

Appendix L
Environment

**THE STUDY ON
REGIONAL DEVELOPMENT OF
THE PHNOM PENH-SIHANOUKVILLE GROWTH CORRIDOR
IN THE KINGDOM OF CAMBODIA**

Appendix L Environment

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APPENDIX L ENVIRONMENT

This appendix reviews current environmental situation and natural resource condition of the study area, analyses environment related issues and shows the direction of environment and natural resource management.

L.1 GEOGRAPHICAL FEATURES OF THE STUDY AREA

L.1.1 Geographical Features of Cambodia

Cambodia covers an area of 181,035km² bordered by Thailand to the west, Lao P.D.R. to the north, Vietnam to the east and Gulf of Thailand to the west. About 58.6% of the country's land is covered by forests and woodland while 21.5% is agricultural land. As shown in **Figure L-1**, the country is mainly divided into the following three regions topographically:

(1) Central Plain

The central plain is low-lying alluvial land that surrounds the Tonle Sap Lake and the Mekong River. The rich sediment deposited during the Mekong River's annual wet season flooding has made the agricultural lands highly fertile. The plain occupies about three quarters of the country and the population concentrates in the flood prone area on the Mekong River basin where rain-fed rice production and truck farms are the dominant land use since the soil is good for cultivation.

(2) Mountains and Plateaus

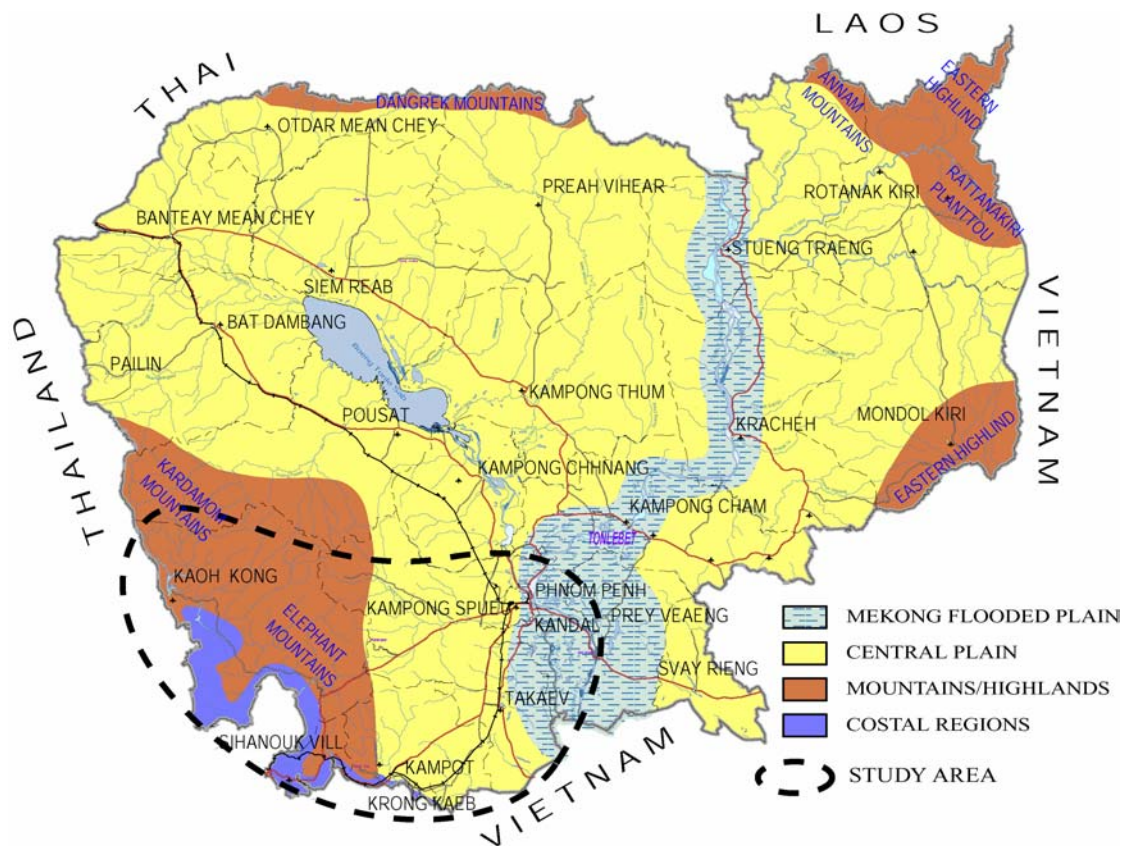
The central plain is surrounded by mountains and plateaus on three sides. The Dangrek Mountains adjoining the Koral Plateau of Thailand lies to the north of the central plain. On the east and northeast of the central plain, hilly plateau regions extend along the border with Laos and Vietnam. Two mountains on the southwest of the plain, the Cardamom Mountains and the Elephant Mountains, cover large part of the area between the Tonle Sap Lake and the Gulf of Thailand. Mount Aoral (1,813 m), the highest mountain in Cambodia, rises in the eastern part of these mountain ranges. Forest reserves are rapidly decreasing in the northeastern plateau areas (Rotanak Kiri and Mondol Kiri provinces), and the Cardamom and the Elephant Mountains in the southwestern areas. The Cardamom Mountains are the remaining great reserve of Indochinese mountain forests with a rich and largely un-studied flora and fauna, much of which is endangered elsewhere in Asia.

(3) Coastal Zone on the Gulf of Thailand

The coastline of Cambodia is about 435 km long along the Gulf of Thailand. Four provinces/municipalities have coastline and these provinces/municipalities hold 10% of the national land area and 7% of the national population. The coastal provinces/municipalities are composed of southwestern mountains and small strips of lowland, and the lowland is densely populated as the central plain is. The coastal

zone is always the first to receive heavy rains due to the mountain ranges rising in the southwest of the Tonle Sap Lake, and is one of the wettest regions (mean annual rainfall is more than 2,000mm). Mangrove forests are the prevailing ecosystem in the coastal zone and some of the best remnant coral reefs in the Gulf can be observed in the coastal waters. However, this valuable marine ecosystem has been degrading by several factors, such as inadequate management of waste and wastewater.

The study area extends over the above-mentioned three different geographical regions. Phnom Penh, Kandal, Takaev, and eastern halves of Kampong Spueu and Kampot are located in the central plain. Most part of Kaoh Kong, and western halves of Kampong Spueu and Kampot are mountainous area. Sihanoukville, southern part of Kampot and western part of Kaoh Kong are facing the Gulf of Thailand. Briefly, the study area has two separated low-lying areas divided by the mountainous area in between. Taking the socio-economic dimension into consideration, the study area is divided into three characteristic sub-areas, greater capital area (Phnom Penh, Kandal), port city of Sihanoukville, and intermediate area (Kampong Spueu, Kampot, Kaoh Kong and Takaev). The detailed geographical feature of each area is described below.



Source: JICA Study Team (Original Source: Review and Assessment of water Resources for Hydropower and Identification of Priority project-Cambodia, Mekong River Commission, June 1995)

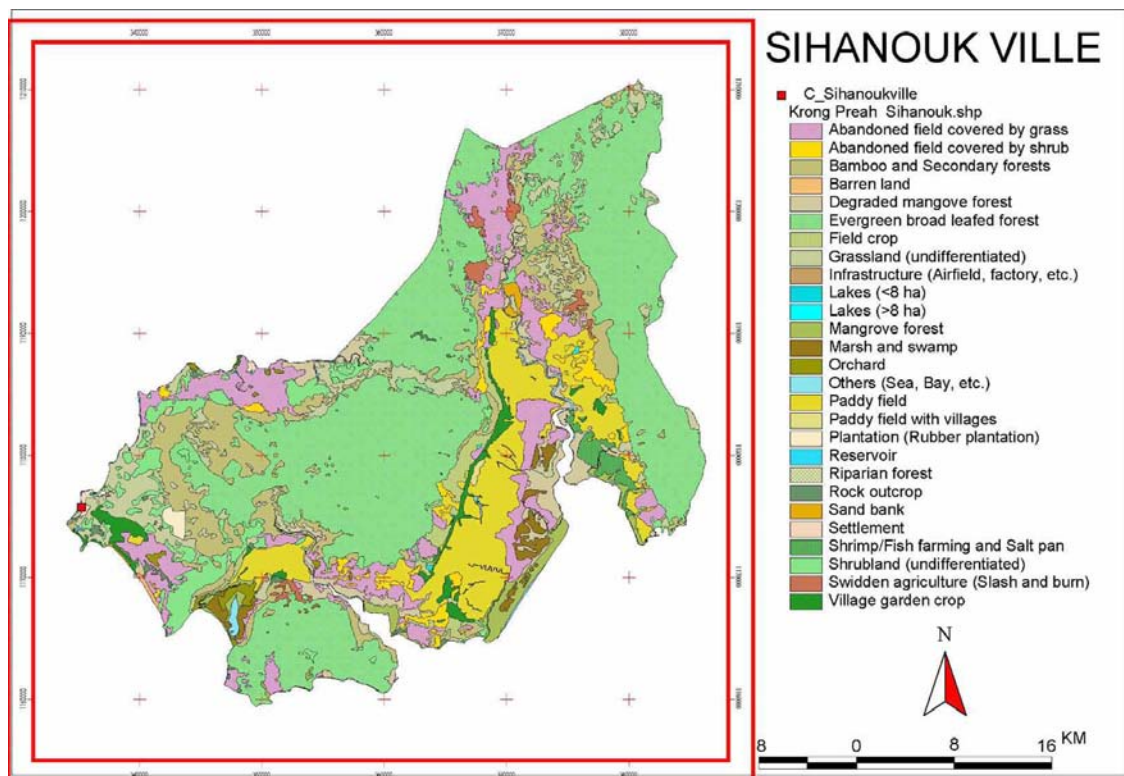
Figure L-1 Geographical Zones in Cambodia

L.1.2 Geographical Features of the Study Area

(1) Sihanoukville

Sihanoukville is located 224 km southwest of Phnom Penh on the coast of the Gulf of Thailand and covers an area of 868km² of which about two-third is classified as mountain or hilly land with the highest peak of 327 m (Phnom Mousna Mountain) and one-third is flatland including wetlands and 24 islands. Topography of Sihanoukville changes from east to west: outskirts of sandstone massif of the Elephant Mountains in the east to mud flat/sandy bottom in the west with the plain area in its center. The coastline of Sihanoukville is 119.5 km long, about a quarter of national total, of which 35 km is sand beach and remaining 84.5 km is rock, mud and mangrove forest. Sihanoukville has a deep-water port, the only national deep-water port in Cambodia.

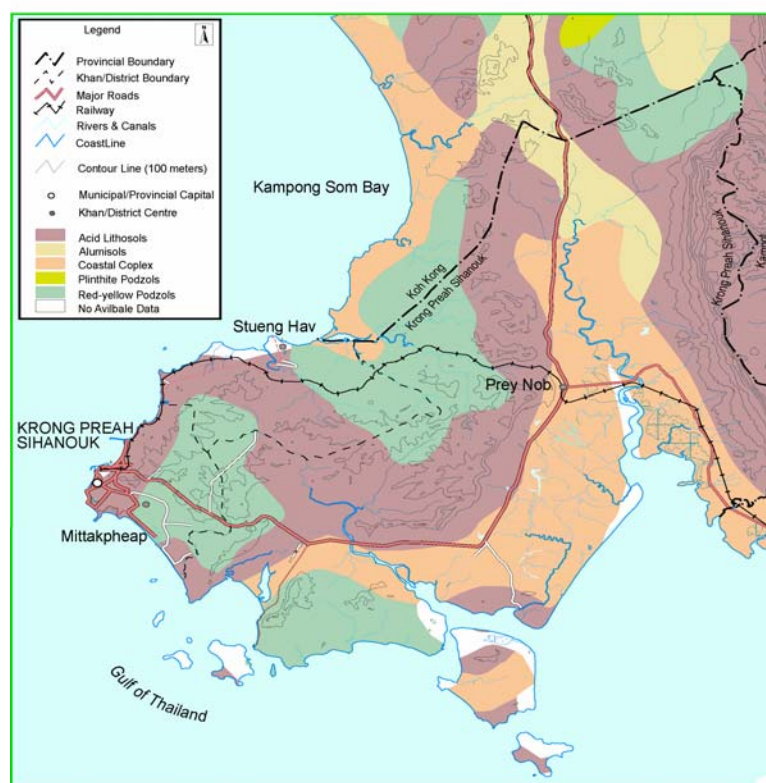
Figure L-2 shows the current land use of Sihanoukville. The land of Sihanoukville was originally covered by large forest area. However, the pattern of land use has been changing because of the expansion of urban area since early 1960s. According to the study conducted by Danida, the current ratio by land use categories is as follows; forest land 65.05%, agricultural land 27.49%, inundated land 3.42%, housing land 3.42%, and vacant land 0.54%¹. Soils are mainly consisted of acid lithosols, coastal ponzols and red-yellow podzols, as shown in **Figure L-3**.



Source: Department of Public Works Research Center

Figure L-2 Current Land Use of Sihanoukville

¹ Ministry of Environment and Danida, *Physical Framework Plan-Sihanoukville*, April 2002, p7



Source: JICA Study Team (Original Source: Physical Framework Plan-Sihanoukville, MOE & Danida, April 2002)

Figure L-3 Soil and Topography of Sihanoukville

The municipal center of Sihanoukville is on the headland of the peninsula and surrounded by the beaches on three sides. The topography of the municipal center is moderately hilly and about 10 m above the sea level with the highest point 130 m. The center covers an area of 88.92km² and the current ratio by land use categories is as follows; residential/commercial area is 16.8km² or 19% of the total area, industrial area 10km² or 11%, tourist area 6.5km² or 6.3%, recreational area 3.5km² or 4%, port area 1.5km² or 1.7%, and protected area and others 51.5km² or 57%².

Climate of Sihanoukville comes under tropical monsoon. **Table L-1** shows the average monthly temperature in Sihanoukville. As shown in **Table L-1**, the average maximum temperature is above 32 Celsius from March to July, while the average minimum temperature is below 24 Celsius from January to February and in December. The highest average maximum temperature is 32.6 Celsius recorded in April and May, while the lowest average minimum temperature is 21.5 Celsius recorded in January in the period from 1997 to 2001. Judging from the average mean temperature, April and May are the hottest months in the year round, but the temperatures of this season in Sihanoukville are lower than the temperatures of the Greater Capital Area.

² The calculation is based on the study conducted by the Fraser Thomas.

Table L-1 Average Temperature in Sihanoukville (average of year 1997 to 2001)

(Unit: Celsius)

Month		Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Province Sihanoukville	Average Minimum	22.4	23.9	24.2	25.5	25.6	24.9	24.2	24.1	24.4	24.1	24.0	23.2
	Average Mean	26.3	27.3	28.2	28.7	28.8	28.3	28.0	27.1	27.1	26.9	27.0	26.6
	Average Maximum	30.3	31.5	33.1	32.6	32.6	32.5	32.5	31.2	30.2	30.5	30.5	30.2

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Sihanoukville receives the highest volume of rainfall in the study area. The annual rainfall in Sihanoukville is 3097.7 mm in 2002 and 3112.3 mm on the five-year average. As **Table L-2** shows, the annual precipitation varies every year, but the volumes are above 2,000 mm throughout past six years. The rainy season is from May to November. As shown in **Table L-3**, the precipitation is especially high from June to September. The highest monthly rainfall volume in the past six years is 962.8 mm recorded in Aug. 2000. On the other hand, the period from January to April and December is dry season. The average monthly precipitation is lower from January to March and in December. Localized torrential downpours during rainy season sometimes cause floods. The monsoon flows from southwest during rainy season and from northwest during dry season³.

Table L-2 Change of Annual Rainfall volume in Sihanoukville (1997-2002)

(Unit: mm)

1997	1998	1999	2000	2001	2002	Average (1997-2002)
2291.1	2749.4	3734.0	3476.5	3324.8	3097.7	3112.3

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Table L-3 Average Monthly Rainfall Volume in Sihanoukville*

(Unit: mm)

Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
30.9	38.9	96.3	169.9	281.6	442.5	564.7	651.9	370.2	284.6	152.6	28.1

*Average of the 1997 to 2002 monthly rainfall volumes

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Sihanoukville has 32 small rivers and streams that flow into the Gulf of Thailand with the water levels increasing and decreasing depending on the volume of rainfall. The Prek Teouksap and Prek Kampong Smach are relatively big among these rivers. Domestic waste and wastewater from the factories are discharged to the rivers with no treatment and the effluent affects the marine ecosystem.

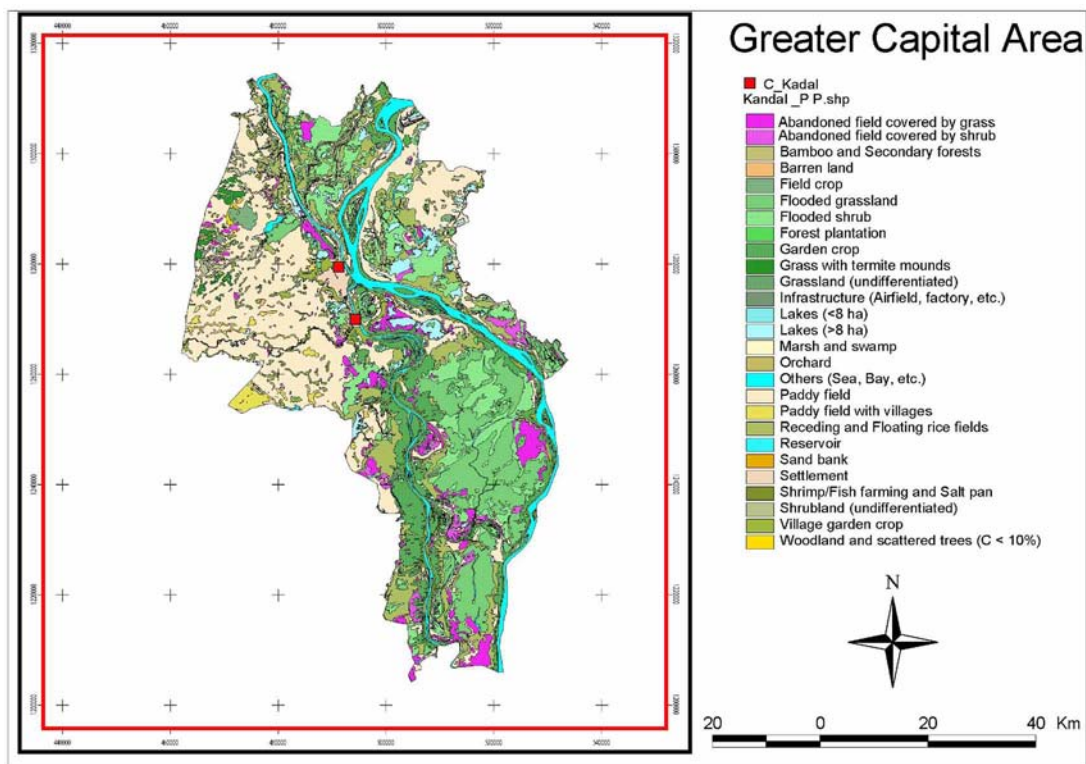
(2) Greater Capital Area

The Greater Capital Area consisting of Phnom Penh Municipality and Kadal Province is located on the delta of four large rivers, Tonle Sap River, Upper and Lower Tonle Mekong Rivers, and Tonle Bassac River, and the south of Kandal borders on Vietnam. The Upper Tonle Mekong River branches off in the other three rivers at Phnom Penh. The Tonle Sap River flows backward to the Tonle Sap Lake from middle of June to

³ According to the record of the meteorological station in the Sihanoukville airport, strong wind had been rarely observed during the period from 1863 to 1979. The strongest wind observed is 9 m/s.

October because of the high water level stems from high volume of rain and melt-water.

Figure L-4 shows the current land use of the Greater Capital Area. The Greater Capital Area covers an area of 3,929km² (Phnom Penh 375km² and Kandal 3,553km²) of which about 37% is used for agriculture and 10.5% is residential area. The topography of the Area moderately slopes down from west to east and from north to south with the highest terrain zone in the northwest (the highest point is 283 m). The Area is flood prone and flooding tends to occur from July to October. The urbanized area in the Greater Capital Area is 27.08km² and the total of residential and commercial use accounts for almost 80% of the land use as shown in **Table L-4**. The Greater Capital Area lies on Holocene and Old alluvium mainly consisting of unconsolidated silt and clay with some sands covers. The alluvium overlays weathered rock and clay at the depth of 30 to 50 m with hard crystalline rock on its base. It is estimated that there is no artesian aquifers in the Greater Capital Area.



Source: Department of Public Works Research Center

Figure L-4 Current Land Use of the Greater Capital Area

Table L-4 Land Use of the Urbanized Area in the Greater Capital Area

Land Use Category	area (ha)	%
Residential Area	1,314	48.5%
Commercial Area	792	29.2%
Industrial Area	80	3.0%
Public Facilities	192	7.1%
Agricultural Land	14	0.5%
Parks & Open Space	36	1.3%
Wetland	-	-
Water Surface	280	10.3%
Total	2,708	100.0%

Source: the Transport Master Plan of the Phnom Penh Metropolitan Area, JICA and Municipality of PHN, 2001

The temperature and rainfall volume of the Greater Capital Area fluctuate affected by the tropical monsoon climate. **Table L-5** shows the average monthly temperature in Phnom Penh (data of temperature on Kandal is not available). As shown in **Table L-5**, the average maximum temperature exceeds 34 Celsius from March to May, while the average minimum temperature is below 23 Celsius from January to February and in December. The disparity between minimum and maximum temperature in the Greater Capital Area is bigger than in Sihanoukville. The highest average maximum temperature is 36.3 Celsius recorded in March, while the lowest average minimum temperature is 20.0 Celsius recorded in December in the period from 1997 to 2001.

Table L-5 Average Temperature in Phnom Penh (average of year 1997 to 2001)

(Unit: Celsius)

Province	Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
		Phnom Penh	22.1	22.9	24.4	25.2	25.4	24.9	24.7	24.7	24.4	24.1	23.1
	Average Minimum	22.1	22.9	24.4	25.2	25.4	24.9	24.7	24.7	24.4	24.1	23.1	21.7
	Average Mean	26.8	27.8	29.6	30.1	29.8	29.2	28.6	28.6	28.3	27.4	26.5	25.9
	Average Maximum	31.5	32.8	34.8	34.9	34.3	33.5	32.5	32.5	32.3	30.9	29.9	30.0

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Table L-6 shows the change of annual rainfall volume in the Greater Capital Area in the past six years. The annual rainfalls in Phnom Penh and Kandal are 1,230.6 mm and 1,190.3 mm in 2002 respectively, and average annual rainfalls of the past six years are 1,568.1 mm and 1385.8 mm. As shown in **Table L-6**, the annual precipitation fluctuates every year. The maximum precipitation is 2095.9 mm recorded in Phnom Penh in 2000 and the minimum is 1190.3 mm recorded in Kandal in 2002. The monthly precipitation also varies as shown in **Table L-7**. The rainfall volume is relatively low from January to April and in December, and then, it increases from May. The precipitation is especially high from September to October.

Table L-6 Change of Annual Rainfall volume in the Greater Capital Area (1997-2002)

(Unit: mm)

Province	1997	1998	1999	2000	2001	2002	Average (1997-2002)
Kandal	1195.3	1204.3	1639.7	1780.3	1304.7	1190.3	1385.8
Phnom Penh	1400.2	1484.5	1593.1	2095.9	1604.4	1230.6	1568.1

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Table L-7 Average Monthly Rainfall Volume in the Greater Capital Area*

(Unit: mm)

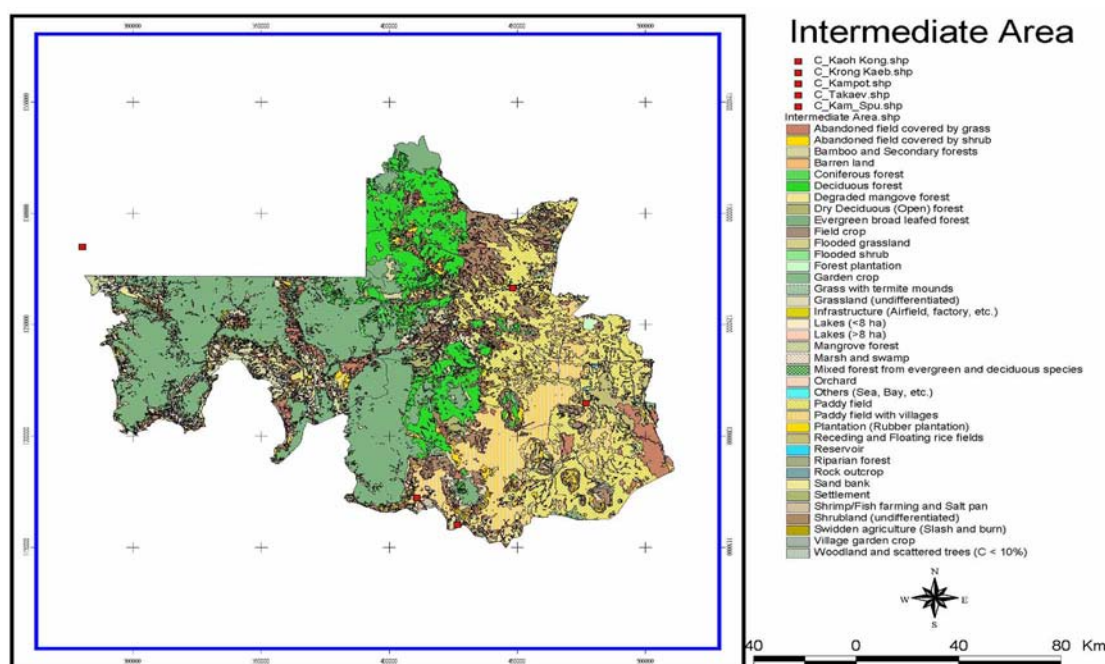
Province	Month											
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Kandal	20.3	6.0	32.1	86.8	113.5	137.1	134.2	180.5	166.6	328.5	127.7	74.6
Phnom Penh	31.9	11.5	58.8	87.6	106.1	168.8	178.2	172.5	246.4	312.7	139.3	76.7

*Average of the 1997 to 2002 monthly rainfall volumes

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

(3) Intermediate Area

The Intermediate Area consists of four provinces; Takaev, Kampong Spueu, Kampot, and Kaoh Kong (from east to west) with an area of 26,949km² which accounts for about 85% of the total study area. Plateau or mountainous area occupies about 61% of the Intermediate Area, and the remaining 28% is categorized as plain and 9% is coastal zone. Most of the area in Takaev, and the areas in eastern halves of Kampong Spueu and Kampot are plain (32% of the area in Kampong Spueu and 38% of the area in Kampot are plain). The Cardamom Mountains and the Elephant Mountains cover most of the area in Kaoh Kong, and the areas in western halves of Kampong Spueu and Kampot. Plateau and mountainous area occupy 83% of Kaoh Kong, 68% of Kampong Spueu, and 52% of Kampot. The current land use of the Intermediate Area is shown in Figure L-5.



Source: Department of Public Works Research Center

Figure L-5 Current Land Use of the Intermediate Area (a part of Kaoh Kong has no data)

Soils of the eastern part of plain in the Intermediate Area (mainly eastern part of Takaev) are black cracking clay with high organic matter benefiting from the annual flooding of the Tonle Bassac River. The higher land in the western part of plain in the Intermediate Area (western half of Takaev, eastern halves of Kampong Spueu and Kampot) has red soils with low organic matter. Soils of plateau and mountainous areas mainly consist of acid lithosols and red-yellow pndzols.

Table L-8 shows the average monthly temperature in Kampot (data of temperature on another provinces in the Intermediate Area is not available). As shown in **Table L-8**, the average maximum temperature is above 32 Celsius from March to May. Judging from the fact that the average minimum temperature rarely exceeds 24 Celsius all year round, it is relatively cool in the night and early morning. The highest average maximum temperature is 33.5 Celsius recorded in April and may, while the lowest average minimum temperature is 23.0 Celsius recorded in January in the period from 1997 to 2001. The change of temperatures in the Intermediate Area is various. Therefore, the above description on the temperature of Kampot cannot apply to the Intermediate Area as a whole.

Table L-8 Average Temperature in Kampot (average of year 1997 to 2001)

(Unit: Celsius)

Month													
Province	Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Kampot	Average Minimum	21.9	22.5	23.0	23.9	24.0	23.7	23.7	24.2	23.9	23.9	23.3	22.9
	Average Mean	26.5	27.1	27.6	28.4	28.3	27.8	27.4	27.7	27.8	27.7	27.2	27.0
	Average Maximum	31.1	31.8	32.2	32.9	32.7	31.9	31.1	31.2	31.7	31.6	31.2	31.1

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

As shown in **Table L-9**, the annual rainfalls in the Intermediate Area vary by year and province. Kampot province, which faces the Gulf of Thailand, has higher volume of rainfall than Takaev and Kampong Spueu, which are located in the eastern part of the area. The minimum precipitation is 734.9 mm recorded in Kampong Spueu in 2002 and the maximum is 2,532.9 mm recorded in Kampot in 1999 in the past six years. The monthly precipitation also varies by province as shown in **Table L-10**. There is hardly any rain from January to February and in December, but the volume of rainfall begins to increase from March in Kampot, and from April in Takaev and Kampong Spueu. The precipitation is especially high from June to October in Kampot, and from August to October in Takaev and Kampong Spueu.

Table L-9 Change of Annual Precipitation in the Intermediate Area (1997-2002)

(Unit: mm)

Year								Average (1997-2002)
Province	Year	1997	1998	1999	2000	2001	2002	Average (1997-2002)
Takaev		904.1	1228.9	1533.9	1599.3	1521.0	1248.7	1339.3
Kampot		1919.8	1255.1	2532.9	2337.0	2316.8	1626.1	1998.0
Kampong Spueu		1020.0	1281.5	1668.8	1877.4	1650.8	734.9	1372.2
Kaoh Kong		no data	no data	no data	no data	no data	no data	-

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

Table L-10 Average Monthly Rainfall Volume in the Intermediate Area*

(Unit: mm)

Month													
Province	Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Takaev		20.0	5.1	42.0	115.3	105.1	89.3	125.8	160.7	176.0	368.5	135.0	45.6
Kampot		26.8	17.2	128.0	132.4	176.7	203.8	282.2	411.7	206.8	243.6	190.2	41.4
Kampong Spueu		36.8	6.5	78.6	117.1	123.6	96.3	101.4	214.7	232.3	245.2	108.4	31.8
Kaoh Kong		-	-	-	-	-	-	-	-	-	-	-	-

*Average of the 1997 to 2002 monthly rainfall volumes

Source: Department of Meteorology, Ministry of Water Resource and Meteorology

The canal network in Takaev is the densest of all the provinces in Cambodia,

comprising 3,450km of principal canals of which about 20 to 25% have been in use⁴. The direction of water flow in the eastern part of plain in the Intermediate Area changes with the annual flooding of the Tonle Mekong Rivers, and the Tonle Bassac River. Along the coastline in the Intermediate Area, the rivers run westwards from the Cardamom Mountains and have catchments of about 15% of the land area. The rivers flowing into the Gulf of Thailand are relatively short and small, and their water levels fluctuate drastically with the volume of rainfall. Nine rivers running in Kampot and six rivers running in Kaoh Kong are relatively big⁵.

L.2 PRESENT CONDITION OF NATURAL ENVIRONMENT IN THE STUDY AREA

L.2.1 Present Condition of Forestry and Land Management

(1) Present Condition of Forestry and Land Management in the Study Area

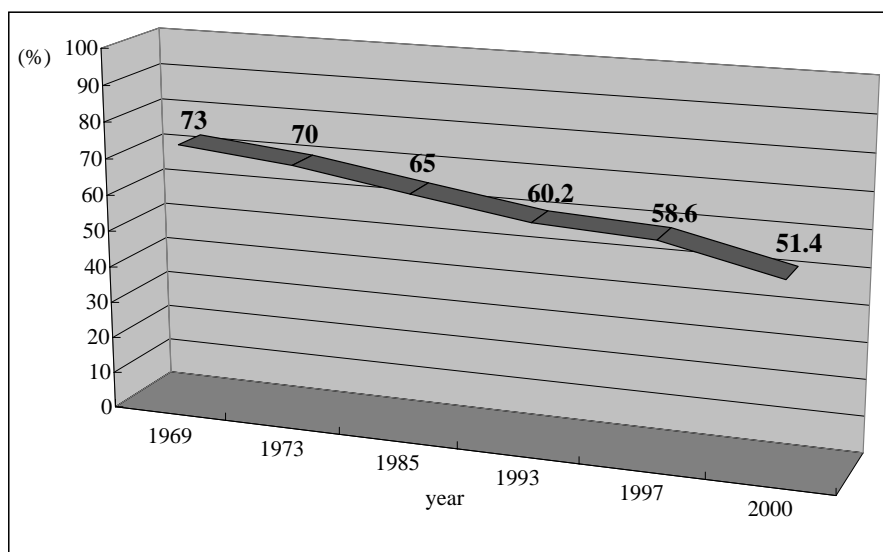
Forestry is one of the most important sectors for Cambodia's socio economic development since it is expected to generate government revenue and it retains the value of tourism resources. The forest cover of Cambodia is diverse, but it is mainly consisted of three types of forests; open deciduous forest, closed semi-deciduous forest and evergreen closed forest. The forest types vary by province depending upon altitudes or climatic conditions. The evergreen forest covers a large area of the western and northwestern regions. The northeastern regions are mainly covered by deciduous forests while the southern and central regions have less forest cover.

Forests covered area in Cambodia is rapidly decreasing. As shown in **Figure L-6**, the forest area was 13.2 million ha or about 73% of the total land area in 1969 but decreased to 9.3 million ha or about 51% of the total land are in 2000. During the civil war from 1970 to 79, forest utilization was limited to the domestic use. Thereafter, from 1979 to 92, the RGC had cleared forest up to 1 km inside of the national/provincial roads and along the Thai border to enhance security. The annual forest harvest had been below the annual allowance cut during this period due to the closed economic policy of the government. However, forest cutting began to increase from 1992 with larger and organized scale for the industrial production. Illegal logging on commercial scales began to appear in 1994 concurrently with the introduction of the concession system (the detailed explanation regarding forest concession is described below.). The volume of forest exploitation peaked in 1997 (roughly 94% of timber production was found to be illegal in 1997) and started to decrease since then owing to enhancement of management systems and capacities, and mounting international pressure. According to the data of FAO, the rate of deforestation form 1990 to 1995 was about 165,200 ha/year while it was 97,600 ha/year (equivalent to 2.6 times as large as the land area of Phnom Penh) from 1995 to

⁴ As canals interlink many reservoirs, there are few discrete irrigation systems.

⁵ Nine rivers in Kampot are Kampong Krognoung, Kbal Romeas, Kampong Bay River, B.G.I, Koh Toch, Kdart, Smach, Thnaut and Trapeng Ampov. Six rivers in Kaoh Kong are Stung Meteouk, Stung Russei Chrum, Stung Sala Munthun, Stung Chhay Areng, Prek Piphot and Prek Kampong Som from north to south.

2000.



Note: Ratio of year 2000 is estimation
Source: JICA Study Team (made by using the data of FAO)

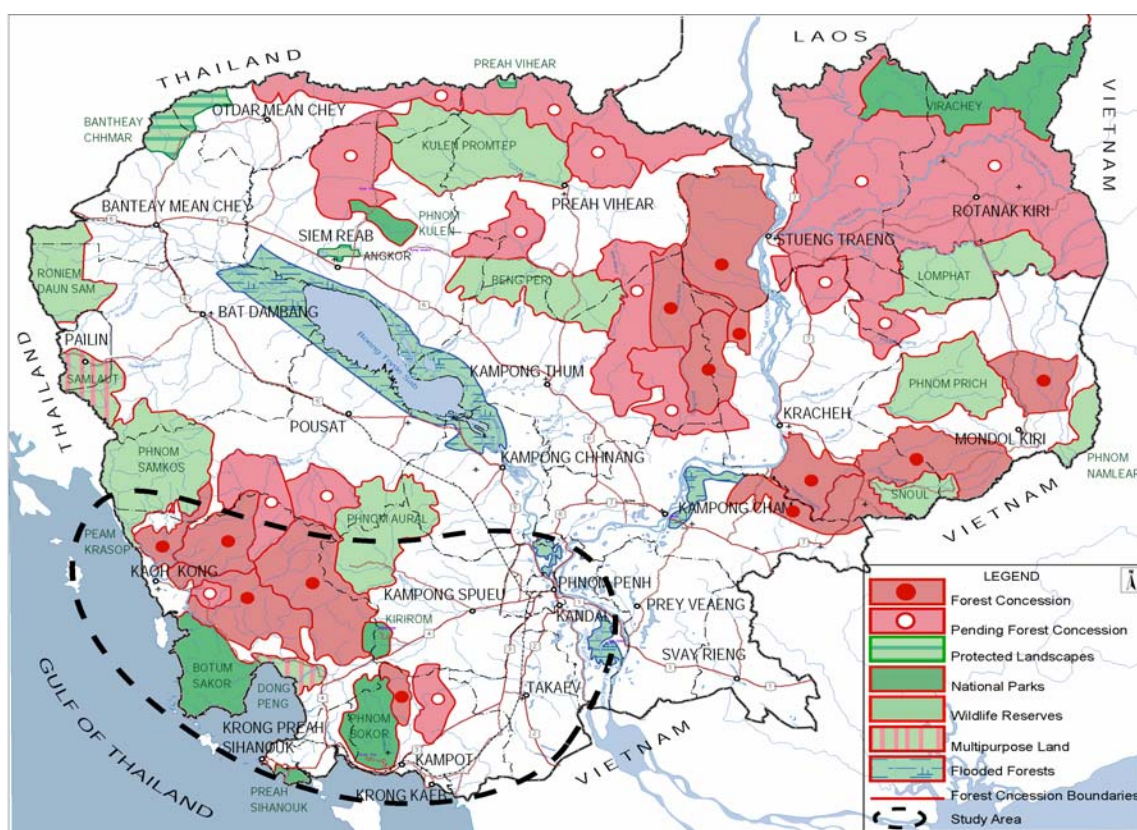
Figure L-6 Change of Forest Cover in Cambodia (1969 to 2000)

The ratio of forest area to the total land area by province/municipality in the study area is shown in **Table L-11**. As the **Table** shows, forest covers about 53% of the land in the study area. Total forest cover in the study area is almost 1.74 million ha and accounts for 16% of the national forest area. Forest covers more than 80% of the land in Kaoh Kong Province where forest rich Cardamom Mountains occupies large part of the province. The ratio of forest cover is also high in Sihanoukville, Kampot and Kampong Spueu (61.8%, 49.8% and 49.7% respectively). On the other hand, the ratio is very low in Kandal, Phnom Penh and Takaev, the provinces/municipality near or in the Greater Capital Area, where most of forestlands have already denuded. The annual change rate of forest cover in the study area is -0.9% while the national average is -0.5%. This means that the pace of deforestation in the study area is faster than the national average. The area deforested during the period from 1993 to 1997 is large in Kaoh Kong, Kampong Spueu, Takaev and Kampot where commercial forest concessions were granted to the private companies except Takaev. The drastic reduction of forest area in Takaev is supposed to be caused by the conversion of forestlands to agricultural plantation or for non-agricultural activities.

**Table L-11 Change of Forest Cover by Province/Municipality in the Study Area
(1992/93, 1996/97)**

Province/ Municipality	Total Area (ha)	Forest Area 92/93 (ha)	Raio of Forest Area	Forest Area 96/97 (ha)	Raio of Forest Area	Change of Forest Area (ha)	Annual Change Rate
Kampot	468,579	239,414	51.1%	233,290	49.8%	-6,124	-0.6%
Kandal	357,111	21,363	6.0%	20,890	5.8%	-473	-0.6%
Kaoh Kong	1,238,532	1,079,154	87.1%	1,048,454	84.7%	-30,700	-0.7%
Kampong Spueu	681,774	356,376	52.3%	339,147	49.7%	-17,229	-1.2%
Krong Kaeb	14,704	3,273	22.3%	3,273	22.3%	0	0.0%
Phnom Penh	37,313	1,118	3.0%	1,118	3.0%	0	0.0%
Sihanoukville	139,125	88,186	63.4%	85,937	61.8%	-2,249	-0.6%
Takaev	349,389	15,600	4.5%	5,218	1.5%	-10,382	-16.6%
Study Area Total	3,286,527	1,804,484	54.9%	1,737,327	52.9%	-67,157	-0.9%
National Total	18,152,982	10,859,649	59.8%	10,638,206	58.6%	-221,443	-0.5%

Source: JICA Study Team (made by using the data from "Forest Cover Statistic 1998", DOFW, Forest Wildlife and Education Institute)



Source: National Environmental Action Plan 1998-2002, MOE, January 1998

Figure L-7 Forest Concessions in Cambodia

In 1993, the new coalition government accelerated the utilization of forests, fisheries and agricultural land by means of land allocation and concession to the private companies. By introducing concession system, the RGC tried to consign responsibility for natural resource management to the private companies. Between 1994 and 1997, 30 international companies had been granted commercial forest concessions encompassing areas of about 6.4 million ha equivalent to 63% of forestland of the country. The locations of forest concessions are shown in **Figure L-7**. Agricultural land concessions have been granted to 53 companies covering the

area of 797,374 ha mainly located in forestlands, but only 19 companies signed the agreement with MAFF with total area of 579,688 ha.

As shown in **Table L-12**, eight companies were granted forest concessions with nine contracts in the study area (except the concessions cancelled in 1999)⁶. Total forest concession in the study area is 926,023 ha and accounts for 20% of the national total. The concessions were granted in Kampong Spueu, Kampot and Kaoh Kong within the study area, and many of concessions were concentrated on the central and northern part of Kaoh Kong Province where the Cardamom Mountains and the Elephant Mountains stretch. According to the agricultural statistics of MAFF, the total harvest from concessions in the study area was 5,465 m³ (1,732 m³ in Kampot and 3,733 m³ in Kaoh Kong) in 1999 and no harvest in 2000 (the national total was 161,388 m³ in 1999 and 78,200 m³ in 2000).

Table L-12 Outline of Existing Forest Concessions in the Study Area

	Name of Company	Country Origin	Province	Concession Area (ha)
1	GAT International Co., Ltd.	Malaysia	Kaoh Kong, Pousat	21,572
2	SL International LTD.	Malaysia	Kampong Spueu, Kaoh Kong	298,598
3	Long Day Machinery Industry Co., Ltd.	Taiwan	Kampot, Kampong Spueu	98,000
4	Super Wood IPEP Ltd.	Malaysia	Kampong Spueu, Pousat	94,419
5	Silverroad Wood Products Ltd.	China	Kaoh Kong, Pousat	215,460
			Kaoh Kong	100,000
7	Wood Tree Peanich Imp/Exp Co., Ltd.	Cambodia	Kaoh Kong	63,050
8	Cambodia Timber Product Pty. Ltd.	Cambodia	Kampot	34,924
Total Concession Area in the Study Area				926,023

Source: Cambodian Forest Concession Review Report, ADB, April 28, 2000

The forest concessions were managed conforming to approved Master Plan and Annual Operations Plans. However, the power of the RGC to control the concessionaires was weakened owing to the dispersion of authority and the self-determination of provincial governments and paramilitary units to seek their own benefit in addition to the implementation of collection permit system⁷. As a result, the timber production rapidly increased and reached unsustainable level. To make the situation change and improve, the RGC cancelled 12 concession contracts with total area 2,350,546 ha. Thereafter, all the forest concessions were removed in late 2001 and logging was suspended in January 2002 awaiting the preparation of 25-year new forest management plans by logging companies⁸. The World Bank has been delaying a \$15 million of Structural Adjustment Credit to the RGC on condition that the new forest management plans were released to the public. Although the plans were opened to the public in November 2002, the contents of the plans are still controversial.

⁶ One company (Talam Resources Sdn Bhd) that has concession in Kampong Spueu and Kaoh Kong voluntarily terminated their concession contract in 1999.

⁷ Sale, transportation and exportation of large volumes of confiscated logs produced by illegal logging were permitted by this system.

⁸ According to the NGO Forum, there is evidence of continuing forest cutting by concessionaires after the order of suspension.

(2) Issues on Forestry and Land Management

Forest relating issues have impacts on forest rich provinces in the study area, especially on Kaoh Kong Province where forests cover more than 80% of the provincial area and large area of concessions were granted to the private companies. Kampot and Kamong Speau, where high plateaus and mountain ranges of the Bokor and Kirirom National Parks form important watersheds and provides freshwater to the provincial centers, are also affected because the forest condition in two national parks has an influence on the quality, quantity and seasonal flow of the freshwater.

1) Forest Concession

One of the biggest issues on forestry is related to the concession system. Although the RGC cancelled and suspended the concessions, the concession systems will remain as a means of forest management in Cambodia. In the past, unsustainable harvesting and illegal logging emerged in and around the forest concessions owing to poor planning and risk evasion of the concessionaires, and over capacity of log processing. The reviews of forest concession system conducted by the World Bank and the ADB admitted the failure of the system and called for reforms to ensure sustainable management of forest concessions.

However, the concessionaires are reluctant to adopt reforms for sustainable forest management (SFM) because implementation of SFM will impose various financial burdens on concessionaires. In addition, introducing SFM in Cambodia would require concessionaires to reduce harvest volume to about 10 m³/ha but operation of concession is not likely to be economically feasible under this harvest volume⁹. Thus, concessionaires keep incentives to continue high intensity harvesting (about 30-40 m³/ha) to increase their returns and to reduce their risks.

As the commercially attractive category of dense evergreen and disturbed evergreen account for only 36% of Cambodia's forests as of 1997¹⁰, some actions need to be taken to prevent the situation from worsening. Otherwise, Cambodia becomes importer of forest products, loses government revenue gained by exporting timber and working opportunity in forest industry.

Careful reviews and adoptions of the new forest management plans made by concessionaires would be imperative as the first step to improve the situation. Concessions without enough bases of commercial timber should be revoked. Concessions granted to the concessionaries that repeatedly infringe agreements or regulations should also be cancelled. In addition, enhancement of the MAFF responsibility on forest management and expansion of forest protection areas like the case of the Central Cardamoms are indispensable. Community involvement in the forest management is also important.

⁹ WB, UNDP, FAO, *Cambodia Forest Policy Assessment*, Report No. 15777-KH, 1996

¹⁰ CDRI, *Cambodia Development Review*, Vol.6 Issue 1 January-March 2002, p3

2) Land Concession and Transaction

In addition to forest concession, land concession system is emerging issue on forest sector. Large areas of primary forest have been cleared to convert to agricultural plantations associated with land concessions. In some cases, the private companies that were cancelled forest concessions have been involved in land concessions to harvest forest. Despite the fact that the clearing causes damage on biodiversity and the livelihood of local communities, the RGC has a plan to expand rubber plantation area and by clearing forestlands granted as land concessions. Further, dispersion of authority and the self-determination of provincial governments on land concessions make the situation complicated. Similar cases have arisen in the study area. As shown in **Table L-13**, 29 companies were granted land concessions in the study, mainly in the provinces, which have vast flatlands and forestlands.

The land transaction and accompanying land sub-division make the situation complicated. Most of the officially recorded land transactions in the study area were taken place in Kandal and Sihanoukville as shown in **Table L-14**¹¹. According to the CDRI report, a large portion of agricultural land transacted has been cleared forestlands.

To diminish negative impact caused by land concession and land transaction to minimum, land concessions in the forest area need to be revoked at least.

Table L-13 Number of Companies Involved in Land Concession in the Study Area

Province	Number of companies
Kampong Spueu	12
Kampot	6
Kaoh Kong	7
Sihanoukville	2
Takaev	2

Source: Agricultural Development Plan 2001-2005, MAFF

Table L-14 Official Transactions of Agricultural Land by Province/Municipality in the Study Area (1995 to 2001)

Location of Land	Number of Transactions							Total
	1995	1996	1997	1998	1999	2000	2001	
Kampong Spueu	27	84	59	23	34	16	2	245 (4%)
Kampot	19	66	18	27	49	19	12	210 (3%)
Kandal	640	791	465	143	159	6	n.a.	2,204 (32%)
Kaoh Kong	34	307	97	77	225	61	4	805 (12%)
Sihanoukville	383	463	569	206	114	68	14	1,817 (26%)
Takaev	n.a.	9	14	41	34	7	12	117 (2%)
Study Area Total (A)	1,103	1,720	1,222	517	615	177	44	5,398 (78%)
National Total (B)	1,156	2,010	1,642	759	777	327	210	6,881 (100%)
A/B	95.4%	85.6%	74.4%	68.1%	79.2%	54.1%	21.0%	

Note 1: Officially recorded land transactions only. The number of transactions recorded officially is very small. Almost 90% of transaction is informal and not included in this table.

Note 2: Phnom Penh is not included since the record is not kept by MLMUPC.

Source: Cambodia Development Review Vol. 6 Issue 2, April-June 2002, Cambodia Development Research Institute

¹¹ A significant number of small portion of land transactions have been done by the forms of: 1) transactions with or without contractual agreement between parties in which the transaction is made without informing any local authority, or 2) transactions with agreement of the village level authority.