/A
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	OK
Latest test in	2010

Arsenic (As)	μg/L	< 50		0
Chlorine (Cl-)	mg/L	< 250		9.23

Coliform Test	N/A
Fecal Coli Test	N/A
Dosing Control	N/A

Note: Blank means N/A

Based on results of the analysis, treatment is not properly carried out. Further, chlorine disinfection is doubtful.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Number of house connections is 503 units and connection ratio is about 50%. Connection is based on demand.

Table 4.13.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population							
Population in supply area						2,625	
Service population						1,520	1,000
Service connection or household						503	
Water supply (intake or treat)					300	426	800
Water supply (distribution)					120	256	640

Note: Blank means N/A

2) Water tariff

Water tariff: 1,800 Riel/m^3

Rate was set up in consultation with MIME and DIME. Billing frequency is once every two weeks. Meter reading is assigned to two persons.

3) Extent of water supply service

At present, 24 hours water supply service is available, but sometimes the service hours decrease to 15 to 17 hours depending on the season.

(5) Financial status of public system

1) Current financial status

Since DIME entrusted the water and electric supply service to a private company, no financial statement is available.

DIME proposed an annual operation budget of 140 Million Riel but only 80% of this was allocated.

4.13.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

Sources of water in the province consist of “tube/pipe wells” (37.4%), “unprotected dug wells”

(31.1%) and "springs, rivers, etc." (21.4%) and the access rate to "improved water" is 44.5%. A high 54.5% of the households depend on remote water sources.

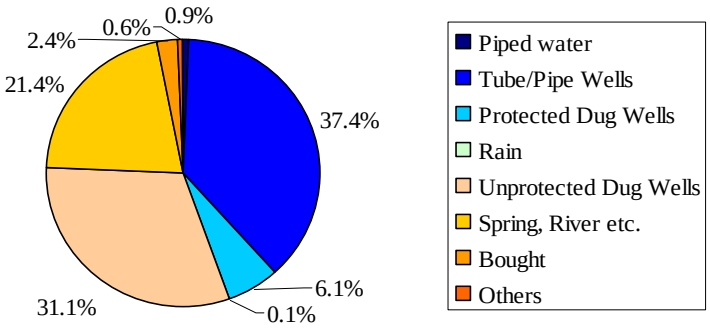


Figure 4.13.3 Type of Water Sources (Preah Vihear Province)

2) Condition of Water Supply Facilities

Since PDRD has not carried out regular monitoring and data management, no information is available on the present condition of water supply facilities in the villages. Meanwhile, based on the District Data Book (2008) of UNDP, the proportion of tubewell which can be fully utilized the whole year is 79.8%, while the non-functioning tube well is 17.4%.

Table 4.13.4 Functioning/Non-functioning Conditions of Water Supply Facilities (Preah Vihear Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	2,371	
Year-round usable pumped or mixed wells	1,893	79.8%
Dry season unusable pump or mixed wells	478	20.2%
Pump or mixed wells needing repair/rehabilitation	413	17.4%
Total number of ring wells	1,084	
Year-round usable ring wells	863	79.6%
Dry season unusable ring wells	221	20.4%
Ring wells needing repair/rehabilitation	202	18.6%
Total number of un-protected dug wells	843	
Year-round usable un-protected dug wells	480	56.9%
Dry season unusable un-protected dug wells	363	43.1%

Source: District Book (2008)

3) Hand pumps

Afridev hand pumps are common in this province. VN6 hand pumps are used for private wells, but tend to break down due to its low quality. Spare parts for VN6 hand pumps are available for procurement, but spare parts for Afridev hand pumps cannot be procured in this province. If WSUG needs spare parts for Afridev hand pumps, WSUG will request PDRD to purchase using MRD financial package.

4) Water Quality of Groundwater

Based on the result of water quality analysis by Arsenic Center, 8.6% of 58 groundwater samples were found to have more than 10ppb of arsenic contamination; no samples exceeded 50ppb of arsenic contamination.

Table 4.13.5 Result of Arsenic Testing (Preah Vihear Province)

Total No. of Tested Wells	As > 50 ppb		10 As < ≤ 50ppb		As ≤10ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
58	0	0.0%	5	8.6%	53	91.4%

Source: Arsenic Center (2005-2007)

Moreover, iron, manganese and hardness contamination is generally high, especially hardness in wells with well depth exceeding 30m. Though iron contamination is high in Choam Khsant and Kuleane, the residents tend to accept it as drinking water.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 23 staff members, with 3 members belonging to the Office of Rural Water Supply and 1 to the Office of Primary Health.

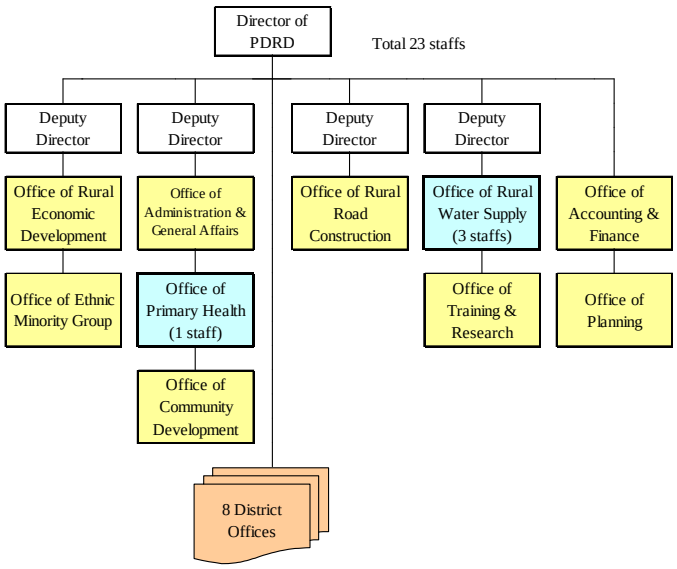


Figure 4.13.4 PDRD Organization Chart (Preah Vihear Province)

2) Budget

"Personal expenses" account for the bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 374.8 million Riel was allocated in 2009 as MRD financial package budget which was mainly used for rehabilitation of existing facilities.

Table 4.13.6 PDRD Budget (Preah Vihear Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	50.0	15.9%	50.0	12.5%
	External charges for services	117.0	37.3%	117.0	29.4%
	Other external charges for services	69.0	22.0%	69.0	17.3%
	Personal expenses	78.0	24.8%	162.5	40.8%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	314.0		398.5	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	374.8	55	under preparation by MRD	
	Well rehabilitation		60		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		115		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

(3) Assistance by Other Donors

1) Existing Project

a. CLTS Project by UNICEF

(i) Period: October 2010

(ii) Target sites: 5 villages, 2 communes

(iii) Component: Hygiene promotion campaign

b. Rehabilitation Project financed by MRD

(i) Period: 2009

(ii) Component: Rehabilitation of 40 existing wells

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation

(ii) Target sites: 4 districts

(iii) Component: Construction of community pond, tube well, rainwater collection, small piped water supply facility and household toilet

(4) Current Condition of Hygiene

Households with toilets account for 7.2% (2,222 households) in the rural areas. Of these households, 32.3% use septic tanks and 30.4% use pit latrines.

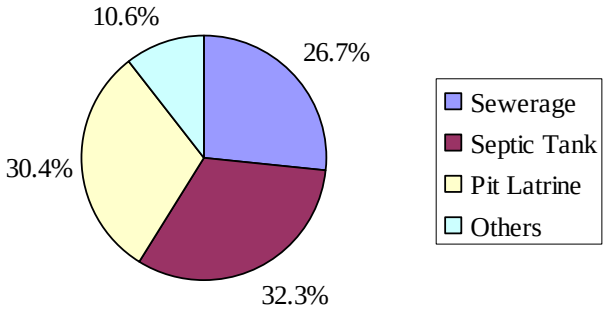


Figure 4.13.5 Type of Toilet (Preah Vihear Province)

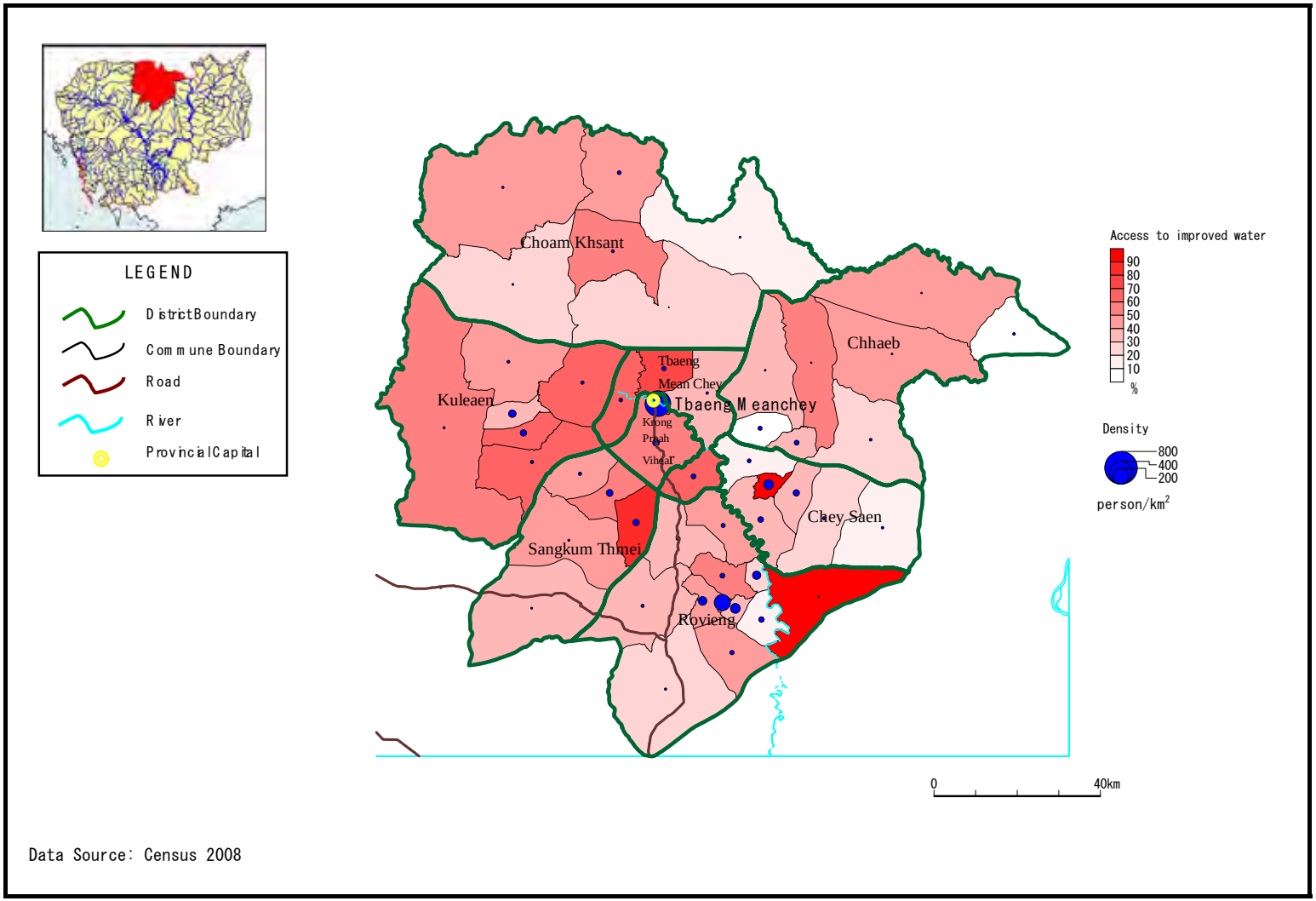
4.13.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown the table below. Of the 49 communes in this province, more than 50% of the households have access to "Improved water" in 17 communes.

Table 4.13.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Preah Vihear Province)

Urban	Rural	Total
1/1 communes	16/48 communes	17/49 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source 2008 Census

Figure 4.13.6 Service Area of Safe Water (Preah Vihear Province)

4.14 Prey Veng Province

4.14.1 Brief Description of the Province

The Prey Veng province has an area of 4,883 km^2, comprised of 13 districts, 116 communes and 1,137 villages. According to 2008 Census, urban population was 33,079 persons (7,009 HH) and rural population was 914,293 persons (219,303 HH). Population growth rate was 0.01% for the whole province, -0.65% in urban area and 0.03 % in rural area.

4.14.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Sangkat Kampong Leav, the provincial capital is served by a public-managed system. At Neak Loeng Commune in Peam Ro District, urban water supply systems are operated through WB assistance (90%) and private company (10%). After 20 years of commissioning, the system is to be transferred to the Government.

Moreover, private-managed urban water supply systems with license from MIME are being operated in three towns.

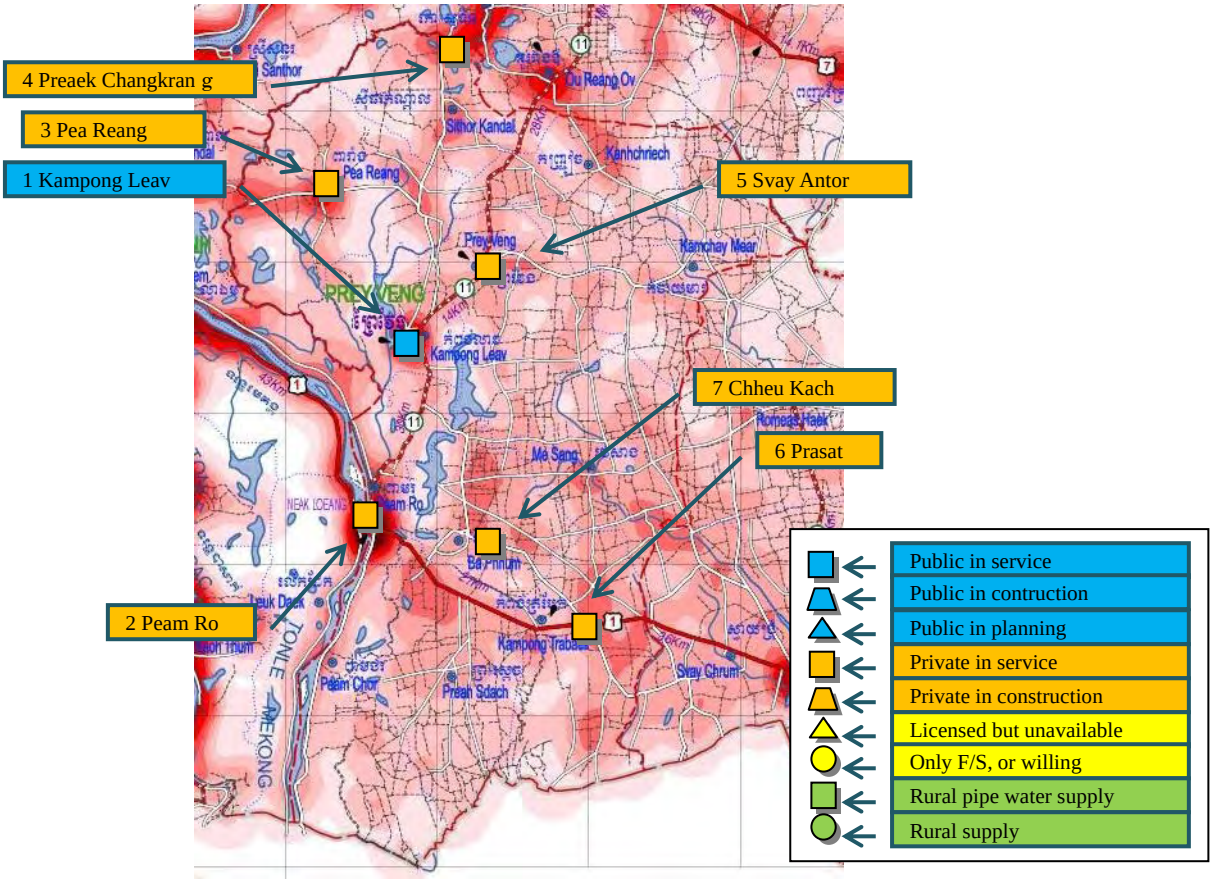


Figure 4.14.1 Existing Urban Water Supply System in Prey Veng Province

Table 4.14.1 Current Status of Urban Water Supply System in Prey Veng Province

No.	Name of Town	Ownership	Year Established	Population	No. of Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Notes
1	Kampong Leav	Pub	1954	8,100	1,620	1,300	Well		1,200	
2	Peam Ro	Pri			3,564	780		158,000	1,560	
3	Pea Reang	Pri			1,652					
4	Preaek Changkran	Pri			2,896					
5	Svay Antor	Pri			1,875					
6	Prasat	Pri			1,031					
7	Chheu Kach	Pri			2,010					

Note: Blank means N/A

2) Historical development of urban and public water supply system

1954 Establishment of water service, well construction, elevated tank and distribution network

Since its construction in 1954, WTP and distribution network have heavily deteriorated. No assistance has been provided so far, hence, water supply project through the initiative of the private sector is being promoted.

3) Support from donor agencies

Though the WB had provided partial assistance, no other assistance is available at present. DIME has prepared a future system development plan and submitted this to MIME. However, the contents appear to be not realistic.

The plan proposes for the rehabilitation of the related facilities but no budget and support from donor agencies are made available. Out of the existing house connections of 1,600 units, 500 units were connected in 1954. Deteriorated connection pipeline has to be replaced from the viewpoint of NRW reduction.

Lack of machinery, materials and labor are some of the problems that beset the maintenance of the existing system. Another problem is pressure shortage in the fringe area of the distribution network wherein water does not come out from the faucets. Further, DIME has still a number of issues to be tackled.

(2) Urban water supply management structure

1) Organization structure of DIME and public water utility

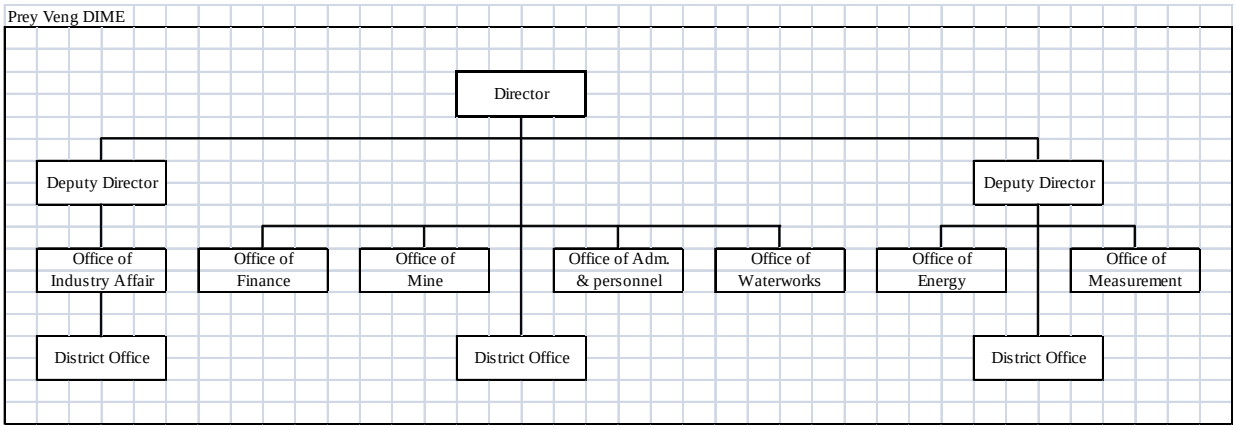


Figure 4.14.2 Organization Chart of DIME in Prey Veng Province

DIME has only three staff in the water supply division and apparently there is shortage of labor. No detailed information on private-managed system is available.

2) Capacity development for staff

DIME needs capacity building program to upgrade the technical level of staff. The number of staff is also insufficient.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Existing public-managed urban water supply system in the provincial capital uses groundwater as water source. Groundwater is pumped to an elevated tank and supplied to the service area by gravity. Groundwater table lowers during dry season but no depletion has occurred.

There are three wells within the WTP premises but one well caused groundwater table lowering. As a countermeasure, manual work to build pump installation base in deeper level is being executed. Well pump has pump head of 51 m and casing diameter is 150 mm.

2) Capacity and operation of WTP

Design WTP capacity is 1,300 m^3/day. Water is directly supplied without water treatment. Chlorine disinfection is not practiced. Elevated tank has a capacity of 50 $m^3$and a height of 20 m built in 1954.

Though the system is equipped with a generator, it is non-functioning since1995 because of breakdown and inefficient fuel consumption. Water supply is therefore suspended during power failure.

Dimension of WTP area is 30 m × 80 m. With the planned WTP replacement, site restriction shall be taken into account.

3) Capacity and operation of distribution system

Service area is a specific/defined of Sangkat. Since the distribution network was constructed in 1954, it has already been heavily deteriorated and DIME is focus on NRW reduction works. At present, NRW rate was reduced from 25% to 20%.

Diameter of distribution main is φ300. Based on the data, distribution system capacity is 260m^3/day, while capacity of the distribution main is supposed to be several thousand m^3/day. Distribution plan shall have to be reviewed.

4) Water supply O&M status

No stock of O&M materials and tools are available.

5) Water quality and control

Water quality analysis was only conducted once in 2006.

Table 4.14.2 Results of WTP Water Quality Analysis

	Parameter	Turbidity	pH	Total Dissolved Solids	Iron (Fe)	Total Hardness	Arsenic (As)	Chloride (Cl^-)
Standard		< 5 NTU	6.5 - 8.5	< 800 mg/l	< 0.3 mg/l	< 300 mg/l	< 50 μg/l	< 250 mg/l
Raw Water								
Potable Water	2006/08/30	2 NTU	6.45	125	0.00	250	0	20

Note: Blank means N/A

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.14.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		13,960	14,055	14,180	14,315	14,315	25,691
Population in supply area		13,960	14,055	14,180	14,315	14,315	25,691
Service population		4,845	5,975	6,805	8,100	8,100	25,691
Service connection or household						1,620	
Water supply (intake or treat)		497	662	603	1,300	1,300	2,183
Water supply (distribution)		372	489	433	1,040	1,040	1,743

Note: Blank means N/A

2) Water tariff

Current water tariff is 1,200 Riel/m^3.

3) Extent of water supply service

At present water supply service hour is 16 to 18 hours. A number of residents living outside of the urban service area are requesting for connection to the system. However the distribution network is only available in specific/defined area, hence they cannot be connected to the system now. Complaints were lodged to this effect. Another complaint is the

provision of water meters that are delayed.

(5) Financial status of public system

1) Current financial status

As profit and loss statement was the only available related document, financial analysis was conducted on income and expenditure.

Table 4.14.4 Financial Statement of DIME in Prey Veng Province

1,000 Riel

	2009	2008	Ratio
Revenue	**362,035**	**276,256**	**100.0%**
Water revenue	331,320	252,174	91.3%
Others	30,715	24,082	8.7%
Expense	**361,681**	**284,489**	**100.0%**
Operating Expense	**358,367**	**281,967**	**99.1%**
Electricity Cost	107,725	85,139	29.9%
Chemicals	0	0	0.0%
Fuel	11,746	4,530	1.6%
Spareparts	112,283	98,575	34.6%
Labor & Temp. staff	32,046	27,707	9.7%
Salary & Allowance	44,665	26,287	9.2%
Depreciation	21,624	31,929	11.2%
Others	28,278	7,800	2.7%
Operating Expense	**3,314**	**2,522**	**0.9%**
Administrative & Tax	3,314	2,522	0.9%
Net income	355	-8,233	-2.9%

Amout of Water Supply	1,300	$m3/_{day}$
Unit Price of Water Supply	582	Riel/m3
Energy Cost per Water	189	Riel/m3
Material Cost per Water	208	Riel/m3
Labor Cost per Water	114	Riel/m3

2) Potentials for sustainable management from water sales income

Recent balance indicated a loss and regarded as a serious problem. Water revenues occupied 91% of the total income indicating a satisfactory performance. Hence, the cause of the rapid decrease in water sales income shall have to be thoroughly investigated.

3) Composition of Expenditures

Major expenditure items were material cost, power cost and depreciation. Labor cost

including temporary labor cost, and salary expense and allowances were also rather high and the big difference was quite doubtful. In general, the account is unclear.

4) Financial stability

As no balance sheet is available, the financial aspect cannot be examined.

5) Fund investment

In the absence of a balance sheet, the financial aspect cannot be examined.

4.14.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

Water sources in this province consist of "tube/pipe wells" (78.8%), "springs, rivers, etc." (8.7%) and "piped water" (4.3%). Access rate to "improved water" is 85.5%. About 13.7% of the households depend on remote water sources.

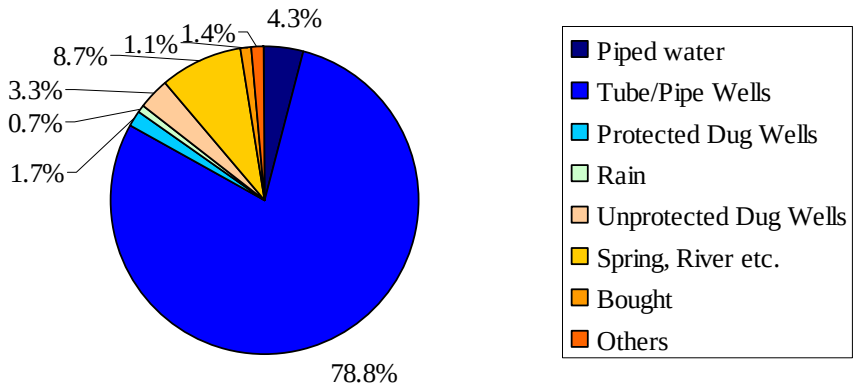


Figure 4.14.3 Type of Water Sources (Prey Veng Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in Table 4.14.5. About 93.9% of the tube well is functional the whole year. VN6 hand pumps are used in both public and private-managed systems with a functioning rate of 78.6% and 94.9%, respectively.

Table 4.14.5 Monitoring Results by PDRD (Prey Veng Province)

Items		Total	Function		Broken	
			No.	Ratio	No.	Ratio
Community tube well	VN6	7,003	5,501	78.6%	1,502	21.4%
	Afridev	405	317	78.3%	88	21.7%
	Total	7,408	5,818	78.5%	1,590	21.5%
Private well	VN6	103,255	98,019	94.9%	5,236	5.1%
Total well		110,324	103,570	93.9%	6,754	6.1%
Community hand-dug well		1,088	606	55.7%	482	44.3%
Community Pond		177	63	35.6%	114	64.4%
Pagoda	well	481	437	90.9%	44	9.1%
Health center	well	31	28	90.3%	3	9.7%
Commune Office	well	43	38	88.4%	5	11.6%

Source: PDRD in Prey Veng (2010)

3) Hand pumps

VN6 hand pumps with a usage of 93%, and easy to maintain and to procure spare parts, are the most common in this province. Only 7% uses Afridev hand pumps, and spare parts cannot be procured in this province. PDRD needs spare parts of Afridev hand pumps for UNICEF Project, but no stock is available until now. Spare parts are procured by residents as follows:

(i) In case of donor- assisted projects, standard spare parts are provided to WSUG.

(ii) If WSUG consumes such parts, it purchases these directly from Phnom Penh.

4) Water Quality of Groundwater

High levels of arsenic content were detected in tube wells in areas around Mekong River. From the result of water quality analysis by Arsenic Center, 25.1% of the 1,712 groundwater samples were detected to have more than 10ppb of arsenic content making the province a high risk area for arsenic contamination.

Table 4.14.6 Result of Arsenic Testing（Prey Veng Province）

Total No. of Tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
1,712	267	15.6%	162	9.5%	1,283	74.9%

Source: Arsenic Center (2005-2007)

Iron, nitric and manganese content are generally high in this province. Since groundwater level is relatively shallow, residents construct tubewell by themselves and can obtain water easily. However, water quality is an issue due to insufficient drilling depth and surface sealing of well.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 126 staff members, with 12 members belonging to the Office of Rural Water Supply and 10 to the Office of Primary Health.

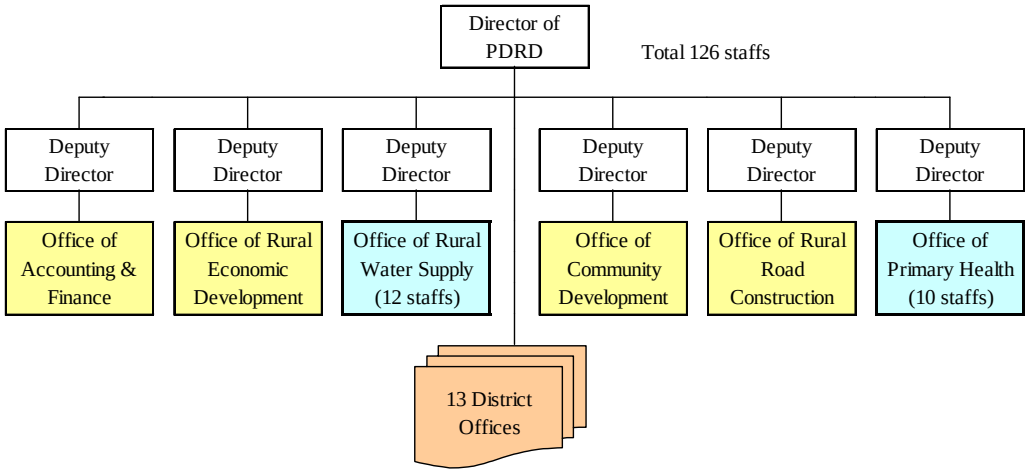


Figure 4.14.4 PDRD Organization Chart (Prey Veng Province)

2) Budget

"External charges for services" and "personal expenses" account for bulk of PDRD's annual budget. No budget is allocated for rural water supply, health care projects and MRD financial package budget in 2009.

Table 4.14.7 PDRD Budget (Prey Veng Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	244.6	20.9%	257.6	21.3%
	External charges for services	348.0	29.7%	333.0	27.5%
	Other external charges for services	265.4	22.7%	265.4	21.9%
	Personal expenses	313.5	26.8%	354.1	29.3%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	1,171.5		1,210.1	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has requested rehabilitation projects every year using the rehabilitation financial

budget of MRD, but no response has been provided. Although PDRD has drawn up the 5 year, 3 year and an annual development plan; however, based on the ministerial decree by the provincial movement, there is no allocation in the development budget for rural water supply and sanitation sector.

(3) Assistance by Other Donors

1) Existing Project

a. Rehabilitation Project for Rural Water Supply financed by MRD

(i) Period: From 2006 to 2008

(ii) Target sites: all districts (10 tube wells / district / year)

(iii) Component: Rehabilitation of VN6 hand pumps (cost: 150US$ / one pump)

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project by IMF

(i) Target sites: 50 villages, 10 communes, 2 districts

(ii) Status: Bidding for construction of water supply facilities is under preparation.

(iii) Component: Construction of 1,168 household toilets

b. Seth Coma Program by UNICEF

(i) Period: From 2006 to 2010

(ii) Target sites: 178 villages, 21 communes, 3 districts (Me Sang, Preah Sdach, and Svay Antor)

(iii) Component: Construction of tube well to schools, CLTS Project (including hygiene awareness and education)

c. Arsenic Mitigation Program by MRD financed by UNICEF

(i) Target sites: 110 villages, 29 communes, 6 districts

(ii) Component: Water quality testing (5655 wells), KAP survey, IEC activities, Provision of alternative water source such as rainwater collection and bio-sand filter

(4) Current Hygiene Condition

Households with toilets account for 15.1% (33,087 households) in the rural areas. Of these households, 43.6% use pit latrines and 41.8% use septic tanks.

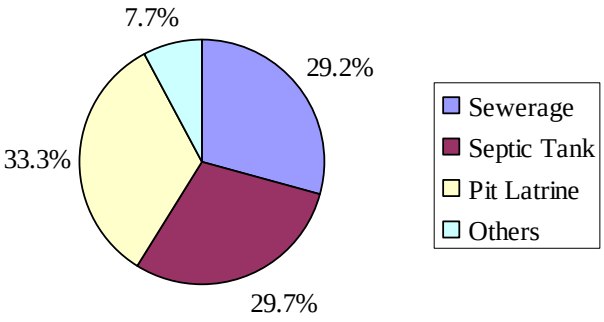


Figure 4.14.5 Type of Toilet (Prey Veng Province)

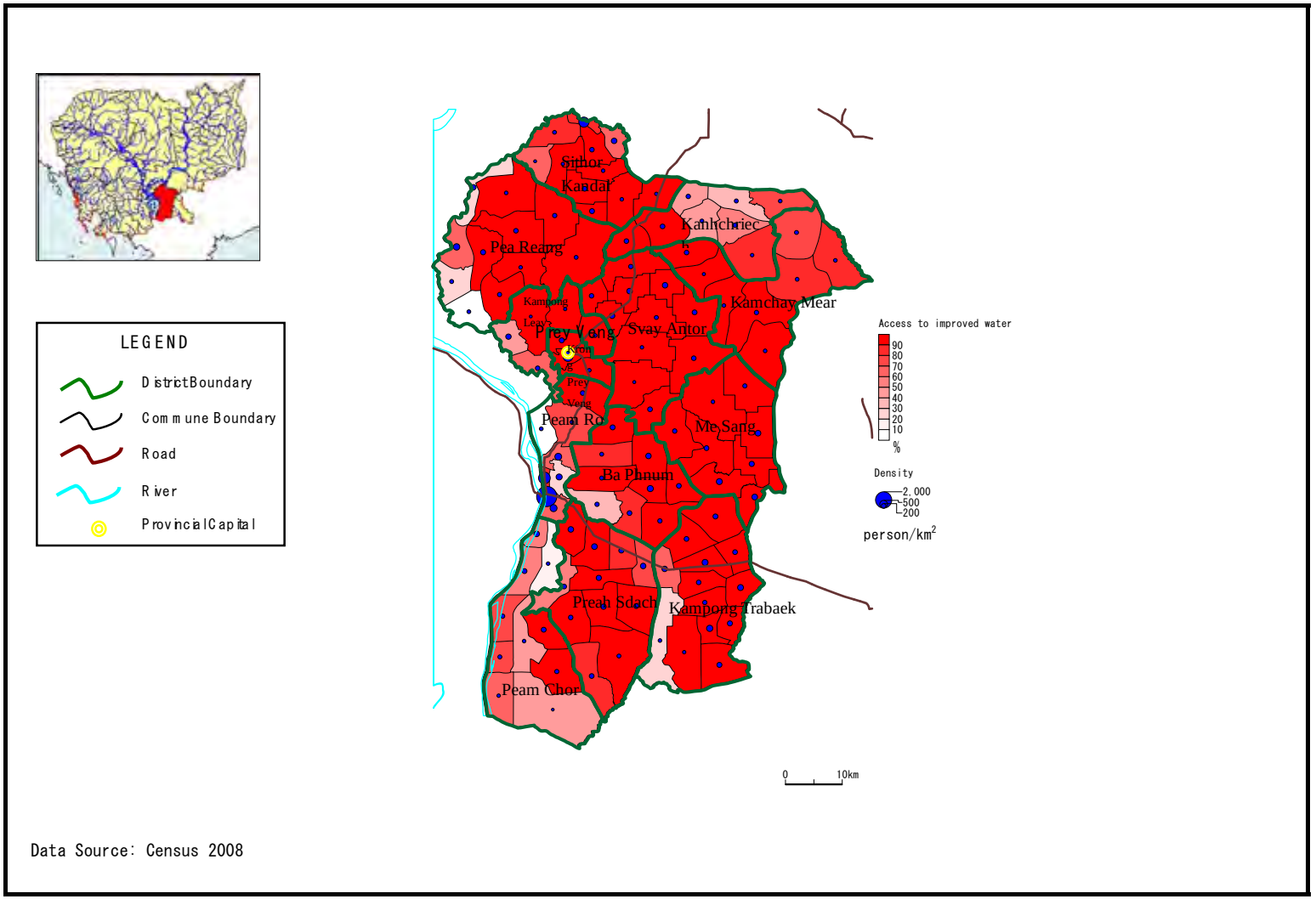
4.14.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown below. Of the 116 communes in this province, more than 50% of the households have access to "Improved water" in 102 communes.

Table 4.14.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Prey Veng Province)

Urban	Rural	Total
3/3 communes	99/113 communes	102/116 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source 2008 Census

Figure 4.14.6 Service Area of Safe Water (Prey Veng Province)

4.15 Pursat Province

4.15.1 Brief Description of the Province

Pursat province has an area of 12,692 km^2, comprised of 6 districts, 49 communes, and 503 villages. According to 2008 Census, urban population was 25,650 persons (5,389 HH), and rural population was 371,511 persons (78,023 HH）. Population growth rate was 0.69 % for the whole province, -0.57% in urban area and 0.79 % in rural area.

4.15.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Pursat, the provincial capital is served by a public-managed water supply system. Aside from this, another public-managed system, one private-managed system and one water supply system without treatment process are operating in this province.

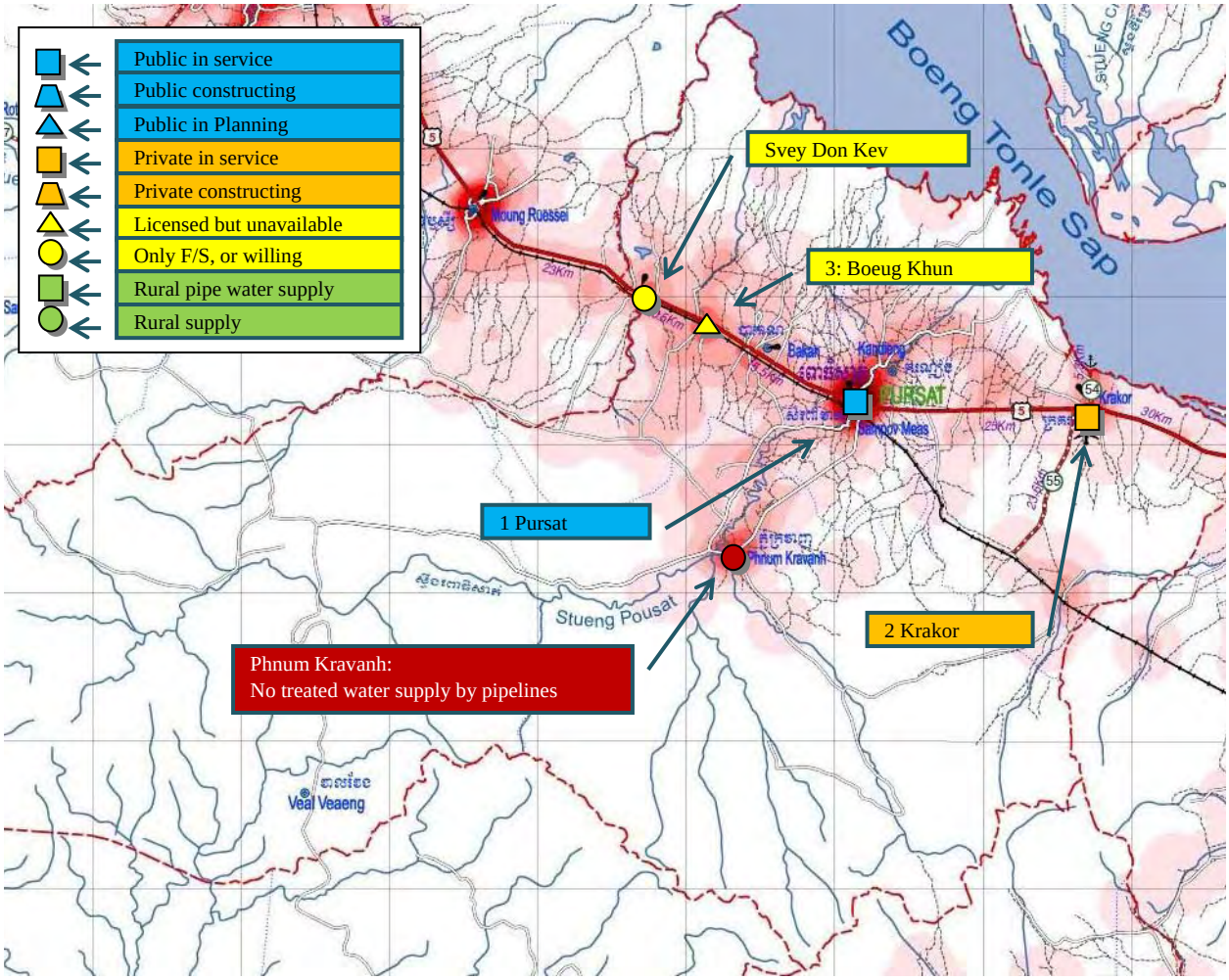


Figure 4.15.1 Existing Urban Water Supply System in Pursat Province

Table 4.15.1 Current Status of Urban Water Supply System in Pursat Province (2009)

No	Name of Town	Ownership	Year Established	Population	No. of Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Remarks
1	Pursat	Pub	1926	18,215	3,643	2,865	River		1,300	
2	Krakor	Pri	2005		600		Well	60,000	1,800	*1
4	Boeug Khun	Pri	Not operated yet (Near future)							

*1: According to the list submitted from MIME, Water tariff is 5,300Riel/m^3, Blank means N/A

2) Historical development of urban and public water supply system

1994 SAWA started rehabilitation project for Pursat water supply system.

2005 Pursat water supply system was established.

2006 ADB started operation of rehabilitated WTP.

Public water supply system of the provincial capital was rehabilitated by ADB and started its operation in 2008. The distribution network was developed few years back. DIME has no information on the historical background of the system and pipelines installed including the technology used before rehabilitation works.

3) Support from donor agencies

There is no information on the system during its early stage. This area was once the site of a Civil War conflict, hence old data were lost. Full-scale rehabilitation work was performed by SAWA during the period of 1993 to 1994. Scope of work included WTP rehabilitation (1,200 m^3/day), and replacement of distribution pipes (φ250～63 × 11,621 m). Since the contractor applied cheap and sub-standard PVC pipes, there is a possibility that it may cause high NRW generation in the future.

The current system was constructed during the period 2006 to 2008 through an ADB loan. The scope included the construction of a new WTP (5,760 m^3/day), and expansion of distribution network（φ250～63 × 14,292 m). A total of 1,050 HH was served by the system.

After these rehabilitation works, reliable information on the original existing system before rehabilitation was lost as earlier stated. As installation year of the existing pipes is unknown, the selection of pipes to be replaced became difficult. Budget for distribution network is absolutely needed.

At present, except ADB, no donor is available. Meanwhile, the UN Habitat prepared a water supply service area expansion plan. This project is implemented two years from April 2004. This project scope covers WTP expansion, service area extension by distribution network development, water meter installation for water charge billing and capacity building of DIME staff. JICA technical assistant project – Phase II is on going and aimed at capacity

development of DIME's operation in Pursat province.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

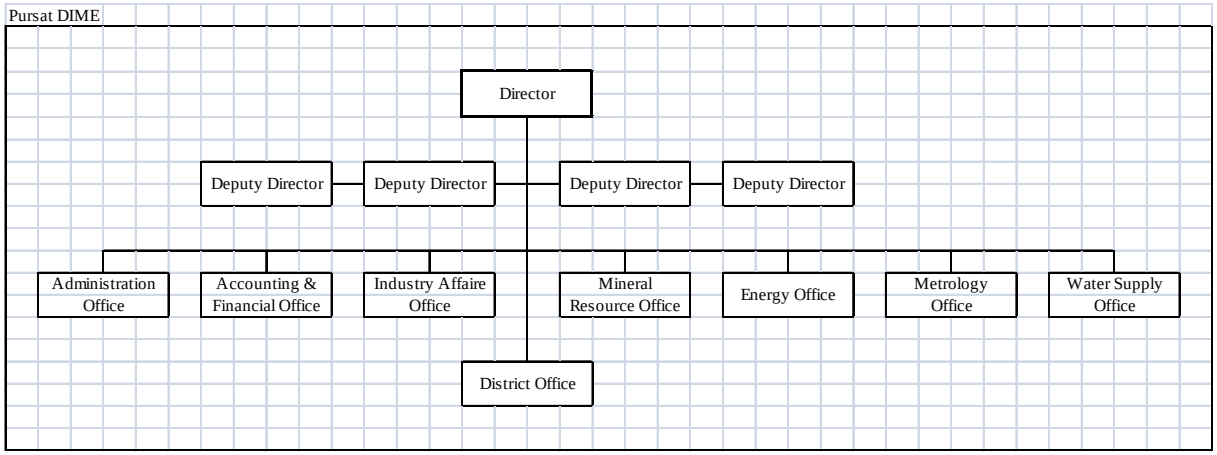


Figure 4.15.2 Organization Chart of DIME in Pursat Province

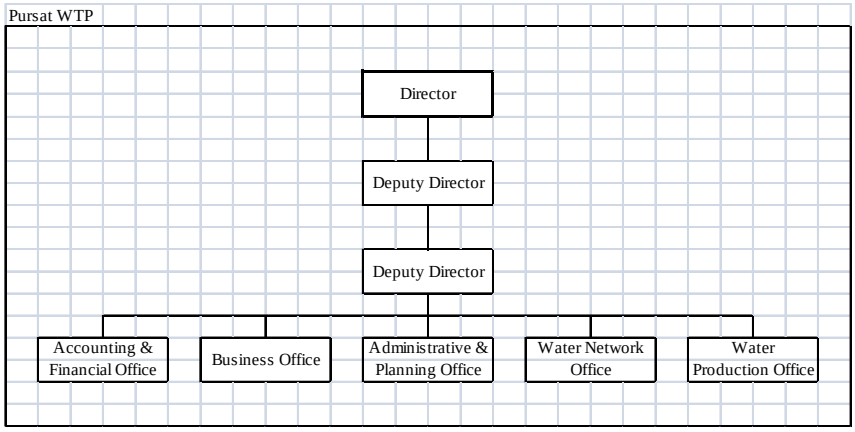


Figure 4.15.3 Organization Chart of WTP in Pursat Province

DIME only undertakes general project management and actual project management is entrusted to PWSA. Project implementation report is also directly submitted to MIME. The number of staff of PWSA is 27: 10 persons are regular staff and 17 persons are temporary workers. DIME is composed of one Director, two Deputy Directors, and 24 staff including 2 engineers. Regular staff is paid by governmental budget while tempory workers are by budget allocated to the water division of DIME.

PWSA is a well functioning organization and the requested data was immediately submitted. Average salary is 250,000Riel for 8 hours of duty a day with 5 working days in a week as set by law.

- Management status of private system
  Mnagers have knowledge on the general information but are not familiar with detailed data. Concern was raised on one of the water supply systems because the system lacks treatment process in spite of poor raw water quality.

2) Capacity building for staff

Regular staff attended a PPSWA seminar and expert training held in Cambodia with the assistance of JICA. Through the capacity development program of JICA, a JICA expert on water treatement technology and distribution system management provided knowledge to all DIME staff. This resulted to a drastic change of approach in project management. Some staff visited JAPAN to participate in a technical training course.

There is a staff recruitment plan as follows: system management–2; water quality analysis–1; and accountant–1. Acceptance is decided through the submitted biodata and evaluation of skills. Newly-accepted staff can attend to weekly training.

Future needs in capacity building program are the following:

Technology/Skill: Water source management, pipe installation, mechanical and electrical equipment, training on water quality analysis
Management: Accountant, human resource management, computer operation

This will also include repair skill on mechanical and electrical equipment which is strongly needed.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Raw water is directly diverted from river source to receiving well. As a typical surface water source, turbidity is relatively high. There are two intakes: a lower one which is used during dry season; and an upper one, used during rainy season. Intake pump is vertical type and pump capacity is 4,800 m^3/day.

Intake pump is frequently malfunctioning and since there is lack of skills for repairing, skills training on the repair of mechanical and electrical equipment by a JICA expert is expected. Volume of raw water fluctuates between dry and rainy seasons. Measures to cope with water demand increase during dry season is being studied.

2) Capacity and operation of WTP

Current WTP capacity is 5,760 m^3/day but distribution amount is only 2,850 m^3/day. According to DIME, this is due to capacity shortage of distribution trunk pipe. Design was undertaken by a Japanese Consultant and the estimated project cost was 265,000 US$.

WTP design is standard ADB conventional method. First treatment is grit chamber and treated water is divided into two chambers. Coagulant is agitated by flash mixer and through horizontal baffling type flocculator, water flows into lateral flow sedimentation tank. As the filtration tank is considerably deep, it is supposed to be gravity type.

The well-designed WTP adopted the minimum machinery which were mainly made in China. In piping design, pipe exchange and in-pipe flow stress measure was also accounted. As the height of elevated reservoir is rather high, this will be advantageous in service area expansion.

3) Capacity and operation of distribution system

Distribution capacity is 2,880 m^3/day with 3,000 m^3/day as maximum. Since turbid water generated by inner pipe encrustation is observed and deterioration is acute, pipe replacement is needed in some sections. Suppposedly, such pipes were installed before the rehabilitation work by ADB. As several projects were implemented by various donor agencies, there is lack of well-defined service areas.

NRW rate was estimated at 21 to 23% but there is uncertainty to this figure because calculated NRW ratios differ by each donor agency. However, NRW records are available.

As repair materials can be purchased in adjoining Battambang province, no huge stock is needed.

4) Water supply O&M status

WTP management staff including the Director precisely understand the present condition of the system. Drawing and documents are kept in proper place for easy confirmation.

O&M staff are inspecting WTP facilities by visual survey and making daily log of repair work record in specific format. Sometimes, repair works are postponed due to lack of materials. Regular safety facility is equipped but not sufficient. Power genrerator is provided together with manuals.

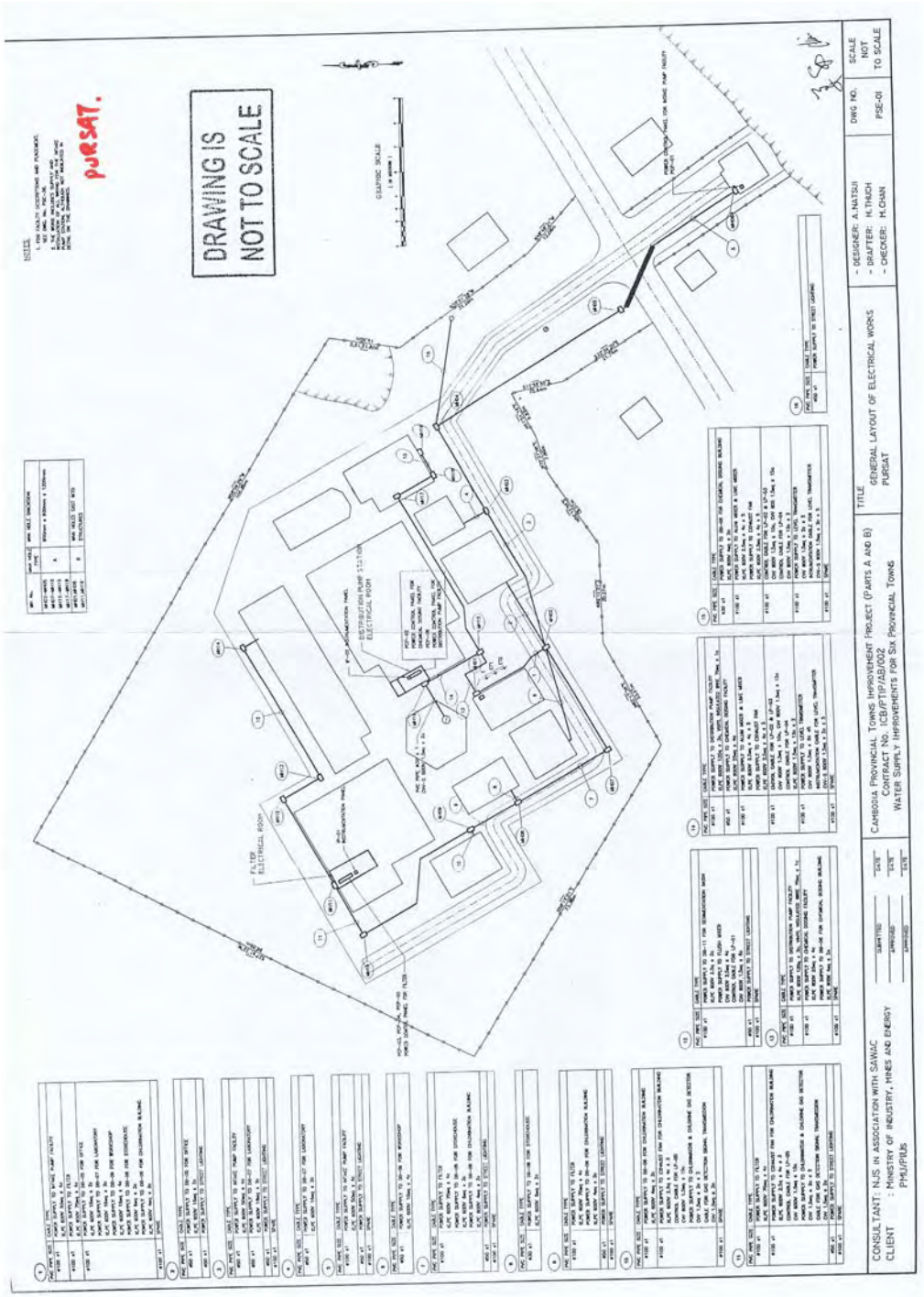


Figure 4.15.4 General Layout of Pursat WTP

Figure 4.15.5 Water Supply System Layout of Pursat Town

5) WTP O&M status

Water supply amount is monitored by water meter installed on the main distribution pipe in front of WTP. No meter to measure intake water amount is installed.

During the first site visit, coagulated sedimentation status was poor and remaining turbidity exceeded 10 UTN. It seemed that the facility was not running efficiently. However, this has greatly improved during the second visit due to application of proper treatment procedures resulting to higher efficiency level.

Alum and slaked lime are used and the stock was abundant. Five tons of coagulant, 3 tons of slaked lime, and 1 ton of chroline agent were stored. A supplier delivers chemicals every 6 to 10 days. Chlorine gas is quite expensive and procurement is difficult.

Chemicals are lifted by hoist device and thrown into a hopper. They are dissolved by hand pump in a chemical mixing/storage tank, and then injected. Chroline gas is applied for disinfection. Chemical dosage management has been exercised according to the instructions given by the JICA expert. Treatment facilities are new and well-organized but there is a need to upgrade WTP O&M skill among the staff.

6) Water quality control and supply water quality

A staff is assigned to water quality analysis and got technical instructions from JICA. All analysis results are stored.

Table 4.15.2 Results of WTP Water Quality A nalysis

Coagulation Management	Unit	Target	Raw Water	Sedimentation	Distribution
Temperature	degree	―	24 - 25	27.4	27.2 – 29.5
pH	―	7.0	7.84	7.3	7.2 – 7.6
Turbidity	NTU	Sed<10 Dis<1.0	87 - 98	6.5	0 – 1.07
Free Chlorine	mg/L	AF>0.1 Dist=1.0			0.47 – 0.61
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	130		28 – 150
Color	TCU	Sed<20 Dis<5	110	13.8	2.9
Alkalinity [mg/L]	mg/L	>10	35 - 42		15 - 17

Note: Blank means N/A

Though turbidity of raw water is high, coagulated sedimentation is functioning. Residual chroline concentration is controlled. Color of raw water is also high but water quality analysis results are satisfactory.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.15.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population of urban area							
Population in supply area		28,406	30,100	35,850	44,477	44,477	
Service population		10,860	12,515	13,235	18,215	19,025	43.97%
Service connection or household		2,172	2,503	2,877	3.643	3.912	
Water supply (intake or treat)		1,102	2,138	2,321	2,865	2,934	
Water supply (consumption)		779	1,520	1,709	2,204		

Note: Blank means N/A

Water distribution capacity is much less compared with the growing water demand and expanding water service area. Historical data on water demand and supply amount in the past years were not collected. Applicable measures to cope with water demand growth especially during the dry season must be examined.

2) Water tariff

Current water tariff is 1,300 R/m^3.

Meter reading frequency is every month or every year. Since water billing is computerized, billing slips are delivered to users periodically. The billing and water charge collection department can respond to user's inquiry. Domestic users pay corresponding charges including delayed payments, but 30 connections to governmental offices have arrears.

3) Extent of water supply service

Basically 24 hour supply, but this cannot be confirmed.

(5) Financial status of public system

1) Current financial status

The newest financial statements were collected: P/L in 2008 and 2009; and B/L in 2009. P/L in 2008 was prepared in a different format. After the proposal of facility investment fund application to MEF, fund is provided from the national treasury with supervision from the fund management committee.

Table 4.15.4 Financial Statement of DIME in Pursat Province

Pursat	1,000 Riel
Aasets	**10,645,525**
Current Aasets	**611,030**
Cash	18,837
Current Receivable	249,752
Materials	342,441
Fixed Assets	**10,034,495**
Land	161,200
Buildings net	4,679,674
Machineries net	5,013,091
Other Equipments net	180,530

Liabilities & Equity	**10,645,525**
Liabilities	**1,119,958**
Current Liabilities	133,459
Long term Liabilities	986,499
Equity	**9,525,567**
Capital	9,567,032
Retained Earnings	-41,465

Fixed Assets Ratio		105.3%
Fixed Assets to Fixed Liability Ratio		95.5%
Equity Ratio		89.5%
Suppy per Assets	10,234	Riel/m3

1,000 Riel

	2009	2007	Ratio
Revenue	**836,602**	**780,735**	**100.0%**
Water revenue	810,728	721,326	92.4%
Others	25,874	59,409	7.6%
Expense	**1,645,589**	**1,296,462**	**100.0%**
Operating Expense	**1,637,482**	**1,289,248**	**99.4%**
Electricity Cost	8,005	6,479	0.5%
Chemicals	134,652	88,855	6.9%
Fuel	729,191	449,117	34.6%
Spairparts	16,492	23,019	1.8%
Labor & Temp. staff	1,870	850	0.1%
Salary & Allowance	61,614	52,016	4.0%
Depreciation	662,873	668,394	51.6%
Others	22,785	518	0.0%
Operating Expense	**8,107**	**7,214**	**0.6%**
Administrative & Tax	8,107	7,214	0.6%
Net income	-808,987	-515,727	-39.8%

Amout of Water Supply	2,850	m3/日
Unit price of Water Supply	751	Riel/m3
Energy Cost per Water	523	Riel/m3
Material Cost per Water	22	Riel/m3
Labor Cost per Water	51	Riel/m3

2) Potential for sustainable management from water sales income

Recent total income was far below the total expenditure resulting in a large deficit balance. If depreciation is excluded, balance is quite reasonable. Though cash flow will not cause an immediate breakdown of the organization, income enhancement measures are urgently proposed to earn water sales income equivalent to investment amount.

Percentage of water sales income with the total income was 92% in 2009, and seemed to be adequate.

3) Composition of expenditures

Major expenditure items were cost for: depreciation, power, and chemicals. Large fluctuation of power cost was quite unnatural, while labor cost seemed to be small.

4) Financial stability

The capital structure is weak due to annual operation loss resulting in a substantial reduction of the equity's capital and net worth.

Although the equity capital ratio is in a reasonable range at 105%, the long-term liability ratio is high at 90% due to heavy debt.

5) Fund investment

Calculated unit investment amount per annual supplied water amount was 10,230 Riel/m^3. Likewise Kampot province, supplied water amount was too small compared with investment amount. Water sales enhancement measures to ensure income equivalent to investment scale must be urgently taken.

4.15.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

Water sources in this province consist of "springs, rivers, etc." (38.7%), "unprotected dug wells" (33.9%) and "tube/pipe wells" (9.5%). Access rate to improved water is 20.9%. About 44.4% of the households depend on remote water sources.

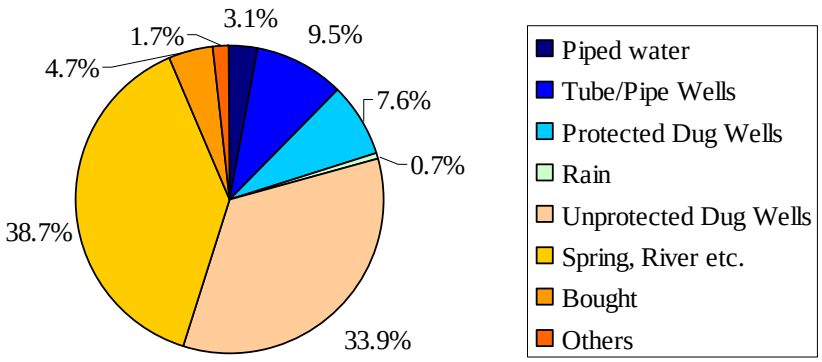


Figure 4.15.6 Type of Water Sources (Pursat Province)

2) Condition of Water Supply Facilities

Since PDRD has not carried out any regular monitoring and data management, the present condition of water supply facilities in villages cannot be ascertained.

Meanwhile, based on the District Data Book (2008) by UNDP, the proportion of tubewells which is functional the whole year is 58.7%, while the proportion of non-functional tube well is 31.9%.

Table 4.15.5 Functional/ Non-functional Conditions of Water Supply Facilities (Pursat Province)

Items	No. of Facilities	Ratio
Total number of pumped or mixed wells	3,742	
Year-round usable pumped or mixed wells	2,195	58.7%
Dry season unusable pump or mixed wells	1,547	41.3%
Pump or mixed wells needing repair/rehabilitation	1,193	31.9%
Total number of ring wells	4,963	
Year-round usable ring wells	3,083	62.1%
Dry season unusable ring wells	1,880	37.9%
Ring wells needing repair/rehabilitation	1,660	33.4%
Total number of un-protected dug wells	1,739	
Year-round usable un-protected dug wells	1,053	60.6%
Dry season unusable un-protected dug wells	686	39.4%

Source: District Book (2008)

3) Water Quality of Groundwater

According to the result of water quality analysis by Arsenic Center, 2.1% of 1,236 groundwater samples were found to have more than 10ppb of arsenic content; no samples exceeded 50ppb of arsenic contamination.

Table 4.15.6 Result of Arsenic Testing (Pursat Province)

Total No. of tested wells	As > 50 ppb		10 < As ? 50 ppb		As ? 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
1,236	0	0.0%	26	2.1%	1,210	97.9%

Source: Arsenic Center (2005-2007)

In addition, 39 tube wells out of 700 tubewells by ADB were detected with iron contamination. For this, although 12 iron removal devices were installed, it could not install in the remaining 27 tube wells due to lack of budget. Water quality testing was carried out only once after construction, hence no monitoring has been carried out.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 49 staff members, with 5 members belonging to the Office of Rural Water Supply and 4 members to the Office of Primary Health.

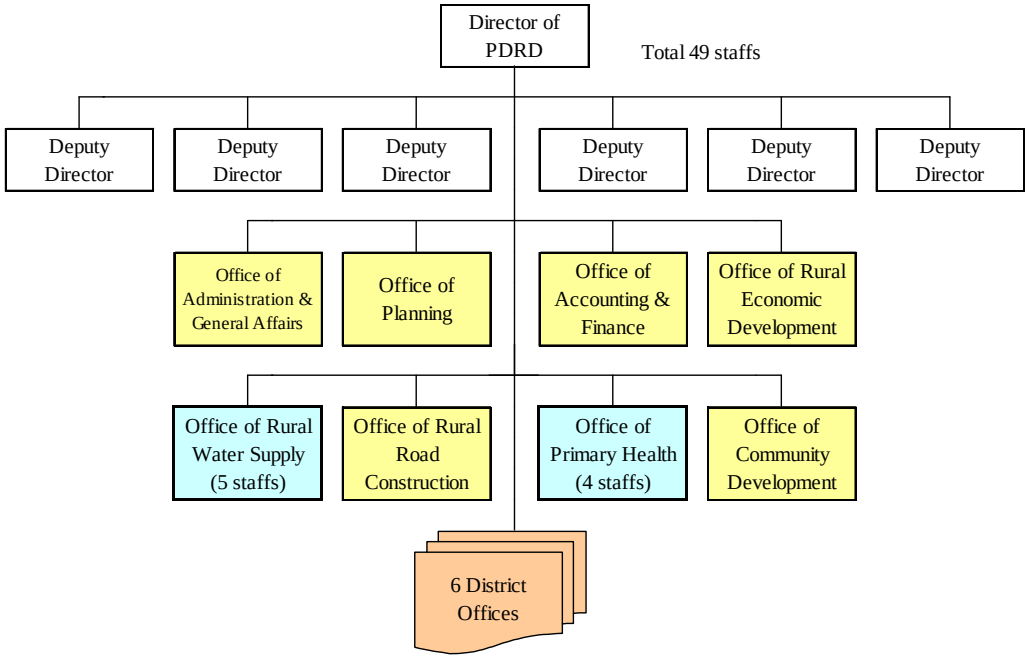


Figure 4.15.7 PDRD Organization Chart (Pursat Province)

2) Budget

External charges for services accounts for a high percentage share of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 246.1 million riel was allocated in 2009 as MRD financial package budget which was mainly used for rehabilitation of existing facilities.

Table 4.15.7 PDRD Budget (Pursat Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	153.0	25.3%	159.0	17.1%
	External charges for services	107.0	17.7%	401.0	43.0%
	Other external charges for services	215.0	35.5%	215.0	23.1%
	Personal expenses	130.0	21.5%	156.0	16.7%
	Taxes and similar services	0.0	0.0%	1.0	0.1%
	Total	605.0		932.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	246.1	7	under preparation by MRD	
	Well rehabilitation		190		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		197		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has recognized the significance of operation and maintenance, and wanted to secure technical assistance for PDRD engineers, financial support and water quality inspection system to include laboratory construction. Although PDRD carried out monitoring activities for water supply facilities during SEILA Program, PDRD has not carried out any monitoring after the program was completed in 2009. PDRD has a monitoring program for 2010 but it may be difficult to carry out due to lack of budget.

(3) Assistance by Other Donors

1) Existing Projects

a. Tonle Sap Water Supply and Sanitation Project by ADB

ADB has conducted the Tonle Sap Water and Sanitation Project from 2006 to 2010. One hundred seventeen villages, 14 communes, 3 districts, namely; Krakor, Kandieng and Bakan which are mostly populated by poor people, were covered by this project and constructed drill wells, toilets, bio-sand filters, community ponds, pipe water supply system and rainwater tanks.

b. Rehabilitation Project financed by MRD

PDRD is carrying out rehabilitation of existing tube wells and dug wells in 27 villages, 8 communes, 3 districts, namely; Krakor, Kandang and Phnam Klavanh. This project is financed by MRD budget.

2) New Projects

a. Second Rural Water Supply and Sanitation Project by ADB

ADB has a new assistance plan whose contents are almost the same as the Tonle Sap Rural Water and Sanitation Project (2006-1010) commenced from July 1, 2010. 3 prioritized districts, where are Krakor, Kandieng and Bakan, are targeted as same as phase I in this project. But Kandieng district may be excluded from target site due to prioritization to other provinces.

b. Tonle Sap Lowlands Rural Development Project by ADB

The Tonle Sap Lowlands Rural Development Project will support 40 communes in the development and upgrading of rural infrastructures such as rural roads, schools, health centers, irrigation facilities, and water supply and sanitation facilities through a combination of community-led and executed activities; and government agency implemented infrastructure development in the provinces of Kampong Chhang, Kampong Thom, and Pursat in the Tonle Sap basin. MOWRAM is the executing agency and several government agencies will be directly engaged in the implementation, including MOWRAM; Ministry of Rural Development (MRD); Ministry of Agriculture, Forestry and Fisheries (MAFF) and Ministry of Interior (MOI). Feasibility study was already completed

and construction stage is expected to commence on June / July 2010. PDRD has no details yet on this project.

(4) Current Hygiene Condition

Households with toilets on the premises account for 14.9% (11,620 households) in rural areas. Of these, 39.2% use septic tanks and 29.2% are connected to sewerage system.

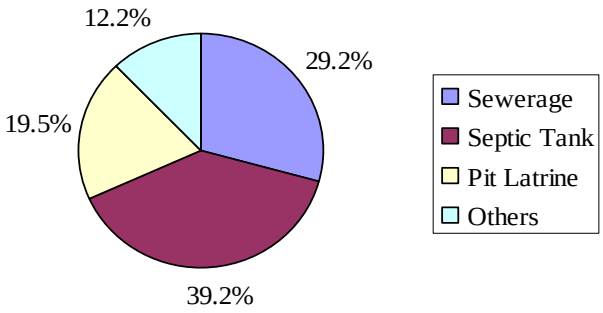


Figure 4.15.8 Type of Toilet (Pursat Province)

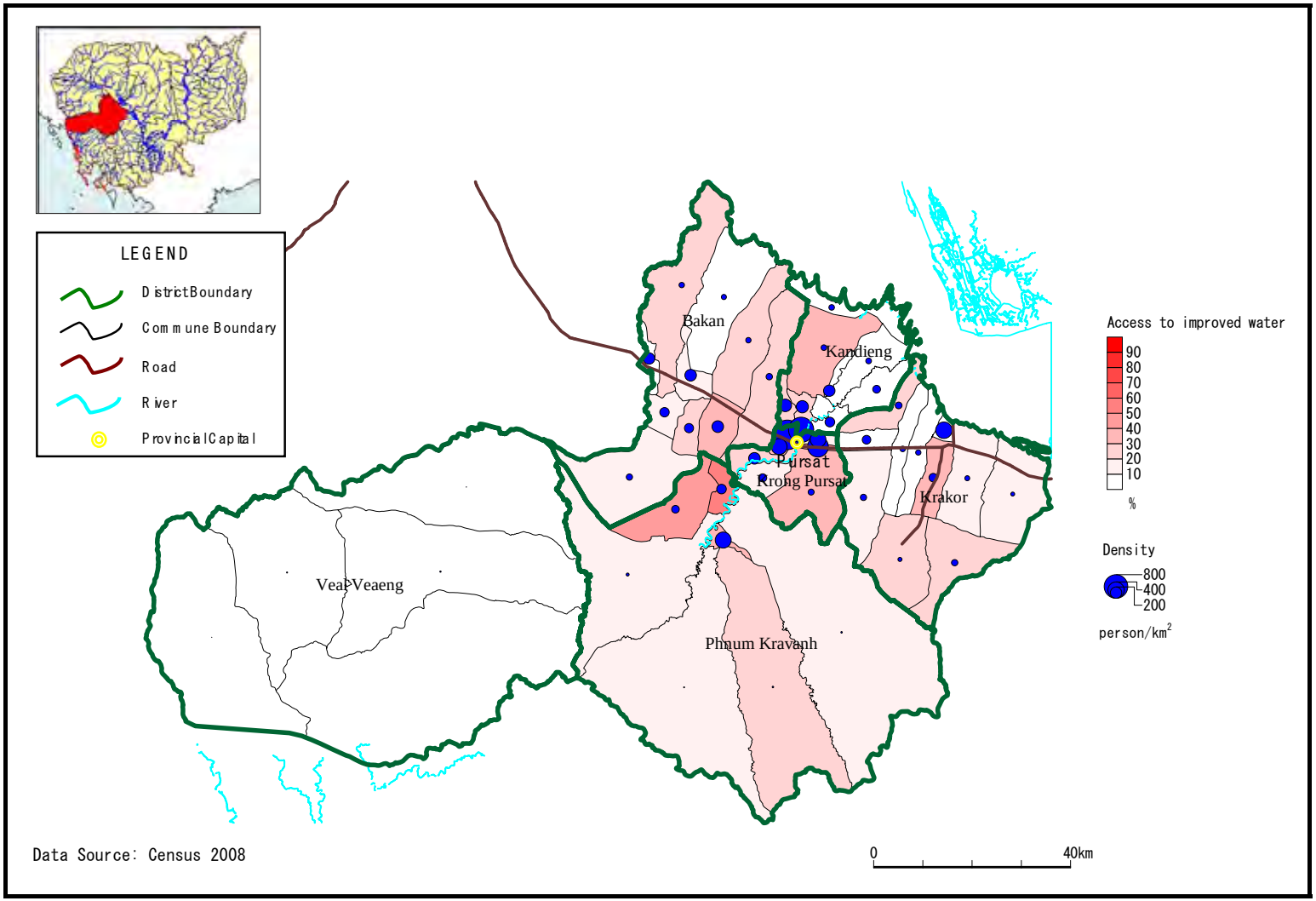
4.15.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the below. Of the 49 communes in this province, more than 50% of the households have access to "Improved water" in 2 communes.

Table 4.15.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Pursat Province)

Urban	Rural	Total
1/3 communes	1/46 communes	2/49 communes

Note: The denominator in the table is the number of Communes/Sangkat



Unit: %, Source 2008 Census

Figure 4.15.9 Service Area of Safe Water (Pursat Province)

4.16 Ratanak Kiri Province

4.16.1 Brief Description of the Province

The Ratanak Kiri province has total area of 10,782 km^2, comprised of 9 districts, 49 communes, and 241 villages. According to 2008 Census, urban population was 19,317 persons (3,746 HH), and rural population was 131,149 persons (23,739 HH). Population growth rate was taken at 4.67% for the whole province, 5.40% in urban area and 4.57 % in rural area.

4.16.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Banlung, the provincial capital is served by a public-managed water supply system. No other urban water supply system exists including that of private-managed system; all available systems are village water supply system.

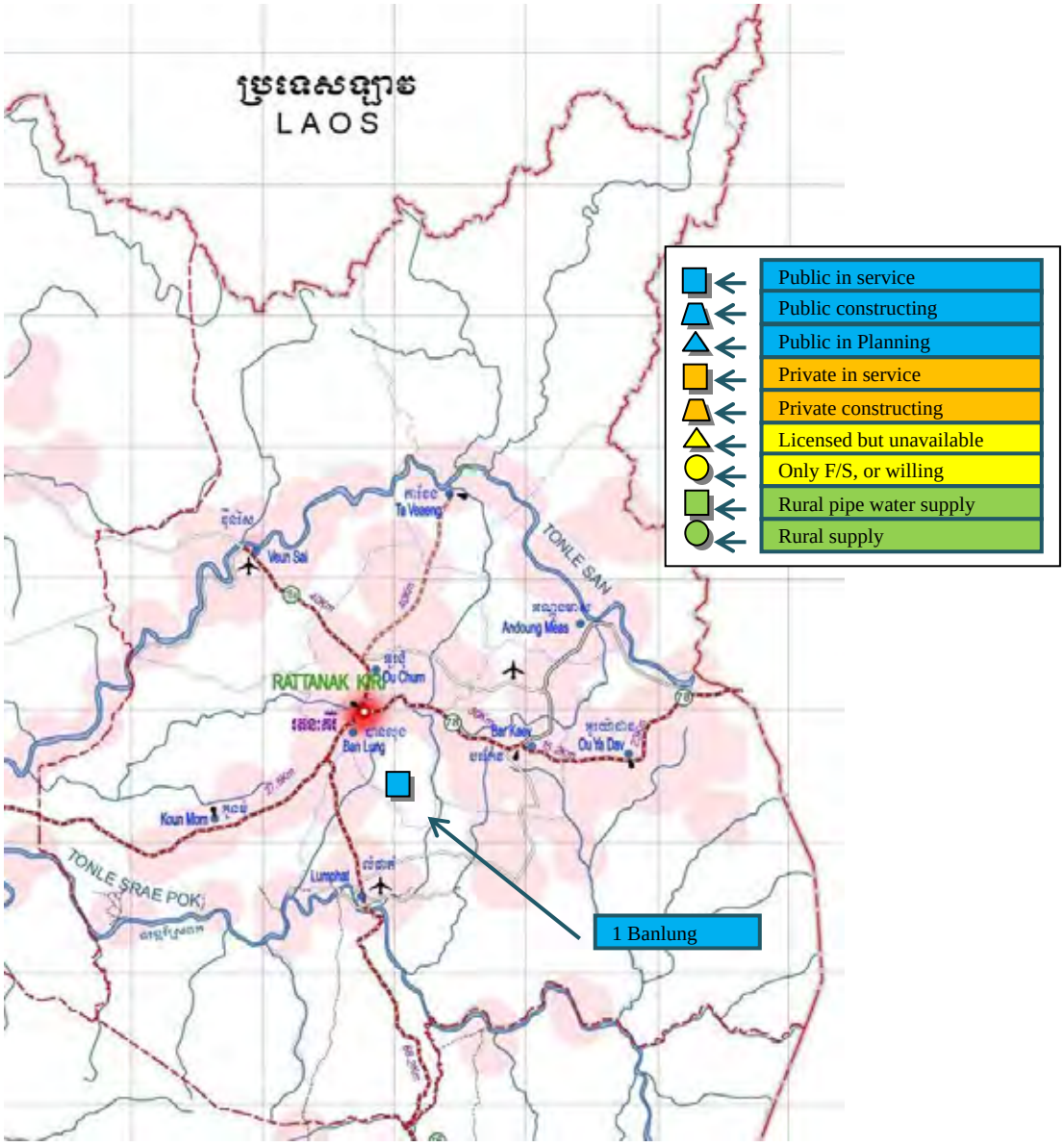


Figure 4.16.1 Existing Urban Water Supply System in Ratanak Kiri Province

Table 4.16.1 Current Status of Urban Water Supply System in Ratanak Kiri Province

No	Name of Town	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Banlung	Pub	1995		570	500	Lake		1,500

Note: Blank means N/A

2) Historical development of urban and public water supply system

1982 Operation of distribution pump was started.

1995 Public-managed water supply system for provincial capital was established.

Provincial capital system started its operation. No other water supply system exists.

3) Other donor agencies

Implementation of F/S is planned. Though water supply system was operated in 1995, supply amount is too small compared with water demand. Upon WTP expansion, land for expansion shall be secured. At present, no activities are being done to this effect; likewise, no fund is available for WTP expansion.

The presence of Technical Support by JICA covering this province is known, but not the details. No assistance from other donor agencies is available. According to DIME, the remote distance from central government is a critical factor in its application for official assistance.

Site survey to locate the construction site for WTP with a capacity of 1,500 m^3/day is now in progress. This is supervised by the Japanese expert assigned to the JICA capacity development project. The capacity of existing water source is scarce and allocated budget is too small for groundwater survey. The study team examined the utilization of volcano lake water and run-off from hydro generator plant. According to the water quality analysis results, volcano lake water contains Arsenic and therefore be excluded. The use of run-off from hydro generator plant was further investigated. WTP construction site has been located and requires a length of 7 km water conveyance pipe. Distribution pump is needed. As to distribution network, key points are measured by GPS.

(2) Urban water supply system management structure

1) Organization structure of DIME and public water utility

No DIME organizational structure was available. However the organizational structure of WTP was collected.

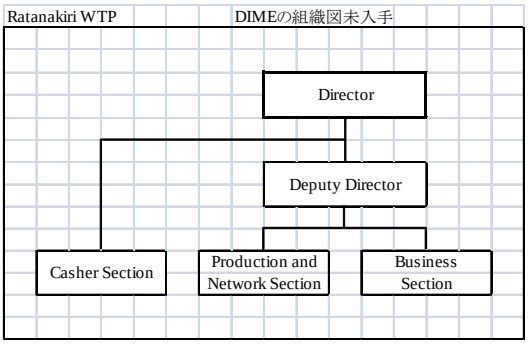


Figure 4.16.2 Organization Chart of WTP in Ratanak Kiri Province

The staff assigned to O&M of urban water supply system is composed of 3 regular staff and 10 temporary workers.

2) Capacity development of staff

The staff is aware of the necessity of capacity building for system O&M but has no idea on what the needs are.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Two water resources are available: groundwater; and lake water. During dry season, only groundwater is used. In rainy season, untreated lake water is mixed with groundwater. Since chlorine injection device was removed, disinfection is not being practiced. DIME informed that exploitable lake water amount is abundant even in dry season.

2) Capacity and operation of WTP

Supplied water amount was 465 m^3/day in 2009. As groundwater is pumped from tubewell drilled in the lakeside and directly supplied by distributiuon pump without any treatment, there are no facilities that can be considered as Water Treatment Facility. This is corresponding to a Level 2 groundwater supply system.

3) Capacity and operation of distribution system

Distribution amount is 400 to 500 m^3/day with a distribution pump capacity of 50 m^3/hr. Diameter of main distribution pipe isφ100mm, rather small compared with distribution amount.

Pipe materials used are DCIP for main pipe and PVC pipe for lateral pipes. Average NRW rate is 19% as monthly fluctuation varies from 2% to a high 36%. NRW investigation program must be reviewed including the method for leakage measurement.

4) Water supply O&M status

WTP monthly operation reports and budget proposal for the new fiscal year were collected. There are no current projects, but there are several future plans.

5) WTP O&M status

Water supply amount is monitored by water meter installed on the outlet pipe of pumping station.

6) Water quality and control

Table 4.16.2 Results of WTP Water Quality Analysis

	Parameter	Turbidity	pH	Total Dissolved Solids	Iron (Fe)	Total Hardness	Arsenic (As)	Chloride (Cl^-)
Standard		< 5 NTU	6.5 - 8.5	< 800 mg/l	< 0.3 mg/l	< 300 mg/l	< 50 μg/l	< 250 mg/l
Raw Water								
Potable Water	(Lake Water)	9 NTU	9.49	7	0.29	25	0	9.6
	(Well Water)	0.1 NTU	5.27	5	0.00	25	0	7.2

Note: Blank means N/A

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.16.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population							
Population in supply area							22,291,
Service population							
Service connection or household						570	
Water supply (intake or treat)							
Water supply (distribution)						400-500	3,749

Note: Blank means N/A

2) Water tariff

Current water tariff is 1,500 Riel/m^3. Rate is scheduled to be raised to 1,800 Riel/m^3 in 2010.

3) Extent of water supply service

Service hour is 12 to 15 hours/day. Users complained about the low water quality.

(5) Financial status of public system

1) Current financial status

Financial statement was not collected.

4.16.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of ”prings, rivers, etc.” (53.5%), “tube/pipe wells” (17.3%) and “unprotected dug wells” (15.5%). Access rate to “improved water” is 27.9%. A high 47% of the households depend on remote water sources.

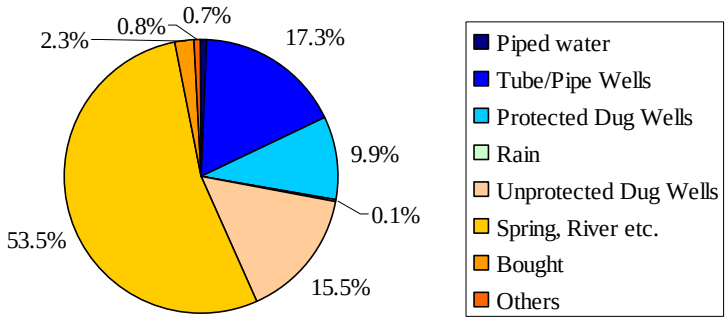


Figure 4.16.3 Type of Water Sources (Ratanak Kiri Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in the table below. The functioning rate of borehole is 91.0%

Table 4.16.4 Monitoring Results by PDRD (Ratanak Kiri Province)

Item	Total	Function		Broken	
		No.	Ratio	No.	Ratio
Tube well (full year)	N/A	820	**	N/A	**
Tube well (half year)	N/A	140	**	N/A	**
Tube well (rehabilitation)	N/A	215	**	N/A	**
Total	1,291	1,175	91.0%	116	9.0%
Hand-dug well (full year)	337	N/A	**	N/A	**
Hand-dug well (half year)	214	N/A	**	N/A	**
Hand-dug well (rehabilitation)	217	N/A	**	N/A	**
Hand-dug well (no ring) (full year)	3,652	N/A	**	N/A	**
Hand-dug well (no ring) (half year)	279	N/A	**	N/A	**
Community pond (full year)	24	N/A	**	N/A	**
Community pond (half year)	23	N/A	**	N/A	**
Community pond (upgrade)	25	N/A	**	N/A	**
Natural lake (full year)	10	N/A	**	N/A	**
Natural lake (half year)	12	N/A	**	N/A	**
Natural lake (upgrade)	16	N/A	**	N/A	**

Source: PDRD in Ratank Kiri (2008)

3) Hand pumps

Afridev hand pumps are common in this province, but their spare parts cannot be easily procured and PDRD do not have stock inventory. If WSUG needs spare parts for Afridev hand pumps, the following conditions are to be applied:

(i) In case of projects from donors, standard spare parts are provided to WSUG; and

(ii) If WSUG consumes such parts, WSUG purchases some parts directly in the local market that is relatively expensive.

4) Water Quality of Groundwater

Water quality is not a problem, except in some areas where there is iron contamination.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 26 staff members, with 2 members belonging to the Office of Rural Water Supply and 2 to the Office of Primary Health.

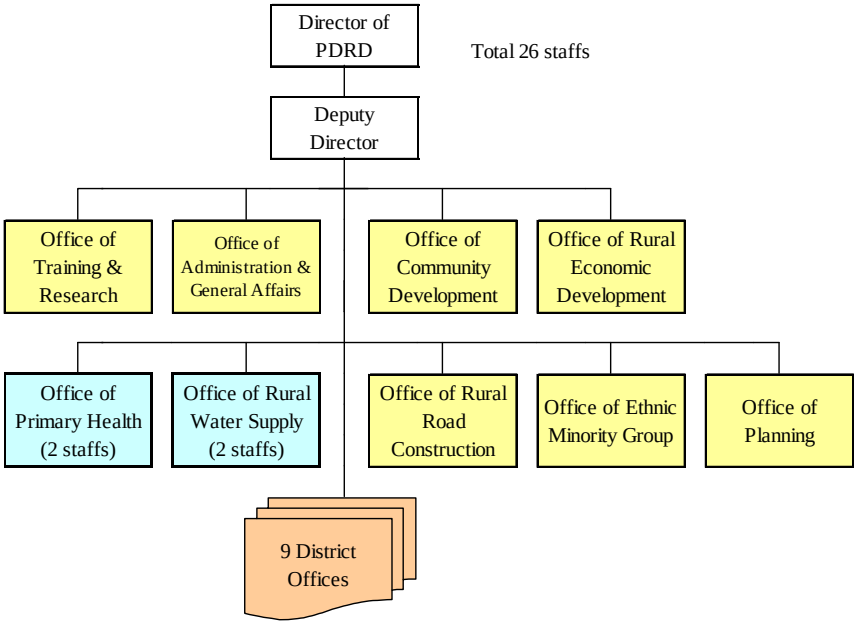


Figure 4.16.4 PDRD Organization Chart (Ratanak Kiri Province)

2) Budget

"External charges for services" and "personal expenses" account for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects as well as the MRD financial package budget in 2009.

Table 4.16.5 PDRD Budget (Ratanak Kiri Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	158.6	16.4%	155.6	5.7%
	External charges for services	568.0	58.7%	2,232.0	82.4%
	Other external charges for services	110.0	11.4%	160.0	5.9%
	Personal expenses	131.0	13.5%	160.0	5.9%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	967.6		2,707.6	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has drawn up the 5 year, 3 year and annual development plan based on the ministerial decree by the provincial government.

(3) Assistance by Other Donors

1) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation.

(ii) Target sites: Total 6 districts (Year 2010: 2 districts: Koiun Mom district : 19 villages in 5 communes, Lumphatdistrict：20villages in 5 communes)

(iii) Component: Construction of tube wells and community ponds, installation of bio-sand filters and rainwater jars and hygiene education

b. CLTS Project by UNICEF

(i) Component: Hygiene education including sanitation campaign

c. PSDD Program (Project to Support Democratic Development through De-centralization and De-concentration) financed by UNDP

(i) Component : This program supports a multi-sectoral approach, such as infrastructure, education, training, well construction and etc.; based on the National Committee for the Management of De-centralization and De-concentration Reform.

(ii) Period: starting from January 2010

d. GAA (German Agro Action: (NGO) Project

(i) Target sites: 30 villages, 2 districts

(ii) Component: Construction of dug wells and tube wells, household toilets, rural roads and hygiene education

e. Rehabilitation Project for Rural Water Supply financed by MRD

(i) Period: 2010

(ii) Component: Construction of 10 tube wells, rehabilitation of 50 existing wells and installation of 100 bio-sand filters

(4) Current Hygiene Condition

Households with toilets account for 11.3% (2,683 households) in the rural areas. Of these households, 39.2% use pit latrine and 31.0% use other types.

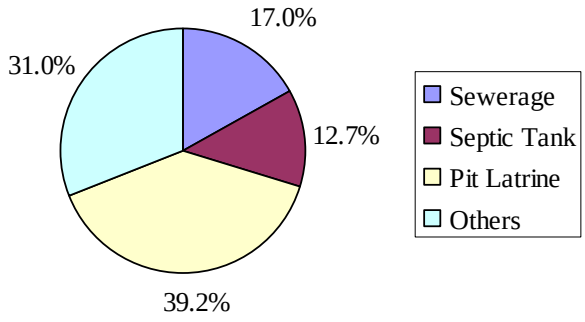


Figure 4.16.5 Type of Toilet (Ratanak Kiri Province)

(5) Provincial Features

Nine ethnic minorities live in this province. This province has low population and population density and is located far from Phnom Penh. Donor support is few.

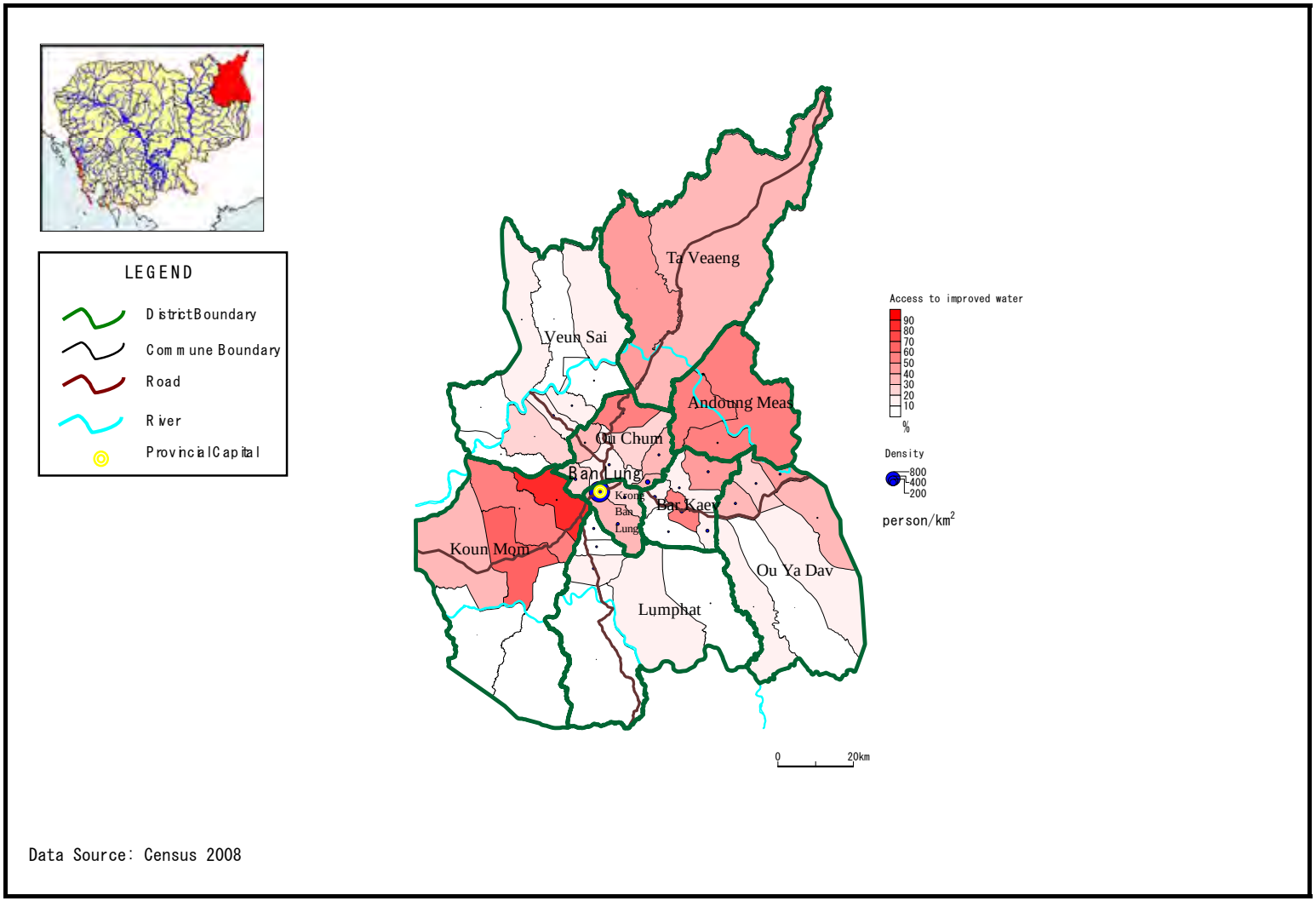
4.16.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 49 communes in this province, more than 50% of the households have access to "Improved water" in 9 communes.

Table 4.16.6 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Ratanak Kiri Province)

Urban	Rural	Total
1/1 communes	8/48 communes	9/49 communes

Note: The denominator in the table is the number of communes/Sang at



Unit: %, Source : 2008 Census

Figure 4.16.6 Service Area of Safe Water (Ratanak Kiri Province)

4.17 Siem Reap Province

4.17.1 Brief Description of the Province

The Siem Reap province has total area of 10,299 km^2, comprised of 13 communes and 111 villages. According to 2008 Census, population growth rate was 2.52 % for the whole province, 5.28% in urban area and 1.96 % in rural area.

4.17.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

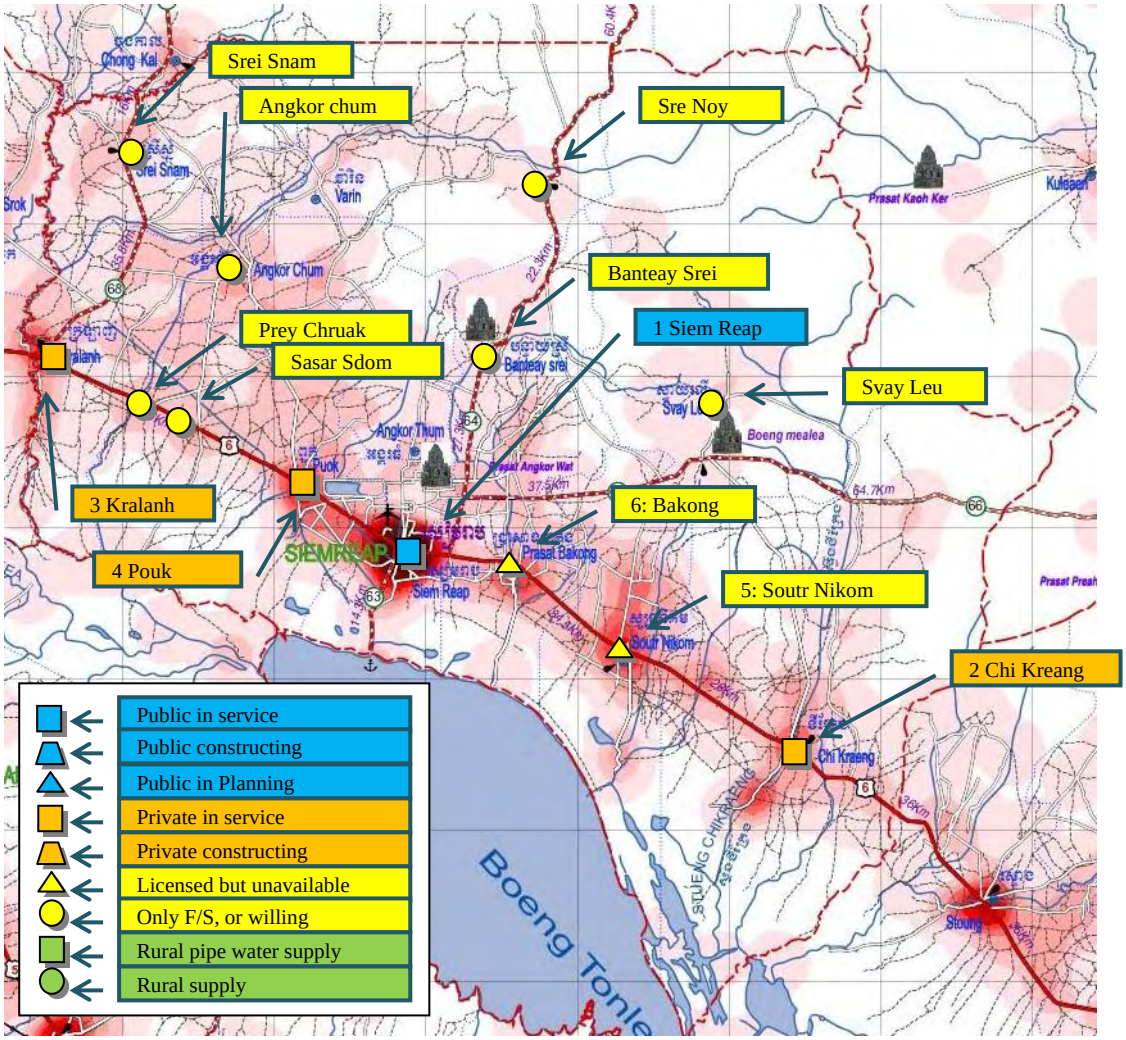


Figure 4.17.1 Existing Urban Water Supply System in Siem Reap Province

Table 4.17.1 Current Status of Urban Water Supply System in Siem Reap Province

No	Name of Town	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)	Remarks
1	Siem Reap	Pub	1995	48,900	3,893	9,007	Well	585,200	1,800	*1
2	Chi Kreang	Pri	N/A		359	1,500		160,000	2,000	
3	Kralanh	Pri	N/A		392	100		150,000	2,700	
4	Puok	Pri	N/A		310	100	Surface	160,000	2,000	
5	Stour Nikom	Pri	Not operated yet (water resource lacking)							
6	Bakong	Pri	Not operated yet (only license)							

*1: Water tariff schedule; 0-7m^3=1,100Riel/m^3; 8-15m^3=1,500 Riel/m^3; 16-30m^3=1,800 Riel/m^3; over 31m^3=2,000 Riel/m^3

Siem Reap, the provincial capital is served by SRWSA. Aside from this, three private-managed water supply systems are in operation. As to the two projects, though licensed as private-managed system, they are not in progress because of fund shortage and water resource issues.

Currently, F/S for water supply system expansion including the construction of a new WTP is in progress by JICA. Communes surrounding the existing system can be served when water supply capacity is increased.

2) Historical development of urban and public water supply system

1995 Water supply system including WTP was established through the support of French government.
2003 Construction of new WTP commenced through JICA assistance.
2006 New WTP was completed and commissioned.

The first water supply system was originally established by the French government. Through the assistance of USA and other donor countries, the following system was developed:

- Raw water is pumped from two tubewells drilled in city center.
- Raw water is treated by oxidation tank but treated water has pH less than 6 and Fe more than 1mg/L.
- Treated water is pumped to an elevated tank and served by gravity.
- Distribution amount was 1,400 m^3/day.

A basic study was then conducted in 1998 and a new WTP with capacity of 8,000 m^3/day was inaugurated in 2006. After training offered by technical cooperation, SRWSA was established and now handling sustainably the water supply project.
In Siem Reap, water demand is quite high, thus SRWSA augmented the supply through construction of a tube well with capacity of 1,400m^3/day within the premises of WTP. Current water supply capacity is about 9,000m^3/day.

3) Support from donor agencies

Preparatory study on water supply system expansion started in 2009. The study aims for a comprehensive system development that involves water supply capacity increase, expansion of service area by construction of new WTP, and review of existing sewerage plan. JICA is the sole donor for urban water supply of Siem Reap and SRWSA also requests assistance from JICA.

Aside from this, another WTP plan was proposed. Reportedly, construction of private-managed WTP planned near the existing WTP was proposed by KTC, Korean Telecommunication Company and contract is scheduled to be signed in 2010. In this project, KTC only sells potable water of 17,000m^3/day to SRWSA without transmission pipe and distribution network development. This may result to capacity shortage in the existing distribution system.

SRWSA is now conducting a water service needs survey to understand the detailed conditions of towns requesting for coverage extension of urban water supply service.

(2) Urban water supply system management structure

1) Organization structure of SRWSA

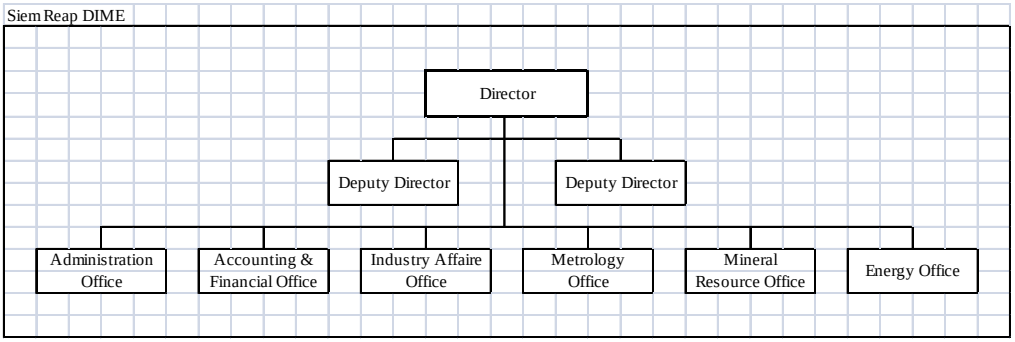


Figure 4.17.2 Organization Chart of SRWSA

The management of the water supply project is held by SRWSA wherein DIME has limited roles. This is mainly due to the following:

- Director of SRWSA is dispatched from MIME;
- SRWSA controls the project on behalf of MIME; and
- SRWSA is independent from DIME in terms of managerial aspect.

2) Capacity building for staff

Upon the establishment of SRWSA, all staff was given intensive technical training and also hold technical seminar by themselves.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Raw water source is 10 tubewells. Based on the impact assessment of groundwater pumping to Angkor Wat Ruins, the location of raw water well in the WTP site was examined not to affect the ruins. Iron removal is the main purpose of WTP.

The original WTP capacity was 8,000m^3/day and was increased to 9,000m^3/day with the drilling of an additional well. The well has a capacity of 1,400m^3/day located within the premises of the exoisting WTP. Raw water quality is stable.

2) Capacity and operation of WTP

Iron removal is performed by chlorine oxidation. Chlorine is injected at the receiving well. Iron is converted into un-dissolvable state at the oxidation tank and removed at the filtration tank. Clear water is then pumped to the elevated tank and supplied by gravity.

In some facility design, Japanese-type design is recognizable such as the anti-wave pipe in water level meter. This equipment is made in Japan. Construction of a second WTP is now being examined to deal with rapid water demand growth.

3) Capacity and operation of distribution system

Before SRWSA becomes a public service organization, NWR rate was almost 40％ but was reduced to 27% in 2006 and to 12% in 2009. The SRWSA is facilitating a NRW reduction program as one countermeasure for an efficient water supply. Further, pipes made of prohibited materials such as Asbestos Cement Pipes have already been replaced.

Along with the construction of a new WTP, the distribution network capacity expansion plan is now being examined. Existing distribution network capacity is almost equivalent to the WTP capacity, around 9,000m^3/day. If more water is supplied, pressure maintenance becomes difficult.

4) Water supply O&M status

SRWSA became a public service organization in 2007 and developed into a self-sustaining organization. Based on successful operation of SRWSA, aggressive management is displaying positive results. For instance, staff's motivation was elevated by salary upgrades and authority transfers. Together with financial transparency and policies to secure water sales income, the management is about to enter into autonomous growth progress. SRWSA is constructing wells to mitigate water shortage by its own budget.

SRWSA director is familiar with the current status of water supply projects in the whole province. Water supply facility map and pipeline layout drawing are stored in WTP. Water charge post is located at city center.

5) WTP O&M status

WTP is directly operated and managed by SRSWA staff. Operation control system is equipped in WTP's administration building and operated by staff with special training. Due to high raw water quality and advanced water treatment method, treated water quality is excellent.

6) Water quality and control

The Study team requested SRWSA to submit water quality data in order to assess WTP's operational status, but could not collect.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.17.2 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future (2017)
Total population		161,100	176,905	184,838	191,149		283,290
Population in supply area			107,259	122,416	126,208	177,820	283,290
Service population		9,699	18,963	23,071	24,067	53,350	232,310
Service connection or household		1,830	3,578	4,353	4,541	4,500	41,871
Water supply (intake or treat)		3,390	6,294	8,687	8,991	9,000	56,000
Water supply (distribution)		2,502	5,000	7,581	7,917	9,000	56,000

Note: Blank means N/A

As Siem Reap has annual visitors exceeding two million, a large percentage of tourism income is earned here. Rapid economic development caused migration from surrounding areas and resulting to rapid increase of population.

Due to world-wide financial recession, the increase in water demand was slightly lowered but still considered at a high level. As the city area of Siem Reap was expanded, correspondingly, the area coverage rate of water supply service was lowered to 16%. Current house connection is 4,500 units of which 3,800 units are connection to common housing. About 1,000 units are wait-listed house connections.

2) Water tariff

Current water tariff applies a progressive system as follows:

0-7 m^3	1,100 Riel/m^3
8-15 m^3	1,500 Riel/m^3
16-30 m^3	1,800 Riel/m^3
Over 31 m^3	2,000 Riel/m^3

House connection fee is 520,000 Riel/unit but is to be refunded upon water service termination. Water charge post is set-up at former WTP site with water charge management office stationed at the same place.

3) Extent of water supply service

Water service is provided 24 hours. As there are many wait-listed connections, expansion of service area is an urgent concern.

(5) Financial status of public system

1) Current financial status

Recent financial statements were collected: P/L in 2008 and 2009; and B/S in 2009. These were all prepared in English and stored in a computer. Prints-outs can be provided upon request.

2) Potentials for sustainable management by water sales income

Recent balance showed a profitable venture with total income exceeding total expenditure. Percentage of water sales income to total income was 89%, indicating a satisfactory level.

3) Composition of Expenditures

Major expenditure items were costs for power, labor and depreciation. Significant variations were rarely observed. Low level of depreciation suggests high income by low investment.

Table 4.17.3 Financial Statement of SRWSA

Siemreap	1,000 Riel
Aasets	**21,454,719**
Current Aasets	**5,016,082**
Cash	2,896,163
Current Receivable	514,295
Materials	1,605,624
Fixed Assets	**16,438,637**
Land	7,783,680
Buildings net	2,248,765
Machineries net	5,727,220
Other Equipments net	678,972

Liabilities & Equity	**21,454,719**
Liabilities	**1,862,658**
Current Liabilities	1,412,697
Long term Liabilities	449,961
Equity	**19,592,062**
Capital	17,560,793
Retained Earnings	2,031,269

Fixed Assets Ratio	83.9%
Fixed Assets to Fixed Liability Ratio	82.0%
Equity Ratio	91.3%
Suppy per Assets	6,531 Riel/m3

4) Financial stability

The capital structure is quite sound with an equity capital ratio of 91% and a long-term liability ratio of 84%.

5) Fund investment

Calculated unit investment amount per annual water supply amount was 6,531 Riel/m^3. As

with Preah Sihanouk, this figure can be regarded as standard level when water supply project is efficiently operated.

1,000 Riel

	2009	2008	Retio
Revenue	**4,771,287**	**3,896,136**	**100.0%**
Water revenue	3,839,815	3,465,661	89.0%
Others	931,472	430,475	11.0%
Expense	**4,069,998**	**3,057,947**	**100.0%**
Operating Expense	**4,069,998**	**3,057,947**	**100.0%**
Electricity Cost	763,189	754,722	24.7%
Chemicals	201,689	162,395	5.3%
Fuel	145,627	101,655	3.3%
Spairparts	930,915	340,062	11.1%
Labor & Temp. staff	287,405	228,434	7.5%
Salary & Allowance	598,722	563,984	18.4%
Depreciation	538,934	496,501	16.2%
Others	603,517	410,194	13.4%
Operating Expense	**0**	**0**	**0.0%**
Administrative & Tax	0	0	0.0%
Net income	701,289	838,189	27.4%

Amout of Water Supply	9,000	m3/day
Unit price of Water Supply	1,186	Riel/m3
Energy Cost per Water	310	Riel/m3
Material Cost per Water	104	Riel/m3
Labor Cost per Water	241	Riel/m3

4.17.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

Sources of water in the province consist of “unprotected dug wells” (40.8%), “tube/pipe wells” (30.9%) and “springs, rivers, etc.” (12.0%). Access rate to “improved water” is 43.1%. About 40.0% of the households depend on remote water sources.

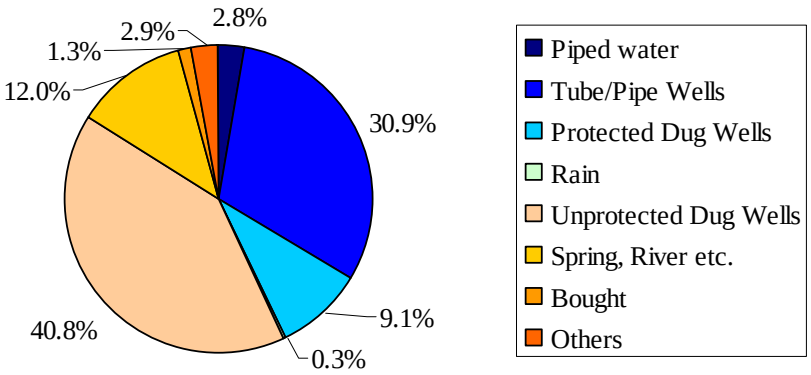


Figure 4.17.3 Type of Water Sources (Siem Reap Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in the table below. The functional rate of water supply facilities is 85.9%.

Table 4.17.4 Monitoring Results by PDRD (Siem Reap Province)

Items	Total	Functional		Non-functional	
	No.	No.	Ratio	No.	Ratio
Boreholes / Mixed Wells	35,864	33,495	93.4%	2,369	6.6%
Open Wells	12,259	10,289	83.9%	1,970	16.1%
Unprotected Open Wells	8,982	5,658	63.0%	3,324	37.0%
Ponds with Filter	73	33	45.2%	40	54.8%
Ponds without Filter	1,293	751	58.1%	542	41.9%
Total	58,471	50,226	85.9%	8,245	14.1%

Source: PDRD in Siem Reap (2009)

3) Hand pumps

Afridev hand pumps and VN6 hand pumps are commonly used, and spare parts for both are available for procurement in this province. Although the type of hand pumps is basically determined by groundwater level, residents prefer VN6 hand pumps because of cheaper cost and easy maintenance than Afridev hand pump.

4) Water Quality of Groundwater

Based on the water quality analysis by Arsenic Center, no groundwater samples exceeded 10ppb of arsenic contamination.

Table 4.17.5 Result of Arsenic Testing（Siem Reap Province）

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
74	0	0.0%	0	0.0%	74	100.0%

Source: Arsenic Center (2005-2007)

A few salts were detected in groundwater samples around Tonle Sap Lake. Iron contamination was also detected. In cases of high iron contamination, iron removal device is installed. According to ADB Tonle Sap Project, a resident pays 7.5 US$ for installation of iron removal device in which the total cost is 500US$. Water quality monitoring is being carried out 2 times per week because of monitoring limitation. Monitoring is not carried out in other areas.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 83 staff members, with 12 members belonging to the Office of Rural Water Supply and 11 to the Office of Primary Health.

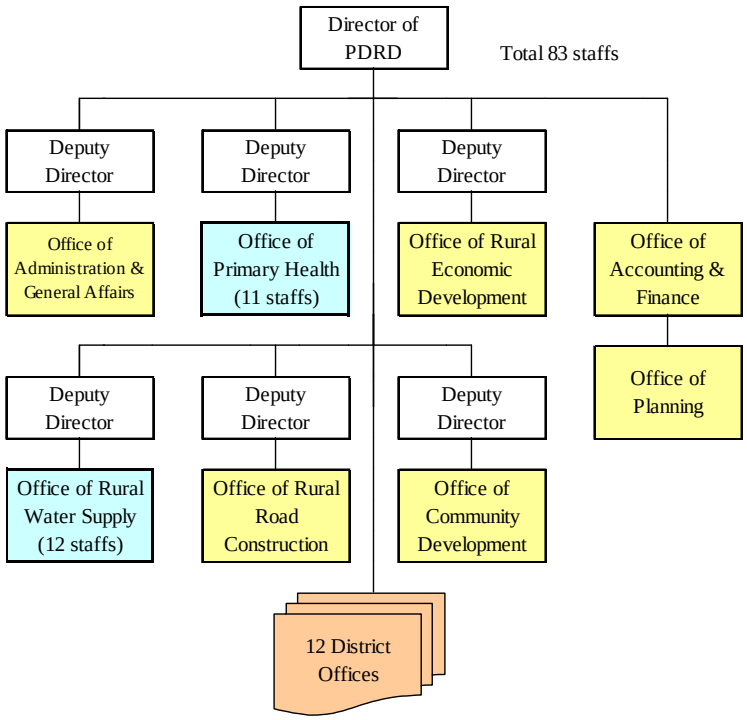


Figure 4.17.4 PDRD Organization Chart (Siem Reap Province)

2) Budget

"External charges for services" accounts for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 60.0 million Riel was allocated in 2009 as MRD financial package budget which was mainly used for rehabilitation for existing facilities.

Table 4.17.6 PDRD Budget (Siem Reap Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	307.0	20.3%	305.0	15.7%
	External charges for services	405.0	26.7%	705.0	36.3%
	Other external charges for services	563.0	37.1%	563.0	29.0%
	Personal expenses	238.9	15.8%	369.4	19.0%
	Taxes and similar services	2.0	0.1%	2.0	0.1%
	Total	1,515.9		1,944.4	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	60.0	0	under preparation by MRD	
	Well rehabilitation		62		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		62		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Although PDRD has recognized the significance of monitoring the water supply facilities, it could not carry out monitoring regularly except for donor projects due to lack of budget. Additionally, PDRD constructed about 300 tube wells using its own drilling rig in the past. But at present, it is difficult to carry out groundwater development by themselves because of insufficient budget allocation and skilled staff.

(3) Assistance by Other Donors

1) Existing Project

a. Tonle Sap Water Supply and Sanitation Project by ADB

ADB has implemented Tonle Sap Water and Sanitation Project from 2006 to 2010. Four districts were targeted in this province and this involved the construction of water supply and sanitation facilities, such as open wells, tube wells with hand pumps, community ponds and toilets.

2) New Assistance Plan

a. GTZ Project

This project, in which the feasibility study has already been completed in 2009, aims at the provision of safe pipe water to 300 households in Sre Noy commune, Varin district and Cha Chhouk commune, Angkor Chum district. The project is currently under preparation for bidding. Based on the plan, all villages in each commune are not covered by this project. Implementation agency is not DIME but PDRD.

b. Second Rural Water Supply and Sanitation Project by ADB

ADB has a new assistance plan, of which the contents are almost as the same as the Tonle

Sap Rural Water and Sanitation Project (2006-1010) to be launched in July, 2010.

(4) Current Hygiene Condition

Households with toilets account for 15.9% (23,121 households) in the rural areas. Of these households, 46.1% are connected to sewerage system and 32.9% use septic tanks.

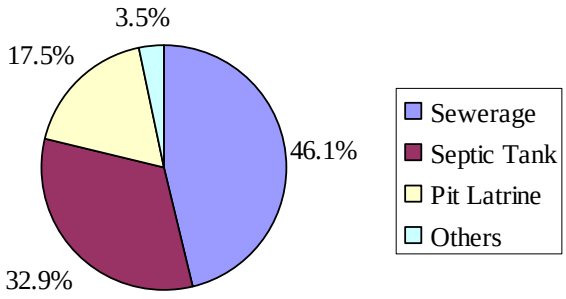


Figure 4.17.5 Type of Toilet (Siem Reap Province)

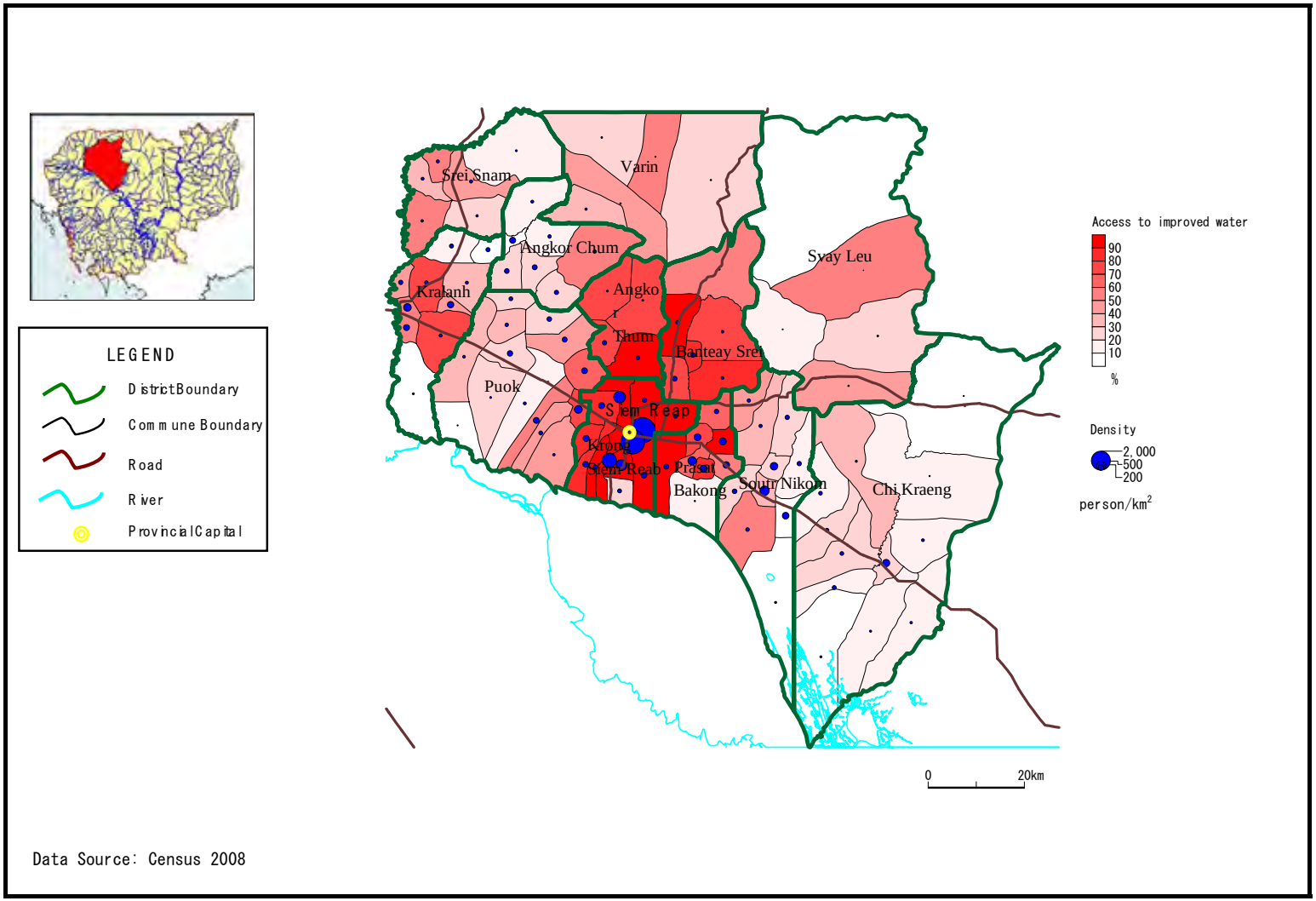
4.17.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 100 communes in this province, more than 50% of households have access to "Improved water" in 42 communes.

Table 4.17.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Siem Reap)

Urban	Rural	Total
6/6 communes	36/94 communes	42/100 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source 2008 Census

Figure 4.17.6 Service Area of Safe Water (Siem Reap Province)

4.18 Preah Sihanouk Province

4.18.1 Brief Description of the Province

The Preah Sihanouk province has total area of 1,938 km^2, comprised of 4 districts, 26 communes, and 110 villages. According to 2008 Census, urban population was 89,447 persons (18,353 HH) and rural population was 131,949 persons (26,303 HH). Population growth rate was 2.54 % for the whole province, 2.93% in urban area and 2.28 % in rural area.

4.18.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Central area of Preah Sihanouk is served by a public-managed water supply system and two more private-managed systems are in operation.

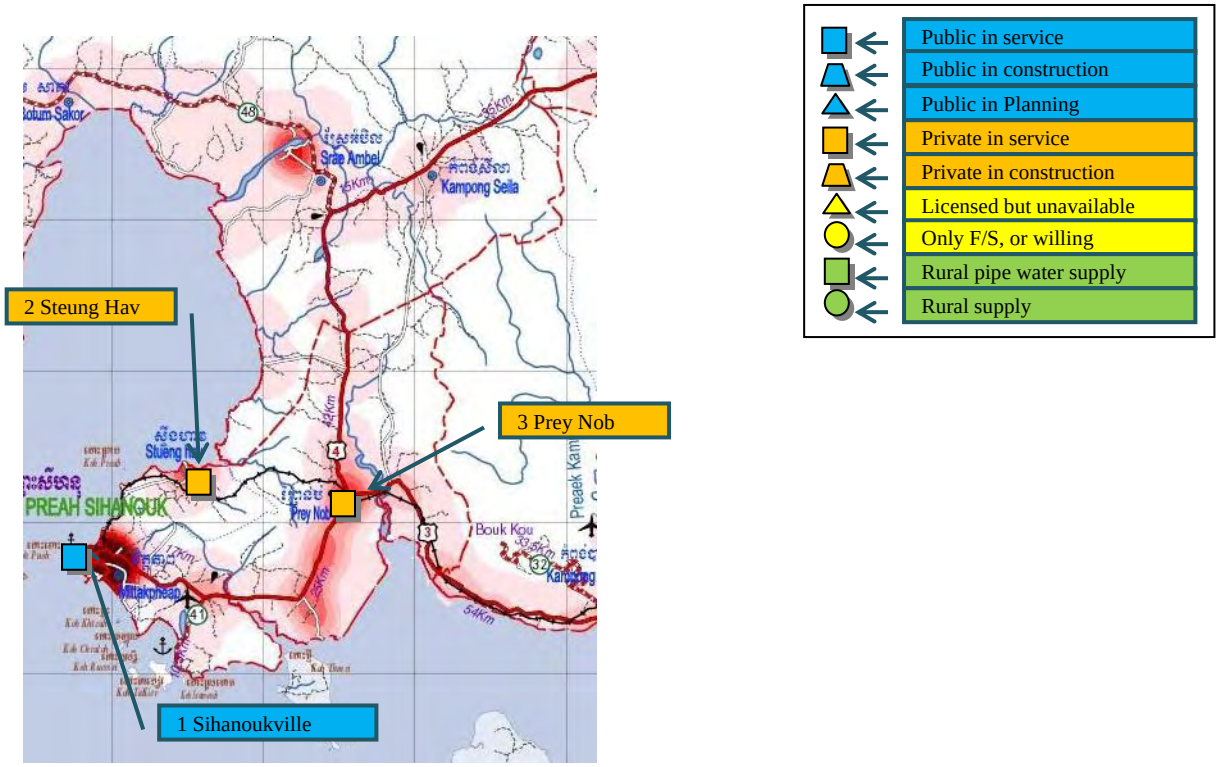


Figure 4.18.1 Existing Urban Water Supply System in Preah Sihanouk Province

Table 4.18.1 Current Status of Urban Water Supply Preah System in Sihanouk Province

No	Name of Town	Ownership	Year Established	Population	No. of Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Sihanoukville	Pub	1958	28,196	3,845	6,551	Lake		1,800
2	Steung Hav	Pri	2005	4,200	300	100	Stream	200,000	3,500
3	Prey Nob	Pri	2005	1,700	1,000	100	Stream	200,000	3,000
4	Prey Nob	Pri	Not operated yet (only license)						

Note: Blank means N/A.

2) Historical development of urban and public water supply system

1958	Water supply system was established in during the French regime.
1975 to 1978	Pol Pot group destroyed the system and water supply was discontinued.
1979	System rehabilitation was started with support from Eastern countries.
1980 to 1993	During rehabilitation works, untreated water was supplied free of charge.
1994	Urgent whole system rehabilitation was undertaken by UNDP.
1998 to 2003	Service area expansion and improvement in operation/management was carried out through the WB loan.

The provincial capital is served by a public-managed system under the jurisdiction of DIME. The former system was constructed by the French government in 1958 but was destroyed by Khmer Rouge regime between 1975 to 1978. In 1979, the government started system rehabilitation through technical cooperation from Russia. From here until 1993, water quality was not acceptable. In 1994, rehabilitation of WTP and distribution system was launched with the support of UNDP. Treated water quality was then drastically improved. At present, water quality is good and complies with WHO standard.

3) Support from donor agencies

JICA technical assistant project – Phase II is executing the training program to capacity deveropment in DIME. At present, there are no other donors except JICA and DIME is requesting distribution network development through JICA's assistance. Dam construction was executed by the private sector.

(2) Urban water supply system management structure

1) Organization Structure of DIME and Public Water Utility

DIME has 74 staff and 49 are assigned to water supply project.

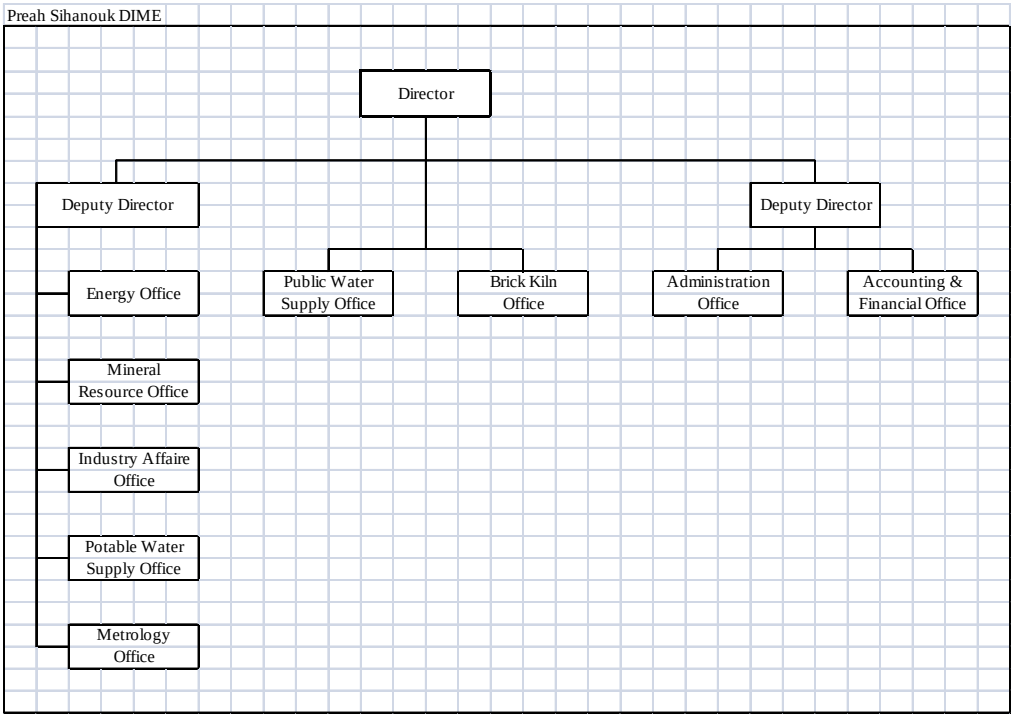


Figure 4.18.2 Organization Chart of DIME in Preah Sihanouk Province

2) Capacity development for staff

Technical seminars were conducted by PPWSA, MIME and JICA. Seminars managed by JICA are the most frequent.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Raw water source comes from lake water of a dam with a surface area of 15.5 ha and a catchment area of 270 ha. Water supply amount was 6,944m^3/day. Aside of this, groundwater source is available. As a seasonal issue, water level of the dam has a tendency to lower / deplete during May causing raw water shortage.

As a counter-measure to this water shortage, dam construction by private fund was started and was commissioned in 2009. Reportedly, this particular concession contract is quite vague. Its contents could not be confirmed.

2) Capacity and operation of WTP

Design capacity is 8,000 m^3/day and current treatment capacity is 6,500 m^3/day. Coagulation and sedimentation facilities based on an old French technology still remains. Dissolved alum is injected in the receiving well and incoming water is treated by circular shaped up-flow sedimentation basin.

Four chambers of filtration tanks equipped with air back-washing devise are installed. Russian and Amas pumps are adopted. New electric equipment appears to be installed

through UNDP assistance. Generally, equipment is satisfactory.
Remarkable point is the installation of sludge treatment facility. No sludge thickener is observed but sludge drying beds are properly operated.

3) Capacity and operation of distribution system
Port facilities and beer brewery are large-scaled conmsumers. Curernt water supply amount is 6,500 m^3/day, covering only 30% of water demand. The low coverage is caused by capacity shortage of distribution pipeline. A study was conducted with support from JICA's technical cooperation project in order to remedy the problem and drawings are available.
NRW rate is 19%. There are 143 cases of water leakage repair works and records are filed by the leakage repair team.
As Preah Sihanouk has rather an undulating topography, comparatively high pressure is needed for water distribution to the whole service area. Consequently, the WTP is built on top of a hill but high pressure might cause water leakage. High pressure is advantageous for service area expansion but application of pressure reducing tank shall be considered for areas near the WTP.

4) Water supply O&M status
DIME director seemed to delegate water supply project to WTP staff. Detailed data was collected in WTP. Reportedly, low salary standard is being complained.

5) WTP O&M status
Coagulation status is not so good, although still in permissible level. In case of Kampomg Chchang, influence of French design is still visible.
Filtration tank is properly functioning and automatic back-washing is performed. Control panels are new and half-automatic. Raw water looks like it has relatively high turbidity. Alum and slaked lime are used, the same as with the other WTPs in Cambodia.
Disinfection is done by chlorine gas. Slaked lime is used for pH adjustment. Chemicals are dissolved and injected by controlled concentration.

6) Water quality control and supply water quality
Standard tools and equipment are installed in the laboratory. Designated water indices are analyzed daily because raw water has high Cu content.
The results of the analysis data are stored in WTP. Technical instruction through technical cooperation program was provided.

Table 4.18.2 Result of WTP Water Quality Analysis

Coagulation Management	Unit	Target	Raw Water	Sedimentation	Distribution
Temperature	℃	－	29 – 31	29 – 31	29 – 31
pH	－	7.0	6.5 – 7.1	6.4 – 6.9	6.6 – 7.2

Turbidity	NTU	Sed<10 Dis<1.0	4.4 – 13.3	1.5 – 6.8	0.4 – 1.9
Free Chlorine	mg/L	AF>0.1 Dist=1.0		0.00	1.15 – 1.6
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	42 – 47	47 - 53	52 – 65
Color	TCU	Sed<20 Dis<5	220		12
Alkalinity [mg/L]	mg/L	>10	12 - 17		11 – 17

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800	20 – 22	24 – 31
Total Hardness	mg/L	< 250	5	12
Total Organic Carbon	mg/L		9.2 – 11.6	2.9 – 4.9
Ammonia (NH3+)	mg/L	< 1.5	<0.01	0.06
Iron (Fe2+)	mg/L	< 0.3	1.59	0.22
Manganese(Mn2+)	mg/L	< 0.3	0.03	0.01
Arsenic (As)	µg/L	< 50		
Chlorine (Cl-)	mg/L	< 250	7.1	8.9
Copper (Cu2+)	mg/L	< 1	0.016	0.000

Testing Status	
Testing Lab	WTP
Daily Record	OK
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	OK
Latest test in	2010
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	N/A

The data in red was taken in March 2010. The data hiligted was taken in April 2010.

Though water quality management structure is satisfactory, treated water quality is not. Compared with other areas, raw water turbidity is rather low but color is quite high, supposedly due to high Fe content.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.18.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		70,947	61,189	65,515	70,399	70,399	
Population in supply area		68,847	59,494	63,820	68,492	68,492	
Service population		20,468	21,700	25,781	26,915	28,196	62,760
Service connection or household		2,924	3,100	3,683	3,845	3,845	8,966
Water supply (intake or treat)		3,793	4,376	4,885	5,352	6,551	
Water supply (consumption)		2,944	3,428	4,121	4,111		

Note: Blank means N/A.

Water supply amount is 6,500m^3/day, while the current water demand in the service area is 8,500m^3/day. Actual water demand coverage is less than 40%. This is basically caused by capacity shortage in the distribution network. Future plan described the following targets:

- House connection of 9,000 units, service population rate of 80%, service population of 72,760 until 2015
- House connection of 12,100 unis, service population rate of 85%, service population of

84,677 until 2020

2) Water tariff

Current water rate is a progressive system as shown below:

Less than 7 m^3	1,500Riel/m^3
8 to 15 m^3	1,800Riel/m^3
More than 16 m^3	2,000Riel/m^3

Water charge is paid at PSWSA office and collected every month.

3) Extent of water supply service

A 24 hours water supply service is available throughout the year. Related procedures are explained to residents upon house connection work.

(5) Financial status of public system

1) Current financial status

P/L in 2008 and 2009 and B/S in 2009 were collected. Cost items were analysed based on them.

Table 4.18.4 Financial Statements of DIME in Preah Sihanouk Province

Sihanouk 1,000 Riel

Aasets	**14,658,073**
Current Aasets	**3,613,210**
Cash	1,837,080
Current Receivable	688,306
Materials	1,087,824
Fixed Assets	**11,044,863**
Land	74,000
Buildings net	967,255
Machineries net	8,063,444
Other Equipments net	1,940,164

Liabilities & Equity	**14,658,073**
Liabilities	**13,756,586**
Current Liabilities	420,357
Long term Liabilities	13,336,229
Equity	**901,487**
Capital	1,281,802
Retained Earnings	-380,315

Fixed Assets Ratio	1225.2%
Fixed Assets to Fixed Liability Ratio	77.6%
Equity Ratio	6.2%
Suppy per Assets	6,130 Riel/m3

1,000 Riel

	2009	2008	Retio
Revenue	**3,805,940**	**3,117,349**	**100.0%**
Water revenue	2,844,589	2,859,757	91.7%
Others	961,351	257,592	8.3%
Expense	**3,726,414**	**2,840,106**	**100.0%**
Operating Expense	**3,661,138**	**2,657,749**	**93.6%**
Electricity Cost	607,212	657,706	23.2%
Chemicals	144,514	164,702	5.8%
Fuel	94,849	170,129	6.0%
Spairparts	872,349	254,146	8.9%
Labor & Temp. staff	159,545	8,864	0.3%
Salary & Allowance	488,771	490,732	17.3%
Depreciation	683,899	773,389	27.2%
Others	609,999	138,081	4.9%
Operating Expense	**65,276**	**182,357**	**6.4%**
Administrative & Tax	65,276	182,357	6.4%
Net income	79,526	277,243	9.8%

Amout of Water Supply	6,551	m3/day
Unit price of Water Supply	1,304	Riel/m3
Energy Cost per Water	415	Riel/m3
Material Cost per Water	106	Riel/m3
Labor Cost per Water	209	Riel/m3

2) Potentials in self-reliance management by water sales income

Recent balance was profitable and total income exceeded total expenditure.

Percentage of water sales income to total income was 92% in 2009 and 75% in 2008, reflecting an unstable condition.

3) Composition of expenditures

Major expenditure items were costs for depreciation, power, and labor. As fluctuation in spare parts and fuel cost is great, a review by re-evaluation of current value of stock assets is necessary. In general, accounting is vague. Material procurement may have been executed based on temporary needs and not on procurement schedule.

4) Financial stability

The capital structure is weak due to annual operation loss attributing to substantially reducing the equity's capital and net worth. The equity debt ratio is 94％ and the long-term liability ratio is quite high at 1,226％due to heavy debt.

5) Fund investment

Calculated unit investment amount per annual water supply amount was 6,130 Riel/m^3. This figure is equivalent to Siem Reap WSA and thus can be regarded as standard level.

(6) Relevant facilities

1) Steung Hav private managed water supply system

● Description of the system

Established in 2005, the service population is 4,200. Water supply amount is 385m^3/day and water intake amount is 400m^3/day. Water rate is taken at 3,500 Riel/m^3. The number of staff is 7.

As WTP is located on top of a hill, the whole service area can easily be viewed. An exclusive commercial area is anticipated to be a major water demand area which is now undergoing development. Roads are not yet paved but factories are already attracted to locate. Future water demand is expected to increase. According to the results of the questionnaire survey, population has doubled in the last five years.

● Water supply facilities

According to DIME, raw water source is an irrigation canal that looks like a lake. Since WTP is located on top of a hill, raw water cannot be transmitted to WTP by a single intake pump. A second engine pump has to be installed halfway the hill.

Water treatment method is similar to that of Pailin public-managed system. After coagulation, sedimentation is executed in vertical flow type rectangular tank.

Several intake pipes are installed but their usage is unknown. Supposedly, water intake from several water sources is installed by staged facility expansion works.

Diameter of PVC supply pipe isφ100 which is rather small but relative water amount can be supplied by gravity because of large elevation interval.

● Operational status

No information has been gathered. Application of chemical dosing and chemicals could not be confirmed.

Though WTP is located in a quite elevated site, no safety device such as walking gallery is installed. Owing to good raw water quality, coagulation was properly performed. Also, due to high turbidity removal, treated water had high transparency.

2) Prey Nob private managed water supply system

● Description of the system

Raw water source is a small pond upstream of a river. During the field survey, the pond was completely dry and raw water was taken from other source.

Based on the questionnaire survey results, the WTP was commissioned in 2005. The system has a service population of 1,700, and a water supply amount of 175m^3/day. Both are gradually increasing. Water supply service is 8 hours, while water rate is 3,000 Riel/m^3.

● Water supply facilities

Though water treatment method is coagulation and sedimentation, chemical agitation method is not obvious. Trough looking device was observed at filtration tank but it seemed to be clogged since treated water was overflowing.

● Operational status

O&M staff is stationed in an office built within the WTP premises. Chemicals are stored in a warehouse but function of the WTP was discontinued.

4.18.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Unprotected Dug Wells” (40.0%), “Protected Dug Wells” (14.2%) and “Piped Water” (12.0%), and the access rate to improved water is 37.1%. About 42.8% of households in this province depend on remote water sources.

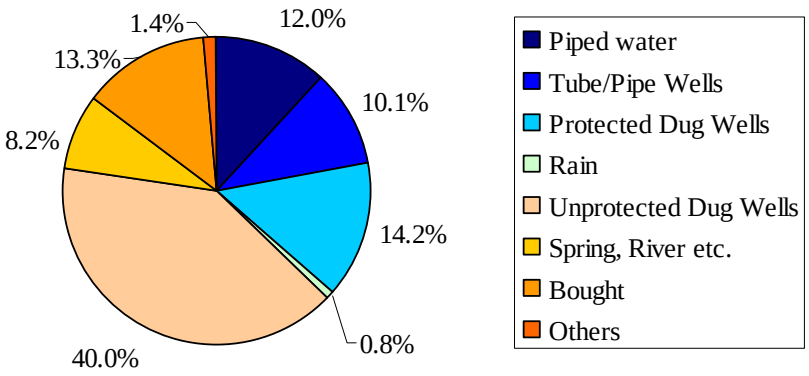


Figure 4.18.3 Type of Water Sources (Preah Sihanouk Province)

2) Condition of Water Supply Facilities

Since PDRD has not carried out any regular monitoring and data management, the present condition of water supply facilities in villages cannot be ascertained. It is estimated however, that 50% of the tube wells out of the 244 managed by PDRD are non-functional at present. The high percentage is due to the over-utilization of these facilities. More than 25 households used one tube well instead of the recommended 25 households by MRD resulting to easy breakdown.

Meanwhile, based on the District Data Book (2008) by UNDP, the proportion of tube wells which is functional the whole year is 85.1%, while the remaining 17.6% is non-functional.

Table 4.18.5 Functioning/Un-functioning Conditions of Water Supply Facilities (Preah Sihanouk Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	2,631	
Year-round usable pumped or mixed wells	2,239	85.1%
Dry season unusable pump or mixed wells	392	14.9%
Pump or mixed wells needing repair/rehabilitation	462	17.6%
Total number of ring wells	4,382	
Year-round usable ring wells	3,741	85.4%
Dry season unusable ring wells	641	14.6%
Ring wells needing repair/rehabilitation	508	11.6%
Total number of un-protected dug wells	1,315	
Year-round usable un-protected dug wells	1,012	77.0%
Dry season unusable un-protected dug wells	303	23.0%

Source: District Book (2008)

3) Hand pumps

Afridev hand pumps are common, while in Islamic and Khmer communities, VN6 hand pumps

are the most widely used. Procurement of spare parts for Afridev hand pumps is difficult in this province, and serious breakdowns of these hand pumps are only responded by PDRD to WSUGs.

4) Water Quality of Groundwater

According to a water quality survey in 2007 by MRD, arsenic contamination was not detected from 3 tube wells. Nevertheless, from existing record, 10% of the 244 wells had problems on iron and salt contamination. Iron removal devices were installed in 4 tube wells by MACEL project.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 23 staff members, with 2 members belonging to the Office of Rural Water Supply and 2 belonging to the Office of Primary Health.

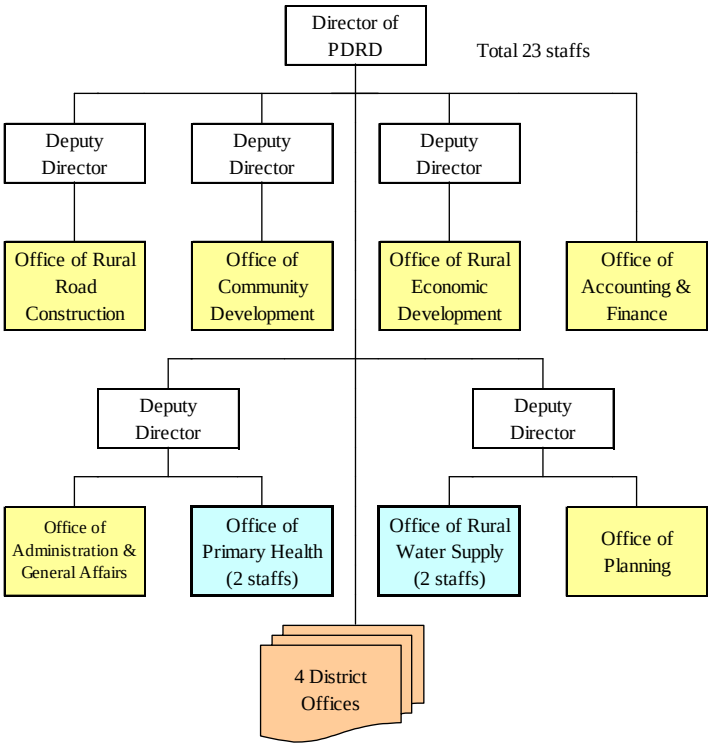


Figure 4.18.4 PDRD Organization Chart (Preah Sihanouk Province)

2) Budget

"External charges for services" and "personal expenses" account for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 154.5 million riel was allocated in 2009 as a MRD finical package budget which was mainly used rehabilitation for existing facilities.

Table 4.18.6 PDRD Budget (Preah Sihanouk Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	173.0	18.4%	170.0	17.8%
	External charges for services	535.0	57.0%	535.0	55.9%
	Other external charges for services	147.0	15.7%	147.0	15.4%
	Personal expenses	84.0	8.9%	105.0	11.0%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	939.0		957.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	154.5	0	under preparation by MRD	
	Well rehabilitation		105		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		105		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Since PDRD has not been allocated sector budget from provincial government, it has carried out monitoring once a year in order to request rehabilitation for existing facilities using MRD finance package. PDRD has also requested funding for a 2010 new development plan but it seems that MRD is difficult to allocate budget this year.

(3) Assistance by Other Donors

1) Existing Project

A total of 242 tube wells with hand pumps were constructed from 1994 to 2009 under the following projects:

- Construction of 66 tube wells with hand pumps by MRD
- Construction of 6 tube wells with hand pumps by MACEL (France student fund) (from 1997 to 2001)
- Construction of 20 tube wells with hand pumps by Social Fund (2003)
- Construction of 100 tube wells with hand pumps financed by the Chinese government (2003)
- Construction of 50 tube wells with hand pumps by Islamic- Khmer Community (2009)

2) New Assistance Plan

a. Rehabilitation Project for Rural Water Supply financed by MRD

PDRD has a plan for rehabilitation of tube wells with hand pump in 2010.

(4) Current Hygiene Condition

Households with toilets account for 28.8% (7,579 households) in the rural areas. Of these households, 41.3% are connected to sewerage system and 41.2% use septic tanks.

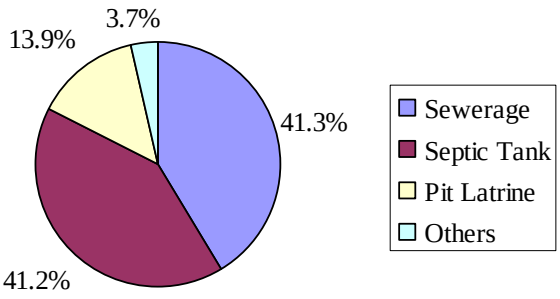


Figure 4.18.5 Type of Toilet (Preah Sihanouk Province)

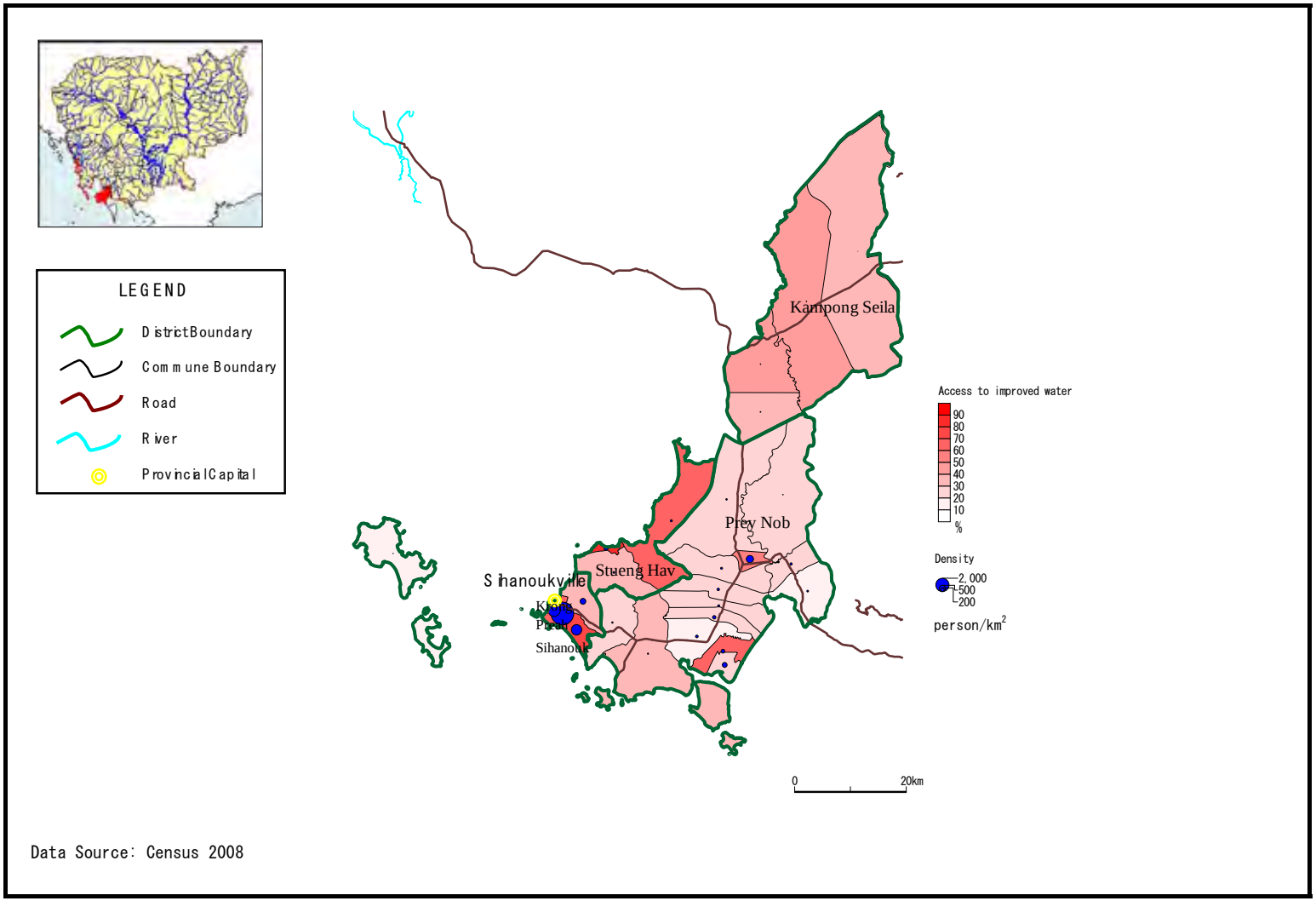
4.18.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 26 communes in this province, more than 50% of households have access to "Improved water" in 7 communes.

Table 4.18.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Preah Sihanouk Province)

Urban	Rural	Total
3/4 communes	4/22 communes	7/26 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.18.6 Service Area of Safe Water (Preah Sihanouk Province)

4.19 Stung Treng Province

4.19.1 Brief Description of the Province

The Stung Treng province has total area of 11,092 km^2, comprised of 5 districts, 34 communes, and 134 villages. According to 2008 Census, urban population was 17,022 persons（3,243 HH）, and rural population was 94,649 persons (17,679 HH）. Population growth rate was 1.17% in urban area, 3.61 % in rural area and 3.20 % in the whole province.

4.19.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Stung Treng, provincial capital is served by public managed water supply sytem. Other areas are served by village water supply system.

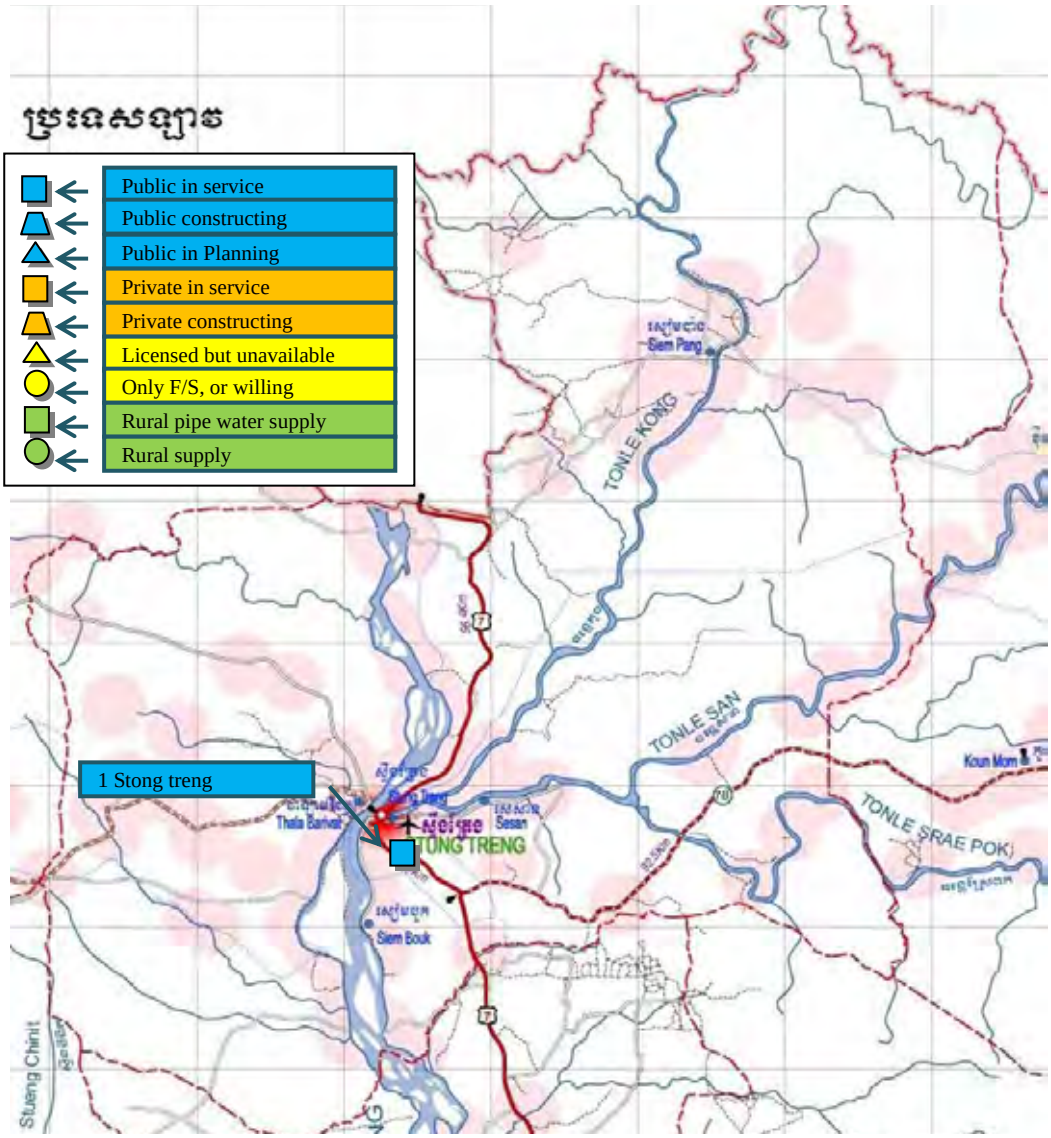


Figure 4.19.1 Existing Urban Water System in Stung Treng Province

Table 4.19.1 Current Status of Urban Water Supply System in Stung Treng Province

No	Town Name	Owneship	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Stung Treng	Pub	1960	7,924	1,498	1,200	River		1,500

*1 Blank means N/A.

2) Historical development of urban and public water supply system

1960 WTP and distribution network was constructed in the provincial capital

1995 to Present Continuousely expanding distribution network by MIME's budget

Provincial capital water supply system has been utilizing the facilities built in 1960.

3) Support from donor agencies

No consolidated master plan report is available. There is a plan to upgrade the village water supply system in two districts into urban water supply system and apply basic study implementation by MIME five years ago, but so far there has been no reply. In the two villages listed below, housing is built in relatively high density area.

1. Thala Barivat commune, Thala Barivat District
2. Koah Sampeay commune, Siem Bouk District

Currently urban water supply system expansion plan was established by ADB. This is related to Triangle Development Project and provinces of Stung Treng and Kratie were extracted as target area in Cambodia. The report was issued under the title of "TA-6484-REG, Mekong Water Supply and Sanitation Project" but it was not kept in DIME.

At present, no other donor's assistance is provided.

(2) Urban water supply system management structure

1) Organization Structure of DIME and Public Water Utility

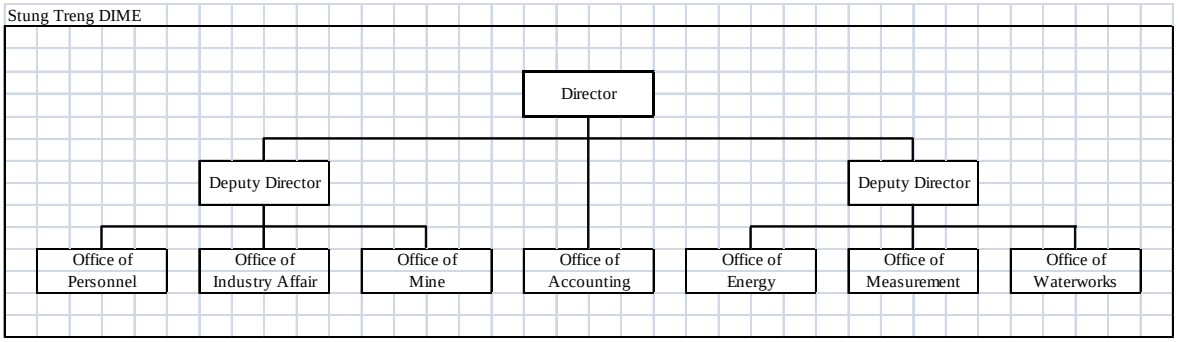


Figure 4.19.2 Organization Chart of DIME in Stung Treng Province

DIME has 21 staff and 14 is assigned to system O&M activities. The composition of O&M team is 4 for administration, 3 for WTP O&M and 7 for distribution network. Major tasks of

the distribution network O&M team are as follows:

- Water meter reading and distribution of water bills, to be paid by users at client liaison office of DIME
- Repiar of water meter
- Repair of distribution pipes

The number of staff shall be increased when the water supply system is expanded. Recruitment of skilled staff is a future concern of DIME.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Raw water is taken from Sekong River. As river water level seasonally fluctuates, a float-type intake device is provided.

2) Capacity and operation of WTP

WTP capacity is 1,200 m^3/day and water treatment method is coagulation, sedimentation and rapid filter. Since the WTP has already deteriorated resulting to capacity shortage, it shall be expanded. However, funds have yet to be sourced. Capacity of elevated tank is 200 m^3 with a height of 16 m.

3) Capacity and operation of distribution system

Existing WTP and distribution network with total length of 5 km was built in 1960. Pipe materials are RC and CI.

Since 1995, MIME has been gradually expanding the water service with the use of its budget. A total additional pipe length of 23.8 km was installed using PVC pipe. The diameter is as follows:

200mm=1,337m
150mm=128m
100mm=7,982m
80mm=1,162m
75mm=197m
60mm=11,898m
49mm=1,075m Total = 23,779m

As with the WTP, the distribution network has also deteriorated and pipe breakage frequently occurs. Replacement of the aged pipes is necessary but fund is not available. Further, as gate valves were not installed at key points of the network, when a pipe is broken, the operation of WTP has to be suspended for repair work. Allocation of fund for gate valve installation is also needed. Diameter of the distribution trunk installed in front of the WTP isφ200 mm which is

equivalent to the supply amount.

According to the project report in 2010, the annual average treated water amount was 1,193 m^3/day, while the distribution water amount was 881 m^3/day. NRW rate was taken at 26.2%. The report further states that water service is provided 12 hours during dry season and 10 hours for rainy season; these seem to be the duration of water demand generation.

4) Water supply project O&M status

DIME has only a stand-by intake pump. A generator is also available but seldom operated due to stable power supply.

5) WTP O&M status

Chlorine disinfection has not been practiced. As incoming water volume exceeds the capacity of down-flow rapid filter, portion of the surface water overflow is flowing into the clear water reservoir mixing with filtered water.

6) Water quality control and supply water quality

Table 4.19.2 Result of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	—			
pH	—	7.0	6.8		6.7
Turbidity	NTU	Sed<10 Dis<1.0	85		15
Free Chlorine	mg/L	AF>0.1 Dist=1.0			
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	230		110
Color	TCU	Sed<20 Dis<5			
Alkalinity [mg/L]	mg/L	>10			

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800	110	50
Total Hardness	mg/L	< 250	48	40
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5	1.29	1.09
Iron (Fe2+)	mg/L	< 0.3	1.31	0.49
Manganese(Mn2+)	mg/L	< 0.3		
Arsenic (As)	μg/L	< 50		0
Chlorine (Cl-)	mg/L	< 250	12.78	5.68
Fluorine (F-)	mg/L		0.05	

Testing Status	
Testing Lab	MIME
Daily Record	N/A
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	OK
Latest test in	2009
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	N/A

*1 Blank means N/A.

Water quality analysis was conducted by MIME once a year or every three months. Daily report on treatment status is not collected. Since treated water has high turbidity, the WTP is

not functioniong well. Ammonia in treated water shows no disinfection effect.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.19.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		14,976	16,697	16,796	19,998	19,998	
Population in supply area		12,048	13,769	13,868	17,070		
Service population		5,548	6,308	7,576	7,790	7,924	
Service connection or household						1,498	
Water supply (intake or treat)		600	800	955	1,010	1,200	
Water supply (distribution)		376	512	668	804	810	

*1 Blank means N/A.

2) Water tariff and extent of water supply service

Current water rate is 1,500 Riel/m^3 and water supply hour is 12 to 14 hours/day.

(5) Financial status of public system

1) Current financial staus

Financial statements were not collected from DIME.

4.19.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (69.7%), “Tube/Pipe Wells” (18.0%) and “Unprotected Dug Wells” (5.2%), and the access rate to improved water are 23.4%. About 40.9% of households in this province depend on remote water sources.

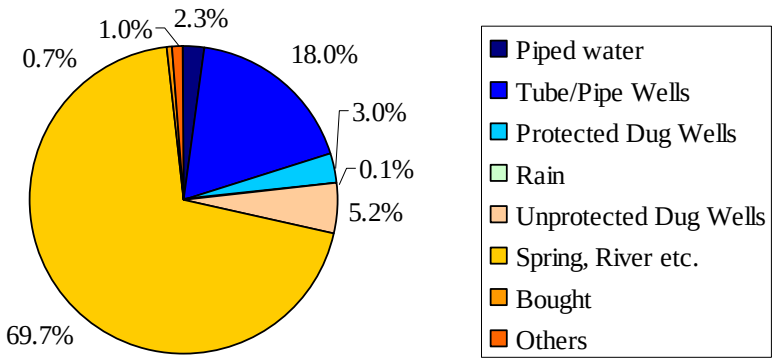


Figure 4.19.3 Type of Water Sources (Stung Trent Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in Table 4.19.4. The functioning rates of water supply facilities are 81.5 percent.

Table 4.19.4 Monitoring Results by PDRD (Stung Treng Province)

Items	Total	Function		Broken	
		No.	Ratio	No.	Ratio
Tube well	626	525	83.9%	101	16.1%
Pulling hand pump from river	25	25	100.0%	0	0.0%
Hand dug well with ring	135	96	71.1%	39	28.9%
Hand dug well no ring	81	66	81.5%	15	18.5%
Pipe water supply system	4	1	25.0%	3	75.0%
Community ponds	22	15	68.2%	7	31.8%
Private pond	0	0	0.0%	0	0.0%
Total	893	728	81.5%	165	18.5%

Source: PDRD in Stung Treng (2009)

3) Hand pumps

Afridev hand pumps are common, and spare parts for Afridev hand pumps have been provided by UNICEF, and another set of standard spare parts from WSUG during the construction stage for of donor-assisted projects. After consuming the spare parts from WSUG, PDRD sells it back to WSUG on actual charge. In addition, although WSUG has been trained in the operation and maintenance of hand pump during the construction stage by PDRD or donors, PDRD usually carries out O&M even in cases of serious failures.

4) Water Quality for Groundwater

According to result of water quality analysis by arsenic center, 7.3 percent out of 343 groundwater samples were detected over 10ppb of arsenic contaminations.

Table 4.19.5 Result of Arsenic Testing (Stung Treng Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
343	1	0.3%	24	7.0%	318	92.7%

Source: Arsenic Center (2005-2007)

According to PDRD, there are no problems on high iron and manganese contents in groundwater.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 26 staff members, with 2 members belonging to the Office of Rural Water Supply and 2 belonging to the Office of Primary Health.

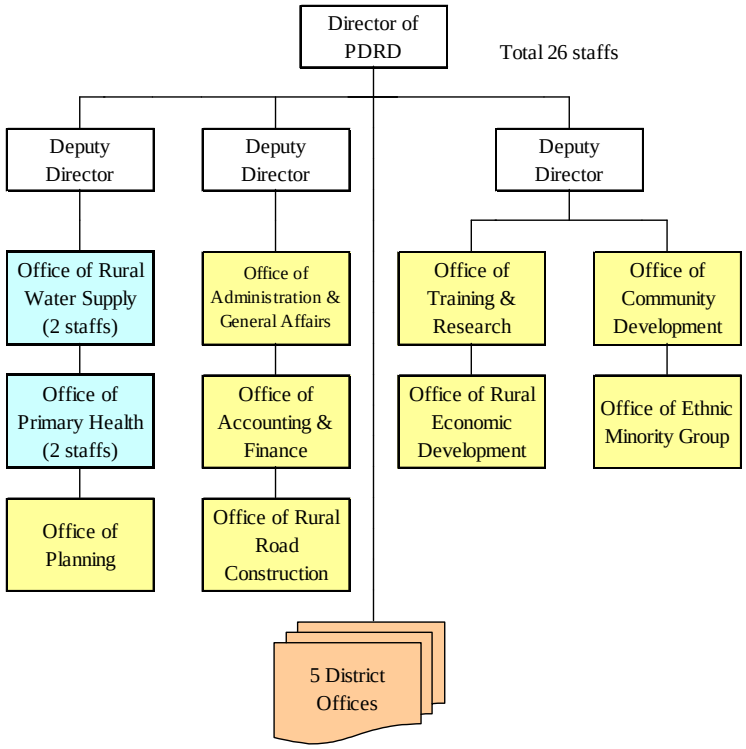


Figure 4.19.4 PDRD Organization Chart (Stung Treng Province)

Two staff is responsible for the operation and maintenance. Other staff has also undertaken O&M training supported by UNICEF. Hygiene education to villagers is very active in this province as gleaned below.

- Water treatment training to WSUG in 2 villages (2009)
- Hygiene education (2009 - 2010): demonstration for understanding of biological and bacterial contamination from drinking water and own hand using chemical by ITC (Institute Technology Cambodia), 3 villages in 2009 and 12 villages in 2010

2) Budget

"Purchase" and "other external charges for services" account for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 390.1 million riel was allocated in 2009 as a MRD finical package budget which was mainly used rehabilitation for existing facilities.

Table 4.19.6 PDRD Budget (Stung Treng Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	185.0	26.7%	185.0	29.9%
	External charges for services	172.0	24.8%	122.0	19.7%
	Other external charges for services	225.0	32.5%	175.0	28.3%
	Personal expenses	111.0	16.0%	135.8	22.0%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	693.0		617.8	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	390.1	0	under preparation by MRD	
	Well rehabilitation		95		
	Upgrading Community Pond		0		
	Rain water collection tank		30		
	Small pipe water supply system		1		
	Upgrading Canals		0		
	Total		126		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD does not own a drilling rig and cannot drill tube well by itself.

(3) Assistance by Other Donors

1) Existing Project

a. CLTS Project by UNICEF

(i) Period: 2009

(ii) Component: Hygiene education including sanitation campaign

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation.

(ii) Target sites: 4 districts (2 districts in 2010)

(iii) Component: Construction of 68 tube wells (excluded construction of toilets because of high coverage of sanitation facilities by 2008 census)

b. Rural Water Supply and Sanitation Project by UNICEF

(i) Period: 2010

(ii) Target sites: 128 villages

(iii) Component: Survey for current status of rural water supply and sanitation

(4) Current Hygiene Condition

Households with toilets account for 26.6% (4,698 households) in the rural areas. Of these

households, 51.7% use septic tanks and 27.2% are connected to sewerage system.

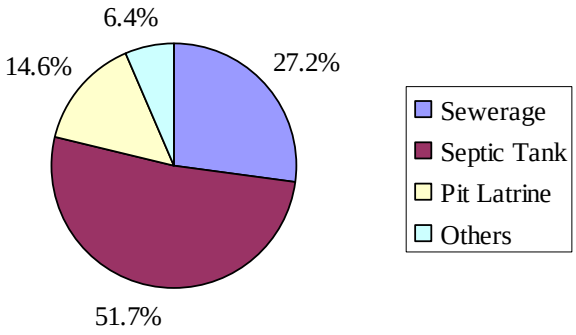


Figure 4.19.5 Type of Toilet (Stung Treng Province)

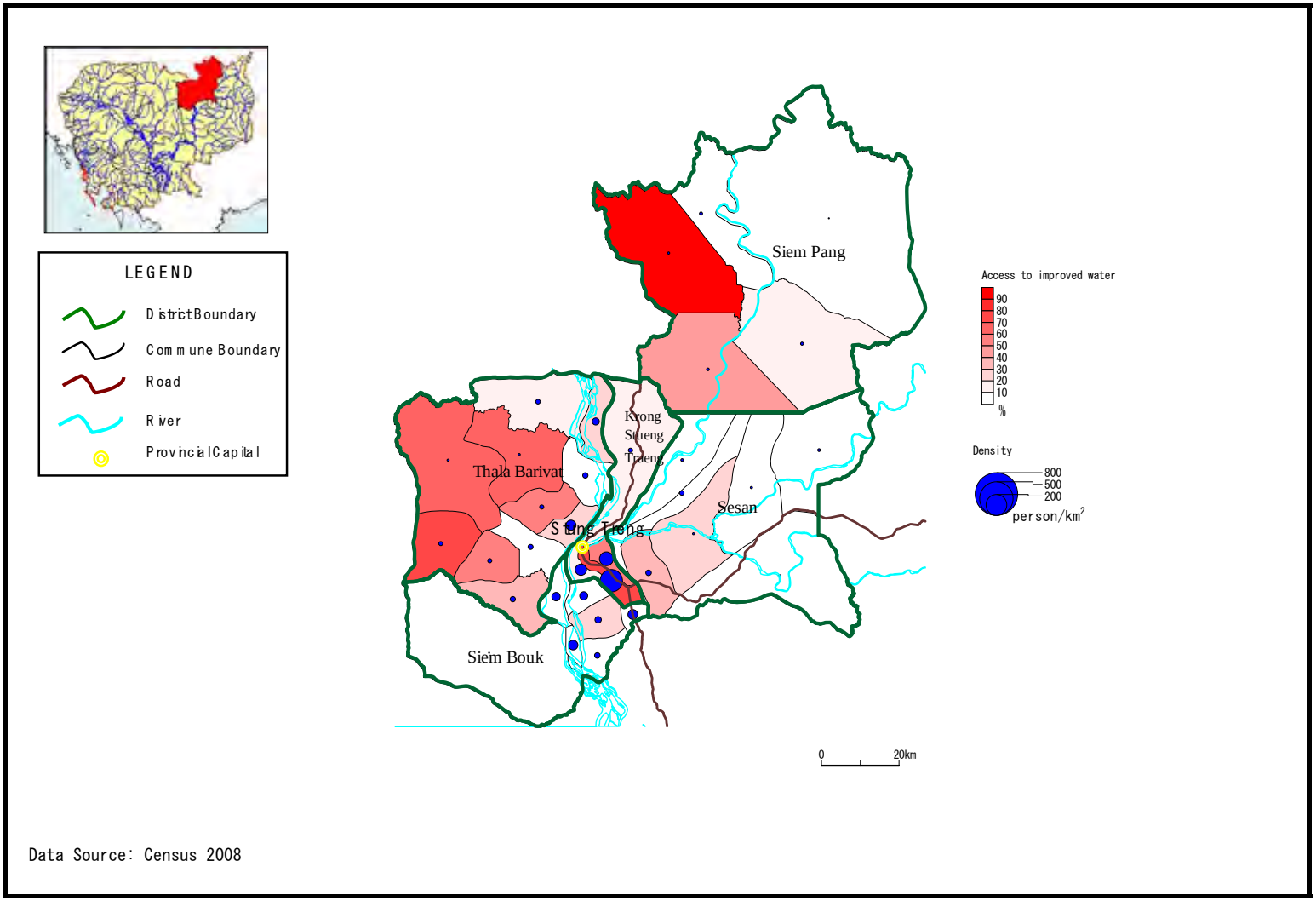
4.19.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 34 communes in this province, more than 50% of households have access to "Improved water" in 8 communes.

Table 4.19.7 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Stung Treng Province)

Urban	Rural	Total
1/1 communes	7/33 communes	8/34 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.19.6 Service Area of Safe Water (Stung Treng Province)

4.20 Svay Rieng Province

4.20.1 Brief Description of the Province

The Svay Rieng province has a total area of 2,966 km^2, comprised of 8 districts, 80 communes, and 690 villages. According to 2008 Census, urban population was 17,029 persons（3,562 HH）, and rural population was 465,759 persons (111,196 HH）. Population growth rate was 0.02% in urban area, 0.09 % in rural area and 0.09% in the whole province.

4.20.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Provincial capital is served by a public-managed water supply system as well as three Sangkat of Svay Rieng, Prey Chhlak, Pou Ta Hao. House connection number is 1,325 units corresponding to one-third of total HH of 3,171. No other public managed system exists.

Aside from provincial capital, five private-managed system projects are on-going under the WB support. License was given to these projects from MIME and facility construction was started in two towns. System O&M activities of three towns are covered by private sector.

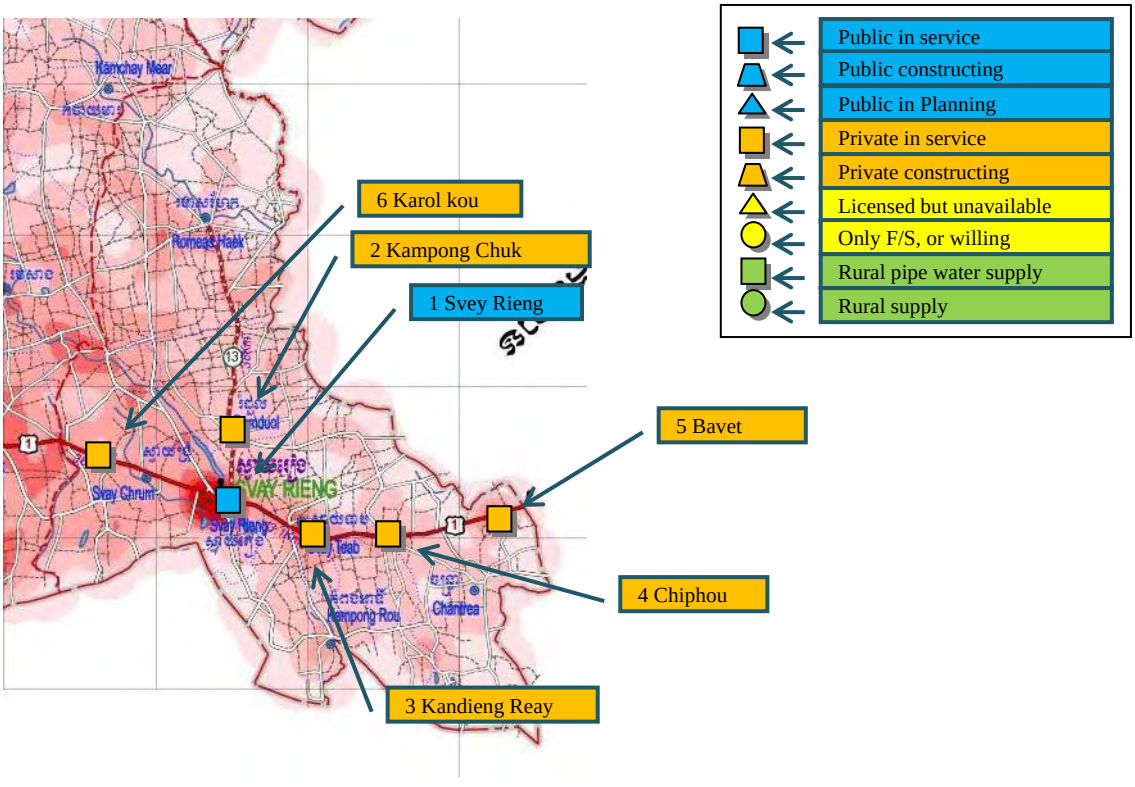


Figure 4.20.1 Existing Urban Water System in Svay Rieng Province

Table 4.20.1 Current Status of Urban Water Supply System in Svay Rieng Province (2009)

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Svey Rieng	Pub	1995	6,702	1,457	1,434	well	200,000	1,200
2	Kampong Chak	Pri			310				2,100
3	Kandieng Reay (Prasot)	Pri			341				2,100
4	Chiphou	Pri			81				1,700
5	Bavet	Pri			148				2,000
6	Karol Kou	Pri							

*1 Blank means N/A.

2) Historical development of urban and public water supply system

1946 Well was drilled in Svey Rieng by the support of the Vietnamese government.

1951 Related facilities were constructred by US assistance and the system was commissioned.

1962 Existing WTP was constructed.

1980 The Vietnamese government renderd technical support, and the system was transferred to DIME.

1985 The facility was rehabilitated through Netherlands assistance, system operation was substituted temporary by NGO.

1995 Additional wells were drilled by support of the WB and SAWA.

2006 System rehabilitation project through ADB

Since 1995, DIME became self-reliant but at that time only assistance from the WB and SAWA was available. This assistance did not cover system O&M and therefore DIME could not handle repairs of malfunctioned facilities. As a result, water supply was frequently suspended.

3) Support from donor agencies

A rrequest for a project for the replacement of deteriorated pipes with a total length of 26 km has been submitted to the Japanese government.

The system development plan prepared by DIME for public and private-managed systems is presented below:

1.	Kraolkou Water Supply System rehabilitation Project	2010	153,400 USD	Completed
2.	Svey Rieng Distribution Network Expansion Project, L = 40 km	2010	400,000 USD	
3.	Romreashak district WTP Construction Project	2010	310,000 USD	
4.	Kampong Ro district WTP Construction Project	2011	215,000 USD	
5.	Chantrea district WTP Construction Project	2011	200,000 USD	
6.	Svey Chrom district	2012	200,000 USD	
7.	Doun Sar commune	2012	180,000 USD	
8.	Chantrey commune	2013	180,000 USD	
9.	Angkor Prase commune	2013	180,000 USD	

Note) Electrical equipment cost was not included

(2) Urban water supply system management structure

1) Organization Structure of DIME and Public Water Utility

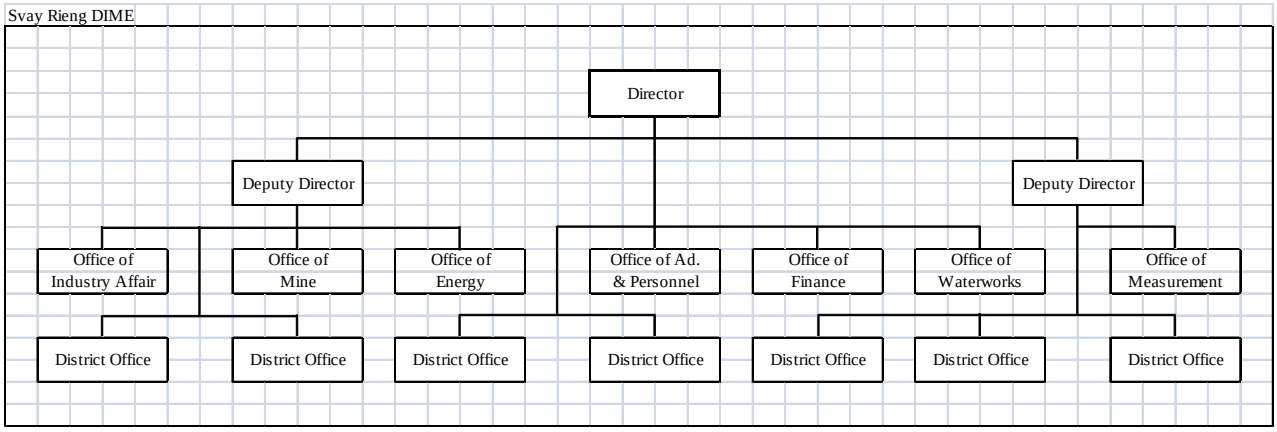


Figure 4.20.2 Organization Chart of DIME in Svay Rieng Province

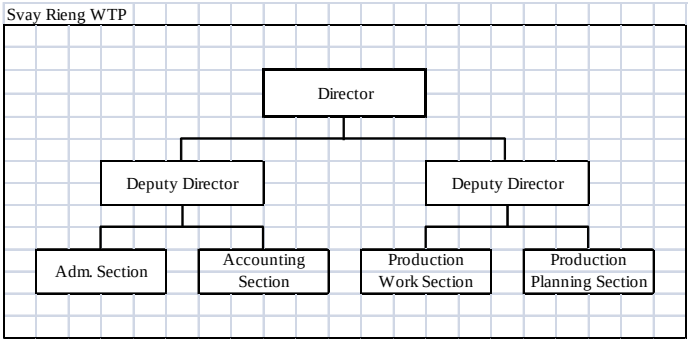


Figure 4.20.3 Organization Chart of WTP in Svay Rieng Province

Total 19 staffs are assigned for WTP operation.

2) Capacity development for staff

WSA staff underwent technical seminar on distribution network development, leakage reduction and water quality analysis.

(3) Water supply facilities and management of public system

1) Capacity and operation of intake facility

Water source is the three groundwater tube wells spread out within the city area. From these wells, groundwater is pumped to the WTP several kilometers away and returned back to the city area as potable water. On the process, energy is being wasted. The possibility of tapping the nearby river water as a source to lessen the cost of power was raised, but it was learned that the river water depletes during dry season.

Three well pumps were installed with a depth of 100 m each and a well capacity of 100 m^3/hr. Two wells are being alternately operated; the remaining is a stand-by. Even during dry season, groundwater is exploitable.

2) Capacity and operation of WTP

Construction of WTP was started in 2004 and completed in 2006. Fund was provided by ADB with a total amount of 2.5 million US$. Scope of work included: construction of WTP with a capacity of 5,280 m^3/day; installation of force main to elevated tank; and development of distribution network.

Water treatment method is not appropriate for the type of raw water quality. Though groundwater is directly discharged into a sand filter for Iron and Manganese removal, its removal is inefficient due to short contact time and catalysis. Manganese precipitation can still be observed at the clear water reservoir. The JICA technical cooperation project team recommended that the Chlorine contact oxidation tank be improved since raw water has high Iron concentration and presence of ammonia.

Two sand filters with capacity of 100m^3/hr are installed together with three units of distribution pumps, two units of backwashing pumps and two units of chlorine injection pumps. Automatic chlorine injection is performed in the clear water reservoir. Backwashing effluent is treated in wastewater pond built within WTP premises.

3) Capacity and operation of distribution system

Diameter of distribution main located in front of the WTP isφ200 which is equivalent to the current distribution water amount. Diameter of the distribution network ranges from φ63 mm to φ250mm. Total length is 23.6 km. CI pipe is used for pipes with diameter larger than φ200 and PE pipes are used for lesser diameter.

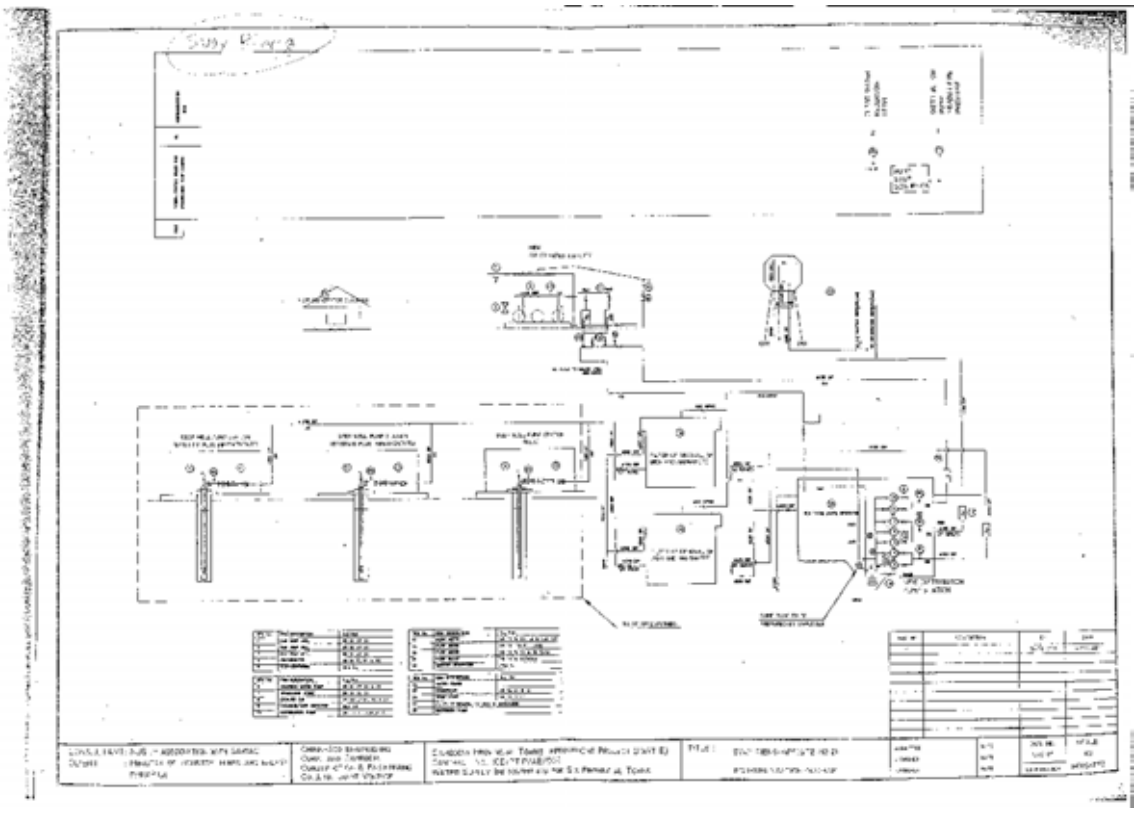


Figure 4.20.4 Flowchart of WTP

Figure 4.20.5 Service Area of Urban Water Supply System in the Capital of Svay Rieng Province

Based on the data from DIME, 90% of the pipes are relatively new but the remaining 10% is deteriorated. NRW rate is 19%. DIME is executing replacement of deteriorated water meters and pipes as part of the NRW reduction program.

4) Water supply O&M status

No O&M materials and tools are stored. During power failure, generator supplies power to WTP facilities.

5) WTP O&M status

Groundewater supply from three wells is manually controlled. Two wells supply groundwater to two sand filters. WTP is well-organized.

6) Water quality control and supply water quality

Five water indices, temperature, pH, color, turbidity and chlorine content are analyzed by the staff in DIME's own laboratory. A complete list of laboratory equipment was prepared.

However, as to bacteriological analysis, the device provided through the assistance of China, cannot be operated since the staff were not given sufficient training.

Aside from public-managed urban water supply project for the provincial capital, no other organizational structure for water quality control and periodical water quality analysis is available.

Table 4.20.2 Result of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	–	29.9		
pH	–	7.0	6.85		6.7 – 7.2
Turbidity	NTU	Sed<10 Dis<1.0	1 – 3		0.5 – 2.0
Free Chlorine	mg/L	AF>0.1 Dist=1.0			0 – 0.72
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500	284 – 334		136 - 149
Color	TCU	Sed<20 Dis<5	2 - 8		2 -19
Alkalinity [mg/L]	mg/L	>10			

The red data were taken in March 2010.

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800	142	148
Total Hardness	mg/L	< 250		
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5		
Iron (Fe2+)	mg/L	< 0.3		
Manganese(Mn2+)	mg/L	< 0.3		
Arsenic (As)	µg/L	< 50		
Chlorine (Cl-)	mg/L	< 250		

Testing Status	
Testing Lab	WTP
Daily Record	OK
Monthly Record	N/A
3 Monthly Record	N/A
Yearly Record	N/A
Latest test in	2010
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	OK

*1 Blank means N/A.

Only treated water quality analysis results are submitted. As color in treated water was extremely high, it is suspicious whether turbidity removal was properly performed.

(4) Water supply status of public system

1) Water supply amount, service ratio and house connection rate

Table 4.20.3 Water Supply Status of Public System

City	Plan	2006	2007	2008	2009	2010	Future
Total population		21,995	22,963	44,855	46,829	48,889	
Population in supply area		18,855	19,685	20,005	20,885	21,804	
Service population		4,625	5,485	5,875	6,702	6,702	
Service connection or household			1,097	1,175	1,316	1,457	
Water supply (intake or treat)		452	1,124	1,236	1,434		1,765
Water supply (distribution)		202	557	775	1,008		

Note: Blank means N/A.

Population differes depends on the data source. Supply water amount as of January 2010 was extracted from monthly reports.

2) Water tariff

Current water rate is 1,200 Riel/m^3. Water charge is collected monthly. Meter reading is undertaken by two staff.

Partly because house connection fee of 130 US$ is needed, house connection has not been expanded as expected.

DIME is fully aware of the necessity of massive information campaign to promote the advantage and safety of water supply system to residents within the urban water supply service area, but no concrete plan has yet been drawn up.

3) Extent of water supply service

Water supply hour is 24 hours. Major complains are as follows:

- Water charge is too expensive.
- High Iron and Manganese content
- Water meter is defective.

(5) Financial status of public system

1) Current financial staus

DIME did not provide its financial statement.

4.20.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Tube/Pipe Wells” (86.6%), “Piped Water”

(3.8%) and "Unprotected Dug Wells" (3.2%), and the access rate to improved water is 93.0%. About 7.5% of households in this province depend on remote water sources.

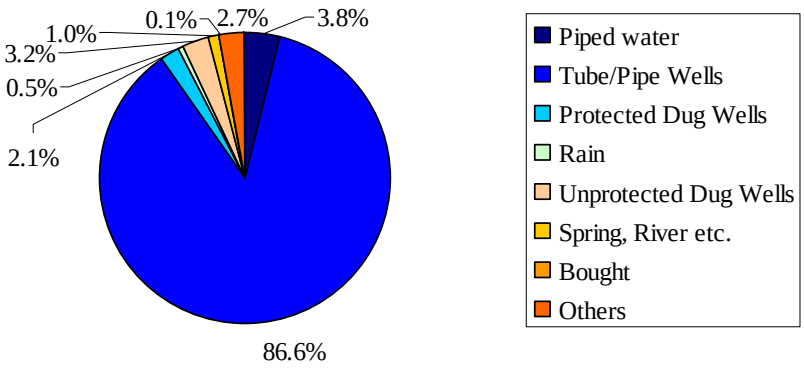


Figure 4.20.6 Type of Water Sources (Svay Rieng Province)

2) Condition of Water Supply Facilities

PDRD is not actively carrying out the monitoring of water supply facilities. It has no knowledge of the present conditions of water supply facilities.

Table 4.20.4 Monitoring Results by PDRD (Svay Rieng Province)

Items	No. of facilities
No. of hand pump (tube well)	80,123
Tube well rehabilitation (already repair)	1,960
Hand-dug well	3,040
Rehabilitation of hand dug well	966
Community pond	347
No water during dry season	390
Upgradeing of community pond	200
Total	87,026

Source: PDRD in Svay Rieng (2009)

Meanwhile, from the District Data Book (2008) by UNDP, the proportion of tubewells which can be used the whole year is 97.0% while the non-functional tube wells is 2.4%.

Table 4.20.5 Functioning/Un-functioning Conditions of Water Supply Facilities (Svay Rieng Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	82,581	
Year-round usable pumped or mixed wells	80,123	97.0%
Dry season unusable pump or mixed wells	2,458	3.0%
Pump or mixed wells needing repair/rehabilitation	1,960	2.4%
Total number of ring wells	4,757	
Year-round usable ring wells	3,040	63.9%
Dry season unusable ring wells	1,717	36.1%
Ring wells needing repair/rehabilitation	966	20.3%
Total number of un-protected dug wells	885	
Year-round usable un-protected dug wells	559	63.2%
Dry season unusable un-protected dug wells	326	36.8%

Source: District Book (2008)

3) Hand pumps

VN6 hand pumps are commonly used by 60%, whose procurement of spare parts and maintenance are normally easy. Local hand pumps made by communities are used by 30%, and Afridev hand pumps by 10%. Afridev hand pumps are adopted by UNICEF and Social fund projects, but spare parts for Afridev hand pumps cannot be easily procured in this province. PDRD has no supply at the office. Procurement method for spare parts by WSUG is as follows:

(i) In case of donor's project, one set of standard spare parts is provided; and

(ii) WSUG directly purchase it form Phnom Penh

4) Water Quality of Groundwater

Arsenic contaminations in groundwater whose level is exceeding water quality standard (50ppb) were detected from 2 tube wells in Svay chrum and Doun Sa commune. And arsenic contamination levels have been increased in some areas than before according to a survey by UNICEF.

Based on the result of water quality analysis by the Arsenic Center, 32.6% of the 1,326 groundwater samples were detected with more than 10ppb of arsenic.

Table 4.20.6 Result of Arsenic Testing (Svay Rieng Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
1,326	8	0.6%	424	32.0%	894	67.4%

Source: Arsenic Center (2005-2007)

In addition, high levels of iron contamination were detected in this province. PDRD and Hanger (NGO) have supported the installation of iron removal device for households. Simple

water treatment device using local materials at community level was developed by UNICEF with corresponding training on the production of this device. Meanwhile, polluted tube wells caused by primarily by bacteria due to insufficient drilling depth and surface sealing were found to be in abundance.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 94 staff members, with 13 members belonging to the Office of Rural Water Supply and 9 belonging to the Office of Primary Health.

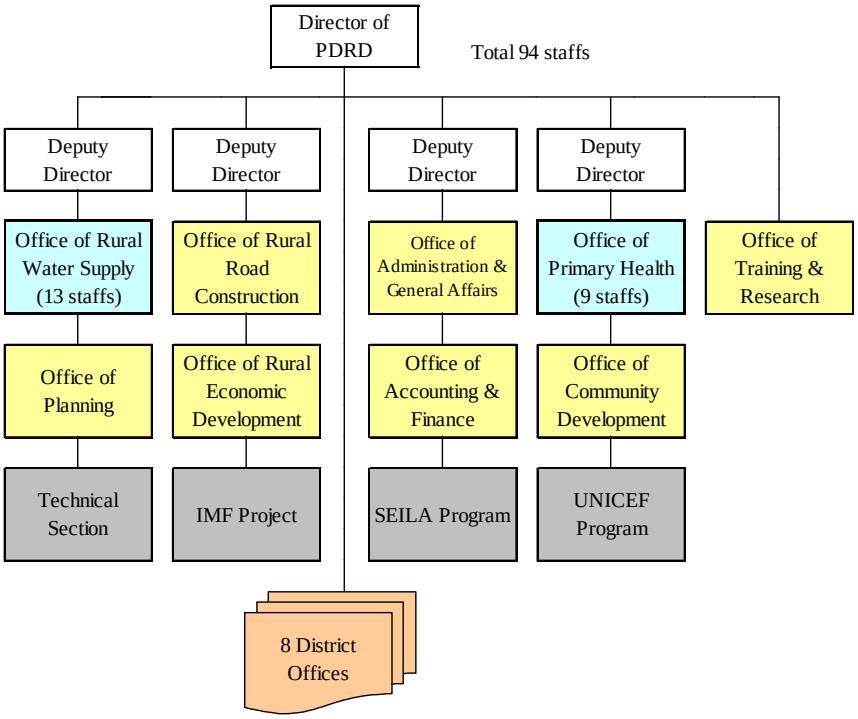


Figure 4.20.7 PDRD Organization Chart (Svay Rieng Province)

2) Budget

"External charges for services" accounts for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects, and also MRD financial package budget in 2009.

Table 4.20.7 PDRD Budget (Svay Rieng Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	221.0	20.7%	220.0	17.7%
	External charges for services	322.0	30.1%	422.0	34.0%
	Other external charges for services	297.0	27.8%	297.0	24.0%
	Personal expenses	229.0	21.4%	301.0	24.3%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	1,069.0		1,240.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has submitted rehabilitation plan for 2010 to MRD using MRD financial package, but there is no available allocation.

(3) Assistance from Other Donors

1) Existing Project

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation

(ii) Target sites: 97 villages, 12 communes, 4 districts

(iii) Component: Construction of 1013 household toilets (excluded component of water supply facilities because of high converge of water supply rate by 2008 census)

b. Seth Coma Program by UNICEF

(i) Target sites: 4 districts (Kampong Rou, Rumduol, Svay Chrum and Svay Teab)

(ii) Component: Construction of tube well, Establishment of WSUG, Training for water quality testing, Education of water use, CLTS project include hygiene awareness and education

(iii) Period: From 2009 to 2010

(4) Current Hygiene Condition

Households with toilets account for 19.1% (21,282 households) in the rural areas. Of these households, 37.6% use septic tanks and 31.8 use pit latrines.

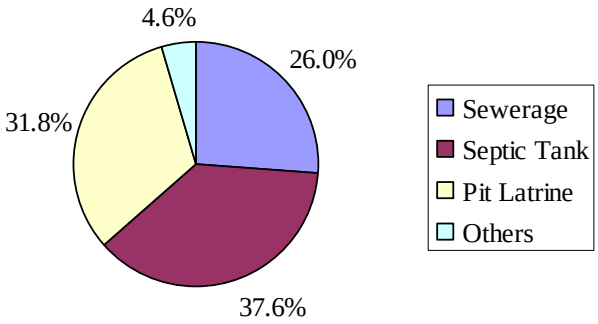


Figure 4.20.8 Type of Toilet (Svay Rieng Province)

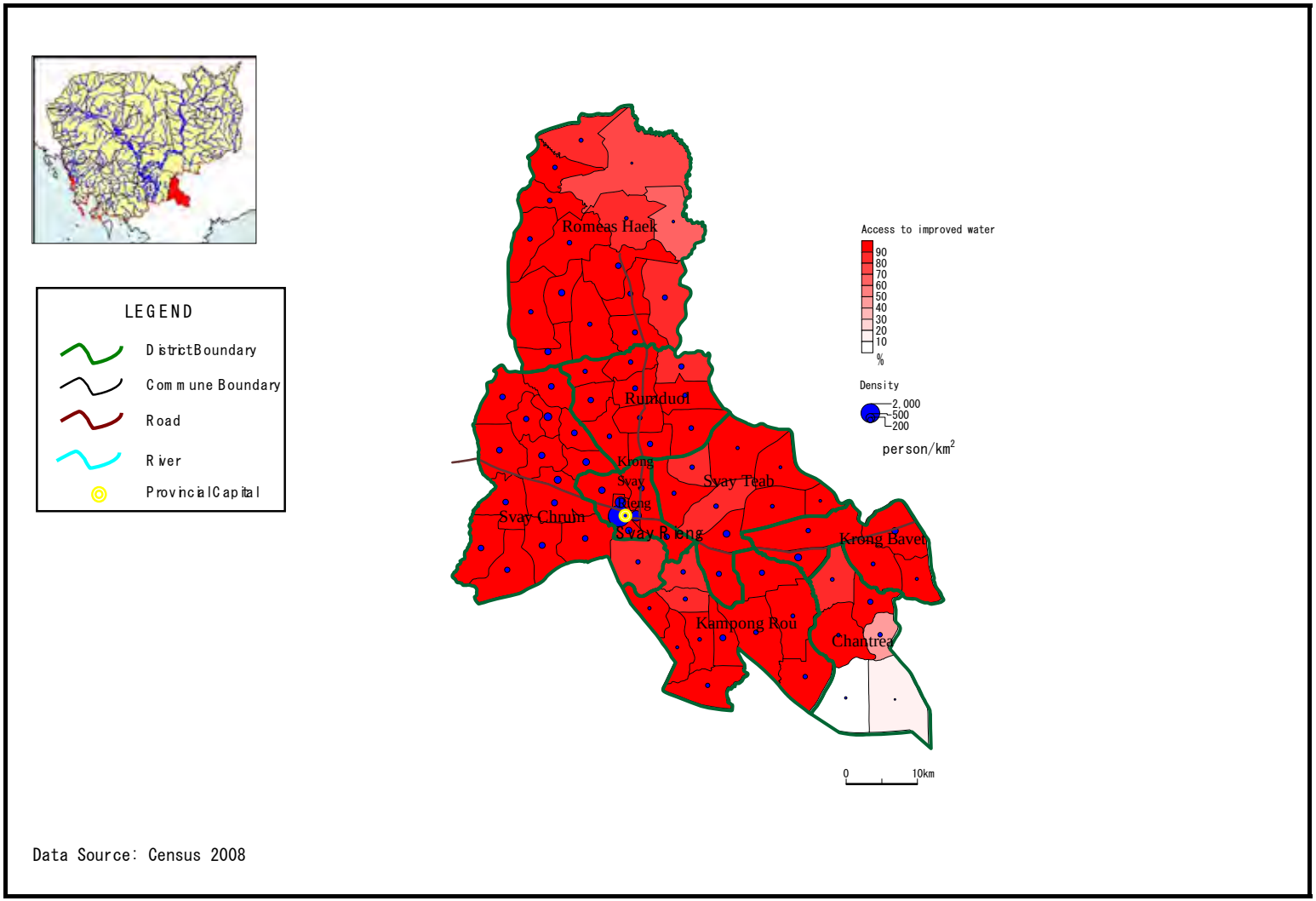
4.20.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 80 communes in this province, more than 50% of households have access to "Improved water" in 77 communes.

Table 4.20.8 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Svay Rieng Province)

Urban	Rural	Total
2/2 communes	75/78 communes	77/80 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.20.9 Service Area of Safe Water (Svay Rieng Province)

4.21 Takeo Province

4.21.1 Brief Description of the Province

The Takeo province has total area of 3,563 km^2, comprised of 10 districts, 100 communes, and 1,116 villages. According to 2008 Census, urban population was 14,456 persons（2,688 HH）, and rural population was830,450 persons (181,054 HH）. Population growth rate was 0.56% in urban area, 0.67 % in rural area and 0.66 % in the whole province.

4.21.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Roka Khnong Sangkat, the provincial capital, is served by a public-managed system. Aside from this 19 other simplified water supply systems are operating with license from MIME. Ten systems are operated by the private sector and the remaining 9 are managed by KOSAN, an NGO.

Out of the19 systems, 4 systems need water treatment process to cope with poor raw water quality. These systems supply untreated raw water due to lack of budget to install the treatment process.

Further, additional 4 private- managed systems were applied by DIME to MIME but only Tram Kak Commune was temporarily approved. No response was given to the remaining 3 Communes.

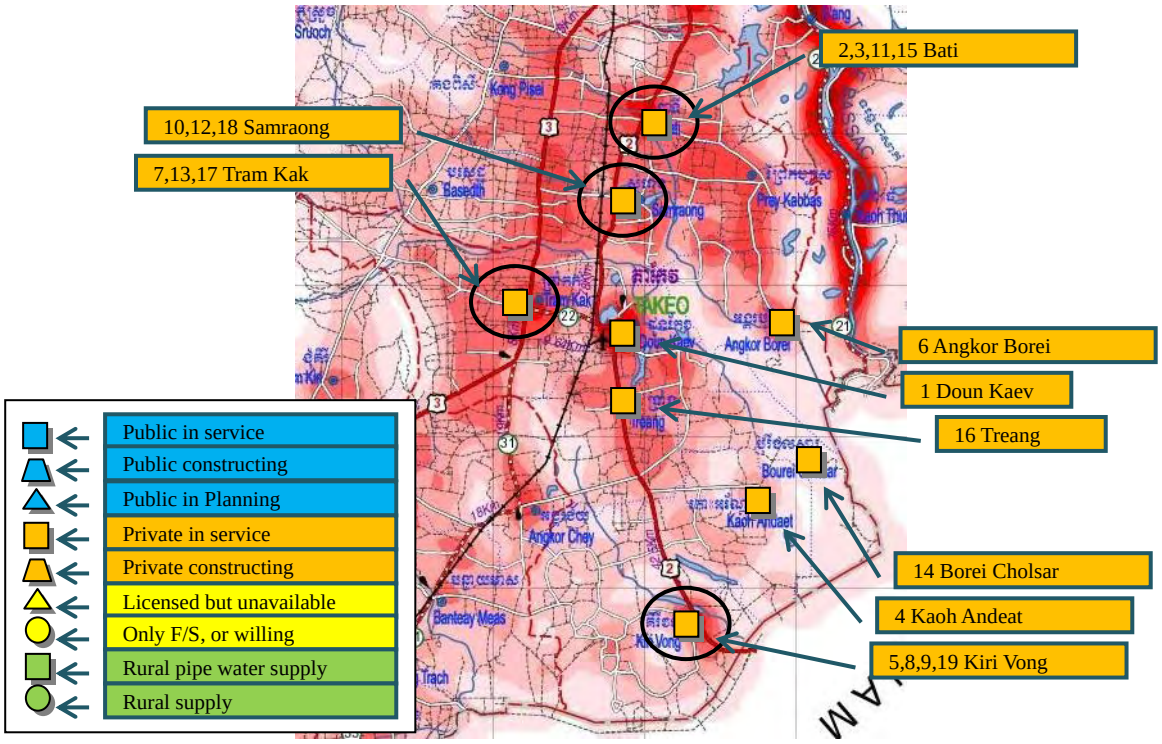


Figure 4.21.1 Existing Urban Water System in Takeo Province

Table 4.21.1 Current Status of Urban Water Supply System in Takeo Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Krong Doun Kaev	Pri			1,494	2,000		246,000	1,800
2	Bati	NGO			410	200		61,500	2,500
3	Bati	NGO			294	200		61,500	2,500
4	Kaoh Andeat	NGO			318	150		61,500	2,500
5	Kiri Vong	NGO			280	130		61,500	2,000
6	Angkor Borei	NGO			310	130		61,500	1,800
7	Tram Kak	Pri			450	233		164,000	2,200
8	Kiri Vong	Pri	Not functioning						
9	Kiri Vong	NGO			151	200		61,500	2,500
10	Samraong	Pri			120	97		41,000	2,500
11	Bati	Pri			65	58		41,000	2,000
12	Samraong	NGO			52	50		61,500	2,500
13	Tram Kak	NGO			98	89		61,500	2,500
14	Borei Cholsar	Pri			95	38		61,500	2,500
15	Bati	Pri			85	38		41,000	2,500
16	Treang	NGO			110	120		61,500	2,500
17	Tram Kak	Pri	Not operated yet (only license)						
18	Samraong	Pri	Not operated yet (only license)						
19	Kiri Vong	Pri	Not operated yet (only license)						

*1 1USD=4,100Riel, Blank means N/A.

2) Historical development of urban and public water supply system

1998 Private-managed system was established in provincial capital.

Water supply system of provincial capital was constructed in 1998 by a private company. Land was offered by MIME. License to operate for 40 years through BOT scheme was granted by MIME. Water rate increases shall be determined in consultation with MIME.
Frequency of water quality analysis is once a year for raw water and once in every three months for treated water. Analysis is performed in their own laboratory.
TKWSA plans for a service area extension to cover an additional 500 HH. Another plan is for the expansion of the WTP which is also in progress.

3) Support from donor agencies
A three-year urban water supply development plan was prepared for the provincial capital. Fund for the distribution network development was supported by the public management authority and USAID, with a 50-50 sharing.
No other assistance was provided by donor agencies. Reports prepared by donor agencies are written in English but are translated to Khmer language for easy understanding of the staff.

(2) Urban water supply system management structure

1) Organization Structure of DIME and Public Water Utility

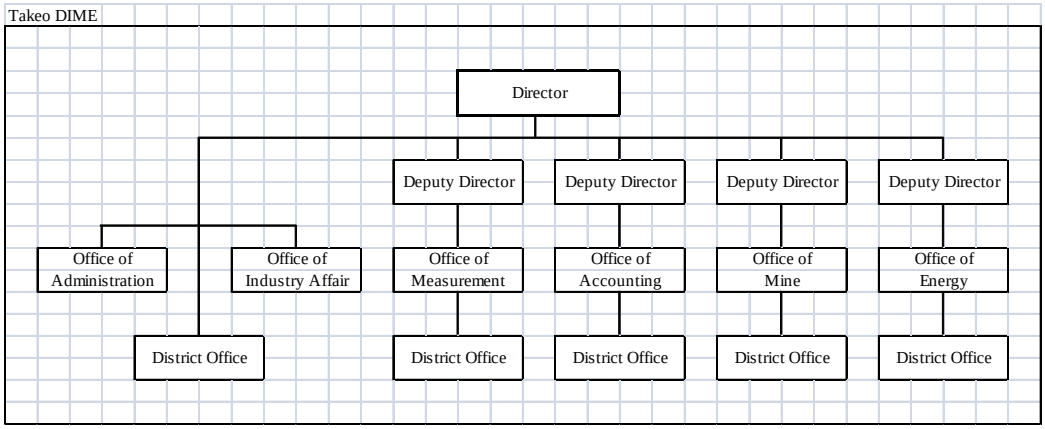


Figure 4.21.2 Organization Chart of DIME in Takeo Province

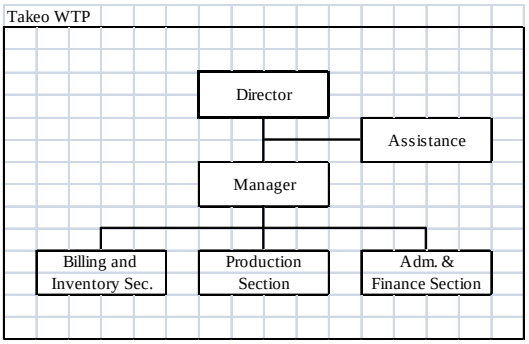


Figure 4.21.3 Organization Chart of WTP in the Capital of Takeo Province

DIME has a total number of staff of 53. The staff related to the water supply projects under the jurisdiction of DIME is the chief officer in-charge of supervising several private-managed water supply projects. DIME clarified that any personnel increase and activities for capacity development are quite difficult because of budget constraint.

As to the simplified water supply system, initiatives to introduce water treatment process to deal with poor raw water quality has not been established due to fund availability of the private sector.

2) Capacity development for staff

In 2005, the WTP staff of the provinces of Kampong Speu, Kampot, Kampong Chhnang and Takeo attended the technical training sponsored by JICA.

(3) Water supply facilities and management of public system

The public water supply project employs 13 staffs and 10 staffs out of 13 are in charge of operation and maintenance of the facility. Water source is taken from a lake and water volume in the lake is sufficient even during dry season. However, since construction of large-scale

commercial facility is on-going in the upper reaches, water pollution in the near future is concerned about.

The WTP has a capacity of 1,300m^3/day with three intake pumps including one stand-by. One unit is on duty in the hours other than the operation hour of the other two units, which is nine hours a day, three hours each in the morning, noon and evening.

Current treatment process flow is as follows:

Coagulation→Sedimentation→Rapid Sand Filtration→Clear Water Reservoir→ Elevated tank.

Two lanes of the process are existing and operational. Chlorination is conducted at two points of the pre-treatment channel and upstream of the clear water reservoir. Back washing of rapid sand filters is done daily and in alternate shifts and backwashing is drained to a nearby open land for drying. Dried sludge is utilized as fertilizer within the WTP premises.

Diameter of the distribution main in front of the WTP is 200 mm. It is evaluated to be appropriate for the WTP water producing capacity and NRW rate is reportedly 20%. There is no storage for O&M materials and tools.

Fixed water rate of 1,800 Riel/m^3 has been applied since 1999. Although a bill raising the tariff to 2,500 Riel/m^3 was brought up for discussion, it was rejected by the provincial government. There is a client liaison office within the WTP premises where users pay their monthly charge at the cashier's window. Water service hour is 23 hours/day.

Major grievances are as follows:

- High water charge
- Strong smell of residual chlorine
- Unsatisfactory water supply due to low remaining pressure

Table 4.21.2 Result of WTP Water Quality Analysis

Coagulation management	Unit	Target	Raw water	Sedimen-tation	Distribution
Temperature	degree	–			
pH	–	7.0			6.6 – 8.0
Turbidity	NTU	Sed<10 Dis<1.0			0 - 1
Free Chlorine	mg/L	AF>0.1 Dist=1.0			
Total Chlorine	mg/L				
Conductivity	us/cm	< 1500			76 - 132
Color	TCU	Sed<20 Dis<5			
Alkalinity [mg/L]	mg/L	>10			

Water quality	Unit	Standard	Raw water	Potable water
Total Dissolved Solids	mg/L	< 800		36 - 63
Total Hardness	mg/L	< 250		21 - 32
Total Organic Carbon	mg/L			
Ammonia (NH3+)	mg/L	< 1.5		

Testing Status	
Testing Lab	MIME
Daily Record	N/A
Monthly Record	N/A
3 Monthly Record	N/A

Iron (Fe2+)	mg/L	< 0.3		0.12 – 0.3
Manganese(Mn2+)	mg/L	< 0.3		
Arsenic (As)	µg/L	< 50		0 - 2
Chlorine (Cl-)	mg/L	< 250		18 - 24

Yearly Record	OK
Latest test in	2009
Coliform Test	N/A
Facal Coli Test	N/A
Dosing Control	N/A

*1 Blank means N/A.

Though record of coagulation and sedimentation control was not submitted, based on the water quality anlysis, water treatment in certain level has been ubdertaken.

4.21.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (41.1%), “Tube/Pipe Wells” (25.3%) and “Unprotected Dug Wells” (19.6%), and the access rate to improved water are 35.6%. About 46.4% of households in this province depend on remote water sources.

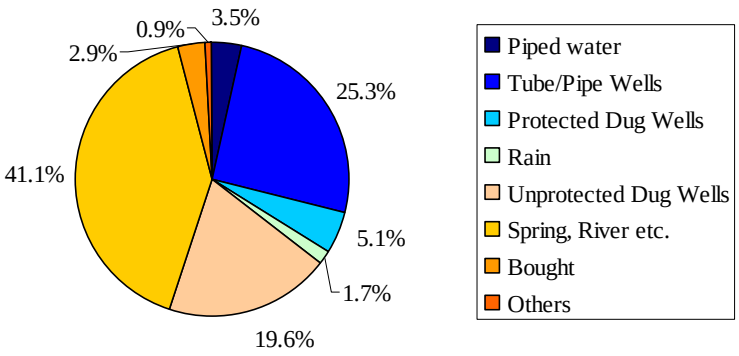


Figure 4.21.4 Type of Water Sources (Takeo Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in Table 4.21.3. The functional rate of public, contribution and private wells are 86.6, 94.4 and 93.1%, respectively.

Table 4.21.3 Monitoring Results by PDRD (Takeo Province)

Items			Total	Function		Broken	
			No.	No.	Ratio	No.	Ratio
Community	Borehole	Indian Mark II	705	500	70.9%	205	29.1%
		Indian Mark III	136	97	71.3%	39	28.7%
		Afridev	1,555	1,367	87.9%	188	12.1%
		VN6	1,553	1,204	77.5%	349	22.5%
		Tara	66	52	78.8%	14	21.2%
	Open well	Open well	1,084	1,053	97.1%	31	2.9%
		Mixed open well	1,147	1,135	99.0%	12	1.0%
		Total	6,246	5,408	86.6%	838	13.4%
Charity	Borehole	Indian Mark II	19	17	89.5%	2	10.5%
		Indian Mark III	9	7	77.8%	2	22.2%
		Afridev	54	41	75.9%	13	24.1%
		VN6	528	488	92.4%	40	7.6%
		Tara	0	0	0.0%	0	0.0%
	Open well	Open well	349	347	99.4%	2	0.6%
		Mixed open well	108	107	99.1%	1	0.9%
		Total	1,067	1,007	94.4%	60	5.6%
Private	Borehole	Indian Mark II	47	46	97.9%	1	2.1%
		Indian Mark III	32	32	100.0%	0	0.0%
		Afridev	62	54	87.1%	8	12.9%
		VN6	10,982	10,120	92.2%	862	7.8%
		Tara	5	5	100.0%	0	0.0%
	Open well	Open well	1,846	1,814	98.3%	32	1.7%
		Mixed open well	104	104	100.0%	0	0.0%
		Total	13,078	12,175	93.1%	903	6.9%
Community pond			1,080	884	81.9%	196	18.1%
Canal			250	N/A	**	N/A	**

Source: PDRD in Takeo (2008)

3) Hand pumps

VN6 hand pumps, of which spare parts are easy to procure in this province, are used by about 85% while Afridev hand pumps are used by only about 10%. Spare parts for this type cannot be procured in this province. Although PDRD has already consumed the spare parts provided by UNICEF, WSUG has to directly purchase these from Phnom Penh. Although India-made Mark III hand pumps are used in some areas in this province, spare parts of this cannot be procured in Cambodia. Thus, PDRD has a plan to replace Mark III hand pumps to Afridev but this has to be implemented yet.

4) Water Quality of Groundwater

There are some areas with arsenic contamination in groundwater. According to the SEILA Program, water quality samples for arsenic testing were collected in 5 districts, namely; Angkor Borei, Kiri Vong, Kaoh Andaet, Krong Doun Kaev and Treang. From the result of the water quality analysis by the Arsenic Center, 4.2% of the 29 groundwater samples were found to have more than 10ppb of arsenic content. No sample was detected with arsenic not exceeding 50ppb.

Table 4.21.4 Result of Arsenic Testing (Takeo Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
429	0	0.0%	18	4.2%	411	95.8%

Source: Arsenic Center (2005-2007)

In addition, there are areas with high salt content in groundwater.

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 119 staff members, with 10 members belonging to the Office of Rural Water Supply and 5 belonging to the Office of Primary Health.

Staffs of the rural water supply office has undergone the training for operation and maintenance through PRASAC, MRD, KOSAN, UNICEF and AICF (NGO) Projects.

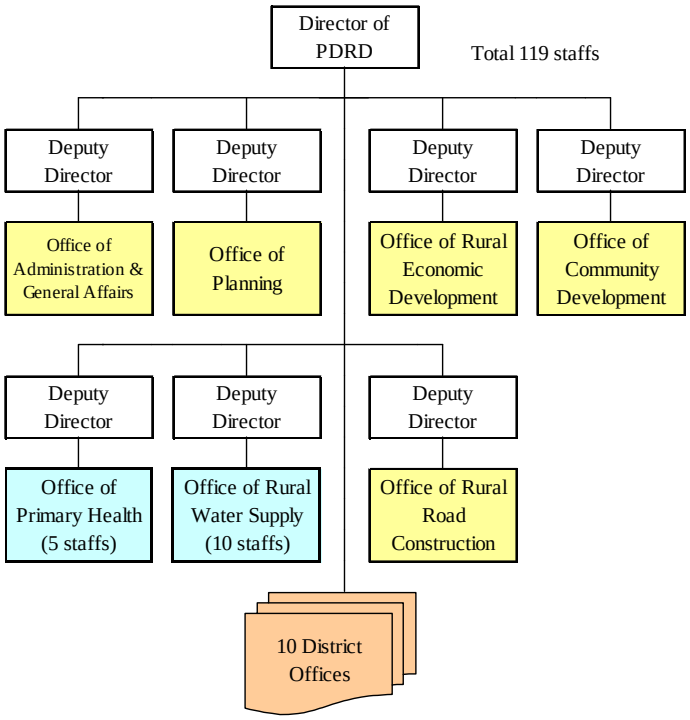


Figure 4.21.5 PDRD Organization Chart (Takeo Province)

2) Budget

"Personal expenses" account for bulk of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 79.1 million riel was allocated in 2009 as a MRD finical package budget which was mainly used rehabilitation for existing facilities.

Table 4.21.5 PDRD Budget (Takeo Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	180.0	18.2%	184.0	17.2%
	External charges for services	185.0	18.7%	185.0	17.3%
	Other external charges for services	215.0	21.8%	211.0	19.7%
	Personal expenses	408.0	41.3%	489.0	45.7%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	988.0		1,069.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	79.1	10	under preparation by MRD	
	Well rehabilitation		0		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		10		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

PDRD has drawn up annual plan for water supply and sanitation sector, but all plans can not be implemented due to lack of budget allocation.

(3) Assistance by Other Donors

1) Existing Project

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Base line survey was already done.

(ii) Target sites: 101 villages, 5 communes, 4 districts

(iii) Component: Construction of 116 tube wells, 25 toilets for school and public, and 4 community ponds

b. SEILA Program by provincial rural development committee supported by UNDP

(i) Target sites: 3 districts (Kiri Vong, Tram Kak and Treang)

(ii) Component: Provision of 1,000 ceramic filters, CLTS Program

(iii) Period: From 2008 to 2009

c. Rural Water Supply and Sanitation Project by Sweden Red Cross

(i) Target sites: 4 districts (Borei Cholsar, Kaoh Andaet, Samraong and Treang)

(ii) Component: CLTS Project include instruction of construction of toilet, Provision of ceramic filters

(iii) Period: From 2009 to March 2010

d. Capacity Building of PDRD by World Vision

(i) Component : Training and instruction of hygiene education, facilitation method and etc. by

expert dispatched by World Vision

e. Rehabilitation Project for Rural Water supply and Sanitation finance by MRD
(i) Target sites: 3 district (Kiri Vong, Tram Kak and Treang)
(ii) Component: Rehabilitation of 20 Afridev hand pumps, 30 VN6 hand pumps and Construction of 20 hand dug wells and 10 tube wells with hand pumps
(iii) Period: From 2008 to 2009

(4) Current Hygiene Condition

Households with toilets account for 23.1% (41,816 households) in the rural areas. Of these households, 52.0% use septic tanks and 31.4% are connected to sewerage system.

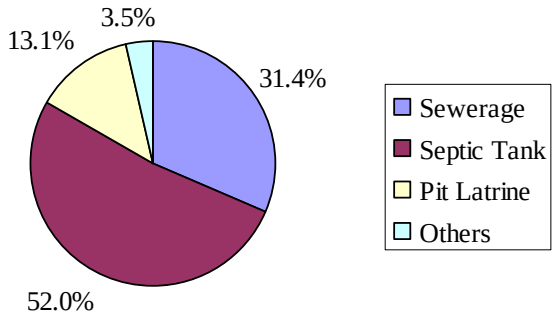


Figure 4.21.6 Type of Toilet (Takeo Province)

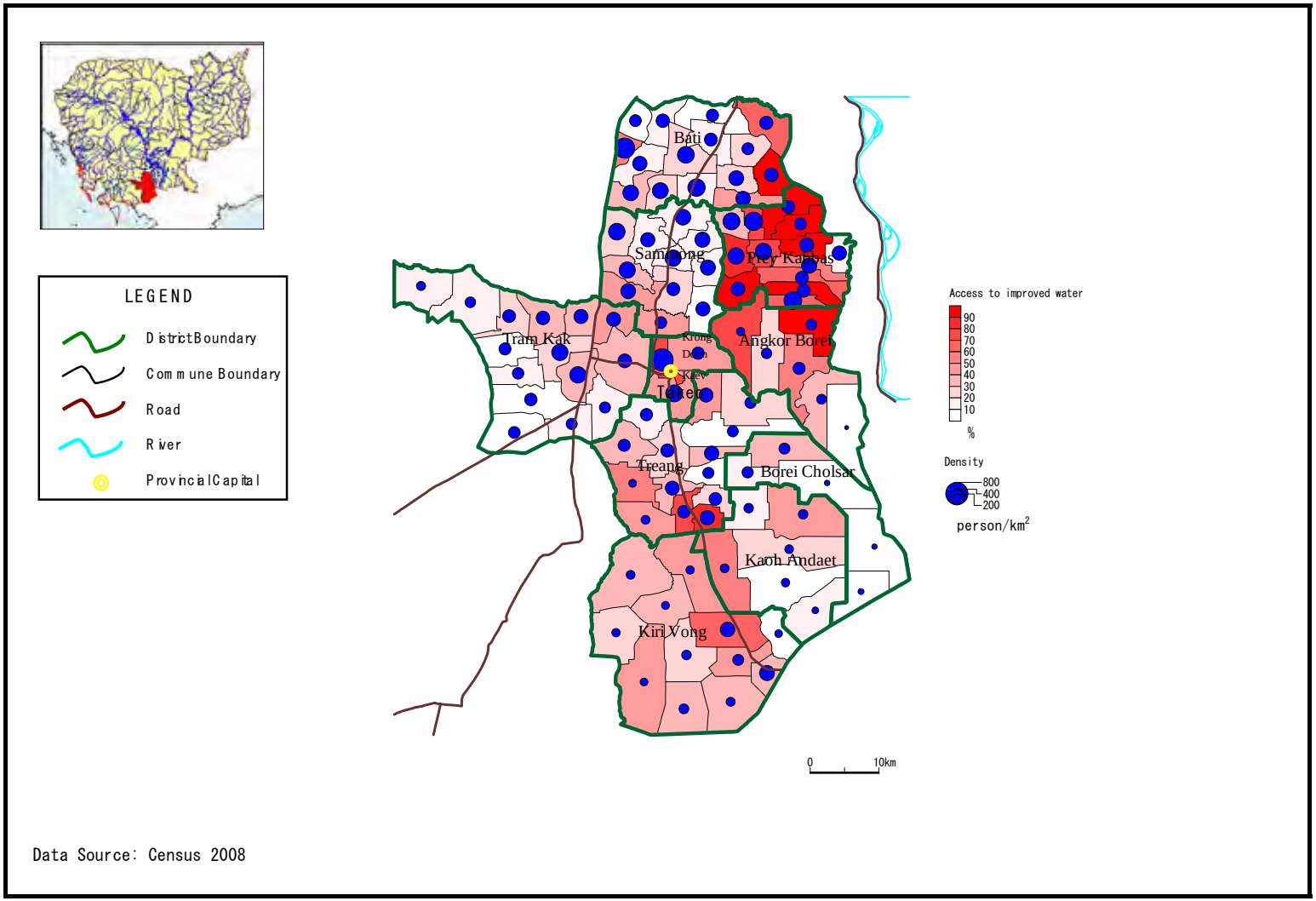
4.21.4 Safe Water Supply Area

Households with access to “Improved water” based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 100 communes in this province, more than 50% of households have access to “Improved water” in 23 communes.

Table 4.21.6 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Takeo Province)

Urban	Rural	Total
1/1 communes	22/99 communes	23/100 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.21.7 Service Area of Safe Water (Takeo Province)

4.22 Otdar Meanchey Province

4.22.1 Brief Description of the Province

The Otdar Meanchey province has total area of 6,158 km^2, comprised of 5 districts, 24 communes, and 288 villages. According to 2008 Census, urban population was 18,694 persons （3,608 HH）, and rural population was 167,125 persons (34,790 HH）. Population growth rate was 4.36% in urban area, 9.26 % in rural area and 8.64 % in the whole province.

4.22.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

There are no public-managed systems. A private-managed system plan was prepared but was not implemented. At present, there are no water supply projects.

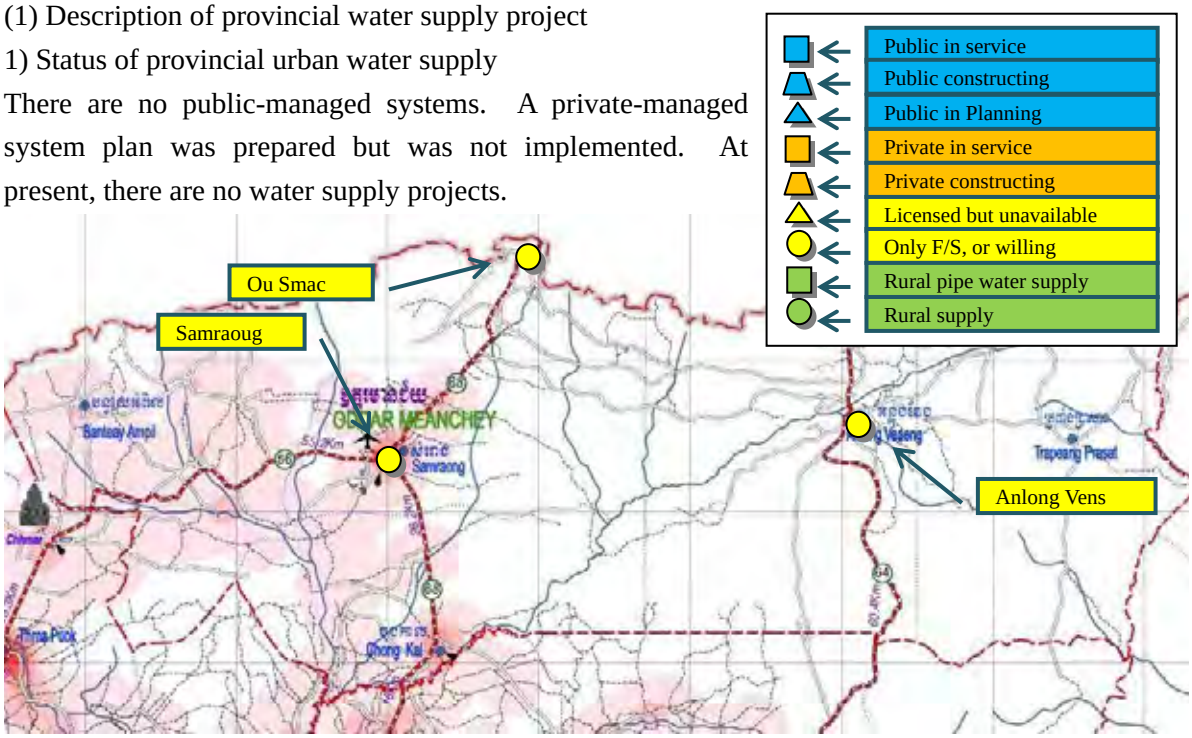


Figure 4.22.1 Existing Urban Water System in Otdar Meanchey Province

Table 4.22.1 Current Status of Urban Water Supply System in Otdar Meanchey Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Samraong		Not operated yet (water resource lacking)						
2	Ou Smac		Not operated yet (only license)						
3	Anlong Vens								

*1Blank means N/A.。

2) Historical development of urban and public water supply system

Neither public-managed nor private-managed water supply projects have been implemented. In 2002, the WB conducted F/S for the three towns in response to a request from DIME. Project feasibility was verified on Ou Smac village located near the national border but the plan was canceled.

As to Anlong Vens village, a water supply construction plan using private fund was approved by

MIME. However, construction work was terminated due to the territorial conflict at the national border. Construction of distribution tank and installation of pump were completed but the distribution network is not yet developed. The private company was the only one interested in water supply system project during the F/S stage. With low population density and project feasibility, no other companies are interested.

3) Support from donor agencies

No other water supply system plan aside from the above-mentioned exists. Likewise, no other donor except the WB can be accessed. Even in the central area of the province, there is no water supply system. It utilizes groundwater pumped from shallow wells, but groundwater contains very high levels of turbidity and sediments. In 2006, ponds were provided in the urban area for water and festival uses. However the urban area residents and hotels preferred using directly untreated pond water.

In 2002, when the WB conducted the F/S, many villages were considered less feasible but recently water use ponds were provided. Power supply started in 2007. Though other infrastructures have been largely improved, the provision of safe water supply for urban area is not yet attained.

If the pond water is applied as raw water, slow sand filter is the optimum water treatment method. Though vast land is needed, the potential for safe water supply only equipped with simplified mechanical equipment seemed to be high. Lake water level, water quality stability, served population and project cost estimation of distribution network need to be investigated by F/S.

(2) Urban water supply system management structure

1) Organizational Structure of DIME and Public Water Utility

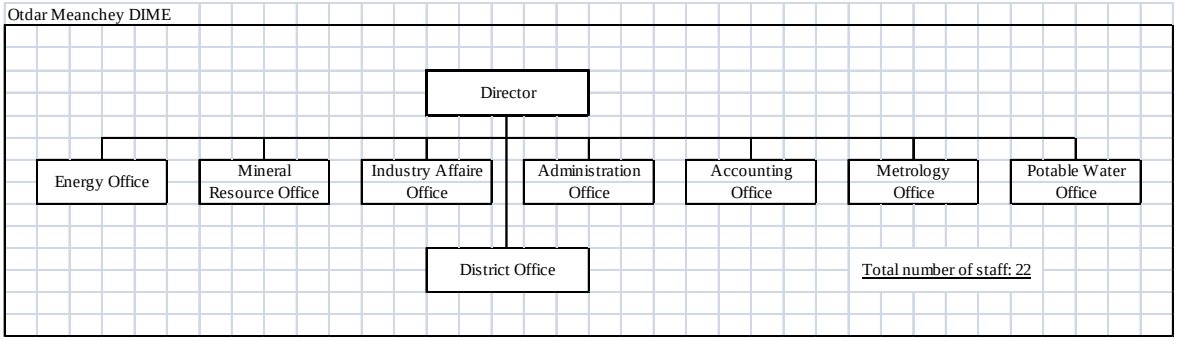


Figure 4.22.2 Organization Chart of DIME in Otdar Meanchey Province

As water supply projects have been difficult to obtain, DIME has a hard time dealing with the provincial government. Because of this, DIME is quite resolute to seek prospective water supply projects.

2) Capacity development for staff

As no water supply project exists, no capacity building program is available.

4.22.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (36.5%), “Tube/Pipe Wells” (28.8%) and “Unprotected Dug Wells” (13.8%), and the access rate to improved water are 41.7%. About 63.9% of households in this province depend on remote water sources.

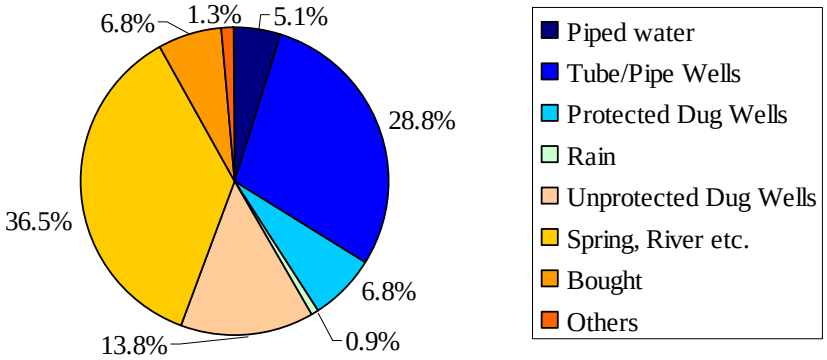


Figure 4.22.3 Type of Water Sources (Otdar Meanchey Province)

2) Condition of Water Supply Facilities

Since PDRD does not carriy out regular monitoring and data management, no information is available on the present condition of water supply facilities in the villages.

Meanwhile, based on the District Data Book (2008) by NCDD, the proportion of tube well which can be utilized the whole year are 79.5%, while the un-functioning tube well is 21.6%.

Table 4.22.2 Functioning/Un-functioning Conditions of Water Supply Facilities (Otdar Meanchey Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	1,921	
Year-round usable pumped or mixed wells	1,528	79.5%
Dry season unusable pump or mixed wells	393	20.5%
Pump or mixed wells needing repair/rehabilitation	415	21.6%
Total number of ring wells	844	
Year-round usable ring wells	497	58.9%
Dry season unusable ring wells	347	41.1%
Ring wells needing repair/rehabilitation	244	28.9%
Total number of un-protected dug wells	738	
Year-round usable un-protected dug wells	311	42.1%
Dry season unusable un-protected dug wells	427	57.9%

Source: District Book (2008)

3) Hand pumps

Afridev hand pumps are mostly used in this province. Although spare parts for Afridev hand pumps cannot be procured in this province, PDRD procured these parts from an agent in Phnom Penh. However, PDRD has ordered spare parts once a year as a job lot with minimum requirements. Until such time that these spare parts are procured, the hand pump remains to be non-functional for a long period. Commune councils used to manage spare parts but since they could not keep up with the inventory of necessary spare parts, PDRD has to take over the responsibility.

4) Water Quality

According to result of water quality analysis by arsenic center, 1.4% of the 147 groundwater samples were detected of more than 10ppb of arsenic but not exceeding 50ppb.

Table 4.22.3 Result of Arsenic Testing (Otdar Meanchey Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
147	0	0.0%	2	1.4%	145	98.6%

Source: Arsenic Center (2005-2007)

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 44 staff members, with 6 members belonging to the Office of Rural Water Supply and 4 belonging to the Office of Primary Health.

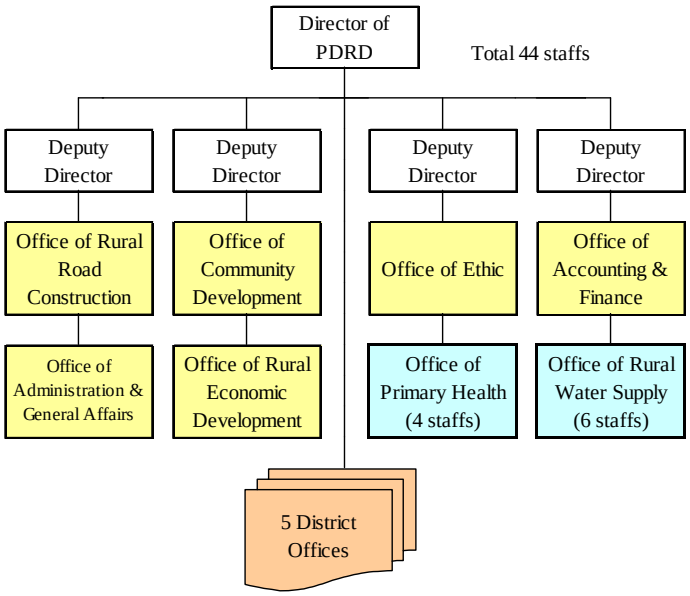


Figure 4.22.4 PDRD Organization Chart (Otdar Meanchey Province)

2) Budget

"External charges for services" accounts for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 232.9 million riel was allocated in 2009 as a MRD finical package budget which was mainly used rehabilitation for existing facilities.

Table 4.22.4 PDRD Budget (Otdar Meanchey Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	56.0	6.7%	56.0	6.6%
	External charges for services	505.0	60.4%	505.0	59.1%
	Other external charges for services	122.0	14.6%	122.0	14.3%
	Personal expenses	152.0	18.2%	170.0	19.9%
	Taxes and similar services	1.0	0.1%	1.0	0.1%
	Total	836.0		854.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	232.9	0	under preparation by MRD	
	Well rehabilitation		160		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		160		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Although PDRD has recognized the significance of monitoring for water supply facilities, PDRD could not carry out regular monitoring except UNICEF projects due to lack of budget.

(3) Assistance from Other Donors

1) Existing Project

a. Rural Water Supply and Sanitation Project by UNICEF

UNICEF has supported rural water supply and sanitation sector such as below.

Period	Target site	Contents
From 2004 to 2005	27 communes, 3 districts (Trapaing Prasat, Anlong Veng, Banteay Ampil)	Construction of 140 tube wells with hand pumps to communities and 34 schools
2006	4 communes, 2 districts (Anlong Veng、Chong Kal)	Construction of toilets such as flush/pour flush to pit latrine in 5 schools
2007	10 communes, 4 districts (Anlong Veng, Chong Kal, Trapang Prasat, Sam Roung)	Construction of 16 tube wells with hand pumps (5 wells to school)
2008	9 communes, 4 districts (Anlong Veng, Trapang Prasat, Sam Roung, Banteay Ampil)	Construction of 20 tube wells with hand pumps (6 wells to school)
2008	4 communes, 2 districts (Sam Roung, Banteay Ampil)	Construction of 5 water tanks (capacity $35m^3$) to 2 schools and 5 health centers
2009	5 communes, 2 districts (Sam	Construction of 15 water tanks (capacity $35m^3$) to

	Roung, Banteay Ampil)	10 schools and 5 health centers
2009	N.A	Well Renovation Project - Rehabilitation of 100 tube wells
2009	12 villagers, 3 communes (Kok Morn, Bosbov, Bangay Reak)	Capacity Building Practice on Water and Sanitation - training and practice including arsenic testing to PDRD staff - hygiene promotion to residents

2) New Assistance Plan

a. Rural Water Supply and Sanitation Project financed by IMF

(i) Status: Bidding for construction of water supply facilities is under preparation.

(ii) Target sites: 4 districts (Anlong Veng, Sam Roung, Choug Kal, and Banteay Ampil)
Not covered 100 percent of villages in target districts

(iii) Component: Construction of tubewell

b. UNICEF Project

Project content is not yet decided according to PDRD. PDRD had a meeting with UNICEF on March 2010. Probably, since unsuccessful well, which was drilled 80m depth, was occurred, water source is supposed to be surface water for rural water supply facilities by this project

(4) Current Hygiene Condition

Households with toilets on the premises account for 20.1% (6,997 households) in the rural areas. Of these households, 40.2% use septic tanks and 31.5% are connected to sewerage system.

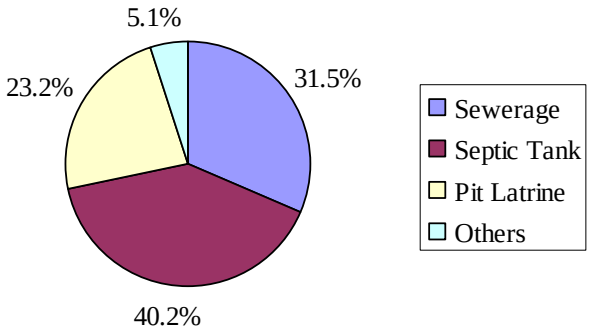


Figure 4.22.5 Type of Toilet (Otdar Meanchey Province)

Access to rural sanitation in Banteay Ampil district is a low 6.47% which is the worst districts of the 5 districts. Sam Roung district has 20%, the best of the districts. PDRD has undertaken the training for hygiene education through a UNICEF project, and PDRD also provided hygiene education to WSUG in 2009. PDRD considers Bosbov commune as a high priority area for the improvement of sanitation and hygiene environment.

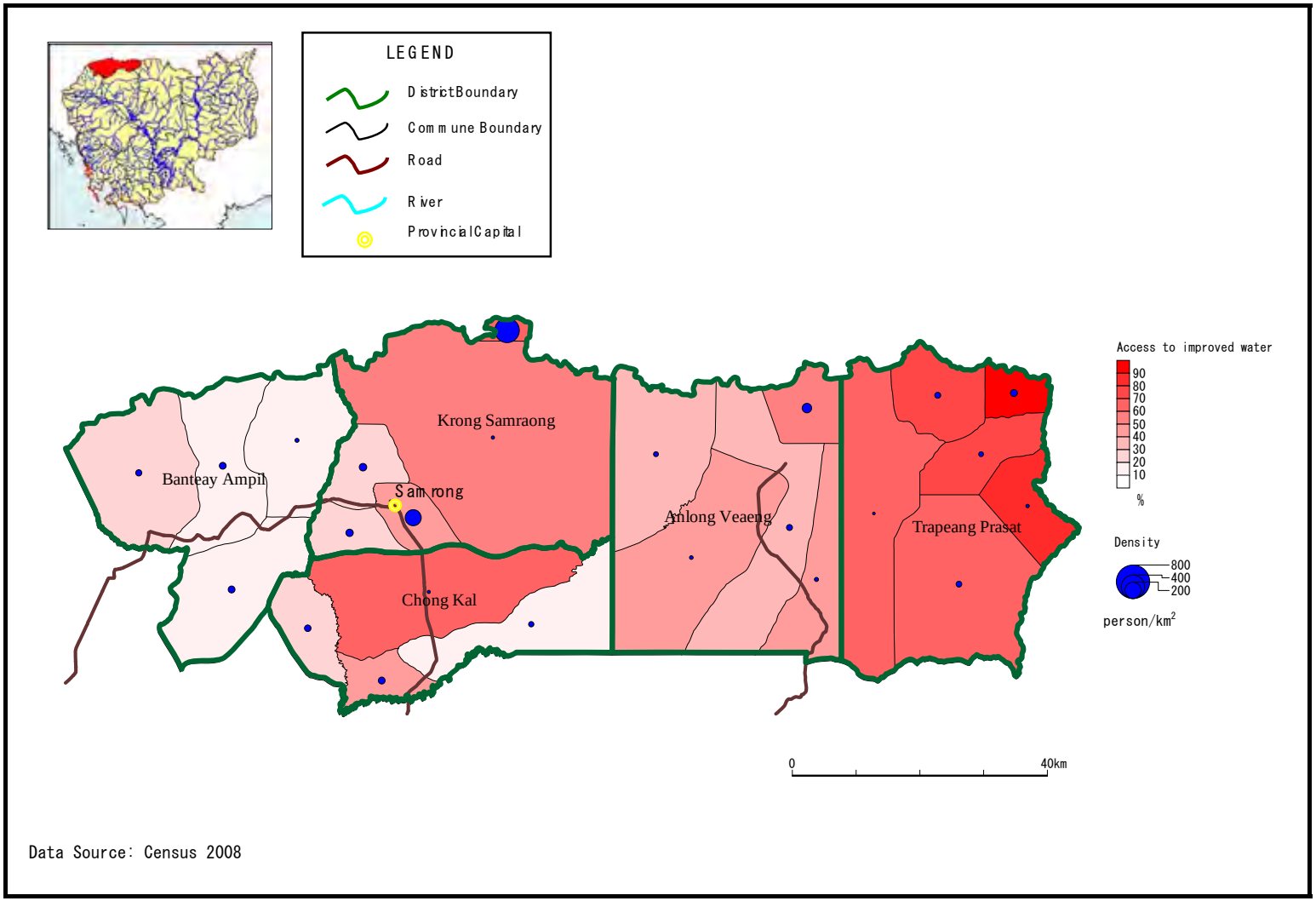
4.22.4 Safe Water Supply Area

Households with access to "Improved water" based on the data for water source usage by household in each commune from the 2008 census are shown below. Of the 24 communes in this province, more than 50% of households have access to "Improved water" in 10 communes.

Table 4.22.5 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Otdar Meanchey Province)

Urban	Rural	Total
1/0 communes	10/23 communes	10/24 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.22.6 Service Area of Safe Water (Otdar Meanchey Province)

4.23 Kep Province

4.23.1 Brief Description of the Province

The Kep province has total area of 336 km^2, comprised of 2 districts, 5 communes, and 16 villages. According to 2008 Census, urban population was 4,678 persons（962 HH）, and rural population was 31,075 persons (6,231 HH）. Population growth rate was 1.52% in urban area, 2.31 % in rural area and 2.21 % in the whole province.

4.23.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Though there is no public-managed water supply system, currently, one private-managed system is being constructed at the dam site. On the rainy season in 2010, dam test filling is scheduled.

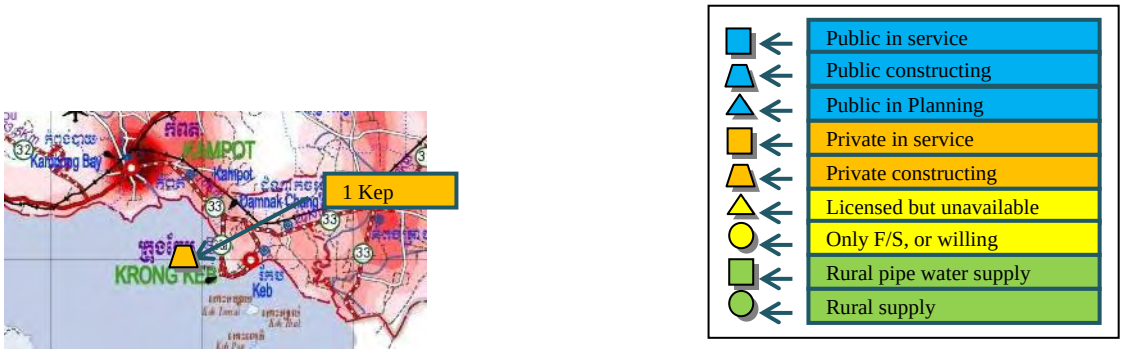


Figure 4.23.1 Existing Urban Water System in Kep Province

Table 4.23.1 Current Status of Urban Water Supply System in Kep Province

No	Town Name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Kep	Pri	Not operated yet (Under construction)						

2) Historical development of urban and public water supply system

1975	Pol Pot group destroyed the dam utilized as water source of urban service area.
1994	Segregated from Kampot province
2010	Private-managed system utilizes dam water is scheduled to be completed.

Only the existing urban water supply system serves Kep Town, the provincial capital. Construction of the other private-managed water supply project to serve Kep Town is also on-going. The old WTP was destroyed during the Civil War and water supply service has long been terminated since then. Construction of the said private-managed system started in 2008 on the initiative of DIME under a BOT type contract. Design service population is 35,000 including tourists.

3) Support from donor agencies

From the viewpoint of total provincial development, power supply has higher priority than water supply; meanwhile, urban residents need immediate connection to water supply system. After the

separation from Kampot province in 1994, DIME has been requesting assistance to JICA, the WB and ADB but no response has been received yet.

As work progresses for the above-mentioned private-managed system, unfavorable situations may occur such as failure on the distribution network development, and system commissioning within 2010 is not achieved. In this case, DIME will take the following actions through MIME:

- Request assistance from donor agencies
- Joint-work with other private company

After system development, the establishment of water quality analysis and control structure will be pursued.

(2) Urban water supply system management structure

1) Orgainization Structure of DIME and Public Water Utility

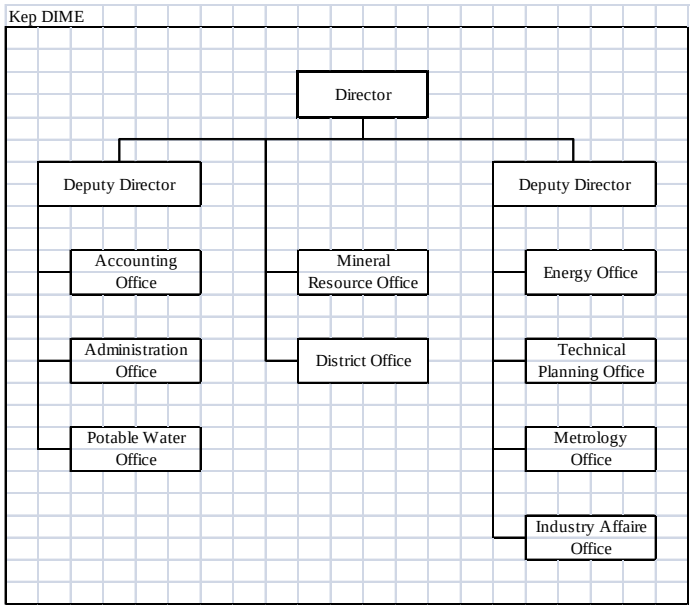


Figure 4.23.2 Organization Chart of DIME in Kep Province

DIME has 7 staff members but nobody is assigned to the water supply service. As Kep province is still newly-established, DIME is now constructing its own building.

- Management status of private system

  Project progress reports are submitted to DIME for their monitoring. Since the area of Kep province is small and residents urgently need water supply service, DIME has a plan to develop urban water supply service to the whole provincial area except some areas with less housing density,.

  A private company has already acquired license from MIME. It has discussed with the company about project implementation by BOT scheme. Five years after the system is commissioned, MIME will examine the performance and review the BOT period.

2) Capacity development for staff

As DIME recognizes the eventual personnel increase and the need for staff capacity development in preparation towards the start of urban water supply, MIME was requested to convene technical training.

(3) Relevant facilities

1) Facilities visited（Western Coastal Development Co. Ltd.）

- Description of the system

  The whole budget requirement for facility construction was invested by Cambodian and French private companies on a 50-50 sharing. To secure water sales income, bottled water factory（RO ＋UV）was built within the WTP premises. Water rate is not yet established.

- Water supply facilities

  Water supply project implemented by the private sector is constructing an earth dam for potable water source. Construction is on-progress and construction of WTP adjoining the dam is also scheduled.

  This dam together with the WTP already existed during the French regime and was destroyed by the Pol Pot regime. Existing spillway can still be used. By visual inspection, the earth dam is structurally weak. Capacity is 2 million m3, H=17 m and test filling is scheduled to commence coming rainy season. It has acquired an EIA from MOE through conferences held between related agencies in the central government.

  Target completion date of WTP is set by the end of 2010. Design WTP capacity is for target year of 2040 and the dimension of secured land is 100 m×100 m. Proposed water treatment method is as follows:

  Coagulation→sedimentation→rapid filtration→clear water reservoir→distribution

  Detailed treatment flow shall be confirmed by drawings.

4.23.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of “Springs, Rivers, etc.” (40.6%), “Unprotected Dug Wells” (36.9%) and “Tube/Pipe Wells” (9.3%), and the access rate to improved water are 20.1%. About 54.7% of households in this province depend on remote water sources.

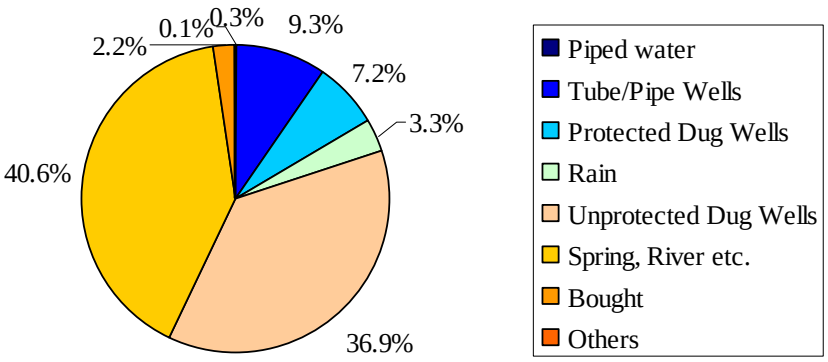


Figure 4.23.3 Type of Water Sources (Kep Province)

2) Condition of Water Supply Facilities

Since PDRD has not carried out any regular monitoring and data management, no information on the present condition of water supply facilities in villages is available.

Meanwhile, according to the District Data Book (2008) by NCDD, the proportion of tubewells which can be used the whole year is 50.3% while the proportion of non-functional tube wells is 29.6%.

Table 4.23.2 Functioning/Un-functioning Conditions of Water Supply Facilities (Kep Province)

Items	No. of facilities	Ratio
Total number of pumped or mixed wells	358	
Year-round usable pumped or mixed wells	180	50.3%
Dry season unusable pump or mixed wells	178	49.7%
Pump or mixed wells needing repair/rehabilitation	106	29.6%
Total number of ring wells	278	
Year-round usable ring wells	212	76.3%
Dry season unusable ring wells	66	23.7%
Ring wells needing repair/rehabilitation	49	17.6%
Total number of un-protected dug wells	33	
Year-round usable un-protected dug wells	18	54.5%
Dry season unusable un-protected dug wells	15	45.5%

Source: District Book (2008)

3) Hand pumps

VN6 hand pumps are used by 20% of the users in this province. Spare parts for VN6 hand pump cannot be procured in this province, but they are available in Kampot province. Afridev hand pumps are used by 80% of the users, but spare parts for Afridev hand pumps are not available. PDRD has stocked spare parts for Afridev hand pump in 1998 provided by UNICEF, but no stock is available at the present. If WSUG needs spare parts, WSUG informs PDRD, and PDRD purchases it from Phnom Penh on actual charge to WSUG

4) Water Quality of Groundwater

Iron and hardness contaminations are normally high in this province, and salt risk is found from groundwater in Angkaol commune, Damnak Chang'aeur district. The commune is located near the Vietnam border and along the coastal area. PDRD has no water quality data for rural water supply facilities.

(2) Organization and Structure/Operation and Maintenance

1) Organization and Structure

PDRD in this province consists of 19 staff members, with 2 members belonging to the Office of Rural Water Supply and 2 belonging to the Office of Primary Health.

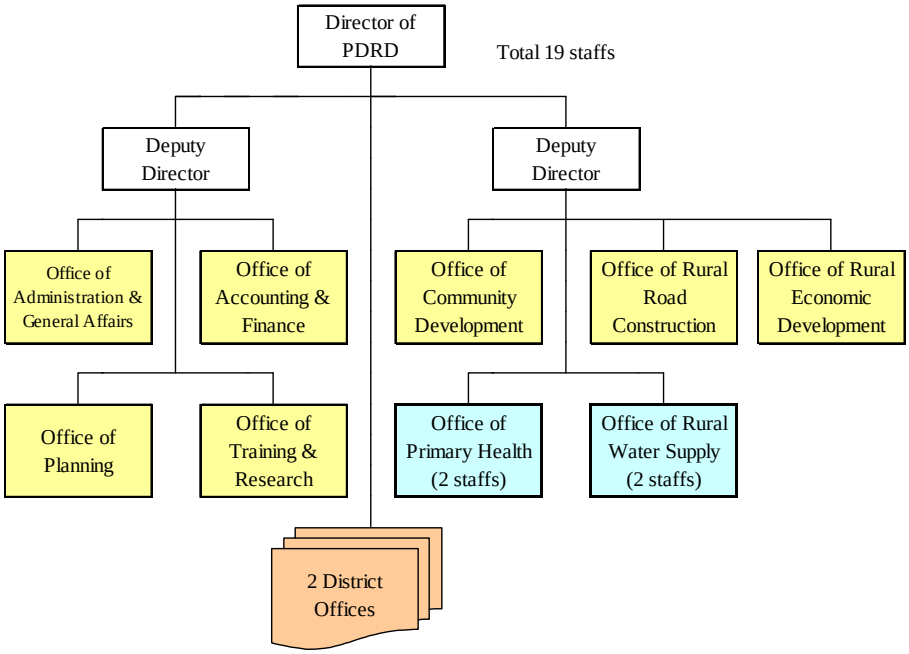


Figure 4.23.4 PDRD Organization Chart (Kep Province)

2) Budget

"Purchase" accounts for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects.

On the other hand, 136.1 million riel was allocated in 2009 as a MRD finical package budget which was mainly used rehabilitation for existing facilities.

Table 4.23.3 PDRD Budget (Kep Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	137.0	58.1%	137.0	53.5%
	External charges for services	16.0	6.8%	16.0	6.3%
	Other external charges for services	23.0	9.7%	23.0	9.0%
	Personal expenses	60.0	25.4%	80.0	31.3%
	Taxes and similar services	0.0	0.0%	0.0	0.0%
	Total	236.0		256.0	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	136.1	6	under preparation by MRD	
	Well rehabilitation		50		
	Upgrading Community Pond		0		
	Rain water collection tank		0		
	Small pipe water supply system		0		
	Upgrading Canals		0		
	Total		56		

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

(3) Assistance from Other Donors

1) Existing Project

a. Rural Water Supply Project by China

(i) Target sites: All districts

(ii) Period: 1997

(iii) Component: Construction of 101 tube wells with hand pumps (Mostly, Indian Mark III hand pumps were adopted by this project)

b. Rural Water Supply Project by UNICEF

(i) Component: This project was carried out 1998s, but details are unknown.

c. Rural Water Supply Project by MRD

(i) Component: Construction of 42 hand dug wells and 14 community ponds

d. Rural Sanitation Project by DRHC (MRD)

(i) Component：Promotion of sanitation facility by informed-choice method

2) New Assistance Plan

a. CLTS Project by UNICEF

(i) Target sites: 9 villages

(ii) Period：From August 2009 to May 2010

(iii) Component: Hygiene education

b. Rehabilitation Project for Rural Water Supply financed by MRD

(i) Component: Construction of 6 tube wells (4 wells in Pong Tuek commune, Damnak Chang'aeur

district, 2 well in Prey Thum commune, Krong Kaeb district) , Rehabilitation of 50 existing tube wells

(ii)Period: 2009

c. Hygiene Promotion by PDRD

(i) Component: Hygiene education to residents (how to use toilet, how to construct toilet, hygiene behavior chage, improve awareness)

(ii) Target sites: 16 villages

d. Rural Water Supply and Sanitation Project financed by MRD

(i) Period: 2010

(ii) Component: Construction of 30 household toilets, and 30 tube wells with hand pumps (not yet approval)

(4) Current Hygiene Condition

Households with toilets on the premises account for 25.1% (1,566 households) in the rural areas. Of these households, 44.8% use septic tanks and 36.0% are connected to sewerage system.

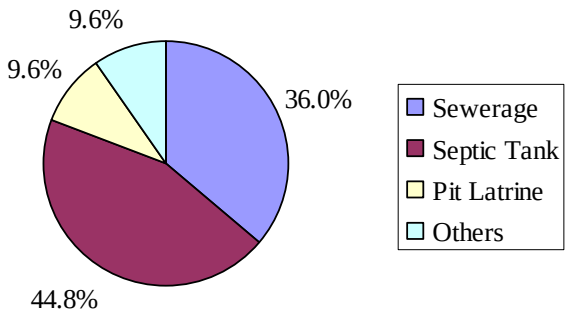


Figure 4.23.5 Type of Toilet (Kep Province)

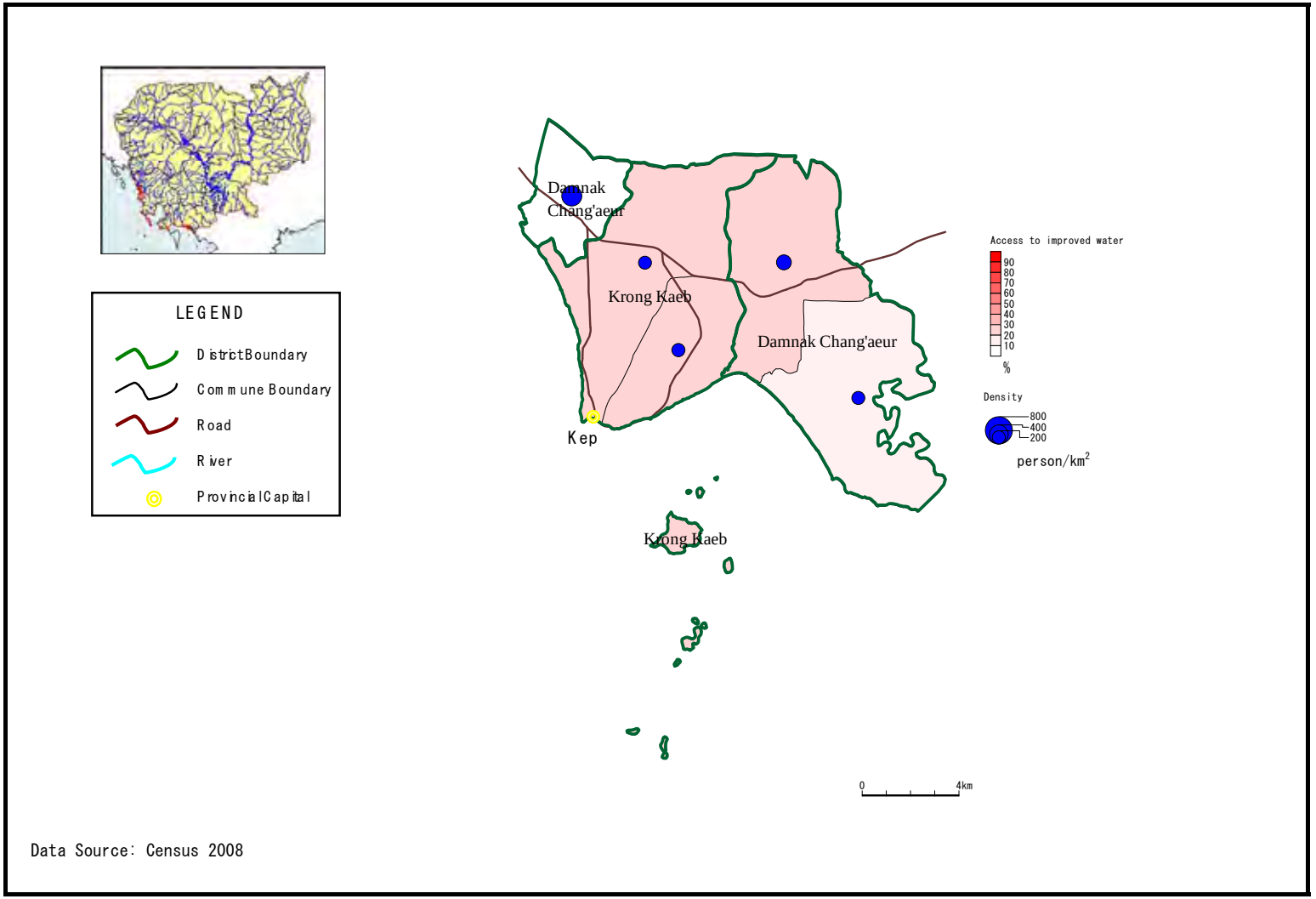
4.23.4 Safe Water Supply Area

Households with access to “Improved water” based on the data for water source usage by household in each commune from the 2008 census are shown in the table below. Of the 5 communes in this province, none of the communes has access to “Improved water”.

Table 4.23.4 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Kep Province)

Urban	Rural	Total
0/1 communes	0/4 communes	0/5 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.23.6 Service Area of Safe Water (Kep Province)

4.24 Pailin Province

4.24.1 Brief Description of the Province

The Pailin province has total area of 803 km^2, comprised of 2 districts, 8 communes, and 83 villages. According to 2008 Census, urban population was 15,674 persons（3,218 HH）, and rural population was 54,812 persons (11,218 HH）. Population growth rate was 6.10% in urban area, 13.36 % in rural area and 11.24 % in the whole province.

4.24.2 Current Status of Urban Water Supply

(1) Description of provincial water supply project

1) Status of provincial urban water supply

Pailin province was newly established in 1997. In 1997, DIME was founded but no public water supply project was implemented yet.

There are only two water supply projects in the province: a private water supply system serving the provincial capital; and another private system being constructed to serve two villages located along the national border.

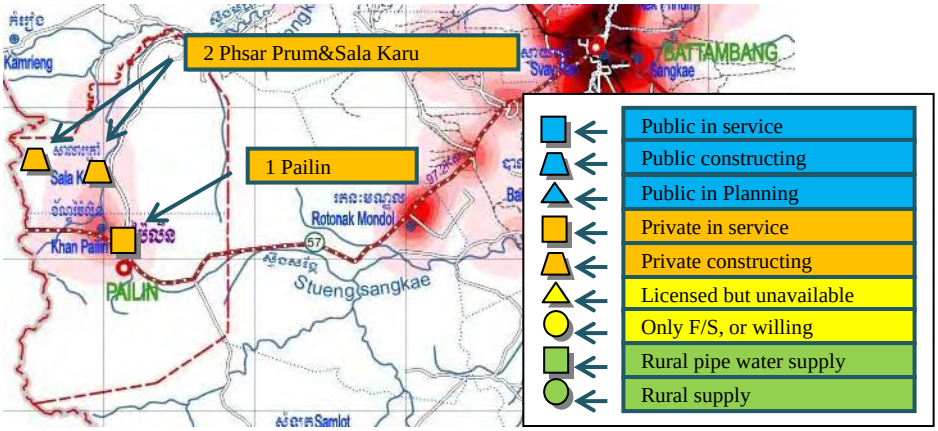


Figure 4.24.1 Existing Urban Water System in Pailin Province

Table 4.24.1 Current Status of Urban Water Supply System in Pailin Province

No	Town name	Ownership	Year Established	Population	Connection	Supply (m^3/day)	Resource	Connection Fee	Tariff (R/m^3)
1	Krong Pailin	Pri	2008		720	2,800	river	200,000	2,000
2	Sala Krau	Pri	Not operated yet (Just started constructing)						

*1 Blank means N/A.

2) Historical development of urban and public water supply system

1996 Palin province was established and DIME was founded in the following year.
2005 Provincial capital was served by private water supply system.
2008 Provincial capital water supply system was organized.

At present, the provincial capital water supply system is private-managed but circumstances are quite complicated. During 1999 to 2001, the first private water supply company was founded but felt into bankruptcy before system completion. The second private water supply company was established and distribution network was completed in 2005 but there was no WTP. In 2007, the facilities of former water supply projects were sold and integrated. In 2008, the WTP was inaugurated and all related facilities were operated until now.

3) Support from donor agencies

Currently, there are not any support from donor agencies.

(2) Urban water supply system management structure

1) Organizational structure of DIME and Public Water Utility

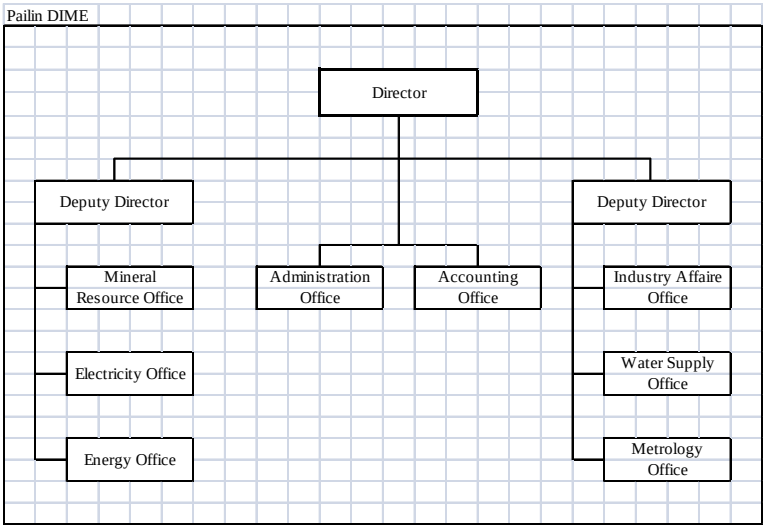


Figure 4.24.2 Organization Chart of DIME in Pailin Province

- Management status of private system

  The supervisor of private company replied that project progress report is submitted to DIME because of obligations.

2) Capacity development for staff

Since no public system exists, no technical training has been provided. DIME needs technical training for both public and private water supply related staff.

(3) Relevant facilities

1) Pailin private water system

- Description of the system

  One company undertaking private water supply in Pailin is “Thomas Company LTD”, a Cambodian company. It domestically procured finance for the system by loan. It has four staffs. The water tariff is 2,000 Riel/m^3.

The raw water is taken upstream from a river. The intake amount is 350m^3/day in rainy season and 400 to 500m^3/day during the dry season. The turbidity looks low and is estimated to be 10 to 20 NTU by visual inspection in the study. Raw water flows into receiving tank by gravity and is introduced into two vertical flow type flocculators. Filtration tank is shallow type.

No reservoir was observed. Filtered water is supplied through exposed PVCφ200 by gravity. Partway, the diameter of this supply pipe is reduced to φ150 and buried.

First impression was that it is an imitation of Cambodian WTP, but the JICA expert explained that the basic treatment technology was provided by the assistance of a US NGO.

Pipe exchange and in-pipe flow stress does not seem to have been considered in the pipe design. As the detour flow flocculator is a structurally weak high-floored type, immediate reinforcement is recommended.

- Operational status

  One O&M staff was assigned.

  Solid coagulant is directly thrown into the flocculator. As this is a quite problematic way of chemical dosing, it is doubtful that effective sedimentation is occurring. Owing to low turbidity and low epidemiological risk in raw water, no issues have been reported so far.

  Alum is the only coagulant being used, and there is a stock of several bags. As it is stored in a building with a roof and ventilation, it is in reasonable condition.

  Bleaching powder is used for disinfection, but it has turned a yellow color. This is thought to be due to its age, and thus its effective chlorine content should have decreased to less than half. Existing stock is only one bag. Every morning at 9 o'clock, bleaching powder is thrown into each flocculation tank. Sustainable disinfection effect cannot be achieved by such chlorine dosing.

2) Small scale water supply facility

- Description of the system

  They explained that this village water supply system was built with the assistance of the Italian government.

- Water supply facilities

  Surface water is taken by stone weir. After natural sedimentation, the water flows into a connection steel pipe（φ200～150）and into a slow sand filter by gravity. The dimensions of the slow sand filter are 6,000 × 4,500 × 2 units. They look rather small and have a transparent cover mounting for natural lighting.

  A reservoir is built next to the sand filter. The village is served by gravity.

  The facility design is not Japanese style. Exposed PVC pipes have been deteriorated by sunlight, and the absence of flow stress measures might be medium to long term

issues.

- Operational status
  No chemicals are used, but this system is fully functioning as a water treatment facility. The system is operated efficiently as a slow sand filter.
  During the field survey, the sand filter was cleaned. The incoming water was found to be blocked by soil. They don't rake up the sand surface. They dug the sand and hauled to a cleaning pit manually. Water supply is stopped during cleaning, but according to the staff, no problems occur with regard to the temporal stop because its timing is announced to all users beforehand.

4.24.3 Rural Water Supply

(1) Current Condition of Rural Water Supply

1) Water Sources

The water sources used in this province consist of "Springs, Rivers, etc." (44.2%), "Bought" (27.3%) and "Tube/Pipe Wells" (10.5%), and the access rate to improved water are 21.3%. About 43.6% of households in this province depend on remote water sources.

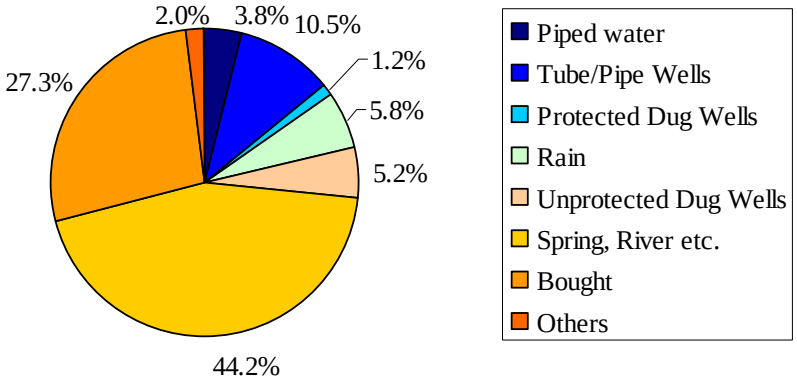


Figure 4.24.3 Type of Water Sources (Pailin Province)

2) Condition of Water Supply Facilities

Monitoring results for existing facilities by PDRD are shown in Table 4.24.2. The functioning rate of water supply facilities is 64.9%.

Table 4.24.2 Monitoring Results by PDRD (Pailin Province)

Items	Total	Function		Broken	
	No.	No.	Ratio	No.	Ratio
Social Fund	158	111	70.3%	47	29.7%
CARE	98	70	71.4%	28	28.6%
MRD + SEILA	25	11	44.0%	14	56.0%
MRD + UNICEF	2	0	0.0%	2	100.0%
EU ASAC	21	7	33.3%	14	66.7%
UNICEF	6	2	33.3%	4	66.7%
ADB	1	1	100.0%	0	0.0%
Japan Social Fund	2	0	0.0%	2	100.0%
Aspeca	2	1	50.0%	1	50.0%
Private + MRD	1	1	100.0%	0	0.0%
Private	2	2	100.0%	0	0.0%
Woman Development	1	1	100.0%	0	0.0%
Total	319	207	64.9%	112	35.1%

Source: PDRD in Pailin (2009)

3) Hand pumps

Afridev hand pumps are common in this province, and spare parts for Afridev hand pumps cannot be procured in this province so that PDRD procure it from Phnom Penh instead of WSUG. In case of heavy failures, PDRD, who already have trained the maintenance, have fixed it.

4) Water Quality for Groundwater and Surface Water

As a result of water testing using simple field kits provided by UNICEF, arsenic contaminations were detected 30 percent of groundwater and surface water. According to this, PDRD has given reminder with painting (red color for high density polution, and blue color for low density pollution). The reason is considered that since mining of diamond is active in this province, polluted water may be penetrated to groundwater and surface water at the time of mining. According to result of water quality analysis by arsenic center, 7.9 percent out of114 groundwater samples were detected more than 10ppb of arsenic

Table 4.24.3 Result of Arsenic Testing (Pailin Province)

Total No. of tested wells	As > 50 ppb		10 < As ≤ 50 ppb		As ≤ 10 ppb	
	No.	Ratio	No.	Ratio	No.	Ratio
114	4	3.5%	5	4.4%	105	92.1%

Source: Arsenic Center (2005-2007)

(2) Organization and Structure/Operation and Maintenance

1) Organizational Structure

PDRD in this province consists of 40 staff members, with 4 members belonging to the Office of Rural Water Supply and 4 belonging to the Office of Primary Health.

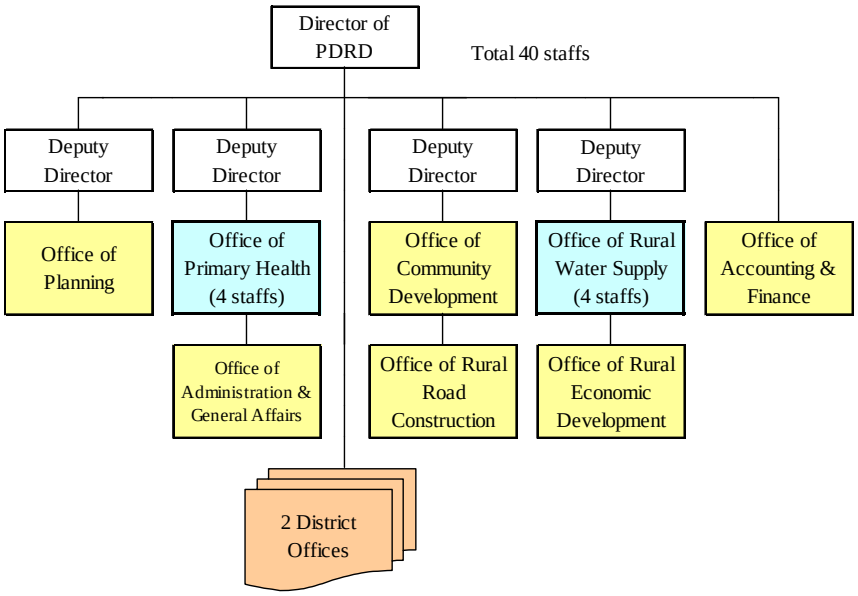


Figure 4.24.4 PDRD Organization Chart (Pailin Province)

2) Budget

"External charges for services" accounts for a high percentage of PDRD's annual budget. No budget is allocated for rural water supply and health care projects, and also MRD financial package budget in 2009.

Table 4.24.4 PDRD Budget (Pailin Province)

Unit: million Riel

Items		2009		2010	
		Budget	Ratio	Budget	Ratio
State Budget	Purchase	128.0	13.8%	177.0	12.0%
	External charges for services	558.2	60.4%	1,009.0	68.4%
	Other external charges for services	108.0	11.7%	108.0	7.3%
	Personal expenses	130.0	14.1%	179.7	12.2%
	Taxes and similar services	0.0	0.0%	2.0	0.1%
	Total	924.2		1,475.7	
		Budget	Qty.	Budget	Qty.
Budget Allocation by MRD (MRD financial package budget)	New well construction	no allocation		under preparation by MRD	
	Well rehabilitation				
	Upgrading Community Pond				
	Rain water collection tank				
	Small pipe water supply system				
	Upgrading Canals				
	Total				

Source: Program Budgeting Plan 2009 for the Ministry of Rural Development, 20 State Budget

3) Operation and Maintenance

Although PDRD is carrying out the monitoring of well conditions periodically, it has no records of its activities.

(3) Assistance Record by Other Donors

1) Existing Project

a. UNICEF Project

UNICEF constructed 19 tube wells with hand pumps in 1998, but two tube wells are removed with road extension among them, and 17 tube wells are working now.

b. SEILA Program

PDRD requested to SEILA Program to support construction of 45 tube wells using construction materials procured by MRD. Although 27 tube wells were constructed by SELA program, 18 tube wells were completed by self-reliance of residents because of shortage of budget by SEILA program.

c. Other Projects

Rural water supply and sanitation projects were done by CARE International, CMAC and Social Fund.

2) New Assistance Plan

a. Rural Water Supply Project financed by MRD

10 tube wells will be constructed supported by MRD in this province.

(4) Current Hygiene Condition

Households with toilets on the premises account for 34.2% (3,836 households) in the rural areas. Of these households, 34.2% use pit latrines and 31.1% use septic tanks.

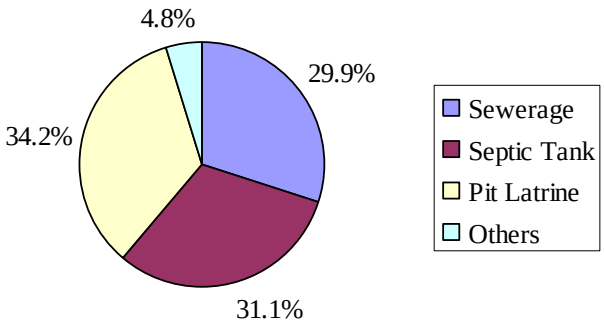


Figure 4.24.5 Type of Toilet (Pailin Province)

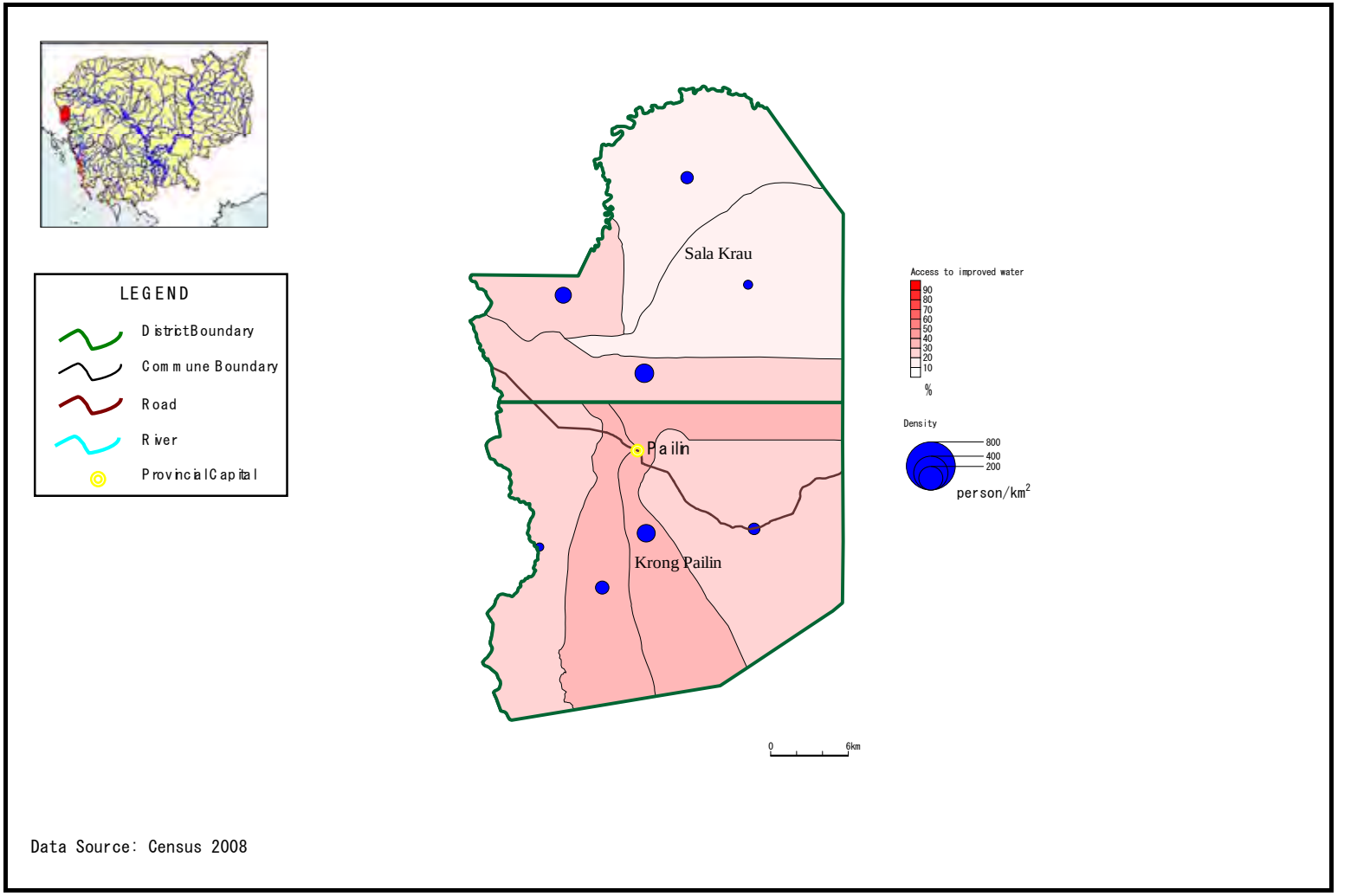
4.24.4 Safe Water Supply Area

Households with access to “Improved water” based on the data for water source usage by household in each commune from the 2008 census are shown below. In this province, there is no commune where more than 50% of households have access to “Improved water”.

Table 4.24.5 Number of Communes of over 50 Percent of HHs with Access to Improved Water (Pailin Province)

Urban	Rural	Total
0/1 communes	0/7 communes	0/8 communes

Note: The denominator in the table is the number of communes/Sangkat



Unit: %, Source: 2008 Census

Figure 4.24.6 Service Area of Safe Water (Pailin Province)