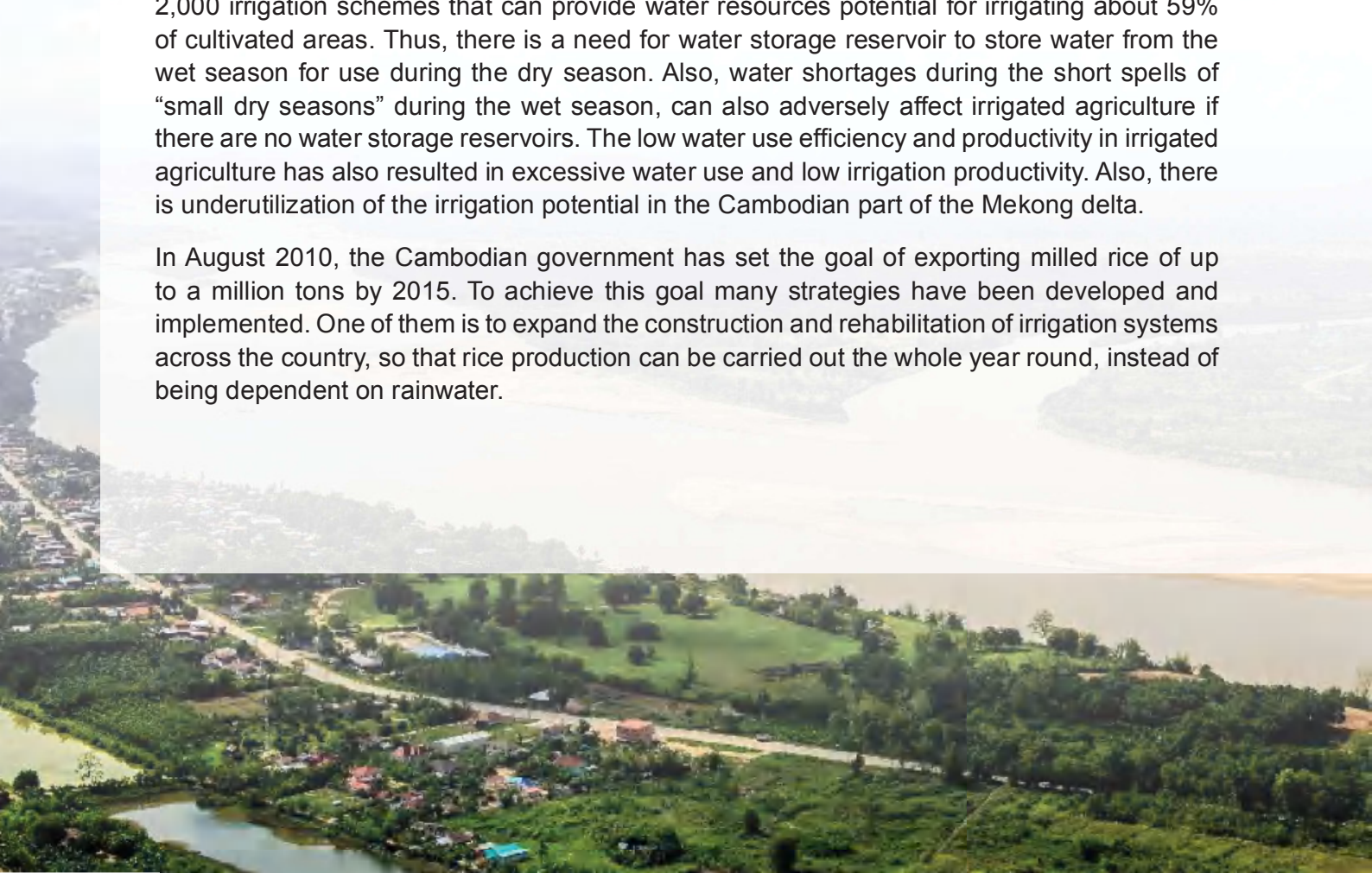


Water resources management and irrigation work operation in Cambodia

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● **Abstract:** The national water resource system of Cambodia consists of a number of river basins, most of them tributaries of the Tonle Sap Lake and Mekong river systems, and a few river basins in the Southwestern part which drain directly to the coast. All of the river basins experience a set of common challenges, while those in the environmentally delicate Tonle Sap Lake region share a unique set of issues and challenges. The Royal Government of Cambodia (RGC) is to develop its water resources, mainly for irrigation and hydropower, by rehabilitating old defunct irrigation systems, and by planning dams for hydropower generation, irrigation and flood control. Cambodia faces many water-related issues, especially floods and droughts. Floods occur during the rainy season throughout the country when rainfall is above average from August to November. Water shortages in the dry season, exacerbated by occasional droughts, makes the people dependent on wells and rainwater for their basic water needs in the upper catchments. Irrigation development have a rich history in Cambodia and can be trace back to the Angkor period, especially from the 11-14 century. During the Khmer rouge regime period from 1975 to 1978, forced labors were used to build several hundred irrigation schemes across Cambodia within a 3 years period. Cambodia, currently there are more than 2,000 irrigation schemes that can provide water resources potential for irrigating about 59% of cultivated areas. Thus, there is a need for water storage reservoir to store water from the wet season for use during the dry season. Also, water shortages during the short spells of “small dry seasons” during the wet season, can also adversely affect irrigated agriculture if there are no water storage reservoirs. The low water use efficiency and productivity in irrigated agriculture has also resulted in excessive water use and low irrigation productivity. Also, there is underutilization of the irrigation potential in the Cambodian part of the Mekong delta.

In August 2010, the Cambodian government has set the goal of exporting milled rice of up to a million tons by 2015. To achieve this goal many strategies have been developed and implemented. One of them is to expand the construction and rehabilitation of irrigation systems across the country, so that rice production can be carried out the whole year round, instead of being dependent on rainwater.



1. Country Context

1.1. Cambodia has an area of 181,035 km²

Its central plain region covers about 75% of the country and is relatively flat with an elevation between 10-30 meters above sea level. The low-lying Dangrek mountain ranges run along the northwest border with the Thailand border, the Cardamom mountain in the southwest along the coastline, and the plateau region in the northeast extends up from the mainstream Mekong River into Lao PDR and Viet Nam. Aside from in Cardamom mountain, all rainfall drains to the Mekong River system, including into the Tonle Sap Lake, towards southern Viet Nam and into the South China Sea.

1.2. Estimated population of Cambodia in 2018 is 16.2 million people of which approximately 80% live in the rural areas and 20% in urban areas.

Over 40% of the population live around the Tonle Sap Lake or in the

Mekong Delta regions. The average household has estimated 4.7 persons, and the national sex ratio is estimated at 49 males per 51 females. The population has been increasing by around 1.5% since 2010 with the urban population projected to increase to 2.8% of the total population by 2025.

1.3. Cambodia's economy has undergone three major phases of reform and development since 1989

When it first started to transform from a central planned to a market-oriented economy: (i) rehabilitation phase from 1993 to 1998; (ii) reconstruction phase from 1999 to 2003; and (iii) economic take-off from 2004 to 2008 and beyond, focusing on public financial management reforms. Overall, it has led to a decline of the agricultural sector's contribution to the economy to around 31% per annum and an increasing contribution of industry and services sectors, currently at 39% and 30% respectively.

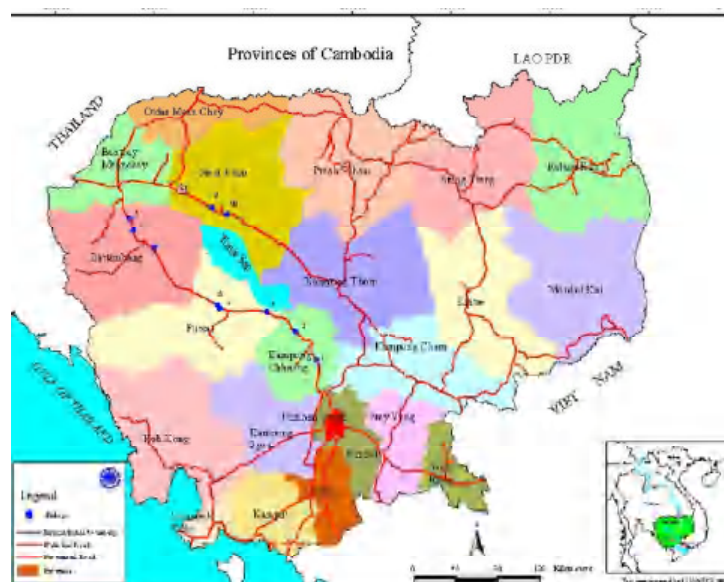


Figure1 Map of Cambodia and her location in the Mekong River Basin

1.4. Poverty incidence has fallen from 47.8% in 2007 to 18.9% in 20121

Some consolidation of land is starting to occur, especially in the southeast region, however, many rural families still own a small 1 hectare (ha) farm plot that they use primarily for subsistence farming, mostly rice, to feed and support themselves, and have limited resilience to market pressure and climate impact. Rural poverty incidence is generally worse than urban centre as there is less resources and opportunities. The Cambodia Socio-economic Survey (2017) reported that rural monthly incomes were on average 85% of national urban (excluding Phnom Penh) and 60% of Phnom Penh monthly incomes. National school attendance rates were about 60% in Phnom Penh and 56% in rural areas with women's attendance slightly lower than men, and 49% in Phnom Penh and 83% in rural areas. Over the past 10 years, agriculture has been playing an important role to lift rural families out of poverty and create opportunities to build a more prosperous future. Partly related to the higher commodity prices are incentivizing farmers to increase profitability of their land through higher production rates, diversification of livestock etc.

Note: ¹ ADB . 2014 Cambodia: Country Poverty Analysis 2014. Manila

2. Status of Water Resources and Irrigation

2.1. Cambodia is the country located in South East Asia

Lying in the Mekong River Basin that shared by 6 countries including China, Myanmar, Thailand, Lao PDR, Cambodia and Viet Nam. The Mekong River is the main water sources for the country that its basin is about 86% of country territory. The total area of the country is 181,035 km² by hydrological and planning aspects, the country Mekong River Basin can be divided to 5 sub-basin areas i.e. Strung Treng (near border of Lao PDR); Kratie (down area after Stung Treng); Sekong-Sesan-Srepok; Tonle Sap; and Mekong Delta.

2.2. The Mekong River basin

The Mekong River basin generates 75,000 MCM/year of surface water runoff, and its aquifers contain an estimated 17,600 MCM of groundwater. This is more than 100 times the amount that is used at present. Annual rainfall varies between 1,400 mm and 3,500 mm. Each year, the Mekong River carries 475,000 MCM from Cambodia to the South China Sea (MOWRAM, 2004).

2.3. The Mekong flows

The Mekong flows for almost 4,800 km from its source in Tibet through China and Myanmar in the Upper Mekong Basin, and Lao PDR, Thailand, Cambodia and Viet Nam in the Lower Mekong Basin (LMB) into the East Sea, draining a basin area of 795,000 km² and with a mean annual discharge of approximately 475 km³. The per capita water resources of 8,500 m³/person/year is high related to other international river basins. There is a very large difference in wet and dry season flow. The associated flooding and drying of major parts of the floodplain creates a rich riverine ecology. The Mekong is the second most bio-diverse river in the world after the Amazon, and supports the world's largest fresh water capture fishery of about 2.3 million tons per year.

2.4. However, current development of water and related resources in the Mekong Basin is limited relative to other international river basins

Most water is used in the most downstream end of the Mekong Basin, the Vietnam delta, which is now one of the world's most productive agricultural areas. Thailand fully uses the wet-season flow and the very low dry-season flow of its Mekong tributaries. There are currently only minor diversions from the mainstream upstream of the delta. Existing reservoir storage of water is less than 5% of the mean annual flow, insufficient to redistribute water significantly between seasons. As a result, the flow regime in the Mekong mainstream is close to its natural state.

2.5. Much of the Mekong Basin remains among the world's poorest areas

A considerable part of the Lower Mekong basin's 60 million people rely on the goods and services provided by the Mekong river system for their food security and livelihoods. While all Lower Mekong Basin (LMB) countries are making good progress towards achieving the Millennium Development Goals, about 25% of the population of Cambodia and Lao PDR has incomes below the poverty line, with much higher percentages in many rural areas. Food security and malnutrition pose great challenges. About half of all households have no safe water supply and half of all villages are inaccessible by all-weather roads. Throughout the LMB, inequalities are generally increasing between urban and rural groups.

2.6. Rainfall is extremely variable across the 39 river basins and 5 River Basin Groups (RBG) in Cambodia within and between years

Record annual rainfall has been as high as 2,400mm in the Cardamom mountain in the south-western region and as low as 800mm in central plains around the Tonle Sap Lake. With a monsoonal climate for 6 months of the year from November to April, the monthly rainfall is often less than 100mm across the country.

2.7. Annually, Cambodia has abundant amount of water but also extreme water shortage due to the lack of water storages and opportunities to store water and access to available water

For water usage, the total amount during the dry season is approximately 6,000 MCM representing 2% of total 105,000 MCM dry season surface water volume. Of this volume, agriculture use account for 96%, domestic rural use for 1% and less than 1% for industry, domestic urban, and aquaculture. Severe water shortage, however, annually occur in all the river basins that drain into the Tonle Sap Lake and in parts of the 3S RBGs (Sekong,

Srepok, and Sesan River Basins) in the northwest region of the country. Much of this information is anecdotal as very few water assessments have been undertaken.

2.8. Extensive flooding, flash flood, and drought are annual that have significant economic, social, and environmental impact.

Flooding has a wide range of impacts including extensive crop and water infrastructure damage, increased spread of water-borne disease, disruption to social and economic activities, and displaced populations and fatalities. The most recent severe flooding event occurs in 2013 where there were 184 deaths and an economic impact of \$525.0 million. Crop losses were estimated to be 150.0 million representing mostly rice paddy crops and some cassava, maize, and sesame crop. In the same year, damage roads were estimated at \$80.0 million and \$15.5 million to educational facilities. The Mekong River Commission (MRC) provides flood forecasting information to its member countries, including Cambodia, to help them to be responsive to sudden rainfall events and upstream water releases. In April 2019, the MRC announced that it is going to integrate drought monitoring into their existing flood forecasting to help member nations address all extreme weather events and development pressures. Their existing centre and program in Phnom Penh are to be renamed and refocused to the Regional flood and Drought Mitigation Management Centre (and program).

2.9. Climate change is likely to intensify storms and extend the number of consecutive dry days during both dry and wet seasons

Based on the Intergovernmental Panel on Climate Change 5th Assessment Report, annual rainfall is projected to increase in Cambodia between 3.6%-4.8% by 2050, whereas the number of wet days is projected to decrease between 3.7%-7.4%². This suggests a generally wetter climate with longer dry periods. In the dry

season, the potential impacts of climate change will likely exacerbate water scarcity for those living in the rain-fed regions around the Tonle Sap RBG but less for those in other regions where there is access to the mainstream of Mekong River and year-round water supply. During the wet season and across the country, it is projected that more severe, frequent, and longer duration flooding will occur, especially in the Mekong RBG.³

2.10. Continuing upstream hydropower development in the mainstream of Mekong River and its tributaries in the People's Republic of China (PRC), Lao PDR, and Viet Nam are already leading to significant alterations of the natural water flow regime and sediment movement, obstruction of fish movement, and degradation on aquatic ecosystems

At the lower reach of the Mekong River, Cambodia is in highly vulnerable location from upstream impacts, especially from poor water management (reservoir water releases), that could result in potentially extensive economic, social, and environmental consequences for the Cambodian economy, food security, and rural livelihoods.

Note:

² Intergovernmental Panel on Climate Change. 2014. *Climate Change 2014: Synthesis. Contribution of Working Groups I, II and III to the Fifth Assessment Report*. Geneva

³ ADB. 2014. *High-resolution Climate Database and GIS Toolkit for Cambodia. Consultant's report*. Manila (Loan 2673-CAM and TA 7610-CAM)

2.11. Surface water is mostly good quality for the Mekong mainstream and the Tonle Sap Lake

This is based on the finding from the MRC

monitoring program that is only for these regions. Other parts of Cambodia such as the river system that drained into Tonle Sap Lake are not yet monitored. Management and disposal of waste water is not yet well managed. Increasing pressure from human activities will likely have an impact on water quality if management is not improved. This is especially the case for the river systems that flow into the western side of the Tonle Sap Lake and in the Mekong Delta region with increasing population densities and pesticide use for farming.

2.12. Groundwater is primary used for drinking and for subsistence farming and is not yet monitored (quantity or quality)

Nationally, it is estimated to be over 270,000 tube wells. Increasing reports of farmers installing tube wells to support small-scale irrigation and provide a supplementary water source for dry season groundwater has so far anecdotal accounts cropping, especially in the Mekong Delta RBG region. The only information about or from findings from a few localized research projects.

2.13. Cambodia has about 2,500 irrigation schemes of which 1,926 schemes are in a condition that have potential to be fully rehabilitated⁴

Approximately 60% are located in the Mekong Delta RBG and 35% in the Tonle Sap RBG. Majority of the irrigation schemes located in the Tonle Sap RBG do not have access to a reliable, year-round water-source. This has serious consequences on being able to support two to three crops per annum. Water delivery within irrigation schemes is generally not efficient. Sufficient volume of water is not delivered to farming plot when most needed or water cannot be delivered due to incomplete canal networks within the scheme. Designs of irrigation schemes have not been always factored in drainage systems to minimize damaged from flooding



Figure2: Water Resources Map

2.14. Significant potential to expand irrigated agriculture command area and production in Cambodia.

The total irrigated command area is around 1.2 million ha and annual irrigated area up to 1.75 million ha (approximately 1.2 million ha wet season cropping and 0.5 million ha dry season cropping). However, irrigation area represents only 22% of all arable land (4.5 million ha) and at least 50% of irrigation schemes are not yet achieving double cropping, over 200% cropping intensity, especially those located in the Tonle Sap RBG. Any expansion of irrigation area will need to be subjected to at least improve access to a reliable water supply (e.g., water storage, pipe system from a perennial river system) and having good quality soils.

Note:

⁴ The 1,926 are irrigation schemes that have a condition greater than 30% representing 43 large schemes (\Rightarrow 5,000ha) 998 medium schemes (\Rightarrow 200 < 5,000 ha), and 885 small schemes (< 200ha) (Data taken from the Cambodian Irrigation Scheme Information System)

3. Finding and Issues for National Water Status

3.1. Cambodia is facing many challenges regarding water resources management and establishment of sustainable irrigation which are explained below and summarized in Table 1.

Table 1: Overview of the Main Challenges and Solutions

Water resource management
Passing of the Sub-decree on Water Licencing and Sub-decree on Water Quality, and other national guidelines, such as a National Water Data and Information Sharing Protocol, to support implementation of Water Law.
Annual water shortage and extreme flooding impacts.
Lack of water storage and options for storing water to support rural people, especially in the north-west region of Cambodia.
Minimal foundation water resources information to support evidenced based decision-making process. -Including water quantity and quality, soil quality, slope assessments, etc.

Water resource management
<p>Modern water analytical tools including remote-sensed and hydrological based models are not fully available and being applied.</p> <ul style="list-style-type: none"> - For example, to investigate the impact of different climate and development scenarios on water availability of highly vulnerable flood prone areas etc.
<p>Minimal water security (secure available and access water) for water users: irrigation, environment, urban, etc.</p>
<p>Flood preparedness measures are not in place in many rural regions across the country.</p>
<p>Very early days of establishing national water resources planning processes to support sustainable development, management, or protection of Cambodia's water resources.</p> <ul style="list-style-type: none"> - For example, river basin plans, water allocation rules, and seasonal operation plans for multiple purpose water infrastructure, etc.
<p>Severe lack of resources available for MOWRAM and PDWRAM to undertake essential water resources management activities such as ongoing monitoring and assessments.</p> <ul style="list-style-type: none"> -For example, skilled and experienced senior technical and operational staff to support the regular collection, assessment, and reporting on the status of water resources. -Effective annual planning and budgeting processes in place to nationwide programs, and provision of adequate annual budgets to support implementation.
<p>Adapting to the new MRC structure and responsibilities that require greater national autonomy in monitoring, assessing, planning, and managing Cambodia's water resources.</p>
Sustainable Water Resources Management and Irrigation
<p>Establishment of National Standards for Irrigation Design, Construction, and Supervision.</p> <ul style="list-style-type: none"> -Varying quality of the designs and construction of reservoirs and irrigation schemes.
<p>Securing water for a full dry season crop.</p>
<p>Implementation of the Manual for O&M of Irrigation Schemes.</p> <ul style="list-style-type: none"> - Establishment of self-sustaining FWUC for new and rehabilitated small to medium irrigation schemes. - Establishment of PDWRAM and private sector support for O&M of large irrigation schemes and multiple purpose large water storages. B29
<p>Minimizing flood and drought impacts for poverty reduction and economic development</p>
<p>Modernizing irrigation schemes to support efficient water delivery and crop diversification.</p>
<p>Lack of understanding on the effectiveness of investment and the need for a nation M&E program on irrigation scheme performance.</p>
<p>Designing and managing multiple purpose reservoirs that can support all water use needs, including for town supplies and environment, and allow for fish movement.</p>

3.2. Making sure that the water sector, among the other three priorities, contributes to the development and rehabilitation of the country

A mission for water resources management, water resources usage and water resources

storage should be implemented in a successful way, the Ministry of Water Resources and Meteorology has been working in closed collaboration with key relevant institutions at national level, other neighbouring countries (Regional and International Trans-boundary) and international development partners.

4. Water Resources

4.1. Cambodia is heavily dependent on water inflows from other countries, receiving 70% its water this way

The MRC's BDP Scenario analysis show that the large scale development of hydropower dams will have major impacts on flows, flow patterns, fisheries and sediment transport and a reduction in the flow reversal volume to the Tonle Sap Lake. Cambodia needs strong international relationships for water management- BDP analysis shows that it has far more to lose than other Mekong countries. As well, coordination with China over operation of UMB dams needs to be strengthened to ensure irrigation expansion.

4.2 IWRM is not ongoing applied as required by the Water Law- Cambodia is still very much in a water development phase

MOWRAM has not yet been able to take up many of its obligations under its Royal mandate, nor implement the Water Law. Irrigation development, to reduce poverty and provide food security has been the focus, but the NSDP 2014-2018 requires a more balanced approach. There are many issues of dry season shortage, over-exploitation and degradation that require urgent attention. There are many management gaps.

4.3. Groundwater is a vital resource in many areas, but is poorly understood and is not being managed

Groundwater is often the only source of water. However, it is only being assessed for water supply projects, not in a strategic way for overall management. Conflicts over use and over exploitation are occurring and water levels are dropping. The need for effective groundwater management frameworks is growing rapidly.

4.4. Cambodia's water resources assessment and monitoring are totally inadequate for management

The water assessment-system is extremely weak, making investment decision high risk. Cambodia needs an enhanced management framework to make accurate data readily available

to all water managers, covering meteorology, hydrology, water quality, water-use, bio-monitoring and wastewater discharge.

4.5. Future water quality assessment must factor in the result of the MRC's BDP Scenario analysis

The result show potentially major impact for Cambodia, affecting flows, flow patterns and sediment transport, and flow reversal to the Tonle Sap Lake. The MRC has noted that its monitoring programmes for water quality, nutrients and sediments should be reviewed in the light of the BDP assessments and, where required, intensified.

4.6. Water catchments-are not being identified and protected

Water catchments generate the water that originates within Cambodia-for example, the catchments and forests of the Coastal and 3S RBG produce the most water per unit area within Cambodia, particularly in the dry times. These need to be delineated and protected.

5. Agriculture

5.1. Lack of financing for irrigation O&M is not economically sound

The lack of sustainable financing for O&M has caused the degraded state of irrigation infrastructure-a reliance on ODA and rehabilitation, rather than an effective O&M approach. However, recent initiatives by MOWRAM to establish sustainable O&M funding need to be supported.

5.2. Irrigation management capacity needs strengthening

A shift in management philosophy and practice is emerging, which will require major changes to the mix of skills at the central, provincial, local authority and FWUC levels. A greater gender balance in farmer initiatives is needed.

5.4. The use of both chemical fertilisers and pesticides is not according to the standards

Fertilisers are greatly under –used, and pesticides are greatly over-used, creating major chemical exposure and contamination of water sources. Farmer education and awareness is needed.

5.5. The fisheries sub-sector, already vulnerable faces a growing number of threats from inside and outside the country

Threats include over-fishing, the damaging effects of dams, loss of habitats, wetland loss, environmental degradation, sedimentation, and climate change. At the same time, the fisheries sector faces increasing demand from a population that is growing at around 1.5% annually. Of greatest significance, however, are the results of the MRC BDP Scenario analysis, which shows that potentially enormous impact on Cambodian fisheries-capture fisheries could decline 44% compared to the Baseline.

6. Aquaculture

6.1. The impacts of the massive development of mainstream and tributary hydropower dams in the LMB will further reduce natural fisheries - by as much as 44%.

Aquaculture development needs to factor in these extreme reduction of natural fish availability throughout the inland parts of the country.

6.2 With wild fishing at its limit or declining, aquaculture is expected to fill the gap in fisheries production.

A declining wild fishery coupled with strong population growth highlights the need for aquaculture expansion. However aquaculture is still based on small scale production. The capacity for Cambodia to achieve the planned four to five-fold increase in production in the coming decades needs strengthening.

6.3 Water quality and pollution from aquaculture and fisheries processing will escalate.

The growth of small, medium and large-

scale aquaculture is strongly supported by the RGC. However, experience in other of countries shows that unregulated aquaculture development leads to local pollution- the levels of pollutants near aquaculture zones are often found to be far higher than international water quality standards. Increasing pollution will go hand in hand with increasing production. As well, wastewater from aquatic processing factories can be a significant environmental problem.

7. Industry

7.1 Industry concentrated in key locations.

Areas of concentration create problem of pollution intensity, but also provide opportunities for a focussed management approach. Enhanced pollution control needs to focus on these areas, and the industry types identified as having high water pollution potential.

7.2 Industrial pollution will continue to increase as industry grows.

Even if all new industries are high tech, which they will not be, the use of existing older plants will continue unabated. A strengthened management framework needs to deal with an ever-increasing pollution load, with increasing toxicity and complexity.

7.3. There is no ambient water quality standard for surface water.

Lack of a standard makes the management of wastewater discharge difficult, as there is no statutory target to aim for.

8. Hydropower

8.1. Commitments to the MRC process to achieve sustainable hydropower development need strengthening.

The BDP DFS includes new storages in China and additional 26 LMB tributary dams. The FFS includes 11 mainstream dams and an additional 30 tributary dams- a total of 56 dams above the Baseline. The analysis shows that Cambodia is hardest hit by impacts, while receiving only 4% to

7% of the benefits. In particular capture fisheries could be reduced by 44%, and flow reversal to the Tonle Sap could be reduced by 13%. Cambodia's has most to gain in taking a strong role in the MRC's ISH processes.

8.2. The Cambodian mainstream Mekong River dams remain on the planning horizon despite the major impact they will cause within Cambodia.

The projects are massive dams that have major environmental and social impacts, mostly within Cambodia. If these 2 dams were excluded from the FFS, economic benefit would be slightly reduced with Cambodia bearing most of this. The absence of these two dams would allow connectivity to be maintained on the Mekong River up to the 3S system, with a consequential less severe impact on capture fisheries. Thus, the losses and gain are substantially borne by Cambodia.

9. The hydropower development potential of the plants to be built in Cambodia in the near future is high.

Compared to the total generation potential of a RBG, the level of development planned in the near future is extremely high for the Upper Mekong RBG (over 70%), for the Coastal (60-70%) and 3S RBG (around 60%). River basin planning needs to be undertaken for those basins where substantial expansion of hydropower is expected.

9.1 More than a million people in urban areas in Cambodia do not have access to a clean and safe water supply.

Funding for urban water supply works is deficient. A strategy and investment plan is needed to address the fact that, based on the 2008 census, only 63% of urban people have access to improved water supply- 1.25million urban people rely on raw water sources.

9.2. Important surface water supply sources are not being protected from pollution or degradation.

Given that rivers account for 70% to 80% of

the urban water supply, surface water quality in these water sources should be monitored and protected. Under the Water Law, a Water Law Implementation Area can be declared if there are likely to be conflicts, problems of pollution or degradation. This provision needs to be applied.

10. Rural water supply and sanitation

10.1 Over 4.4 million rural people, often the poorest, use unprotected water sources for their water supply.

Funding for rural water supply works is deficient, despite the government's ambitious targets. An investment plan is urgently needed to address the fact that around 4.4 million rural people, dispersed throughout the country, are using raw water sources, especially given the extent of open defecation being practiced.

10.2 Groundwater sources, essential for rural water supply, are not being identified or protected from degradation.

Given that groundwater accounts for 50% of the improved water supply, its management and particularly well-head management, needs a far greater focus. Under the Water Law, a Water Law Implementation Area may be declared if there are likely to be conflicts or degradation of an aquifer. This provision needs to be applied.

10.3 Nearly 9 million people in rural areas are practicing open defecation- approximately 76% of households.

11. Policy and Implementation Framework

11.1. Cambodia's National Strategic Development Plan 2019 – 2023 sets out the framework for implementing the Rectangular Strategy including agricultural priorities.

Relevant priorities to the National Water Resources Management and Sustainable Irrigation Road Map and Investment Program 2019-2033 include (i) establishment of fully operational irrigation schemes; (ii) strengthening water resources management legal and policy

frameworks; (iii) budgeting processes to O&M and multi-purpose water infrastructure to improve reliability of water supply and minimize flood and drought impacts; and (iv) establishing a comprehensive, national hydromet monitoring network. Irrigation –related targets under the National Strategic Development Plan 2019-2023 are: (i) average rain-fed paddy river yield to increase from 3.15 tons per ha to 3,25 ton per ha; (ii) annual irrigated target areas to increase from 1,48 million ha to 1.63 million ha; (iii) rice production to increase from 9.7 million tons to 10.85 million tons; and (iv) paddy rice surplus to increase from 5.2 million tons to 6.0 million tons.

11.2. Cambodia's National Water Resources Policy (2004)

Sets out policy directions for an integrated water resources management (IWRM) approach to managing water resources. Key provision include (i) equitable water sharing; (ii) mitigation of water-related hazards; protection of water for critical human needs and the health of priority aquatic ecosystems; and (iv) improvement of water analytic tools, including hydromet data collection, analysis and forecasting, and warning systems. The National Water Resources Policy provisions are generally viewed as good practice for achieving

sustainable water resources management that have been successfully demonstrated in other countries.

11.3. The Water Law (2007) sets out the legal provisions for sustainable water resources management and development.

This includes (i) establishment of a National Water Resources Inventory (database); (ii) water licensing (i.e., water use, mineral extraction or filling, groundwater drilling); (iii) water use fees (irrigation service fees); (iv) FWUCs; and (v) flood retention areas and management of water resources at the river basin and sub-river basin scale (not administrative scale). Sub-ordinate instruments that have been approved are the Sub-decree on FWUCs (2015) and the Sub-decree on River Basin Committees (2015). The draft Policy and Implementation Guidelines for Sustainable FWUC and the Policy and Implementation Manual for O&M of Irrigation Schemes are currently under review. A Prakas for Irrigation Service Contribution (fee) for routine and periodic irrigation scheme O&M is also under preparation. Draft sub-decrees on water quality and water licensing are under consideration by the government.



Abbreviations	
ADB	- Asian Development Bank
BDP	- Basin Development Plan
DFS	- Definite Future Scenario (under the MRC's BDP analysis)
FFS	- Foreseeable Future Scenario (under the MRC's BDP analysis)
FWUC	- Farmer Water User Community
GDP	- Gross Domestic product
Ha	- hectare
IWRM	- Integrated Water Resources Management
LMB	- Lower Mekong Basin
MCM	- Million cubic meters
mm	- millimeter
MOWRAM	- Ministry of Water Resources and Meteorology
MRC	- Mekong River Commission
NSDP	- National Strategic Development Plan
O&M	- Operation and Maintenance
ODA	- Overseas Development Assistance
PDWRAM	- Provincial Department of Water Resources and Meteorology
RBG	- River Basin Group
RGC	- Royal Government of Cambodia
UMB	- Upper Mekong Basin

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