

The Study on Groundwater Development in Central Cambodia
Final Report

Main Report

LOCATION MAP

EXCHANGE RATE AND LIST OF ABBREVIATION

EXECUTIVE SUMMARY

CONTENTS

CHAPTER 1 INTRODUCTION.....	1-1
1.1 Background.....	1-1
1.2 Objectives and Scope	1-2
1.2.1 Objectives	1-2
1.2.2 Scope	1-2
1.3 Study Area	1-4
1.4 Study Schedule	1-5
1.5 Study Team.....	1-5
CHAPTER 2 NATURAL ENVIRONMENT	2-1
2.1 Climate	2-1
2.1.1 Seasons	2-1
2.1.2 Rainfall	2-1
2.1.3 Evaporation	2-2
2.2 Hydrology.....	2-2
2.2.1 River Water Level	2-2
2.2.2 River Discharge	2-2
2.3 Topography.....	2-3
2.3.1 Topographical Feature of Kampong Chhnang Province	2-3
2.3.2 Topographical Feature of Kampong Cham Province	2-3
2.3.3 Basin Division	2-3
2.4 Geology	2-4
2.4.1 Geological Units in the Existing Materials	2-4
2.4.2 Results of Field Reconnaissance Survey	2-5

CHAPTER 3 SOCIO-ECONOMY AND WATER SUPPLY	3-1
3.1 Socio-Economy	3-1
3.1.1 Population and Demographic Characteristics	3-1
3.1.2 Local Administrative Divisions	3-5
3.1.3 Economic Situation	3-6
3.1.4 Socio-economy in the Study Area.....	3-9
3.2 Rural Water Supply.....	3-16
3.2.1 Water Supply Organizations	3-16
3.2.2 Rural Water Supply Situation	3-17
3.2.3 Organization and Capacity of DRWS and PDRD.....	3-21
3.2.4 Five Year Rural Water Supply Plan.....	3-23
3.2.5 Financial Constraints.....	3-24
3.3 Health and Hygiene.....	3-26
CHAPTER 4 GROUNDWATER INVESTIGATION	4-1
4.1 Topography and Geology.....	4-1
4.1.1 Kg. Chhnang Province	4-1
4.1.2 Kg. Cham Province	4-2
4.1.3 Geological Unit	4-4
4.1.4 Hydrogeologic Structures.....	4-4
4.2 Test Well Drilling and Pumping Test	4-8
4.2.1 Drilling Sites	4-8
4.2.2 Results of Drilling.....	4-13
4.2.3 Hydrogologic Features	4-17
4.2.4 Pumping Tests.....	4-50
4.3 Groundwater Levels	4-120
4.3.1 Purpose.....	4-120
4.3.2 Methodology	4-120
4.3.3 Survey Results.....	4-125
4.4 Groundwater Quality.....	4-138
4.4.1 Purpose.....	4-138
4.4.2 Methodology	4-138
4.4.3 Results of Laboratory Analysis.....	4-140
4.4.4 Results of Field Measurement.....	4-194
4.5 Groundwater Resource Evaluation	4-260

4.5.1 Hydrogeological Unit	4-260
4.5.2 Aquifer Productivity	4-260
4.5.3 Groundwater Potential.....	4-263
4.6 Water Balance Analysis	4-266
4.6.1 Methodology	4-266
4.6.2 Measured Parameters.....	4-266
4.6.3 Estimated Parameters	4-267
4.6.4 Result of Computation.....	4-271
CHAPTER 5 VILLAGE SURVEY.....	5-1
5.1 Selection of Target Village.....	5-1
5.1.1 Conditions of Requested Villages	5-1
5.1.2 Selection Process and Criteria for the Target Villages.....	5-2
5.2 Survey of the 303 target villages	5-13
5.2.1 Objectives	5-13
5.2.2 Methodology	5-13
5.2.3 Socio-Economic Conditions.....	5-17
5.2.4 Water Supply Conditions	5-24
5.2.5 Health and Hygiene Conditions	5-40
5.3 SURVEY OF PRIORITY VILLAGES	5-44
5.3.1 Methodology Used	5-44
5.3.2 General Feature of Socio-Economy of the Area	5-45
5.3.3 Rural Water Supply Situation.....	5-54
5.4 Analysis on Hand Pump Well Utilization	5-75
5.4.1 Background of The Analysis and Data to Be Analyzed.....	5-75
5.4.2 Utilization of Hand Pump Well.....	5-77
5.5 Gender Analysis	5-84
5.5.1 Overview of Women's Situation in Cambodia	5-84
5.5.2 Field Survey on Gender Issues	5-87
CHAPTER 6 COMMUNITY PARTICIPATION PROGRAM.....	6-1
6.1 Objectives and Policy	6-1
6.1.1 Objectives.....	6-1
6.1.2 Community Participation Policy	6-1
6.2 Water Supply Facility.....	6-1
6.2.1 Deep Well.....	6-1

6.2.2 Hand Pump.....	6-2
6.2.3 Platform and Drainage (drawing shown in Figure 6.2.2).....	6-4
6.2.4 Iron Removal Device (drawing shown in Figure 6.2.3).....	6-5
6.3 Establishment of VWC and WPC	6-6
6.3.1 Central and Provincial Level Activities	6-6
6.3.2 Village Level Activities	6-7
6.4 Health and Hygiene Education.....	6-8
6.5 Operation and Maintenance Education	6-8
6.5.1 Purpose of Education	6-9
6.5.2 Scope of Education Program.....	6-9
6.5.3 Development of Education Materials.....	6-10
6.5.4 Main Topics of Education.....	6-10
6.5.5 Education Approach by Level.....	6-12
CHAPTER 7 GROUNDWATER DEVELOPMENT PLANNING	7-1
7.1 Groundwater Development Policy	7-1
7.1.1 Area distinction by groundwater potential.....	7-1
7.1.2 Development policy	7-1
7.2 Target Aquifers	7-3
7.2.1 Aquifers and Drilling Depth.....	7-3
7.2.2 Development Scale.....	7-4
7.3 Standard Well Design	7-4
7.3.1 Target Depth.....	7-5
7.3.2 Drilling Method.....	7-5
7.3.3 Well Completion	7-5
7.4 Groundwater Investigation Methodology in Kg.Chhnang.....	7-5
7.4.1 Topographical and geological reconnaissance survey	7-6
7.4.2 Water level and water quality survey	7-6
7.4.3 Electric resistivity survey (Vertical and Two dimensional)	7-6
7.5 Considerations for Water Quality	7-9
7.5.1 Arsenic and Fluoride	7-9
7.5.2 Nitrate.....	7-9
7.5.3 Acceptability aspects in the WHO Guideline	7-9
CHAPTER 8 WATER SUPPLY PLAN	8-1

8.1 Water Supply Plan Policy.....	8-1
8.2 Project Area and Village Selection.....	8-2
8.2.1 Target Project Area.....	8-2
8.2.2 Classification of 303 Villages	8-3
8.2.3 Target Village Selection.....	8-3
8.2.4 Alternative Water Source	8-4
8.3 Design Standards.....	8-5
8.3.1 Standard Amount for Water Consumption.....	8-5
8.3.2 Water Demand Projection	8-6
8.3.3 Hand Pump Selection	8-6
8.3.4 Required Hand Pumps.....	8-6
8.3.5 Number of Hand Pumps Required	8-7
8.4 Water Supply Facility.....	8-9
8.5 Project Cost	8-11
8.5.1 Condition of Estimate.....	8-11
8.6 Project Implementation	8-13
8.6.1 Implementing Body	8-13
8.6.2 Implementation Schedule	8-13
8.7 Operation & Maintenance and Monitoring Program.....	8-14
8.7.1 Policy.....	8-14
8.7.2 Organization	8-14
8.7.3 Notification system and maintenance record	8-19
8.7.4 Troubles to Happen	8-21
8.7.5 Spare Parts and Maintenance Tools	8-21
8.7.6 Operation and Maintenance Cost	8-23
8.7.7 Monitoring Program	8-24
8.8 Guidance in O&M & Sanitation Campaign	8-25
CHAPTER 9 HYGIENE EDUCATION PLAN	9-1
9.1 Present State of Villagers' Consciousness on Hygiene.....	9-1
9.1.1 Findings obtained by the Village Survey Results	9-1
9.1.2 Findings obtained by Hygiene Education Activity to Villagers.....	9-2
9.1.3 Evaluation of Villagers' Consciousness on Hygiene	9-3
9.2 Present State of Hygiene Education	9-4
9.2.1 Hygiene Education in School	9-4

9.2.2 State of Main Relevant Project	9-4
9.3 Hygiene Education Plan.....	9-6
9.3.1 Necessity of Hygiene Education and Its Effects to Projects	9-6
9.3.2 Evaluation of the Present State	9-7
9.3.3 Hygiene Education Policy.....	9-7
9.3.4 Proposed Method of Hygiene Education in the Implementation of HP Projects...	9-8
9.3.5 Implementation System.....	9-9
CHAPTER 10 PROJECT EVALUATION.....	10-1
10.1 Consideration for Evaluation	10-1
10.1.1 Overview	10-1
10.1.2 Increased Beneficiaries in the Target Villages.....	10-2
10.1.3 Improvement in Health Conditions.....	10-2
10.1.4 Time Saving Effect of Water Collection.....	10-4
10.1.5 Opportunities for Better Farming.....	10-4
10.2 Financial Analysis.....	10-5
10.2.1 Financial Project Cost	10-5
10.2.2 Financial Sources	10-6
10.2.3 Recovery of Capital Cost and Recurrent Cost	10-7
10.3 Economic Evaluation	10-8
10.3.1 Basic Assumptions	10-8
10.3.2 Economic Project Costs	10-8
10.3.3 Economic Benefits	10-9
10.3.4 Cost and Benefit Analysis.....	10-11
10.4 Social evaluation and WID	10-11
10.4.1 Village organization.....	10-11
10.4.2 Hygiene Awareness.....	10-12
10.4.3 WID.....	10-13
10.4.4 Other issues	10-13
10.5 Organizational and Institutional Evaluation.....	10-14
10.5.1 Central Agency.....	10-14
10.5.2 Provincial Agencies	10-15
10.5.3 Community Organizations	10-15
10.5.4 New O&M System.....	10-15
10.6 Initial Environmental Evaluation	10-16
10.6.1 Screening.....	10-16

10.6.2 Scoping	10-16
10.6.3 Result of IEE	10-17
CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS	11-1
11.1 Conclusions	11-1
11.1.1 Groundwater Development	11-1
11.1.2 Water Supply Plan	11-2
11.1.3 Project Evaluation	11-2
11.1.4 Social Cosideration/WID and IEE.....	11-3
11.2 Recommendations	11-3
11.2.1 Early Implementation of the Project.....	11-3
11.2.2 Water Supply Plan Coupled with Sanitation Plan.....	11-3
11.2.3 Water Quality Survey, Measures and Management	11-4
11.2.4 Promotion of Village Development with Emphasis on Water Supply.....	11-5
APPENDICES	
Hydrogeological Map	

CHAPTER 3

SOCIO-ECONOMY AND WATER SUPPLY

CHAPTER 3 SOCIO-ECONOMY AND WATER SUPPLY

3.1 Socio-Economy

3.1.1 Population and Demographic Characteristics

(1) Statistical Data on Population

The National Institute of Statistics (NIS) conducted the population census in March 1998, which was the first census in 36 years. The first report on the census was published in August 1998 containing the preliminary results of this census based on a quick tabulation of summary figures provided by the enumerators. The final figures of the census were scrutinized and tabulated in the Final Census Results published in July 1999.

The previous census was conducted in 1962. According to the 1962 census, Cambodia had a population of 5,728,771 in April 1962. There have been no further censuses and no systematic national surveys until 1998.

In 1980, the newly established Government of the People's Republic of Kampuchea carried out a population count. The official total was put at 6,589,954 at the end of 1980.

The NIS carried out the Demographic Survey of Cambodia in March 1996, with sample size of approximately 20,000 households in different parts of Cambodia. As a result, the population was estimated at 10,702,329 in 1996.

As mentioned above, the General Population Census of Cambodia was conducted in March 1998 by the NIS with technical and financial support of United Nations Population Fund (UNPA). The final results of this census indicated a total population of Cambodia as 11,437,656 with 5,511,408 males and 5,926,248 females. The number of household and population of Cambodia by province are shown in the following table.

Total Population of Cambodia by Province in 1998

No.	Name of the Province	No. of Households	Population		Total
			Male	Female	
01	Banteay Mean Chey	111,856	283,358	294,414	577,772
02	Bat Dambang	148,356	388,599	404,530	793,129
03	Kampong Cham	312,841	775,796	833,118	1,608,914
04	Kampong Chhnang	82,638	197,691	220,002	417,693
05	Kampong Spueu	115,728	287,392	311,490	598,882
06	Kampong Thum	106,908	272,844	296,216	569,060
07	Kampot	104,993	253,085	275,320	528,405
08	Kandal	206,189	515,996	559,129	1,075,125
09	Kaoh Kong	24,964	67,700	64,406	132,106
10	Kracheh	49,326	130,254	132,921	263,175
11	Mondol Kiri	5,657	16,380	16,027	32,407
12	Phnom Penh	173,678	481,911	517,893	999,804
13	Preah Vihear	21,491	59,333	59,928	119,261
14	Prey Veang	194,185	445,140	500,902	946,042
15	Pousat	68,235	172,890	187,555	360,445
16	Rotanak Kiri	16,758	46,396	47,847	94,243
17	Siem Reab	127,215	336,685	359,479	696,164
18	Krong Preah Sihanouk	28,015	76,940	78,750	155,690
19	Stueng Traeng	14,323	40,124	40,950	81,074
20	Svay Rieng	98,244	225,105	253,147	478,252
21	Takaev	155,030	376,911	413,257	790,168
22	Otdar Mean Chey	12,531	34,472	33,807	68,279
23	Krong Kaeb	5,369	14,014	14,646	28,660
24	Krong Pailin	4,133	12,392	10,514	22,906
Cambodia Total		2,188,663	5,511,408	5,926,248	11,437,656

Source: General Population Census of Cambodia 1998

The following table shows the population data available in Cambodia after 1962.

Statistical Data on Population in Cambodia

Source of Information	Male	Female	Total
1962 Census	2,862,939	2,865,832	5,728,771
1980 General Demographic Survey	3,049,450	3,540,504	6,589,954
1993-94 Socio-Economic Survey	4,714,000	5,156,000	9,870,000
1996 Demographic Survey	5,119,582	5,582,742	10,702,324
1998 Census *	5,511,408	5,926,248	11,437,656

Source: * General Population Census of Cambodia 1998, July 1999

(2) Population Characteristics

The Cambodian population presents several important features. First, due to the baby boom after 1979, younger generation under 19 years of age accounts for 54% of the total population. Secondly, the proportion of women in the adult population is high, due mainly to the civil war and political turmoil. This is evidently reflected on the sex ratio (number of males per 100 females) and percentage of Female-Headed households. The sex ratio was ideally balanced in 1962. It drastically fell to 86 in 1980 due to heavy mortality among men. From that year onwards it is showing an increasing trend, reaching 93 in 1998. Sex ratio is higher in urban areas (96.0) than that in rural areas (92.6). Percentage of female-headed households (FHHs) is 30.1 percent in urban and 25 percent in rural area. Almost one-fourth of the households in Cambodia are FHHs (25.7%).

Sex Ratio in Cambodia, 1962 – 1998

Source of Data	Sex Ratio
1962 Census	99.9
1980 General Demographic Survey	86.1
1993-94 Socio-Economic Survey	91.4
1996 Demographic Survey	91.7
1998 Census	93.0

Source: General Population Census of Cambodia 1998

(3) Population Density

In 1962, the population density was 32 persons per sq km. With a density of 64 in 1998, it has doubled between the two censuses. In 1998, Phnom Penh had the highest density with 3,441 persons per sq km. The provinces with higher density are Kandal (301), Takeo (222), Kampong Cham (164), Svay Rieng (161), and Kampot (108). The provinces with lower density are Mondol Kiri (2), Stung Traeng (7), Rotana Kiri (9) and Otdar Mean Chey (11).

(4) Population Size by Province

The 1998 census indicates that the biggest province by population size is Kampong Cham with a population of 1,608,914, which accounts for 14.1 percent of the total population. The second biggest is Kandal with 1,075,125, followed by Phnom Penh with 999,804, Prey Veng with 946,042, Battambang with 793,129, and Takeo with 790,168.

Population Ranking in Top 13 Provinces

Ranking	Name of Province	Population (1998)
1	Kampong Cham*	1,608,914
2	Kandal	1,075,125
3	Phnom Penh	999,804
4	Prey Veng	946,042
5	Bat Dambang	793,129
6	Takaev	790,168
7	Siem Reap	696,164
8	Kampong Spueu	598,882
9	Banteay Mean Chey	577,772
10	Kampong Thom	569,060
11	Kampot	528,405
12	Svay Rieng	478,252
13	Kampong Chhnang*	417,693

Note: The Study Area covers the area of 2 provinces with asterisk (*).

Source: General Population Census of Cambodia 1998, NIS

(5) Urban and Rural Population

In the National Census in 1998, all provincial towns (headquarters of the 24 provinces) have been treated as urban areas. In the case of Phnom Penh Municipality, four out of seven districts are treated as urban. Sihanouk Ville, Krong Kaeb, and Krong Pailin are totally urban. All the remaining areas of the country are treated as rural. The result of the census shows that 84.3 percent of the population lives in rural areas, while 15.7 percent live in urban areas.

(6) Growth Rate of Population

The country has an estimated rate of population growth of between 2.5 to 3.0 percent per annum (World Bank 1992). The annual growth rate of the population is estimated to be 2.8% by government of Cambodia. With population growth rate of 2.8% - 3.0%, population will

increase by about 20% by the year 2005, and will increase by about 40% by the year 2010.

Population Projections

Year	Annual growth rate at 2.8%	Annual growth rate at 3.0%
1998	11,437,656	11,437,656
2000	12,087,132	12,134,209
2005	13,876,784	14,066,874
2010	15,931,417	16,307,363

Source: Estimated by the Study Team

(7) Household Size

Final results of 1998 census indicate that number of household in Cambodia is 2,188,663 with average household size of 5.2. Out of these households, 1,866,417 (85.3 percent) are located in rural areas. Average household size is higher in urban area (5.5) than in rural area (5.1).

(8) Ethnic Group

Ethnically the population consists of about 90 percent Khmer, 5 percent each of Chinese and Vietnamese and small numbers of hill tribes (Chams and Burmese). Khmer is the country's official language. It is spoken by more than 95 percent of the population.

3.1.2 Local Administrative Divisions

Cambodia is administratively divided into 21 provinces and 3 municipalities. These provinces and municipalities consist of 183 districts that are further sub-divided into 1,609 communes. With a total of 13,406 villages, each commune consists of about 8 villages on average.

Administrations at province as well as district and commune are weak due to personnel and financial constraints. Those factors are due mainly to inadequately and insufficiently trained personnel, insufficient financial resources, and difficulties of communication between districts and provinces.

Local Administrative Divisions

Code	Province	District	Commune	Villages
01	Banteay Mean Chey	8	63	604
02	Bat Dambang	12	89	611
03	Kampong Cham	16	173	1,748
04	Kampong Chhnang	8	69	546
05	Kampong Spueu	8	89	1,319
06	Kampong Thum	8	81	737
07	Kampot	8	92	477
08	Kandal	11	147	1,087
09	Kaoh Kong	8	32	127
10	Kracheh	5	46	257
11	Mondol Kiri	5	21	98
12	Phnom Penh	7	76	637
13	Preah Vihear	7	49	204
14	Prey Veang	12	116	1,136
15	Pousat	6	49	495
16	Rotanak Kiri	9	50	240
17	Siem Reab	12	100	882
18	Krong Preah Sihanouk	3	22	85
19	Stueng Traeng	5	34	128
20	Svay Rieng	7	80	690
21	Takaev	10	100	1,116
22	Otdar Mean Chey	4	18	108
23	Krong Kaeb	2	5	16
24	Krong Pailin	2	8	58
Cambodia Total		183	1,609	13,406

Source: General Population Census of Cambodia 1998

3.1.3 Economic Situation

(1) General Economic Condition

In 1999 GDP growth rebounded to 4.3% after two consecutive years of low economic growth (only 1% growth in 1997 and 1998) as a result of continued expansion of exports, especially of garments, expansion in tourism and favorable crop harvests. The inflation rate fell sharply down to almost 0% after rising up 12.6% in 1998. The exchange rate was stable ranging around 3,800 Riels per US dollar.

Despite the recent improvements in the economy's performance, Cambodia is one of the poorest countries in the world with a per capita income of approximately US\$260. While

Cambodians' economic condition has improved since 1989 when the Government implemented its market-oriented economic reforms, the country is not clearly better off than in the late 1960s yet, reflecting the traumatic events of last two decades.

(2) Economic Growth Rate

The economic reforms that was gradually initiated towards the end of 1980s and after the election of 1993 the RGC has accelerated its economic and public sector reform. The result of such reform was largely favorable to the economic growth.

Real Gross Domestic Product (GDP) of Cambodia at 1989 prices was 326.8 billion Riels in 1995, which increased to 372.1 billion Riels in 1999, recording average annual growth rate of 2.7 percent. Industry sector and services sector recorded higher rates than agriculture sector in these 5 years.

GDP Growth in 1995-2000

Unit: Billion Riel at 1989 prices

	1996	1997	1998	1999 *	2000 **
GDP at 1989 prices	349.7	353.2	356.7	372.1	392.5
Annual growth rate (%)	7.0	1.0	1.0	4.3	5.5

Note: * Estimate ** Projection

Source: (1) Cambodia: Recent Economic Developments, 1998, IMF (2) Socio-economic Development Requirements and Proposals, April 2000, Royal Government of Cambodia

(3) Inflation

The hyperinflation, which reached almost 200 percent in 1992, has been brought under control by the government successfully. The cause of such inflation was the domestic money creation to finance large fiscal deficit. Restrictive fiscal policy, as well as the high level of financial support from international community which reduced the expansionary financing of the budget, has contributed to the growth without inflation for the recent years. Inflation rates have accelerated from 9.1% in December 1997 to 12.6% in December 1998. However, since the beginning of 1999, the rate of inflation began to decelerate gradually, dropping from 12.6% in December 1998 to -0.03% in December 1999.

Rate of Inflation 1995-1999 (Final quarter basis)

	1995	1996	1997	1998	1999
Annual Percentage Change	2.9	9.0	9.1	12.6	-0.03

Source: Annual Report 1999, National Bank of Cambodia

(4) Public Finance

Cambodia's fiscal situation is characterized by its high dependence on foreign aid. The total amount of tax and non-tax revenues is even less than current expenditures. This means that Cambodia relies on virtually all of its capital expenditures on foreign aid flows.

Public Financing

Unit: Billion Riels

	1995	1996	1997	1998	1999
Revenue	643	749	881	943	1,330
Expenditure	1,201	1,441	1,260	1,569	1,846
Deficit	-558	-692	-379	-626	-516
Foreign financing	559	575	597	n.a.	n.a.

Source: (1) Cambodia: Recent Economic Developments, 1998, IMF (2) Socio-economic Development Requirements and Proposals, April 2000, Royal Government of Cambodia

In 1999, current and capital expenditures rose by 16% and 9% respectively compared to 1998. Current expenditures reached 1,096 billion Riels, of which 43% accounts for defense and security spending and 57% for civil expenditures. Public investment expenditure was 627 billion Riels, of which 64% accounted for externally financed projects and 36% for locally financed projects.

(5) Urban-Rural Gap

Urban- rural gap can be seen from several socioeconomic indicators. Access to social services is far better in urban areas than rural area as indicated in the following table.

Socio-economic Indicators

Indicator	Phnom Penh	Other Urban	Rural
Households with motor cycle/scooter	93.7%	35.1%	16.6%
Electricity as main source of lighting	59.7%	22.3%	2.2%
Households with piped water supply	48.3%	8.8%	1.3%
Availability of medical doctors	69.2%	27.9%	3.9%

Source: Cambodia Socio-Economic Survey 1999

The gap is also reflected on the average household expenditures in which Phnom Penh was 3.5 times that of the rural areas according to the Cambodia Socio-Economic Survey 1999. The gap between urban and rural area in their access to social and economic infrastructure is large and possibly growing. With 84 percent of population living in rural area, accelerated rural development is essential to raise Cambodia's standard of living and reducing poverty.

Average Monthly Household Expenditure

Phnom Penh	Other Urban	Rural	Cambodia
1,007,019 Riels	453,336 Riels	284,444 Riels	361,736 Riels

Source: Cambodia Socio-Economic Survey 1999

3.1.4 Socio-economy in the Study Area

(1) Outline of the Study Area

The study area covers the rural area of two provinces, i.e. Kampong Cham and Kampong Chhnang provinces in the central region of Cambodia. The breadth of the study area is about 250 km from east to west and the length is about 50 to 100 km from north to south, with a total area of 15,330 km². Kampong Cham, the capital of Kampong Cham province is located at about 120 km northeast of Phnom Penh by way of highways 5, 6 and 7. Kampong Chhnang, the capital of Kampong Chhnang province is located about 90km northwest of Phnom Penh by way of highway 5.

Outline of the Study Area

Province	Area (km ²)	Number of District	Number of Commune	Number of Village	Population (1998)	Population Density
Kampong Cham	9,799	16	173	1,748	1,608,914	164
Kampong Chhnang	5,521	8	69	546	417,693	76
Total	15,330	24	242	2,294	2,026,607	133

Source: General Population Census of Cambodia 1998

(2) Population

1) Kampong Cham Province

Kampong Cham province is located in the northeastern direction from Phnom Penh, bordering Vietnam in the south. Kampong Cham is the biggest province in Cambodia with a

population of 1,608,914 in 1998, comprising 775,796 males and 833,118 females. Administratively, the province consists of 16 districts, 173 communes and 1,748 villages. The population of this province constitutes 14.1 % of Cambodia's population.

Kampong Cham district is located in the central part of the province, and constitutes the urban portion with a population of 43,354 or 2.7% of the total population in the province. Among 16 districts in the province, Tboung Khmum district has the biggest population size with 214,780 or 13.3% of the total population. Prey Chhor district is the second biggest in population size with 127,683.

Density of population in the province is 164 persons per sq. km which is much more higher than the national average of 64. Population of the province by district is tabulated below.

Population by District in Kampong Cham Province

District	Households	Males	Females	Total Population
Batheay	17,541	43,382	47,538	90,920
Chamkar Leu	24,338	61,500	64,362	125,862
Cheung Prey	14,562	35,181	39,678	74,859
Dambae	9,738	25,233	26,417	51,650
Kampong Cham	8,236	22,089	23,265	45,354
Kampong Siem	18,884	47,472	51,584	99,056
Kang Meas	17,661	43,502	47,710	91,212
Kaoh Soutin	14,187	33,392	37,280	70,672
Krouch Chhmar	18,982	48,111	51,584	99,695
Memot	21,775	54,078	57,218	111,296
Ou Reang Ov	16,940	39,327	43,479	82,806
Ponhea Kraek	24,261	59,797	64,082	123,879
Prey Chhor	24,892	61,635	66,048	127,683
Srei Santhor	18,224	43,969	47,796	91,765
Stueng Trang	20,996	52,822	54,603	107,425
Tboung Khmum	41,624	104,306	110,474	214,780
Total	312,841	775,796	833,118	1,608,914

Source: General Population Census of Cambodia 1998

The total number of households is 312,841 comprising a population of 1,608,914 with an average household size of 5.1. Female-headed households (FHHs) constitute 21.7 % of the total households.

2) Kampong Chhnang Province

Kampong Chhnang province is located in the central part of the country with a population of 417,693 in 1998, comprising 197,691 males and 220,002 females. Administratively, the province consists of 8 districts, 69 communes and 546 villages. The population of this province constitutes 3.7 % of Cambodia's population. Kampong Chhnang district constitutes the urban portion with a population of 41,703 or 10 % of the total population in the province. Among 8 districts in the province, Rolea B'ier district has the biggest population size with 81,134 or 19.4% of the total population. Kampong Tralach district is the second biggest in population size with 74,541.

Population by District in Kampong Chhnang Province

District	Households	Males	Females	Total Population
Baribour	10,418	24,212	27,304	51,516
Chol Kiri	4,918	13,883	14,417	28,300
Kampong Chhnang	7,692	20,133	21,570	41,703
Kampong Leaeng	6,955	18,010	19,369	37,379
Kampong Tralach	14,422	35,460	39,081	74,541
Rolea B'ier	17,157	37,190	43,944	81,134
Sameakki Mean Chey	11,660	27,014	30,156	57,170
Tuek Phos	9,416	21,789	24,161	45,950
Total	82,638	197,691	220,002	417,693

Source: General Population Census of Cambodia 1998

The total number of households is 82,638 comprising a population of 417,693 with an average household size of 5.0.

(3) Employment

The economically active population (labor force) in Kampong Cham province accounts for 728,949, of which 375,085 or 51.5 % are females. Unemployment rates are higher for females in urban as well as rural area. Out of the total labor force, 85.4% are employed in the primary sector, i.e. agriculture, forestry and fishery. The secondary and tertiary sectors account for 2.8 % and 11.8 %, respectively. Rice cultivation is the most important agricultural activity.

The economically active population (labor force) in Kampong Chhnang province accounts for 195,530, of which 106,792 or 54.6 % are females. Unemployment rates are higher for females in urban as well as rural area. Out of the total labor force, 85.5 % are employed in the primary sector. The secondary and tertiary sectors account for 1.7 % and 12.8 %, respectively. Rice

cultivation is the most important agricultural activity.

(4) Economic Activities

1) Agriculture

Farming is the main activity of the people in the study area. Most villagers (about 85 %) are engaged in rain-fed rice cultivation in small plots of land. The principal crops grown are rice, cassava, maize, beans, and vegetables.

Kampong Cham province produced 460,935 tons of rice, 103,700 tons of cassava, 21,296 tons of maize, 4,290 tons of sweet potato, 5,883 tons of peanut and other crops in 1999/2000. Although rice production was ranked the third among 22 provinces, rice production was not sufficient to meet the requirement of the whole population of the province. However, the province is the biggest producer of cassava and peanut in the country. Peanut production in the province accounted for about 64 % of the total production in the country.

The province is also famous for its rubber production. There are seven rubber plantation companies in the province. Tapping area of these companies was 39,719 ha in 1999. Exploitation of dry rubber was 45,262 tons in the same year.

Rubber Exploitation in Kampong Cham Province in 1999

Companies Name	Tapping Area (ha)	Exploitation of Dry Rubber (ton)
Chup	8,369.95	12,694
Pearm Chang	2,921.78	3,460
Krek	4,103.97	4,502
Memot	6,390.61	7,235
Snuol	3,034.03	3,286
Chamkar Andong	6,267.74	8,101
Ket	7,875.62	4,759
IRCC	755.19	1,161
Total	39,718.89	45,198

Source: Agricultural Statistics 1999-2000

Kampong Chhnang province produced 152,400 tons of rice, 8,840 tons of cassava, 1,561 tons of maize, 2,039 tons of sweet potato, and other crops in 1999/2000. Although rice yield is not very high (1.63 tons per ha), food balance of rice recorded surplus in 1999/2000.

Rice Production in Kampong Chhnang Province in 1999/2000

District	Area (ha)	Production (ton)	Yield (ton/ha)
Baribour	13,897	22,614	1.63
Chol Kiri	3,999	9,967	2.49
Kampong Chhnang	541	1,127	2.08
Kampong Leaeng	7,168	11,338	1.58
Kampong Tralach	14,536	24,400	1.68
Rolea B'ier	23,445	38,285	1.63
Sameakki Mean Chey	14,786	21,912	1.48
Tuek Phos	14,885	22,790	1.53
Total	93,256	152,433	1.63

Source: Provincial Department of Agriculture, Kampong Chhnang

The province exploited 17,900 tons of inland capture fish in 1998-1999 with the largest share (25 % of the total capture fish in the country) among the provinces. The province also produced 2,200 tons of aquaculture fish in 1999.

2) Livestock

Livestock keeping is not a major economic component in the visited villages. Out of the total stock of cows and buffaloes, about half are used as draft animals for farming. Livestock keeping is predominantly traditional and is composed more or less entirely of indigenous stock. In Kampong Cham province, there are 364,242 cows, of which 167,739 are used as draft animals. Of 65,968 water buffaloes, 35,962 are used as the same. In Kampong Chhnang province, there are 147,843 cows, of which 58,983 are used as draft animals. Of 41,442 water buffaloes, 26,743 are used as the same.

3) Other Economic Activities

As mentioned above, the main economic activity in the study area is agriculture. Apart from this, some of the target villages have natural forests that are rich in trees harvested for various uses such as timber, poles, fuel and charcoal. Other sectors regarded as productive are inland fishery, and small industries. Other economic ventures done by the community include handicraft, skilled trades (basket making), lumbering, timber sales, trading, poultry, bricks, charcoal, firewood cutting and so on.

(5) Social Services

1) Education Facilities

In Kampong Cham province, there are 845 schools including 723 primary schools. Out of 1,748 villages in the province, only 723 villages (41 % of the total villages) have primary schools. In Kampong Chhnang province, there are 254 schools including 217 primary schools. Out of 546 villages in the province, only 217 villages (39.7 % of the total villages) have primary schools.

Basic Information of Schools in Kampong Cham and Kampong Chhnang Provinces

Province	Number of Schools		Teaching Staff		Enrollment	
	Total	Primary	Total	Female	Total	Female
Kampong Cham	845	723	1,850	518	339,508	153,864
Kampong Chhnang	254	217	2,119	660	89,404	39,988

Source: Basic Information of Schools, Ministry of Education, Youth and Sport

Primary education facilities are not sufficient in the target villages. Most of the schools lack basic facilities and are characterized by poor buildings, inadequate teachers and teaching materials.

2) Medical Facilities

Medial facilities consist of the referral hospitals, the health centers and the health posts. Medical facilities are inadequate and poorly distributed at village level. In most cases patients travel long distances to access medical facilities. In situation where the health posts are available, medicines are either inadequate or not available at all.

In the villages where no health facility is available, villagers have to travel long distances to neighboring villages for medical treatment. In serious medical cases, patients are referred to a health center, which are available in each district, or to a hospital.

3) Water supply

In Kampong Cham province, more than 64 % of the households rely on the dug wells as the main source of drinking water. About 14 % use water from pond, river and stream. Only 9 % of the households get water from tube/pipe wells.

Distribution of Households by Main Source of Drinking Water

Piped water	Tube/Ppe well	Dug well	Spring, river stream	Bought	Other
4.4 %	9.0 %	64.5 %	13.9 %	6.0 %	2.2 %

Source: General Population Census of Cambodia 1998

In Kampong Chhnang province, more than 52 % of the households rely on the dug wells as the main source of drinking water. About 24 % use water from pond, river stream and rain. About 17 % of the households get water from tube/pipe wells. Piped water accounts only for 0.8 %.

Distribution of Households by Main Source of Drinking Water:

Piped water	Tube/Pipe well	Dug well	Spring, river stream	Bought	Other
0.8 %	17.4 %	52.9 %	24.3%	1.1 %	3.5 %

Source: General Population Census of Cambodia 1998

4) Other Social Facilities

Other social services available in the study area include shops, go-downs, markets, temples, and mosque. Few shops exist in villages. Licensed shops are found in big villages. Big shops, restaurants, bars, and guesthouses are only found in District headquarters. Almost in all district headquarters, the major government institutions are available.

(6) Infrastructures**1) Transport**

National roads Nos. 5, 6 and 7 are connecting Phnom Penh to Kampong Cham provincial headquarters. The roads are well maintained and are in good conditions. However, national road No. 7 in the eastern part of the Mekong, provincial road No. 11 and other roads in the province are not well maintained and in poor conditions although some parts of the roads are being rehabilitated under the ADB project.

National road No. 5 is connecting Phnom Penh to Kampong Chhnang provincial headquarters. The road is well maintained and is in good conditions. However, national road No. 5 in the northern part of the province, provincial road No. 53 and other roads in the province are not well maintained and are in poor conditions.

Poor road condition is a major obstacle to development. Poor transport causes poor supply of farm input, marketing of crops and physical accessibility of social services.

2) Telephones

Mobile telephones can be used at provincial headquarters and some district headquarters located along the main roads. In these headquarters, mobile telephone boxes are provided for the public use. At the village level, however, telephone services are not available. Villagers can use wireless radio facilities to send messages in emergency cases at some of commune offices.

(7) Village Structure and Village Development Committee

Most of target villages are old villages. Each village has a village government structure consisting of a village chairman and one or two sub-chairmen, under which there are several groups of families.

In some villages the village development committees (VDCs) are established for the execution of rural development activities. In Kampong Chhnang province, VDCs have been established in 317 villages (58 % of the total villages) under support from various agencies and organizations such as PDRD, PRASAC, LWS, WVIC, CESVI, and VATANAKS.

Each VDC is composed of a President, a Vice-President, a Secretary, a Treasurer, three to five general members and one or two advisers.

To undertake water use management including domestic water supply and irrigation water use, the village water committees (VWCs) are established under VDC. In the villages where some water facilities exist, water point committees (WPCs) are established per each water source.

3.2 Rural Water Supply

3.2.1 Water Supply Organizations

There are three different ministries that are responsible for water supply in Cambodia. They are the Ministry of Industries, Mines and Energy (MIME), the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Rural Development (MRD).

The MIME is responsible for water supply in urban area, such as the headquarters towns in the provinces through the Department of Provincial Water Supply (DPWS). However, water supply in Phnom Penh City is being operated and managed by the Phnom Penh Water Supply Authority (PWSA), a semi-autonomous state enterprise under the Governor of Phnom Penh City. The MRD is responsible for overall development and management of rural water supply systems in the country. On the other hand, the MAFF is promoting the development of surface and groundwater for irrigation purposes, though some of these wells are being utilized for domestic purposes in the rural area.

Water supply is one of the major activities of the MRD aiming at the provision of the basic need of the rural community. The Department of Rural Water Supply (DRWS) has been established under the MRD. Before 1993, the Ministry of Health (MOH) was responsible for rural water supply with the assistance of UNICEF and implemented the rural water supply projects through the Central Water Base (CWB). The staff, equipment and materials were transferred to DRWS at the time of establishment of the MRD after the general election in 1993.

3.2.2 Rural Water Supply Situation

In the rural areas of Cambodia, people traditionally resort to the use of rivers, ponds and shallow dug wells for their domestic water needs. In the rainy season, people use rainwater mostly for drinking and cooking. Water sources usually dry up in the dry season and are also exposed to contamination of human and livestock wastes. This contamination causes high infant mortality and water-borne diseases, which hinders having a healthy population in the rural areas. Shortage of clean water eventually impedes the development of active rural communities.

In order to overcome such conditions, the GRC has been implementing rural water supply programs. The program started in response to the urgent need of clean water in 1983. However, the program has been relying almost totally on external sources of financing. Technical expertise provided by external agencies, such as UNICEF and NGOs, as well as materials and supplies procured by them, constituted essential part of the rural water supply projects.

(1) Assistance by UNICEF

1) History

UNICEF's assistance to Cambodia began in 1972, and was interrupted only during the Khmer

Rouges regime (1975-1979). Thus UNICEF has had the longest presence in Cambodia of the international aid organizations.¹

In 1979, when the Khmer Rouge regime was ousted, UNICEF established an emergency program to provide drinking water. Between 1983 and 1985, the UNICEF activities focused on the repair and installation of water systems for selected public institution - hospitals, school, orphanage, teacher training colleges, and so on.

In 1985, in cooperation with the National Center for Hygiene and Epidemiology (CNHE) of the Ministry of Health (MOH), UNICEF established a rural water supply program in seven districts of Kandal and Kampong Supieu provinces and in the municipality of Phnom Penh, aiming at both drilling new wells and rehabilitating existing ones.

In 1986, UNICEF's program was expanded to the additional provinces of Kampot, Takeo and Kampong Chhnang. By the end of 1987, two mechanical rigs and two manual drilling teams had provided water facilities to 300 villages.

In 1987, a Central Water Base (CWB) was established in Phnom Pen within CNHE. This became operational center of UNICEF's water and sanitation program (WES). Facilities for water analysis and hydrogeological mapping were also provided. After the end of UNICEF's support, these analytical activities have not been carried out.

In 1987, WES was extended to seven provinces. In 1990, the UNICEF program began to change from centrally administered supply-oriented assistance to one of cooperation with provincial offices of CNHE. Focus was placed on training, managerial and organizational support. By 1991, WES program had been expanded to 11 provinces.

The peace agreement was signed in October 1991. UNICEF reoriented its program to drill wells in response to the emergency situation brought about by the Internally Displaced Persons. Water supply project was extended to cover four northern provinces of Bat Dambang, Pursat, Banteay Mean Chey, and Siem Reap, in cooperation with UNHCR.² In 1993, as mentioned previously, the CWB was transformed into the DRWS and the rural water supply program has been succeeded to the MRD.

Between 1983 and 1999, the MRD and MOH (before 1993) have constructed and rehabilitated 10,512 tube wells with assistance of UNICEF. Present coverage for the rural population is about 29 % if the number of users assumed to be 180 per well (except Phnom

¹ Developing Rural Cambodia, Swedish International Development Cooperation Agency

² Water and Environmental Sanitation in Cambodia, UNICEF

Penh and Sihanouk Ville) and all these wells are functioning and being used. The actual cost per well is reported to be about USD 2,000.

Wells constructed by MRD/UNICEF 1983-1999

Year	Mechanical Rig	Manual Rig	Well Rehabilitation	Total
1983 to 1995	5,335	4,335	190	9,880
1996	142	0	30	172
1997	167	0	10	177
1998	98	0	44	142
1999	141	0	0	141
Total	5,883	4,335	274	10,512

Source: DRWS and JICA Report, 1997

2) CASD program

UNICEF formulated a new program called CASD (Community Action for Social Development) to be conducted for the period of 1996 and 2000. The program focused on the enhancement of the capacity of the community, with particular emphasis on women's and youth organization in order to achieve basic social goals. The program comprised three major sub-programs, i.e. 1) capacity building, 2) community education and child-care, and 3) food, water and environment. The project areas covered seven provinces of Svay Rieng, Bat Dambang, Kampong Thom, Kampong Supeu, Takaev, Prey Veng, Stung Treng and Kratie. Water supply projects were a part of community development program, which emphasized on initiative and participation of the community. With emphasis on such bottom-up approach, UNICEF ceased to set numerical target on well construction.

CASD program was completed in 2000 and the new program called CACR (Community Action for Child Right) has started in 2001 covering 5 provinces of Kampong Thom, Kampong Supeu, Prey Veng, Stung Treng and Svay Rieng.

(2) PRASAC

Program de Rehabilitation et Appui au Secteur Agricole du Cambodge (PRASAC), i.e. Rehabilitation and Support Programme for the Agricultural Sector of Cambodia, is a rural development program focusing on irrigation schemes, domestic water supplies, credit schemes and small enterprise promotion. It comprises the major part of EU development assistance to Cambodia, with a budget of approximately US\$44 million. PRASAC is working through government structures with representation from the MAFF and the MRD, as its formal counterpart.

In Phase I of the program that was conducted in 6 provinces between June 1995 and April 1999, provincial operations were managed by three consultancy firms that operated in each of two neighboring provinces under co-managers appointed by PRASAC. PRASAC I operations were conducted in Kampong Cham and Kampong Chhnang, PRASAC II in Takeo and Kampong Speu, and PRASAC III in Prey Veng and Svay Rieng.

PRASAC operations are presently at its Phase II stage that started in May 1999. All operations are under management of one consultancy firm (technical assistance by GTZ) and the program is now called as PRASAC II.

PRASAC activities include: i) community development; ii) irrigation; iii) agriculture; iv) rural credit; and v) domestic water supply. PRASAC office in Kampong Cham has 102 staffs, of which 16 staffs are engaged in domestic water supply. Domestic water supply office consists of a WATSAN team (6 members), a drilling team (4 members), an installation team (4 members) and a storage keeper. Project areas cover 5 districts of Batheay, Cheung Prey, Kampong Siem, Kang Meas, and Prey Chhor. As of December 2000, a total of 362 wells have been drilled where 340 hand pumps have been installed. In addition, hand dug well drillings, provision of water jars, and construction of ponds has also been conducted.

(3) Assistance by Non-Governmental Organizations

Various NGOs have been working in the field of water supply in this country. Structures for NGO coordination in Cambodia are quite well developed through the Cooperation Committee for Cambodia (CCC) and through NGO Forum. These organizations are not only serving to promote dialogue among NGOs but also to promote communication between NGOs and multilateral and bilateral agencies.

In order to promote cooperation and avoid possible duplication of projects among NGOs, international organizations and bilateral agencies working in the rural water supply and sanitation area, Water Supply and Sanitation Sectoral Working Group Meeting is held on monthly basis at MRD.

NGOs Activities in Rural Water Supply Sector, Kampong Chhnang Province

NGOs	Hand Pump Well	Combined Well	Hand Dug Well	Activity Status
IRC	47	0	80	completed
CONCERN	0	0	232	completed
CESVI	93	13	0	completed
LWS	71	0	68	continuing
WVS	0	0	367	continuing
KAFC	20	0	0	completed

Source: PDRD, Kampong Chhnang

3.2.3 Organization and Capacity of DRWS and PDRD

(1) Department of Rural Water Supply (DRWS)

As was mentioned in the previous section, DRWS became the main implementing agency for rural water supply in Cambodia since 1993. It has the following functions.

- 1) Overall planning, designing and coordination of rural water supply activities including import, transport and storage of supplies and their distribution to the provinces;
- 2) Drilling of tube wells upon request from the villages in the provinces; and
- 3) Training of technicians in the design and construction of water supply.

DRWS consists of 5 sections; (i) Small Scale Irrigation and Energy, (ii) Design and Planning, (iii) Supply and Finance, (iv) Drinking Water, and (v) Administration (Figure 3.1). Total number of staff is 133. The number of staffs of DRWS by function is presented in the following table.

Staff of DRWS by Function

Function	Number of Staff
Director	1
Deputy Director	3
Bureau Chief	5
Bureau Vice-Chief	5
Small Scale Irrigation and Energy	11
Design and Planning	14
Supply and Finance	15
Drinking Water	68
Total	122

Source: DRWS

The majority of the staffs belong to technical sections that conduct well drilling, hand pump installation and repair. Presently, the DRWS owns 9 drilling rigs. Small drilling rigs, such as PAT201, were allocated to each province.

Drilling Equipment owned by DRWS

Type of Rig	Unit	Condition in use
Ingersoll Rand, TH-10	2	80 %
PAT301	2	80 %
Edson 5000	1	65 %
Edson 2000	1	50 %
Hydreque	1	40 %
Borndrill	2	Not in use
Total	9	

Source: DRWS

Most of the budget of DRWS is used for the payment of salary of the staffs. The monthly salary of the staffs averages R 49,800 (USD 13). The budget of the DRWS is not sufficient to implement the projects without external financial assistance.

In order to keep its drilling team working, part of the money collected from villagers are used for compensation for the drilling team. The actual cost of the drilling is estimated between US\$ 900-1,600 including the casing pipes and a hand pump. The total amount paid by the villagers is approximately 4% to 7% of the drilling cost.

(2) Provincial Department of Rural Development (PDRD)

PDRD provides promotion of small enterprise, credit, public health and water supply services to the rural communities. Its organization is mirrored the MRD's organization and consists of the following 5 offices.

- a) Administration, Finance and Planning
- b) Rural Water Supply
- c) Primary Health Care
- d) Community Development
- e) Rural Economy

Generally, the rural development projects implemented under the supervision of PDRD are as follows.

- Clean Drinking Water and Sanitation Program: hand dug well digging, hand pump well drilling, mixed-well digging, sanitation education on well water use, well rehabilitation and maintenance

- Primary Health Care Program: construction of family and school latrines, health and sanitation education, prevention of AIDS, diarrhea, etc.
- Infrastructure Works: Rural road rehabilitation and construction, rehabilitation and construction of culverts, bridges, dikes, small irrigation, ponds, schools, etc.
- Rural Development Economy: Rural credit, water pump credit, rice bank, cow bank, village shops, etc.

PDRD in Kampong Cham has six sections under three deputy directors as depicted in Figure 3.8. The total number of staff is 119, of which 7 persons belong to Water Supply Section. PDRD in Kampong Chhnang has 83 staffs, of which 17 persons belong to the Water Supply Section. Small type of drilling equipment is used at provincial level. Spare parts for hand pumps are not constantly kept at the provincial level.

District Rural Development office consists of administration section and technical section. Main activities of the technical section include community development, rural economy, primary health care, and water supply. In Kampong Cham province, there are 16 district rural development offices where 4 to 8 staffs are stationed. In Kampong Chhnang province, there are 8 district rural development offices where 4 to 8 staffs are stationed. On commune level, currently there are no permanent staffs.

It is MRD's policy to shift various functions regarding well construction, monitoring, operation and maintenance from national level to provincial and district level.

3.2.4 Five Year Rural Water Supply Plan

Access to water supply, which is defined as a basic level of service for drinking water requirements throughout the year, varies significantly by regions of the country. Across all regions of the country, about 6.8 million people (estimated 71% of rural people) in the rural areas lack access to clean water. The Second Five-Year Socio-Economic Development Plan of MRD will set up a development plan of rural water supplies to access clean water from 29 % (2.8 million rural people) to 40 % (3.8 million rural people) by the end of year 2005 in order to attain universal coverage.

Major Targets for Water Supply and Sanitation Development, 2001-2005

Sub-sector	Current Situation (estimate)	Target by 2005
Access to safe water supply	Rural population: 29 % Urban population: 48 %	Rural population: 40 % Urban population: 87 %
Sanitation facilities	Rural population: 8 % Urban population: 56 %	Rural population: 20 % Urban population: 90 %

Source: Second Five-Year Socio-Economic Development Plan of MRD

It is estimated by MRD that in order to supply clean water to 3.8 million people by the year 2005, 44,700 water point sources needed. The development strategy is to mix technologies depending upon the hydrological situation and consumer preference thus optimizing the available resources.

Target Number of Water Point Sources in Rural Areas, 2001-2005

Technology	2001	2002	2003	2004	2005	Total
Hand-dug well	3,500	3,500	3,700	3,700	3,700	18,100
Dug/Drilled well	1,750	1,750	2,000	2,000	2,000	9,500
Hand pump shallow well	2,000	2,000	2,000	2,500	2,500	11,000
Hand pump deep well	1,100	1,100	1,300	1,300	1,300	6,100

Source: Second Five-Year Socio-Economic Development Plan of MRD

The costs of providing safe water supply to 40 percent of the rural population by the year 2005 are presented in the following table. A capital investment of nearly US\$ 30.5 million, or an average of about US\$ 6.1 million per year, will be required to achieve the target. The cost will be met from multiple sources, including the RGC, international organizations, NGOs as well as the communities themselves through labor and material contributions.

Rural Water Supply Investment Requirement, 2001-2005 (US\$'000)

Technology	2001	2002	2003	2004	2005	Total
Hand-dug well	1,050	1,050	1,110	1,110	1,110	5,430
Dug/Drilled well	1,137	1,137	1,300	1,300	1,300	6,174
Hand pump shallow well	1,600	1,600	2,000	2,000	2,000	9,200
Hand pump deep well	1,760	1,760	2,080	2,080	2,080	9,760
Total	5,547	5,547	6,490	6,490	6,490	30,564

Source: Second Five-Year Socio-Economic Development Plan of MRD

3.2.5 Financial Constraints

Apart from the fund from foreign aid, almost all of the MRD's budget (domestic budget) was

allocated to current expenditures such as salary and other administrative expense.

For capital expenditures such as construction of wells and small irrigation system in the rural villages, MRD must rely on funds from other sources. DRWS has long been supported by UNICEF, which provided most of the equipment for drilling, well construction material, pumps and spare parts, as well as some portion of office expense.

MRD's domestic budget (mostly current expenditure) was R 1,579 million in 1997. The budget (actual expenses) in 2000 increased to R 12, 539 million including R 483 million for salary and compensation, R 2,982 million for administration, and R 9,075 for public works. Public works expenses consisted of R 1,364 million for road rehabilitation and R 7,710 million for hand pump equipment. MRD's annual budget for 2001 is R 520 million for salary, and R 4,300 million for administrative expenses. No budget is planned for public works expenses.

The responsibility for budget of PDRD has been transferred to chief of each province from MRD as a process of decentralization. On the other hand, budget for capital expenditure allocated to MRD (mostly foreign grant aid) is controlled and allocated to projects in each province by MRD.

Of its R 12,539 million domestic budget in 2000, R 483 million was allocated to salary for MRD personnel. With the total staffs of 576 in the ministry, average salary was R 69,900 or about USD 18 per month.

Important issue that should be taken into consideration in designing sustainable development project in Cambodia is the institutional weakness of the current government. Most of the government employees' salaries are insufficient to maintain effective institution. It is recommended by many observers that drastic government restructuring whilst also recognizing that such reform would be the enormously risky and difficult form political point of view.

Recently MRD prepared 3rd draft on "Proposed Outline of a Policy for the Rural Water Supply and Sanitation Sector (RWSS)". This policy states the financial rules as follows:

- 1) Although the Government will have the relief responsibility for funding the RWSS activities, sustainability is based on community participation. In financial terms this means that the beneficiaries would be required to pay part of the capital cost of basic services and all of the recurrent cost of their water and sanitation facilities.
- 2) Regard end-user payment for a service as a form of investment while taking into account their willingness and ability to pay.
- 3) Emphasize the recovery of capital costs of high levels of services in order to generate additional resources for the sector.
- 4) Establish sustainable financial mechanisms supported by end-users, which will enable the operation and maintenance of installations to be managed by the end-user groups themselves, or by private/public enterprises if that is the alternative preferred by the end-users.
- 5) Ensure that the responsibilities of the deliverers and receivers, particularly as regards operation and maintenance and ownership of facilities, are clearly in agreements with the end-users.

3.3 Health and Hygiene

(1) Overall health and hygiene condition

Cambodia has made impressive progress improving the health status of its population since the end of the Khmer Rouge period. However, the health situations in Cambodia remains one of the poorest in the world with extremely high infant and maternal mortality rates, chronic malnutrition, malaria, tuberculosis and the fastest growing HIV infection. Alcohol and drug abuse, traffic accidents, landmines, poor labor working conditions and poor hygiene also remain serious public health concerns requiring sustained effort.

Main health problems in Cambodia

Health problems	Number of Cases	Number of Deaths	Case Fatality Rate (%)
Others	85,744	3,285	3.83
Tuberculosis (TB)	30,793	335	1.09
Malaria	26,529	836	3.15
Acute Respiratory Infection (ARI)	20,351	454	2.23
Road Accidents	10,206	45	0.44
Diarrhea	8,701	103	1.18
Gyneco Obstetric	8,304	232	2.79
Dysentery	2,266	7	0.31
Dengue Hemorrhagic Fever	1,175	50	4.26
Meningitis	824	117	14.20
Mine Accidents	376	6	1.60
Measles	261	1	0.38
Other Tetanus	139	36	25.90
Neonatal Tetanus	94	43	45.74
Acute Flaccid Paralysis	27	1	3.70
Total	195,790	5,551	
HIV	7,726		

Source: National Health Statistics Report (1999), MOH

Regarding main health problems of inpatient in Kampong Chhnang and Kampong Cham Province, there are comparatively a high morbidity rate of tuberculosis, malaria, acute respiratory infection and others disease. Especially tuberculosis and malaria disease rises in recent year (Table 3.1).

(2) Level of health services in Cambodia

Since 1996, the Ministry of Health has been implementing a Health Coverage Plan to expand and rationalize population access to health facilities. It calls for the establishment of network of health centers and referral hospitals grouped into operational districts (OD), so that the entire population has a rational and equitable access to basic health and referral services.

Under the plan of Ministry of Health, 67 referral hospitals, 8 national hospitals and 817 health centers are to be established in 73 operational districts (OD). The health centers are replaced commune clinics that have formed the lowest level of health care delivery network. However only about 40% of health center were in place in 1999.

Regarding the private health sector, it is growing in a completely unregulated and uncontrolled by the government. Actually there are private clinics, laboratories, illegal pharmacies were found in the towns or large-scale villages.

The health infrastructure in Cambodia, it is still an insufficient situation at the village level. Actually the average for number of health center per 100,000 people is 9.43 in whole country, however it is 7.96 in whole Kampong Chhnang and it is 8.14 in whole Kampong Cham Province. The average for number of beds in referral hospital per 100,000 people is 80.95, however it is 50.28 in Kampong Chhnang Province and it is 30.27 in Kampong Cham Province (Table 3.2).

The health infrastructure in District level in the Kampong Chhnang and Kampong Cham Province, Kampong Cham OD, Ponhea Krek OD in Kompong Cham Province and Kampong Trakach OD in Kampong Chhnang Province has insufficient number of beds. These OD are covering about ten districts (Table 3.3).

In addition to above, Provincial Department of Rural Development (PDRD) has health services organization as the primary health care office (Figure 3.1). The primary health care office mainly has activities concerning for establishment of village health volunteer and its training.

The other hand, Provincial Department of Rural Development (PDRD) has health organization primary health care office, and the office, UNICEF and AusAID is assisting their activities.

(3) Department of Health, Ministry of health

Regarding the organization of health services in the Kampong Chhnang Province, Provincial Health Department (PHD) is operating a technical office for prevention mother & infant, epidemic campaign, health promotion, planning & statistics and health training (Figure 3.2).

The PHD controls the two of Operational Districts (OD) such as including Kampong Chhnang District Referral Hospital and Kampong Tralach District referral hospital. Kampong Chhnang Referral Hospital is controlling 23 health centers and it is covered 50 communes with 356 villages. Kanpong Taralach Referral Hospital is controlling 11 health centers and it is covered 21 communes with 199 villages (Figure 3.3).

Regarding the organization of health services in the Kampong Cham Province, the

organization is bigger than Kampong Chhnang Province and World Health Organization (WHO) is dispatching health adviser. PHD in this province also organizes a technical office for prevention mother & infant, epidemic campaign, health promotion, planning & statistics and health training.

PHD controls the ten of Operational Districts (OD) and Referral Hospitals. However, Australian save children (SCA) is assisting to Memot Operational District and its Referral Hospital. Theses ten OD is controlling 128 health centers in total, and it is covered 173 communes and 1,675 villages in total (Figure 3.4, Figure 3.5).

(4) Health center

The health center consists of 5 to 9 staffs such as primary nurse, secondary nurse, midwife and other medical assistants but there is no doctor. If serious outpatient comes to health center, Health center sends patient to referral hospital (Figure 3.6, Figure 3.7).

- Examination of clinic, general disease treatment
- Pregnancy examination
- Extension delivery
- Delivery
- Chronic examination (Tuberculosis, Leprosy etc.)
- Health education
- Medical supervision, collection of village health report
- Monthly vaccine infection in villages
- Monthly consultation for pregnant and extension delivery in villages

(5) Office of Primary Health Care in PDRD

Primary health care office in the PDRD and the staffs in district rural development office (PDRD) are operating the primary health care services to the villages. The primary health care office consists of malnutrition section, family health cares section, health education section and mobile health worker section (Figure 3.8, Figure 3.9, Figure 3.10). Its duty is as follows:

- Health training in short-term (provincial level)
- To organize village health volunteer by short term-training
- To research the priority village on the primary health care
- To operate the malnutrition program for poorest children and mother

- To establish health development project in village
- To find NGO who assist to primary health project in village
- To supply staffs and supporting for health education in village
- To educate about water born disease and HIV
- To educate how to clean the environment around their house
- To send mobile health worker to the villages (only temporary treatment)
- To conduct the report on primary health care in whole province

Table 3.1 Main Health Problem of Inpatient in Kampong Cham and Kampong Chhnang

Disease Name	Number of disease Morbidity rate		Kampong Cham						Kampong Chhnang						Whole Country					
			1995		1997		1999		1995		1997		1999		1995		1997		1999	
	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)	No. of disease	Morbidity rate (1,000)
Cholera	37	0.03	9	0.01	21	0.01	0	0.00	5	0.01	0	0.00	226	0.02	146	0.01	411	0.04		
Dengue Hemorrhagic Fever	234	0.16	226	0.14	86	0.05	31	0.09	668	1.84	8	0.02	2,042	0.20	3,662	0.34	1,175	0.10		
Dianhea	1,009	0.70	788	0.49	670	0.42	362	1.04	182	0.50	148	0.35	10,738	1.05	5,293	0.49	8,701	0.76		
Dysentery	435	0.30	262	0.16	145	0.09	148	0.43	68	0.19	28	0.07	3,449	0.34	2,078	0.19	2,266	0.20		
Gyneco Obstetric	2,408	1.66	1,381	0.86	620	0.39	873	2.51	169	0.47	228	0.55	18,659	1.83	6,745	0.63	8,304	0.73		
Acute Respiratory Infection	2,586	1.78	2,739	1.71	2,145	1.33	408	1.17	343	0.94	359	0.86	18,414	1.81	14,008	1.31	20,351	1.78		
Malaria	1,113	0.77	1,302	0.81	1,610	1.00	173	0.50	254	0.70	416	1.00	16,503	1.62	20,626	1.93	26,529	2.32		
Meningitis	151	0.10	120	0.07	71	0.04	20	0.06	16	0.04	10	0.02	857	0.08	798	0.07	824	0.07		
Acute Flaccid Paralysis	5	0.00	0	0.00	0	0.00	0	0.00	1	0.00	0	0.00	17	0.00	5	0.00	27	0.00		
Tuberculosis	907	0.63	1,109	0.69	2,481	1.54	405	1.17	374	1.03	680	1.63	10,573	1.04	12,674	1.18	30,793	2.69		
Others	7,485	5.16	7,999	5.00	5,755	3.58	2,173	6.26	3,753	10.34	2,868	6.87	68,376	6.71	84,398	7.89	100,388	8.78		
Population	1,450,557		1,600,397		1,608,914		347,341		363,050		417,693		10,188,228		10,700,332		11,437,656			

Source : National Health Statistics Report (1995), MOH
National Health Statistics Report (1997), MOH
National Health Statistics Report (1999), MOH

Table 3.2 Health Infrastructure in Cambodia

Health infrastructure Provinces	Population	Medical doctor	Doctor per 100,000	Medical Assistant	Pharmacist	Nurse	Midwife	Referral hospital	Health Center	Health Center per 100,000	Number of beds in hospital	Beds per 100,000	Remark
Phnom Penh	999,804	95	9.50	133	17	317	145	13	37	3.70	1,686	168.63	5 referral hospitals and 8 national hospitals
Kampong Cham	1,608,914	113	7.02	121	17	711	325	10	128	7.96	487	30.27	
Takéo	790,168	38	7.34	88	14	414	97	5	70	8.86	345	43.66	
Kratie	263,175	22	8.36	35	4	217	81	2	22	8.36	235	89.29	
Kampong Chhnang	417,693	29	6.94	42	8	312	127	2	34	8.14	210	50.28	
Kandal	1,075,125	89	8.28	111	18	489	199	8	88	8.19	380	35.34	
Battambang	793,129	90	11.35	144	19	802	354	4	67	8.45	635	80.06	
Banteay Meanchey	577,772	48	8.48	52	6	484	206	3	54	9.35	436	75.46	
Koh Kong	132,106	24	18.17	32	3	68	33	2	12	9.08	102	77.21	
Ratanak Kiri	94,343	16	16.98	12	2	149	73	1	10	10.61	99	105.05	
Preah Vihear	119,261	9	7.55	12	2	77	57	1	12	10.06	130	109.00	
Ponsat	380,445	35	9.71	46	4	243	143	2	30	8.32	267	74.08	
Siem Reap	754,443	60	7.95	59	13	416	231	4	57	7.56	505	66.94	
Krong Preah Sihanouk	155,690	39	25.05	31	16	136	60	1	11	7.07	80	51.38	
Stung Treng	31,074	15	18.50	26	4	103	58	1	10	12.33	108	133.21	
Prey Veng	946,042	39	4.12	117	11	543	230	7	90	9.51	387	40.91	
Kampong Speu	598,882	48	8.01	58	9	421	85	3	50	8.35	291	48.59	
Svay Rieng	478,252	47	9.83	33	6	351	76	3	37	7.74	185	38.68	
Kampong Thom	569,080	44	7.73	52	8	295	176	3	50	8.79	357	62.74	
Kampot	528,405	42	7.95	62	8	341	132	4	47	8.89	369	69.83	
Krong Kaeb	28,680	6	20.94	4		383	5	1	4	13.96	10	34.89	
Mondul Kiri	32,407	5	15.43	21	3	440	14	1	6	18.51	30	92.57	
Krong Pakin	22,906	9	39.29	18		14	29	1	3	13.10	65	283.77	
Total	11,427,636	983	12.37	1,309	192	7,736	2,936	82	929	9.43	7,399	30.93	

Note : Underlined number is average

Source : National Health Statistics Report (1999), Ministry of Health

Table 3.3 Health Infrastructure in Provinces

Kampong Cham Province

Health infrastructure O.D. & R.H.	Population covered by O.D. and R.H.	Health Center	Number of Beds	Health Center per 10,000	Beds per 10,000	Remark (Covering districts by O.D. and R.H.)
Kampong Cham	265,590	22	40	0.83	1.51	Kg Cham, Kg Siem, Koh Sotin, Stung Treng, Tbong khmum
Prey Chhor	171,873	15	59	0.87	3.43	Prey chhor, Kang meas
Cheung Prey	165,893	13	48	0.78	2.89	Cheung prey, Banteay
Chankar Leu	149,882	13	65	0.87	4.34	Chankar Leu, Stung Treng
Kroch Chmar	106,377	9	67	0.85	6.30	Kroch chmar, Stung Treng
Tbong Khmum	175,641	13	75	0.74	4.27	Tbong Khmum, Kroch chmar
Ponhea Krek	168,255	14	25	0.83	1.49	Panhea krek, Dam ber
O Reang Ov	87,982	8	40	0.91	4.55	O reang ov, Koh sotin
Memot	108,705	8	28	0.74	2.58	Memot
Srey Santhor	139,114	13	40	0.93	2.83	Srey santhor, Kang meas
Total	1,539,312	128	487	0.84	3.42	

Kampong Chhnang Province

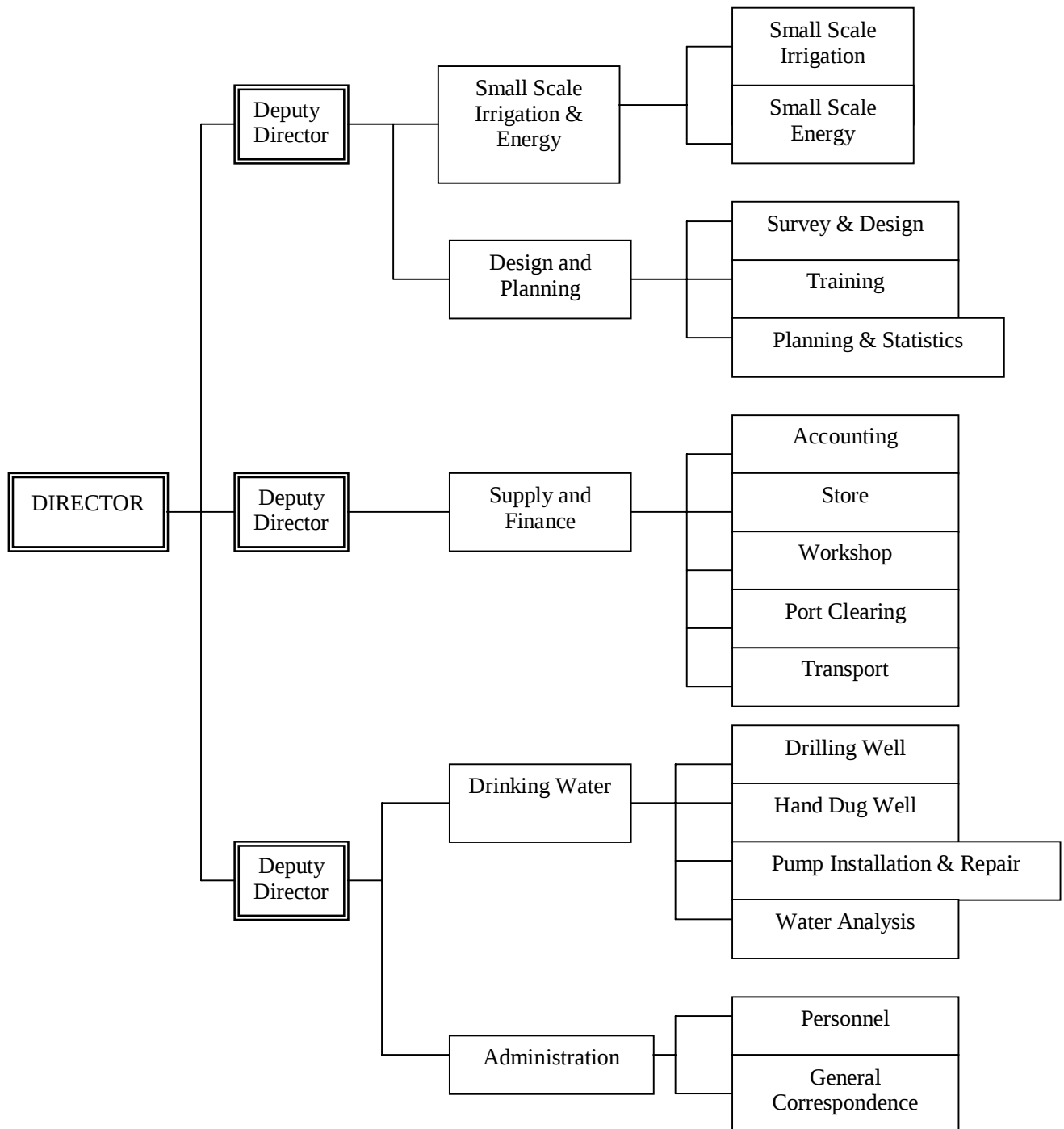
Health infrastructure O.D. & R.H.	Population covered by O.D. and R.H.	Health Center	Number of Beds	Health Center per 10,000	Beds per 10,000	Remark (Covering districts by O.D. and R.H.)
Kampong Chhnang	279,973	23	195	0.82	6.96	Kg Chhnang, Rolepieas, Barbo, Chal kiri, Tukpho, Kg Leng
Kampong Tralach	139,477	11	15	0.79	1.08	Kg Tralach, Chal kiri, Samak meanchey
Total	419,450	34	210	0.81	4.02	

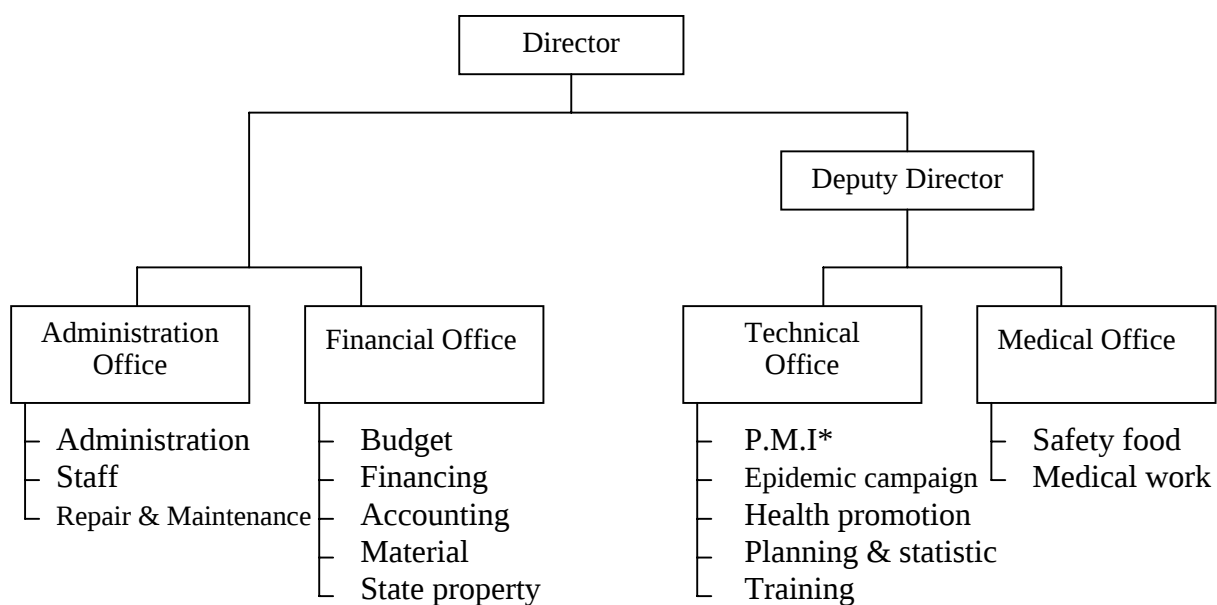
Note : Underlined number is average

O.D. is Operational District

R.H. is Referral Hospital

Source : National Health Statistics Report (1999), Ministry of Health

**Figure 3.1 Organization Chart of DRWS**



* : Prevention Mother & Infant

Figure 3.2 Organization Chart of Provincial Health Department (PHD) in Kampong Chhnang Province

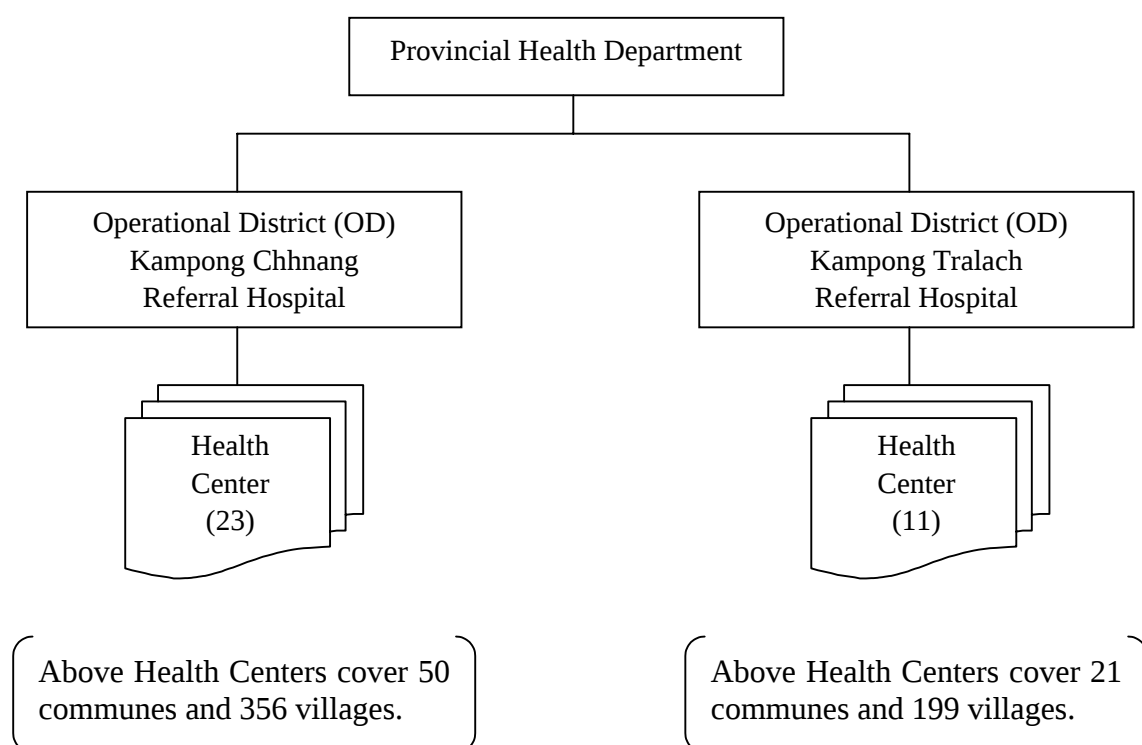


Figure 3.3 Organization Chart of Provincial Health Facilities in Kampong Chhnang Province

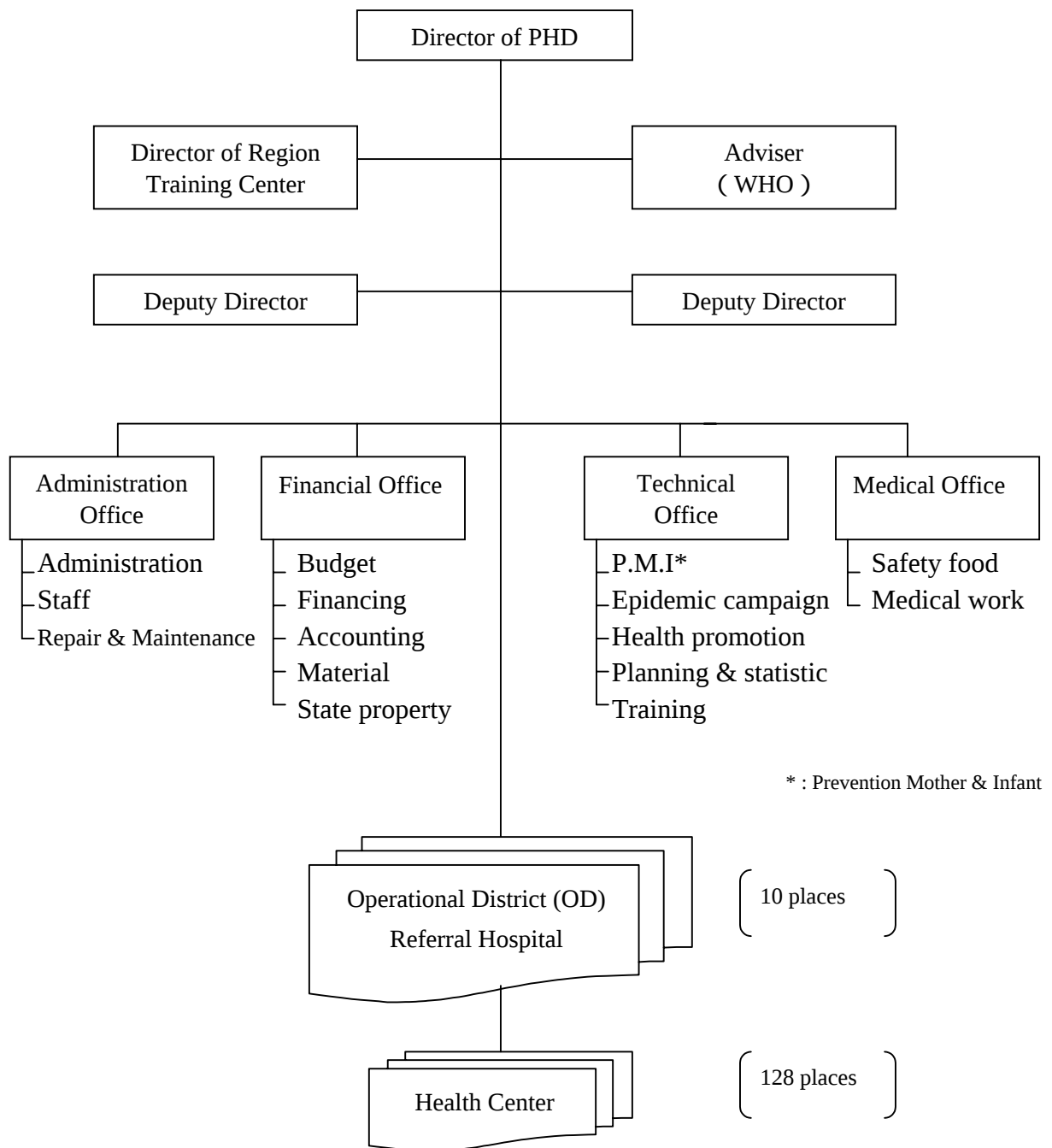


Figure 3.4 Organization Chart of Provincial Health Department (PHD) in Kampong Cham Province

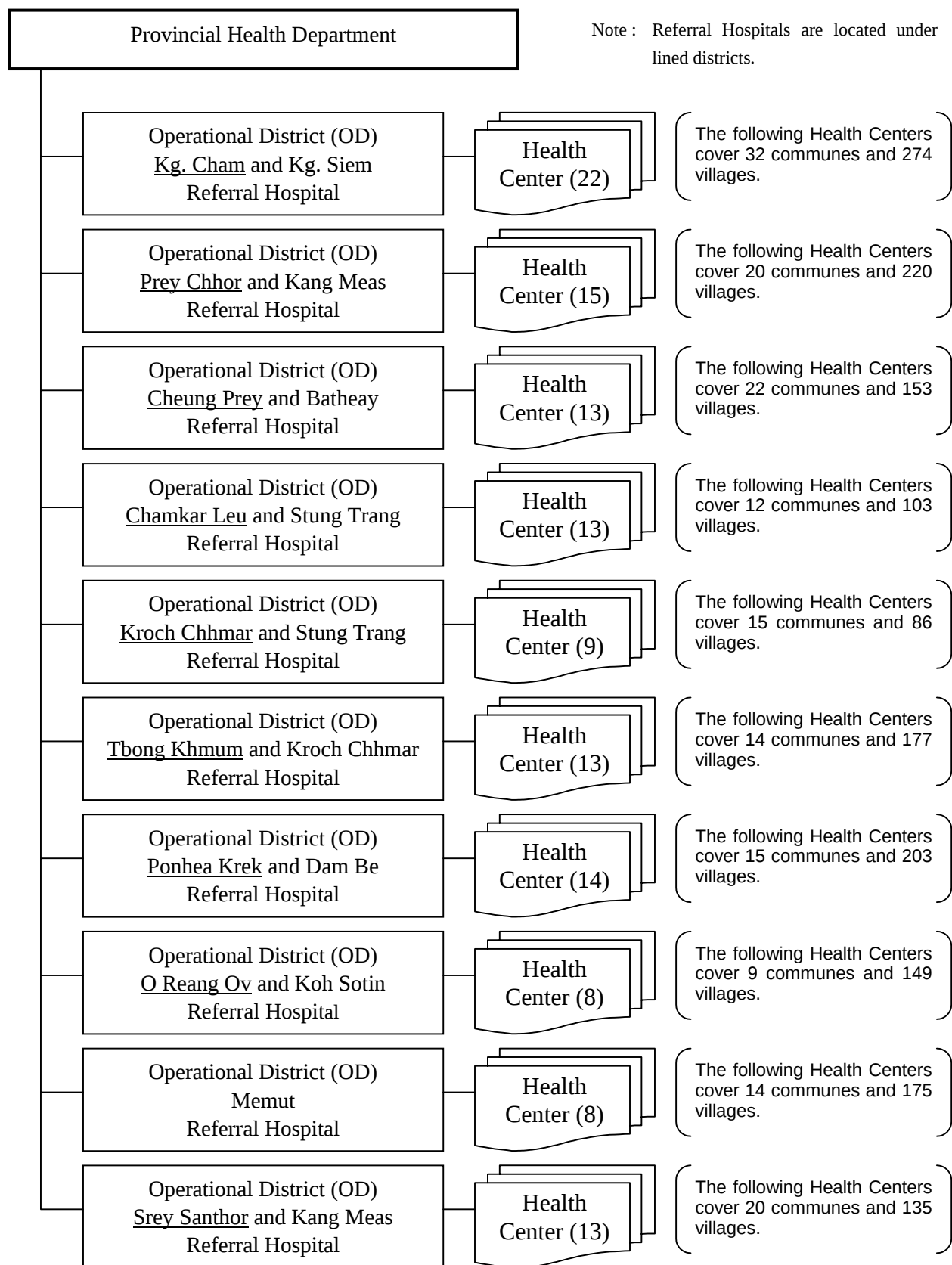
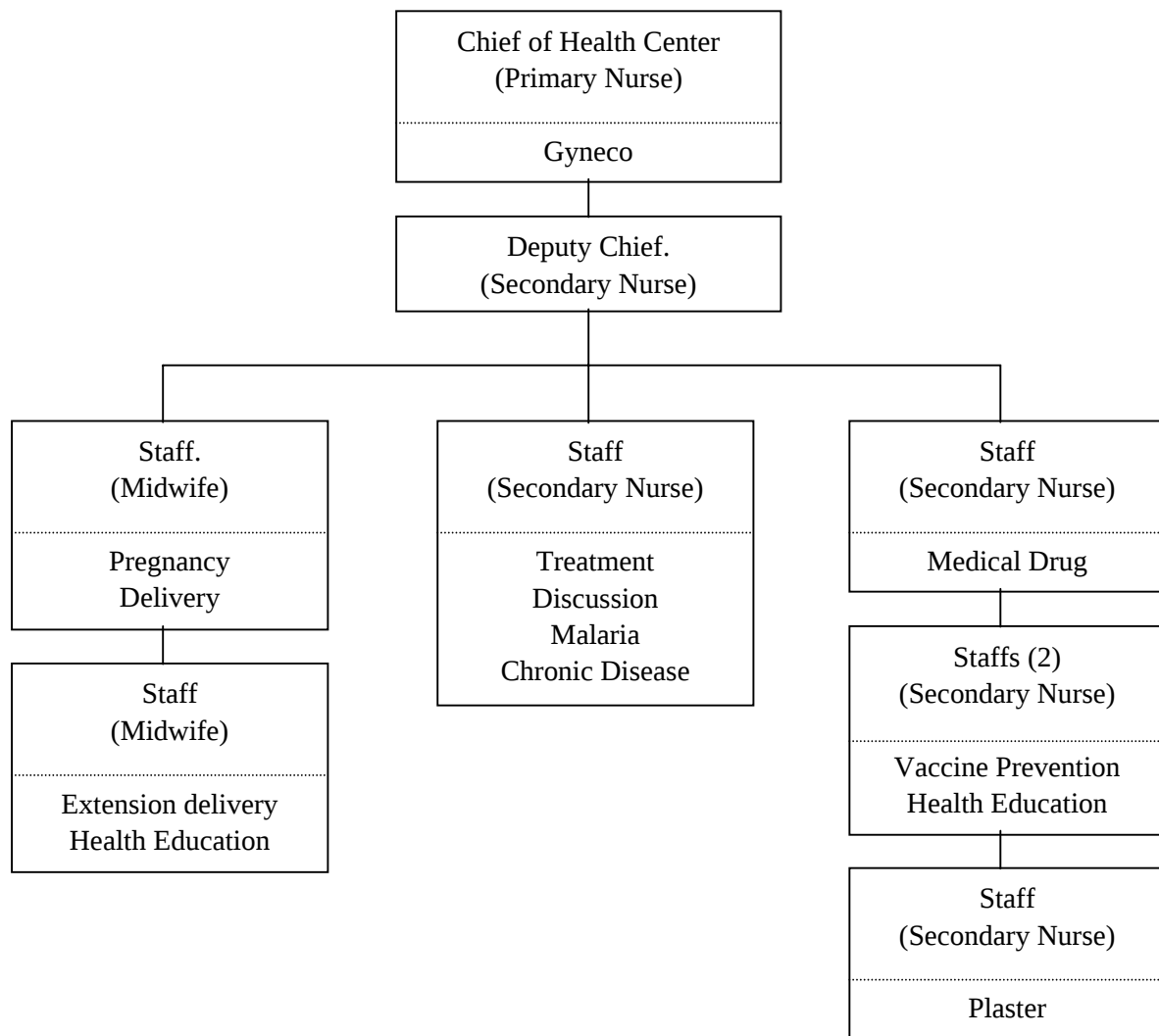


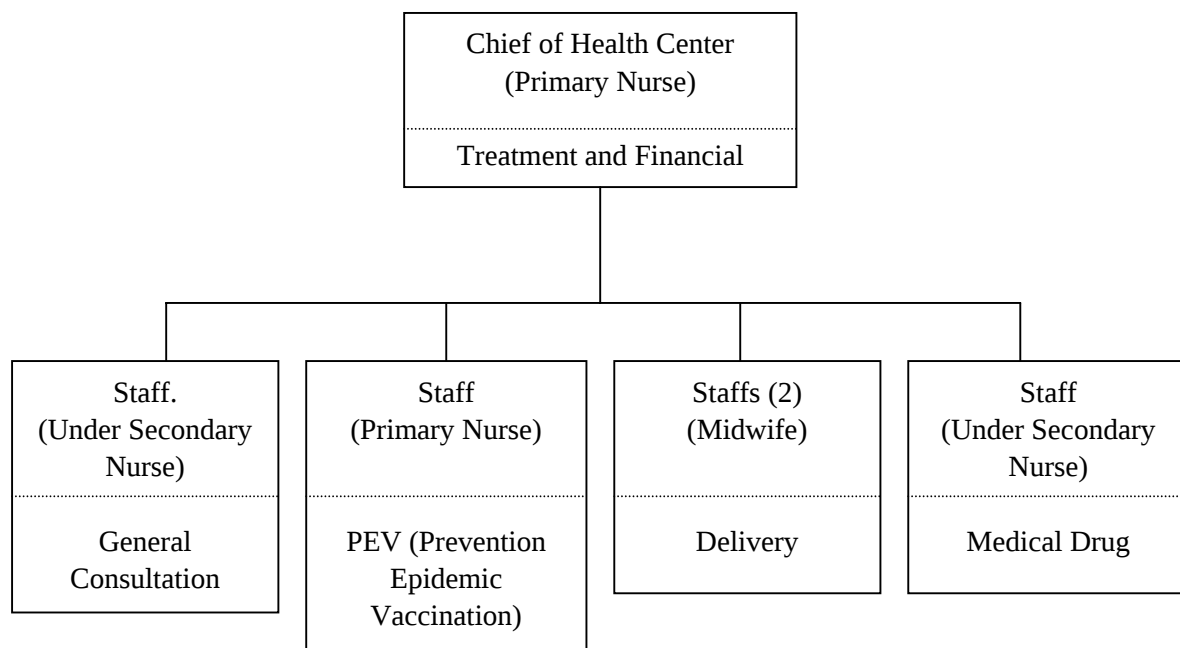
Figure 3.5 Organization Chart of Provincial Health Facilities in Kampong Cham Province



Main activities in Cheap Health Center

- Examination clinic, General treatment, Malaria, Genital infection
- Pregnancy examination
- Extension delivery
- Delivery
- Chronic examination (Tuberculosis, Leprosy)
- Health education
- Medical supervision, village report collection
- Monthly vaccine infection in each village
- Monthly pregnant, extension delivery in each village

**Figure 3.6 Organization and Activities of Health Center
(In Case of Cheap Health Center)**



Main activities in Khnol Dombang Health Center.

- Examination and consultation.
- PEV (Prevention Epidemic Vaccination)
- Pregnancy examination
- Delivery
- Monthly meeting with VHV and Health Supporting Committee.
- Health and hygiene education in 10 villages
- Chronic examination and send patient to OD

**Figure 3.7 Organization and Activities of Health Center
(In Case of Khnol Dombang Health Center)**

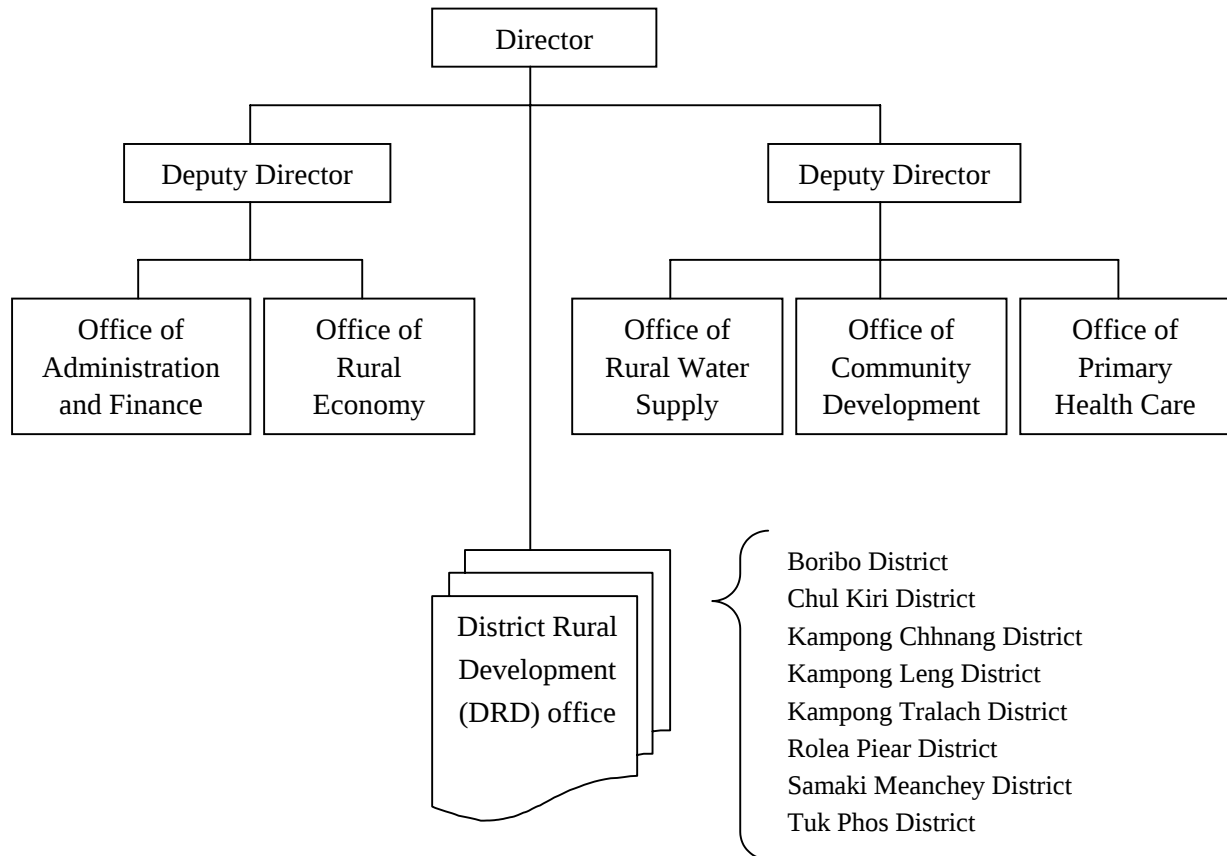


Figure 3.8 Organization Chart of Provincial Department of Rural Development (PDRD) in Kampong Chhnang Province

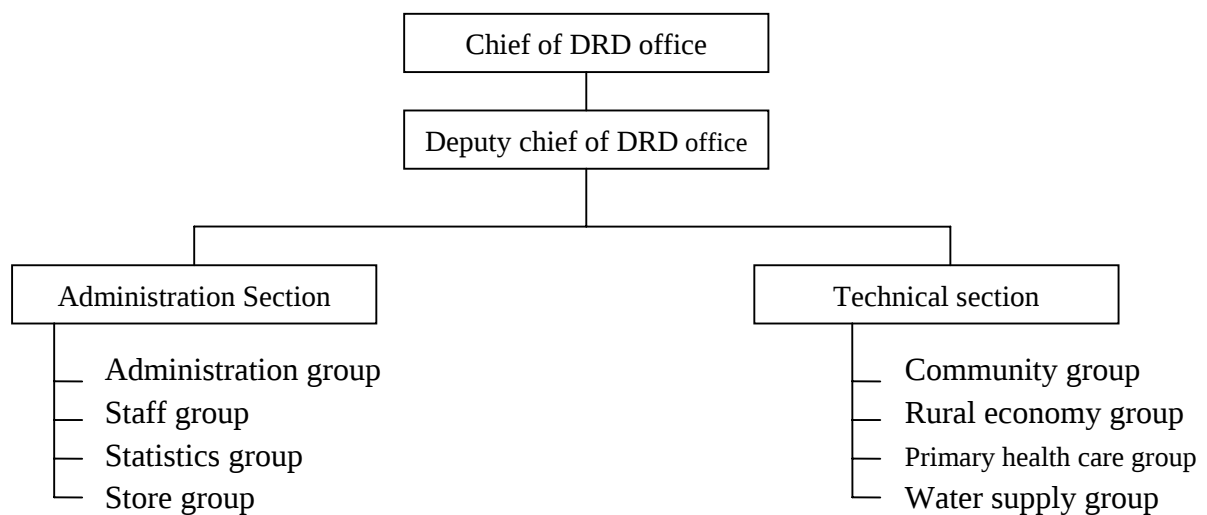


Figure 3.9 Organization Chart of District Rural Development Office (DRD) in Kampong Chhnang Province

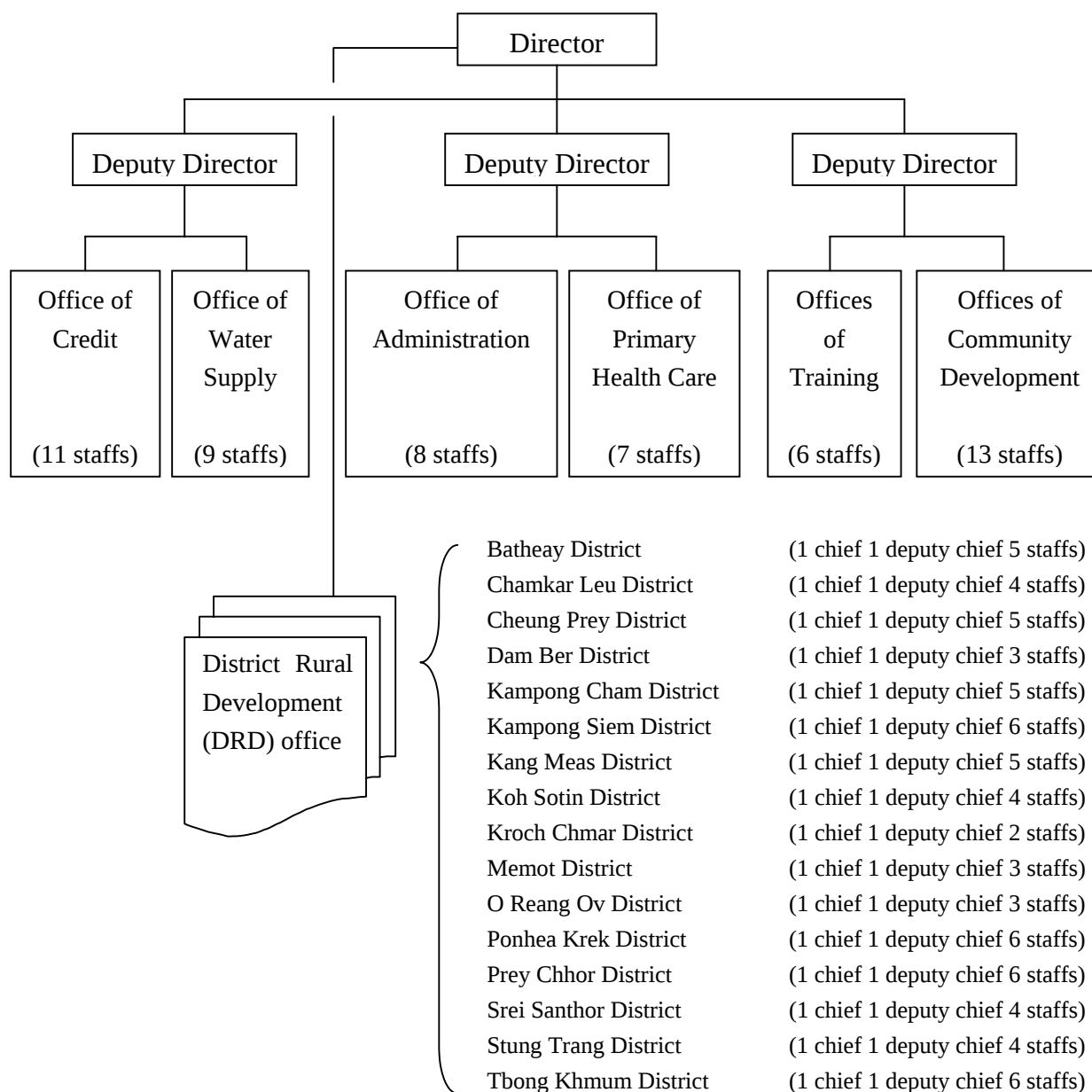


Figure 3.10 Organization Chart of Provincial Department of Rural Development (PDRD) in Kampong Cham