

2.1 Cambodia



1 | Country Information

Table 2.1.1 Basic indicators

Land Area (km ²)	181,035 (2013)*	
Total Population	15,288,489 (2019)*	
GDP (current USD)	27.08 billion (2019)**	
GDP per capita (current USD)	1,643 (2019)**	
Average Precipitation (mm/year)	1,840 (1901–2016)***	
Total Renewable Water Resources (km ³)	476.1 (2017)	
Total Annual Freshwater Withdrawals (billion m ³)	2.184 (2017)	
Annual Freshwater Withdrawals by Sector	Agriculture	94% (2017)
	Industry	1.51% (2017)
	Municipal (including domestic)	4.48% (2017)

(Source: FAO 2020, *Ministry of Planning 2019, **World Bank 2020a, ***World Bank 2020b)



Figure 2.1.1 Tonle Sap Lake

2 | State of Water Resources

Cambodia is located in the middle reach of the Lower Mekong Basin and 86% of its land area, including Tonle Sap Lake (TSL), drains into the Mekong River (FAO 2020). The floodplains, TSL, and the Mekong Delta are the major sinks of sediments and nutrients, which are essential for aquatic ecosystems and agriculture. The Mekong-TSL is one of the world’s unique aquatic ecosystems, in that high flow conditions of the Mekong River in the wet season induces reverse flow through the TSL River into the lake. Due to the reverse flow as well as runoff from tributaries around the lake, the TSL transforms in size by six times on average, reaching approximately 13,000 km² with an average depth of 8–10 m (TSA 2015).

In the subsequent dry season, water draining out of the lake is critical for the overall flow condition in the downstream Mekong Delta. The Bassac River splits from the mainstream Mekong River and further splits into numerous channels, forming a wedge shaped delta in Vietnam. The Mekong Delta is a major grain basket for both Cambodia and Vietnam. This distinctive hydrological cycle and associated sediment and nutrient regime is vital for aquatic biodiversity, including migrating fish, and Tonle Sap Lake forms the sole source of livelihood for about 40% of Cambodia’s population (MRC 2010).

Cambodia has an ample supply of water, mainly from the Mekong River, Tonle Sap River, Bassac River and other tributaries, but most parts of the country encounter water shortages during the dry season, especially for domestic and irrigation uses. Water in Cambodia remains regulated only in part, resulting in an overabundance of water during the rainy season and deficiency in the dry season.

Groundwater availability is estimated at 17.6 billion m³ (MoWRAM 2012), which is primarily used for household water supply, irrigation and industry. Groundwater use is increasing by 10% every year, and many places in Cambodia have experienced overuse of groundwater due to rapid population growth and increasing demands from agriculture and industry (UNDP 2020); for example, an average groundwater level decline of 14 cm per year was reported for wells in Prey Veng and Svay Rieng between 1996 and 2008 (Johnston et al. 2013).

3 | State of Ambient Water Quality

3.1 Rivers

The water quality of rivers was assessed as good and water pollution is not considered to be a significant problem (MOEC 2020). However, in recent years water quality deterioration has been reported in river water bodies. Water quality monitoring conducted by Department of Water Quality Management, Ministry of Environment of Cambodia (MOEC) at the Chroy Changva Station of the Mekong river showed a rising trend in nutrient pollution in river water since 2011 (Figure 2.1.2). Although concentrations of total nitrogen (T-N) remained below the national standard value, it exceeded the national standard value in 2018 and 2019. Total phosphorus (T-P) concentrations exceeded the national water quality standard from 2012 to 2019. However, Biological Oxygen Demand (BOD), and Chemical Oxygen

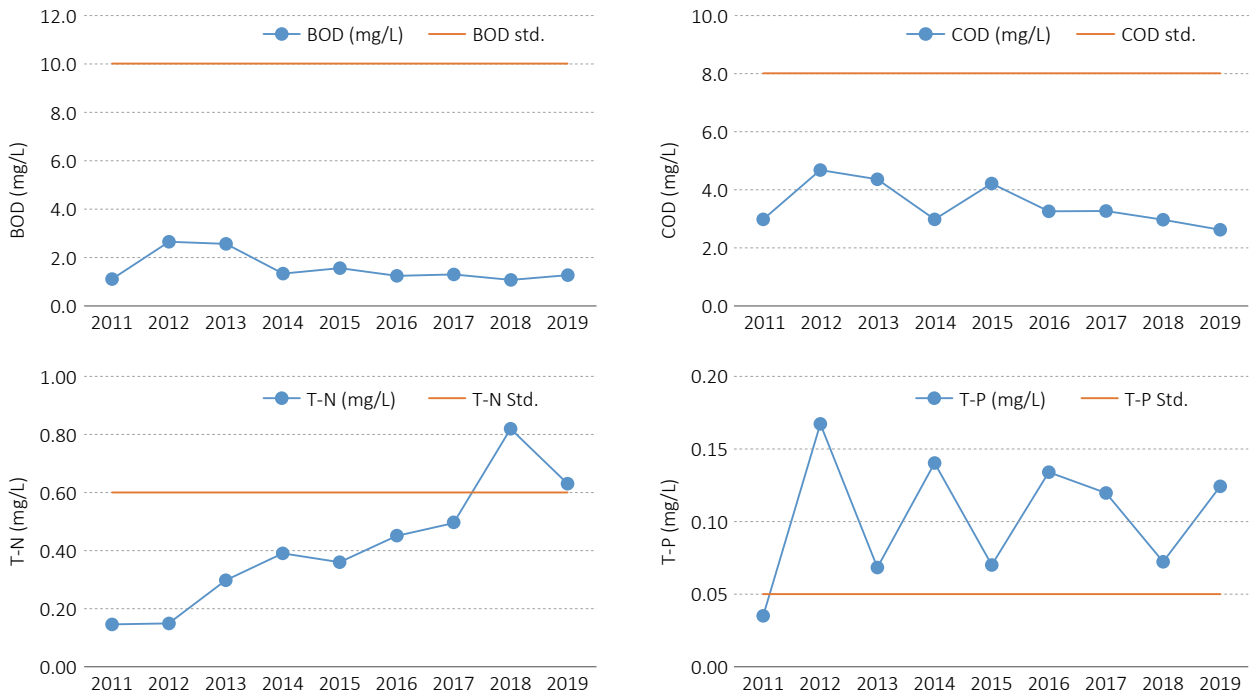


Figure 2.1.2 Water quality of Mekong River at Chroy Changva Station (Source: MOEC 2020)

Demand (COD) values imply that organic pollution is low.

3.2 Lakes and Reservoirs

Tonle Sap Great Lake (TSL) is the largest freshwater lake and a unique flood-pulse in Southeast Asia. It covers an area of 13,000 km² during the rainy season and shrinks to 2,500 km² during the dry season. About 1.7 million people live in 1,037 fishing villages of TSL and surrounding floodplains and their livelihoods directly depend on TSL's

resources (Shivakoti and Bao 2020). However, due to degradation of the TSL water environment, caused by the inflow of anthropogenic pollutants, the livelihoods of millions of local residents is affected (Ung et al. 2019). Water quality in TSL was monitored by the Department of Water Quality Management, MOEC at the Chhnok Trou village from 2011 to 2019, and also revealed deterioration of water quality of TSL (Figure 2.1.3). According to the monitoring data, both BOD and COD



Figure 2.1.3 Water quality of Tonle Sap Lake at Chhnok Trou village, 2011–2019 (Source: MOEC 2020)

values remained well within the national water quality standard for lakes, which implies organic pollution is not a major issue for water environment management in TSL. In contrast to BOD and COD, concentrations of T-N and T-P exceed the water quality standard for most of the monitoring period, which indicates TSL water could be highly polluted by agricultural pollution such as runoff of fertilizer, manure, which can also derive from household products such as soap and detergent.

3.3 Coastal Water

Cambodia’s coastal shoreline is 435 km long on the Gulf of Thailand, and the seaward boundary of the coastal zone has been delimited as the outer limit of the country’s exclusive economic zone with an area of 55,600km². The landward boundary of the coastal zone has not yet been satisfactorily defined, but is currently considered to be about 5 km from the shore. The coastal zones are situated in the four provinces of Koh Kong, Kampot, Sihanoukville and Kep municipalities. In general, coastal water is considered to be of fairly good quality, but development activities such as those in economic zones and seaports may exert a negative influence on coastal water and coastal ecosystems if sound management of solid and liquid wastes generated from those activities has not been properly implemented. According to the results of monitoring in 2018, concentrations of T-N, T-P and oil and grease exceeded the national water quality standard for coastal water, which indicates anthropogenic activities are the main threats for the coastal water environment.

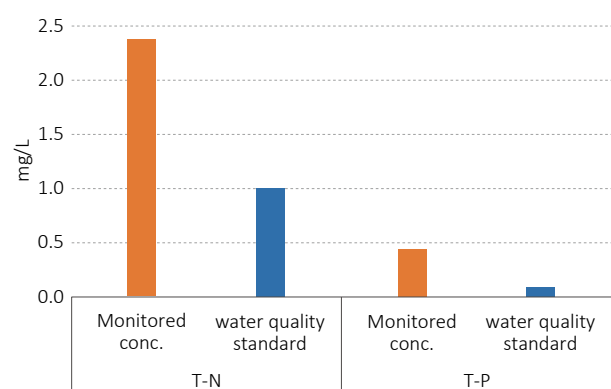


Figure 2.1.4 Coastal water quality in Kep Municipality, 2018
(Source: MOEC 2020)

3.4 Groundwater

Groundwater in Cambodia is generally of good quality, and dependency on groundwater as a source of domestic water is as high as 62–100% (MoWRAM 2008). However, high levels of arsenic, iron, manganese, fluoride, and total dissolved solids (salinity) are observed in some areas (UNDP 2020). Arsenic concentrations in groundwater

in many parts of Cambodia exceeded both the WHO standard of 10 mg/L and the Cambodia National Drinking Water Quality Standard of 50 mg/L. Many shallow wells are also contaminated by fecal coliforms (IWMI 2013).

4 | State of Wastewater Treatment

Sewerage and sanitation in Cambodia are not well developed and types in existence are aging or constructed in the old colonial period. In most places, wastewater is primarily treated by septic tanks and discharged to the environment. As of 2019, only three centralized wastewater treatment plants (CWTPs) are under operation, located in Battambang City, Siem Reap City and Preah Sihanouk City (Rady 2020). Further, Phnom Penh has natural lagoons that receive wastewater from the drainage system. The current centralized WWTPs can treat only 5% of urban wastewater (Heng 2019). Monthly service fees have been collected by the Department of Public Work and Transport for the centralized wastewater treatment facilities, such as in Preah Sihanouk City, where fees of 2.5 to 1,125 USD are collected per building based on building category.

Cambodia has prioritized the development of sewerage systems and centralized wastewater treatment in several locations, and the urban wastewater management plan has selected priority towns for future centralized WWTPs in Cambodia (Table 2.1.2). In addition to centralized systems, NGOs such as ESC-BORDA promote decentralized wastewater treatment solutions in schools, communities, hospitals, and small and

Table 2.1.2 List of existing and future centralized wastewater treatment plants

Location of Centralized WWTPs	Capacity (m ³ /day)	Status
Battambang city	2,800	In operation
Siem Reap City	8,000	In operation
Preah Sihanouk City	25,000	In operation
Poipet City	3,000	Feasibility study
Srei Saophoane City	3,000	Feasibility study
Kampot City	6,000	Feasibility study
Kep City	3,000	Feasibility study
Phnom Penh	30,000	Feasibility study
Takhmao City	12,000	Feasibility study
Pursat City	6,000	Feasibility study
Kratie City	6,000	Feasibility study
Steung Sen City	3,000	Feasibility study
Bavit city	3,000	Feasibility study

(Source: Heng 2019)

medium-sized enterprises. To date, ESC-BORDA has implemented 62 DEWATS across Cambodia (BORDA 2017).

5 | Frameworks for Water Environmental Management

5.1 Legislation

The current legislative framework for water environment management in Cambodia is shown in Figure 2.1.5. Under it, the protection and promotion of environmental quality and public health is the objective

of natural resource management including water (Article 1, Law on Environmental Protection and Natural Resource Management). The Law on Water Resources Management (2007) includes aspects of water quality management, such as requiring wastewater discharge licenses or permission for activities that could have negative impacts on water quality and human and ecosystem health (Article 22), as well as designations for dangerous or restricted zones for water use where the water quality, quantity and ecological balance are endangered (Article 23).

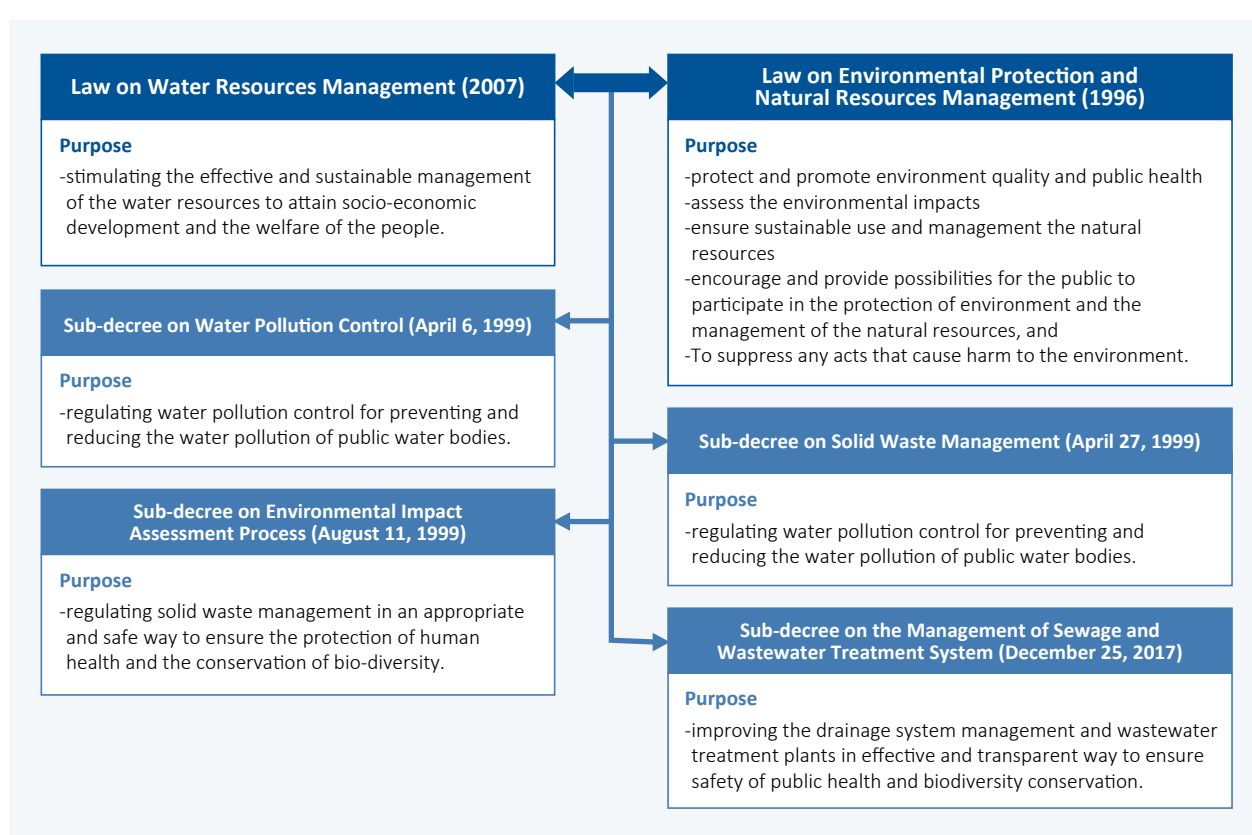


Figure 2.1.5 Legislative framework of water environment management in Cambodia

Details on water environmental conservation measures can be found in the Sub-decree on Water Pollution Control, established in 1999 under the Law on Environmental Protection and Natural Resources Management. This sub-decree aims to regulate various activities that could pollute and/or have already polluted public water areas (e.g., rivers, lakes, groundwater, and sea water). Ambient water quality standards for human health and bio-diversity (Article 7), as well as effluent standards for pollution sources (Article 4) are set by this sub-decree. Other elements of the sub-decree include monitoring of pollution sources and their effluents (Chapter 4), monitoring of public water areas (Chapter 5), and inspection rules (Chapter 6). Other sub-decrees

under the Law on Environmental Protection and Natural Resources Management, such as the Sub-decree on Solid Waste Management and the Sub-decree on Environmental Impact Assessment Process, also contain articles related to water environmental conservation.

Currently, two new pieces of legislation are being drafted in relation to water quality management, namely the Law on Sewerage System in Cambodia by Ministry of Public Works and Transport (MPWT) and the Sub-decree on Water Quality by the Ministry of Water Resources and Meteorology (MoWRAM). The sub-decree on Water Pollution Control (April 6, 1999) is being updated to reflect the context of Cambodia.

5.2 Institutional Arrangement

In Cambodia, several ministries deal with water environment management (Table 2.1.3). MOEC is responsible for protection and management of the environment and natural resources in the country based on the Law on Environmental Protection and Natural Resource Management (Article 9), and local authorities such as provincial and municipal environmental departments are in charge of water environmental

management, such as water quality monitoring. MoWRAM was established in 1999 as lead water sector agency, and exercises overall responsibility for water management and conservation including Integrated Water Resource Management (IWRM). Ministry of Public Work and Transport is responsible for urban wastewater management. Other important agencies include Ministry of Industry, Mine and Energy (MIME), and Ministry of Rural Development (MRD), Tonle Sap Authority (TSA).

Table 2.1.3 Institutional arrangement of water environment management in Cambodia

Agency	Responsibilities
Ministry of Environment (MOEC)	<ul style="list-style-type: none"> - Assess the environmental impact (EIA) of all existing and proposed projects/activities (Article 6) - Research and assessment of environmental impacts on natural resources (Article 9) - Provide recommendations to other concerned ministries to ensure conservation and rational use of natural resources (Article 9) - Develop inventories of pollution sources (Article 12) - Develop sub-degrees to prevent and reduce pollution (Article 13) - Monitor pollution sources and natural resource development activities (Article 14) - Conduct inspection of pollution sources (Article 15) and order improvement for violations (Article 20)
Ministry of Water Resources and Meteorology (MoWRAM)	- Water management and conservation through Integrated Water Resource Management (IWRM)
Ministry of Public Work and Transport (MPWT)	- Urban wastewater management
Ministry of Industry, Mine and Energy (MIME)	- Drinking water supply for cities and towns
Ministry of Rural Development (MRD)	- Clean water supply for rural areas
Tonle Sap Authority (TSA)	- Coordinate management, conservation, and development in Tonle Sap area and relevant areas

5.3 Ambient Water Quality Standards

Ambient water quality standards

Ambient water quality standards for public water areas are set by the Sub-decree on Water Pollution Control (April 6, 1999). There are two kinds: the first covers biodiversity conservation, which is designated for rivers (five parameters), lakes and reservoirs (seven parameters), and coastal water (seven parameters); and the second covers public health, which designates standard values for 25 parameters related to harmful effects on human health. These water quality standards will also be revised through amendment of the sub-decree on Water Pollution Control. There is no groundwater quality standard, but water quality is assessed by standards designated for specific uses, such as national drinking water quality standards.

Water quality monitoring framework

Since the promulgation of the Sub-decree on Water Pollution Control in 1999, MOEC has been responsible for regular control and monitoring of water pollution in public water areas throughout Cambodia. MOEC monitors river water quality at seven points, coastal water quality at seven points and lake water quality at three monitoring points every month. Water quality is analyzed at MOEC laboratories. Further, under the Mekong River Commission Water Quality Monitoring Network Program, MoWRAM measures water quality monthly at designated stations in rivers and related tributaries. Details of the water quality monitoring framework are shown in Table 2.1.4.

Table 2.1.4 Water quality monitoring framework of MOEC and MoWRAM

Item	MOEC	MoWRAM
Name of monitoring parameters	Surface water: pH, Total suspended solids (TSS), COD _{Mn} , BOD, Chromium (Cr ⁶⁺), T-N, T-P Sea: pH, COD _{OH} , Dissolved oxygen, Coliform, Oil & Grease, T-N, T-P	T °C, pH, EC, Alkalinity/ Acidity, DO, COD, BOD, T-P, T-N, NO ₃ -N, NH ₄ -N, Faecal coliform, TSS, Calcium, Magnesium, Potassium, Sulfate (SO ₄ ²⁻), Chlorine
Number of sampling points	17	19
Frequency of monitoring	Monthly	Monthly
Frequency of monitoring report published	Quarterly	-

5.4 Effluent Standards

Effluent standards

Aiming at managing effluents discharged from pollution sources, the Effluent Standard for Pollution Sources Discharging Wastewater to Public Water Areas of Sewers was established under the Sub-decree on Water Pollution Control. Standard values are set for 52 parameters, such as temperature, pH, BOD, heavy metals, agricultural chemicals, and organic solvents. In principle, the standards are applied to all industries and other pollution sources designated by the sub-standards. For areas which require special treatment for protection of human health and biodiversity, MOEC can establish separate effluent standards for pollution sources in the area (Article 5 of the sub-decree). As mentioned in section 6.1.1, the Sub-decree on Water Pollution Control is being updated to reflect the context of Cambodia. The effluent standard will be updated through amendment of the Sub-Decree on Water Pollution Control.

Effluent inspection procedure

Under the Sub-decree on Water Pollution Control, all business operators are obliged to self-monitor effluent and submit periodic reports of results to MOEC. However, as some do not, MOEC conducts regular on-site inspections to check whether they are in compliance with effluent standards, which involves taking and analyzing water samples of effluent as well as treated

water. Two types of monitoring programs are in place at pollution sources: (i) regular effluent monitoring at normal factories and hotels, conducted at 90 day intervals, and (ii), regular effluent monitoring at factories that use chemicals and/or chemical compounds for production, which should be conducted at 45 day intervals.

Measures against non-compliance

When violations of effluent standards are found, MOEC issues written orders to industries to correct current activities in order to be in compliance with the standards. Industries are fined and punished for violations in the monitoring and reporting of, and compliance with effluent standards stipulated under the Sub-decree on Water Pollution Control for failure to act on orders issued by MOEC.

5.5 Major Policies on Water Environmental Management

The major ways in which Cambodia has responded to date have been legislative, in the form of pollution related decrees and laws, creation of an institutional framework – especially under MOEC and MoWRAM – as well as introduction of monitoring and enforcements. One such response is the National Water Resource Policy for the Kingdom of Cambodia, developed by MoWRAM in 2014. Its main objectives are: (i) protect, manage and use water resources in an effective, equitable and sustainable manner; (ii) solve water issues in collaboration with related institutions within public and private sectors; (iii) develop and carry out the national strategy and policy towards water resource management; (iv) direct stakeholders for developing, managing and utilizing water resources; and (v) achieve the national policy objective on poverty reduction and sustainable national economy development. The Cambodia National Environmental Action Plan (NEAP) 1998–2002 is the first environmental action plan initiated by MOEC to develop and implement to integrate environmental concerns as well as decision-making processes of various stakeholders into national policies. NEAP incorporates issues relevant to the water environment from the viewpoints of fisheries, Tonle Sap Lake, wetlands, public health (water borne diseases), as well as minimizing environmental impacts from energy industries (hydropower, oil and gas industries).

6 | Recent Developments in Water Environmental Management

There are several developments in government policies that will have significant impacts on water environment management, as follows:

- i. Sub-decree on Management of Sewage and Wastewater Treatment System, enacted on 25 Dec. 2017, which provides a mandate for management of sewage systems and wastewater treatment systems to sub-national authorities.
- ii. Development of draft Environmental Code (ENRC), which consolidates several existing legislative arrangements for environmental protection and conservation of natural resources, including provisions for waste and pollution control and implementation of SDGs.
- iii. Development of draft Sub-decree on self-monitoring and report, which aims to enhance monitoring of high potential pollution sources by installation of real-time online monitoring equipment and regular reporting to MOEC.
- iv. Updating of Sub-decree on Water Pollution Control, which is to include revisions of water quality standards and effluent standard.

7 | Challenges and Future Plans

Based on the current state of water quality management in Cambodia, several key management challenges have been identified, as follows:

1. Lack of specific water quality management policy and strategies
2. Weak inter-ministerial coordination for water environment management
3. Improvement of human resources and institutional capacity, especially MOEC, in order to implement Cambodian Sustainable Development Goals framework (CSDGs), National Environment Strategy and Action Plan (NESAP) and ENRC
4. Development of sewers and wastewater treatment to deal with drainage problem and pollution of water bodies; Master plan for sewerage and drainage sector for towns/country also required

5. Barriers to appropriate management of water quality due to insufficient equipment for laboratory/field testing
6. Shortage of expert technical officers at national and local levels to carry out adequate water quality management and enforcement
7. Budget limitations of government, especially for improvement of capacity of laboratories in terms of facility infrastructure/equipment and human resources

In order to overcome these challenges the following actions will need to be taken by the line ministries and agencies:

- i. Initiation of development of the National Water Quality Management Strategies by MOEC
- ii. Strengthening collaboration with other countries for capacity development on water quality monitoring and enforcement
- iii. Enhancing cooperation with development partners to construct planned central sewage treatment plants in priority cities
- iv. Establishment of inter-ministerial coordination mechanisms, to enhance cooperation among line ministries such as Ministry of Environment, Ministry of Water Resources and Meteorology, Ministry of Agriculture, Forestry and Fisheries, Ministry of Mines and Energy, and Council for the Development of Cambodia towards sound management of water environment in Cambodia