FINAL REPORT
STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

CONSULTANCY TO CARRY OUT A STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE STRATEGIC PLANNING FRAMEWORK FOR FISHERIES (SPF) 2010-2024 IN CAMBODIA

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Abbreviations and acronyms

ASDP	Agricultural Sector Strategic Development Plan for 2014-2018
AFD	Agence Française de Développement
ASDP	Agricultural Strategic Development Plan 2014-2018
AEC	ASEAN Economic Community
ASEAN	Association of Southeast Asian Nations
ASEAN GAqP	ASEAN Good Aquaculture Practices
BDS	Basin Development Strategy
BOD	Biological Oxygen Demand
CMAC	Cambodia Mines Action Centre
CAMCODE	Cambodian Code of Conduct for Responsible Fisheries 2010
CAPFish	Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector
CC	Climate Change
CCCSP	Cambodia Climate Change Strategic Plan
CCPAP-AFF	Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries 2014-2018
CCTT	Climate Change Technical Team
CF	Community Forestry
CFis	Community Fisheries
CNMC	Cambodian National Mekong Committee
CSOs	Civil Society Organisations
CamboWP	Cambodia Water Partnership
D&D	Decentralisation and Deconcentration
DDT	Dichlorodiphenyltrichloroethane
DEPC	Department of Environmental Pollution Control
DFID	Department for International Development from UK
DEVCO	Directorate for International Cooperation and Development
DO	Dissolved Oxygen
EC	European Commission
EEZ	Exclusive Economic Zone
EIA	Environmental Impacts Assessment
ELC	Economic Land Concession
EM-DAT	International Disaster Database

EPA-US	Environmental Protection Agency of United States
EU	European Union
EUD	European Union Delegation
FA	Forestry Administration
FAO	Food and Agricultural Association of the United Nations
FiA	Fisheries Administration
FWUC	Farmer Water Use Community
GDANCP	General Directorate of Administration for Nature Conservation and Protection
GDP	Gross Domestic Profit
GHG	Greenhouse Gas
GHS	Global Harmonization System
GIS	Geographic Information Systems
GPS	Global Positioning System
GGMP	Green Growth Master Plan
GWP	Global Water Partnership
HACCP	Hazard Analysis Critical Control Point
ICEM	International Centre for Environmental Management
IFAD	International Fund for Agricultural Development
IFREDI	Inland Fisheries Research and Development Institute
NCCS	National Climate Change Strategy
IPOA-IUU	International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
LDC	Least Developed Countries
LMB	Lower Mekong Basin
MAFF	Ministry of Agriculture, Forestry and Fisheries
Mekong ARCC	Mekong Adaptation and Resilience to Climate Change
MDGs	Millennium Development Goals
MEF	Ministry of Economy and Finance
MEM	Ministry of Energy and Mines
MIH	Ministry of Industry and Handicraft
MLMUOC	Ministry of Land Management, Urban Planning and Construction

MoC	Ministry of Commerce
MoE	Ministry of the Environment
MoH	Ministry of Health
MOWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
NADS	National Aquaculture Development Strategy
NAMAs	Nationally Appropriate Mitigation Actions
NAPAs	National Adaptation Programme of Actions
NARDI	National Research and Aquaculture Development Institute
NCCC	National Climate Change Committee
NCSD	National Council for Sustainable Development
NEMA	National Environment Management Authority
NESAP	National Environment Strategy and Action Plan
NGO	Non-Governmental Organisation
NPCA	Notification, Prior Consultation and Agreement
NPF	National Forest Programme
NSDP	National Strategic Development Plan 2014-18
NSPAD	National Strategic Plan for Aquaculture Development
NSPGG	National Strategic Plan on Green Growth
PAs	Protected Areas
PES	Payments for Ecosystem Services
PFM	Public Financial Management
PM	Prime Minister
R&D	Research and Development
RGC	Royal Government of Cambodia
RSC	Rectangular Strategy in Cambodia
RUPP	Royal University of Phnom Penh
SCI-CAP	Scientific Capacity Development Initiative
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SPF	Strategic Planning Framework for Fisheries
SRES	Special Report on Emissions Scenarios
TEEB	The Economics of Ecosystems and Biodiversity
ToR	Terms of Reference

TSA	Tonle Sap Authority
TSBR	Tonle Sap Biosphere Reserve
TN	Total Nitrogen
TSS	Total Suspended Solids
TP	Total Phosphate
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USD	United States Dollar
WHO	World Health Organisation

1. Summary

The Strategic Environmental Assessment (SEA) addresses the Strategic Planning Framework for Fisheries 2010-2024 (SPF) and the National Aquaculture Development Strategy Policy (NADS), and the EU-Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries (CAPFish) composed of two complementary components i.e. aquaculture and capture fisheries. These represent the major channels of implementation for fisheries and aquaculture development for the period 2017-2022 with an expected contribution of EUR 100 million from the EU. The SPF/NADS and CAPFish programme includes inland and marine fisheries including exploitation and conservation of stock and habitats, as well as aquaculture and institutional support.

CAPFish involves potential social and environmental costs with fisheries developments, which have been assessed with this SEA. This assessment addresses how policies, plans and interventions should respond and account for interrelations between biophysical, socio-economic and cultural issues linked to the fisheries sector. Overall, the objective of this SEA is to appropriately apply environmental safeguards to the programme.

The SEA should enhance environmental performance of CAPFish and also provide suggestions for the reorientation of the SPF/NADS in the near future. Meanwhile, CAPFish will address constraints in the fisheries sector in order to increase food security, improve nutrition and foster further economic development. Overall, the SEA is very important as it considers the wider implications of different key issues for fisheries. This approach is paramount as fisheries are very important for the population of Cambodia and particularly inland fisheries and their migratory species. The role of the SEA is to assist the fisheries sector and evaluate and vulnerabilities, threats and issues, which could impede the ambitions of the SPF/NADS and CAPFish. This process also includes the analysis of key national policies encouraging the development of the fisheries sector.

Climate change adaptation and resilience scenarios for the country are being taken seriously and integrated into CAPFish through fisheries policies. Climate forecasts indicate both positive and negative impacts for the CAPFish and the environment. Therefore, the programme and policies for the fisheries sector have been assessed in the SEA in relation to forecasted changes and responses through policy. For example, glacier melt from the Himalayan and Tibetan mountain ranges is likely to become increasingly less reliable with climate change. This may cause the annual flooding of the Mekong River and Tonle Sap Lake, flood plains and the Mekong delta to become less predictable, and specifically that for floods and droughts provoking the greatest problems, rather than the severity of the events themselves.

Alterations of quality and/or quantity of water in water bodies from numerous different activities, such as dams, combined with climate change within river ecosystems could be catastrophic for aquatic systems, fisheries and beneficiaries. Cambodian capture fisheries are particularly vulnerable to changes in temperature and hydrological flows that are directly associated with climate change. Overall, modifications of water flow combined with the effects of climate change could have significant impacts on migration, breeding and spawning patterns of fish, and potentially damage key aquatic habitats for fisheries.

The SPF and NADS are interrelated and under Programme 3 of the Agricultural Sector Strategic Development Plan (ASSDP) 2014-2018. The strategy's general objectives are to contribute to a competitive, profitable job-intensive and environmentally-sustainable and

climate-resilient fisheries and aquaculture sector across Cambodia. The SPF and NADS are integrated policy documents above all associated with several overarching strategies and plans, including the Rectangular Strategy and integrated with international policies and covenants such as the Sustainable Development Goals (SDGs). The four pillars of the SPF are capture fisheries and management, inland and marine aquaculture, fisheries value chains, and regulatory and services. Meanwhile the major features of the SPF's integrated approach include co-management with communities, conservation of fish stocks and fish habitats, notably the flooded forest, and development of sustainable fisheries resources and aquaculture. The aims of SPF are to contribute to ensuring people's food security and to socioeconomic development for the nation, SPF also emphasis increasing product value while increasing production through sustainable intensification of aquaculture. NADS is complementary with SPF and aims to encourage commercially viable and environmentally sustainable aquaculture, which will contribute to food security, improved nutrition, socioeconomic development, and growth in GDP and export earnings. The focus of NADS is on the development of a diversified aquaculture industry which includes both traditional small-scale fish farming and more commercially venture on various scales.

The CAPFish programme will be launched during 2017 and is composed of CAPFish Aquaculture and CAPFish Capture. The programme addresses the constraints of the fisheries sector, the increase in food security, improvement of nutrition and the fostering of further economic development through fisheries and aquaculture development at inland and coastal sites. CAPFish will also play a vital food security and nutritional role in Cambodia, as the fisheries and aquaculture sectors are important sources of nutritious food and animal protein for much of the country's population including notably small-scale fish farmers. The priority areas for CAPFish support are the disruption of migratory pathways of important fish species related to mainly hydro-dam developments, degradation of important aquatic habitats for fisheries, increasing demand and competition for low value fish for aquaculture feeds, limited capacity of Government and local communities to manage fisheries, and potential severe climate change risks for fisheries in the Lower Mekong Basin (LMB). Finally, it is important to mention that CAPFish is still being formulated and subject to potential refinements and changes.

Alternatives to CAPFish Aquaculture provided to the consultant by the EUD in Cambodia include support to coastal/marine fisheries versus freshwater fisheries, support to intensive/commercial fisheries versus small scale fisheries, and support to specific species versus all species. These alternatives are considered with the partner donor Agence Française de Développement (*AFD). Similarly there are alternatives for* CAPFish Capture, which include support of CFis versus intensive/commercial fisheries, enhancing wild stocks versus management of existing stocks in the wild, applying integrated water resources management (IWRM) versus protection without IWRM for capture fisheries, promote economic diversification versus only capture fishery activities, and apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries. The credibility of each of these alternatives is analysed briefly and discussed later in the study within the context of key issues.

The relevant policies and legal frameworks for capture fisheries and aquaculture are numerous and discussed in the study, although there are key documents which could have an immediate impact upon the development of fisheries. These key policies and legal frameworks include the Rectangular Strategy in Cambodia, Agricultural Sector Strategic Development Plan (ASDP), the Law on Fisheries, Sub-decree on Community Fisheries Management, SPF/NADS, and Cambodian Code of Conduct for Responsible Fisheries (CAMCODE). There is also the National Strategic Plan for Aquaculture Development which is in draft and will address the important issue of efficient use of low value fish and need for

high quality fish feed for aquaculture development. In addition, there are the Action Plans on Building Resilience to Climate Change (CC), which are orientated to mitigation and adaptation measures for sustainable fisheries.

The principal institution for fisheries is the Ministry of Agriculture, Forestry and Fisheries (MAFF) and specifically the Fisheries Administration (FiA) and their various departments, and deconcentrated offices composed of inspectorates, cantonments and divisions. FiA also has important responsibilities for CC with MAFF, while the General Directorate of Agriculture has a significant role over crop production and irrigation impacting on fisheries. In addition, MAFF works with the CC team through the Climate Change Prioritised Action Plan for Agriculture, Forestry and Fisheries Sector 2014-2018. Other key fishery institutions are mainly orientated to research and notably include among others, the Inland Fisheries Research and Development Institute (IFREDI).

The Ministry of Environment (MoE) has responsibilities for water quality and environmental monitoring, environmental standards, pollution management including wastewater discharge licensing, and environmental impact assessments (EIAs), although tasks are not always fulfilled, weakening the frameworks for fisheries. Similarly, there is a National Council for Sustainable Development (NCSD) with its General Secretariat of Sustainable Development (GSSD) based at the MoE, which is in charge of CC and development, although not too effective at present. The principal legislation for the MoE related to fisheries is the Law on Environmental Management and Natural Resource Conservation of 1996 and associated laws and codes. In addition the MoE is responsible for several key strategies for the environment and CC including the National Environment Strategy and Action Plan and the Cambodia Climate Change Strategic Plan 2014-2023. The Ministry of Water Resources and Meteorology (MOWRAM) is responsible water resources management and laws related to this including management of storm water runoff to prevent flooding and downstream erosion, and improve water quality in waterbodies. Key legislation amongst others within the framework include the Law on Water Resources Management and Sub-decree on River basin management. Attached to MOWRAM is the Tonle Sap Authority (TSA) focusing upon the natural resource management of Tonle Sap Lake and catchments regarding hydrology, flooding, agriculture, fishery, degradation of water quality in dry season and livelihoods in floating villages. However, the TSA only represents the interests of government agencies and do not necessarily account for either communities or civil society.

There are numerous other ministries which have a direct or indirect impact upon fisheries. Although the most prominent is the Ministry of Mines and Energy as it is responsible for hydropower development across Cambodia. Hydropower development is very controversial, as this development can provoke conflicts of interest between users, notably concerning water for either electricity or fisheries.

The most important international body in region is the Mekong River Commission (MRC) is an inter-governmental organisation that works directly with the governments of Cambodia, Lao PDR, Thailand and Viet Nam and mandated to aim for sustainable watershed basin development of the Mekong River. Each country has its own National Mekong Committee. MRC is very important as it looks across all sectors, including fisheries sustainability, identification of opportunities for agriculture, freedom of navigation, sustainable hydropower, flood management, preservation and conservation of important ecosystems within the watershed basins. Important framework strategies for MRC include its MRC Strategic Plan 2016-2020. In addition to this international strategy, there are numerous others including the Sustainable Development Goals (SDGs) and 2030 Agenda for Sustainable Development in Cambodia.

The key and prioritised issues for fisheries and aquaculture, which are addressed in this SEA are based upon a broad range of issues flagged by stakeholders and in various studies and reports. The key high and medium priority issues retained for this SEA were as follows:

- hydropower and irrigation developments (high)
- poor management of fisheries and livelihoods (high)
- chemical and pollution risks for aquatic environment and fisheries (medium)
- effects of deforestation upon rivers and lakes and within coastal areas (medium)
- climate change (CC) and its interaction upon aquatic ecosystems (medium)
- unregulated imports of fish and fry (medium).

In addition to the six key issues identified, there were several other issues ranked as lower priority in relation to the secure production of fish and fish products and impacts upon the environment in Cambodia. Subsequently lower priority issues are not discussed in detail, but do remain in the SEA.

The approach and methodology for the SEA was based on international best practices and guidance. The scoping phase identified preliminary key environmental concerns in the fisheries and aquaculture sectors. Key issues were then defined and baseline information acquired to further evaluate the issues and eventual prioritisation for both capture fisheries and aquaculture in the CAPFish programme. Prioritisation was based upon a combination of expert judgment and matrices of responses from stakeholders and review during workshops.

The intervention area is not specifically defined by the CAPFish programme, although the aquaculture component refers to periphery of Tonle Sap Lake and the Mekong Delta, whilst capture fisheries focuses upon existing and important freshwater and marine fishery zones. MAFF and FiA want to do further studies to identify specific sites in the near future for aquaculture. Potential for fisheries development in these areas refers to principally inland capture being rice-fisheries and fishing wild stocks; and aquaculture in cages, ponds and paddy field integrated systems.

The assumptions, uncertainties and risks as well as the issues and mitigating actions for this SEA were broad in nature. The assumptions were availability of data and key persons. Sometimes specific data was missing for water monitoring and catch data for example, where alternative data or professional interpretations had to be made. Meanwhile the uncertainties and risks included limited time for study and orientation of project to positive results and not negative issues. Many government experts had to be contacted informally to accelerate the process of organising meeting. This process meant that the study could not cite the person, but only the department, which was sufficient for the SEA.

Environmental indicators for CAPFish could derive from key sectoral strategies. The analysis of these strategies focused upon the compatible with the policies' objectives and indicators. The draft of the National Environment Strategy and Action Plan (NESAP) focuses on putting environmental sustainability and inclusive green growth into development programmes and their projects. The baseline and periodic monitoring data for NESAP are measured against agreed indicators and targets reporting against Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs) linked the National Strategic Development Plan (NSDP) performance framework and database, which are equally appropriate for CAPFish. The National Forest Programme (NPF) orientates forests to contribute to macro-economic growth and poverty alleviation in rural areas through conservation and sustainable management with all stakeholders. Meanwhile targets for forest include cover, benefits and areas with recognised Community Forest rights, which could include mangroves, and

flooded and upland forests. Finally, there are no specific indicators in the Green Growth Master Plan (GGMP), however, it provides orientation to green balanced growth for the economy, environment, society and culture, and aims at to eradicate, where appreciate indictors could be anticipated. Similarly, the National Strategic Plan on Green Growth (NSPGG) focuses on blue economy development including sustainability and the green environment providing opportunities for appropriate indicators. Combinations of blue and green approaches could orientate to sustainable and better management of existing capture fisheries and expansion of aquaculture and their dependable natural resources including water, forests and mangrove systems

Climate change (CC) indicators are also found in key sectorial strategies. The principal policy is the Cambodia Climate Change Strategic Plan (CCCSP). The promotion of climate change resilience could be beneficial for the application of the SPF/NADS and the initiation of CAPFish activities, as it encourages water security and the increase in production from fisheries and other sectors. There are sector specific indicators, although there is an indicators framework including two categories measuring institutional response for climate change management and development of performance statistics including fisheries sector. However, it is important to note that there could be conflicts with this policy, such as the encouragement of renewable energies promoting the emergence of hydropower. MAFF's Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries Sector supports climate change adaptation and resilience to enhance the fisheries sector. Socio-economic, areas mapping for integrated zoning, increase in mangrove and flooded forest cover, and numbers of fisheries whose capacities have been strengthened are clear targets with positive ambitions. However the baselines will need to be established and correlate well with SPF/NADS and CAPFish targets. Integrated management and increasing key habitats like flooded forest and mangroves are major steps to conserving or increasing production from capture fisheries and aquaculture.

Cambodia is a rich country in aquatic resources which has led to the development of the fisheries sector over thousands of years. The hydrology is dominated by the Mekong river, which flows across a large part of the territory. Meanwhile the other major river the Tonle Sap, starts at the largest lake in the country being the Tonle Sap Lake, and joins the Mekong River in Phnom Penh. These hydrological systems are based and supported by a tropical monsoon season from May to October when 80 percent of the annual rainfall occurs, turning the lowlands into an extensive floodplain. During the dry season, water drains from the Tonle Sap Lake (also known as the Great Lake) into the Tonle Sap River and eventually into the Mekong Delta. As the monsoon rains flood the lowlands and fill the Mekong River, the rise in river water level causes the Mekong to push water back up the Tonle Sap River into the Great Lake.

Forest cover as a percentage of total land area in 2010 was 57.07%, which is still high but remains under threat from logging and agriculture. Agriculture continues to be the dominant employment sector absorbing the majority of the population. Almost 80% of agricultural land use is for rice farming and reliant upon rainfall, which has encouraged the development of irrigation systems and dams. Fish provides up to 76% of all animal protein in-take in the Cambodian diet and fish production contributes about 10% of Cambodia's GDP, creating six million full-time and part-time jobs. The main inland fisheries are predominantly found along the rivers, lakes and wetlands such as the Tonle Sap Lake and the Mekong River. Meanwhile, tourism is the third largest sector after agriculture and the garment industry. Finally, only 17.2% of the total population including 6% of the rural population had access to electricity in 2012. This low figure has stimulated the political agenda to provide access to cheap electricity for the entire population. This process has developed recent scenarios for the creation of hydropower facilities and potential conflicts with fisheries.

Historically, temperatures in Cambodia have increased and this trend is projected to continue with mean monthly temperatures increasing, while there will be higher rates at low latitudes. There is also an increasing trend in seasonal rainfall between June and August in the northwest, and a decreasing trend in the northeast of the country. However, inconclusive evidence for climate change impacts upon mean annual rainfall has projected an increase in rainfall for Cambodia and the Mekong Basin, which would lead to potentially erratic and more severe flooding events in general. In addition, the sea levels in the region are projected to rise significantly, which would cause permanent inundation of about 25,000 ha of the coast by 2090. Overall these impacts could have dramatic effects on fisheries and agriculture systems, which will need to adapt and build in resilience mechanisms in the future to avoid potential and serious economic hardships for the country.

Hydropower developments would lead to the construction of large reservoirs within Cambodia and upstream including China, which may have significant impacts upon water regimes, flood levels, sediment loading and longitudinal fish migration for both long and short migrations associated with white and grey species of fish, respectively, although there could be new opportunities for capture fisheries and cage cultures. According to ICEM, there were only 16 hydropower dams on the Mekong in 2000 compared to 77 to 88 expected dams in Lower Mekong Basin by 2030, and 227 dams either in operation or planned within the entire Mekong Basin by 2030. Economic impacts from just 11 new mainstream hydropower projects within the LMB are estimated to have annual losses of 340,000 metric tons of fish by 2030. Overall, the proposed schemes on principally the mainstream sections of the Mekong in Cambodia and its upper reaches from Laos to China could have devastating results and almost destroy migrant capture fisheries.

Irrigation canals from gravitation irrigation schemes, there would be the building of reservoirs which may have impacts upon the lateral migrations of some important fish species water abstractions and diversions from ponds and rivers during the dry season would have impacts upon the maintenance of fish stocks and breeding grounds. There has also been a relatively recent rise in irrigation projects over the last 10 years with government rehabilitation of hundreds of schemes built from the Khmer Rouge period. In fact more irrigation dams for crop farming have been encouraged by government following the severe dry season of 2015-2016 induced by El Niño in Laos, Thailand and Cambodia. Similar to hydropower, irrigation schemes will affect the water balance, where agricultural priorities often outweigh the downstream requirements from fisheries.

Together hydropower and irrigation developments are high priority issues which could put in jeopardy both CAPFish and SPF/NADS objectives and threaten the sustainability of investments in the aquaculture and fisheries sector in the future. Key recommendations to respond to a potential fisheries crisis include the establishment of a national working group within MRC to lobby for Notification, Prior Consultation and Agreement (NPCA) processes related to dams. Urgent requirement to introduce detailed scientific work on fish ladders; and more importantly the conception and application of comprehensive environmental safeguards for proposed dam projects. There is also a need to analyse the real costs and benefits of fisheries compared to gains from hydropower projects within and outside Cambodia. Finally the inter-ministerial bodies must play a real role through positive dialogue and actions to support dialogue, including the EIA process, at local, national and regional levels with MRC and CNMC in Cambodia.

The poor management of fisheries and impacts upon livelihoods is another high priority key issue for the development of fisheries under CAPFish. Currently there are significant unsustainable catches of small fish used as animal or fish feed for aquaculture, which could

have negative national food security consequences due to low and inefficient conversion ratios. These issues for aquaculture are compounded for local people, who could potentially also face escalating fish prices, if markets are orientated to exports at the demise of small wild fish being used as cheap feed. These matters are assembled upon a lack of natural resource management associated with the weak capacity of associations, open access (tragedy of commons), and lack of stock assessment and monitoring. The result of this malaise in fisheries has led in part to previous trends for recorded fish catches per fisher in Communes dropping significantly from 1940 to 1995 and likely to have continued to fall until now. Overall poor management is also damaging to commercial benefits from fisheries through value chains for production associated with inputs, domestic and international sales, and salaries for workers.

The principal authorities for managing fisheries in Cambodia are MAFF and specifically FiA, who have co-management responsibility for CFis and state-managed waters such as national lakes, rivers, coastal and offshore areas. Meanwhile, the Tonle Sap Authority (TSA) is responsible for fisheries in the Tonle Sap Lake region. These authorities work in collaboration with sub-national authorities including commune, district and provincial authorities to supposedly regulate illegal fishing. However, there is virtually no management of fisheries by these bodies at present. The introduction of CAPFish does now offer some opportunities to improve the situation through both regulation and research including monitoring of fish stocks with these organisations and communities.

Recommendations for improvements in fisheries management and for livelihoods are paramount and effectively offer opportunities for the CAPFish programme and SPF/NADS. Key aspects of management need to address the issues with applied research promoted by FiA to strengthen CFi's, the application of legislation and improvement of technical capacities. This approach would include better understanding of the value of ecosystem services within CFis. To manage fisheries requires major improvements in the monitoring of fish, and in particular fish stocks and notably small/recruitment stocks of fish known as "trashfish" used as cheap feed for aquaculture. The capacity building of CFis would also mean the reorientation of the proposed new Law on Fisheries to provide more rights for CFis to assist them to use manage and protect their fisheries.

Chemical and agrochemical pollution risks for aquatic environment and fisheries are localised, but widespread in Cambodia and therefore need to be taken seriously, as a medium priority key issue for fisheries. The evolving use of chemicals and/or agrochemicals for principally crops, for example watersheds around the Tonle Sap Lake where there is significant rice production, pose serious chemical risks to fisheries and eventual human food chains. Aquaculture development itself could also be detrimental to fisheries as excessive amounts of nutrients and organic matter from units could provoke eutrophication and pollution promoting diseases and depleting dissolved oxygen. Similarly urbanisation and industrialisation near watercourses, such as towns including Phnom Penh, Kandal and Kampong Channg and industrial zones have and will provoke serious localised pollution issues and eutrophication of waterways killing fish species. Meanwhile, localised mining activities, and specifically the surge in gold mines using toxic chemicals such as cyanide and mercury, pose serious threats to capture fisheries and aquaculture through bioaccumulation of chemicals damaging fish and their ecological systems and travelling through human food-chains.

MOWRAM and MoE have responsibility to monitor pollution risks associated with water quality and controls in natural systems. However national monitoring data are either both limited and not available, or non-existent. Meanwhile MRC has some monitoring sites for bio-physical monitoring of water using US EPA standards, although the certification of their

laboratories is unsure. Currently, there is no monitoring of pesticides, which could be significant for fisheries now and in the future. Overall, there is not one competent authority for monitoring polluting substances, while responsibilities split amongst various authorities are partially accountable for the demise of the system.

Key recommendations related to chemical and pollution risks point to the necessity to support integrated planning for the development of fisheries and aquaculture related to the siting and registration with planning regulations for agriculture, settlements, industries, and mining near and around existing or proposed aquaculture and CFis. It is important to add that the development of fisheries and specifically aquaculture can in themselves be conflictual requiring planning restrictions with good practices and development of fish feed regulations. This approach would require collaboration between MAFF and MoE, which could be assisted by CAPFish with potential cooperation with JICA's current rice projects for pesticide and fertiliser issues. This collaboration could include capacity building of FiA to monitor all fishery sectors associated with pollution in collaboration with MOWRAM and MoE for water quality, in particular cropland including pesticides with the agricultural division of MAFF. Similarly there is need for closer cooperation and sharing of information with key ministries and the Ministry of Energy and Mines (MME) and Ministry of Industry and Handicraft (MIH) regarding mining and industrial pollution, respectively. To achieve these goals CAPFish may also need to support the certification of labs which conform to international norms. In addition MOWRAM and MOE should work to improve water qualities and fully implement the existing regulations, as the health of aquatic ecosystems for fisheries is a priority of CAPFish and SPF/NADS.

The effects of deforestation of upland natural forests upon rivers and lakes and within coastal areas has evolved over many years and accelerated during the past decade in Cambodia and seen as a key issue for fisheries development. The deforestation is largely due to industrial plantation expansions, logging, and conversion for agriculture or even under the guise of agriculture to access timber in natural forests. The loss of forest cover means less protection for soils leading to potential erosion on steeper slopes. In addition, forest cover and soils maintain water storage within watersheds, which is vital for the stabilisation and buffering of water balances in strategic watercourses for fish. Deforestation is also severe in flooded forests, which are very important for the reproduction of wild fish stocks. Similarly, mangroves are threatened by various developments such as tourism projects and potential medium to large aquaculture schemes limiting sustainable management opportunities for coastal and marine fisheries. Overall deforestation is impacting upon the fisheries sector and thereby jeopardizing the implementation of the SPF/NADS and the CAPFish programme through changes caused to water flows and sediment load, from upland deforestation in particular, settling is slow moving water bodies such as the Tonle Sap Lake, as well as losses of crucial habitats.

Key legislation for the protection of forests with integrated management for multiple beneficiaries includes the Law on Environmental Protection and Natural Resources Management of 1996. This law marries with ambitions for sustainable management of natural resources and in particular forests attached to the Agricultural Sector Strategic Development Plan (2014-2018) under MAFF. This strategic plan focuses on five major programmes including sustainable fisheries and forestry resources management, which is highly appropriate for planning within the context of forests and watersheds. Meanwhile, the two key ministries for forest management or protection are MAFF and MoE with responsibility for the management of forest and forested lands. In addition land use planning issues associated with deforestation under the guise of Economic Land Concessions (ELCs) is also linked with these two Ministries, although the role of the MoE, in principle, is to protect all land including ELC areas from any form of deforestation. However, these two bodies do not appear to work closely at present with the Ministry of Land Management, Urban Planning

and Construction (MLMUOC), which has responsibility for governing land use, urban planning, construction projects, and for the resolution of land use conflicts, and can effectively counter any potential efforts of MoE or MAFF to conserve forests.

Some key recommendations for the protection of important forests for fisheries include the use of Integrated Water Resource Management (IWRM) within fishery watersheds involving the collaboration of a broad range of people and organizations from within entire watersheds. The objective of IWRM is to offer opportunities to reduce deforestation and inappropriate sedimentation of strategic habitats and migration pathways for fish in line with the CAPFish programme and SPF/NADS. IWRM may also present an entry for the empowerment of community forestry (CF) schemes in the uplands linked to CFis in the lowlands with sustainable use and management of flooded forests and mangroves. This approach also ties in with potential support from CAPFish for capacity building of institutions being MAFF and MoE principally, from national to regional levels including TSA, and at grassroots through the CFis.

Climate change (CC) and its interaction upon aquatic ecosystems could be very critical for fisheries development in the future and therefore a key issue for CAPFish and SFP. CC provokes erratic water levels associated with flooding and droughts. This situation can also seriously affect cage and pond aquaculture production, when ambient temperatures are high and water levels become seriously low. Meanwhile on the coast CC could provoke saline intrusions with rising seas levels and cause flooding and destruction of coastal infrastructure including aquaculture. A highly significant factor of CC could be the decrease in fish biodiversity and stability of fisheries production with rising temperature, despite some CC benefits in some areas from increasing flooding and nutrient loading. Responses to CC may come from opportunities for the protection of forests and mangroves through blue carbon linked to the important relationships between fisheries and the carbon footprints of potential aquaculture units. Adaptation may include the integration of capture fisheries with aquaculture and agriculture, which can help farmers cope with drought through diversification of household incomes and nutrition.

The key aspects of the institutional, policy and legal framework for Climate Change are associated with Climate Change Prioritised Action Plans for MAFF (MAFF CCPAP) 2014-2018, the strategic paper on Building Resilience to Climate Change: A Strategy to Respond to Impacts of Climate Change 2014-2018, and the Cambodia Climate Change Strategic Plan (CCCSP) 2014-2023. Meanwhile, the National Climate Change Strategy paper considers measures to ensure climate change resilience of critical ecosystems including coastal ecosystems, protected areas and mangrove ecosystems under the National Climate Change Committee (NCCC). There are also blue carbon opportunities for mangroves within the Low Carbon Development Strategy for Cambodia towards 2050. The NCCC has the mandate to determine national positions and strategies for participating in international negotiations, and coordinating the development and implementation of policies, plans, and measures to address climate change issues. The Prime Minister is also the Honorary Chair of the NCCC. At national level, the NCCC also manages and monitors the CCCSP implementation with technical support from the Climate Change Technical Team (CCTT) and administrative support from the NCCC Secretariat.

The key recommendations related to climate change and interactions include amongst others the support of more scientific research on the impact of changing hydrological regimes on fish species including vulnerability mapping for losses/changes and networks of fish refuges. These steps could then lead to the provision of simple management and monitoring tools in collaboration with the CC Unit of FiA, which should correlate with clear and concrete village-level, principally CFis, adaptation actions to CC. These approaches have to engage more holistic planning and dialogue between MAFF/FiA and other key entry

points such as MoI, MoE/NCCC, MOWRAM and MEM. These recommendations will be dependent upon the capacity building of staff and the institutions in fisheries and include above all the development of technical CC and fishery specialists. Meanwhile, adaptation projects could potentially include blue carbon offsetting schemes and REDD+ for the planting and conservation of flooded forests and mangroves, which could be facilitated by CAPFish and correlates with the objectives of SPF/NADS.

Unregulated fish and fry impact on fisheries was not evident until more information from various Ministries and experts began to reveal the risks posed by this key issue for the CAPFish programme and the SPF/NADS. Unregulated imports of fish and fry arrive in the country on a daily basis, as Cambodia is already a significant transit country for products moving through the AEC region from Vietnam and Thailand. Cambodia is also a significant importer of seed and broodstock for aquaculture and live fish for human consumption. The principal risk are the introduction and translocation of potential invasive fish species, as well as impacts on local species and the genetic integrity of wild stocks i.e. hybridisation. There are also risks from existing exotic fish species in collections escaping into the wild. Meanwhile, current fish populations in aquaculture cages and ponds could transmit diseases affecting wild stocks with impacts upon aquatic biodiversity. Similarly there could be disruption of aquatic habitats and ecosystems linked to live fish and fry imports. Weak border controls linked to regulation of these imports and movements compounds the risks. In addition, it is likely that fish diseases will increase in the future with CC and rising temperatures.

The key aspects of the institutional, policy and legal framework for unregulated fish and fry are principally based upon the Law on Fisheries supported in part by the Sub-decree on Sanitary Inspection of Animals and Animal Products. Some strategic plans which may assist regulation of fish and fry include the SPF addressing exotic species and fish diseases, the National Biodiversity Strategic and Action Plan regarding dangers of unregulated fish and fry in relation to national biodiversity conservation, and the National Strategic Plan on Green Growth 2013-2030 for safe ecosystems and natural resources management. It is important to note the FiA has no other regulations and policies for controlling products and fish quality apart from the Law on Fisheries. However this legislation may be reinforced since FiA drafted the National Strategic Plan for Aquaculture Development (NSPAD) for Cambodia until 2030, which goes further and addresses quantity, quality and safety of aquaculture products. MAFF has responsibilities and duties to implement animal sanitation controls and identify the source of products. These responsibilities include inspection of fish and fishery products by the Department of Production and Animal Husbandry and FiA. However the capacity and competency of FiA and staff is still restricted in terms of monitoring and laboratories for genetic problems, diseases, viruses and microbes or parasites. Meanwhile laboratories and suitability qualified personnel including fish geneticists are limited while laboratories are not certified.

Key recommendations related to unregulated fish and fry include promoting the creation of small private hatcheries in places closer to the fish farmers, diminishing the transport costs and the reliance on imports with their associated risks. This measure could work in parallel with restrictions on the raising of exotic species in aquaculture ponds. In addition, participatory training of communities such as CFis could raise awareness of risks from invasive species through simple reporting procedures, which could offer opportunities for target capture of exotics with new outbreaks. Overall risk assessments of unregulated fish and fry need to be performed to assist the imposition of restrictions on imports through MAFF supporting Customs. These recommendations need to be reinforced through the enhancement of institutions with appropriate labs, geneticists and specialists to assess fish genetic and disease risks based upon initial work established at IFReDI.

The general conclusions for this SEA are numerous, although there are some pertinent key findings. FiA/MAFF is retro-fixing current CFis based upon reforms and statements from the past; however, this needs to be replaced with practical and working plans for the sustainable management of CFis. Overall sustainability is at risk from principally proposed hydropower development, agriculture and deforestation, irrigation, and water pollution from point and non-point sources from domestic, agricultural and industrial sources, and unregulated fish and fry, which are all aggravated by climate change. These issues are compounded by non-transparent policies from ministries in particular energy and mines with potentially conflicting interests for fisheries resulting in an overriding need for dialogue. This situation is made worse by institutions lacking capacity and resources, in particular FiA and CFis, and their poorly managed CFis. Meanwhile, similar flaws in fisheries are sometimes the result of overriding of laws at high political levels. The future development of fisheries requires investment in capacity, research and M&E in fish production dynamics, diseases, genetics and costs and benefits from various sectors to show the true value and potential of fisheries for the country. These changes need to be initiated with planning composed of detail mapping and zoning for fisheries in the near future. Finally, it is important that this SEA becomes an official strategic document for Cambodia raise national awareness of highly important significance of fisheries compared to other sectors. In addition capture fisheries cannot simply be ignored and compared to the smaller and developing potential from aquaculture.

The recommendations for the formulation of CAPFish-Capture are divided into performance indicators and technical assistance and equipment for environmental performance and policy needs. Performance indicators include capacity building of CFis for good management of fisheries including success in protecting aquatic habitats measured using aquatic habitat cover indicators for all CFis. This approach is essential for the ecology of fish. Secondly and related again to key aquatic habitats, it will be important to create fish refuges as exotic species can destroy habitats and damage genetic stock through hybridisation, while this is also an adaptation measure for potential CC impacts. Technical assistance and equipment needs are divided into an array of sub-sectors as follows: promoting inter-sector coordination; develop capacities of CFis on good management of fisheries; policy dialogue related to energy and fisheries; researcher support of fish ladders for large dams and their role in EIAs; best practice monitoring of pollutants with appropriate lab equipment; participatory monitoring training linked to a national monitoring system; and finalisation of the Law on Fisheries.

The recommendations for the implementation of the CAPFish – Aquaculture component are divided into performance indicators and technical assistance and equipment for environmental performance and policy needs. Performance indicators include the reduction of the dependency of aquaculture upon undersized/young fish known as ‘trash fish’ and imported feed. Therefore the indicator would be an increase in the production of alternative and sustainable feeds from Cambodian factories. This approach should contribute to the sustainable development of aquaculture. Secondly, IWRM schemes should be introduced and monitored to ascertain a baseline of water related conflicts, which should aim to reduce conflicts annually throughout the project from 2017 for a representative sample of producers in key CFis and involve local CFi committees. This approach should ensure more sustainable, climate-resilient and inclusive growth for aquaculture. Technical assistance and equipment needs are divided into an array of sub-sectors as follows: alternative feed production (excluding trash fish); participatory monitoring training; good aquaculture practices; improving environmental management plans for aquaculture units in terms of water use, waste management and disease control; and the development and upgrading of fish hatcheries through FIA and NARDI.

The recommendations for enhancement of the SPF / NADS policy framework only address potential ways for the EU with the GoC to enhance specific aspects of the SPF/NADS through on-going dialogue related to principally the development pillars and indicators. The key recommendations are summarised as follows: enforcement of fishing rules by FIA and CFi communities linked to the key indicators such as with gear, zones and fish size; encourage to apply Good Aquaculture Practice as this will improve the quality of the fish and the environment; define a direct link between the policy to encourage good practice for aquaculture and good hygiene with national food security, as they are inseparable for the development of the industry; environmental mangers overseeing the key issues in the SEA related to policy and regulatory services for CFIs and all other public domain water bodies; building resistance for fisheries through adaptive planning principles means a greater role for all ministries to work together and avoid clashes for the national interest; aggregation of multiple sources of existing data combined with new monitoring schemes for fisheries; enhance the functionality with staff reviews leading to training combined with capacity building at CFi level in cooperation with the private sector and staff from FiA; enhance the importance of inter-ministerial committees and exchanges between ministries; enhance ecosystems with monitoring and planning for fisheries and aquaculture; define roles of individual members within community structures and their rights over resources and relationship with FiA; costs and benefits of development projects compared against fisheries; monitoring and evaluation need to emphasise sectorial trends; and enhance financial resources from programme with leverage to attract co-financing bodies while to encouraging local taxation from cooperative or private sectors to contribute to management of fisheries.

Finally the analysis of alternatives for each of the six key issues is presented in Section 8 of the SEA. This is a summary of analysis of alternatives in each key issue section of the study. The analysis shows that alternatives to the proposed CAPFish programme for aquaculture and capture fisheries can often be positive and add value to both CAPFish and the needs of fisheries in Cambodia. There were also a few exceptions, where alternatives are likely to be negative and thus should be avoided.

Part I: Background

2. Scope, rationale and objectives

2.1 Scope

This report is prepared in accordance with reporting requirements outlined in the Terms of Reference (ToR) in the Appendices (No. 1) of this report. In addition, the report corresponds to the Project Agreement/Contract signed between Particip Consortium and the Delegation of the European Union in Cambodia for the execution of **Consultancy to carry out a Strategic Environmental Assessment (SEA) of the Strategic Planning Framework for Fisheries (SPF) 2010-2024 in Cambodia (Specific Contract No. 2016/376383)**. However it is important to note that the Fisheries Administration (FiA) of Cambodia asked the consultants to refer more explicitly in this study to the recent and modified version of their strategy, known as the Strategic Planning Framework for Fisheries (SPF) Update 2015-2024.

The scope of the Strategic Environmental Assessment (SEA) addresses the SPF and the EU-Cambodia CAPFish programme, which represents the major channel of implementation for fisheries and aquaculture development for the period 2017-2022 with an expected contribution of EUR 100 million from the EU (probably more than two thirds of the total funding for the sector including national contributions). The SPF and CAPFish programme includes inland and marine fisheries, including exploitation and conservation of stock and habitats, as well as aquaculture and institutional strengthening, in line with the implementation of Public Financial Management (PFM) and Decentralisation and Deconcentration (D&D) reforms. The SEA should provide opportunities to enhance the environmental performance of the CAPFish programme for the benefit of the sectors across Cambodia. Although the SPF has been finalised by the government, the SEA will also provide suggestions whereby the SPF can be orientated to the findings and recommendations of this report and thereby potentially improve the impacts of the SPF during the next decade.

Fisheries are very important for the population of Cambodia and particularly for inland fisheries is the importance of migratory species (grey and white species). Therefore the SEA considers the wider implications of different key issues for fisheries.

It is important to mention that the Government of Cambodia is officially committed to the application of the SEA process through the Environment and Natural Resources Code of Cambodia, which is being finalised at present. Consultees stated during the development of this study, that the SEA could be officially adopted for the sector and reach beyond the current CAPFish programme influencing other potential developments in the fisheries sector.

2.2 Rationale

For the period 2014-2020 of the EU budget, the EU cooperation with Cambodia will focus on the focal sector "Agriculture and Natural Resources Management", and more particularly the fisheries sector, given the sector's importance and potential in terms of employment, income generation, nutrition and most generally poverty alleviation. The EU's response to address constraints in the fisheries sector in order to increase food security, improve nutrition and foster further economic development is within one large programme being the **Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFish)**, composed of two complementary components i.e. aquaculture and capture fisheries.

The fisheries sector may be vulnerable to serious threats and issues, which may impede the Fisheries Administration's capacity to reach the objectives, set in its strategy. Due to the importance of fisheries for the people of Cambodia, the EU is providing support for the implementation of key national policies to encourage the development of the sector.

As climate change adaptation and resilience scenarios for the country are being taken seriously in Cambodia, the EU has decided as part of CAPFish to also support the dimensions of fisheries policies related to climate change and related environmental degradation. Responses to climate change and degradation will require vulnerability assessments as proposed in national communications to the United Nations Framework Convention on Climate Change (UNFCCC). Climate forecasts could indicate both positive and negative impacts for the project, the environment and its natural resources. Meanwhile, the development of the sector itself could invoke changes leading to environmental degradation and increased vulnerability to climate change. Therefore, the programme and policy for the fisheries sector needs to be assessed in the SEA in relation to forecasts and related policies for environmental and climatic changes.

It is clear that the hydrological regime upon which inland fisheries depend will change, in particular in the case of the Mekong, which receives much of its flow from glacier melt from the Himalayan and Tibetan mountain ranges, which will become increasingly less reliable with climate change. This may cause the annual flooding of the Mekong River and Tonle Sap Lake, flood plains and the Mekong delta to become less predictable, and specifically that for floods and droughts provoking the greatest problems, rather than the severity of the events themselves. This situation is also made worse by dam construction on the upper Mekong (Yunnan province of China), while countries in the lower basin (Lao Republic & Thailand) also plan damming and diversion infrastructure, which would further aggravate the situation for Cambodia, which is located downstream. The impacts of these projects on water regimes combined with climate changes within river ecosystems could be catastrophic for water flows for fisheries and other users, as they represent physical barriers for notably migratory fish species, and could also change nutrient flow dynamics.

Cambodian capture fisheries are especially vulnerable to the changes in temperature and hydrological flows that are associated with climate change. Such changes could have significant impacts on migration, breeding and spawning patterns of fish, while also adding pressure upon critical fisheries habitats. In addition, the future of the fisheries sector including aquaculture developments could also be uncertain due to proposed dams that, if constructed, will also affect hydrological flows in important Cambodian aquatic systems, notably in the Mekong River, Tonle Sap Lake and Mekong delta areas.

Transitioning from subsistence for poorer communities to better management of capture fisheries and modern aquaculture could also have both positive and negative effects upon people, the environment and its natural resources. Assuming that rapid population growth with respective demand for food is unavoidable, the lack of commercialization in fish production through sustainable value chains could be the biggest threat to the environment compounded by climate changes across Cambodia. These factors could be compounded in Cambodia by the following issues:

- population growth and increasing population density combined with worsening socio-economic inequalities
- unsustainable levels of resource use, increasingly driven by the demands of export-led growth rather than nationally consumed resources
- dams on rivers systems, fishery habitat pollution and encroachment
- lack of integrated planning, poor governance, corruption and trafficking of resources.

The SEA proposed by the Royal Government of Cambodia (RGC) and its partner the EU shows both insight and foresight regarding the risks, constraints, opportunities and impacts of the CAPFish's capture fisheries and aquaculture components including their interdependence associated with various environments, climate change scenarios, biological factors and uses of natural resources.

2.3 Objectives

There are potential social and environmental costs with fisheries developments, which need to be planned and assessed prior to implementation through measures such as the SEA for both capture fisheries and aquaculture. Land use policies and plans at all levels are needed to warrant that interventions aim to improve productivity from capture fisheries and aquaculture. These policies, plans and interventions should also account for pertinent biophysical, socio-economic and cultural issues associated with the fisheries sector.

The overall objective of the SEA is to appropriately apply safeguards for Cambodia's strategic goals attached to the EU's fisheries and aquaculture support programme (CAPFish) and the government's policy (SPF), while accounting for environmental responsibilities, equity and inclusiveness, and resilience to climate change factors. The SEA process should ensure sustainable growth through various fishery and aquaculture value chains with appropriate support from the RGC and its EU partner. The SEA process also accounts for future development of appropriate and necessary policy across the fisheries sectors.

The specific objectives can be divided into the following:

- describe, identify and assess potential effects upon the environment and opportunities for implementing the Strategic Planning Framework for Fisheries 2010-2024 and Update 2015-2024 with the National Aquaculture Development Strategy (NADS) ;
- identify and assess key environmental and/or natural resource constraints for fisheries and aquaculture imposed by various sectors including the fisheries sector in Cambodia and the Mekong region;
- provide relevant information (qualitative & quantitative) to decision makers associated with CAPFish (RGC & EU) to assist in the identification and assessment of environmental management and climate change adaptation and resilience needs with the formulation of the CAPFish-capture component, the operational design of the CAPFish-aquaculture component, and possibly a future revision of the SPF update or formulation of a Master Plan for the Agriculture, Forestry and Fisheries sector.

3. Background

3.1 Description of sector strategic documents

3.1.1 Strategic Planning Framework for Fisheries (SPF) Update 2015-2024 and National Aquaculture Development Strategy (NADS)

SPF was first devised for period 2010-2019 and updated in 2014 for the period 2015-2024 (SPF update). The NADS was drafted in 2014 and further refinesthe aquaculture component (clearly mentioned on p 21 of the SPF Update). The SPF and NADS are further developed for the period 2014-2018 under Programme 3 of the Agricultural Sector Strategic Development Plan (ASSDP) 2014-2018, costed at EUR 72.5 million.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) under the SPF Update for 2015-2024 are focusing on fishery production in Cambodia. The strategy's general objectives are to contribute to a competitive, profitable job-intensive and environmentally-sustainable and climate-resilient fisheries and aquaculture sector across Cambodia. This is important as freshwater capture fisheries are located within a multitude of watersheds and floodplains towards the coast covering almost 30% of the nation's territory as they expand during the wet season. In addition, fisheries represent an important economic activity for Cambodia and contribute between 10 to 18% of Gross Domestic Profit (GDP) according to the EU's ToR for this study, and a significant contribution to national food security providing 76% of total animal protein, 28% of fats and 37% of iron intake. In addition, approximately 3 million (20% of the population) are engaged in fisheries in Cambodia on a full-time or part-time basis according to FAO's Country Fact Sheet of 2014.

The SPF is an integrated policy document above all, as it is associated with several overarching strategies and plans, including notably the "Rectangular Strategy" for Growth and the National Strategic Development Plan 2014-18 (NSDP). In addition, the SPF is integrated with international policies and covenants, including the Sustainable Development Goals (SDGs), UN Framework Convention for Climate Change, the Code of Conduct for Responsible Fisheries including Illegal Unreported, Unregulated (IUU) fisheries, and Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries and equivalent national plans and strategies.

Major features of the SPF's integrated approach include co-management with communities (with 516 Community Fisheries already established in the country and along the coast), conservation of fish stocks (in particular during the dry season, thanks to fish sanctuaries deep pools, community fish refuges and community-managed fish conservation areas) and fish habitats (notably the flooded forest), and development of sustainable fisheries resources and aquaculture to contribute to ensuring people's food security and to socioeconomic development in order to enhance people's livelihoods and the nation's prosperity. Meanwhile, emphasis for the sectors is to go from increased production to increased value, where the main driver for increasing production is sustainable intensification of aquaculture.

Other key aspects of the SPF regarding capture fisheries are associated with:

- open access of the fisheries domain (for subsistence / family-sized activities)
- importance for capture fisheries of enhanced rice field fisheries, thanks to the creation of community fish refuges
- joint management with community fisheries, with 516 CFi established across the country and at various levels of development.

The SPF will also develop the fisheries value chain including capture fisheries, although aquaculture will have the major role in increasing production and value. In this area, the SPF encourages the uses of standards such as the Hazard Analysis Critical Control Point (HACCP) or develops exports in competition within a more open market amongst neighbouring countries in ASEAN and associated with the ASEAN Economic Community (AEC). To assist these processes, regulations and services are required including monitoring and evaluation (M&E) for the implementation of SPF. Key human resources and trained personnel with appropriate capacities are the foundation of the SPF to provide its services and means to regulate.

The aims of the Strategic Planning Framework for Fisheries (SPF) Update are defined into four pillars with results, indicators and targets. This shows what will happen and how the sectors will expand in the future under the guidance of the SPF Update policy, which will influence the analysis of impacts and reorientations for fisheries and aquaculture development in the SEA.

Table 1: Pillar, results, indicators and targets of the SPF Update policy

Pillars & Results	Indicators & Targets (in brackets)
Pillar 1 Capture fisheries and management Availability of freshwater and marine fisheries production maintained through sustainable management and conservation of natural resources applying sound environmental principles.	1. Capture fisheries production from all resources Baseline & Target: 600,000 T/y (maintain production) 2. Effective operational community fisheries (CFis) Baseline & Target : 50 CFis (increase numbers) 3. Area under effective conservation Baseline and Target: 26,674ha (increase area)
Pillar 2 Aquaculture: inland and marine Commercially viable and environmentally sustainable aquaculture contributing to food security, socio-economic development, GDP and export earnings	1. Aquaculture production has a 20% annual increase Baseline & Target: 120,000T/yr (increase) 2. Number of registered medium to large scale commercial aquaculture operators that adopt Good Aquaculture Practice Baseline and Targets: 8 (increase) 3. Aquaculture production value Baseline & Target: 240 million USD (increase)
Pillar 3. Fisheries value chain The value chain standards, processes, and procedures are developed in support of food security, sustainable livelihoods, and equitable and profitable trade.	1. Contribution of fisheries sector to national GDP Baseline & Targets: 8% (maintain %) 2. Increase export of regulated fisheries and aquaculture fish/products Baseline & Target: 17,500T (increase) 3. Increase number of medium/large fish processing companies that are certified for good hygiene practices: Baseline % Target: 1 (increase)
Pillar 4. Regulatory and services The RGC policy, regulatory actions and services in the fisheries sub-sector are sufficient,	1. Aquaculture and fisheries are seen as desirable careers. Baseline & Targets: 40 students in related fields in 2014 (increase)

appropriate and enabling.	2. Official letters from ministries to DG of FiA requesting inputs, laws etc. related to fisheries Baseline and Targets: 436 in 2014 (increase) 3. Improvement of perception of fisheries policy and legislation implementation and impact by private sector and community stakeholders Baseline & Target: M&E survey in 2015 (+ve increase over time)

The indicators and targets for each pillar are generally well intentioned as a strategy to advance for the sustainable development of the fisheries sector. However, it is clear that some indicators and targets may be difficult to achieve for various reasons including suggestions, as follows:

- fishery conservation areas are not effectively managed at present. sanitary certificates and Global GAP processes are voluntary and may not be a necessity for markets at present
- waste management issues and good hygiene practices are often not addressed and there is no incentive to move towards better hygiene.

The development of aquaculture is guided by the NADS. NADS aims to encourage commercially viable and environmentally sustainable aquaculture, which will contribute to food security, improved nutrition, socioeconomic development, and growth in GDP and export earnings. NADS identified seven strategic objectives to guide the development of the aquaculture sector as follows:

- increase access to high quality seed for a range of species in demand in local, regional and global markets
- increase access to sufficient and consistent supplies of high quality water, and to reduce flood risks
- ensure widespread availability of sustainably sourced, reasonably priced, high quality feed suitable for a range of species
- improve efficiency, profitability and sustainability of aquaculture production through increased knowledge, skill and organization
- maintain environmental quality and minimize loss from disease
- increase the quality and value of production
- facilitate access to credit as appropriate to the needs, potential and risks associated with aquaculture development.

The focus of NADS is on the development of a diversified aquaculture industry which includes both traditional small-scale fish farming, which involves some 65,000 households, and more commercially oriented small, medium and large sized farming enterprises. Meanwhile, commercial farms will provide the majority of economic growth in the fisheries sector through expansion and value added approaches. In addition the Agricultural Strategic Development Plan 2014-2018 (ASDP) includes fisheries as part of its strategy to enhance productivity, commercialisation and diversification with target growth of approximately 5% per annum. Specifically, the ASDP will focus upon developments in the rice field capture and aquaculture sectors. The ASDP will also build upon established work with development partners addressing laws and regulations and their dissemination, technical capacity building, community fisheries development, technical extension services and fisheries resources conservation.

3.1.2 CAPFish programme

The Royal Government of Cambodia (RGC) and its partner the European Union (EU) are primarily implementing the Strategic Planning Framework for Fisheries Update (SPF) 2015-2024 integrated with the National Aquaculture Development Strategy (NADS), through the "Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFish)". This programme addresses constraints in the fisheries sector relating to the increase in food security, improvement of nutrition and fostering of further economic development. The CAPFish concentrates on fisheries and aquaculture development at inland and coastal sites.

The CAPFish programme is composed of two components, focusing respectively on aquaculture (CAPFish Aquaculture) and capture fisheries (CAPFish Capture). The funding of the programme is as follows:

- EU budget contribution is EUR 100 million
- parallel/joint co-financing by AFD (for the aquaculture component) and Royal Government of Cambodia (current national budget allocation to FiA amounts to between USD 6 and 7 million per year); and potential grant beneficiaries, which will be identified.

The aquaculture component of CAPFish has been scoped and designed, and decided in December 2016. It will be launched in 2017. The capture fisheries component was identified and is being formulated. It should be launched by end of 2017 or beginning of 2018. The overall objective of the programme is derived from the "Vision" set for the sector in the SPF update: to contribute to food security and socioeconomic development in Cambodia in order to enhance people's livelihoods and the nation's prosperity. Meanwhile, specific objectives include sustainable development and climate-resilient and inclusive growth in the fisheries value chains linked to inland and coastal/marine fisheries, and to aquaculture.

The key and expected outputs of CAPFish are summarised as follows:

- sustained inland and coastal capture fisheries production through ecosystem protection resilient, competitive commercially viable and environmentally sustainable aquaculture development with focus on MSMEs with enhanced services and an enabling environment
- increased value, quality, sustainability and safety throughout the fisheries value chain for MSMEs with special focuses on marketing, logistics and infrastructure, and services, regulation and research.

CAPFish will also play a vital food security and nutritional role in Cambodia, as the fisheries and aquaculture sectors make a crucial contribution to the country's economy and the wellbeing and prosperity of a number of households through important sources of nutritious food and animal protein for much of the country's population. Small-scale fish farmers have discovered that adopting new technologies is often not enough to increase their productivity unless the fish value chain for their products is enhanced at the same time. Improved value chains lead to increased production and consumption of fish, especially by poor consumers, and increased income for producers, processors and traders. Finally, it is important to mention that CAPFish is still being formulated and subject to potential refinements and changes.

The priority areas for support and analysis of problems for capture fisheries and aquaculture stated in *EU's Final and Revised Initial Action Document for the Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (*CAPFish*)* are listed below:

- disruption of migratory pathways of important fish species, through hydro-dam development, infrastructure and urban development. Various studies suggest that these disruptions may lead to between 34 and 50% loss of fisheries production[1]
- degradation of river, lake, coastal and floodplain habitats that serve a vital role in providing food, shelter and protection for fish spawning, nursing and feeding
- increasing demand and competition for low value fish for “prahoc” (fermented fish paste), animal and aquaculture feeds
- limited capacity of Government and local communities to conserve the ecological underpinning of fisheries productivity; this is compounded by a plethora of NGOs offering alternative solutions to communities according to varied agendas
- fisheries in the Lower Mekong Basin (LMB) are considered to a great extent 'buffered' against climate change by the exceptionally large aquatic ecosystem biodiversity. Nevertheless, a recent global study of the vulnerability of 132 national economies to the impact of climate change on fisheries ranks Cambodia as 30th most vulnerable in the world[2]. This ranking is mainly due to Cambodia's economic and nutritional dependence on fisheries and low structural capacity.

CAPFish will also aim to capitalise upon the potential of fisheries and aquaculture in Cambodia by addressing the following:

- community fisheries are currently not allowed to benefit commercially from the resource they 'manage' under the CFi: this limits households to subsistence fishing and micro/small scale transformation (smoked fish and fish paste). Currently a sub decree to allow some commercial possibilities for CFi is being discussed following a proposal by the Fisheries Administration.
- inefficiencies in the value chain for both upstream and downstream aspects. Upstream deficiencies for aquaculture include reliance on imported seeds, empirical technology development, etc. Downstream issues include export trade which is increasingly informal due to difficult administrative procedures, poor domestic infrastructure and lack of access to regulated finance. The market is functioning primarily in response to volume rather than cumulative value in a competitive market chain. Value added is extracted by relatively few, and much of this in neighbouring countries
- skills and knowledge relating to handling, quality and food safety are poor; market infrastructure and services are limited and poorly regulated; logistics, storage and preservation are inadequate and wastage is high. The emerging safety standards within ASEAN are likely to constrain both formal and informal exports to regional markets.
- statistics and understanding of the industry and the various value chains are extremely limited.

[1] IFREDI 2013 “Food and nutrition security vulnerability to mainstream hydropower dam development in Cambodia. Fisheries Administration

[2] Allison et al, 2009, "Vulnerability of national economies to the impacts of climate change on fisheries"

CAPFish is aware of and will address the risks associated with intensive commercial aquaculture as follows:

- industry uses large quantities of low value fish in the feed and generates significant pollution
- industry is in direct competition with highly intensive production in Vietnam, prices are low, value added limited and indebtedness common. As the industry further intensifies and concentrates, disease is almost certain to become a significant factor, further reducing returns
- feed conversion efficiency in the commercial aquaculture sector can be improved, and use of low cost fish as feed can be reduced through research and better practice
- low labour costs and a wide range of aquatic species in strong demand in both niche and commodity markets (local, national, regional)
- technology of seed production for high value species is well established, and with appropriate support could take off
- growing recognition of a market based value to natural assets, through blue carbon or payment for ecosystem services.

The CAPFish aquaculture component (already formulated) will be pursuing the following results:

- Making available high quality seed, in line with demand, while dependency from wild seed collection and low quality imported seeds is reduced
- Mitigating risks associated to water availability and climate change impacts
- Making widely available quality feed and efficient feed formulations adapted to a range of aquaculture activities and decreasing dependency on “trash fish” and imported feeds
- Making available sound, situation specific, technical, economic and business advice to existing and potential aquaculture operators
- Attenuating possible negative impact of aquaculture production on the environment through effective environment and disease management systems
- Improving the sanitary condition of aquaculture products
- Making accessible financial services adapted to supporting aquaculture development

3.2 Alternatives being considered

As the Strategic Planning Framework for Fisheries (SPF Update 2015-2024) is a finalised and approved policy document, no alternatives to this policy have been considered under the scope of the present SEA.

The scope of the proposed CAPFish Aquaculture component includes both "pro-poor" aquaculture (small-scale extensive and semi-extensive systems) and more intensive and larger-scale aquaculture relying on high trophic carnivorous species. It will associate investments in aquaculture Research and Development (R&D) and scaling-up of already proven models, following a geographically-differentiated value chain development approach. However, alternatives were provided to the consultant by the EUD in Cambodia based upon their previous discussions with the government for the aquaculture component as follows:

- **support to coastal/marine fisheries versus freshwater fisheries:** focus on coastal and marine or freshwater production systems, which would have been orientated to strong and/or promising fisheries development system for capture fisheries and/or aquaculture
- **support to intensive/commercial fisheries versus small scale fisheries:** support either intensive and commercial systems or small scale fish farming towards production for semi-industrial or industrial production on large farms to meet growing demand for cheaper and accessible food sources
- **support to specific species versus all species:** target specific species for aquaculture, such as snakehead in freshwater, rather than all species currently used by fish farmers.

These alternatives are considered for the operational design of the component, which will be the base of the agreement that will be signed with the *Agence française de développement* (AFD).

As the CAPFish-Capture component is still under formulation, there are still opportunities for alternatives. Major alternatives for capture fisheries, reported to the consultant by the EUD, after previous consultations with the government, considered:

- **support of CFis versus intensive/commercial fisheries:** engagement or not in community-based management with CFis: CAPFish opted to support communities as this is a key pillar of the SPF and a major concern regarding current poor management of significant fishery stocks for the country. The question is whether or not to invest in CFi given their weaknesses and, if yes, to what extent and for which roles.
- **enhance wild stocks versus management of existing stocks in the wild**: engagement or not in wild stock enhancement: CAPFish opted to include wild stocks know as capture fisheries in the SPF, as this is the most important source of fish production at present in the country. The question is whether to engage or not in production and release of fingerlings into the wild (fisheries enhancement is a common practice in Cambodia).
- **apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries:** using integrated water resources management (IWRM) with various approaches: this aspect is related to CAPFish's pillar to sustain captured fisheries production in the SPF through protection of habitats and community capacity-building. However, the question is whether or not to include IWRM in the programme (as it is not in the SPF) and if yes, how would this would be done, such as under the guise of conservation of habitats.
- **promote economic diversification versus only capture fishery activities:** promoting diversification of fishers from fisheries to other sectors and activities: the question is whether the sector can sustain current levels of effort in capture fisheries or if the SPF update will require incentives and measures aimed at reducing levels of effort
- **apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries:** assessing opportunities for "payments for ecosystem services" (PES) in aquatic systems: the PES approach could potentially be a tool to reduce efforts in capture fisheries and is orientated to sustainable fishing. In addition, the PES approach could be integrated during a later phase of CAPFish.

3.3 Environmental policy, legal and planning framework for the SEA

3.3.1 Ministry of Agriculture, Forestry and Fisheries (MAFF)

Policy and legal framework relevant to capture fisheries and aquaculture

The Royal Government of Cambodia has put in place a number of policies and laws to guide and regulate the fisheries and aquaculture sectors. These policies and laws are attached to the Ministry of Agriculture, Forestry and Fisheries (MAFF). Since these sectors are related, there are mutual policies and laws as well as those which are specific to capture or aquaculture presented in Table 2 below.

Table 2: Existing relevant policies and legal frameworks for capture fisheries and aquaculture

Policy and legal instruments	Applicable sector (s)	Main features
The Rectangular Strategy for Growth, Employment, Equity and Efficiency in Cambodia (2004) & The Rectangular Strategy in Cambodia for Growth, Employment, Equity and Efficiency phase III:2013-2018 (2013)	Multi-sectors including food security and fisheries	It is a national policy framework for "Growth, Employment, Equity and Efficiency". The policy is related to principally the agricultural sector including fisheries, where fisheries are clearly defined as crucial to people's livelihoods and the national economy of Cambodia.This phase of the strategy provides a strong emphasis on fisheries for nation growth by: aiming to boost fish production for domestic consumption and export markets; enhancing research and development for fish breeding, fish health, feed production, and farming systems for aquaculture; and provision of laws for sanitary and phytosanitary measures to notably avoid fish diseases. Overall this policy appears to be more orientated to aquaculture development.
Green Growth Master Plan (GGMP) & National Green Growth Roadmap (2009)		The aim of the green growth policies are to link together the country's strategies with green growth. The policies set out interventions for the medium to long-term based upon green technology and green energy. In addition the policies aim to strengthen international competitiveness, develop the capacity of trade services, and support businesses entering the global green economy. However, the policies do not discuss trading possibilities, such as carbon, related to climate change and mitigation; although they do facilitate discussion for potential policy responses for trading.

Policy and legal instruments	Applicable sector (s)	Main features
Agricultural Sector Strategic Development Plan (ASDP) for 2014-2018	Agricultural development including fisheries (programme III)	This 5-year plan is the base of the MAFF programme budgeting. It is structured in programmes, with programme III corresponding to the implementation of the SPF Update. It includes important aspects of development of fisheries and aquaculture through: enhancement of production, diversification and commercialisation; promotion of production with animal health; sustainable management of fisheries and forests (important for flooded areas including mangroves); and institutional capacity building. The ASDP has some similarities with the Rectangular Strategy, which could encourage harmony between the strategy and this plan, and be potentially advantageous for fisheries development.
A Statement of the Royal Government on National Fisheries Sector Policy (2005)	Fisheries, Aquaculture and post-harvest fisheries	Policy that provides a broad focus on "management, conservation, and sustainable fisheries contributing to people's food security and socio-economic development, thereby enhancing people's livelihoods and the nation's prosperity." It emphasizes upon: management and development of fisheries, management of community fisheries and family fisheries, aquaculture development, fishery processing development, fisheries conservation, fisheries institutions, and budgeting and infrastructure development.
The Law on Fisheries (2006)	Fisheries, Aquaculture and post-harvest fisheries	The law provides a vision to: ensure sustainable fisheries management; enhance the development of aquaculture and management of fisheries post-harvest, and to promote livelihood development with protection of environmental and biodiversity conservation. The law extends to all fisheries: natural, artificial and aquaculture in Cambodia. The revision of this law is envisaged in the future. To date a draft has mostly looked at aquaculture, while FAO support will generally look at international obligations regarding marine fisheries and IUU issues.
Policy paper on Gender Mainstreaming Policy and Strategy in the Fisheries Sector (2007) & Gender Mainstreaming Planning Framework 2016-2020 (2015)	Gender in fisheries sector: captured fisheries, aquaculture and value chain of fisheries	The policy provides guidelines for the enhancement of gender equality in the fisheries sector through active cooperation of both women and men for the opportunity to contribute and benefit equally from the activities of all sub-sectors in the fisheries sector. The policy provides a basis for gender

Policy and legal instruments	Applicable sector (s)	Main features
	products	mainstreaming and a holistic approach to fisheries sector and co-ordination. It provides compliance goals for national and international endeavours to promote fisheries and rural development in Cambodia.
Sub-decree on Community Fisheries Management (2007)	Community Fisheries	Determines the rules and legislative procedures for establishing and managing community fisheries throughout the Kingdom of Cambodia. It provides a legal framework that facilitates the establishment of community fisheries. Its objectives are to; (1) manage and protect fisheries areas, for both inland and marine areas including inundated forest and mangrove forest areas; (2) manage fisheries resources in a sustainable manner and ensure equitable sharing of benefits for Khmer citizens; (3) increase understanding and recognition of the benefits and importance of fisheries; (4) improve the standards of living and contribute to poverty reduction (alleviation).
The Strategic Planning Framework for Fisheries (SPF): 2010-2019 (2010) and Update for 2015– 2024 (2015)	Fisheries including aquaculture and post-harvest	Fisheries development plan used as the planning tool to direct fisheries development and action plans. It provides key goals regarding fisheries resource management and development and sustainable livelihood and food security of people and national economic development. It provides the principles for management and development of the following: capture fisheries (domains and associated resources are in healthy and resilient conditions and sustainably managed), aquaculture, processing, and community fisheries being healthy and valuable sources of food and employment.
The CAMCODE: Cambodian code of conduct for responsible fisheries (2010).	Fisheries	CamCode is more general and not like the fisheries policy. It generally directs to “how” things should be done while policies define “what” should be done over a limited period. It is different from the law on fisheries, while it complements the laws and supports the implementation of laws. Generally the CamCode is composed of principles and guidelines for the development of policies and planning. It assists the implementation of programmes or interventions in fisheries development and conservation including

Policy and legal instruments	Applicable sector (s)	Main features
		research, fishing operations, aquaculture and post-harvest development. In addition, this Code does encourage good aquaculture practices, as it promotes sustainable resources management, environment, conservation and livelihood development, rather than just profitability. This Code is under the auspices of FiA, whilst the private sector across the value chain is obliged to apply this code. N.B. This is an official Code and has more weight than Guidelines and also constitutes the 3rd Volume of the SPF. The good intentions of CAMCODE have not come to fruition as yet, as the code is generally not used by FiA to encourage better management of CFi and aquaculture development. However, this code exists and is official, and could be used immediately with enormous potential for the outcomes of the CAPFish programme.
Action Plans on Building Resilience to Climate Change: A Strategy to Respond to Impacts of Climate Change 2014-2018 (2014) & Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries 2014-2018 (CCAFF), May 2014)	Agriculture, including fisheries	Provides a vision of fisheries sector with responsible climate change mitigation and adaptation measures for sustainable fisheries and resources management. Aim is to increase fisheries productivity, fish stocks and aquatic resources to ensure food and nutrition security and contribute to poverty alleviation. It also addresses concerns for transboundary issues: hydropower and diversification of rural economy from fisheries in Cambodia. The plans will promote aquaculture production systems and practices that are more adaptive to climate change with climate resilience of wild fishery resources. Adaptation will also focus upon the enhancement of fish and fisheries products in the entire value chain in response to climate change impacts.
Drafted National Strategic Plan for Aquaculture Development (NSPAD) in Cambodia for 2030 (February 2014)	Aquaculture	Focus on quantity, quality and safety of aquaculture products meeting nutritional needs for the poor and increasing demand for high value fish products for national, regional and international markets. Efficient use of low value fish and need for high quality fish feeds formulated to produce high value species for regional and global markets.
Agricultural Extension Policy in Cambodia (2015)	Agriculture including fisheries	Provides directions for effective service delivery to famers and farming communities including fisheries sectors. Aim to improve decision-making for production operations and commercialization of agriculture to generate and increase household incomes. It also aims

Policy and legal instruments	Applicable sector (s)	Main features
		to build upon the foundation of economic growth and accelerate poverty reduction.
Forest Law of 2002	Forestry	Defines the framework for management, harvesting, use, development and conservation of forests in Cambodia

Other relevant institutions and agencies for fisheries and aquaculture

The other relevant institutions for the capture fisheries and aquaculture sectors are listed below:

- Royal University of Agriculture (RUA)
- Prek Leap National School of Agriculture
- National Agriculture College of Kampong Cham
- Cambodia Agricultural Research and Development Institute (CARDI)
- Inland Fisheries Research and Development Institute (IFREDI)
- Marine Aquaculture Research Development Centre (MARDEC)
- National Research and Aquaculture Development Institute (NARDI)
- Bati Fish Seed Station, Prey Veng
- Cambodia Development Research Institute (CDRI)

Institutional framework for Ministry of Agriculture, Forestry and Fisheries (MAFF) and Fisheries Administration (FiA)

Currently the overall responsibility of capture fisheries and aquaculture in coastal and inland areas falls under the Ministry of Agriculture, Forestry and Fisheries (MAFF) and specifically the Fisheries Administration (FiA) within MAFF. These are shown in the organogram in **Figure 1**. Meanwhile, the MAFF, apart from FiA, is also divided into other important sections:

- General Directorate of Ministry
- Forestry Administration
- General Directorate of Agriculture
- General Directorate of Rubber

The FiA is divided into various Departments, and deconcentrated offices composed of inspectorates, cantonments and divisions (not illustrated in organogram in Figure 1, although they will be within the urban and provincial fisheries box).

The overall objective of FiA is to support sustainability of market oriented fish production and added value for improved food security and household income. FiA also has responsibility for climate change and resilience issues within the MAFF structure and through the Strategy to Respond to Impacts of Climate Change 2014-2018 and the Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries 2014-2018. The General Directorate of Agriculture is part of the MAFF and very important in relation to crop production and associations with irrigated water supplies, pesticides and fertilisers. Meanwhile, Forestry is also part of MAFF and important for notably soil protection in watersheds in association with fisheries, as well as timber production for Cambodia.

Figure 1: Organogram for FiA

3.3.2 Ministry of Environment

Institutional and policy framework for the management of environment and natural resources

Management of the environment and natural resources is assigned to the Ministry of Environment (MoE) to cover water quality and environmental monitoring, environmental standards, pollution management including wastewater discharge licensing, and environmental impact assessments (EIAs).

Aquaculture is not expressly mentioned among the activities that are subject to the EIA system. However, the establishment of any activity involving logging or situated in sensitive areas of specific sizes, such as concession forests or flooded and coastal forests should undergo an EIA. Meanwhile, the Fisheries Law makes provisions for inland aquaculture authorisation by MAFF and control of water quality and discharge of waste matter from aquaculture. As the EIA legislation is not specific for aquaculture, this has left a lacuna in the legislative system. Meanwhile, monitoring of environmental plans for aquaculture, similar to the case of industrial units in Cambodia, is often not achieved.

There are other important general directorates and departments within this Ministry with responsibility to regulate, coordinate and monitor different sections of the environment and include:

- General Directorate of Administration for Nature Conservation and Protection (GDANCP) in charge of protected area policy implementation, regulations and awareness (Protected Areas/PAs etc.)
- General Directorate of Environmental Protection (Environmental Impacts Assessments (EIAs)…)
- General Directorate of Environmental Knowledge and Information (awareness)
- General Directorate of Administration and Finance (staff and budgets)
- General Directorate of Local Community (community development)

In addition, there is the new structure called the National Council for Sustainable Development (NCSD) which has a General Secretariat of Sustainable Development (GSSD) at MoE in charge of Climate Change, green economy, science and technology, biodiversity conservation and planning. The NCSD and its GSSD are associated with the Prime Minister's office, therefore by definition this is a high level political group. According to authorities, the inter-sectoral coordination benefits are limited at present, as often ministries prioritise their own interests. However, they could potentially play a role in addressing some key issues identified in the SEA, such as on water allocations between sectors, deforestation and the use of agrochemicals which are inter-sectoral issues affecting both water quality and fisheries. Overall the MoE is sometimes not effective for environmental protection when larger economic and political interests for example mining, hydropower and irrigation schemes take preference over fisheries.

National Environmental Legislation

There is key legislation associated with the Law on Environmental Management and Natural Resource Conservation (1996) as well as other key guidelines and strategies listed below:

- Law on Protected Areas Management Plan (2008)
- Environmental Guidelines on Solid Waste Management in the Kingdom of Cambodia (2006)
- Royal Decree on the establishment and management of the Tonle Sap Biosphere Reserve (TSBR) (2001)
- Sub-decree on Solid Waste and Wastewater Management (1999)
- Sub-decree on Water Pollution Control (1999) and Water Quality Standards
- Sub-decree on Environmental Impact Assessment, 1999 (and under Draft)
- Environment and Natural Resources Code of Cambodia and its Chapter on Fisheries (Draft Version 6), which also proposes SEAs for Cambodia.

3.4 Key environmental and climate change policies

The environmental and climate change policies can have direct or indirect impacts on the development of the fisheries sectors. These policies are often orientated to natural resources management in which fisheries are located. In addition, the climate change documents listed in this section are composed of action plans and strategies which will have an impact upon the development of capture fisheries and aquaculture in the future. The key documents influencing fisheries and aquaculture are listed below:

- Environment:
  - National Biodiversity Strategy and Action Plan (2016)
  - National Protected Areas Strategic Management Plan (draft).
  - National Environment Strategy and Action Plan 2016-2023 (draft, 2016)
- Climate Change:
  - Cambodia Climate Change Strategic Plan 2014-2023
  - Climate Change Prioritised Action Plan for Agriculture, Forestry and Fisheries Sector 2014-2018 (MAFF Technical Working Group on Agriculture & Climate Change)
  - Climate Change Mainstreaming Guidelines for Sub-national Administrations 2015
  - Cambodia's Second National Communication to UNFCCC, 2015.

3.4.1 Ministry of Water Resources and Meteorology

Institutional and policy framework for the management of water resources

The Ministry of Water Resources and Meteorology (MOWRAM) has the mandate to manage, lead and supervise the implementation of the law on water resources management. MOWRAM plays a principal coordination role in Cambodia for all projects/programmes related to water resources management and development.

MOWRAM, in collaboration with other concerned agencies, may designate any floodplain area as a Flood Retention Area (FRA) for the purposes of flood protection. Within a Flood Control Area (FCA), MOWRAM with other agencies and local authorities will develop plan(s) for flood prevention and mitigation to ensure the safety of humans, animals and property. Effectively, designated FRAs will exist upstream from FCAs, as they are used to manage storm water runoff to prevent flooding and downstream erosion, and improve water quality in adjacent rivers, streams, or lakes. Meanwhile within FCA there are flood management systems put in place to assist the control of regular flooding events. In addition, MOWRAM can also suspend activities which could damage flood protection works or obstruct the natural flow of water in these given areas.

With relation to international rivers management, MOWRAM pays attention to optimum and effective use of the Mekong River Basin for all sectors including navigation and transport, which is consistent with the governing principles of the Cambodia National Mekong Committee (CNMC).The CNMC is a national institution operating under direct supervision of MOWRAM and linked to the Mekong River Commission (MRC), coordinating the management, preservation, conservation and development of water and other related resources in the Cambodian part of the Mekong River Basin, except the Tonle Sap lake area under the auspices of the Tonle Sap Authority or TSA (see below).

Attached to MOWRAM is the TSA established by the Royal Government of Cambodia in 2009. The CNMC was responsible for all issues related to the Mekong including the Tonle Sap prior to the development of the TSA, which now coordinates all government and NGO activities in the Tonle Sap. TSA is an inter-ministerial organization, chaired by MOWRAM and mandated to coordinate the management, conservation and development of the Tonle Sap Lake region. Since 2010, TSA has focused on natural resource management in the following areas: hydrology, flooding, agriculture, fishery, degradation of water quality in dry season and livelihoods in floating villages. Since 2011 and with the support of the International Office for Water and French decentralised cooperation support, the TSA has started to develop pilot IWRM within the watershed of the Stung Sen River. However, the TSA only represents the interests of government agencies and do not necessarily account for either communities or civil society. Meanwhile, communities and civil society from the Tonle Sap are often not involved in conflict resolutions and the determining of access to fisheries according to Johnston et al. of WorldFish in 2013.

Overall the MOWRAM and authorities attached to it such as TSA are quite weak as they is little or no monitoring or reporting on water quality or quantity issues. Again this is linked to political motivations and orientations at regional and national levels towards the development of industry in preference to environmental protection and safeguards for fisheries.

Legislation and policies for the management of water resources

There are laws and policies including MRC agreement that support sustainable use of water resources, equitable water sharing and poverty alleviation and include the following:

- The National Water Resources Policy (2004)
- Law on Water Resources Management (2007)
- National Policy on Water Resources Management (2004)
- Proclamation on the establishing community-based water management - Circular No. 1 for the implementation of sustainable irrigation policy (2000)
- Sub-decrees on the procedure for establishing a Farmer Water Use Community (FWUC) (2015),
- Sub-decree on River basin management (2015)
- Integrated Water Resources Management-based Basin Development Strategy 2016-2020 for the Lower Mekong Basin and the MRC Strategic Plan 2016-2020 (replacing the Basin Development Strategy for 2011-2015)
- Mekong River Commission (MRC) Agreement, 1995 (see below).

Mekong River Commission (MRC)

The Mekong River Commission (MRC) is the only inter-governmental organisation that works directly with the governments of Cambodia, Lao PDR, Thailand and Viet Nam to jointly manage the shared water resources and the sustainable watershed basin development of the Mekong River. As a regional facilitating and advisory body governed by water and environment ministers of the four countries, the MRC ensures the efficient and mutually beneficial development of the Mekong River watershed, while minimising the potentially harmful effects on the people and the environment in the Lower Mekong Basin.

The MRC is a platform for water diplomacy and regional cooperation in which member states share the benefits of common water resources despite different national interests within the watershed. It also acts as a regional knowledge hub on water resources management that helps to inform the decision-making process based on scientific evidence. In addition, the MRC looks across all sectors, including fisheries sustainability, identification of opportunities for agriculture, freedom of navigation, sustainable hydropower, flood management, preservation and conservation of important ecosystems within the watershed basins. It also helps its member states face the future effects of more extreme floods, and prolonged drought and sea level rise associated with climate change. In providing its advice, the MRC aims at facilitating dialogue among governments, the private sector, and civil society.

It is one of the few international organisations that are governed by a specific set of rules developed to coordinate technical cooperation among its members. Since its establishment in 1995 by the signing of the Mekong Agreement, the MRC has adopted a series of procedures, namely the Procedures for Water Quality, Procedures for Data and Information Exchange and Sharing, Procedures for Water Use Monitoring, Procedures for Notification, Prior Consultation and Agreement, and Procedures for Maintenance of Flows on the Mainstream, to provide a systematic and uniform process for the implementation of this accord within their mandated watershed basin of the mainstream.

The MRC Secretariat is the operational arm of the organisation with National Mekong Committees in each member state coordinating work at the national level. China and Myanmar, the upstream countries of the Mekong River Basin, are Dialogue Partners of the MRC. The Commission engages a wide range of stakeholders in its strategies, plans and

work. Meanwhile, the MRC is funded through contributions from the four Member Countries and development partners (country governments, development banks, and international organisations).

The effectiveness of the MRC is questionable as each national Commission has no power over other members. Effectively the sovereignty of each country holds with regard to use of water on the Mekong. In addition, bilateral agreements between countries such the recent Laos and Cambodia accord to sell electricity supplies may not prioritise or consider fishery issues above interests to secure national energy supplies.

3.4.2 Other important Ministries and their institutions and national strategies

The other potentially important Ministries and institutions for the SEA process may include the following:

- Ministry of Lands, Urban Planning and Construction (Lands Dept.)
- Ministry of Commerce (imports/exports in fish related products)
- Ministry of Industry and Handicraft (standards in fish related products and industrial waste)
- Ministry of Mines and Energy
- Ministry of Rural Development (water supply and sanitation)
- Ministries managing customs and frontier security e.g. police/military.

Important national strategies and plans to consider include the following:

- Trade SWAp Road Map 2014-2018
- National Strategic Development Plan (NSDP) 2014-2018
- Vision 2030.

The **Ministry of Energy and Mines (MEM)** governs the development of renewable energy including notably hydropower. The key strategic documents for renewable energy development and this Ministry are the NSDP listed above and the Rectangular Strategy. Meanwhile, two important aspects of these policies for electricity which could be conflicting between water needs/users and electricity production are:

- focusing on technical and economic efficiency and minimize environmental and social impacts;
- (realizing) the goal by 2020, whereby all villages in the Kingdom of Cambodia will have access to electricity supplied by the national grid and other sources.

It is important to note that the MEM is quite a secretive organisation and does not appear to cooperate with fisheries. During the SEA it was not possible to find a person from mines or energy to talk about conflicting interests between energy (hydropower) and mines (gold and other mines using chemicals) with fisheries.

3.5 Description of important international strategies, guidelines and initiatives

Important international strategies, plans and codes to consider for the SEA include the following:

- Sustainable Development Goals (SDGs) and 2030 Agenda for Sustainable Development in Cambodia (2015)
- RAMSAR Convention, ratified by Cambodia in 1996 (although the Wetlands Plan of 1996 remains in Draft)
- ASEAN Sectoral Integration Protocol for Fisheries & Road Map for Integration of the Fisheries Sector
- FAO Code of Conduct for Responsible Fisheries, 1995
- International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU), 2001
- FAO/ILO Guidance on Addressing Child Labour in the Fisheries and Aquaculture Sector
- ASEAN Sectoral Integration Protocol for Fisheries (in particular the Road Map for Integration of the Fisheries Sector)
- Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication by FAO (2014) and adopted by RGC
- Guidelines on ASEAN Good Aquaculture Practices (ASEAN GAqP) of 2015
- Intended Nationally Determined Contribution (CC Adaptation) 2016-2023.

3.6 Key issues identified and prioritised

During the scoping study, the team undertook literature reviews and field visits to Kampong Chhnang inland area on and next to the Tonle Sap River and to coastal areas of Kampot, to observe existing activities and start initial SEA discussions with various key stakeholders. In addition, key persons from institutions at the national level including donors, NGOs, MAFF (crops and FiA) and other departments, as well as the Ministry of the Environment and its Climate Change Department were interviewed. This provided for the draft of the first list of key / strategic issues for t**h**e sector.

In addition, during the SEA, some of these stakeholders and additional interested parties were further consulted and additional site visits conducted to observe the key issues. Key issues are sometimes also associated with interactions with various cross cutting sectors for a broad range of environmental issues with one or several key entry points. In conjunction with the entry points and key issues the institutional, policy and legislation frameworks are assessed in detail in the next part of the report. These sections will also address capacity issues, as well as any financial, technical and regulatory support related to the key issues identified in this SEA. The assessment will also gauge, where appropriate, if the government is the best provider of support.

The key and prioritised issues for fisheries and aquaculture, which are addressed in the SEA are based upon a broad range of issues flagged by stakeholders and in various studies and reports. All the issues were reviewed and validated by a technical committee under the auspices of the EUD in discussion with the consultants to provide the final approved list for the SEA. The final list of key issues was subsequently divided into high and medium priority issues based upon discussion during the SEA workshop with stakeholders and assessment of the importance of issues with regard to the development of fisheries and aquaculture in Cambodia. The high priority issues have an immediate impact upon the production of fish

and fish products and the surrounding environment, while medium priority issues are not immediately detrimental, although they could become high priority in the future. The high and medium key issues are placed into their respective categories, discussed and analysed in detail in Section 7 and summarised below.

High Priority Issues

- **Key Issue 1: Hydropower and irrigation developments:**

Cambodia shares the Mekong River and watersheds with several countries, which are very important for water for agricultural irrigation schemes and fisheries for Cambodia, especially for wild fish migrations and rice-field fisheries production, which is significant for the country and depends on the natural flood of large areas of rain-fed rice fields during significant period of time. However, the Government of Cambodia sees hydropower as a priority area for development in the energy sector, although concerns have been raised by civil society and communities that inadequate attention is being paid to the negative impacts upon fisheries. Lao PDR is also building and planning new hydropower schemes as it sees energy as one of its major sector of exportation, which will also have an impact on downstream countries like Cambodia. These schemes may provide electricity supplies to Cambodia and the region, but at what cost to the fisheries in the country. Therefore the development of hydroelectric and irrigation dams will require careful scrutiny and planning to avoid any conflicts with countries sharing water resources, which are vital for fisheries, or between fisheries and agricultural sectors. In addition hydropower developments could lead to greater water retention to secure energy production, and thus decrease downstream flows, compromising water availability for other sectors and also compromising ecological water flows. These factors could also be exacerbated by climate change with fluctuating rainfall patterns and flows in rivers.

- **Key Issue 2: Poor management of fisheries and livelihoods:**

The Communities Fisheries (CFIs) were created after the fishing lots system was abolished and completed in 2012 to manage open access areas and create conservation zones. The majority of these CFis across Cambodia remain weak and are not fully operational. Often these associations lack knowledge of, or means to enact, community-based management associated with natural resources management of their fisheries. CFis often do not have the capacity and sometimes lack the courage to take risks to try to control illegal fishing in their areas associated with net and mesh sizes, and quantity of undersized or “trash” fish catches, often used as feed for aquaculture. In addition, competition for small fish for aquaculture for exports could effectively increase the cost of fish for feed and the cost of fish for food in Cambodia. In addition, habitat destruction through clearances of principally flooded forest by villagers will also have detrimental effects upon co-management of fish production by the state and fishers leading to the loss of biodiversity, potential soil erosion from clearances, damage to and/or loss of spawning areas, and pollution of water if agricultural chemicals are used.

The results of these poor management practices are less aquatic resource for fishers and traders in Cambodia and reduced potential financial benefits for the country. Overall the impacts of poor management of fisheries on livelihoods will affect levels of poverty and food security for the population including nutritional advantages of fish consumption, notably proteins and iron intake. Livelihoods are composed of key socio-economic factors for fishing communities, which have a direct relationship with fishery resources management and the environment. If poor management of fisheries continues, it would likely have adverse effects upon livelihoods and worsen the overall situation for communities and the environment in a

downward spiral. In conjunction with fisheries management, the capacities of government institutions to address these issues are also discussed.

Medium Priority Issues

- **Key Issue 3: Chemical and pollution risks for aquatic environment and fisheries:**

Chemicals are often used principally for crop and some livestock farming, and are important components for the modernization of these industries, but equally present local pollution threats for fisheries. In addition, intensive aquaculture feeds and chemical wastes, such as pesticides and antibiotics, released from units and processing facilities could also have serious localised impacts upon fisheries and the environment. Meanwhile, nutrients in water bodies could also provoke eutrophication of aquatic environments. In addition to pollution from notably agricultural sources and potential risks from aquaculture, chemical and pollution in localised water bodies can often derive from urban settlements and some industries in towns, as well as mining in some rural areas, e.g. mercury issues. These wastes regularly flow into aquatic ecosystems without any form of treatment. It is important to mention that lower flows, associated to some extent with climate change, but also linked increased water uses by other sectors (hydropower and irrigation) could lead to higher concentrations of some pollutants.

The environmental impacts of chemicals and pollution upon fisheries can follow two courses with negative outcomes. Direct impacts upon fisheries are associated with pollutants and chemicals in water bodies, which can poison fish species and risk being transported through the food chain to humans. Meanwhile, indirect impacts are caused by pollutants provoking eutrophication, which can reduce dissolved oxygen and increase turbidity, often during dry seasons, and also lead to fish kill in wild and aquaculture stocks. These issues would be notable where there is intensive agriculture in the watershed, near urban areas, and potential concentrations of aquaculture units in the future, and worse with a combination of these factors. Although often localised, the impacts may be significant for the larger populations of fishers in key fishing areas. Meanwhile, fish products consumed near polluted fisheries pose risks of poisoning and sicknesses through the food chain for potentially large numbers of people near towns and those fisheries. This problem for humans could also be exported from larger isolated and polluted fishery sites to other areas as fish products.

- **Key Issue 4: Effects of deforestation upon rivers and lakes and within coastal areas:**

Cambodia's deforestation has been accelerating over the past decade, largely due to industrial plantation expansions, logging, and conversion for agriculture or under the guise of agriculture to access timber, and potential issues with tourism development. Deforestation produces conflicts for aquatic ecosystems and in particular for some fisheries. The principal impacts are associated with deforestation of flooded forest and shrub land in area such as Tonle Sap Lake area leading to negative impacts upon fish spawning and feeding grounds. Meanwhile deforestation in watersheds can provoke sedimentation and reduce migration passages. Deforestation within watersheds generates sediments providing food for fish with positive results, although deforestation within watersheds can also serious affects the buffering capacity of forest and their water flow regulation processes, which are advantage to maintain flow regimes in watercourses. On the coast, the deforestation of mangrove forests is significant as these areas are often rich breeding grounds for wild fish stocks. In addition, mangrove losses could lead to potential serious coastal erosion and damage to existing or proposed infrastructures associated with capture and aquaculture fisheries.

Deforestation has often been associated with land occupations and Economic Land Concessions (ELCs) and associated conflicts manifesting in various parts of the country including key fish areas and flooded woodlands. This situation may escalate if more parcels of land are demarcated by land speculators. Similarities have been observed and may continue on the coast, where land has high value for property development including tourism. In addition, trees are also cleared by villagers for farming purposes, and the collection of timber and wood being significant in some coastal mangrove areas. These rationale for deforestation will have direct and indirect impacts upon fisheries in the near to long-term with particular significance for small-scale fishers and production from fisheries.

- **Key Issue 5: Climate change and its interaction upon aquatic ecosystems :**

Climate change interactions upon the aquatic ecosystems associated with capture fisheries and aquaculture production includes erratic and unpredictable precipitations linked to flooding (associated with glacial melt in the Himalayas and changes in rainfall patterns) and droughts events in lakes and rivers across Cambodia. This phenomenon creates sequential effects throughout interrelated water catchments and systems effecting water levels and temperatures in deep pools in rivers, rice-fisheries stock pools and pond systems. Climate change can also interact with cage aquaculture production too; when ambient temperatures are higher, particularly during the dry seasons when water bodies are sometimes lower than average and naturally warmer. Climate change could also provoke saline intrusions with rising seas levels affecting freshwater fisheries near the coast, as well as flooding/destruction of coastal aquaculture units. Overall climate change interactions with fisheries could reduce the production of existing fisheries where some fish species in both terrestrial and marine habitats could be definitely lost in the relatively near future.

The relationship between climate change and fisheries development is associated with carbon footprints from energy needs for the industry, where fossils fuels are used, and includes energy sources for the manufacture and transport of feeds, materials and production processes for fisheries. Meanwhile, carbon offsetting schemes including planting and conservation of inundated forest/shrub land and mangroves could offer a good opportunity from fisheries developments associated with policies and programmes for capture fisheries and aquaculture.

- **Key Issue 6: Unregulated imports of fish and fry:**

Cambodia is a transit country for many different types of products including fish and fry moving through the AEC region associated with principally Vietnam and Thailand, which has created and provoked unregulated imports from neighbouring countries. This situation is compounded by weak and/or unaware border controls into the country.

Potential dangers of unregulated fish and fry importations for Cambodian fish species and fisheries derive from introductions and translocations of potential invasive and exotic species. These species can seriously damage natural aquatic habitats, compete for food and wipe out native populations of fish. In addition, the problem of hybridisation and maintenance of genetic stocks of native species in Cambodia is also at risk. Threats also come from some exotic fish species which are already present in collections across Cambodia including some species of fish which were purposely introduced to the wild for commercial reasons in the past. In addition, some exotic species and intensive populations of fish in aquaculture cages and ponds could provoke the transmittance of diseases, if they escape, potentially affecting wild stocks and other aquaculture units, as well as national fry hatcheries. These circumstances would have negative impacts upon aquatic biodiversity and the overall economy of fisheries in Cambodia. Fish and fish product imports can also distort markets and frustrate local fishers and fish farmers with potential serious socio-economic impacts,

which is an important part of the equilibrium between fisheries management practices and fishers in Cambodia.

Lower Priority Issues

In addition to key high and medium priority issues presented in this report, the SEA also collated other issues, which were ranked as lower priority regarding the secure production of fish and fish products in relation to impacts upon the environment in Cambodia. These issues are not analysed in detail, but still carry importance or potential importance for capture fisheries and aquaculture.

Two of the lower priority issues include sand dredging, and landmines and unexploded ordnance, which were classified and reclassified as lower priority with some details and justifications below:

- **Sand dredging:**

During the last 10 years there has been a rise in the exploitation of san ds from beaches for landfill, as reported by UNIDO from Sihanoukville and Koh Kong areas, which are often sent to Singapore, while sand-dredging of rivers (lower stretches of localised parts of Tonle Sap and Mekong Rivers) is used for construction sands, which are mainly consumed in Cambodia, but can also be exported to neighbouring countries like Vietnam. Based upon observations by scientists from Fisheries, the disturbance of the coast by dredging for sand can encourage fish due to nutrient distribution into the water, although it can provoke coastal erosion of localised areas of mainly sandy shorelines. Meanwhile within rivers the disturbance is localised within wide parts of rivers which have been less important for fish production compared to the upper reaches of rivers and the lakes in Cambodia, which have not been dredged at present. In addition, disturbance will allow downstream and upstream flows of nutrients providing food for fish, although there could be localised impacts on spawning grounds in some parts of lower stretches of rivers. Similar to coastal zones, the key issue is erosion, where banks collapse and take land used for agriculture and homes, although this would again provide nutrients for fish. Meanwhile, Worldfish has stated, with reference to the Gange River, that impacts associated with erosion in the riverbed could be very important for the expansion of the flood. According to a spokesperson from Ministry of the Environment, “the Ministry of Mines and Energy has all the information to see if all of the licenced companies have done all of the necessary steps” and went to add that the Ministry of Mines and Energy knows the environmental impacts of dredging, but should work more closely with MoE for EIAs (Phnom Penh Post, 2016). However, it is evident that the process has not been completely transparent. Meanwhile the issue could gain higher importance if dredging was to multiply further, but remains a lower priority at present for fisheries.

- **Landmines and unexploded ordnance:**

As a result of decades of conflict an estimated 4 to 6 million landmines were laid during the civil war. In addition there is unexploded ordnance from principally bombing campaigns. Concentrations of material are found in the north-west and south-east parts of the country. In 2006, landmines and unexploded ordnance had over 1000 victims per year, although this has dropped significantly in recent years to 100 or more, and affects principally farmers according to Cambodia Mines Action Centre (CMAC), and would include some fishers. Therefore mines and unexploded ordnance found on agricultural lands including water bodies still pose some potential dangers to rural communities, although the impact on fisheries development is a lower priority.

The remaining summaries for lower priority issues for fisheries development are as follows:

- conflicts between navigation needs with fisheries and aquaculture infrastructures in inland and coastal sites
- coastal tourism development on Cambodia's southern coastline may limit access for private and public fish landing sites while also provoking the risk of mangrove clearances carrying capacities of water bodies for fisheries and aquaculture are important factors which need to be established to assess natural carrying capacity limitations of areas/sites to sustain fisheries and aquaculture, before damage to ecosystems arises
- labour issues, such as the need to employ foreign specialists, as limited numbers of Cambodians may have the required technical knowledge for extensive aquaculture development. This issue may provoke social conflicts with local communities and increase labour costs
- unclear tenure rights over water bodies including coastal aquaculture areas within public domains (requiring legislation) and potential conflicts with aquaculture regarding space for jetties, landing sites and cages or ponds (land areas) and sites used by local communities/fishers
- conflicts between aquaculture development and hotels/lodges (tourism development and aesthetics/landscapes) on the coast of Cambodia and potential natural stretches of river, elsewhere
- local fish supplies from aquaculture would increase and may lead to fall in prices for traditional fishers
- increase in demand for local services notably accommodation, waste disposal, security, potable water and power at landing and aquaculture sites
- potential disruption of the navigation systems on lakes and along the banks of the major rivers e.g. Mekong and Tonle Sap
- gender or women's issues aligned to fisheries and aquaculture activities is part of the socio-environmental dynamics of Cambodia and profound, and notably for capture fisheries and growing interests in aquaculture production. Therefore the cultural dimensions of fisheries and aquaculture production for women are important.

4. Approach and methodology

4.1 General approach

This approach and methodology of the present SEA was based on international best practices and guidance provided by the EU's DEVCO environment and climate change mainstreaming facility and EUD in Cambodia as well as the team's own specific SEA experience. This SEA consisted of two key phases being a scoping study and the SEA study, while the methodological approach used in this study is presented in this section.

The scoping phase was oriented at making a preliminary identification of the key environmental concerns in the fisheries and aquaculture sectors, taking into account both the effects of degraded natural resources in key regions for the activities, as well as the existing and potential impacts on the environment associated current fisheries and aquaculture activities. Based on these findings, elements for the organisation of the main SEA study phase were identified, including the key issues that would deserve specific attention, the baseline information required and the areas targeted for site visits. The key issues are critical to the SEA, as it allows the study to focus efforts and recommendations on these important aspects that need to be solved to achieve a significant improvement in the environmental performance of the both capture fisheries and aquaculture in the CAPFish programme.

This preliminary identification of key issues was based upon a comprehensive examination of all relevant policy and strategic documents through mapping out environment and capture fisheries/aquaculture interactions. This process was combined with consultations with key stakeholders including short field visits to provide perceptions of both capture fisheries and aquaculture in inland and marine environments in Cambodia, as well as consultations with local actors. Preliminary analysis of issues was based upon a combination of expert judgment and matrices of responses from stakeholders (see Appendices) to verify consistency and potential environmental implications associated with capture fisheries and aquaculture.

The preliminarily key issues were discussed and validated in a stakeholders' scoping workshop (see Appendices), attended by approximately 30 participants from relevant government institutions, donors and NGOs or CSOs. Key Issues were partially prioritised based on expert judgement and the experiences of the participants at the scoping workshop. In addition an SEA Reference Group was consulted to assist the consultant in the finalisation process of key issues.

The SEA Study phase assessed the key issues in detail and identified options to address them being options that would minimise environmental impacts and make best use of opportunities to enhance the state of the environment and the opportunities for climate change adaptation. The analysis took into account the policy and regulatory framework, the institutional settings and the existing capacities. It is important to stress the importance of secondary data and information in the process including maps, tables and graphs in reports combined with the sector experiences of various actors. The SEA Study made use of a combination of qualitative semi-open question methods with focused stakeholder consultations from a mix of actors involving some short field visits to make observations of commercial bag net fishery on the River Tonle Sap (DAI), municipal and industrial waste outfalls, irrigation reservoir and dam infrastructures, and fish pond production units.

The baselines for the key issues were supported by specific data and trends were available, which were used to analyse the importance of various factors. This approach is most important regarding opportunities and threats to the programme. Finally some ad hoc institutional capacity analyses, such as staffing, were carried out.

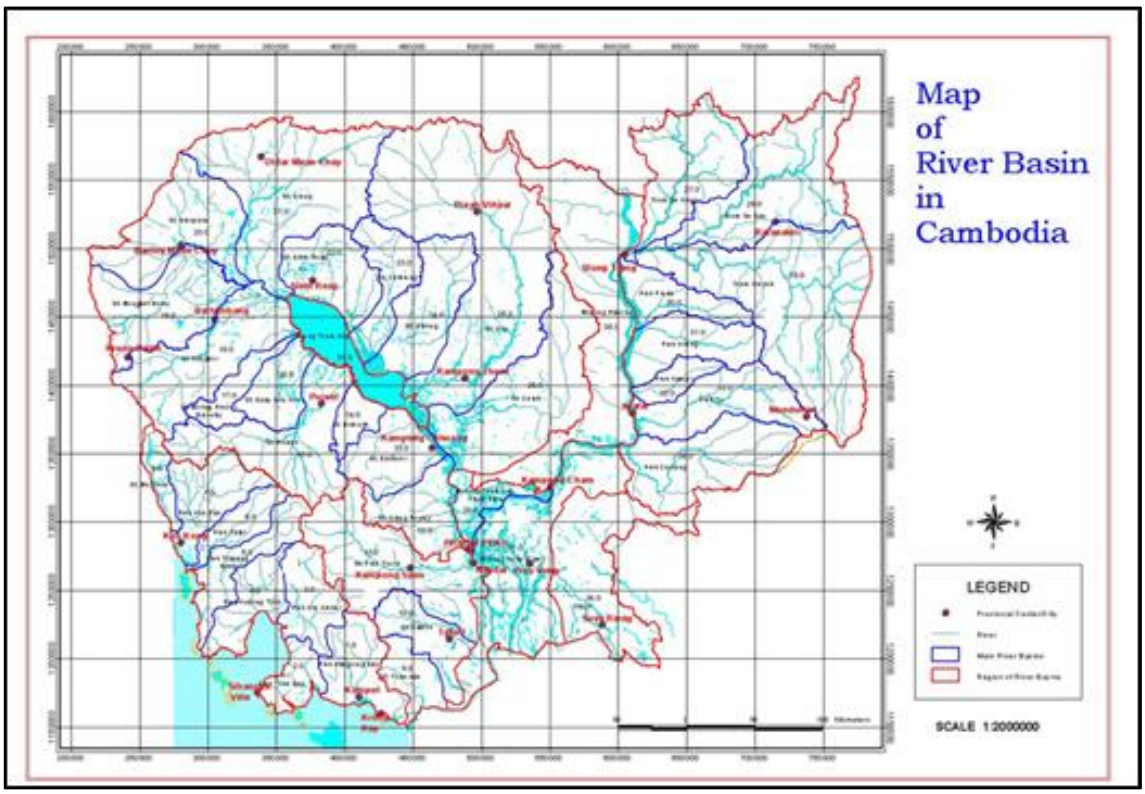
All activities were carried out in close coordination with the Fisheries Administration (FiA) of MAFF and the EUD in Cambodia. Field visits were organised in conjunction with FiA's provincial personnel, who sometimes accompanied the SEA team to sites allowing opportunities to verify findings with provincial experiences. Efforts were made to regularly consult with and brief the EUD as well as the Directorate for International Cooperation and Development/DEVCO's C2 thematic unit.

4.2 Geographical or environmental units

The intervention area is not specifically defined by the CAPFish programme for capture fisheries or aquaculture development sites across Cambodia, although the aquaculture component refers to periphery of Tonle Sap Lake and the Mekong Delta, whilst capture fisheries focuses upon existing and important fishery zones (both freshwater and marine). However, MAFF and specially the Fisheries Administration (FiA) want to do further studies to identify specific sites in the near future for the development of aquaculture specifically (pers. com Mr Somany, FiA).

The immense hydrological system is clearly displayed in Figure 2, although the river systems also cross frontiers into neighbouring countries notably from Laos feeding into China along the Mekong River, and also its tributaries into Vietnam.

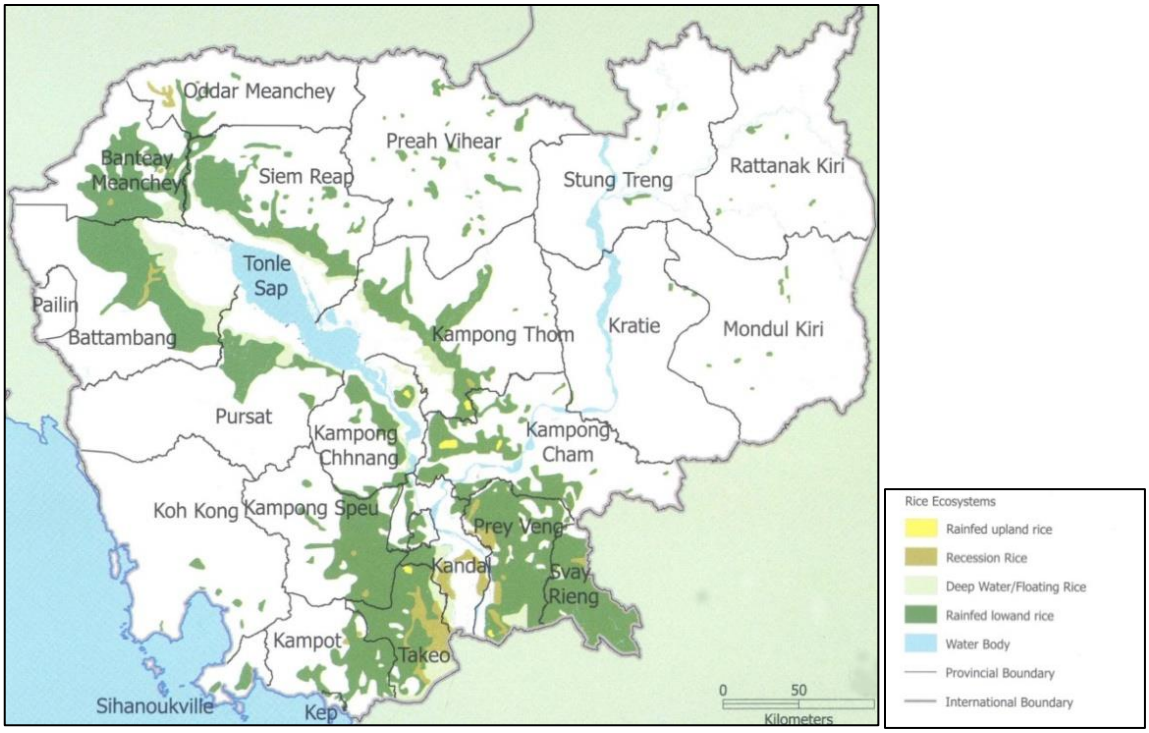
Figure 2: Hydrological map



Rice production is the most significant and important crop for Cambodia, in particular rainfed lowland rice. The principal rice producing zones in Figure 3, which is important to recognise,

as rice paddy areas are the most productive fisheries in Cambodia at 360,000 T/year followed by flooded shrub land at 90,000 T/year in 2016 (WorldFish, 2016).

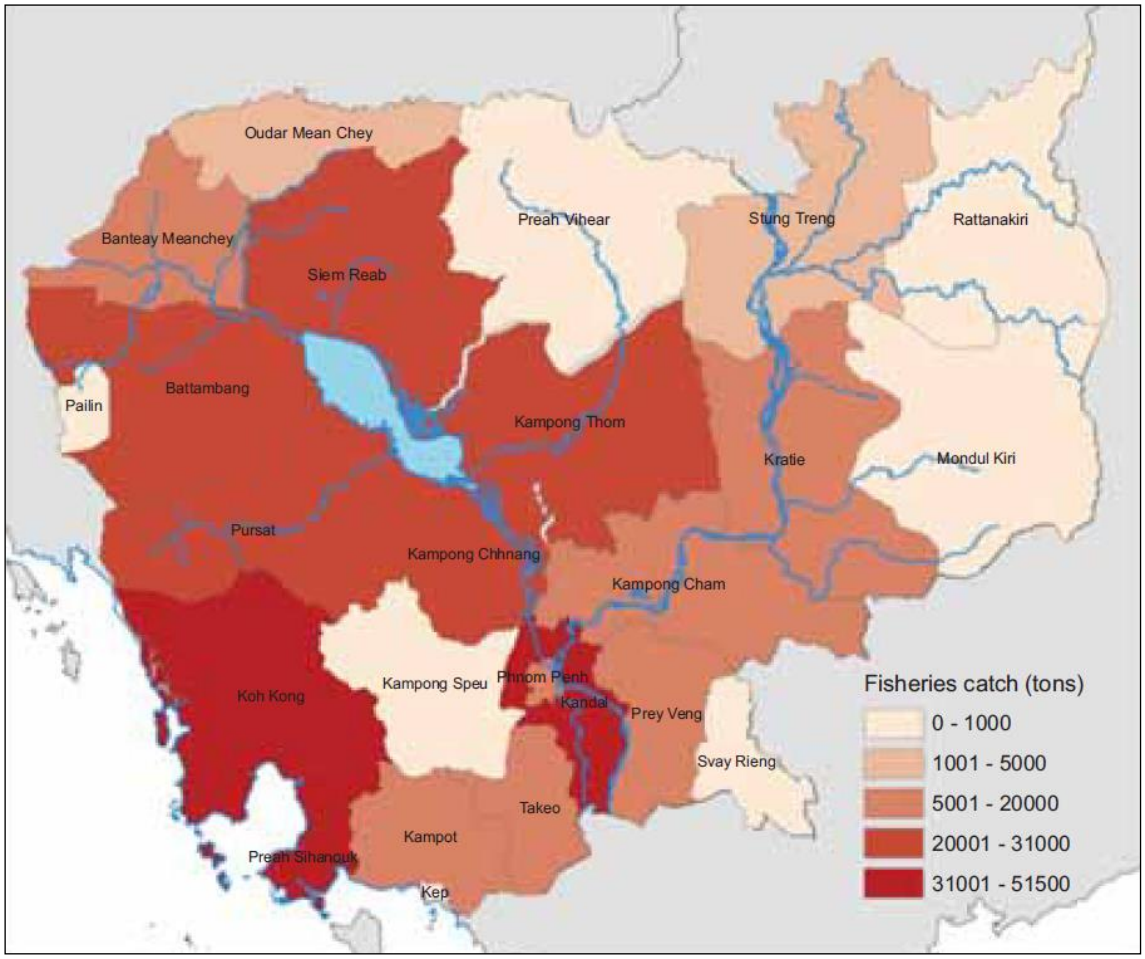
Figure 3: Principal rice producing ecosystems in Cambodia



The major fish production areas of the Cambodia are clearly shown in Figure 4. Meanwhile, the SPF states that the development opportunities have been noted for the Tonle Sap Lake and River, the Mekong and coastal waters. Inland areas produce significant amounts of fish each year and offer potential for fisheries development for both inland capture (rice-fisheries and fishing wild stocks) and aquaculture (cages, ponds and paddy field integrated systems).

Meanwhile coastal fisheries have relatively lower recorded production figures compared to inland water bodies, although provinces attached to the coast can be high such as in the Koh Kong Province. These areas also offer potential for improved capture management and the development of coastal aquaculture (cages and ponds, including salt ponds).

Figure 4: Fish production areas across Cambodia in 2012



Overlaying the sequence of maps above provides the study with an insight of the major units for capture fisheries and aquaculture including rice field-fisheries across the country. The entire country is composed of a myriad of rivers and tributaries cascading down from the upland areas around the Tonle Sap, Koh Kong to the coast, and the upper stretches of the Mekong within northern Cambodia and beyond. These upland areas are composed of intricate tributaries collecting water from the uplands leading to large lowland wetlands including important floodplains during rainy seasons, which can increase by 5 or 6 times. Capture fisheries are widespread while the potential for aquaculture is vast due to series of main rivers and tributaries. Integration of the hydrological map with the rice production map shows clearly the importance of flooded areas around the lakes and lower sectors of the country. In addition, the relationship between the Mekong and Tonle Sap rivers provide large migrations of fish trapped by seasonal bag netting near the Phnom Penh districts. The flooded areas included important breeding and feeding grounds for fish species amongst swamps and flooded forests, notably around the Tonle Sap Lake. These areas have large production from capture fisheries and rice field fisheries, particularly during the floods. Equally, the areas with good access to water near open waters and permanent tributaries are very good fishery sites with existing and significant aquaculture units and potential for expansion of both cage and pond fish farming.

Access to water for inland fisheries is equated in production of fish in the map. This production is mainly from capture fisheries and significantly high in areas of production around the Tonle Sap Lake, while migrations and *dai* catches on the lower stretches of the Tonle Sap and Mekong Rivers are substantial. The south-eastern districts of Cambodia are

also good fishing areas, although this part of the country is influenced by mainly capture fisheries associated with the sea and significant areas of coastal mangrove forest. In addition, there are numerous smaller aquaculture units developing along these coastal areas.

4.3 Assumptions, uncertainties and risks with mitigation actions

For the successful completion of the assignment, it is prudent that assumptions, and uncertainties and risks are identified and mitigated, where possible, at the beginning, and during if necessary, of the study. Uncertainties and risks in this case are those factors that may cause a failure to meet the objectives and jeopardize the successful completion of the assignment in terms of quality of results, time required, and the final outputs of the SEA.

The main objective of this section is to appreciate the potential assumptions, and uncertainties and risks, and then derive means of managing and minimising them for the successful completion of the assignment. Meanwhile, the overview of assumptions, and uncertainties and risks with issues and mitigating actions are described in Table 3.

Table 3: Overview of assumptions, uncertainties and risks with issues and mitigating actions

Assumptions, uncertainties and risks	Issues and/or Mitigating Actions
Assumptions	
Sufficient historic, current and forecasting data and information are available for socio-economic, biophysical, cultural and climatic factors in Cambodia.	For many sectors there was sufficient data and information available. However, the situation is not the same for all sectors. Notable areas of difficulty concern fisheries statistics related to as catches, effort and species. In addition, some Ministries or specific departments were not accessible concerning issues linked to ELCs, forest concessions, mining and energy. The consultants addressed the issues using best practice approaches including secondary data and other sources of information from key persons in NGOs etc.

Key personnel from various ministries and authorities in Cambodia will be available during the study.	Some key ministry personnel where available, however some had to be interviewed informally as the process to access senior staff from the authorities would have required excessive time, which was not available for the duration of the SEA study. The information provided by informal meeting in the form of documents was integrated into this study, although the specific sources of verbal information could not always be cited and were referenced to an expert from a Ministry etc.
Uncertainties and Risks	
The time frame for this innovative and challenging study is limited and may require further developments following the final report.	The report will provide recommendations which will highlight the need for the acquisition of new data, further analyses and potential further related studies. In addition, climatic changes and adaption is new to many countries including Cambodia. Caution and caveats are included in parts of this study to avoid being overly conclusive. Also proposed further and/or detailed analyses and studies are indicated in appropriate sections of the report.
The sector's development has priority over the findings of the report, which may orientate the report to positive results and/or mitigations measures, where political and environmental difficulties could outweigh the reality for the potential development of the sector.	The fundamentals of the SEA approach have to be explained and communicated through the reports to guarantee an understanding of its purpose from the beginning for all stakeholders in Cambodia. Potential impasses for the projects have been flagged which may require options for reorientation

5. Indicators for sectoral strategies related to the environment and climate change

This section captures the government's environmental and climate change objectives and indicators that are relevant to the sector, as reflected in national environment and climate change policies, and sectoral policies and strategies including those aligned to international commitments. The analysis focuses on the implementation of policy and CAPFish, to asses if they are compatible with such objectives and indicators. The purpose is to assess if the sector activities could be in conflict with Cambodia's environmental or climate change commitments.

The documents referred to in Section 3 were reviewed from various sectors. The key official and endorsed policy documents with objectives and indicators for the environment and climate change associated with fisheries and aquaculture sectors are presented in the section. Each indicator from sectoral strategies is assessed according to its relevance and potential conflicts.

5.1 Environment

5.1.1 National Environment Strategy and Action Plan (NESAP)

The NESAP (Draft version dated December 2016) focuses on putting environmental sustainability and inclusive green growth at the heart of Rectangular Strategy, NSDP and other sector policies. The principal mission of NESAP 2016- 2023 is to:

- provide a roadmap for resource mobilization and actions, for ministries/agencies, private sector, civil society organizations, and development organizations to achieve balanced and inclusive development
- identify priority sectors and concrete programmes and projects which NESAP can focus on in the near term to demonstrate opportunities and benefits in shifting to an inclusive and green development.

NESAP has also identified four major strategic objectives as follows:

- strengthen cross-sectoral collaboration and relevant instruments/guidelines to improve coordination, regulation and delivery functions for sustainable development outcomes.
- improve resources use efficiency resulting in minimizing production inputs and prevent and minimize pollution from industrial, mineral operations (prospecting survey, exploration, exploitation and closure), urban and agriculture sources for healthy environment and social well-being, while increasing business competitiveness and incentivizing technological innovation.
- adopt and implement financing mechanism, benefit-sharing schemes and fund mobilization plan for investing in green and resilient economy and sustainable local livelihood with special focus on women, children and other vulnerable groups, and support to transfer of functions and resources to sub-national level.
- raise public awareness, build individual and institutional capacities for sound environmental management and natural resource use, and promote technology transfer and strengthen use of monitoring science and technology.

NESAP's projects/programmes include baseline assessment data used from the inception phase to the annual internal review, midterm strategic review and the programme's external evaluation. Both baseline and periodic monitoring data are measured against agreed indicators and targets for reporting against MDGs, SDGs, and the NSDP performance framework and database. The NESAP encompasses key indicators which will be measured on a semi-annual basis to track progress on the implementation status of NESAP and its programmes and project against the NESAP's generic indicators and targets, and specific projects and programmes.

Foremost, the NESAP intertwines the importance of the Rectangular Strategy and NSDP with environmental management and development initiatives, which include fisheries resources management. These processes are near term orientated, which fit with the timing for the CAPFish programme proposed from 2017 balancing with other sectors notably agriculture and energy production in Cambodia. NESAP focuses on cross-sectoral activities for sustainable development, which is pivotal for fisheries as there is a serious lack of cooperation between sectors and their respective Ministries. Meanwhile, there is a conceptual effort to bring about efficiency and reduce wastes, which could have an important role to curb toxic pollution and its impact on fish products through aquatic ecosystem food chains. This approach to development also encompasses resilience, which is essential for fish species and habitats based on various climate change scenarios. Overall these steps are reinforced through NESAP's commitment to capacity building and monitoring of natural resources from sound baselines using key and generic indicators, which are severely lacking across the fisheries sector in Cambodia.

5.1.2 National Forest Programme (2010-2029)

The overall objective of National Forest Programme or NPF (2010-2029) is "the forest resources provide optimum contribution to equitable macro-economic growth and poverty alleviation particularly in rural areas through conservation and sustainable forest management, with active participation of all stakeholders." In addition, the key objectives and strategies related to cross-cutting issues, which could influence the fisheries sector and specifically the SPF and CAPFish programme, and summarised below:

- economic growth and poverty alleviation particularly in rural areas through conservation and sustainable forest management, with active participation of all stakeholders
- linkage between climate change adaptation and livelihoods
- integrated land-use planning across jurisdictional zones i.e. watershed management.

The NFP clearly targets livelihood improvements at national and local levels, and particularly in rural areas, which are conducive and compatible with SPF and CAPFish, as diversification of various economic activities is required with fisheries development. Again livelihoods are the key fact for climate change adaptation too, which is similar for fisheries, whereby the benefits of adaptation with fisheries resource management respond to the needs of the population. However, the benefits of good forestry management or protection are not necessarily beneficial for fisheries if there is no integrated planning between forests and fisheries, and within natural boundaries such as watersheds in the uplands, flooded forest areas and mangroves.

The key indicators and targets of the NPF also concern the proposed CAPFish programme and SPF and are summarised below:

- current level of forest cover will be increased to 60% of the total land area including targets for sustainable silviculture plantations and protected forests
- economic benefits from carbon sequestration will be targeted from forests

- fully recognise the rights of Community Forest areas

There have been serious levels of losses of principally natural forest cover over the last 50 years and moreover during recent times for flooded forests, mangroves. In addition, natural forest buffers in the uplands, which are very important for fisheries, could benefit from targets to increase their cover. However, it is important that high value habitats for fisheries are not simply replaced by plantations or newly planted areas for silviculture or natural forest species. Alternative means to give added value to these natural forests through carbon initiatives such as Reducing Emissions from Deforestation and Forest Degradation (REDD+) and Blue Carbon could lead to forest conservation and eventual benefits for fisheries. These initiatives could also work in unison with the reinforcement of land and usufruct rights for important forests with direct benefits for fisheries and communities, such as those associated with flooded forests and mangroves.

5.1.3 Green Growth Master Plan (GGMP), 2030

The objective of Green Growth Master Plan (GGMP) of 2030 is to promote a national economy with growth stability, reduction and prevention of environmental pollution, safe ecosystems, poverty reduction, and the promotion of public health service, education quality, national resource management, sustainable land use and water resource management to increase energy efficiency and ensure food safety. The key cross-cutting objectives are summarized below:

- promote a national economy with growth stability, reduction and prevention of environmental pollution, safe ecosystems, poverty reduction
- promote national resource management, sustainable land use and water resource management to increase energy efficiency and ensure food safety.

There are no specific indicators in the GGMP 2030; however, this national strategic plan provides orientation to green balanced growth for the economy, environment, society and culture, and aims at to eradicate poverty.

Meanwhile the **National Strategic Plan on Green Growth** (NSPGG) 2013-2030 indicates nine strategic directions, which will focus their principal attentions amongst others upon the following:

- blue economy development including sustainability
- green environment and natural resources management.

Overall the GGMP and its associated NSPGG are key documents to orientate fisheries development and accompany the SPF and CAPFish as they provide support to protect natural resources and the environment through balanced growth while supporting poverty reduction. Effectively these objectives and strategies could be used to negotiate improved management of the hydrological systems within the Cambodia for fisheries and other users, although foreign activities in the Mekong area would not necessarily follow this green strategy. Within the country, safe ecosystems and pollution control would be beneficial for fisheries and aquaculture regarding threats of pollution from industry, agriculture, settlements and aquaculture itself. Combinations of blue and green approaches could orientate to sustainable and better management of existing capture fisheries and expansion of aquaculture and their dependable natural resources including water, forests and mangrove systems.

5.2 Climate Change

There are two important policy documents associated with the Climate Change Department based at the MoE, and the MAFF, which are reviewed in this section.

5.2.1 Cambodia Climate Change Strategic Plan (CCCSP) 2014-2023

The key strategic objectives, aspects of the sub-objectives and indicators linked to fisheries and related to the Cambodia Climate Change Strategic Plan (CCCSP) are summarised below:

- promote climate change resilience through improving food, water and energy security and efficiencies, while increasing productivity from crops, livestock, forestry and fisheries. These objectives should include watershed and ecosystem management with carbon market incentives and the promotion of renewables through decentralised energy sources including solar, and the rehabilitation of existing irrigation schemes. Proposed projects should now also integrate climate change factors into their EIA processes
- ensure climate resilience of critical ecosystems (Tonle Sap Lake, Mekong River, coastal ecosystems, highlands, etc.), biodiversity, and protected areas with ecosystem services payments and REDD+, and land use planning initiatives.
- encourage low-carbon planning and technologies to support sustainable development related to notable sectors for fisheries linked to energy and forest management through renewable energies and carbon market mechanisms
- support adaptive social protection and participatory approaches in reducing loss and damage due to climate change with micro-financing for local communities
- strengthen institutions and coordination frameworks for national climate change responses linked notably to inter-ministerial coordination in policy development, and integrate national monitoring and evaluation framework into the NSDP and NSPS with development of specific strategies and action plans for sectors including fisheries
- strengthen collaboration and active participation in regional and global climate change processes and notably for trans-boundary initiatives e.g. Mekong River Basin framework and use of carbon market mechanisms and other relevant carbon credit schemes, and strengthen the national institutional platform with capacity to negotiate at international levels and engage with regional and global initiatives and programmes for fisheries and other sectors
- no sector specific indicators are in the CCCSP, although there is an indicators framework, which includes two categories measuring institutional response for climate change management and development of performance statistics from various sectors including fisheries
- considers protection measures to ensure climate resilience of critical ecosystems including coastal ecosystems and biodiversity in protected area, and also to improve mangrove ecosystems, coastal zones and protected areas
- opportunities for low carbon development plans including blue carbon in mangroves through four policies and several strategies known as the Low Carbon Development Strategy for Cambodia toward 2050.

The promotion of climate change resilience could be beneficial for the application of the SPF and the initiation of CAPFish activities, as it encourages water security and the increase in production from fisheries and other sectors. However, securing water for energy with an orientation to renewables, and inevitably hydropower, could be highly conflicting for both the SPF and CAPFish. In addition, an increase in agricultural production could lead to localised pollution conflicts with fisheries is some watersheds. Encouragement of EIAs applying

climatic change factors could raise protection through the management of national water supplies, although impacts on river systems outside Cambodia's borders and in particular upstream would likely remain difficult to mitigate. Key areas for climate resilience overlap with some of the key areas for fisheries development being Tonle Sap, Mekong and coastal areas, which is again an opportunity to reinforce SPF and CAPFish activities. Although carbon mechanisms may be an advantage for forest conservation including flooded forest and mangroves for fisheries, they could also be an opportunity for renewable energy, such as hydropower, whose externalities need to be fully accounted to protect fishery interests associated with SPF and CAPFish. Adaptation through microfinancing could be a positive step which offers synergies with CAPFish, although it is important that investment leads to growth in the sector and not just mitigation to attain zero change.

The institutional and inter-ministerial improvements for the application of fisheries management frameworks, in particular the climate change strategy of FiA with NSDP and NSPS, correlate well with SPF's orientation. Climate change may also be an immediate precursor to manage water in the country and region for multiple users, whereby rivers and tributaries of exceptional importance for fisheries are protected or conserved. Similarly the motivation of climate change to monitor changes could also be a form of motivation for fisheries to vastly improve its data collection for fisheries with complementary physical and socio-economic data to determine if targets or objectives prescribed in the SPF and the CAPFish programme are being approached.

5.2.2 MAFF's Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries Sector 2016-2020

The key strategic and cross-cutting objectives for fisheries based upon MAFF's Climate Change Priorities Action Plan for Agriculture, Forestry and Fisheries Sector 2016-2020 are summarised below:

- support climate change adaptation and resilience to enhance fisheries i.e. aquaculture and capture fisheries and throughout their value chains
- strengthen risk prevention and reduction, effective emergency preparedness and response and enhance early warning systems, recovery and rehabilitation initiatives in the fisheries sector
- map out land uses including fisheries with integrated management including carbon accounting
- mainstream climate change adaptation into institutions with enhancement of knowledge management.

The indicators and targets for the key strategic objectives of MAFF are also summarised in relation to the contribution of the sector to climate change adaptation as follows:

- employment and benefits from agro-related activities including fisheries will increase by 20% and related to target increases in exports and opportunities for formal loans for an increased number of SMEs (it is important to note that these activities could be in conflict with the environment as they could have negative impacts upon biodiversity and promote pollution risks)
- targets for mapping integrated zones including fisheries (this could be a good initiative if it assesses potential conflicting interests between sectors and focuses upon harmonisation of activities within integrated zones)
- focus on specific number of aquaculture farmers with target increases in production including support by extension services (it is important to note that these activities could be in conflict with the environment as they could have negative impacts upon biodiversity and promote pollution risks)

- targeted increase in forest cover for flooded forest and mangroves, which are very important for fisheries. This initiative could be associated with carbon accounting schemes to encourage natural forest development.
- strengthened fishery communes and communities for adaptive capacity and resilience to climate change.

Fisheries have been recognised as very important sector to protect by climate change decision makers and MAFF. In addition, support will go beyond adaptation and resilience towards the enhancement of the sector. This policy would run in parallel with the SPF objectives and is a very good ministerial opportunity to support CAPFish to pursue the development of aquaculture and capture fisheries. Integrated management with or without climate change issues will be a positive step forward for the assimilation of SPF policies and projects attached to CAPFish, while increasing the value of natural resources such as forests in terms of carbon sequestration and productivity for fisheries. Within the Ministry and specifically FiA, there are opportunities to develop capacities for climate change, which could go beyond the weak structures in place at present for the sector's development. Similarly advantages could materialise during mainstreaming for climate change with knowledge enhancement of personnel in fishery institutions at all levels, which correlates well with capacity building ambitions associated with SPF and CAPFish. Finally, indicators have clear targets, although the baselines will need to be established, while proposed production increases and capacity need to correlate well with SPF and CAPFish. Equally the focus on integrated management and increasing key habitats like flooded forest and mangroves are major steps to conserving or increasing production from capture fisheries and aquaculture.

6. General environmental and climate change baseline

6.1 General environmental baseline

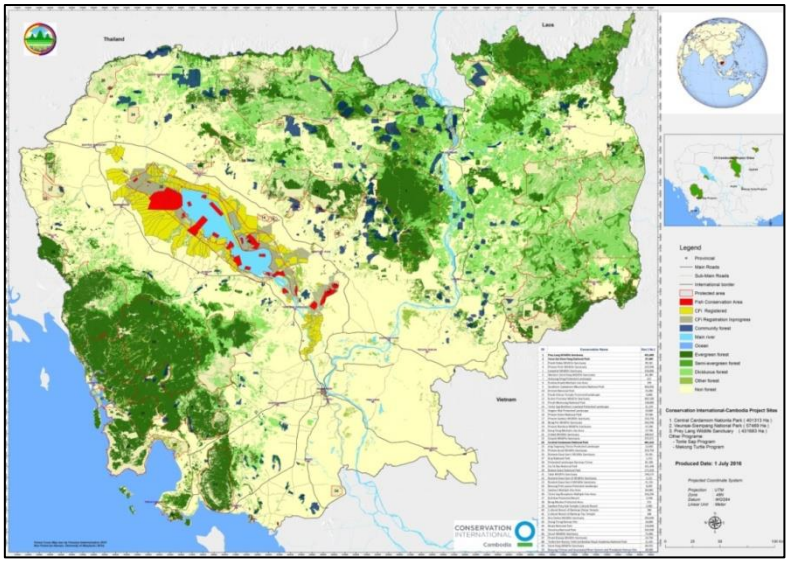
Cambodia lies in the south western Indochina peninsula between Thailand to the west and Vietnam to the east, and shares a north eastern border with Laos. It has a total land area of 181,035 km, and a coastline stretching along the Gulf of Thailand for 435 km supporting an Exclusive Economic Zone (EEZ) of 500,000 sq. km with 64 islands and extensive mangroves and coral reefs.

Cambodia is rich in species diversity and home to more than 135 species of mammals, 599 species of birds, 173 species of reptiles, 72 species of amphibians, 350 species of moths and butterflies, 955 fresh and marine fish and aquatic species, and more than 4,500 vascular plant species. These figures are according to the recent estimates by the Forestry Administration (FA).

Cambodian forests are dominated by Dipterocarpaceae, Leguminosae, Lythraceae, and/or Fagaceae families and, in some places, Pinaceae or, Podocarpaceae families, and/or bamboo. The flora of the lower altitudes is typical of the Indochinese floristic province and, as such, contrasts with that of the Chinese, Indo-Burma and Indo-Malayan provinces, while the higher altitudes share an affinity with compositions of the Indo-Malayan region.

Cambodia is a rich country in aquatic resources, with a hydrology dominated by the Mekong river, which flows through 486 Km of its territory and by the Tonle Sap river, of 120 km. that joins the Mekong in Phnom Penh and that has its origin in the Great Lake of Tonle Sap, the largest in the country. The principal land cover for Cambodia is shown in Figure 3.

Figure 3: Cambodia's protected areas updated in 2016 with land uses and community and conservation fishing areas.



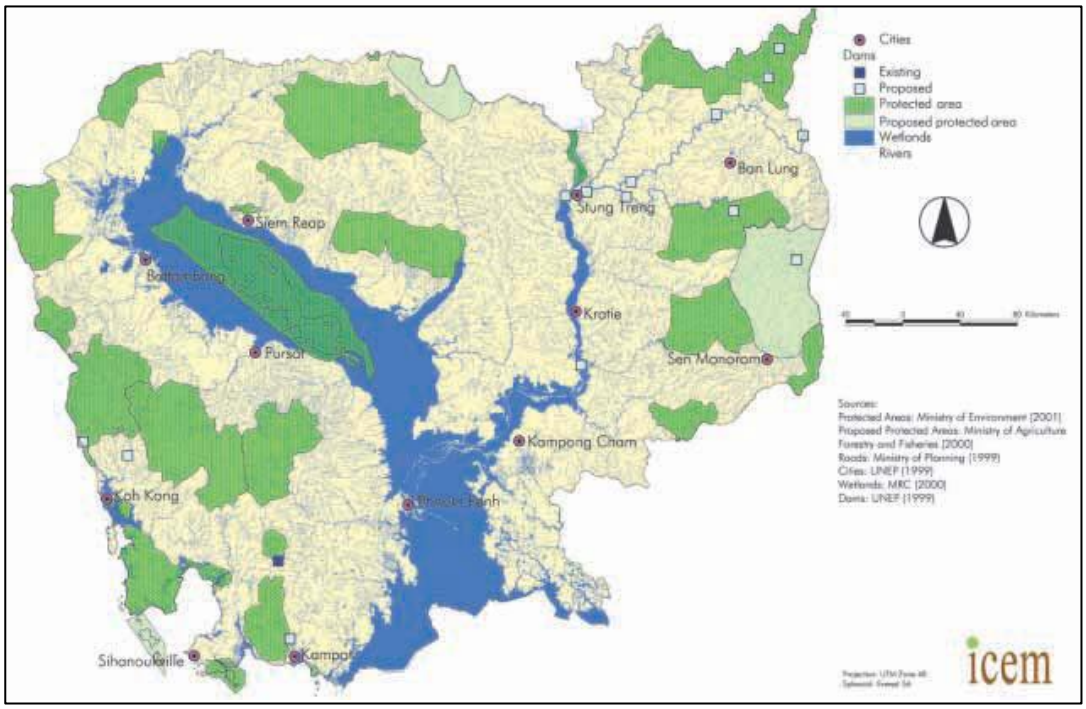
Source: Conservation International, 2016

Cambodia is divided into a number of regions by mountain ranges. The Central Plains occupy three quarters of the country, and include the alluvial plains and wetlands of the

Mekong River and Tonle Sap Lake as well as plains in the northwest (near Battambang), northeast and in the east near Kompong Cham. The plains are flat with an elevation of 5-10 metres. Key protected areas in this region include the Tonle Sap Multiple Use Management Area, Angkor Protected Landscape and the Kulen Promtep and Beng per Wildlife Sanctuaries. Figure 3 also shows Cambodia's protected areas including biosphere and Ramsar sites, updated in 2016, and including land cover and community (CFi) and conservation areas used for fishing.

Cambodia's tropical climate includes an annual monsoon season from May to October when 80 percent of the annual rainfall occurs, turning the lowlands into an extensive floodplain. During the dry season, water drains from the Tonle Sap Lake (also known as the Great Lake) into the Tonle Sap River and eventually into the Mekong Delta. As the monsoon rains flood the lowlands and fill the Mekong River, the rise in river water level causes the Mekong to push water back up the Tonle Sap River into the Great Lake. During this season, the lake can increase between four to seven times its usual size. When the Mekong River levels recede, the lake begins to lose its water back into the Tonle Sap River. In this way, the Great Lake acts as an extensive natural flood retention basin. Figure 4 shows Cambodia's vast wetlands including the extent of flooding during the monsoon season.

Figure 4: Wetlands during flooding across Cambodia



Source: International Centre for Environnemental Management (ICEM), 2003

The plains are surrounded by the more densely forested and sparsely populated highland areas. To the southwest are the Cardamom and Elephant Mountains, a linked chain separating the coastal strip from the rest of the country. In the north the Dang Rek Mountains form a steep escarpment along the border with Thailand and, with an average of 500 metres in height, announce the transition from the Tonle Sap Basin to the Thai Korat Plateau.

The ranges in the east rise to form the Ratanakiri Plateau while the Chhlong Highlands are punctuated by hills that reach 700-800 metres in height. The north-eastern provinces of

Ratanakiri and parts of Mondulkiri form a transition zone to the Annamite Ranges in Vietnam.

Cambodia has achieved a long-term macro-economic growth (1994 – 2011) of 6-7% in its GDP annually. The stable and steady economic growth is largely attributed to the continued good performance of the agriculture, garment, construction and tourism sectors. A project-based planning approach is steadily giving way to programme-based planning in consolidating sustainable development. Better data collection and management are contributing to improving planning systems, and the effective allocation of resources. However, economic diversification is limited and there is still a considerable percentage of the population who are unskilled.

Forest cover as a percentage of total land area in 2010 was 57.07%, of which more than 3 million ha of protected areas is under the jurisdiction of the Ministry of Environment (MoE). Agriculture continues to be the dominant employment sector absorbing the majority of the population and accounting for 57.6% of the labour force.

According to the NSDP Update 2009 – 2013, as of 2008, the total arable land area was in the range of 3.31 million ha, and rice farming constituted 2.61 million ha, 0.59 million ha of permanent crops, and 0.11 million ha of rubber plantations. The Strategy for Agriculture and Water (2006 – 2010) indicates that only 7 – 8% of arable land is fully irrigated, 10% is supplementary irrigated, while the remaining 80% relies on rainfall.

Fish provides up to 76% of all animal protein in-take in the Cambodian diet (Vilain et al., 2016) and fish production contributes about 10% of Cambodia's GDP, creating six million full-time and part-time jobs nationwide. The main inland fisheries are predominantly found along the rivers, lakes and wetlands such as the Tonle Sap Lake and the Mekong River. Tourism is the third largest sector after agriculture and the garment industry. National revenue from tourism has increased 17-fold from USD 100 million in 1995 to USD 1,786 million in 2010, generating 315,000 jobs in the same year.

Only 17.2% of the total population including 6% of the rural population had access to electricity in 2012. Meanwhile the per capita electricity consumption was approximately 199KWh per annum in 2013. Fossil fuel-based electricity production accounts for 95.2% of total energy production, while hydropower and other renewable resources represented only3.3% and 1.5% respectively. More than 80% of the population still depends upon fuel-wood and charcoal for household cooking. Overall, this fact shows why the government is looking to renewables and principally hydropower at present.

6.2 General climate change baseline

6.2.1 Background

Historically, temperatures in Cambodia have increased and this trend is projected to continue with mean monthly temperatures increasing between 0.013^{o}C and 0.036^{o}C per year by 2099, depending on location, with higher rates at low latitudes.

There is an increasing trend in seasonal rainfall between June and August in the northwest, and a decreasing trend in the northeast of the country. However, inconclusive evidence for climate change impacts upon mean annual rainfall has projected an increase in rainfall for Cambodia and the Mekong Basin, which would lead to potentially erratic and more severe flooding events in general.

According to the Fourth Assessment Report of the IPCC, sea levels in the region are projected to rise under various Special Report on Emissions Scenarios (SRES) by 2090 relative to 1980-1999, from 0.18 to 0.43m under low emission scenarios (SRES B1), to 0.21 to 0.52m under medium emission scenarios (SRES A1B), and up to 0.23 to 0.56m under the high emission scenarios (SRES A2). If there was a 0.56m rise under the high emissions scenario (SRES A2), this would cause permanent inundation of about 25,000 ha of Cambodia's coast.

6.2.2 Implications

The principal implications from climate change in Cambodia are as follows:

- increase in temperature is likely to affect agricultural productivity (according to the International Rice Research Institute, rice grain yield will decline by 10% for each 1^{o}C increase in growing-season minimum (night) temperature in the dry season) and very likely the production from fisheries too with depleted oxygen levels in water bodies while increased oxygen consumption from aquatic organisms.
- provinces at higher elevations will receive more rainfall during the wet season but will get drier during the dry season; this could hamper the production of coffee and rubber in Cambodia according to Mekong Adaptation and Resilience to Climate Change - Mekong ARCC
- the 435 km Cambodia coastline is vulnerable to sea-level rises and the severe impacts of more frequent typhoons under future climate projections. This could affect tourism potential and cause coastal erosion, which may damage habitats for crustaceans and their production.,
- strong winds associated with typhoons could seriously damage settlements in coastal areas of Cambodia
- as only 7-8% of total production land area is under full irrigation, it is difficult for Cambodia to achieve 5% annual agricultural growth in order to meet the target of agricultural production export by 2030 under climate change impacts e.g. drought, especially for some cash crops such as rice, without further investment in the expansion of irrigation schemes
- according to the International Disaster Database (EM-DAT), natural disasters in 2011 resulted in economic losses to Cambodia of about 4.3% of its GDP. Climate-related flooding is projected to increase in its frequency and intensity especially in the central plains. While the coastal zones would be affected by tropical cyclones from the Pacific, the central plains would experience seasonal flooding caused by increased rainfall. Both regions are of significant economic importance due to their fiscal revenue contributions generated from tourism, services, navigation, fishing and agricultural production.

Based upon the information presented above, it is crucial that measures are put in place to minimize the impacts of climate change risks and disasters in order for Cambodia to achieve the desirable economic growth and development expected in the national development programmes.

Finally, it is important to state that Greenhouse Gas (GHG) emissions in Cambodia are currently extremely low compared to regional and global averages. According to the Second National Communication under the UNFCCC, in 2000 Cambodia emitted only 47.6 million tonnes of CO^2 equivalent, while its forestry sector absorbed 48 million tonnes of it. Over the same period, energy consumption by sector was highest for transport followed by electricity production for residential and industrial sectors. Cambodia needs to increase energy production to boost industrial activities, while improving energy efficiency in the transport and

residential sectors. During this stage of increasing energy supply, it is important that integration of renewable energy sources be considered in future energy production. These options should include solar as well as careful planned sites for integrated management of water resources with hydropower production.

Part II: Analysis of key issues

7. Key Issues for the SEA

This section presents the prioritised environmental issues to be addressed in the SEA based upon a broad range of issues flagged by stakeholders and in various studies and reports. The key issues are classified as “high priority” and “medium priority” issues and addressed in the section of the report. Meanwhile, “low priority” issues are not analysed in detail, but remain in the SEA.

7.1 High priority Issues

The organisation of this section focuses on all the relevant dimensions of each key issue, the rational for its selection and includes trends for key issues. An assessment of the state of the environment and/or climate change is included and addresses how they could affect sector performance and the potential significant impacts upon the environment associated with sector strategy implementation. The analysis also takes into account the institutional and regulatory framework. Based upon the findings and analysis, key recommendations are presented for each key issue. The results from this assessment will contribute to the strategy and the environmental sustainability of the programme.

7.1.1 Key Issue 1: Hydropower and irrigation developments

Rationale for the selection of the key issue

The rationale is based upon the findings from the scoping study and composed of the following key points:

- construction of reservoirs for hydropower and irrigation (within Cambodia and upstream including China) may have significant impacts upon water regimes, flood levels, sediment loading and longitudinal fish migration for both long and short migrations associated with white and grey species of fish, respectively, although there could be new opportunities for capture fisheries and cage cultures
- irrigation canals from gravitation irrigation schemes and some reservoirs may have impacts upon the lateral migrations of some important fish species water abstractions and diversions from ponds and rivers during the dry season would have impacts upon the maintenance of fish stocks and breeding grounds, which could put in jeopardy both CAPFish and SPF objectives and threaten the sustainability of investments in the aquaculture and fisheries sector.

Baseline (including institutional, policy and legal framework specific to the key issue)

Context

The Cambodian energy sector needs considerable development in generation and transmission if it is to meet the growing needs of the country and provide a stable and affordable power supply to potential investors in industry. The government sees hydropower as a priority area for development in the energy sector. Over recent years, investors and developers from China, Vietnam, Korea, Russia, Canada and Japan have all studied the opportunities for hydropower development in Cambodia. Concerns have been raised by civil society and communities affected by hydropower projects, that inadequate attention is being paid to the negative impacts while public consultation is inadequate. High quality environmental impact assessments and open decision making are crucial to ensure that the hydropower sector is developed in a way that minimises harm while maximizing the benefits for Cambodia being its people and investors. Meanwhile, in a broader strategic sense, it is paramount to ensure environmental sustainability of hydropower developments through planning at regional levels, i.e. beyond Cambodia, as it is important to mention also that the country is impacted by dam development from upstream countries. This process would also need to indicate potential sites for development and no-go zones to ensure the integrity of critical ecosystems including key corridors within aquatic environments to assure the conservation and movement of fish species.

According to WorldFish in 2015, there were 16 operating hydropower dams in the Mekong River Basin in 2000. Currently, the number of dams expected to be completed now or in the near future on the Mekong River Basin is 28 (including three major dams of Xayanaburi, Don Sahong and Lower Sesan II under construction or near operational), while another 49 to 60 are proposed by 2030. These numbers include approximately 20 proposed large scale hydropower dams on the mainstream of the Mekong, of which 4 proposed dams are located in Cambodia and approximately 10 in Laos.

Based upon Mekong River Commission's Strategic Environment Assessment (SEA) of proposals for 12 mainstream dams in the Lower Mekong Basin (LMB) by the International Centre for Environmental Management (ICEM) in 2010, there are serious risks associated with potential hydropower scheme developments, which are summarised below[3]:

- mainstream projects would have significant net negative impacts on the fisheries sector. The losses in fisheries due directly to LMB mainstream dams, if all were to proceed are estimated at 476 million USD per year, excluding effects on the coastal and delta fisheries in Vietnam, which are likely to be significant but have not been studied. This is associated with loss of migration species, as fish yields in the Mekong are comprised of at least 35% long-distance migrant species ("white species"), whose migrations would be barred by dams, in addition to reduced nutrient loads for other fish species downstream
- impacts on fisheries sector can only be partially mitigated. The proposed reservoirs would only be capable of producing approximately 10% of the losses from capture fisheries
- loss of fisheries and associated proteins would lead to declines in nutritional health in LMB populations, particularly in Cambodia and Lao PDR where up to 30% of the national

[3] Of these 12 LMB mainstream dams, 2 are already under construction in Lao PDR (Xayaburi and Don Sahong) and Lao PDR has recently notified the Mekong River Commission of its intention to build a third one in Pak Benk. Also, in October 2016, Cambodia 's Council of Minister has given its green light ot the Ministry of Mines and Energy to engage with developers to study the feasibility of 2 additional mainstream dams in the country (Stung Treng and Sambor).

protein supply would be at risk if all mainstream dams were to go ahead. These food security issues are likely to affect both the rural and urban poor

- suspended sediment loads in the Mekong River system are estimated at 160 to 165 million tonnes per year. Approximately 50% of this load could be removed by storage hydropower projects in China and the 3S Rivers alone. Meanwhile, if all 12 LMB mainstream dams are developed, the sediment load would be halved again, i.e. the Mekong near Kratie would be at 25% of the current load (~42million tonnes per year). This reduced suspended load of sediments will have significant implications for the transport of nutrients with severe implications for the aquatic food chain, fish habitats and fisheries, and reduced fertilisation of the Tonle Sap system and between 23,000 to 28,000 km2 of the floodplains across Cambodia and Vietnam
- mainstream projects in the LMB could induce a 12-27% reduction in the primary productivity of the aquatic systems i.e. loss in vegetal productivity, with implications for the overall productivity of river ecosystems
- LMB projects would have a negative impact on ecosystems of international importance, where a significant number of species and a number of globally endangered species likely leading to their extinction. The loss of habitats would encourage the proliferation of general species that do not migrate over long distances and which breed within the body of the reservoir and do not require specialised habitats or hydrological triggers to induce spawning ("black species"). The fragmentation of the river system would isolate aquatic populations into pockets leading to a loss of species. If all mainstream projects proceed, 55% of the Mekong River between Chiang Saen and Kratie would be converted into reservoir, shifting the environment from riverine to lacustrine. At least 41 riverine fish species found only in the mainstream upstream of Vientiane and would therefore be threatened
- fish passes are not a realistic mitigation option for Mekong's mainstream dams. Fish ladders may be a mitigation option for low dams on tributaries, but existing types and sizes of fish ladders cannot accommodate the intensity and diversity of fish migrations on the mainstream. If fish passes are to be successful, they must be considered at the earliest planning stages during the determination of dam location and design and must be designed for identified target fish species. To date, only three of the 12 LMB mainstream dams have explicitly included fish passes, while none considered fish passage before location was finalised, and none have been designed upon findings from studies for target fish species.

Irrigation has been an important agenda for Cambodia for many years leading to numerous irrigation dams across the country including the large areas of lowlands requiring rice field irrigation. Government has used this form of development to mobilise political support for rural transformation being a necessity for poverty alleviation and subsistence agriculture. This policy for irrigation expansion received wide support in Cambodia including donor agencies. However, some assessments have shown that irrigation schemes have not always achieved their expected outputs and resulted in cost overruns, negative impacts upon fish migration through fishways and/or fish ladder constructions, and general problems with project governance for different beneficiaries of water. Meanwhile, hydropower dams can impose adverse impacts on the irrigation sector, which can only be partially mitigated if significant capital is invested to re-equip the irrigation sector to use reservoir water supplies. In addition, the potential offset gains from reservoir fisheries and irrigation are expected to be only worth 14 million and 15.5 million USD year, respectively, which is not significant compared to potential losses in the order of over 400 million USD per year after the construction of proposed hydropower dams on the mainstream of the Mekong according to ICEM in 2010.

It is important to recognise that infrastructures for irrigation are far more numerous than for hydropower and will have effects as stated above upon the movement of water, sediments and fish species. To place irrigation infrastructures in perspective, it is important to note that one of the most important areas for fisheries in Cambodia, being the Tonle Sap Basin, had over 7000 structures in 2007 according to WorldFish, which were composed of 55 water stores (reservoirs), 3992 water routes (canals) and 3294 water flow controls (smaller dams, dikes etc.). This situation is similar elsewhere in the country notably the Mekong basin where irrigation and flood mitigation infrastructures have been and continue to be developed. These infrastructures are not on the mainstreams of the large rivers compared to the relatively recent surge of some hydropower projects, but will have impacts on fisheries management within the watersheds of numerous tributaries.

Fish migration in Cambodia often corresponds with the “flood pulse” which is principally what keeps the river systems between the Tonle Sap area and Mekong alive and vibrant in fish numbers and species, while the Tonle Sap Lake itself accounts for an enormous 60% of all Cambodia’s capture fisheries. In addition, the Mekong provides approximately 57% of the water in the Tonle Sap Lake, which demonstrates the very important inter-connectivity. There are two major concerns associated with water for fish species, as follows:

- fish production in relation to water and sediment availability: the flow of water from the upland provides both flows and water resources for fish, which allows fish to move either laterally or longitudinally and carry nutrients in the sediments from the watershed, which are vital sources of food for fisheries
- fish migration for black, grey and white groups of fish species: black species are able to survive in swamps with limited movement, and are mainly carnivorous or detritus feeders and include Channidae (Snakeheads), Clariidae, Bagridae and Anabantidae species. White group species are strong lateral and longitudinal migratory species such as cyprids including *Pangasisus* sp., and Trey Riel which is a common, but a nationally important fish consumed by Cambodians. Meanwhile, some of the grey species group fall between the categories mentioned above, as they still migrate but within smaller watersheds, such as the Tonle Sap tributaries. However, it is very important to add that longitudinal migrant fish species make up approximately 63% of the annual national catch according to Van Zalinge et al. in 2000.

Institutional framework

At regional / transboundary level:

Cambodia shares the Mekong River and watershed with several countries with an international agreement to protect the uses of natural resources, principally water, under the Mekong River Commission (MRC) agreement established in 1995. Any development linked to water usage, in particular hydroelectric dams, will require careful scrutiny and planning to avoid any conflicts with countries sharing this resource. This is very important for countries whose existence is highly dependent upon water for agriculture and fisheries, especially wild fish migrations, from upper stretches and tributaries on the Mekong, notably Cambodia and parts of Vietnam located downstream. Cambodia is represented at the MRC by its Cambodian National Mekong Committee (CNMC), a body composed of 10 government ministries including MAFF, MEM, MoE and others related to the development of the country. One of the key aims of this CNMC is to contribute to the sustainable economic and infrastructure development associated with two parliamentary commissions for the oversight of developments on the Mekong in Cambodia. Effectively these commissions provide potential importance to decisions regarding the Mekong and issues affecting the river with probable national interests or concerns being deferred to Cambodian decision makers i.e. elected members of parliament. Water resources management in the Lower Mekong Basin (LMB) is a mix of a ‘cooperative and coordinating model’ at the basin-scale, facilitated

through the MRC, and four national models, where individual sovereignty, customs and administrative systems dominate. All LMB countries now have a dedicated agency responsible for water resources management, while river basin organizations/committees are being established for participatory water management at the sub-basin level within member state countries including Cambodia.

MRC's Basin Development Strategy (BDS) 2016-2020 maintains the development opportunities prioritised in the previous MRC Strategy as follows: tributary hydropower development; expansion of irrigated agriculture; mainstream hydropower development; and other opportunities. The actions of the Strategy are defined under 7 basin-wide priorities addressing longer term risks and opportunities as follows:

- reduce remaining knowledge gaps to minimise risks
- optimise basin-wide sustainable development and cost and benefit sharing
- strengthen the protection of mutually agreed environmental assets
- strengthen basin-wide procedures and national implementation capacity
- improve national water resources development
- enhance information management, communication and tools
- increase cooperation with partners and stakeholders.

The key potential activities associated with the strategy priorities for the Mekong and Cambodia include:

- conducting strategic studies to assess trade-offs, uncertainties and risks associate with basin development opportunities (including fish ecology), under priority 1
- assessment of alternative medium-term basin-wide scenarios to examine trade-offs and more optimal pathways, under priority 2
- support to national planning, water and related sector agencies to improve national water resources development and management, under priority 5, with preparation and promotion of best practices guidelines to support better design and operation of individual national water related projects and programmes

MRC has been criticised in recent years, as it is often regarded as an organisation with objectives to promote and coordinate sustainable development and management of the Mekong's water, but effectively limited powers to make any changes, particularly hydropower developments in tributaries outside its scope being the mainstream of the Mekong. Meanwhile, MRC has no control over Thailand, Laos, Vietnam and Cambodia and their current hydropower ambitions on the mainstream. In addition, instruments such as NPCA procedures are probably insufficient to fulfil the ambitions of MRC. Currently countries like Cambodia, whose migratory fish populations could be significantly affected by hydropower schemes have sometimes aligned themselves with foreign projects, being a proposed purchaser and consumer of electricity from a major hydropower project on the Mekong in Laos, as stated in an international agreement in late 2016. Overall, the sovereign decisions of countries and the economic advantages of projects, in particularly for the exportation or importation of electricity from member states in the Mekong Basin, will continue to play significant roles in decision-making processes.

At national level:

Many government institutions are consulted for dam projects and include MAFF, MOWRAM, MoE, and MEM. But the key institutions are MOWRAM and MME, while the MEM is responsible for hydropower dam projects and MOWRAM is responsible for irrigation dams. Even though the CNMC is the Cambodian official body attached to the MRC being the key international institution addressing dam projects within the Mekong River Basin, the Ministry of Energy and Mines has the final say for hydropower and it does not appear to be transparent in its operations. The strategies correspond with principally the NSDP and the Rectangular Strategy; however specific hydropower plans for the future remain guarded political strategies. Meanwhile, the proposed large dam at Sambor in Cambodia lies under secrecy during the current phase of feasibility studies. Similarly, irrigation dams are often highly political decisions, where tangible consultations with various authorities are limited or likely do not exist.

It is important to state that in Cambodia provincial Departments of Environment are mandated to approve EIA reports for investment projects of up to $2 million, but are limited in capacity and staff as well as budget allocations. In addition, provincial leaders who want to improve their economic development performance frequently allow project owners to delay in submitting an EIA report for review until the last minute, which is similarly observed at central level. National EIA technical working groups for various projects including hydropower and irrigation are chaired by MoE and began in 2011 with facilitation from donors. The NGO Forum on Cambodia and Development and Partnership in Action (DPA), among others, are included as civil society representatives of the working group. This approach can be viewed as a model of good practice for cooperation in the region. Nevertheless, stakeholders involved in the working group report that it operates in an ad hoc manner without a clear strategic direction according to Wells-Dang et al. in 2016. Participants from civil society are often only given one week or less to review EIA reports consisting of hundreds of pages, which can often limit their inputs and feedback to tokenistic gestures. However, this step remains a mechanism through which the public and civil society can engage in a potentially more deliberative and participatory process.

The key aspects of the institutional, policy and legal framework for dams are the Law on Water Resources Management (2010), Law on Fisheries (2006), National Water Resource Policy (2004), National Fisheries Sector Policy (2005), Strategic Planning Framework for Fisheries: 2010-2019, Cambodian code of conduct for responsible fisheries (2010) and the Strategic Planning Framework for Fisheries: 2015–2024. Also MRC's Basin Development Strategy (BDS) 2016-2020 is an important internal strategic plan and policy framework relevant to dams, and in particular hydropower dams. The National Fisheries Sector Policy (2005) provides a broad focus for the "management, conservation, and sustainable fisheries contributing to ensure people's food security and socio-economic development-enhancing people's livelihoods and nation's prosperity." It emphasizes on areas such as management and development of fisheries, aquaculture development, and fisheries conservation, which means that dams should take heed of the fisheries sector policy objectives. Meanwhile, the National Water Resource Policy (2004) focuses on the major functions of water for: (i) agriculture; (ii) energy; (iii) industry, small manufacturing enterprises and services; (iv) domestic use; and (v) navigation and tourism, were international aspects of water sharing and utilisation were mentioned in this policy, which is vital for transboundary water management on the Mekong.

The Law on Fisheries (2006) is a principal document for fisheries, which aims to ensure good resources management for fisheries, the conservation of biodiversity, and the

protection of natural heritage for sustainability across Cambodia. In relation to fish migration pathways, which are of particular concern with hydroelectric damming, the Law articulates that **the building of dams/dikes across lakes, streams, affluent, rivers or any navigated canals, and the digging of canals, ponds, holes, reservoirs and other constructions, that could cause damage to fisheries resources in fishery domain, shall be studied or evaluated by MAFF**. However, as MOWRAM authorises water management for irrigation schemes, while the Ministry of Mines and Energy controls hydropower development, MAFF has limited influence in terms of capacity and leverage. The discussions are orientated within existing inter-ministerial coordination mechanisms; however, as often these schemes are highly political by nature between central office and governors in respective districts, then MAFF's influence may be limited. Effectively, these decisions could often flout the legislation protecting water flows and requiring EIAs including environmental safeguards for water systems.

Other concerns relate to dam or other constructional impacts upon water flows or pathways addressed in the Law on Water Resources Management (2010) including the subject of licensed or authorisation relating to activities in rivers, tributaries, streams, natural lakes, canals, and reservoirs. Effectively this law will control abstractions and diversions of water flows through infrastructure such as irrigation dams for agriculture or hydroelectric schemes for electricity. This law is regulated by **MOWRAM regarding the licencing and authorisation to use water**. The law is aimed at fostering effective and sustainable management of the water resources in Cambodia, which is vital for the potential harmonising processes required between capture fisheries and hydropower production. Again, it is important to add that irrigation schemes often have populist orientations, while in more recent times the development of hydropower, with private investors and their vested interests, are often highly political. Therefore the effectiveness of the law to balance and complement decisions for integrated water resources management is not necessarily achievable at present, where licences granted for irrigation schemes may not be related to sustainability or water balances.

Within Cambodia and in line with the institutional policies of the country and the MRC region, there are Integrated Water Resources Management (IWRM) goals. Cambodia is divided into 23 provinces and 1 municipality (Phnom Penh). These bodies can be widely involved in the operation, maintenance and monitoring of IWRM according CNMC's IWRM Implementation in Cambodia from 2009. The provinces are centrally governed and the communes are managed by elected councils, which can conduct their own commune-level development planning for IWRM. Meanwhile some IWRM tasks can be undertaken at the district level and even village level.

The Water Resources Framework Law was passed in 2007 and gave MOWRAM responsibility for water resources management and water allocation associated with IWRM. MOWRAM is also in charge of irrigation infrastructure and inherited this task in 1998 from the former Ministry of Irrigation, when MAFF became responsible for agriculture, forestry and fisheries.

Water supplies and service delivery are shared between many ministries, and similarly for groundwater management. However water quality within IWRM is shared between MOWRAM, MOE and MOH. In addition, the TSA was created and given responsibility for the Tonle Sap lake area and IWRM issues.

Apart from the government system, the following organisations are also involved in IWRM in Cambodia:

- Mekong River Commission (MRC), undertaking studies, knowledge-sharing and dialogue between the member countries and dialogue partners

- Cambodia National Mekong Committee (CNMC), a government agency formed as a network of sector agencies, and in charge of national liaison with MRC. As the only such body, CNMC plays an important role in the inter-ministerial dialogue about water-related development
- Cambodia Water Partnership (CamboWP) is a network of organisations and individuals involved in water resources management, under the umbrella of SE Asia Water partnership and Global Water Partnership (GWP)

MRC and the National Mekong Committees including CNMC divided the Lower Mekong Basin into sub-areas or 'water management districts' for IWRM, which were partly delineated by hydrological and administrative boundaries including national borders. Cambodia was divided into four such areas, covering the 86% of Cambodia within the Mekong Basin. However, there are still challenges at national level for IWRM, which include the following:

- further improvement and implementation and enforcement of policies, laws, regulations and procedures (including relevant MRC procedures)
- improvement of water related monitoring networks and databases
- establishment of appropriate levels of coordination and data and information exchange between vertical and horizontal levels of government.

The structures associated with IWRM will sometimes work with various local to national partners. TSA is also currently developing some IWRM capacity support within the Stung Sen River water catchment.

Overall these goals are to develop water resources for irrigation and hydropower through the rehabilitation of mainly old or defunct irrigation schemes and the planning of new dams for hydropower generation combined with infrastructures for irrigation and flood control. These goals are also combined with a vision to address:

- access for all to safe and affordable potable water
- protection of livelihoods from floods and droughts
- water required for food security, livelihood needs and economic activities
- unpolluted water supporting healthy fisheries and aquatic ecosystems.

The results from the former Millennium Development Goals (MDGs) to SDGs in 2012 showed improvements for IWRM as follows for water management: rise in access to piped potable water at 18% with increased supplies of metered water combined with improved sanitation coverage for larger cities e.g. Phnom Penh and Siem Reap. Flood management is addressed in the IWRM approach but appears to be overwhelming at a national level with annual natural flooding cycles across the country, which may also augment with climate change. Meanwhile, the National Strategy for Rural Water Supply, Sanitation and Hygiene (2011-2025) is part of IWRM for Cambodia, although the results are limited compared to needs for wastewater management and treatment. Finally, monitoring is part of Cambodia's IWRM approach with the Lower Mekong Basin. However, riparian countries are still very dependent upon MRC and foreign partner investment support to fulfil all their delegated activities. Monitoring by Cambodian authorities is rarely or never completed, due to no or lack of funds, even though it is implicitly referred to in the Law on Water Resources Management and the Sub Decree on Water Pollution Control (see section addressing pollution issues in this report).

The Cambodia National Mekong Committee (CNMC) and Tonle Sap Authority (TSA) are within Ministry of Water Resources and Meteorology (MOWRAM), which has to deal with the Ministry of Energy and Mines and (MEM) concerning energy issues (from rivers and lakes and other renewable sources). However, MME appears to be rather opaque and reportedly

does not communicate openly, which effectively undermines MOWRAM's institutions and potentially MoE including the CC Department associated with potential changes to seasonal flows of water with the Lower Mekong Basin and its tributaries.

Finally, it is clear that there may be potential clashes within Cambodia's IWRM approach between the goals for irrigation and hydropower and the vision including health of fisheries with the development of livelihoods and economic activities. It appears that IWRM is not the governing concept, as it is principally lead by irrigation and hydropower policies and strategies, whereby the national frameworks discussed above and MRC's policies and mandate can be circumvented for the principal IWRM goals in Cambodia, i.e. irrigation and hydropower.

Analysis

Trends

Hydropower development will be a major driver of change, with heavy impacts on river fish yields. According to ICEM, there were only 16 hydropower dams on the Mekong in 2000 compared to 77 to 88 expected dams in Lower Mekong Basin by 2030, and 227 dams either in operation or planned within the entire Mekong Basin by 2030 (Figure 4; Figure 5). It is clear from these maps that proposed hydropower efforts are being targeted principally in the mountainous regions of Laos near Cambodia, while the Government of Cambodia committed in 2016 to buying electricity from Laos. Similarly there has been a relatively recent rise in irrigation projects over the last 10 years with government rehabilitation of hundreds of schemes built from the Khmer Rouge period. However, these projects will not carry the same level of negative impacts upon fisheries as the proposed hydropower schemes.

Figure 4: Commissioned, Under Construction and Planned Dams (Hydroelectric and/or Irrigation) on the Upper and Lower Mekong System

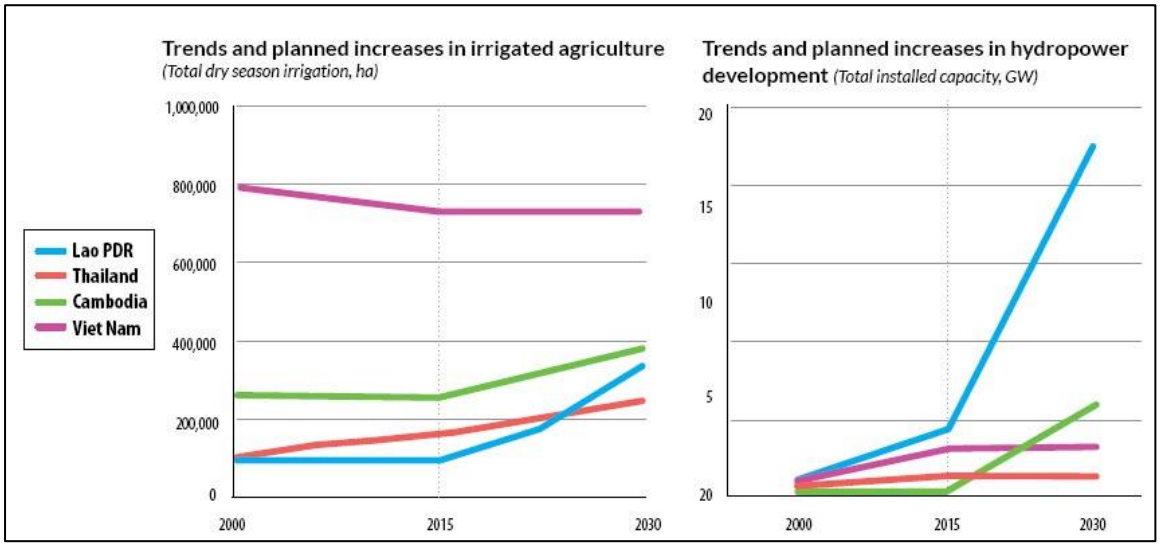
Source: CGIAR, 2016

Figure 5: Commissioned, Under Construction and Planned Dams (Hydroelectric and/or Irrigation) within Cambodia on the Lower Mekong System

Source: CGIAR, 2016

Hydropower development is one of the largest proposed development initiatives, which could have a major influence on the future of the basin's natural resources. The trends and proposed increases in production shown in Figure 6 from hydroelectric dams are quite significant for notably Laos, which is proposing to sell electricity to Cambodia.

Figure 6: Trends and planned increases in hydropower in the member countries of the MRC



Source: MRC

Potential impact on sector strategy implementation from hydropower dams

If hydropower dam developments move ahead they will have an impact upon three main environmental factors, as follows:

- water flows, in particular for fish migrations,
- fish migrations of economically important White fish and some Grey fish species
- restricted sediment supply of nutrients to principally rivers, lakes and floodplains.

The context of hydropower under construction and their impacts would present serious impacts for fisheries as discussed in this section reducing part of capture fisheries production each year. However, the effect of proposed schemes in the future and principally the mainstream sections of the Mekong in Cambodia and its upper reaches from Laos to China would provide additional and potentially devastating results, and potentially almost destroy the majority of migrant capture fisheries in the country.

For the Tonle Sap, upstream hydropower developments could have the largest impact during dry years. Then storage volumes compared to flow volumes are relatively larger than during the wet years. The Tonle Sap inflow could decrease by 10-25% during a dry year. A 10% inflow decrease corresponds to about a 0.5 metre maximal flood height decrease and a 10% decrease in the flooded area. A decrease in the area flooded means less breeding habitat for fish, and a decrease in flood height means less volume for fish food production. Upstream dam developments on Tonle Sap can also delay flood arrivals from between one week to one month and flood duration is correspondingly shortened. This delay can be critical for breeding fish adapted to regular flood seasons, and in particular short cycle species such as Trey Riel. It is also clear that shortened inundation shortens the time when fish can feed over the floodplain. Overall, the energy authorities remain rather secretive about their dams and water flow requirements and are developing theories such as the use of fish ladders to apparently solve flow and fish migration issues for example, according to anonymous sources in the fisheries sector. This tenor appears to have promoted some mistrust among some interested parties.

Fisheries are already stressed during drought years, particularly on migratory rivers. The additional stress caused by built structures will significantly affect the fish, although it cannot be reliably assessed at present based upon available data. However, it is clear that realisation of all potential hydropower and irrigation schemes on the Mekong Basin could represent a threat to migratory fisheries especially during drier years. Based upon other studies for proposed dams on the Mekong, dry season discharge of the Mekong will increase by 13% to 22%, while the flood level will decrease by 30cm, resulting in a loss of floodplains amounting to 250,000 hectares with an impact on crops and capture fisheries, such as rice field fisheries, and small scale aquaculture including rice-fish systems.

Most proposed dams are located in the north of Cambodia or across the border into Laos, as the topography is much higher in this area and suitable for hydro-electric schemes. According to ICEM, the construction of 11 mainstream hydropower projects is expected to reduce fish production. This impact would correspond to annual losses of approximately 340,000 metric tons of fish by 2030 within the LMB. Therefore mainstream dams could lead to critical consequences for food security, nutritional needs and poverty alleviation in Cambodia (see Key Issue 2).

The construction of the proposed large scale hydropower dams at Sambor and Stung Treng being mainstream dams in Cambodia are predicted to reduce the supply of inland fish and other aquatic animals by between 34,000 and 182,000 metric tons according to IFReDI's Food and Nutrition Security Vulnerability to Mainstream Hydropower Development in Cambodia study of 2013. The uncertainty range depends mainly upon the hypothesised distribution of long-distance migrants' spawning habitat (White fish), and highlights the importance of the need for new research on spawning areas. Meanwhile the potential losses in fisheries yields would be significant and could be compared to very significant loss estimates on the Lower Sesan 2 dam, which is likely to be a loss of approximately 9.3% of national capture fisheries according to Ziv et al in 2012. This data serves a clear sign of the risks from dams to fish production across the country.

Dams are also going to retain sediments and nutrients resulting in substantially clearer and less productive waters. ICEM forecasts a total loss of sediments due to retention reaching 75% of the total sediment load. This impact is likely to lead to a reduction of fish stock due to substantial losses of nutrients and could also have a significant impact on floodplain agricultural productivity. The opposite effect could occur and is associated with heavy flows from active dams leaving to erosion of riverbanks and impacts upon neighbouring village fields or gardens.

<u>Potential impact on sector strategy implementation from irrigation dams:</u>

Large areas of floodplains, rice paddies, rivers and tributaries and lakes, numerous irrigation systems and existing or potential pond sites are available in Cambodia. But according to WorldFish, irrigation has been curtailed until now due to the principal lack of investment in infrastructure to use existing or potential water supplies. However, water abstractions and diversions for aquaculture units, in particular during the dry season, may have adverse impacts upon natural breeding grounds for fish. These factors combined with varying rainfall patterns and regular dry seasons have sometimes developed more intensive competition between crops farming and water required for wild fish species and aquaculture. In some livestock areas, the need for water may also have some impacts on local water bodies. Often water will be pumped from rivers to agricultural sites, although variable water and dry seasons could encourage the development of irrigation dams for cropping. Again the issue of water balance is at stake, where agricultural irrigation priorities may often outweigh the downstream requirements from fisheries.

Irrigations dams are numerous across Cambodia and in particular with the vast floodplains of Cambodia around the Tonle Sap lake, where according to WorldFish in 2007, the number of structures included 55 reservoirs, 3992 canals and 3294 flow controls (dams, embankments dikes, gates…) being 44% of all structures across Cambodia. Many of these structures have been or will be rehabilitated in the forthcoming years. Irrigation dams are often located in the floodplains, while some in the mountains of southern Cambodia do not pose any serious problems for fisheries as they often do not inhibit the migration of key fish species (pers. com. CI), although fish ladders are sometimes fitted for localised movements of fish in between water bodies. In fact more irrigation dams for crop farming have been encouraged by government following the severe dry season of 2015-2016 induced by El Niño in Laos, Thailand and Cambodia. These reservoirs of water have the potential to be used for the development of capture fisheries using principally Black fish species and possibly some Grey fish. Key aquatic habitats in the area and access for local fish movements are very important for existing local fisheries according to Koponen et al. The influence of the structures also depends upon how they are used and managed. For example, flow controls and routing infrastructures can manage water movements and control flooding, but effectively block the movement of short or long distance migratory fish species, if not managed correctly or if there is insufficient understanding of fish movements, at specific sites.

Overall there appears to be conclusive impacts from hydropower dams, and irrigation and reservoir schemes on fisheries marked by a severe clash of interests and impacts associated these sectors versus fisheries. Currently the modus operandi is orientated to extraction of significant water resources for agriculture and the production of electricity at present. If this course is not changed to a harmonised and sustainable use of resources for fisheries, the SPF's objective for sustained production is likely to be highly compromised. The result would be a significant lesser role in the country for capture fisheries, while aquaculture is unlikely to bridge these losses in production for the foreseeable future.

The key issues or sub-issues for hydropower and irrigation developments are summarized and assessed according to their probability and impact, as follows:

Table 4: Key issues or sub-issues for hydropower and irrigation developments

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Change of principally water flows within mainstreams and some of its key tributaries of LMB due to hydropower dams	High	High	Large
Fish migrations of economically important White fish and some Grey fish species are affected by water flow changes*	High	High	Large
Restricted sediment supply of nutrients to principally rivers, lakes and floodplains	High	Average	Large
Change in water flows in floodplains for flood control and irrigation needs	Average	Average	Small to Medium
Fish migrations and local movements of Black fish and some Grey fish species are affected by water flow changes	Average	Average	Medium to Large

* Note: water flow could also be influenced by climate change

Analysis of alternatives

This section compares the issues or sub-issues for hydropower and irrigation developments with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Focus on coastal aquaculture could mask the issues linked to potential reduced flows of water and lower nutrient levels in freshwater aquaculture systems due to hydropower and irrigation developments.
Support to intensive/commercial fisheries versus small scale fisheries	Reduction of water in LMB and tributaries could have a serious direct impact upon large and small scale aquaculture developments, although the impacts upon small scale alternatives will be far greater regarding fish production and the livelihoods for thousands of households.
Support to specific species versus all species	N.A

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Lack of engagement in CFis could compound the effects of potentially lower fish production associated with some hydropower and irrigation developments, as management of fisheries is already poor for fish production and could be exacerbated further by negative issues linked to the disturbance of water and nutrient availability.
Enhance wild stocks versus management of existing stocks in the wild	If fingerlings are not released into the wild, which would normally enhance production from some aquatic habitats with sufficient carrying capacities , this may be seen as a green light for hydropower to take significant volumes of water from some key aquatic systems to the detriment of potential wild stocks.
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	IWRM approaches place importance upon aquatic ecosystems and fisheries facing demands from finite water resources to meet hydropower/energy and agriculture/irrigation demands.
Promote economic diversification versus only capture fishery activities	Economic diversification for fishers may be necessary if capture fisheries production is reduced by impacts from principally hydropower schemes.
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	Introduction of PES schemes adds value to aquatic ecosystems and their fisheries, such as rivers associated with tributaries on the Mekong, where upstream foreign or national extractors (government and/or private sector) of water for hydropower pay for losses to ecosystems services with impacts downstream i.e. erratic water availability and limited or blocked access for migrating fish leading to fish production losses.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

The key recommendations to address issues related to hydropower and irrigation developments are presented below:

- develop a new multi-national approach and/or the extension of MRC responsibilities over the tributaries which is required to promote planning and strategies whereby key fish migration pathways are not lost in exchange for large hydropower or irrigation schemes. This process could be linked to the improvement of how and when Notification, Prior Consultation and Agreement (NPCA) procedures are enacted by MRC and member states. The Government could form a working group within MRC to lobby for NPCA. The EUD could consider supporting this work through the CAPFish programme.

- More specific research study on the impacts of fish ladders and fish migration by Inland Fisheries Research and Development Institute (IFREDI) with FiA and MAFF support, as the design standards of fish ladders need to be studied to minimise negative impacts on fish migration. This recommendation could be in collaboration with the CNMC and MRC. It is important to add that research for fish ladders is not a means to condone dams for hydropower or irrigation with ladders, but a recommendation to do more research to define how ladders could be improved and where they may be successful, as well as unsuccessful with regard to various species and localities in relation to flow and climbs for migratory fish. In addition, basic environmental safeguards could be developed for potential dam construction schemes, which could be applied to all projects in MRC countries
- wild stock black and grey fish species need to be conserved in designated aquatic ecosystem reserves under FiA control and potentially with CFis (if appropriate conservation areas with native black/grey species), as these fish may be important genetic fisheries resources for the future, if there is a significant loss of production from long-distance migratory white fish species. Ideally designated fish stock reserves should be created by FiA on key water bodies and/or tributaries. These aquatic areas would have restricted fishing access and be protected within their water catchments from any potential threat from developments, being principally dam construction schemes
- IFREDI and FiA to analyse the real costs and benefits (values) of fisheries compared to gains from hydropower projects within and outside Cambodia. This process needs to take lessons from various countries including Sweden, which applied cost/benefit analysis for salmon fisheries versus hydropower developments according to Hakansson et al in c. 2003. Specifically, the study assessed the opportunity costs of releasing more water from schemes for the potential benefit of upstream salmon migrants, i.e. adult spawners. However, in the case of Mekong species, the study would have to be more detailed and broader. The study could gain from partnering with The Economics of Ecosystems and Biodiversity **(**TEEB), which is a global initiative focused on "making nature's values visible**"**, and similar to the PES approach. Results from this form of valuation could potentially validate the importance of aquatic ecosystems providing evidence based information to decision makers
- support water management planning for multi-use zones, agriculture zones, and protected zones which do not exist at present. It will also be important to integrate into this process the ELCs associated with key fisheries areas, for example where agricultural ELCs linked to proposed irrigation systems may provoke deforestation of flooded forest areas. The entry point would be inter-ministerial and principally concerns MAFF, MoE, MOWRAM and the PM's office. Overall this would be the responsibility of the PM's office to coordinate the planning with the respective key ministries led by MOWRAM
- MRC is the key regional institution involved in dam projects on the mainstream of the Mekong, however MAFF, MOWRAM, MoE, and MME are also involved in dam and reservoir construction at national levels. The key institutions for the environment are MOWRAM and MoE, where MoE with MME are mainly responsible for hydropower dam projects, while MOWRAM, MAFF and MoE are in part responsible for irrigation dam projects. As fish biodiversity and fish migration issues need to be considered in the design stage of dams and reservoir, then MAFF, and in particular FiA for fisheries management, need to work closely with MoE, MOWRAM and MME and promote the following:

- networking and collaboration for MAFF (FiA) and MOWRAM and MoE related to the potential harmonising of irrigation schemes with fisheries. This process needs to start with transparency from within MAFF itself concerning irrigation projects. Moreover, the EIA processes are often orientated to self-interests of agriculture at national and regional levels, where the effectiveness of debate is weak and projects are often under challenged. Therefore this issue needs to be addressed and reformed to provide fisheries with the important status that it deserves.
- inter-ministerial bodies must play a real role through positive dialogue and actions to support the EIA process at local, national and regional levels with MRC and CNMC in Cambodia, whereby the processes are transparent and accountable to all stakeholders through public participation, where the national media has access to all decision-making processes for the benefit of the public and stakeholders. Most importantly the role of inter-ministerial bodies is to allow the respective opinions of different key ministries to be heard and debated i.e. energy, fisheries and agriculture, whereby the interests of all parties are shared, and where possible compromises are forged. During the early stages of the EIA process, it will be paramount that alternatives are identified and discussed by all parties. These alternatives should include various sites and scales for the projects at the beginning of the EIA process. The trade-offs need to be clearly shown through cost/benefit analyses as early as possible, and should be presented to all concerned, to influence decision-making processes and the eventual outcomes for proposed dam projects. This process would require clear responsibilities of MAFF, MOWRAM, MME, MoE, CNMC and MRC, and may need to involve scientific institutions in Cambodia, such as the Royal University of Phnom Penh (RUPP). Capacity and leverage for this process could include capacity building in EIA processes for key members of staff from these institutions to help them to understand and apply all EIA processes and steps. This process needs much greater transparency from the Ministry of Energy regarding development projects for hydropower. Often the Ministry of Energy is secretive and non-responsive (as observed when this SEA was being developed). Similar to irrigation dams, the EIA process is often not conducive to discussions due to limited time and interactions between concerned parties. In addition, the hydropower dams are often much larger and complex, which compounds the difficulties. Again, this situation must change immediately to allow fisheries into the debate with competing water management with dams
- need for the development of strategic planning for dams in Cambodia, which will address the potential cumulative impacts of the schemes at national and international levels within MRC countries. Planning systems are required which could define effective restricted or no-go zones combined environmental safeguards, which currently do not exist. There is a need to promote strategic planning at the current Ministry of Energy with other ministries such as MOWRAM and Ministry of Mines moving beyond planning for management of water resources (see above for different users of a source) towards a holistic and strategic national and international plans for multiple sectors from food security needs to energy requirements for households and industries. This approach should account for all sectors which are dependent upon or influence water resources and integrate climate change adaptations.

7.1.2 Key Issue 2: Poor management of fisheries and livelihoods

Rationale for the selection of the key issue

The rationale for this issue is based upon the findings from the scoping study and composed of the following key points:

- aquaculture development under CAPFish and directed by SPF policy could have negative impacts, as a potential focusing upon exports could lead to an escalation in fish prices
- while the capture of large amounts of small wild species is traditionally used for “prahoc” (fermented fish), there are also significant unsustainable catches of small fish (particularly in the context of poor management – see below) used as animal or fish feed for aquaculture, which could have negative national food security consequences due to low and inefficient conversion ratios
- poor management of capture fisheries is a current natural resource management issue due to the weak capacity of associations associated with open access (tragedy of commons), lack of stock assessment and monitoring, etc., which together are imposing negative impacts upon the livelihoods of fishers. On a broader scale, poor management will affect capture fisheries and aquaculture's numerous direct and indirect commercial benefits through value chains for production associated with inputs, domestic and international sales, and salaries for workers.

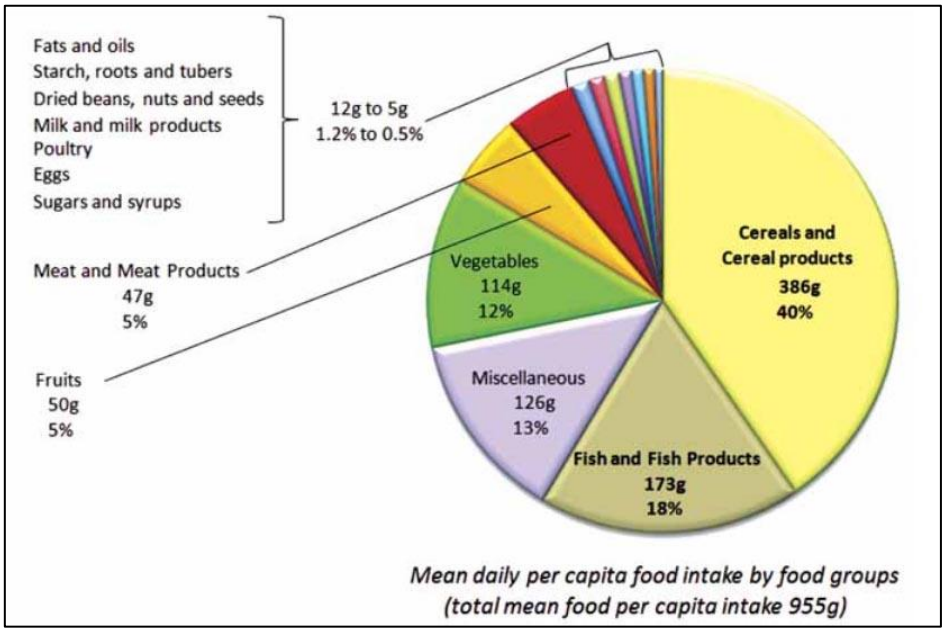
If current poor management observed in inland, coastal and marine capture fisheries continues, it would also jeopardise any investment in the fisheries sector, as could lead to (or for some species) overfishing of renewable stocks. Moreover, support to the aquaculture sector, through CAPFISH-aquaculture, could create an even greater incentive to overexploit and the perpetuation of poor management practices.

Baseline (including institutional, policy and legal framework specific to the key issue)

Context

This section has a relatively broad but interconnected series of issues being food security and nutrition, poverty alleviation and poor management of fisheries. Fish and fish products intake (from both inland and marine sources, plus aquaculture and other aquatic animals) are the second largest dietary component at 172.5 grams per person per day, accounting for 18% of the total food intake. This fish and fish products food group follows cereals being the principal group of foods and dominated by rice in Cambodia as shown in Figure 7.

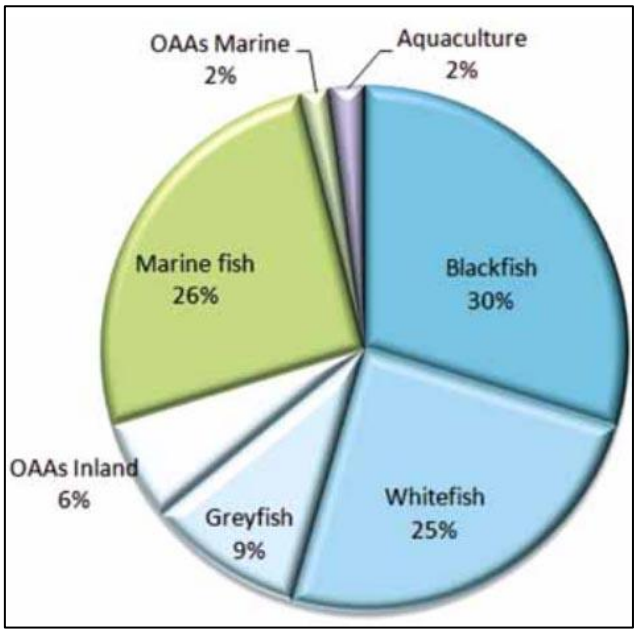
Figure 7: Mean daily per capita food intake in Cambodia by food groups



Source: IFREDI, 2013

Figure 8 shows the percentage of each fish sub-group in terms of total fish consumption, clearly demonstrating the importance of inland fish and the proportion of both floodplain residents (Blackfish) at 30% and long-distance migrants (Whitefish) at 25%, as part of fish and fish product consumption. Similarly the proportion of marine fish consumed is significant at 26%. It is important to note the relative insignificance of aquaculture at present compared to wild capture from principally inland followed by marine fisheries. However, aquaculture is a growing sector and regarded as a key factor for the future of fish production by CAPFish.

Figure 8: Fish groups as percentage of total fish intake



Source: IFREDI, 2013
Note: OAAs - Other Aquatic Animals

Overall, fish and fish products are the main contributors of protein for up to 37% of the total protein intake and 76% of animal protein intake per capita (Vilain et al., 2016),, and provides 27.8% of total fat intake per capita, and also an important source of iron at 37.3% of total iron intake per capita. It is important to add that migratory white fish contribute to 12% of total household fat needs and 21% of national iron requirements. The CAPFish programme aims to encourage the production of fish and play a vital role in providing principally capture fish products followed by aquaculture, which would meet some of the daily nutritional needs of the nation. However aquaculture development under CAPFish and directed by SPF policy could have negative impacts, as a potential focus on exports could also lead to an escalation in fish prices at local markets leaving the people with inadequate supplies, if export-oriented aquaculture was to develop by diverting significant volumes of wild fish, such as “trash fish”, from the market. These potentially higher prices could then present a food security risk for the country. If capture fisheries was to decrease with hydropower, this situation would worsen, although it is important to add that mainly good quality wild species of fish are already sold to neighbouring countries like Thailand with higher purchasing powers, while lower quality fish products are imported into Cambodia from its neighbours to cater for local poorer markets. Therefore the development of the fish industry with CAPFish support through capture fisheries and the recognition of the importance of migratory fish should primarily focus on better management and improved livelihoods from fish production for fishers and their households in Cambodia.

Communities with the highest levels of dependence on fishing tended to be located either closest to, or within, fishing lot areas. This factor may positively influence their perceptions of policy reforms, in particular for community fishing zones which were transferred from the former fishing lots during the initial phase. However, full time fishers have been concerned by seasonal fishers who are also taking advantage of improved access according to the UKs’ Department for International Development (DFID) in 2004. It is also important to recognise that Cambodian fishers have some of the highest levels of dependence on fishing, but also some of the poorest groups in rural Cambodia, as they are generally landless and dependent upon an intensely seasonal and variable natural resource, which makes them particularly vulnerable to poverty. The efforts of CAPFish aligned to the SPF policy should encourage effective operational community fisheries, which is an important step to improve fisheries management for fishers, and in particular for vulnerable groups.

Cambodia’s fisheries face a number of threats including poor management, fish harvests that exceed sustainable limits, widespread use of illegal fishing methods, habitat degradation, and in recent times climate change. This issue is associated with poverty and the limited capacity to invest in productive assets including dependence on relatively small and cheap fishing gears. This factor has made many of them open to the economic abuses of wealthy buyers of fish who buy gear for the fishers including illegal gear. Later these fishers become indebted to the wealthier investors. These buyers can often be members of the community, who may also fish but principally trade in fish and sometimes have large floating cage units for freshwater aquaculture either in the CFis or neighbouring public waters. Better management of fisheries combined with opportunities for poorer fishers to become small-scale aquaculture farmers through support from CAPFish could offer major improvements towards sustainable fisheries.

CFis[4] are the key stakeholders for the sector as their members catch the bulk of capture fisheries production in freshwater environments and associated with Figure 8. However, in

[4] The National Sub-Decree on Community Fisheries define a CFi as "*a group of physical persons holding Khmer citizenship who live in or near the fishing area, voluntarily established and taking the initiative to improve their*

marine environments, mainly foreign boats within the EEZ are catching the majority of fish, while a CRS study in 2010 on shrimp fishing estimated that CFis accounted for 20% of the annual catch. However, the majority of the CFis remain weak and not fully operational as co-managed entities. CFis often lack the understanding of the concept and opportunities associated with community-based management and do not have the capacity to keep threats at bay such as illegal fishing, and the skills to upgrade from natural resources reliance. CFis do not cover the whole fishing domain nor the national marine and inland protected areas. The impact of poor management has created a change in the composition of inland catches in recent years for capture fisheries according to WorldFish as follows:

- catches composed of small fish including juveniles and known inappropriately as "trashfish" are increasing, which could include 2 to 5 million fish taken out with mosquito nets and includes many taken out for aquaculture as fingerlings and feed for cultured fish
- catches of medium sized fish are decreasing
- sharp decline of catches of larger fish

On the coast there is also a shift in the size composition of species (pers. com. Flora & Fauna NGO).

The scenarios above are a result of the tragedy of the commons resulting from open access to fishery resources. It may also be due to too many people fishing from a limited/defined resource base with user rights. These hypotheses are based upon government and fisher observations combined with historical data in other freshwater fisheries according to Welcomme in 1995.

Due to the lack of viable data, the information in Figure 9 is more than likely highly inaccurate (pers. com. FiA) especially for inland and marine capture fisheries, while aquaculture may be closer to truer figures. Therefore both data and trends for fisheries and aquaculture are hard to define and use. Meanwhile, it is almost certain that capture fishers have reached their limits and could be being fished at 50% above their sustainable levels at present according to monitoring NGO, SCI-CAP, and based upon principally observations of fish sizes at their monitoring sites. In addition it is also important to note the trend for fish catches per fisher in Communes have dropped significantly from approximately 347 kg/person/annum in the 1940s to between 190 to 192 kg/person/annum from 1975 and 1995 periods, respectively (MRC, 2003). It is important to add that rice-field fisheries within inland production systems are the largest producer of fish in Cambodia.

Figure 9: Production from aquaculture and marine and inland capture fisheries in Cambodia from 2009 to 2015

SOURCE	2009	2010	2011	2012	2013	2014	2015
Inland Production	390,00	405,000	445,000	509,000	550,000	505,005	487,905
Marine Production	75,000	85,000	91,000	99,000	100,000	120,250	120,500

own standard of living by using and processing fisheries resources sustainably to contribute to economic and social improvement and poverty alleviation". The CFis can be considered as "artisanal fishery" groups defined by the FAO Voluntary Guidelines on Sustainable Small-Scale Fisheries.

Aquaculture	50,000	60,000	72,000	74,000	80,000	120,000	143,141
Total	515,000	550,000	608,000	682,000	730,000	745,255	751,546

Source: FiA/MAFF, 2016

Lack of opportunities in other rural sectors may have encouraged more rural people to use fishing as a safety net with negative impacts on fulltime fishers. The current number of fulltime fishers is more than 1 million, while part-timers account for less than 5 million fishers attached principally to the 516 CFis across the country (pers. com. TSA). Therefore they account for about 40% of the national population being approximately 15 million growing a rate of 1.8%. These figures have grown significantly since the fishery reforms of 2002 and 2012, while 80% of all fishers could be classified as poor at present (pers. com. TSA).

In the Cambodian seas, illicit fishing (IUU) is practiced by large and smaller boats from Cambodia, Vietnam and Thailand within offshore and shallow coastal waters of Cambodia. These boats are often authorised by higher authorities in the country. The results of these practices are less marine resource for fishers and traders in Cambodia and reduced potential financial benefits for the country.

Policy and legal framework

The key aspects of the institutional, policy and legal framework for food security and poor management of fisheries are the Law on Fisheries (2006), and the Sub-decree on Community Fisheries Management (2007), The Rectangular Strategy in Cambodia (CRS) for Growth, Employment, Equity and Efficiency phase III-2013-2018, the National Strategic Development Plan (NSDP) 2014-2018, and the Agricultural Sector Strategic Management Plan (2014-2018).

The National Strategic Development Plan (NSDP) 2014-2018 is a development framework and a road map for the implementation of the Rectangular Strategy Phase III (discussed below) and lays out the political commitments to a socio-economic development process. It outlines visible and realistic actions, programmes and projects that strive to make its people educated and healthy, and be harmonised within society, which could provide security and poverty alleviation from various sources. The NSDP highlights the potential progress that the country has made towards fisheries reform including the increase in conservation areas and the promotion of community-based fisheries management. The NSDP also prioritises fisheries laws and emphasizes the importance of strengthening fishing communities and conservation zones. The government also aims to continue to implement measures to sustain freshwater and marine fisheries to meet their goal of boosting fish production for domestic and export markets. However, the ambitions of the NSDP will only be achieved if there is political will and investment for FiA and communities to improve the management of fisheries, which is where CAPFish could provide important support for this strategy.

The Rectangular Strategy in Cambodia (RSC) for Growth, Employment, Equity and Efficiency Phase III 2013-2018 and the National Food Security Strategy 2014-2018 provide a strong emphasis on the promotion of agriculture and a policy framework to ensure that average annual economic growth is maintained at 7%. This strategy is also beneficial for food security and nutrition, poverty alleviation and poor management of fisheries.

The Law on Fisheries (2006) and the Sub-decree on Community Fisheries Management (2007), aims to ensure the sustainable management and conservation of fisheries to safeguard rural people's food security. In addition the Law also tries to encourage good fishery resources management, and enhance aquaculture development, production and processing. Meanwhile, the Sub-decree on Community Fisheries Management (2007) determines rules and legislative procedures for establishing and managing community fisheries (CFi).

The Agricultural Sector Strategic Management Plan (2014-2018) targets "an increase in agricultural growth around 5% per annum", which may again encourage food production for security rationale and nutritional benefits. This strategic plan focuses on four pillars; enhancement of the agricultural productivity, diversification and commercialization; promotion of livestock and aquaculture; sustainable fisheries and forestry resources management; and strengthening the institutional capacity and increasing efficient supporting services and human resource development. The latter is likely to be very important for pollution management, monitoring and control by various institutions from multiple ministries.

The Fisheries Law 2007 and CFi Sub-decree 2007 have also paved the way for management, conservation, and sustainable fisheries contributing to ensure people's food security and socio-economic development-enhancing people's livelihoods and nation's prosperity. They also emphasise the management and development of fisheries, management of community fisheries and family fisheries, aquaculture development, and fishery processing development, which are vital for poverty alleviation, while fisheries conservation could provide a sustainable source of food from fisheries and aquaculture. Their statements also support fisheries institutions and budgeting with infrastructure development, which would be necessary to monitor nutritional issues and food production.

It is important to mention that the SPF envisages that it will address management issues in fisheries. This approach could provide positive inputs for management; therefore it may also be beneficial to support related policies, as discussed above.

Institutional framework

The principal authorities managing fisheries in Cambodia are MAFF and specifically FiA, who have co-management responsibility for CFis and state-managed waters such as national lakes, rivers, coastal and offshore areas. In addition the TSA is responsible for fisheries in the Tonle Sap region in collaboration with sub-national authorities. At sub-national levels, the commune, district and provincial authorities, in principal, help to regulate illegal fishing and the conversion of flooded forest, wetland and coastal habitat (mangrove forest), Tonle Sap and coastal zones. Meanwhile, there is no fishermen's organisation at present in Cambodia. However, the recently approved project "Strengthening capacity of fishers' network and NGO coalition towards fisheries resources sustainability and ownership in Mekong and Tonle Sap regions" implemented by FACT, may assist the process of federating CFis at least. In addition, CAPFish does offer some opportunities to improve the situation through both regulation and research including monitoring of fish stocks.

CFis are responsible to: (1) manage and protect fisheries areas in both inundated forests and mangrove areas; (2) manage fisheries resources in a sustainable manner and ensure equitable sharing of benefits for Khmer citizens; (3) increase understanding and recognition of the benefits and importance of fisheries; and (4) improve the standard of living to contribute to poverty reduction. All these points, if adhered to, should offer opportunities for food security and nutrition, poverty alleviation and improvements upon existing poor management of fisheries in the capture fisheries and aquaculture sectors. Again the need for

improved management of fisheries with technical training and support from CAPFish is essential to achieve these ambitions including the revision of the law to provide more decentralised management powers to communities

However, both management of fisheries and the application of legal and policy frameworks for fisheries management are weak at present. CFis have been devolved responsibilities but do not have the resources and authority to manage fisheries, such as they cannot arrest illegal fishers. In addition, without knowledge of stocks, aquatic ecology, and current levels of capture, neither FiA nor the CFis can manage the fisheries. As fisheries provide potentially significant socio-economic benefits for the livelihoods of fishers, there could be important gains from CAPFish supporting the improvement of policies.

Analysis

The key issues or sub-issues for poor management of fisheries and livelihoods are summarized and assessed according to their probability and impact, as follows:

Table 5: Key issues or sub-issues for poor management of fisheries and livelihoods

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Development of export-oriented sector could lead to increase in prices affecting food security	Average	Average	Small and medium
Capture of large amounts of smaller wild species for animal and fish feed for aquaculture	High	Average	Large
Weak management of fisheries and application of policy and legal frameworks for the sector	High	High	Large

Analysis of alternatives

This section compares the issues or sub-issues for poor management of fisheries and livelihoods with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Focus on coastal or freshwater aquaculture is unlikely to change the current production issues associated with poor management relationship between coastal and inland capture fisheries in CFis and aquaculture units (cages and ponds), unless the inefficient harvesting of small fish (trashfish) is curbed and alternative efficient feeds are developed and used in aquaculture. Orientation of the project to small-scale will provide alternatives for fishers at CFIs, if CAPFish encourages CFi fishers to adopt a combination of sustainable capture fishing with the development of small-scale aquaculture.
Support to intensive/commercial fisheries versus small scale fisheries	Encouragement of small scale aquaculture production is preferable from majority of farmers for cheaper and accessible food sources i.e. fish will be beneficial for the population of Cambodia and livelihoods of fishers. This may focus on low tropical species to reduce need for trash fish / protein. These alternative supplies for Cambodia could be derived from other countries/sources in SE Asia, which may already have or the potential to have sustainable environmental management practices for aquaculture.
Support to specific species versus all species	N.A.

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Lack of engagement with CFis would only exacerbate the effects of poor management of fisheries, which is already exacerbated by negative issues associated with illegal fishing and fishing pressures and the general poor management of natural resources in these areas.
Enhance wild stocks versus management of existing stocks in the wild	Wild stocks of fish are the most important asset for CFis, therefore their improved management is essential.
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	IWRM approaches can add value to aquatic ecosystems and fisheries management whereby they can coexist with other users for the improved management of fisheries.
Promote economic diversification versus only capture fishery activities	Economic diversification for fishers would be beneficial through a potential integrated food security and nutrition approach targeting fishers and their households with market gardening and small-scale aquaculture and livestock production.
Apply "payments for ecosystem services" (PES)	PES schemes for CFis could provide a clear

versus production without PES for capture fisheries	insight for fishers to manage and value their aquatic ecosystems.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

Recommendations for poor management of fisheries and livelihoods are as follows:

- applied research promoted by FiA for improved management approaches for fisheries to strengthen CFi's through the application of legislation and improvement of their technical capacities. There is also a need for better understanding of the value of ecosystem services, carrying capacities, etc. to generate good management and housekeeping of fish stocks and habitats within CFis. This could be based upon the foundation of strengthening CFIs coupled with production and zoning research studies between CFi members with FiA and aquatic ecosystem management NGOs/partners. Empowerment and improvements could be attained by applying the following methods: promotion of alternative types of gear for CFi members for diversified fishing approach of specific target species according to seasons, weather, tides. Gear diversification using selective small-scale fishing gear could decrease the pressure on undersized/young/recruitment fish stocks (known as trashfish)
- calculation of fishing quotas for community members only within CFis zones based upon the development of knowledge baselines and need for evaluation of carrying capacities associated with habitat zoning (restricted fishing areas) etc. This approach would also require the reinforcement of capacities of CFi members and the adoption of new legal mandates for CFis to allow them to apply quotas with other management tools
- development of fishing zones including buffer zoning in fisheries with temporary closure systems
- research on the benefit and opportunities of green labelling for fish products from sustainably managed fisheries
- cost/benefit analysis of all of the above approaches compared with current scenarios for fisheries

- monitor key habitats e.g. flooded forests, fish stocks including small/recruitment stocks of fish known as "trashfish" use with alternative feeds for aquaculture
- promote community participative data collection in fisheries (coastland inland) with comparative socio-economic and bio-physical data (simple, limited and key data only using for example dash-board techniques) i.e. no excuse to do nothing as need to make the best from limited data to show trends to decision-makers. This approach could also use catch-effort ratios for fishers, which is simple and indicative of fishery pressures.
- establishment of a special task force to police fisheries, which has both the human, technical and financial resources to achieve its goals within fisheries and at landing sites. The task force should control and monitor the fishery products, fishing gear/material, which can be seized from home and fish landing site. This needs to be supported and applied at the legislative level and potentially financed through permitting for fishing, local catch taxes, and the sale of illicit gear and fines
- orientate proposed new Law on Fisheries to provide more rights for CFi to use, manage and protect fisheries with capacity and competency to implement the management for inland and marine fisheries including inundated forests, mangroves & conservation

areas, which needs to correspond with the new structures in both MAFF and MoE for protected areas

- natural fish habitats, in particular in key parts of lakes and rivers and flooded forest/mangroves, need to be conserved and rehabilitated to increase fish population and production with research studies to understand the impact with analysis of costs and benefits economic valuations of ecosystem services including feasibility studies for potential application of PES. This approach could also focus on the creation of appropriate habitats in existing or proposed reservoirs/water storage areas. This approach could be promoted by government services such as MAFF and FiA in cooperation with CFi partners and NGOs, which could be advantageous for the fisheries sector and its beneficiaries versus other sectors including hydropower.
- CFI is the local organization playing an important role in fisheries management. Their capacity and competency in implementing the fisheries management and development within their allocated fishing ground needs to be built with technical, material and financial supports. Similarly, the capacity and competency of co-management i.e. PDAFF and FiA needs technical and financial support. Key aspects of the programme should also address management issues and include the review and development of effective financing mechanisms for CFi management; review and refining of laws/decrees related to powers, capacity and responsibilities of CFi organisations to ensure they can fulfil their management roles; the development of targets and indicators suitable for CFis, the strengthening of monitoring for effectiveness CFi management, the development of harvest control rules; and the support of research on fishery management needs and approaches through appropriate institutions and the policy/regulatory frameworks.
- harmonise policies which are not conducive for fisheries management, for example the RS III-2013-2018, provides a strong emphasis on the promotion of agriculture and cropping; while the ASDP (2014-2018) wants to "increase the agricultural growth around 5% per annum" with increases in rice commercialization. This may have negative local impacts on fisheries in terms of water utilisation and chemical pollution if zoning of agriculture production is not integrated with fisheries area e.g. Tonle Sap Lake and its floodplain. This recommendation assimilates with the strengthening of inter-sectoral coordination.Through these processes there could be greater opportunities to promote the diversification of income sources to support the livelihoods of fishers, such as community ecotourism activities related to their daily lives, cultures and natural environment.

7.2 Medium Priority Issues

7.2.1 Key Issue 3: Chemical and pollution risks for aquatic environment and fisheries

Rationale for the selection of the key issue

The rationale for pollution risks is based upon the findings from the scoping study and composed of the following key points:

- evolving use of chemicals and/or agrochemicals for principally crops (notably around the Tonle Sap where there is significant rice production in watersheds associated with fisheries), and livestock production carry environmental pollution risks. Chemicals and/or agrochemicals are all important components of the modernisation of these industries with potential risks for fisheries health, in particular for confined parts of lakes linked to large agricultural zones, and secondly for humans through consumption of fish through the food chain. Chemicals draining into soils and water tables can kill microorganisms and harm the flora and fauna in the area, while chemical elements like potassium,

calcium, zinc cause eutrophication reducing oxygen levels and limiting the capacity of habitats to support fish. Meanwhile heavy metals such as lead can be accumulated in a body of water and similarly in aquatic organisms including fish. It is important to add that chemicals can be used in intensive aquaculture which is equally a potential threat to fish and their consumption. Sometimes inappropriate uses are due to access to banned chemicals and medicines for fish, as well as the lack of clear information for the application or use of these products may be lead to pollution and health risks. It is important to mention that there is a lock of pollution data available in Cambodia. However, data and details from growing industry and agriculture combined with the pesticides and chemicals used by these sectors does infer widespread localised impacts upon fisheries. These factors have also been confirmed through discussion and debate in previous SEA reports and workshops for this study.

- intensive aquaculture feeds and wastes released from units and processing facilities into local water bodies (including groundwater) could lead to excessive amounts of nutrients and organic matter, which could provoke eutrophication and pollution of waters and can in turn be detrimental to fisheries, by promoting fish skin diseases and depleting dissolved oxygen. Cases of pollution and eutrophication in watercourses have already occurred in the region, notably in Vietnam near the border with Cambodia, provoked by nutrients in wastewater from large aquaculture units
- urbanisation near watercourses (such as large towns including Phnom Penh, Kandal and Kampong Channg) identified by UNIDO, also provokes serious localised pollution issues (eutrophication issues and some localised heavy metal pollution), due to both industrial and household/human wastes flowing into ecosystems and often without any form of treatment
- localised pollution from numerous artisanal mines across Cambodia, which are often gold mines using toxic chemicals. Many gold deposits are in watercourses or near streams and rivers, where toxic chemicals such as cyanide and mercury are used in mining and eventually flow into aquatic ecosystems. Toxins pose serious threats to capture fisheries and aquaculture through bioaccumulation of the chemicals in fish ecological systems and transferred via food-chains to humans. Based upon studies in neighbouring Laos in the Bolixhamaxy Province, the losses of mercury to gold production ratios are estimated between 2:1 and 3:1. Rising gold prices had encouraged an increase in artisanal mining activities in various parts of Laos. Prior to this change, gold production was relatively low; however, production rose where risks from mercury poisoning became significant for the environment and fisheries and the health of humans according to UNIDO in 2007. As gold prices are still high, the risks from mercury, and potentially cyanide too, will remain significant
- water pollution by chemicals and heavy metals used in agriculture, industry and mining and the eutrophication of water bodies due to excess nutrients from fertilisers and household and husbandry waste wastes could have serious negative impacts upon the implementation of the SPF and CAPFish programme. In addition, uncontrolled use of feeds and drugs by the aquaculture sector itself can even exacerbate these risks.

Baseline (including institutional, policy and legal framework specific to the key issue*)*

Context

Cambodia is currently developing significantly with GDP currently at approximately 7% per annum. In addition population growth is at 1.8% according to the World Bank. These factors have increased development with potential greater risks of pollution in aquatic environments and their fisheries and aquaculture developments. The sectors of influence include principally the following:

- settlement growth
- industries
- agriculture
- mining
- development of aquaculture

This section distinguishes between the impacts of pollution on fish populations and those on human health associated with the consumption of fish in contaminated areas. These differences are put into context and discussed for the five potential sources of pollution, while the consequences on human health of water pollution by agriculture is beyond the scope of this SEA. However use of chemicals for aquaculture can be an impact for both the environment and consumers' health. It is also important to state that no water quality or food chain toxicity data were available or offered by MOWRAM, MoE or MIH.

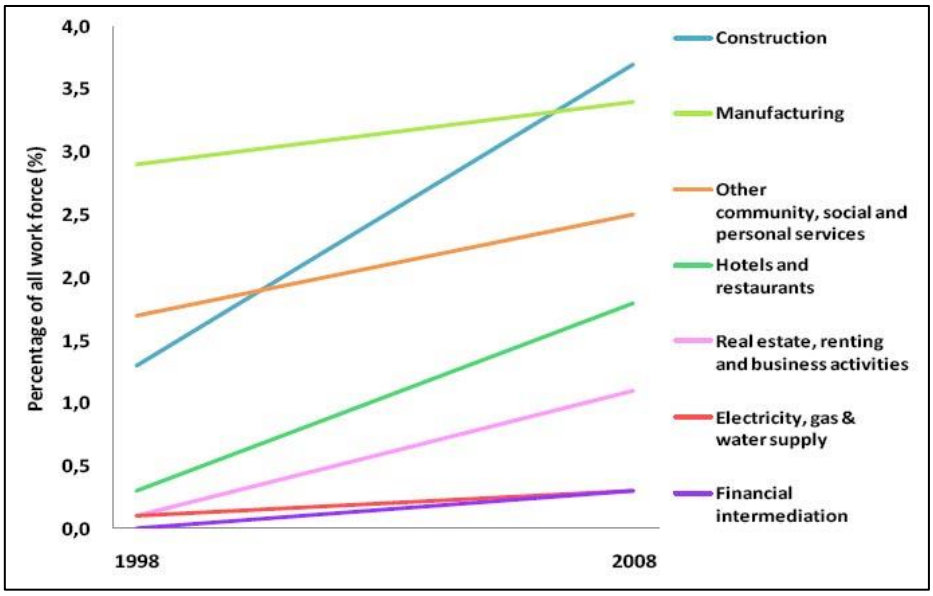
The growth in population has led to larger towns and cities developing across the country. Although Cambodia has a relatively small urban population at approximately 21% in 2015, it is expanding at 4.4% a year from 920,000 people to 1.4 million between 2000 and 2010 according to the World Bank. Often these settlements are located near watercourses and wetlands were domestic wastes including wastewater are evacuated. The situation is similar to industries, where untreated waste reaches the aquatic environment and this may be direct pollution where homes back onto streams, rivers or lakes. Currently from survey undertaken, domestic waste is composed of over 60% organic material including E-coli, although the economic growth combined with increased household wealth across the country could also increase toxic wastes from various domestic products. This fact is compounded by the fact that on average only 37% of people used improved sanitation facilities, while 54% practice open defecation according to UNICEF and the World Health Organisation (WHO) in 2013.

Organic waste may be beneficial for fish production, but excess combined with warm temperatures could provoke eutrophication with higher Biological Oxygen Demand (BOD) values reducing oxygen in the waters and clogging by vegetation and overall damage to ecosystems. Therefore, the impacts upon fish species from non-point sources are often limited near settlements. However, if poor quality sources of water are used to catch fish and clean or cool fish with ice, then pathogens leading to diseases such as E-coli can proliferate into the human food-chain, although this is often localised. As E-coli is a pathogen which often provokes diseases such as diarrhoea in Cambodia, which is a leading killer of children under 5 years old and accounted for approximately 10% of their deaths in 2013 according to UNICEF.

Although Cambodia remains a predominantly agriculturally based economy, there are national changes taking place. A good example of this combined with a major fishery zone is

the Tonle Sap Lake. In this area there have been shifts in activities as agricultural workforces dropped from 1998 to 2008 from 66% to 61%; while fishing as a principal activity represented 4.5% of the total workforce in 2008. Due to human pressure in search of resources and employment, there is now greater diversification of job opportunities in the Tonle Sap Lake region, as clearly shown in Figure 10, which shows significant growth in all sectors.

Figure 10: Baselines and trends for industrial growth in Cambodia in Tonle Sap area

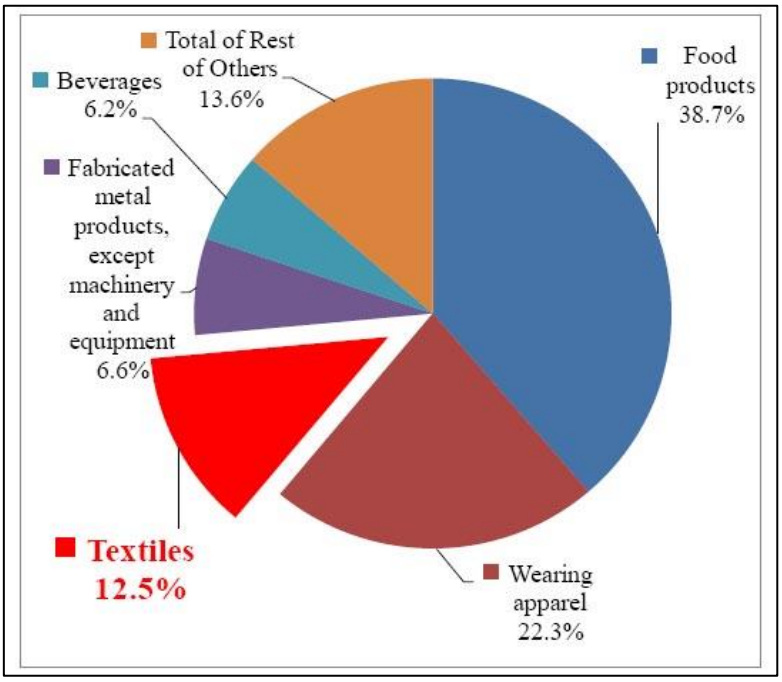


Note: Based upon two data points

The manufacturing establishments in Cambodia in

Figure 11 is composed of various sectors and dominated by food products followed by production of cloths (wearing apparel) and textiles, and various others including food products and beverages at 45% of all industrial activities. All these industries will produce potential pollution including waste water. However, it is important to add that most waste will be organic and increase the BOD in water and reduce oxygen. Meanwhile **textile dyes are often very toxic**, although these operations may be limited at present in Cambodia. According to JICA in 2013, the number of fibre dying companies is less than 1%, although garment production within the textile classification could also be a pollution risk according to the NGO Open Development, as some garments may include dying of material/cloth. Similar to settlement pollution sources, both textiles and manufacturing are growing in Cambodia and need to be monitored for principally human health issues in and near urban areas

Figure 11: Composition of manufacturing establishments in Cambodia in 2011



Source: Government of Cambodia, 2011

Often wastewater from industries is often untreated or passes through minimal treatment in Cambodia (pers. com. MOWRAM and MIH). Untreated or partially treated water will frequently be sent to canal and rivers which flow into wetlands areas near towns and industrial estates.

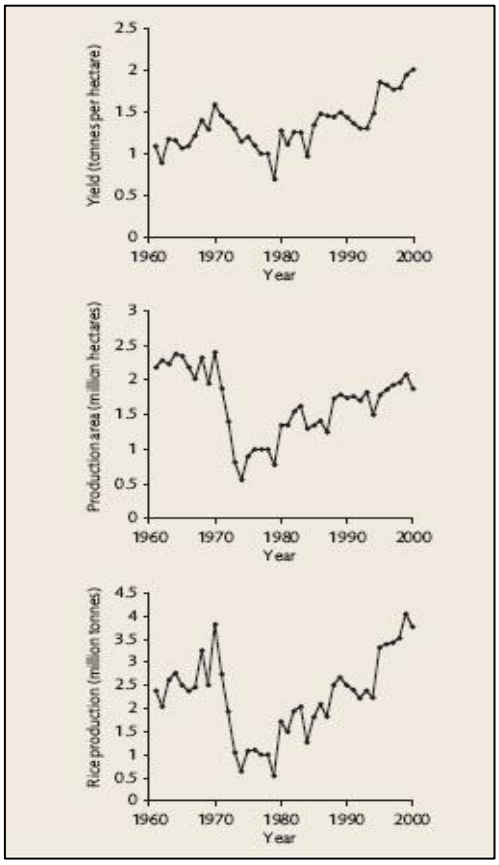
The impacts upon fish species from pollutants will be localised within the aquatic ecosystems. The most serious issue for fish would be high BOD waste from industry, which would reduce oxygen and fish numbers in relatively small localities. However, the bioaccumulation of metals, for example from dyes, entering the food chains and eventually fish species, could have serious upon human health, when fish products are consumed. As industrial development is often in larger settlements, then the consumption of fish with toxins could be higher risk for these urban dwellers. Settlements in coastal areas often have less industry although towns with manufacturing near coastal water could increase organic pollution, but only with local impacts on fish numbers, and potentially beneficially impacts for fish production further downstream. In addition, large amounts of fish gear waste can also be damaging to fish populations especially in breeding and feeding areas, where large numbers of fish may be lost in abandoned nets and other gear.

Pollution from agriculture derives from mainly fertilisers and banned pesticides and limited and localised livestock farming issues (cattle and pigs). The future nitrate load in many catchments across the country will be influenced by land use change for agriculture, and commonly for crops and rice production. This development is likely to increase nitrate levels as more land is converted for agriculture, and particularly due to increases in fertilizer use. Nutrient increases for fish may be positive in promoting feed in watercourses, but they can also develop localised algal blooms and encourage the development of excess vegetation such as water hyacinth which can later decompose and reduce the oxygen levels in water. However, fertiliser loads have remained low in Cambodia at approximately 10 kilos per hectare, which means that water load will also be relatively low across the country. However, this does not discount the risk of localised events which could have serious effects on important local fisheries or concentrations of valuable aquaculture units.

With regard to pesticides, the situation is becoming more serious each year with increasing trend developments for crop production shown in Figure 12 correlating with increasing importations of pesticides shown as a value in USD in Source: Environmental Justice Foundation, 2002

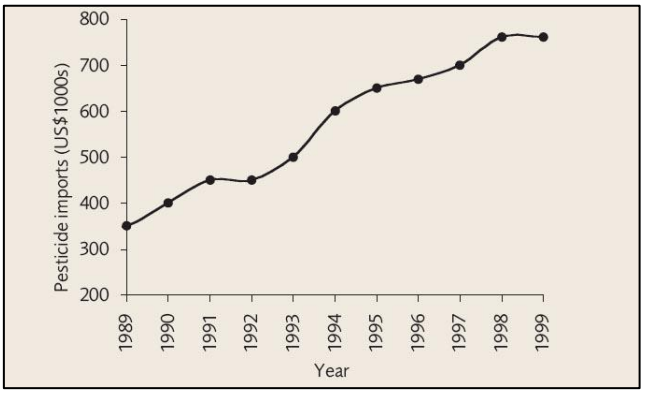
Figure 13 Pesticide inputs within the Tonle Sap Lake, which produces 60% of Cambodia's fish, are very high at 1.3 million litres of **pesticides within the lake's catchment during 2000 according to Environmental Justice Foundation. Most chemicals used are illegal and classed as highly or extremely hazardous to human health** (World Health Organisation's (WHO) Class 1 chemicals). An estimated 10 tonnes of Dichlorodiphenyltrichloroethane (DDT) & methyl-parathion have run-off from 2000 ha from Mung-bean crops in recent years near the Tonle Sap. Pesticides including endosulfan and methyl-parathion are also illegally used to kill fish, when they are poured onto the lake's surface. Finally it is important to add that most users of pesticides are highly ignorant of potential for harm and risks from these chemicals for themselves, their food i.e. fish, and their environment in general. There is a danger from commonly used pesticides such as DDT which can get into the ecosystem and bioaccumulation in fish, as well as localised kills of wild fish stocks including risks to concentrations of aquaculture production units.

Figure 12: Crop production trends in Cambodia



Source: Environmental Justice Foundation, 2002

Figure 13: Pesticide use trend in value terms (USD)



Source: Environmental Justice Foundation, 2002

The future development of agriculture could produce complex interactions, which could cause significant changes in riverine nutrient levels affecting downstream ecosystems and beyond to coastal environments, although principal issues would concern inland aquatic systems. However, it is important to add that impacts on fish themselves from pesticides and fertilisers will only be serious near point sources on rivers and broader in slow moving and relatively shallow water bodies such as the Tonle Sap Lake. Fertilisers can support the development of nutrient sources for fish in the area, although excess in the system can provoke serious algal blooms causing fish kill due to low oxygen with higher temperatures. Serious blooms have been recorded on Tonle Sap Lake from agricultural runoff. Concentrations of pesticides mixing will pose more serious threats to human health when they accumulate through the food chain to fish, which are consumed by rural households and local people. This situation could be significant in the rice field fisheries, as they are often located within or next to crops and often rice, as well as pollution from aquaculture developments. The situation could deteriorate with current government policy to increase rice production for exportation from Cambodia, if safeguards are not put in place. The Strategic Planning Framework for Fisheries (2015-2024) has placed some concerns on pollution from agriculture. It noted that increased commercialisation of rice production with higher chemical inputs could affect highly productive rice-field fisheries and physical nature of water within rice-field systems, which could be detrimental to fisheries.

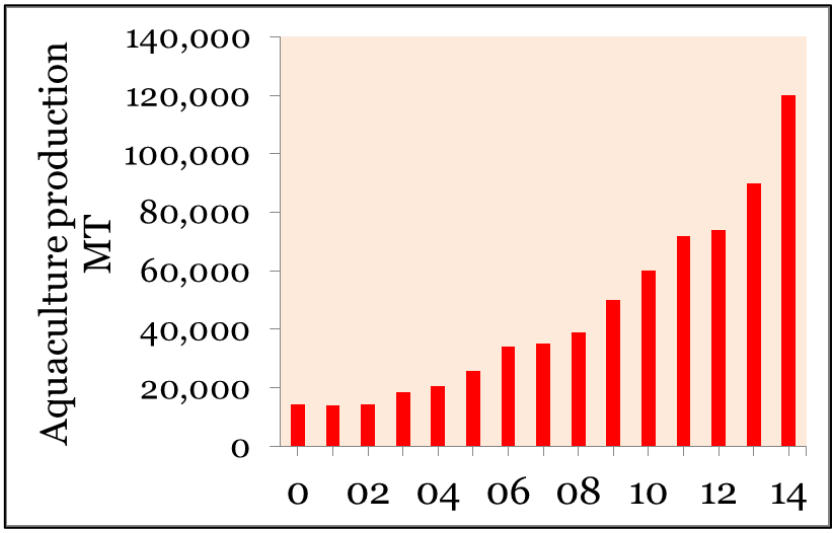
The mining sector in Cambodia is mostly undeveloped, and active mining enterprises are typically small-scale quarries producing materials for construction, such as laterite, marble, granite, limestone, and gravel. In addition there are several oil and gas coastal and offshore blocks, and one which was previously held by Chevron Oil, but no significant finds to date. If this oil and gas was to develop, then it would be important to consider the risks of oil pollution upon marine aquaculture and fishing. There is no active industrial-scale extraction of minerals as yet, although many exploration licenses have been granted to mining companies and some have reported promising finds of gold. However in September 2016, the first industrial mining license for gold was issued to a mining company working in Ratanakiri. Meanwhile, the industry and ~10 exploration companies, which are quite small, are waiting for major finds and rising global prices before base metals can be exploited from commercial mines. However, initial interests are focused on gold deposits from sites with licences, although some mines have statuses which are unclear. Equally it is no sure how these potential mines may deal with their wastes and what products will be used for extraction purposes in particular toxic chemicals and the management of settlement ponds for wastes and mining sediments.

There are thousands of artisanal miners recovering gold and gemstones, often on a seasonal or part-time basis. Issues arise from artisanal gold mines and pollution risks from

mercury and/or cyanide in watercourses, which is deadly to fish and their ecosystems at the each locality, and through the food chains downstream. In 2010, NGO Mercury Watch estimated that Cambodia was releasing 7.5 tonnes of mercury per annum, which is significant. Growth in population and poverty could also increase the number of mines in the future, and will also be influenced by a relatively high international spot price for gold. In 2004, the Government identified **19 deposit areas for gold across the country. These deposits will each have multiple mines and thousands of miners** and their families within them according to Government and was already between 6000 to 10,000 miners in 2004, as the number of mines surged, according to WWF. In addition and in recent years, there has been an increase in dredging for gold which stirs up sediments in the rivers of Laos near the 3S river system. According to NGO Open Development, the extraction of gold in this area may include the use of toxic mercury and cyanide. A recent study on mercury in Cambodia by Murphy et al in 2013, found abnormal levels of mercury contamination in the Srepok basin, which was probably linked to gold mining and upstream deforestation. The study also showed increases in mercury occurring after the completion of hydroelectric dams, as methyl-mercury levels typically increase with the impoundment of water.

Aquaculture provides a small part of overall fish production in Cambodia, which was approximately 12% in 2011, although this is growing each year as shown in Figure 14. Currently there are no reported severe cases of pollution from aquaculture in Cambodia related to drugs, chemicals and nutrients from fish feeds. A common issue for aquaculture in the world is the irrationalised use of fish feed in intensive cage farming often leads to fish skin diseases according to various fish health monitoring activities. Large scale aquaculture units on the southern coast of Cambodia during the 1990s were reportedly closed after issues with their farm design and the in-situ spreading of disease (pers. com. FiA). It is also important to mention that eutrophication and pollution risks may be more problematic in pond aquaculture compared to cage culture in lakes and rivers or on the coast with movement or flows in water supplies

Figure 14: Trends in aquaculture production in Cambodia



Source: FiA/MAFF, 2016

The Ministry of Environment (MoE) of Cambodia suspects a large evacuation of nutrient rich waters leaving a large scale aquaculture farm in Vietnam, which combined with warm coastal waters produced a large toxic algal bloom in early 2016 (pers. com. FiA/MAFF). Another similar and recent pollution case reported by a Vietnamese agency concluded that poor management was responsible for large scale losses of shrimp in aquaculture units. The shrimps had died from Streptococcus sp. bacterial infections due to pollution of water and

changeable weather combined with weakened natural resistance in the low oxygenated waters caused by anaerobic bacteria, *Vibrio alginolyticus*. Effectively, pollution provoked by poor management of water flow and feeds in systems can be negative for aquaculture units themselves, and surrounding fisheries. This would be more pertinent to medium and large scale units, although it would also be a risk for multiple smaller scale farms and wastes in given area during low flow period and higher temperature, often in the period near the month of April in Cambodia. However, the scale of aquaculture, i.e. larger units, will without doubt raise the risks and threats for the environment and from for fish from diseases (see Key Issue 6).

It is important to add that wastewater can also enter the food chain and fish products through water supplies including ice from producers or more often middlemen according to UNIDO in 2015. Often the source of water for ice may not be known and untreated with risks of E-coli etc., while sanitary measures for fishers and their products are not applied and can compound the problems for food safety from fisheries and aquaculture.

Regulatory framework

Cambodia has made some progress in developing a legal framework for guiding sanitary management of products and pollution control supported by key pieces of legislation and policy including the Law on Water Resources Management (2010), the Law on Fisheries (2006), the Law on Mineral Resource Management and Exploitation (2001), the Law on Environmental Protection and Natural Resources Management (1996), the Sub-decree on Water Pollution Control (1999), the Sub-decree on Solid Waste Management (1999), the Sub-decree on Sanitary Inspection of Animals and Animal Products (2003), and the Sub-decree on the Standards and Management of Agricultural Materials (1998). In addition, the Strategic Planning Framework for Fisheries (2015-2024) is also very relevant to the issue of pollution.

The Law on Environmental Protection and Natural Resources Management (1996) is the principal law regarding environmental protection, pollution control and natural resource management in Cambodia. It promotes environmental quality; ensures rational and sustainable conservation, development, management, and use of natural resources to encourage; enables the public to participate in environmental protection and natural resource management; and suppresses any acts that may cause harm to the environment.
Meanwhile, the Law on Water Resources Management (2010) addresses water quality management and states that discharges disposal or deposit of polluting substances, which are likely to deteriorate the quality of water and to endanger human, animal and plant health, shall be subject to a water license or authorisation. This law places concern over water quality for rivers, streams and lakes, and pollution to water resources which could be toxic to humans, agriculture production, animals and aquatic life. In addition, the Sub-decree on Water Pollution Control (1999) regulates water pollution while preventing and reducing water pollution in public areas, protecting human health and conserving biodiversity. Meanwhile, the Sub-decree on Solid Waste Management (1999) regulates solid waste and promotes management using good practice technics in a safe manner to ensure the protection of human health and biodiversity. River and lake pollution of fishing grounds is also clearly addressed in the Law on Fisheries (2006). This law prohibits electric fishing gear, explosives, and poisons. In addition, all activities are banned in the fishery domains that involve disposing, discharging, dumping or littering of poisonous substances (solid or liquid), and that could poison or harm aquatic fauna, although this is clearly not been enforced by authorities in Cambodia.

For mining and mineral resource exploitation, the Law on Mineral Resource Management and Exploitation (2001) controls the management and exploitation of mineral resources

linked to mining operation in the Kingdom of Cambodia. Meanwhile, exploitation of petroleum and gas is addressed in a separate law. The laws do not address clearly either the issue of pollution control or causes of pollution from mining operations. However the law does refer to the Law on Environment Protection and Natural Resource Management (1996) concerning environmental protection, environmental impact assessments, environmental management plans, mine site restoration and rehabilitation and financial guarantees for the environment in the mining and the mineral resource sectors.

Cambodia government have also tried to address illegal mining with the first formal artisanal mining community established in Mondulkiri Province in 2015, although the extent of artisanal mining across the country with transboundary issues remain a major challenge to control. Meanwhile there is policy framework in place which addresses the issue known as the "Strategic Plan on Management of Mercury in Artisanal and Small Scale Gold Mining (SPASGM), 2012-2016" to promote safe and good management of mercury and eliminate its release into the environment and notably to rivers from artisanal mining sites in Cambodia. This strategy is orchestrated by the Department of Environmental Pollution Control (DEPC) within the MoE. This strategy embraces the Action Plan on the Management of Releasing Mercury in Cambodia (2008-2010), Cambodia Mercury Inventory Report (2008), National Mercury Waste Management Plan (2011-2015), and Technical Guideline on Environmentally Sound Management of Mercury Wastes (2011).

The Sub-decree on the Standards and Management of Agricultural Materials (1998) was initiated to ensure high quality agricultural materials. This sub-decree also extends to fertilisers, agricultural medicines, seeds, animal drugs, and animal foods and supplements, which are all major factors to increase crop and animal productivity in the future. The sub-decree is also partially focused on pollution related to the protection of environment and risks from agriculture production.

The Government has enforced pesticide labeling regulations including the development of labels in local Khmer language in line with the FAO's Code of Conduct on the Distribution and the Use of Pesticides. Meanwhile, MAFF is reviewing and updating the pesticide list including banned, restricted and permitted products through Ministerial proclamation No. 484 MAFF dated 26 November 2012, which lists 98 chemicals. Also the MoE is starting to introduce the GHS (Global Harmonization System) for pesticide labelling with support from the Japan International Cooperation Agency (JICA). However, according to the Standards Department at the Ministry of Industry and Handicrafts, they do not have the means, budget or lab facilities to monitor and control the sale and use of pesticides. They also stated that many products pass through borders without control, while the knowledge of pesticides by customs is negligible.

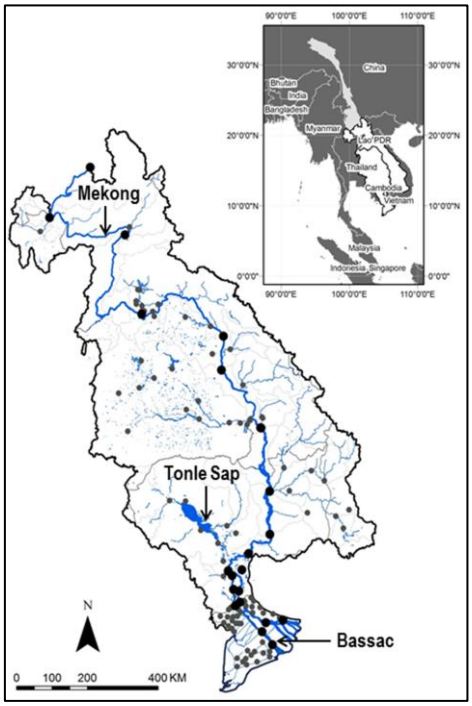
Institutional framework

MOWRAM and MoE have responsibility for water quality and pollution control within natural water bodies and systems. MoE also implement the law and regulations to control pollution and water quality according to standards in the Law on Environment Protection and Natural Resource Management (1996), the Sub-decree on Water Pollution Control (1999) and the Sub-decree on Solid Waste Management (1999). Similarly, MOWRAM implements the law and regulations to control pollution and water quality in accordance to the Law on Water Resources Management.

There is no reported control by FiA for aquaculture or by MAFF for agricultural activities. However, there is some monitoring by MRC including the following parameters: pH, BOD, Dissolved Oxygen (DO), Total Suspended Solids (TSS), conductivity, Total Nitrogen (TN), Total Phosphate (TP), temperature and a few heavy metals at various monitoring points

shown in Figure 15 according to Chea et al. in 2016. At present there is no monitoring of pesticides, which could be significant for fisheries now and in the future with the challenges of population growth, urbanisation, limited or non-existent wastewater management, the need to feed people and orientations to exports leading to expected changes in water quality in the LMB. It is important to add that MRC's laboratories use standards from the Environmental Protection Agency of United States (EPA-US) for water quality measurements, although it remains unclear if the laboratories or equipment are certified according to Chea et al. in 2016. In spite of the multiple pressures from point and non-point sources of pollution, the Mekong mainstream was less polluted than its tributaries. Potentially, the degradation of water quality in the mainstream was caused by the low quality of water discharged from its tributaries and the surrounding watersheds. Eutrophication and salinity increases in many tributaries could represent the main water quality issues in the LMB, particularly in areas identified as pollution hotspots. To date, few studies have quantified the impact of eutrophication on aquatic life e.g. fish and fisheries resources in LMB, in the pollution hotspots, where effective management is needed to mitigate these impacts.

Figure 15: Lower Mekong Basin (LMB) monitoring sites



Note: grey dots are sites on tributaries, while black lack dots are on the mainstream

Source: Chea et al, 2016

MAFF has the mandate for implementing laws concerning food safety at primary production level, which it shares with five other ministries (MEF, MoC, MoH, MIH, and MoT). Food safety still lacks updated legislation and modern equipment in some of labs, while there is also a need to have comparable and adopted laws for monitoring in Cambodia and similar to those in other ASEAN countries. Some progress has been made by clarifying existing mandates of the respective Ministries through the Inter-Ministerial regulations on food safety. However, the regulation simply clarifies the mandates of the Ministries, but does not change the body of existing food safety legislation. According to industrial experts at the UNIDO office in Cambodia, there is not one competent authority for monitoring polluting substances, while responsibilities are split amongst various authorities, which can be problematic when

trying to move issues forward in the sector, and all along the value chain (from farmer's gate to the plate).

Analysis

The key issues or sub-issues for chemical and pollution risks for aquatic environment and fisheries are summarised and assessed according to their probability and impact, as follows:

Table 6: Key issues or sub-issues for chemical and pollution risks for aquatic environment and fisheries

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Eutrophication from organic and toxic waste from settlements e.g. nitrates and potassium affecting fisheries production	Low	Average	Small
Industrial waste, notably from textiles e.g. mercury pollution contaminating fish	Low	High	Small
Pesticide and fertiliser pollution from agriculture e.g. nitrates causing eutrophication affecting production and contaminating fish	Average	Average	Small
Pollution from gold mining and impact of cyanide and mercury on fisheries	Low	High	Small
Pesticides and excessive feed from aquaculture units causing pollution in aquatic systems	Low	Low to Average	Small

Analysis of alternatives

This section compares the issues or sub-issues for chemical and pollution risks for aquatic environment and fisheries with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Freshwater aquaculture is likely to lead to pollution risks from the units themselves, while concentrations of fish are also prone to ad hoc pollution from other sources e.g. agriculture etc. However aquaculture pollution risks could be less frequent in marine habitats, which supports the alternative for coastal/marine fisheries.
Support to intensive/commercial fisheries versus small scale fisheries	Large scale fish farming could be major sources of pollution for themselves and small-scale aquaculture. Production from small scale aquaculture production should be prioritised to encourage the majority of small-scale producers to develop cheaper and accessible food sources for the country.
Support to specific species versus all species	N.A.

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Engagement with CFis to oversee capture fisheries development in their area, could be a way to sensitize fish farmers on environmental impacts and limit development of non-sustainable practices.
Enhance wild stocks versus management of existing stocks in the wild	N.A.
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	IWRM approaches provide added value to aquatic ecosystems and fisheries management whereby they can coexist and may consider Integrated Pest Management (IPM) and agro-ecology systems to minimise pollution versus conventional agricultural risks from polluting sources in watersheds.
Promote economic diversification versus only capture fishery activities	Economic diversification for fishers who orientate to agriculture or industry could develop alternative local sources of pollution for fisheries. Current opportunities in Cambodia include rice field fisheries being integrated agricultural and fish production which offer the means to develop awareness and better management of fisheries vis-à-vis pollution from principally crop farming and other sources. This process could be managed through the national planning

	regulations through collaboration between the Ministry of Planning (MoP) and MAFF. This alternative may be difficult to apply in inland sites as the influences upon water quality are often within large watersheds requiring complex planning and management. However, there may more opportunities in coastal areas for principally aquaculture as the ecosystems are easier to demarcate and potentially manage.
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	PES in watersheds could account for the costs and benefits of uses and polluters of principally water resources in catchments and the value of aquatic ecosystems for fisheries. This approach could be similar to or integrate the Polluter Pays principle.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

The key recommendations related to chemical and pollution risks in the food chain and environment (settlement, industry, mining and aquaculture), human health and institutional policy and legal framework are presented below.

Integrated development and fisheries:

- support integrated planning for the development of fisheries and aquaculture with other sectors notably agriculture, settlements, industries, and mining near and around existing or proposed aquaculture and CFis. It is important to add that the development of fisheries can, in themselves, be conflictual. Therefore, it is imperative that all sectors follow integrated planning for the siting and registration with planning regulations through support from MAFF/FiA, MIH and Ministry of Planning with support from CAPFish
- promote appropriate techniques and technologies for greener production from aquaculture units through the fisheries' value chains from feed through aquaculture to the customer, that minimises health risks from contamination through support from MAFF/FiA, MEM, MIH and Ministry of Health in collaboration with UNIDO and assisted by CAPFish.

Agriculture:

- encourage, through policy dialogue with MAFF, improved nutrient management by applying fertilizers in the proper amount, at the right time of year and with the right method can significantly reduce the potential for pollution. This approach would focus on farmers in local runoff areas only affecting key aquatic habitats and also linked with the use of buffers such as planted trees, shrubs, grasslands and wetlands around fields, especially those that border water bodies, which can help to absorb or filter out nutrients before they reach water bodies through collaboration between MAFF and MoE and assisted by CAPFish with potential cooperation with JICA's current rice projects
- support management waste from animals and crop runoff with preventative measure to natural sumps to avoid direct impacts into streams, rivers and lakes keeps by nitrogen and phosphorus out of the water near sensitive capture fisheries and aquaculture near sensitive capture fisheries and aquaculture through collaboration between MAFF and

MoE with a focus on farmers in local runoff areas only affecting key aquatic habitats assisted by CAPFish with potential agricultural projects (current or future).

Aquaculture:

- need to support disposal of waste feeds in aquaculture at all levels in planning of the aquaculture value chains in sensitive zones, in particular, localised potentially eutrophic sites on lakes and possibly watercourses coordinated by FiA
- fish feed regulations need to developed and applied prior to aquaculture systems increasing across Cambodia regarding content of feed and impacts on natural systems, which may have polluting effects. This approach requires the assistance of the National Standards Institute at MIH supporting FiA. In fact all environmental risks posed by aquaculture would be an entry point opportunity for CAPFish and SPF, where they could mitigate potential negative impacts assist planning measures to avoid development of aquaculture sites in areas regarded as environmentally sensitive or of environmental value including landscape areas of importance, where risks from pollution could evolve through coordination with Ministry of Planning and FiA.

Human health:

- support the improvement and development of health standard(s) complementary to the technical regulations capable of providing good support for the operation of the fisheries industry, paying attention to conflicting requirements developed between MIH (Standards) and FiA
- assist the improvement of national standards with good technical guidance with respect to international best practices for processing, manufacturing and hygiene practices and associated issues attached to health and safety assurance systems developed by MIH (Standards), Ministry of Health and FiA.

Institutional policy and legal framework

- capacity of MAFF and FiA needs to be built to monitor all fishery sectors associated with pollution in collaboration with MOWRAM and MoE for water quality, in particular cropland including pesticides, and the minor influence of aquaculture activities at present. It is important to note that good water quality levels in water bodies have to be maintained, as the health of aquatic ecosystems for fisheries is a priority of CAPFish
- support the endorsement of water quality standards related to pollution and fisheries and aquaculture with involvement from all stakeholders, in particular those who are related to crop production and development, to minimise pollution. As the point sources of pollution may be difficult to trace, a practical step forward for improvements is to promote good agricultural practices and regulation/good management of pesticides and inorganic fertilisers. As this issue is under the remit of agriculture, fisheries could benefit from cooperation within MAFF itself with support from CAPFish
- CAPFish should consider assisting MAFF and MIH (Standards) to reinforce controls on pesticide use based upon UN acceptable lists with support from border control and police
- MOE works on water quality with MORAM – need to fully implement Sub-decree on Water Pollution Control (1999) and Sub-decree on Solid Waste Management (1999), which are, according to various authorities, not applied
- Ministry of Energy and Mines (MEM), and Ministry of Industry and Handicraft (MIH) work on energy, mining and industrial pollution respectively, but there is a reported serious lack of data sharing amongst these ministries concerning pollution monitoring. Therefore, it would be advantageous to create a shared national database for water quality with the respective ministries and MoE and MAFF supported by CAPFish

- build & strengthen capacity of staff and laboratory in relation to qualifications and experiences of staff, exchange programmes with labs in ASEAN or elsewhere. In addition, the certification of labs which would confirm that the norms, equipment and methods, used by MAFF, MOE and MOWRAM in relation to water pollution and water quality monitoring are bona fide. In addition, MAFF needs to guarantee standards and monitoring of toxicity and diseases in food safety with its partners from among six ministries (MEF, MoC, MoH, MAFF, MIH, and MoT). Currently there are three key labs in Cambodia, although the capacity of personnel is weak for this role at present, in spite of recent equipping and training established in at least 2 FIA labs for capture fisheries (marine lab supported by JICA on coast and potentially for aquaculture use too) and the lab attached to IFReDI)
- support institutions and labs to work together to monitoring the quality of wastewater discharges for regulation purposes and for waste management information systems; and developing and applying integrated waste management and reuse systems, adapted to the localised situations
- legislation, national standards and policies for environmental protection with fish production from aquaculture need to be supported and move swiftly and immediately, and be applied with actions, beyond pilot projects across the country, this should focus upon and encompass current and developing policies for aquaculture related to international frameworks in the ASEAN region to mitigate pollution risks
- policy strategies for aquaculture development need to avoid environmental degradation in pursuit of fish production and the errors of natural resources mismanagement from aquaculture in the past regarding pollution risks. This strategy need to be developed through a collaborative approach whereby there is participatory management of aquatic systems including wetlands for all parties. The overall objective being sustainable integrated fisheries and natural resources management encompassing aquaculture
- reinforce the application of the SPF Policy for sustainable management of fisheries with an emphasis upon the protection of aquatic ecosystem for all proposed aquaculture developments to avoid conflicts from pollution for other users
- MOWRAM has responsibility for management of water resource including water quality. However, water quality standards are still being drafted. Currently there are no water quality regulations, nor guidelines in place at MOWRAM, other than the Law on Water Resource Management. Thus the water quality standards need be endorsed and publicly promulgated to attain the involvement of all stakeholders and minimise pollution of the aquatic environment through management and conservation of water resources.
- MOWRAM and MOE should work on water quality, and fully implement the existing regulations which are the Sub-decree on Water Pollution Control (1999) and the Sub-decree on Solid Waste Management (1999). These two existing regulations can potentially help to regulate water quality standards and control pollution, especially pollution from agriculture, aquaculture, and human settlements. However, the missing or weak points of that sub-decree should be added such as the water quality benchmarks for aquatic life and agriculture production and supplements to the existing regulations for controlling water pollution and solid waste management. While the aquaculture and agriculture pollution would be responded by MAFF and FiA, the guideline or framework for controlling water pollution from aquaculture and agriculture should be considered
- the Ministry of Mines and Energy (MME), and the Ministry of Industry and Handicraft (MIH) work on energy, mining and pollution respectively. However they are neither willing to share data nor not having the data and study report on mining and pollution from hydropower dam issues at present. Thus the inter-ministerial network for data sharing and research study should be built and regulated.
- other policies may be in competition with fisheries management, for example the CRS III-2013-2018, provides a strong emphasis on the promotion of agriculture, and intends to achieve economic growth at 7%. ASDP (2014-2018) also wants to "increase the

agricultural growth around 5% per annum" with increase rice commercialization. It may cause negative impacts on fisheries in terms of water utilization and chemical pollution if the zone of agriculture production is not set aside from the fisheries area e.g. Tonle Sap Lake. Thus MAFF needs to have an integrated plan to avoid the harm to fisheries and aquaculture and vice versa as well as controlling aquaculture to protect itself.

- need to modify the existing legal framework of the Ministry of Health, which is missing legal mandates for food safety, which is its responsibility and has major implications for the fish products within the human food chain

7.2.2 Key Issue 4: Effects of deforestation upon rivers and lakes and within coastal areas

Rationale for the selection of the key issue

The rationale for this issue is based upon the findings from the scoping study and composed of the following key points:

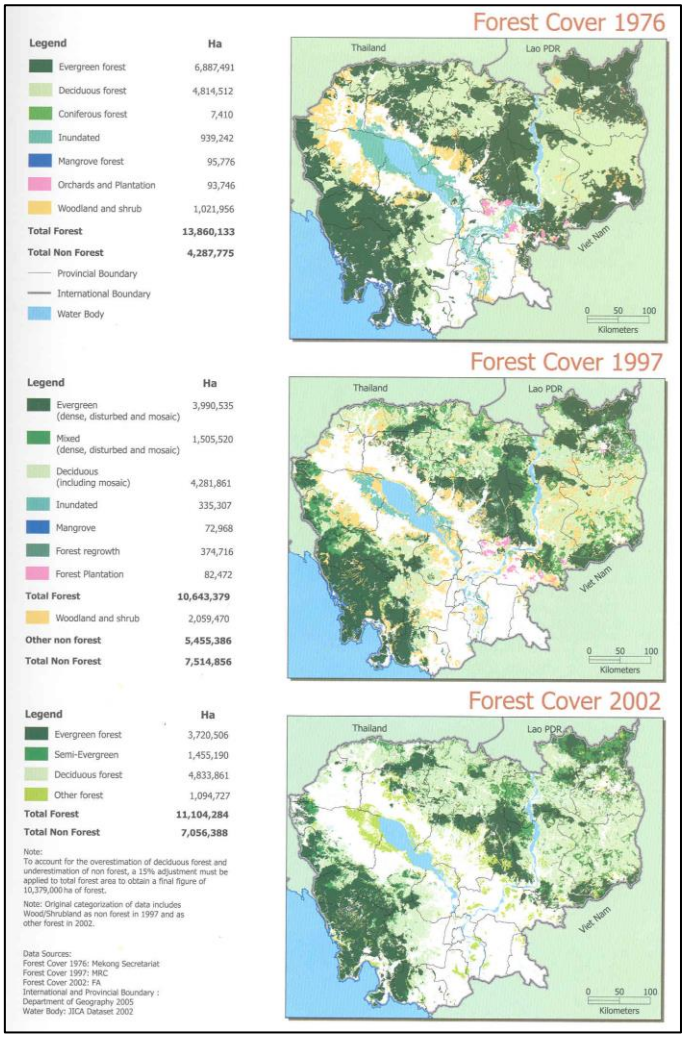
- Cambodia's deforestation has been on-going for many years and potentially accelerating over the past decade, largely due to industrial plantation expansions, logging, and conversion for agriculture or under the guise of agriculture to access timber, when forest cover is important to protect soils and maintain water storage within watersheds associated with key fish tributaries and water bodies
- current and potential threats to flooded forest and mangrove forests from various developments including potential medium to large aquaculture schemes could be a threat to the development of sustainable coastal and marine fisheries
- Deforestation is impacting the fisheries sector and thereby jeopardizing the implementation of the SPF and the CAPFish programme, through changes caused to water flows and sediment load (upland deforestation in particular) and loss of fish spawning and breeding habitats (loss of flooded forest and mangroves).

Baseline (including institutional, policy and legal framework specific to the key issue)

<u>Context</u>

Estimates from 1976 show that Cambodia was once covered in 75% forest including scrubland according to the Mekong Secretariat. Based on MRC work in 1997, this cover drops to 58%, although it was calculated at 61% by the Forestry Administration (FA) in 2002. The data varies slightly, but it does show the dramatic losses over a period of approximately 25 years due to former forestry concessions, which were suspended after the year 2000. Then the concessions were also accused of laundering timber from outside their contractual areas including PAs and integrating this wood into their timber stocks.

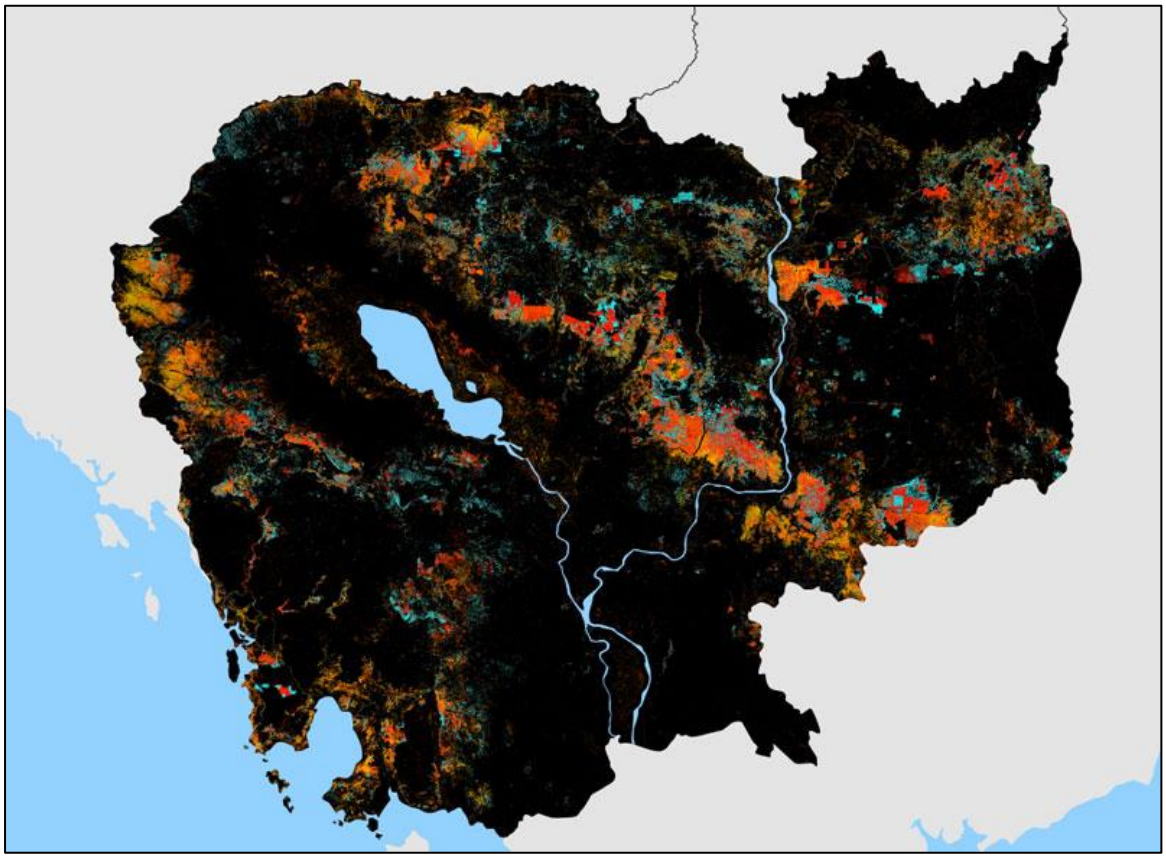
Figure 16: Forest cover for years 1976 to 1997 and 2002



Source: Atlas of Cambodia, 2006

The amount of forest lost is still substantial across parts of the country although recent analysis by Maryland University (see Figure 16) published in notably Forest Trends show significant annual losses across the country. According to Forest Trends in 2015, Cambodia is losing its natural forests at a rate of about 208,000 hectares a year. However, some stakeholders state that this figure is not clear or false for various reasons from lack of ground-truthing of data to the definition of natural forests, as opposed to scrubland or degraded forest. However, it appears that significant deforestation and losses of natural forest and secondary forest cover has occurred, although figures need to be checked.

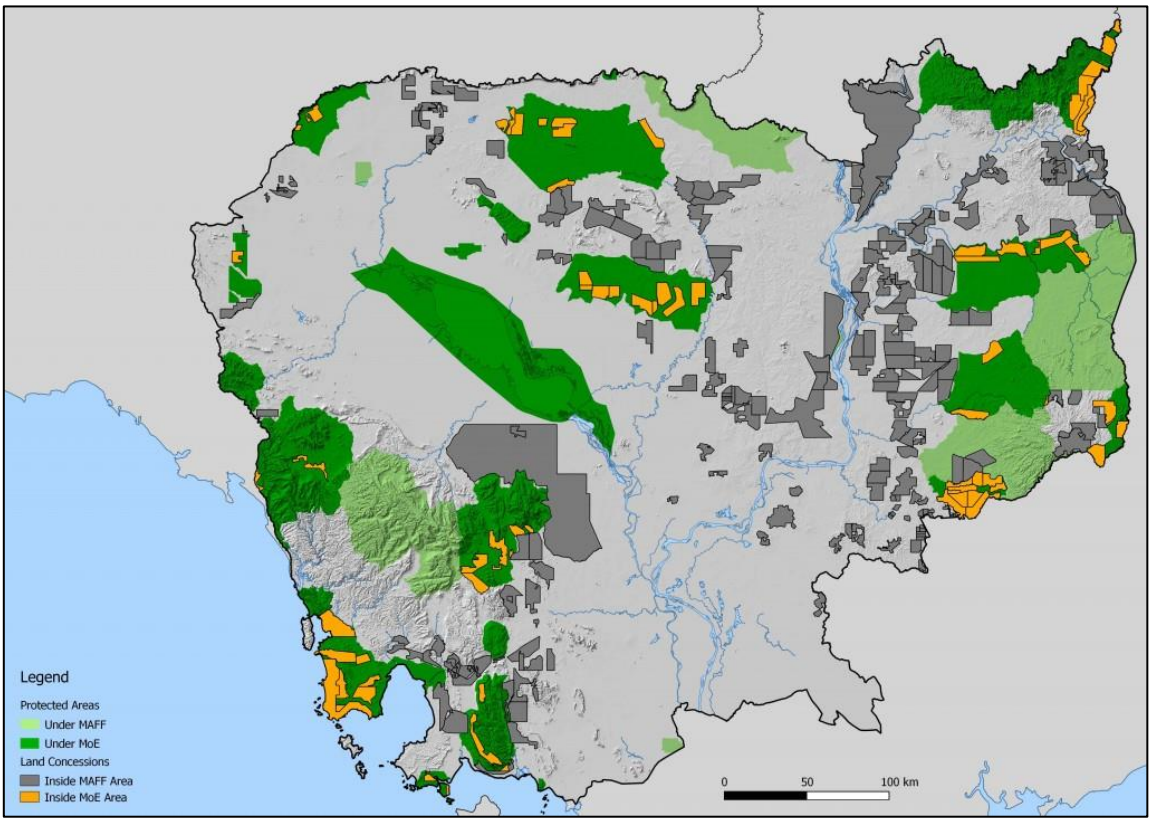
Figure 17: Deforestation and natural forest losses in Cambodia from 2000 to 2014



Source University of Maryland in Forest Trends , 2015.
Notes: Blue shows area of tree cover loss in 2014. Yellow, orange and red show areas in which tree cover was lost between 2000 to 2013.

Later land concessions were granted by the government and have also been blamed for deforestation and forest losses in more recent times. The areas were intended for large-scale commercial agricultural crops in supposedly degraded lands. However, they have been accused of occupying areas with valuable natural forests. These Economic Land Concessions (ELCs) are also accused of being a vehicle to circumvent national laws in order to profit from the clearance of timber, with or without ultimate intentions to deliver on agricultural development commitments. Thus, many ELCs are operating almost as de facto logging concessions similar to the former concessions. Forest Trends also state that in 2013 the extent of these ELCs reached 2.6 million hectares, almost four times the amount land occupied in 2004. By the end of 2014, nearly 14% of the country had been allocated to domestic and foreign corporations for large-scale agriculture and other development, while approximately 80% of the ELCs were also within Protected Areas (PAs) according to Forest Trends and shown in Figure 18.

Figure 18: Protected areas (PAs) under MoE and sites under MAFF (now also under MoE) and Economic Land Concessions (ELCs) in 2015



Source: Forest Trends, 2015

Flooded scrubland or forest is very important for captures fishers and produces approximately 90,000 T/year (pers. com. WorldFish) and being second to most productive fisheries from rice fields at approximately 360,000 T/year (Baran, 2005). The flooded forests are important for fisheries as they provide the following key ecological services:

- fish habitat, fish refuges, shading….
- spawning grounds
- provide food for fish growth

According to TSA and MoE, flooded scrubland or forests are being destroyed at a severe rate due to fires and in part speculative ELC developments. This practice has had severe implications on the inundated forests/scrubland near the lake side of Tonle Sap as shown in Figure 18, where from 1970 to 2011 the area decreased by almost 350,000 hectares, which is very significant with a high annual loss rate of approximately 8750 hectares.

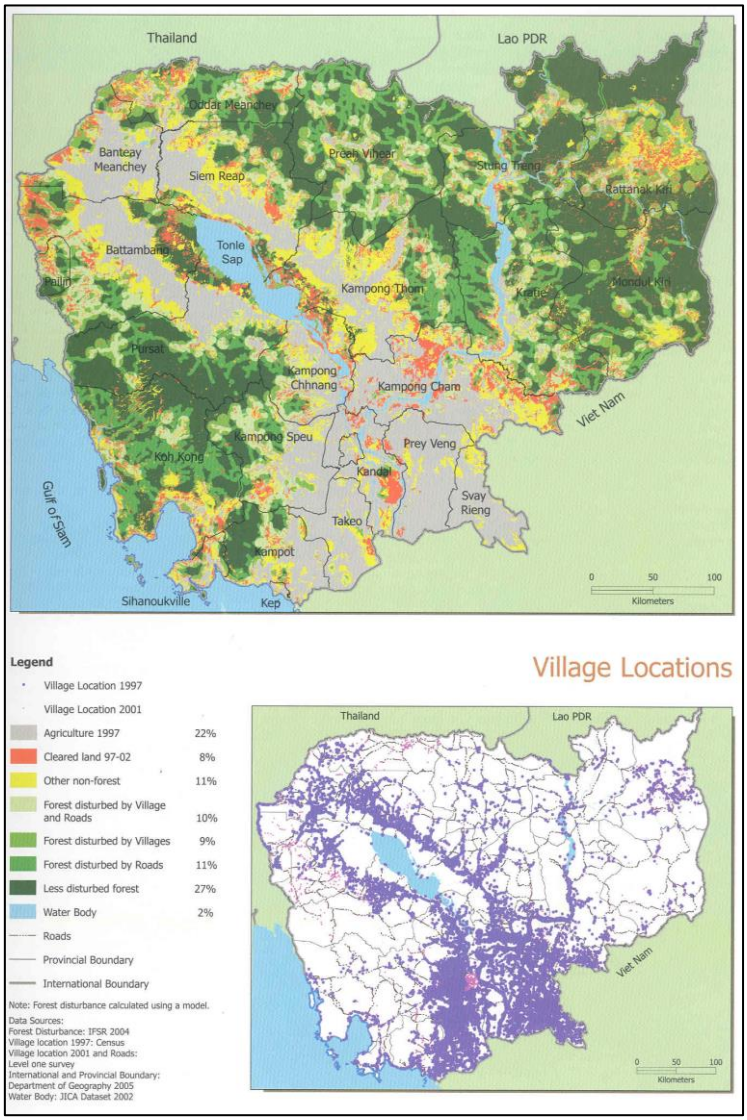
Table 7: Loss of flooded scrubland and/or forests near Tonle Sap Lake from 1970 to 2011

Year	Hectares
1970	994,175
1980	992,400
1985	823,600
2002	791,000
2005	688,170
2011	647,406

Source: TSA

It is important to recognise that historic forest clearances combined with impacts from ELCs are also in the sensitive upland catchments of the notable Tonle Sap Lake and its river system and the Mekong. Therefore, forest losses in these areas could have an impact upon the storage capacity of the soils and watershed as well as posing greater risks from soil erosion leading to sedimentation in water bodies and eutrophication. In addition a rising population in villages with rural and subsistence livelihoods, which induced them to clear lands to cultivate and fires, in addition to ELC pressures, as observed in the past across Cambodian and shown in Figure 19.

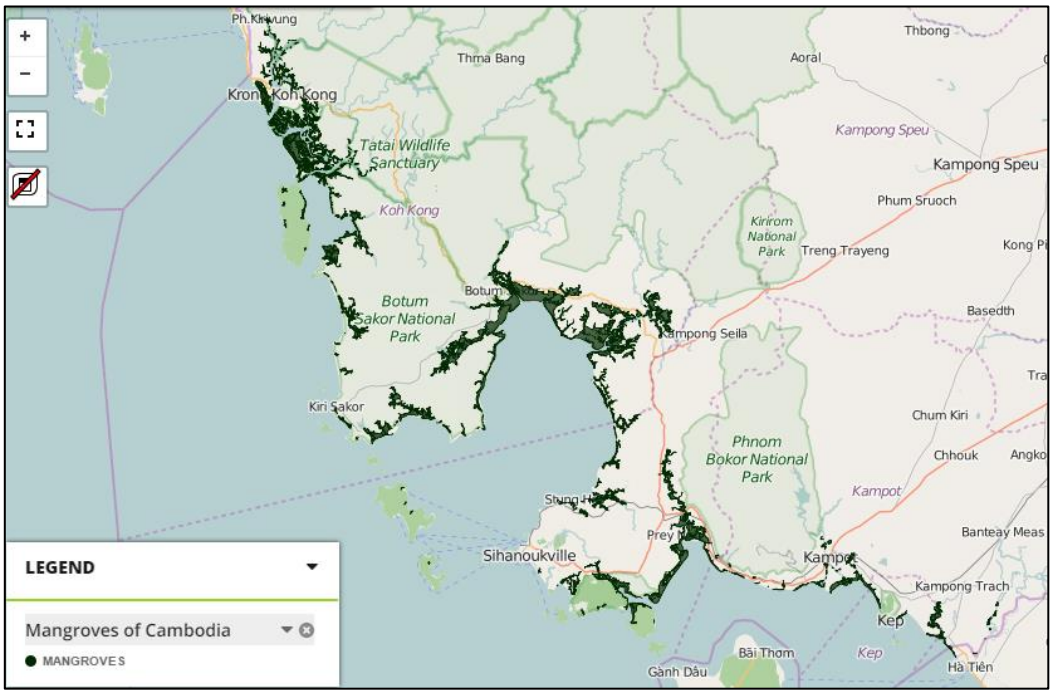
Figure 19: Deforestation and forest losses due to villages and road access



Source: Atlas of Cambodia, 2006

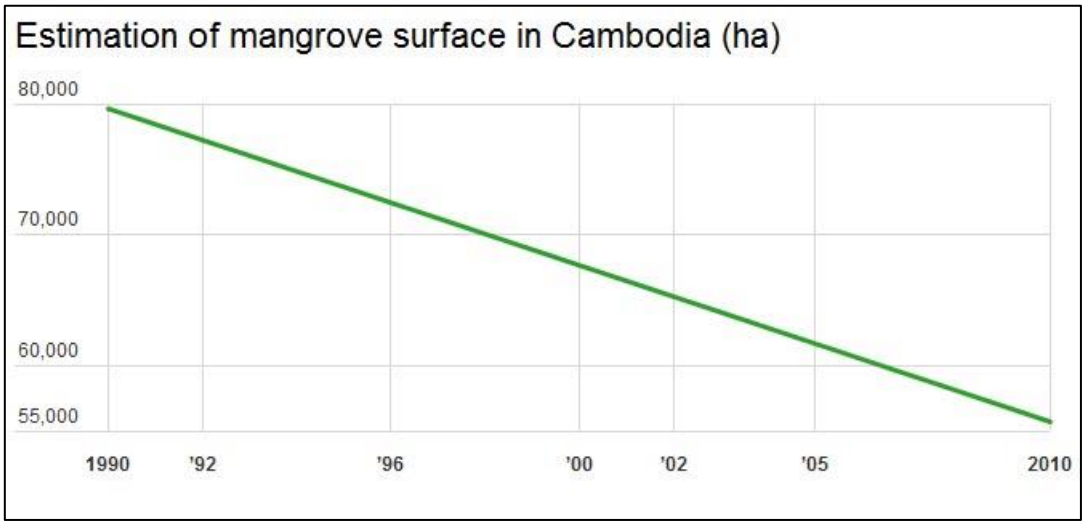
In the marine environment the mangrove forests are also under threat from deforestation. Along the coastal zones of Cambodia, there have been occasional destructions of critically important habitats of marine species, which involve mangroves, seagrasses and coral reef as reported by UNIDO in 2015. The total area of mangrove was approximately 80,000ha in 1990 and dropped to about 55,000 ha by 2010. The mangrove forest has observed quite a significant trend in losses as given in Figure 16. The areas of mangrove cover most of the coastline of Cambodia, although there are larger and denser areas near Botum and Kron Koh Kong and within the PAs (Wildlife Sanctuary and National Park), as shown in Figure 20.

Figure 20: Mangrove cover along the coast of Cambodia



Source: Open Development Cambodia, 2016

Figure 21: Estimation of mangrove cover based upon trend line from 1990 to 2010

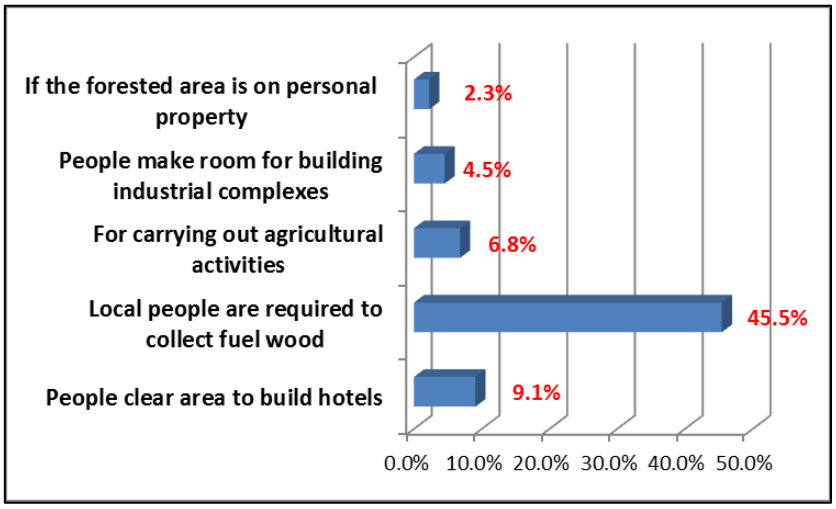


Source: Open Development Cambodia, 2016.

Notes: Trend line based upon mangrove cover data for 7 yearly interval points from 1990 to 2010

Large industrial ventures including ELCs are occasionally being approved at the expense of productive mangrove, such as Kampot and Sihanoukville, involving clear felling of mangroves. In addition, people living in the vicinity of the forest area lack access to energy from often expensive electricity and gas supplies, which is the reason they cut mangrove forests. Figure 16 shows that a significant proportion of local people (45.5%) cut mangroves on a regular basis (often or every day) according to UNIDO, as they need to access fuelwood.

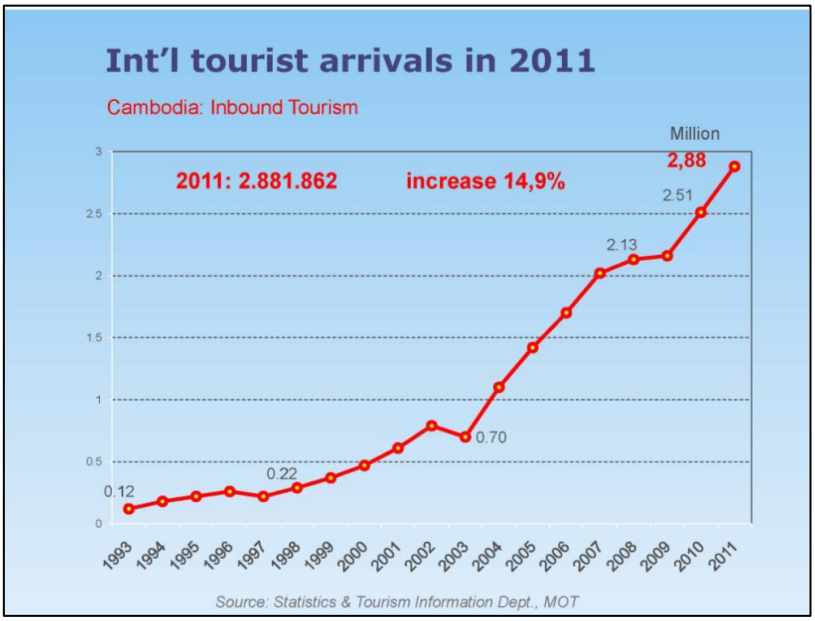
Figure 22: Reasons for mangrove destruction as perceived by local respondents



Source: UNIDO, 2015

In addition, hotel development for tourism is also noted and not insignificant at 9.1%. The tourism sector has and is seeing a significant growth trend as indicated in Figure 18 rising from approximately 120,000 in 1993 to almost 3 million in 2011. Due to competition for resources on the coast this activity may become confrontational in the future.

Figure 23: International tourist arrivals from 1993 to 2011



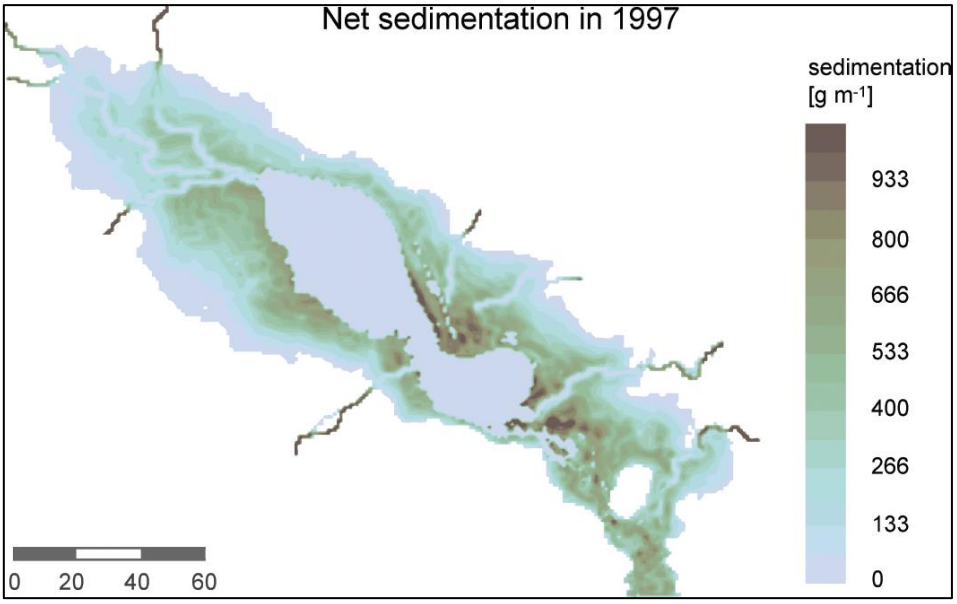
Local people tend to believe that the level of mangrove destruction is much higher when industrial ventures provoke clear felling of large tracts of mangrove forest. Often industrialists gain approval from a higher authority, which is difficult for FiA officials to stop. Local people and sometimes NGOs launch protests if they observe mass mangrove destruction. However, their protests are often found to be too weak to curtail such activities. In addition, clearances of mangroves are also associated with smaller scale salt farming and marine aquaculture.

Deforested areas are prone to risks from soil erosion reducing fertility of soils and releasing surges of sedimentation and potential pollutants into the aquatic ecosystems. The most prone soils to erosion are the lithosols soils. Severe cases of deforestation have evolved from private land speculations including deforestation of sensitive habitats, such as inundated forests and mangroves. Noted areas include the watersheds to the north of the Tonle Sap Lake, where concessions and ELCs have contributed to forest losses.

Deforestation of mangroves has posed a serious local issue associated with the development of large scale aquaculture during the 1990s. One site which was severely affected has been landfilled and used as a port and factory, while some of the areas have been recolonised with mangroves. Proposed developments including aquaculture in the future could provoke mangrove clearances, although the sizes and locations are unknown at present. The habitat, when removed, is prone to severe coastal erosion and may threaten coastal infrastructures including aquaculture pond systems. The dominant loss of mangroves is due to firewood collection at present, although it does not appear to be as severe as inland forest losses.

A good case study is the Tonle Sap lake by Kummu et al. in 2008 where sedimentation studies indicated conclusively that rates of sediment accumulation within the lake are relatively low, and that there is no threat of the lake filling up with sediment in the short term. However, it is important to note that localized problems of excess sedimentation remain, particularly on the estuary part of the lake and some of the main tributaries (see Figure 24), which could inhibit the passage of fish species.

Figure 24: Simulation of results of net sedimentation on Tonle Sap Lake in 1997



Source: Kummu et al in Ambio, 2008

Although sediment dynamics in the Tonle Sap Lake system are understood in part, more research is needed in areas around the lake and other water bodies in order to better understand and quantify possible future threats to the Tonle Sap Lake and similar aquatic environments with heavy sediment load issues. The extent and nature of localised problems of erosion and sedimentation, as well as the impact of predicted climate change on the

hydrology and ecology of the lake and its surrounding wetlands could potentially impede migration and damage breeding grounds for fish. However, the major losses for fisheries in freshwaters like the Tonle Sap derive from deforestation of flooded forests, which provide important habitats for fish reproduction and growth.

Similarly on the coasts, there are mangrove forests, which are very important for marine capture fisheries. Specific studies have not been done in Cambodia to assess mangroves being converted to commercial shrimp farming, although a pertinent study from neighbouring Thailand was prepared in 2004 by Barbier and Sathirathai. The study showed that it was financially profitable for the private sector to exploit the mangroves, but it was not economically viable for the society. Although shrimp farming creates enormous private benefits for those who can afford the undertaking, the net social benefits of the enterprise, taking into account its externalities in terms of mangrove destruction and water pollution are not so economically viable. This verdict is especially true when the specific mangrove forest is located along the coast and serves as an important nursery ground for small fish and marine life. Moreover, the results from the analysis indicate that when off-shore fisheries are well managed by local communities, the foregone benefits of mangroves in terms of support for off-shore fisheries will increase the value of the mangroves and render their conversion to be less economically viable. Therefore site planning, management and integration of proposed aquaculture units are paramount before even limited areas of mangroves are removed.

Regulatory framework

The key policy and legislation documents relevant for deforestation/forest loss, soil erosion and sedimentation are: the Law on Forestry (2002); the Law on Fisheries (2006); the Law on Environmental Protection and Natural Resources Management (1996); the Royal Decree on the Protection of Natural Areas (1993) and the Law on Protected Areas (2008); Sub-decree No.197 on boundary establishment of flooded forest area in six provinces surrounding the Tonle Sap Lake (2011); and Sub-decree No. 69 on the Transfer of the Protected Forest, Forest Conservation and Production Forest Areas and Economic Land Concessions between MAFF, and MoE (2016). Also the National Forest programme 2010-2029, the National Biodiversity Strategic and Action plan- (2016), the National Strategic Plan on Green Growth 2013-2030, and the Agricultural Sector Strategic Management Plan (2014-2018) are relevant documents to the sector.

The Law on Forestry (2002) and the Law on Fisheries (2006) aim to ensure the sustainable management of forests. The Law on Forestry would regulate the sustainable management of the terrestrial forest and upland forest, while the Law on Fisheries (2006) would regulate the sustainable management and development of flooded forest, mangrove forest, and inundated land. The law on fisheries prohibits the expansion of agriculture lands within protected and inundated forest areas, including cutting, clearing, burning or damage to flooded forests and mangroves.

Law on Environmental Protection and Natural Resources Management (1996) is the principal law regarding environmental protection, pollution control and natural resource management in Cambodia. It is regulatory framework to protect against deforestation and eventual soil erosion and sedimentation. The law also promotes environmental quality; ensures rational and sustainable conservation, development, management, and use of natural resources to encourage sustainable development; enables the public to participate in environmental protection and natural resource management; and prohibits any acts that may cause harm to the environment, such as pollution.

The 1993 Royal Decree on the Protection of Natural Areas and the Law on Protected Area (2008) intend to protect ecologically and culturally important places, and recognise 23 protected areas covering over 18% of Cambodia's land area and classified into eight categories of protected areas, which are dependant upon the character of each area and the objectives of their protection and preservation. These eight categories of natural protected areas are; (1) national parks; (2) wildlife sanctuaries; (3) protected landscapes; (4) multi-purpose-use management areas – natural stability of water, forestry, wildlife and fishery resources; (5) biosphere reserves; (6) natural heritage sites; (7) marine parks; (8) Ramsar sites – areas recognized for the importance of their wetlands and surrounding environment, including wildlife, habitats and ecosystems. This decree established natural PAs under MoE control and now related in part to the new 2016 Sub-decree for transfer of additional forest PAs from FA to MoE (see below).

The National Forest Programme 2010-2029 of MAFF is the forest management policy framework to reduce deforestation and soil erosion in upland areas. It is a strategic and policy framework for sustainable management of the country's valuable forest resources with six programmes focusing upon principally: management, conservation, and development of forest resources and biodiversity. If applied this programme could be very advantageous to conservation in watersheds.

The National Biodiversity Strategic and Action Plan (2016) is a comprehensive strategic document for biodiversity conservation and management in Cambodia. It serves as a roadmap for supporting the environmental component on the country's sustainable development, and to use, protect and manage biodiversity for sustainable development in Cambodia. Meanwhile, the National Strategic Plan on Green Growth 2013-2030 is complementary as it is a strategic framework for sustainable development, and contributes to upholding stable economic growth; and to improve the quality of the environment and promote poverty alleviation. It also focuses on the reduction and prevention of environmental pollution, benign ecosystems, poverty reduction, national resources management, and sustainable land use and water resource management. Therefore this plan is potentially very useful of fisheries and aquaculture development

Regarding sustainable management of natural resources and in particular forests, the Agricultural Sector Strategic Development Plan (2014-2018) is also a very pertinent strategic development plan attached to MAFF. The strategic plan focuses on five programmes including sustainable fisheries and forestry resources management, which is appropriate for the planning within the context of forests in watersheds.

Institutional framework

There are two key ministries being MAFF and MoE with responsibility for the management of forest and forested lands. In addition land use planning issues associated with deforestation under the guise of Economic Land Concessions (ELCs) is also linked with these two Ministries, although the role of the MoE, in principle, is to protect all land including ELC areas from any form of deforestation now. These bodies do not appear to work closely at present with the Ministry of Land Management, Urban Planning and Construction (MLMUOC), which has responsibility for governing land use, urban planning, construction projects, and for the resolution of land use conflicts.

Based on the Law on Forestry (2002) and Law on Fisheries (2006), MAFF and its line administrations i.e. FA and FiA are responsible for the management of forests and areas under administrative boundaries including the flooded forest, mangrove forest, and inundated land area. Meanwhile the Ministry of Environment (MoE) also has responsibility to manage forest including terrestrial, flooded and mangrove forests within their administrative boundaries, but under the Law on Environmental Protection and Natural Resources Management (1996), the Royal Decree on the Protection of Natural Areas (1993) and Law

on Protected Areas (2008). Within the existing regulatory framework, there were problem in responsibility to manage, control and development of forest. This occurred due to overlaps in mandates between the two ministries and in part the lack of resources to protect the forests from deforestation.

In response to this overlap in May 2016, the Royal Government issued a new sub-decree and was endorsed in order to make effective management of protected areas and non-protected area forests by redefining the responsibility of key ministries being MAFF and MoE. The new Sub-Decree No. 69 for the Transfer of the Protected Forest, Forest Conservation and Production Forest Areas, and Economic Land Concessions are divided between MAFF and MoE. Effectively this Sub-decree transforms all former FA forest PAs to be managed with natural PAs, except for Ta Moa Protected Forest in Takeo province. Over a half of the natural PAs are under the classification Wildlife Sanctuary. According to Sub-decree No.69, both the MoE and MAFF are now responsible for cracking down on any illegal logging. Meanwhile MAFF/FA manages economic land concessions, while MoE manages all conservation and production forests in addition to the natural PAs.

Within Sub-decree No 69 (2016), the management framework for terrestrial forest is likely to be improved although there are problems in managing of ELC within the protected areas. Effectively Sub-decree No 69 gives the Ministry of Environment (MoE) the responsibility for much of the land concession areas that are allocated within official protected areas. However, it is unclear how the ELCs will be addressed, and in particular those located in natural PAs under the auspices of the MoE. This problem undermines the purpose of the Law on Protected Areas, which does not provide for legal development of large-scale plantations or ELCs within PAs. In addition the transfer of responsibilities should also be supported by the allocation of resources (including technology/knowledge, material and fund) to match the new responsibilities. This revision should also include more staff such as field agents attached to MoE, which are lacking at present (pers. com. CI).

The mangroves forest is considered part of fisheries resources, since mangrove forest is governed under Fisheries Law. However, the development of coastal resources including mangroves is under co-management of the MoE and MAFF (FiA), although the current debate on exploitation of these areas is highly political as the coast has high development value. The existing legal provisions are good enough to address deforestation, if political leaders realise the negative consequences of encroachment into coastal habitats, such as mangroves. Recently MoE was proactive in blocking the development of large scale foreign investment in aquaculture on the coast. However, the project is reported to be advancing again according to FiA. Based on this example it is clear that co-management of mangroves between MAFF/FiA and MoE does not appear to be working.

The flooded forests and inundated land areas or wetlands are considered part of fishery resources and governed under Fisheries Law. MAFF, particularly FiA is responsible to manage the flooded forest. The flooded forest and wetlands within the protected areas such as Biosphere Reserve and Ramsar sites are governed and managed under co-management of MAFF (FiA) and MoE. As the relationship between the two ministries is stretched for mangroves, it is unsure how well these protected sites are managed. In 2011, Royal Government endorsed Sub-decree No.197 on boundary establishment of flooded forest area for the 647,406 hectares in 6 provinces surrounding Tonle Sap Lake. This Sub-decree orders the governors of each of the six provinces as well as the Tonle Sap Authority (TSA) and relevant ministries (particularly MAFF/FiA) to preserve the area. However, the governors have political power to override TSA and other authorities, which has sometimes had negative consequences for the environment. Effectively non protected areas of flooded forest are dependent upon governors. Normally, each provincial governor has a duty to protect the flooded forest, both seasonal and permanently flooded, against any offences within their province, where failure to take responsibility would result in government action.

This sub-decree places concern over the flooded forest within the Tonle Sap Lake which is important for fisheries. It regulates and gathers the key ministries MAFF/FiA, MoE, MOWRAM/TSA and provincial authorities involved under formal committees at provincial levels for protecting, conserving and controlling the flooded forest and potential encroachment. As provincial governors are in charge of these committees, they can only be as effective as the governor may see fit. There are still many problems related to forest fires, encroachment for agriculture, cutting for firewood and fishing tools etc. Meanwhile provincial governors and local authorities, which have failed to take responsibility for the protection of flooded forest, have never been prosecuted or called into question. With severe reduction in flooded forest, there is now urgent need for political will to protect these forests.

Strategic plans such as National Forest programme 2010-2029, the National Biodiversity Strategic and Action plan- (2016), National Strategic Plan on Green Growth 2013-2030, and Agricultural Sector Strategic Management Plan (2014-2018) could assist the enforcement of laws and regulations to protect, manage and develop forest with mitigation for deforestation, soil erosion and potential sedimentation. However, this would be curtailed at present by lack of resources and political will.

Analysis

The key issues or sub-issues for the effects of deforestation upon rivers and lakes and within coastal areas are summarised and assessed according to their probability and impact, as follows:

Table 8: key issues or sub-issues for the effects of deforestation upon rivers and lakes and within coastal area

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Deforestation of upland forest (often associated with ELCs) can provoke sediment of rivers and lakes impeding fish migration	High	Low	Small
Loss of flooded forest (sometimes associated with ELCs) will reduce production from freshwater capture fisheries	High	High	Medium
Loss of mangrove forest will reduce production from marine capture fisheries (often associated with ELCs and potentially for aquaculture development)	Average	High	Medium to High
ELCs still exist with PAs and outside PAs in sensitive forested areas.	Average to High	Average	Medium

Analysis of alternatives

This section compares the issues or sub-issues for the effects of deforestation upon rivers and lakes and within coastal areas with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Focus on freshwater or marine aquaculture could be affected seriously by deforestation, in particular, flooded forest and mangroves, therefore an emphasis upon both should orientate CAPFish to make efforts to counter deforestation, and equally avoid unplanned and potentially harmful development of marine aquaculture in or near mangroves on the coast.
Support to intensive/commercial fisheries versus small scale fisheries	Orientation of the project to small-scale or large scale aquaculture could be the cause of further losses of flooded forest and the revival of losses of mangroves, with in return some negative effects upon aquaculture, due to erosion, sedimentation and lack of flood or storm control buffering. However, this issue could be minimised if aquaculture is oriented towards integrated mangrove-aquaculture systems and potentially similar systems in the flooded forests, and address the most numerous units being smaller scale CFis.
Support to specific species versus all species	If a broad range of wild fish species is targeted as opposed to a few specific species, then the conservation of flooded forest and mangroves will be very important as these habitats represent biological reserves for a vast number of potentially important fish species.

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Lack of engagement with CFis could lead to inappropriate exploitation of flooded forest and mangroves for firewood and/or agricultural fields.
Enhance wild stocks versus management of existing stocks in the wild	Engagement with wild stock enhancement programmes will require the imperative conservation of flooded forest and mangroves which serve as habitat and feeding and breeding grounds for the species released.
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	IWRM should be an option to broaden the definition of key habitat protection in CAPFish from a focus upon aquatic environments to integrated watershed protection i.e. conserve forest, in particular those areas in upper highland

	catchments. This alternative to the programme would provide the sources of water with controls and management support and water quality, quality and flows within the hydrological systems and the eventual aquatic habitats for fish.
Promote economic diversification versus only capture fishery activities	N.A.
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	PES would account for the value of aquatic ecosystems for fisheries, in particular flooded forest and mangroves for fisheries, paid for by a potential national fund to support fisheries and fishers' livelihoods in flooded forest and mangrove systems, which would effectively be a form of subsidy for the industry.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

The key recommendations related to deforestation, forest loss, soil erosion and sedimentation are presented below:

- use IWRM approach within fishery's watersheds involving the collaboration of a wide range of people and organizations often across an entire watershed is vital to reducing deforestation and inappropriate sedimentation of key habitats and migration pathways. State governments, farm organizations, conservation groups, educational institutions, non-profit organizations, and community groups all play a part in successful efforts to minimise or stop inappropriate losses of forest within important catchments where integrated management is required
- support research to measure the value of ecosystems services to build an evidence base for awareness raising and decision making for the protection of mangrove and flooded forest
- promoting vegetation cover through natural regeneration and afforestation of degraded forests can protect watershed and reduce soil erosion within watersheds.
- encourage and empower community forestry (CF) schemes in the uplands of Cambodia linked to community fisheries (CFi) in the lowlands with sustainable use and management of flooded forests and mangroves. This approach could assist in the protection of the illegal felling, reduce forest fires and deforestation, and ultimately reduce soil erosion in upland areas through the CF collaboration, and safeguard flooded forest and mangroves at the CFi level This approach could support CFis which are already empowered (at least on paper) through the CFI sub-decree, which gives them the right to maintain, protect and replant inundated forest and mangrove (see Article 10)
- support capacity building of institutions being MAFF and MoE principally, from national to regional levels (including TSA) and at grassroots (CFis). The implementation of terrestrial, flooded and mangrove forest protection and conservation needs to be enhanced in collaboration with trained local community support including both technical and financial support. The capacity of governmental institutions should also be improved with technical support, materials and above all financial resources to fulfil their post to enforce the law in protecting, managing and developing of forest. The roles of local communities (CFi and CF) should be improved to assist in protecting, controlling and fighting against illegal activities such as illegal logging, burning, cutting and

encroachment into forests. The entry point would be integrated fisheries management policy for CAPFish in collaboration with other donors and NGOs focusing on forests including mangroves and flooded forest

- assist MAFF and MoE to work more closely with MLMUOC related to land use planning in order to protect forest in key water catchments, as MoLMUP is responsible for governing land use, urban planning, construction projects, and for the resolution of land use conflicts
- assist MAFF to develop its soils and mapping unit and move forward with national and regional erosion hazard mapping with baseline data and support from key mapping/GIS units including the Geography Department from the University of Cambodia with FiA's GIS Unit. Request partnership with FAO which has been engaged in global soil risk mapping for many years and MoE, who are working on soil erosion (partnerships could assist funding of the project)

7.2.3 Key Issue 5: Climate change and its interaction upon aquatic ecosystems

Rationale for the selection of the key issue

The rationale for climate change and interactions with fisheries and aquaculture is based upon the findings from the scoping study and in part some of the key global climate change (CC) issues for Cambodia (RGC, 2013) in Section 6, which are summarised below:

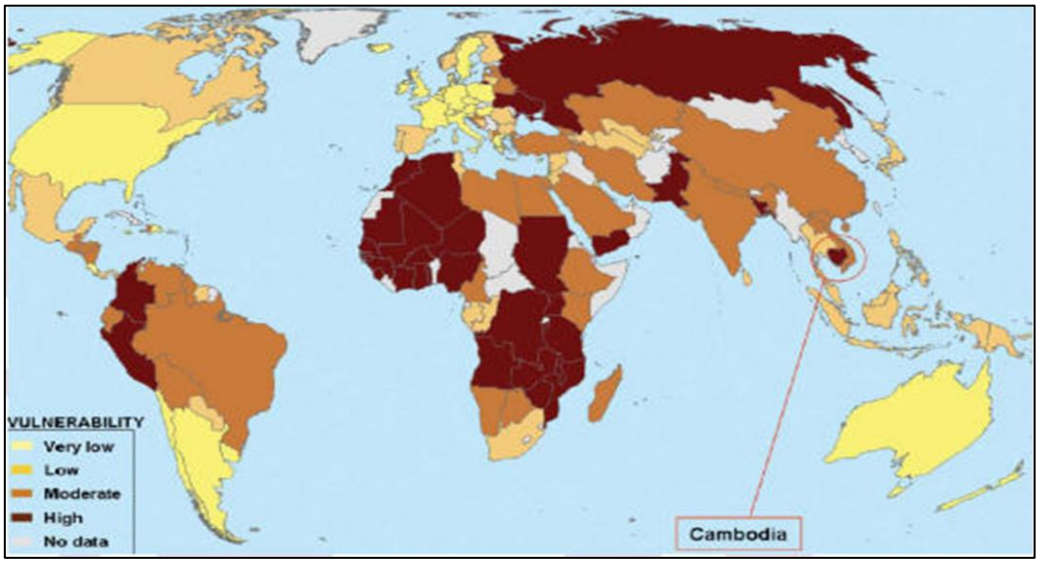
- CC provokes erratic water levels associated with flooding and droughts which have been recorded in lakes and rivers, which makes the management of these resources more difficult
- CC can also seriously affect cage and pond aquaculture production, when ambient temperatures are high and water levels become seriously low
- CC could provoke saline intrusions with rising seas levels affecting freshwater fisheries
- CC can lead to flooding and destruction of coastal infrastructure including aquaculture
- CC is likely to decrease fish biodiversity and stability in fisheries sector production due to principally rises in temperature, despite some climate change benefits in some areas associated with increasing flooding and nutrient loading
- important relationship between fisheries and aquaculture carbon footprints linked to energy needs for aquaculture units and processing plants (if fossils fuels are used) including feeds, materials and production of fish fry. This leads to blue carbon offsetting schemes such as planting and conservation of inundated forest/shrub land and mangroves is an opportunity for developments associated with capture fisheries and aquaculture policy and programmes
- fish may be able to provide opportunities to adapt to climate change through integrating capture fisheries with aquaculture and agriculture, which can help farmers cope with drought through diversification of household incomes and nutrition.

Baseline (including institutional, policy and legal framework specific to the key issue)

Cambodia is highly vulnerable to the effects of climate change (CC), where one of the most immediate and dramatic of these effects is likely to be felt in Cambodia's fisheries sector. This issue is also significantly serious at a global level for Cambodia, as illustrated Figure 25. Even small changes to the hydrological system induced by CC and sustaining Cambodia's fisheries could have disastrous consequences for food security associated with nutrition and poverty in Cambodia (see Key Issue 2). The low levels in the Mekong River in 2010 were attributed to both upstream dam development and climate change according to MoE and UNDP and cited in Almack in 2012. Cambodia is particularly vulnerable to climate change

impacts because of the magnitude of these impacts, the reliance of people on fisheries, and limited adaptive capacity.

Figure 25: Vulnerability of fisheries to climate change with Cambodia highlighted as one of the most vulnerable countries



Source: K. Almack, WorldFish, 2012

The impact of climate change on Cambodia's fisheries sector will occur through multiple pathways and interactions as summarised in Figure 26. The changing productivity of natural capture fisheries is closely related to natural hydrological patterns and the integrity of fish habitats. There are many uncertainties and indirect impacts from changing hydrological regimes. These include changes to migration patterns and the level of flood peaks and area of land flooded. In the short term, climate change is expected to impact freshwater fisheries through incremental changes in water temperature, nutrient levels, and in particular lower rainfall during the critical dry season period for fish. Climate change will also increase the uncertainty of fish production in capture fisheries and aquaculture. The effects of climate change on fisheries are therefore likely to be felt both at the level of local households and at the level of the national economy according to MoE.

Figure 26: Overview of climate change related to inland fisheries in Cambodia

Factor	Change predicted	Trend [a]	Remark
Temperature	+0.3° to +0.6° by 2025		
Rainfall in wet season	+3% to +35%		Direction of change certain, but magnitude uncertain
Rainfall in dry season	No change or decrease		
Extreme events	More frequent and more intense		Extreme events = floods, drought, storms
Runoff	+21%		Higher sediment load in water, impact on fishery productivity
Tonle Sap level in rainy season	+2.3 meters		Increased rainfall in wet season will raise flood levels
Tonle Sap level in dry season	+0.1 meter		

Note that the thickness of arrows indicates the degree of certainty

Source: WorldFish, 2008

Although there are many uncertainties, the Greater Mekong sub-region has been identified as one of the regions least able to respond to climate change impacts (Johnston et al. 2009). The effect of changing temperatures and hydrologic regimes is expected to have a major impact and summarised in Table 9

Table 9: Symptoms of climate change for inland fisheries

Symptoms	Effects on	Impacts
- Rainfall changes - Evaporation changes - Modified river flows - Changing lake levels - Changing thermal structure of lakes - Increased severity of extreme weather - Increased frequency of extreme - Temperature increases/decreases	Ecology - Species composition	- Production and yield - Species distribution - Species diversity - Fish diseases
	Fishing operations/Postharvest	- Safety and ability to get fish - Ability to process fish - Infrastructure damage
	Livelihoods (local)	- Loss of livelihoods - Changes in livelihood strategies - Health risks - Displacement and migration of fishers
	Wider society/Public policy	- Adaptation costs - Market impacts/Impacts on - Demand

Source WorldFish Center, 2012

In Cambodia, the impact of climate change on fisheries operates on many levels as follows:

- the timing of the flood along with the number of peaks during the flood season are important factors in how fish migrate, breed and spawn
- methods used by fishers and the social-economic context in which fishers operate
- fish catches are increasingly made up of species such as Henicorhynchus spp. (*trey riel* in Khmer) that are considered unstable because their abundance is largely driven by the

annual flood pattern. The *trey riel* migration could be significantly impacted with implications for food security.

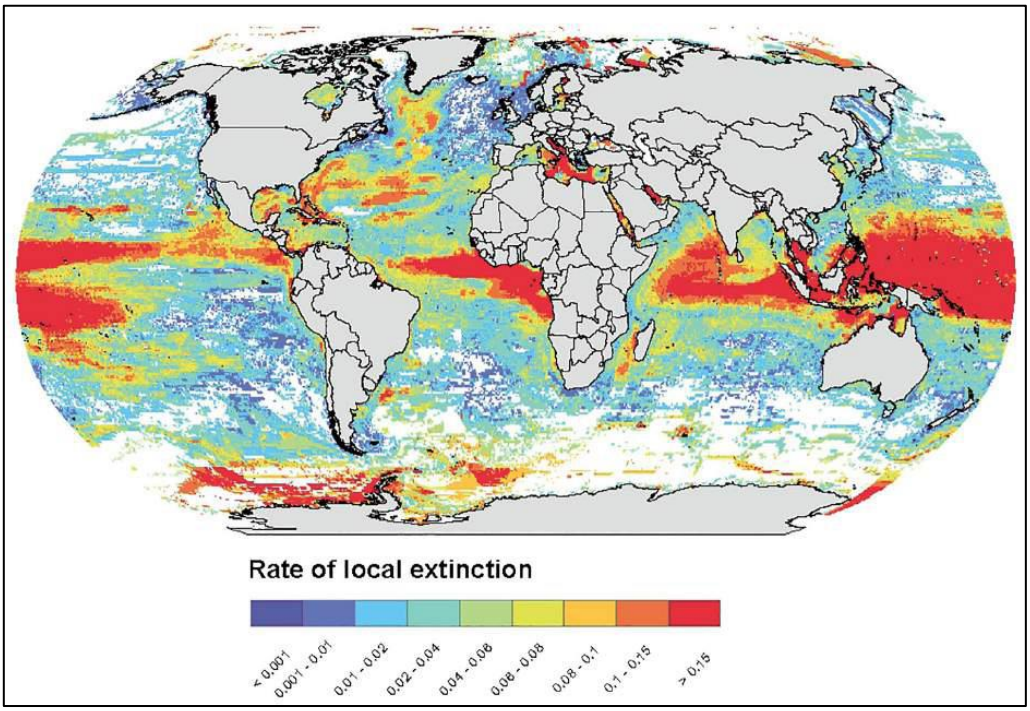
The combination of overfishing, hydropower developments, and habitat destruction with CC could push the aquatic ecosystem to an unstoppable decline in productivity. These activities could have direct and/or synergistic impacts; however, there have not been any appropriate studies of damming projects interacting with CC variables, as yet, to ascertain the eventual impacts upon fisheries in Cambodia. There is a possibility that some of the 300 species in the Mekong catchment could do better under CC, although this is not yet clear, while negative impact forecasting is more profound and clear, which is not a good sign for Cambodia. The NAPAs (National Adaptation Programs of Action) and plans of the Least Developed Countries (LDC) will need to address these issues for the fisheries sector. There are also compounding risks associated with multiple factors such as pollutants (see Key Issue 3) and rising temperate interactions in fisheries. It is also important to note that stress synergy, or the combined effects of increased temperature, decreased dissolved oxygen, and pollutant presence will have a deleterious effect on fish populations regardless of temperature effects on toxicity, and effectively the economy associated with fish and human health. Therefore it is apparent that a proactive response to managing fisheries in the face of a changing climate is required to ensure functional fish communities in the future, while minimising potential multifariously negative impacts from other key anthropogenic factors, such as dams, fish disease introductions and pollutants (see other Key Issues).

The key to successful adaptation for fishers is to diversify livelihoods so when one economic option fails another is available. Adaptation should be a combination of diverse and flexible livelihoods, plus diverse and adaptable institutions and policies. Education, awareness diversification and occupational mobility should be considered in developing a climate change adaptation strategy. In addition, reducing the stress on fishery resources through removing or mitigating external stresses such as the degradation of ecosystems will increase the capacity of people to adapt, although this may be difficult given the current poor state of fisheries management, particularly in CFis (see Key Issue 2). Finally and as outlined in Key Issue 4 of this study, the degradation of forests and wetland ecosystems including the inundated scrubland and forests would make fisheries and aquaculture more vulnerable to local and regional climatic variations.

Implication of climate change is not yet a major issue in coastal Cambodia. However, the research and academic communities find it has a data gap, which is why the general awareness level appears to be low. Information from the International Fund for Agricultural Development (IFAD) suggests that climate change might change the environment of coastal fisheries, which could trigger a decline in productivity of marine fisheries. The loss in biodiversity for fish species associated with climate change forecasts by the International Union for the Conservation of Nature (IUCN) was reported in 2016 and shown in

Figure 27 with major impacts in tropical regions. Such predicted distribution shifts would result in large-scale changes in patterns of species richness through species invasions (occurring in new areas) and local extinctions (disappearing from previously occurring areas).

Figure 27: Rate of local extinction of marine fish species for the world and SE Asia.



Source: IUCN, 2016

Policy and regulatory framework

The key aspects of the institutional, policy and legal framework for Climate Change are associated with Climate Change Prioritised Action Plans for MAFF (MAFF CCPAP) 2014-2018, the strategic paper on Building Resilience to Climate Change: A Strategy to Respond to Impacts of Climate Change 2014-2018 (2013), and the Cambodia Climate Change Strategic Plan (CCCSP) 2014-2023. In addition, the National Climate Change Strategy paper considers measures to ensure climate resilience of critical ecosystems including coastal ecosystems and biodiversity in protected area, and also to improve mangrove ecosystems, coastal zones and protected areas under the National Climate Change Committee (NCCC). There are also opportunities for low carbon development plans including blue carbon in mangroves through four policies and several strategies known as the Low Carbon Development Strategy for Cambodia towards 2050.

At a national level, the Government of Cambodia has developed the Cambodia Climate Change Strategic Plan (CCCSP) 2014-2023. The CCCSP covers 8 strategic objectives, as follows: (1) promote climate resilience through improving food, water and energy security; (2) reduce vulnerability of sectors, regions, gender and health to climate change impacts; (3) ensure climate resilience of critical ecosystems (Tonle Sap Lake, Mekong River, coastal ecosystems, highlands etc.), including biodiversity, protected areas and cultural heritage sites; (4) promote low-carbon planning and technologies to support sustainable development in the country; (5) improve capacities, knowledge and awareness for climate change responses; (6) promote adaptive social protection and participatory approaches to reduce losses and damage; (7) strengthen institutions and coordination frameworks for national climate change responses; and (8) strengthen collaboration and active participation in regional and global climate change processes.

With regard to climate change, MAFF has developed a climate change strategic plan called Climate Change Prioritised Action Plans for MAFF (MAFF - CCPAP) 2014-2018. The plan provides five strategies including: (1) ensure food security by increasing of crop production, agro-industry at 10% per annum; (2) increase sustainable livestock production 3% per year

and animal health control and avoid adverse impact on public welfare and contribute to reducing 1% of greenhouse gases emissions from animal production from 2015; (3) enhance sustainable forest management through afforestation and reduce emissions from forest degradation and deforestation, to obtain carbon credit (not in place as yet) and enhance local communities whose livelihoods dependant upon forestry by ensuring zero balance deforestation by 2020; and (4) enhance management, conservation and development of fishery resource in a sustainable manner. It is evident that the CCPAP could have contradictory policies where the increasing in crop production which is likely to require water for irrigation purposes could clash with water needs for fisheries. Therefore, integrated systems including managed rice field fisheries and fish refuge systems with artificial lakes and reservoirs may become necessities. These infrastructures would only be constructed whereby the impact upon water flows and nutrient including existing water body and coastal dynamics are not severely disrupted and potential losses in fishery production and effects upon aquatic ecosystems do not outweigh the gains.

FiA under MAFF set up its own strategic plan for climate change, which is the strategic paper Building Resilience to Climate Change: A Strategy to Respond to Impacts of Climate Change 2014-2018 (2013). FiA's climate change strategic plan focuses upon transboundary issues, hydropower, rural economy diversification to the fisheries within the context of CC adaptation and responses in Cambodia. This plan also provides a vision for the fisheries sector in response to climate change mitigation and adaptation measurements for sustainable fishery resources management. The aim of the plan is to increase fisheries productivity, fish stocks and aquatic resources to guarantee food and nutrition security and contribute to poverty alleviation.

Institutional framework

The National Climate Change Committee (NCCC) was established in 2006 by the Royal Government of Cambodia. It is comprised of senior policy-makers from 20 ministerial agencies and the Department of Climate Change (DCC) of MoE, which serves as the NCCC secretariat. The NCCC has the mandate to determine national positions and strategies for participating in international negotiations on climate change. The NCCC is responsible for coordinating the development and implementation of policies, plans, and measures to address climate change issues within Cambodia. The Prime Minister is the Honorary Chair of the NCCC. At national level, the NCCC has overall responsibility for the management and monitoring of CCCSP implementation with technical support from the Climate Change Technical Team (CCTT) and administrative support from the NCCC Secretariat.

Line-ministry levels include climate change focal points and/or working groups have already been established. The responsibilities of these focal points and working groups will be clarified in the near future, in particular their relationship with other line ministry departments, to ensure that the planning of sectoral policies, programmes and investments take full account of climate change risks and opportunities. Meanwhile at sub-national administrative levels, there are guidelines for development planning within the context of climate change. These measures were put in place in June 2014 under the leadership of the NCCC Secretariat.

Analysis

The key issues or sub-issues for the effects of climate change and its interaction upon aquatic ecosystems are summarized and assessed according to their probability and impact, as follows:

Table 10: Key issues or sub-issues for the effects of climate change and its interaction upon aquatic ecosystem

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Competition for water due to changes in seasonal water flows during dry season between agricultural development e.g. needs for irrigation and water for both capture fisheries (in natural pools and refuges) and aquaculture (cage and pond)	Average to High	Average to High	Medium
Uncertainty and unpredictability related to CC, loss of production and biodiversity for fisheries and lack of mechanisms to build adaptive capacity for local communities to respond to these changes	Average to High	High	Medium
Effect of CC on coastal fisheries	High	High	Large

Analysis of alternatives

This section compares the issues or sub-issues for climate change and its interaction upon aquatic ecosystems with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Both freshwater or marine aquaculture could be affected seriously by climate change and its interaction upon aquatic ecosystems in various ways. Firstly high temperatures will induce high levels of stress on fish population in ponds or cages, which could kill the fish populations and/or reduce their productivity. In freshwater systems this would be provoked further with erratic water flows and particularly when low flows occur during the dry and warmer seasons. The situation is likely to be more fragile inland as opposed to the coast which will have the benefit of constant seawater, although high temperatures will be problematic for fish in coastal aquaculture units.
Support to intensive/commercial fisheries versus small scale fisheries	N.A.
Support to specific species versus all species	Broad range of wild fish species should be targeted as opposed to a few specific species is an approach which could offer more resistance and adaptive options to CC regarding variations in temperature and erratic flooding and water flows. These CC events could have serious impacts upon fish biodiversity in natural reserves such as pool refuges and flooded forests, and mangroves and coral reefs on the coast. The threat of biodiversity being severely reduced by CC is foreseen as a scenario for the future. Therefore, it would be unwise to focus on a few species as opposed to a broad range of species, which would provide greater assurance for the future development of aquaculture.

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Lack of engagement with CFis in the future regarding CC events would be serious for local fishers and their associations, as CC issues require not only dissemination of information, but also fundamental understanding of potential impacts and practical options for fishers to use to cope with these changes for the management of capture fisheries and development of aquaculture units (cages or ponds). It is already understood that CFis are poorly managed, therefore lack of adaptation to CC could add to this weak position and potentially lead to a disastrous situation for

	CFis in the future.
Enhance wild stocks versus management of existing stocks in the wild	Engagement with wild stock fish species enhancement is essential (as stated above for aquaculture), since fish biodiversity is likely to fall in CC scenarios, therefore species options may be required in the future from the broad genetic reserve of fish species existing today
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	IWRM is essential for both capture fisheries and aquaculture development in response to CC impacts. If water flows become highly erratic with temperature rises in water bodies, it will be essential that all water balances are addressed between users and issues including nutrient loads causing potential eutrophication and algal blooms. These issues combined with CC need to be managed and monitored in harmony with multiple activities in watersheds, as well as the application of appropriate CC adaptions for all parties. IWRM may also re-orientate the CAPFish programme to CC adaptation for the long-term. This alternative encompassing CC would mean a focus on appropriate species development for the future (following intense research on fish characteristics and adaptability), and potential development of artificial habitats including reservoirs and storage, foreseeing disease issues and developing gene banks for resistance and potential vaccines in advance for the fisheries sector. In addition, integrated resource management issues incorporating the role of fish with other foods, such as nutritional crops adapted for growth with CC, are prioritised. Effectively, CC and all components of CAPFish would be led by CC issues for fisheries and aquaculture, rather than the inverse.
Promote economic diversification versus only capture fishery activities	Diversification of activities for fishers associated with aquaculture and capture fisheries will be essential to respond to CC impacts as opportunities for livelihoods from purely fish may be limited, while diversification offers assurance, particularly for small-scale producers, in cases where fish production fails or is low during a specific year or season.
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	N.A.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

The key recommendations related to climate change and interactions are presented below:

- support need for more scientific research on the impact of changing hydrological regimes on fish species, especially economically important species like *trey riel,* as the science of climate change and the impacts on fish and fishers are largely uncertain
- develop early warning system led by MoE/Climate Change Department with MORAM including a regional map showing areas that are particularly vulnerable to losses/changes of fishing capacity and indirect impacts from climate change
- encourage sharing of innovate CC information and technologies for CC adaptation including funds for adaptation which are also accessible to local communes i.e. both downstream and upstream communication needs are put in place with results
- provide simple management and monitoring tools in collaboration with the CC Unit of FiA and with MoE for CC to participating communities (CFis) to help them to gauge the impacts/changes and needs for adaptation
- support clear and concrete village-level, principally CFis, adaptations to CC in relation to fish resources and the objectives associated with conservation and management of their fishery resources
- improve holistic planning between sectors including more dialogue with the forestry and agricultural sectors within MAFF and other key entry points such as MoI, MoE/NCCC, MOWRAM and MEM and their specific institutes or departments, as adaptive strategies need to be designed with a multi-sector perspective and integrate with other hazard reduction programmes.
- support line-ministries through established CC focal points and working groups associated with fisheries with fully assigned responsibilities This process has to go beyond to sub-national level local administrations, where again the responsibilities need to be clarified, and capacities built to develop and implement plans and actions in response to climate change
- CC adaptation action plans for species conservation will include a network of freshwater protected areas to provide refuges for important Cambodian fish populations. This process could involve NGOs focused on fisheries and aquatic environments, CFis and FiA through the CC Alliance (inter-ministerial) with the MoE and its CC activities. This initiative could benefit from CAPFish partnering with CC co-financing, such as CC funds and instruments
- support the capacity building of staff and the institutions regarding climate change including technical (CC and fishery specialists) and financial support for MAFF and FiA to meet targets and commitments to CCCSP in order to implement the MAFF and FiA climate change strategic plan
- develop with MAFF/FiA long-term adaption measures to conserve and retain water availability for fisheries and integrated into FiA's climate change strategic plan, such as:
  - rehabilitation of natural water system: the natural fish habitat i.e. lakes, reservoirs, and rivers need to be rehabilitated and conserved in order to collect and store the water for fisheries in response to climate change
  - construction of man-made water systems for water availability for fisheries and adaption to climate risks e.g. droughts, where artificial lakes and reservoirs are considered and constructed to increase fish habitats with fish production (see precautions in the baseline discussion above).

- blue carbon offsetting schemes and REDD+ are adopted and supported by CAPFish, such as planting and conservation of inundated forest/shrub land and mangroves could be a good opportunity from developments associated with the capture fisheries and aquaculture policy and programme. Entry points could be FiA/MAFF with MoE and its CC Department and potential local beneficiaries associated with forests (principally flooded forests and mangroves), but also upland forest to conserve and buffer watersheds linked to IWRM
- CAPFish could build upon programmes like the former FAO and the current USAID / WorldFish integrated systems combining fish refuges.

7.2.4 Key Issue 6: Unregulated fish and fry impact on fisheries

Rationale for the selection of the key issue

The rationale for unregulated fish and fry interactions is based upon the findings from the scoping study and composed of the following key points:

- unregulated imports of fish and fry arrive in the country on a daily basis, as Cambodia is already a significant transit country for products moving through the AEC region associated with principally Vietnam and Thailand. Cambodia is also a significant importer of seed and brood stock for aquaculture and live fish for human consumption. The principal risks are as follows:
  - introduction and translocation of potential invasive fish species disturbing natural aquatic habitats in Cambodia,
  - risks created by potential fish escaping from ponds and cages and their impacts on local species and the genetic integrity of wild stocks i.e. hybridisation
  - risks include some exotic fish species already present in collections in Cambodia as well as risks from populations in aquaculture cages and ponds could provoke transmittance of diseases affecting wild stocks with impacts upon aquatic biodiversity
  - disruption of aquatic habitats and ecosystems linked to live fish and fry imports.
- weak border controls linked to regulation of these imports and movements can only exacerbate or reinforce this key issue.

It is important to mention that the monitoring data for this key issue has to be established to assist with the clarification of this key issue. However, the risks associated with unregulated fish and fry trends have been confirmed by multiple stakeholders in the sector and reiterated by an aquatic biologist/geneticist from SCI-CAP during this SEA study.

Baseline

The key factors related to unregulated fish and fry concern exotics and invasive species and isolated populations often linked to aquaculture, and the risks associated from these fish regarding hybridisation and diseases. The reason for movement of fish and fry is due principally to a bottleneck for rural aquaculture development in Cambodia associated with the insufficient fish seed production capacity of hatcheries. This issue was underlined by several projects and studies including DFID and Danida, and USAID's Harvest project, which did not achieve its ambitions due to shortages of controlled fry from hatcheries in Cambodia.

The introduction of alien species can cause the extinction, near extinction or displacement of native species. Although some introduced species may provide principally food for the country as well as attractive collection fish, these exotics can cause serious reductions in

native biodiversity. This problem is more prevalent when there are already pressures on the biodiversity i.e. reduced heterogeneity. Some of these key exotic or alien species include those listed below, and also mentioned in the hybridisation sub-section, as follows:

- invasive species Ramora sp. or Sucker Fish from aquariums are likely to have disturbed Cambodian aquatic ecosystems
- exotic Pacum sp. from South America is also an invasive exotic and provokes problems in the natural environment.

Introduced fish species will often compete with native species for food and/or habitat or they may even prey on them. At present there is only limited knowledge of the detrimental effects of alien invasive species in Cambodia. There are also some activities in agriculture, forestry, and fisheries development which involve the intentional introduction of alien species. The listing known as Fish Base also lists 13 fish species which were introduced into the Cambodia over time, although higher numbers of 31 are reported by the NGO Wildlife Conservation Society (WCS). However, the homogeneity of some commercial species has been on-going for hundreds of years due to the interconnectivity of the countries and people in the region.

Interspecific hybridization of fish genetics occurs widely across a taxonomically diverse array of species. Multiple factors typically interact to affect the outcome of hybridization events. Some species have been historically isolated regarding their reproduction in Cambodia, due to principally the timing of spawning activities, preferences for different habitat, and associated courtship display, amongst other factors. Human activities including aquaculture through species introductions, with loss or alteration of habitats i.e. lower heterogeneity, were frequently implicated. Some of the key species which are judged to have had hybridisation impacts upon local fisheries in Cambodia until now (pers com. SCI-CAP) include the following:

- exotic species African Catfish *Clarius batrachus* from aquaculture units and has almost certainly been hybridising with native species
- invasive Tilapia sp. are likely hybridising and one of the most dominant species across the country.

With the likelihood of growing human impacts upon aquatic habitat and biodiversity from various developments including aquaculture in Cambodia, the expectation is that the frequency of interspecific hybridization in freshwater fishes is likely to increase over time.

According to UNIDO in 2015, biosafety involving indiscriminate import of larvae or fry for cultures without quarantine was and is an issue for Cambodia, which may grow in the future through the development of inland and coastal aquaculture. There are allegations that larvae or fry of foreign origin are being imported through the international borders with neighbouring countries including Thailand for aquaculture without going through any quarantine procedures. Therefore, these larvae or fry are a potential threat to spreading known, unknown and new viral and/or diseases to other fisheries related diseases. An outbreak of diseases for fish could severely affect both marine and inland fisheries resources, in particular for aquaculture units with dense populations of fish.

Diseases can spread from principally dense populations of fish in aquaculture units to wild freshwater fish species, and potentially to other units within inland systems, as well as between aquaculture units on the coast. Disease can be provoked by aquaculture (pers com. Scientific Capacity Development Initiative /SCI-CAP) and includes the following factors:

- lack of resilience in natural Cambodian fish populations to new diseases or strains from aquaculture stocks

- in-breeding and dispersion of fish into the wild from aquaculture
- isolated aquaculture fish populations get into the wild carrying diseases

It is also important to highlight that diseases are likely to augment in the future with CC and rising temperatures (see Section 5).

Regulatory framework

The key aspects of the institutional, policy and legal framework for unregulated fish and fry are the Law on Fisheries (2006), Sub-decree on Sanitary Inspection of Animals and Animal Products (2003), Strategic Planning Framework for Fisheries: 2010-2019, the Strategic Planning Framework for Fisheries: 2015– 2024, the National Biodiversity Strategic and Action Plan (2016), and the National Strategic Plan on Green Growth 2013-2030.

With regard to unregulated fish and fry, the Law on Fisheries (2006) is concerned with exotic species, diseases caused by imported species, and to promote the use of domestic species for aquaculture production. The Sub-decree on Sanitary Inspection of Animals and Animal Products (2003) controls animal sanitation and the origins of animal products to prevent the animal epidemics, and ensure animal and public health care and public health care. It also states that veterinary actions are required for the transit, importation and exportation of live fish products. These products are normally subject to animal sanitation and origin controls and the animal origin products across the Kingdom of Cambodia for all contagious routes for animal to animal and/or or animal to human or vice-versa disease transmissions.

Besides the Law on Fisheries (2006), the Fisheries Administration has no other regulations and policies for controlling products and fish quality, as well as the environments which might be harmed by aquaculture production. However this legislation may be reinforced since FiA drafted the National Strategic Plan for Aquaculture Development (NSPAD) for Cambodia until 2030 (2014) which focuses on quantity, quality and safety of aquaculture products meeting nutritional needs for the poor and increasing demand for high value fish products for national, regional and international markets. But the technical guidelines or norms for aquaculture practice to protect the environment has not been clearly mentioned in terms of species and culture technology

The Strategic Planning Framework for Fisheries 2010-2019 addresses exotic species introductions and the promotion of aquaculture production using domestic species. It supports the management and development of capture fisheries and ensures that fishery domains and associated resources are in a healthy and resilient condition and sustainably managed, and remain a healthy and valuable source of food for the country. To achieve these objectives, the Strategic Planning Framework for Fisheries: 2015– 2024 places an emphasis of concern upon fish diseases.

The National Biodiversity Strategic and Action Plan (2016) focuses on biodiversity's conservation and management and makes reference to unregulated fish and fry in Cambodia. This strategic document serves as a roadmap for supporting the environmental component on the country's sustainable development, and to use, protect and manage biodiversity for sustainable development in Cambodia including its fish species. Meanwhile, the National Strategic Plan on Green Growth 2013-2030 promotes the national economy with stable growth, reduction and prevention of environmental pollution, safe ecosystems, poverty reduction, and promotion of public health service, national resource management, and ensuring food safety, where unregulated fish and fry could be detrimental.

The border and importation authorities (Inspectorate) have allowed until now the importation of fry or larvae, as only an official explanation from the importer with supporting information from the exporter are required, according to UNIDO. If the authorities are satisfied, they authorize the importation. Only if something goes wrong such as the outbreak of a disease, will an import license be cancelled. However, this measure would effectively arrive too late.

Some NGOs associated with fisheries and aquaculture developments believe that there is need for a quarantine clause in the legal framework for importations of live fish for human consumption and/or aquaculture. This clause should also state the necessary institutional support required to fulfil the ambitions of such a clause. This quarantine process would have to be done in cooperation with the FiA and at appropriate levels the administration.

Meanwhile the control of potentially invasive species is very difficult. Firstly, it is inherently problematic to monitor populations of organisms that live underwater and only surface when caught in a fisherman's net, which could be an incident that usually goes unreported. In addition, it would be obvious that a species has established in an ecosystem, once it has already become quite numerous. This means that if invasive control action is taken, it is very difficult to gauge when a species is completely eradicated. It is also virtually impossible to reduce the numbers of the target invasive species without affecting other fish species as well.

Due to these issues any control programme would be a vast undertaking requiring a substantial amount of financial resources and could run a high risk of not succeeding. All of these factors make it difficult to find financial and political will for such an undertaking. However, it is important to minimize the risk of further introductions of exotic species into the Cambodian ecosystems. As there is an existing cultural preference for the growth of indigenous fish over exotic fish in natural waters and the potential to develop freshwater fish networks in the wild for native species, it may be relatively easy to implement restrictions on the raising of exotic species and finding local species suitable for aquaculture.

Institutional framework

The Minister of Agriculture, Forestry and Fisheries (MAFF) has responsibilities and duties to implement animal sanitation controls and identify the source of products. The Minister also has the authority to inspect the products through the Department of Production and Animal Husbandry and the Fisheries Administration (FiA) in relation to fish and fishery products. However the capacity and competency of FiA and staff is still restricted in terms of monitoring and laboratories for genetic problems, diseases, viruses and microbes or parasites. At present the fisheries laboratories are in the process of being equipped, although suitability qualified personnel including fish geneticists are limited in number or none existent, while there is no certification for the laboratories in country.

Finally there is a serious lack of human resources and staff that are educated and trained in fish genetics and diseases with laboratory skills. Meanwhile, most laboratories for fisheries and aquaculture are not well equipped with modern laboratory tools that can monitor or analyse genetics, diseases, microbes or parasites, and pollution issues.

Analysis

The key issues or sub-issues for the effects of unregulated fish and fry impact on fisheries are summarised and assessed according to their probability and impact, as follows:

Table 11 Key issues or sub-issues for the effects of unregulated fish and fry impact on fisheries

Issues & sub-issues	Probability	Impact	
		Intensity	Scale
Exotic species damages natural habitats and compete with native species	Average	High	Small to Medium
Hybridisation of isolated fish biodiversity reserves of native species	High	High	Small
Diseases are spread into the wild fish stocks from illicit fry imports and developing aquaculture fish sources	Average	Average	Medium

Analysis of alternatives

This section compares the issues or sub-issues for unregulated fish and fry impact on fisheries with certain aspects of alternatives for aquaculture and/or capture fisheries given in Section 3.2. The key findings from this analysis are presented below.

Aquaculture:

Alternatives	Analysis
Support to coastal/marine fisheries versus freshwater fisheries	Both freshwater or marine aquaculture could be affected seriously affected by unregulated fish and fry due principally to diseases. Meanwhile aquaculture itself and dense quantities of productive strains of fish for aquaculture are potential reserves for the spread of diseases into capture fishery populations. As the largest source of disease or genetic hybridization for fish is attached to freshwater fisheries, then this should be the priority target.
Support to intensive/commercial fisheries versus small scale fisheries	Support for intensive fish production in aquaculture has to seriously address the risks of diseases spreading from these aquaculture fish stocks to wild populations and other aquaculture units. Meanwhile support to smaller-scale units needs to also address fry and fish issues which could effectively reinforce the spread of potential diseases and conflicts over a much wider area for aquaculture fish populations. .
Support to specific species versus all species	Broad range of wild fish species are targeted as opposed to a few specific species is a good approach which could provide greater assurances for the future development of aquaculture in cases where some aquaculture species and varieties become too prone to new diseases. These chronic or worse acute outbreaks of diseases are risks posed by illicit fish and fry imports.

Capture fisheries:

Alternatives	Analysis
Support of CFis versus intensive/commercial fisheries	Lack of engagement with CFis in the future regarding unregulated fish and fry would only proliferate the current risks in the future for captive fisheries and potential growth in aquaculture. Options are to encourage the use and development of hatcheries by CFis.
Enhance wild stocks versus management of existing stocks in the wild	Engagement with wild stock fish species enhancement is essential (as stated above for aquaculture), since fish biodiversity in the wild is at high risk from illicit fish and fry imports due to diseases, competition and habitat damage and hybridisation issues. At the same time it would be important to avoid risks of hybridisation between farmed and wild stocks when using fingerlings or fish from hatcheries during an enhancement programme. However, as exotic species are well established in the wild, the programme could continue to develop better production from existing exotic and native species and accept the situation in Cambodia. This approach would allow the programme to focus its efforts upon production and development of all species with potential for capture fisheries and aquaculture without differentiating the importance of native species over exotics.
Apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries	N.A.
Promote economic diversification versus only capture fishery activities	CAPFish accepts the immediate weaknesses of production from hatcheries in Cambodia and focuses upon quality controlled imports of fish and fry through support of economic diversification of neighbouring countries in the ASEAN region for the production of regulated fish and fish fry. Cambodian fishers would gain regulated fish and fish fry, but also development opportunities attached to different rural economic activities encouraged by CAPFish with its partners, such as agriculture and industry, which could provide income in unison with fisheries.
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	N.A.

Recommendations

The recommendations are specific to the key issue in this section of the report. Meanwhile, recommendations in Section 8 of the SEA are based on this section, but orientated to performance indicators and technical assistance and equipment for CAPFish's capture fisheries and aquaculture sectors.

The key recommendations related to unregulated fish and fry are presented below:

- promote the creation of small private hatcheries in places closer to the fish farmers, diminishing the transport costs and the reliance on imports with entry points via FiA, IFReDI and NARDI
- assist the raising awareness about invasive species and encourage communities to report any new species encountered in their areas i.e. a simple form of "early-warning system", which is essential in preventing the spread of invasive species through target capture of exotics with new outbreaks. Key entry point would be CFis in collaboration with FiA
- implement restrictions on the raising of exotic species in aquaculture ponds within the maximum flooding zone of rivers, in order to reduce the risk of accidental introductions occurring orchestrated by MAFF
- risk assessment for all exotic fish in the aquarium and aquaculture trade regarding their possible impact on the aquatic ecosystems and existing stocks. Use this risk assessment as a decision making tool to impose restrictions on imports through MAFF supporting Customs
- capacity building of institutions and staff in genetics and disease risk to enhance and develop upon the lab work already established at IFReDI in terms of skills, materials, and financial resources to implement research and monitoring the unregulated fish and fry
- develop technical guidelines and norms for aquaculture practice to protect the environment, providing support to FiA extension officers and inspectors, and aquaculturalists.
- CAPFish support planning and design procedures for aquaculture production, which should be strictly zoned for pond and cage aquaculture, and follow the technical guidelines/norms for aquaculture practices. For example, the culture of exotic species may not be permitted.

8. Conclusions and recommendations

8.1 General conclusions

The general conclusions for the SEA are summarised in this section and presented below:

- FiA/MAFF is retro-fixing current CFis based upon reforms and statements from the past. Need to use lessons learnt to develop practical and working plans for the sustainable future of CFis, and fisheries and aquaculture in general. To assist this process of reform there are opportunities to enhance sustainability through both components of CAPFish.
- sustainability of fisheries in Cambodia is at risk from various pressures, mainly hydroelectric developments altering water availability and quality, agricultural developments (water pollution and land clearances, with potential to contaminate fish and also lead to eutrophication of water systems), deforestation (eliminating spawning grounds, increasing nutrient flows), reduced water availability for use in crop production (irrigation), and water pollution from point and non-point sources from domestic, agricultural and industrial sources, and unregulated fish and fry, which are all aggravated by climate change.
- policies are not transparent across all ministries in particular energy and mines which have or could have potentially conflicting interests for fisheries at national and local levels. Therefore, there is also an important need for policy dialogue, especially for issues requiring coordination of different sectoral authorities
- institutions are weak requiring capacity building and resources, in particular FiA, and more so at CFis levels where FiA is co-manager of poorly managed fishery resources. Most important decisions are made at high political levels, which can override laws and policies and undermine the relatively good sector policies, laws and general institutional structures. Responses to this dilemma require coordinated actions through various institutions and their respective stakeholders, as well as awareness and development of coping strategies and application of the regulatory framework by all the institutions.
- capture fisheries plays a major role in Cambodia which cannot be ignored compared to the smaller and developing potential from aquaculture, which need to evolve with other key sectors including crop production, alternative energy sources, and industry
- need for capacity building and research combined with M&E focusing on fish production dynamics, diseases, genetics and costs and benefits from various sectors and their impacts on resources i.e. principally water quality and seasonal qualities
- lack of planning with detailed mapping and zoning for the development of current capture fisheries and potential aquaculture production
- SPF's SEA is used to create an official Cambodian SEA for the sector for the benefit of fisheries development and other related sectors.

8.2 Recommendations for the formulation of the EU support programme to capture fisheries (CAPFish-Capture)

8.2.1 Introduction

The recommendations in this section of the SEA are based on recommendations from key issues in others section of report, although they are orientated in this section to performance indicators and technical assistance and equipment for CAPFish's capture fisheries sector.

Recommendations are provided in this section based upon the findings of the SEA to improve the environmental performance of the capture fisheries sector through the formulation of Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFish).

8.2.2 Performance indicators for CAPFish-Capture

The most pressing environmental concerns, or high to medium key issues from the SEA for the capture fisheries and aquaculture sectors, should be reflected in the performance indicators for the disbursement of variable tranches, in the case the programme is implement through budget support modality. It is recommended that the EC, within the context of the CAPFish-Capture programme places some importance upon the proposed performance indicators based upon the rationale given in Table 12.

Table 12: Performance indicators

Performance indicators	Rationale
Capacity building of CFis for good management of fisheries including success in protecting aquatic habitats. This could be measured using aquatic habitat cover indicators for all CFis. The aim would be to reduce the losses of habitat by 10% per annum from 2017 compared to previous annual losses. The entry point would include notably CFis and FiA with potential collaboration from NGOs focused on fish ecology (SCI-CAP) and limited remote sensing in Cambodia.	Natural habitats such as flooded forest and mangroves are essential for spawning grounds, nurseries and feeding areas for fish. Therefore the production of fisheries is dependent upon the protection of these key aquatic habitats.
Develop a list of all potential sites for refuges of native genetic stock by 2017 and increase the number of gazetted sites to protected refuges in freshwater systems by 5% /year from 2018 (% based on a feasible rate of change for an indicator and similar to realistic % targets for indicators in the ASDP, 2014-2018). Entry points would be FiA with NARDI.	Due to lack of production of fish fry from hatcheries many fry taken from wild or from other countries (wild or bred) with unregulated movements. Exotic species can compete in ecosystems with natives, destroy habitats and damage genetic stock through hybridisation and be the source of disease from isolated communities in aquaculture units. In addition these refuges are important adaptation measures in case of CC.

8.2.3 Technical assistance and equipment for environmental performance and policy needs

The contents of this section are based on the findings of the SEA and recommendations for capacity building in the institutions notably FiA, which will be evaluated during forthcoming mid-term and final reviews of CAPFish. It is important to note that this technical assistance and equipment is ultimately orientated to CFis to promote sustainability of the sector. This assistance should also support diversification of livelihoods as an adaptation strategy. Over they address key issues to reduce pressures and building resilience, such as safe havens for fish species and stocks. This assistance will also promote good practices and use of appropriate technologies in parallel with monitoring and enforcement. Therefore, it would be advantageous for the CAPFish programme to recruit technical expertise as follows:

- promoting inter-sector coordination addressing issues such as deforestation, agrochemicals and IWRM
- providing support to develop capacities of CFis on good management of fisheries
- development of policy dialogue to address issues related to energy and agriculture sectors, such as water allocations between sectors and forestry issues in water catchments
- technical researcher support with global partners for fish ladders for large dams and how they are addressed in EIAs and floodplain irrigation dams orchestrated by FiA with the Ministry of Energy in partnership with WorldFish and IFReDI from 2017
- expertise for best practice monitoring using international approaches for pollutants with appropriate lab equipment at 3 principal laboratories attached to FiA. It would be also important to create a national baseline for Cambodia to define standards, monitoring systems and develop capacities. This technical expertise would also support standards for pollutants and water quality with MoI and MOWRAM, respectively, from 2018
- monitoring expertise in genetics and disease control with appropriate lab equipment at 3 principal laboratories attached to FiA for unregulated fish and fry issues from 2018
- participatory monitoring training linked to a national monitoring system (to be established and mentioned above) providing simple techniques for socio-economic, physical and biological parameters with basic equipment and reporting mechanisms for agents and communities associated with aquaculture. This training could be done in partnership with SCI-CAP and similar bodies monitoring fish stocks from 2017
- technical support to assist the finalisation of the Law on Fisheries in 2017, and policies and strategies assistance for the development of improved and practical management of aquatic ecosystems and fisheries at CFis from 2018.

8.3 Recommendations for the implementation of the CAPFish – Aquaculture component

8.3.1 Introduction

The recommendations in this section of the SEA are based on recommendations from key issues in other sections of report, although they are orientated in this section to performance indicators and technical assistance and equipment for CAPFish's aquaculture sector.

Recommendations are provided in this section based upon the findings of the SEA to improve the environmental performance of aquaculture sector through the formulation of Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFish) – Aquaculture component.

8.3.2 Performance indicators for CAPFish – Aquaculture component

The most pressing environmental concerns or high to medium key issues from the SEA for the capture fisheries and aquaculture sectors should be reflected in the performance indicators for the disbursement of variable tranches. It is recommended that the EC, within the context of the CAPFish – Aquaculture component places some importance upon the proposed performance indicators based upon the rationale given in Table 13.

Table 13: Performance indicators

Performance indicators	Rationale
Contribute to food security and sustainable development through efficient feed formulations adapted to the range of aquaculture activities. Currently there is a dependency upon undersized/young fish known as 'trash fish' and imported feed. Increase the production of alternative and sustainable feeds in Cambodian factories by 10% per year from 2017 for a representative sample of producers in key CFis. This indicator will be reviewed during the mid-term and final evaluation of the programme.	Growth in aquaculture for both coastal and inland systems is currently highly dependent upon feed from undersized fish from capture fisheries in rivers and lakes in Cambodia or similar dried feed or mixes from neighbouring countries. This approach should normally contribute to the sustainable development of aquaculture.
IWRM schemes should be introduced and monitored to ascertain a baseline of water related conflicts, which should aim to reduce conflicts annually throughout the project from 2017 for a representative sample of producers in key CFis and involve local CFi committees, CSOs and subnational offices of FiA. This indicator will be reviewed during the mid-term and final evaluation of the programme.	This approach should ensure more sustainable, climate-resilient and inclusive growth in the aquaculture sector regarding water availability and climate change impacts for aquaculture.

8.3.3 Technical assistance and equipment for environmental performance and policy needs

The points below are based on the findings of the SEA and recommendations for capacity building in the institutions, notably FiA, and which will be evaluated during the mid-term and final reviews. It would be advantageous for the CAPFish – Aquaculture component to recruit technical expertise to support the following:

- technical support related to research for alternative feed production (excluding trash fish) including life cycle analysis and feasibility studies at all levels of the value chain in Cambodia and elsewhere from 2017 in association with FiA and NARDI
- participatory monitoring training specialist providing simple techniques for socio-economic (socio-economic/livelihood indicators), physical (water quality: oxygen levels and sediment/turbidity load indicators) and biological parameters (feed inputs and fish production as tonnes/annum indicators) with basic equipment for agents and households i.e. small-scale producers associated with aquaculture in partnership with FiA and NGOs such as SCI-CAP and similar bodies monitoring fish stocks from 2017
- good aquaculture practices from 2017 in Cambodia
- improving environmental management plans for aquaculture units in terms of water use, waste management and disease control, which is also linked to fish and fry stocks and the upgrading of fish hatcheries from 2018 through the private sector in collaboration with FiA, MoE, MIH and National Research and Aquaculture Development Institute

(NARDI). This improvement will include the enforcement of regulatory standards for aquaculture and raising capacities within aquaculture units

- development of an assessment of climate change risks for aquaculture at local and regional levels towards the development of policy and strategies concerning CC and its impacts upon aquaculture development in the future from 2018 in collaboration with FiA and MoE
- management support for the development and upgrading of fish hatcheries through FIA and NARDI from 2017 to provide nationally produced quality and disease free fry for the development of Cambodian aquaculture.

8.4 Recommendations for enhancement of the SPF / NADS policy framework

The key strategic document for fisheries and aquaculture is the Strategic Planning Framework for Fisheries (SPF) 2010-2024 and its Update 2015-2024. It is important to state that the SPF is an approved and finalised document. It is also integrated with the Agricultural Strategic Development Plan (ASDP) and the National Aquaculture Development Strategy Policy (NADS). Therefore, these recommendations only address potential ways for the EU with the GoC to enhance specific aspects of the SPF/NADS through on-going dialogue related to principally the development pillars and indicators, and some priority guiding development principles in relation to the SEA as follows:

- Pillar 1: capture fisheries and management by principally CFis is recognised to be very poor by some communities, technicians in government and scientists in particular. The production figures are likely to be far lower than statistics released by government according to anonymous sources in FiA. Thus CFis are fishing unsustainable stock, often small fish and juveniles, and therefore there is a need for better management of capture fisheries and aquaculture, and which are also interdependent as wild stocks are used as feed for aquaculture. The future of capture fisheries will be dependant upon enforcement of fish rules associated with overfishing using illegal nets and gear. In addition, fishing needs to respect the seasons and conservation areas for fishing in CFi zones. Enforcement of rules by FIA and CFi communities needs to be directly linked to the key indicators, such as the number of cases of rules being broken associated with gear, zones and fish size etc. These indicators need to monitored and measured with specific targets for each fishery across the country, to achieve the overall goal being good national fisheries management
- Pillar 2 (and NADS): aquaculture is not dominated by medium to large units, as a vast part of the production comes from smaller family fish farms, which use small fish or “trashfish” for production. The target of increasing production will have to look at conversion ratios for food and sources of feed for aquaculture to be environmentally friendly and not destroy wild fish stocks. Small units should be encourage to apply Good Aquaculture Practice as this will improve the quality of the fish and the environment they live in (habitat, water quality etc.), while there is a need for technical and human resource support to provide monitoring and training across the CFis and elsewhere. To achieve the goal of Good Aquaculture Practice requires regulations linked to international standards. These practices could be disseminated with the assistance of FiA extension services working with CFis and individual fishers
- Pillar 3: policy to improve value chains and production with sustainable livelihoods and food security needs to monitor the risks of creating higher prices, where local people and/or poorer consumers are forced to buy local quality and potentially toxic and cheap imports from neighbouring countries. Therefore there is a need to define a direct link between the policy to encourage good practice for aquaculture and good hygiene with national food security, as they are inseparable for the development of the industry
- Pillar 4: environmental management and sciences for sustainable development of fisheries and aquaculture need to be developed into training programmes at FiA with

environmental mangers overseeing the key issues in the SEA related to policy and regulatory services for CFIs and all other public domain water bodies. There is also an imperative need for these environmental managers to harmonise strategies for sustainable development, for example conflicts between crop production and irrigation and pesticides in local environments promoted in part by the ASDP

- building resistance for fisheries through adaptive planning principles means a greater role for all ministries to work together and avoid clashes for the national interest. There is a need to enhance the importance of fisheries of the nation in this long term resistance approach where other sectors such as energy from hydropower may have to realise the true consequences for a largely poor and agricultural society
- evidence based upon accountable principles points directly to poor or no data for the fisheries and environment sectors, which makes decision-making difficult within the legal and policy frameworks, as well as potential planning in the future,. Therefore aggregation of multiple sources of existing data combined with new monitoring schemes need to be established, whereby all ministries related directly or indirectly to the sector can benefit from shared databases
- operation principles for planning purposes need to enhance the functionality of FiA at national and local levels, where morale and purpose of staff at various levels has to be reviewed leading to training. This approach can be enhanced through capacity building at CFi level (cooperatives etc.) too in cooperation with the private sector and staff from FiA. Some levels and aspects of capacity building will benefit from technical advisors and researchers
- addressing coherence and aims amongst various ministries needs to enhance the importance of inter-ministerial committees and exchanges between ministries with a particular emphasis upon environmental management in particular for interacting sectors such as fish and water needs
- the viability and sustainability of ecosystems needs to be enhanced with monitoring and planning for fisheries and aquaculture with other sector
- legal rights for communities and individuals needs to be enhanced with research looking at alternative models for the management of principal CFis and the roles of individual members within community structures and their rights over resources as well as addressing where FiA has a role given their lack of management until now
- sustainability and costs and benefits of decisions in fisheries have to be accounted, likewise this approach has to be enhanced with comparative cost and benefits for other sectors such as water for hydropower compared to the long term losses from capture fisheries
- monitoring and evaluation need to emphasise the importance upon resource trends and adapt the process to feasible and practical solutions to achieve goals
- it is important to enhance financial resources from programme by using its leverage to attract co-financing bodies from bilateral and multilateral agencies, but also a need to encourage local taxation as early as possible from cooperative or private sectors in fishing to contribute to the management of the resources.

8.5 Summary and conclusions from analysis of alternatives for all key issues for CAPFish aquaculture and capture fisheries

The results in Table 14 show the key findings from the analysis of alternatives for CAPFish aquaculture and capture fisheries in relation to the key issues from the SEA. In parenthesis for each alternative against each key issue there is a positive (+ve) or negative (-ve) sign. These signs show whether the proposed alternative for aquaculture or capture fisheries would be beneficial or not.

The conclusion for alternatives and aquaculture are that all the alternatives are more negative. This is not to say that the alternatives could not bring about anything positive, but implies that the CAPFish programme's approach is already well orientated to the key issues and aquaculture regarding environmental sustainability and climate resilience.

The alternatives for capture fisheries and key issues appear to be positive for every alternative and the key issues. This positive position does not mean that the existing CAPFish approach is not appropriate; however, it does imply that the alternatives may be options to enhance the CAPFish approach.

The most positive for all key issues appears to be "support of CFis versus intensive/commercial fisheries" alternative. This alternative orientates the programme to CFis which are the most important organisation for fisheries and production in the country and will address key issues to enhance environmental sustainability and climate resilience.

The alternatives: "enhance wild stocks versus management of existing stocks in the wild", "apply integrated water resources management (IWRM) versus protection without IWRM for capture fisheries" and "promote economic diversification versus only capture fishery activities" appear to be the second most suitable for the improvement of CAPFish. Again, the use of these alternatives would add to the environmental sustainability and climate resilience of the programme through the key issues.

Finally the alternative "apply 'payments for ecosystem services' (PES) versus production without PES for capture fisheries" is similarly positive for most of the key issues and would add to the environmental sustainability and climate resilience of the programme.

Table 14: Summary of analysis of alternatives for all key issues

AQUACULTURE & KEY ISSUES						
Alternatives	**Hydropower & irrigation**	**Poor management of fisheries & livelihoods**	**Chemical & pollution risks**	**Deforestation**	**Climate change**	**Unregulated fish & fry**
Support to coastal/marine fisheries versus freshwater fisheries	Not recommended as focus on coast/marine areas could mask the issues. **(-ve)**	Freshwater CFIs are more important to assist in terms of scale compared to coast/marine fisheries. **(-ve)**	Focus on freshwater as fewer risks for coastal/marine fisheries. **(-ve)**	Important to focus on deforestation on both the coast (mangroves) and freshwater (flooded forests). **(-ve)**	Important to assist both sectors, although more effort needed for inland fisheries at higher risk. **(-ve)**	Freshwater fisheries are prioritised, as largest source of disease or genetic hybridisation. **(-ve)**
Support to intensive/commercial fisheries versus small scale fisheries	Impact could be worse for small-scale, so a need to assist vast numbers of small-scale units. **(-ve)**	Improve small-scale to enhance livelihoods (revenue and food) before intensive and commercial. **(-ve)**	Large scale could produce devastating pollution levels compared to small-scale. **(-ve)**	Integrated systems for both, although there should be priority for the vast number of smaller scale units. **(-ve)**	N.A.	Focus on smaller-scale units covering a much wider area for aquaculture fish populations **(-ve)**
Support to specific species versus all species	N.A.	N.A.	N.A.	Broad range of species is best within forest reserves/refuges. **(-ve)**	Broad range of species is targeted to spread risk factor from CC impacts. **(-ve)**	Broad range of species providing large genetic pool for fish will spread risk factor **(-ve)**
CAPTURE FISHERIES & KEY ISSUES						
Alternatives	**Hydropower & irrigation**	**Poor management of fisheries & livelihoods**	**Chemical & pollution risks**	**Deforestation**	**Climate change**	**Unregulated fish & fry**
Support of CFis versus intensive/commercial fisheries	Important to support CFIs, as already weak against other sectors. **(+ve)**	Important to focus on CFIs and their poor management. **(+ve)**	CFIs are means to sensitise large numbers of fishers towards good practices. **(+ve)**	Engagement with CFis could lead to reduction in deforestation. **(+ve)**	Lack of engagement with CFis could lead to greater impacts from CC. **(+ve)**	Lack of engagement with CFis would proliferate the risks from fish diseases and genetic hybridization. **(+ve)**
Enhance wild stocks versus management of existing stocks in the wild	Enhancement of some wild stocks demonstrates value of aquatic habitats and their water.	Enhancement is essential. **(+ve)**	N.A.	Wild stock enhancement promotes aquatic habitat needs and could reduce deforestation. **(+ve)**	Enhancement from a broad genetic stock is essential as fish biodiversity is likely to fall with CC. **(+ve)**	Enhancement is important, although this would require careful selection of wild species to avoid enhancement with hybrid stock or diseases. **(+ve)**
Apply integrated water resources management (IWRM) versus protection	IWRM is a sustainable compromise. **(+ve)**	IWRM can add value to fisheries and livelihoods. **(+ve)**	IWRM can encourage Integrated Pest Management (IPM)	IWRM would encourage protection of forests in fishery	IWRM could be a conduit towards long-term CC adaptation	N.A.

without IWRM for capture fisheries			approach. **(+ve)**	catchments. **(+ve)**	actions and planning. **(+ve)**	
Promote economic diversification versus only capture fishery activities	Diversity is a necessity if new hydropower is established. **(+ve)**	Diversification would be a good food security and production strategy. **(+ve)**	Diversification such as rich-fisheries would educate farmers-fishers to risks from crop pesticides. **(+ve)**	N.A.	Diversification is paramount as fishery activities may be limited by CC. **(+ve)**	Focus on other economic activities in Cambodia and import fry and fish from controlled foreign hatcheries. **(+ve)**
Apply "payments for ecosystem services" (PES) versus production without PES for capture fisheries	PES can add value to fisheries and their ecosystems. **(+ve)**	PES is positive for management and valuing. **(+ve)**	PES accounts for cost/benefits i.e. Pollutants Pay Principle, so beneficial. **(+ve)**	PES would provide values to upland forest, flooded forest and mangroves. **(+ve)**	N.A.	N.A.

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10. Technical appendices

Matrice Of Concerns And Issues

Concerns/Issues	Cohorts for parties expressing concerns				
	Govt	**Value chains**	**CSOs or NGOs**	**Research Bodies**	**Donors**
Socio-economic					
Illegal small foreign fishing boats, e.g. Vietnamese boats trawling shrimps, reducing quantities for local fishers and buyers		X	X		X
Illicit agreements for larger fishing vessels with senior officials		X	X		
Potential corruption between various authorities regarding activities of small-scale and illegal fishers (national and foreign) concerning fishing practices in zones and gear used		X	X		
Interest rates at banks are often too high for most people to borrow for the development of aquaculture		X			
Drought provoking poverty and disease for fishers and others	X		X	X	X
Lack of investment/wealth to pump water to ponds		X			
Pumping of water from rivers, lakes and fish conservation areas during the dry season for irrigation	X	X	X	X	X
Imports of foreign fish from neighbouring countries at lower prices leading to competition to develop fisheries and aquaculture in Cambodia		X			
No sustainable management plans attached to community fisheries – “tragedy of commons scenario”.	X	X	X	X	X
Biophysical					
Capture fish species used as fish feed to supply to aquaculture units in freshwater and marine environments	X	X	X	X	X
Wealthier community fishing members are illegally trawling in shallow waters damaging the ecosystem services and natural capital in these areas		X			
Droughts and El Niño Effect change/lower water levels and flows and provoke fish kill in all water bodies associated with	X			X	X

evaporation and lowering groundwater and water table in ponds reducing production of fish					
Hydropower and dams have major impacts on upper water flows, levels and pulses for principally white group fish	X			X	X
Loss of habitat and species due for land prospecting and fires e.g. inundated forests/shrub land, mangroves, impacts on sensitive flagship species e.g. river dolphin			X	X	
Risks for local species from illicit exotic species			X	X	
Risks for fish and humans from poisonous contaminants in feed, which may come from unregulated national producers or imports.	X				X
Institutional & others					
Lack of financing and resources for FiA to manage and monitor fisheries in the field	X				
Limited or no support from FiA for small fish farmers in Provinces		X			
Very few FiA agents are present in capture areas to control these sites		X			
Deleterious publicity for aquaculture in general from nature conservation bodies	X				
Inter-ministerial committees for some new sector laws/policies can be derisory if some ministries are slow or even stop progress for a sector. Poor inter-ministerial relations in some key areas	X				X

Attendance List

Consultation workshop for the scoping of Strategic Environmental Assessment (SEA) of the Fisheries policy and EU-support programme

Place: Cambodiana Hotel

Phnom Penh, Date: Oct,21-2016

No	Name	Sex	Organization	E-mail/Phone number
1	H.E. Eng Cheasan	M	FiA	012 915 567
2	Hav Viseth	M	FiA	012 977 567
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4	NOM SOPHEARITH	M	Particip/SEA	012 646 981
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6	Tin HEALV	M	Aquaculture	
7	Chan Danith	M	TWGF/FiA	ch.danith@gmail.com
8	JOFFERE OLIVIER	M	World Fish	011 318 797
9	CHHOUN CHAMNAN	M	FiA	017 353 363
10	Enic BHKAN	M	World Fish	012 449 703
11	Nicklas MACCSeN	M	NIKKS/FiA	087 333492
12	Choum Srey orm	F	FWKK	016 4488580
13	Thay Somony	M	FiA	012 829 971
14	Grovel Maric	F	AFD	
15	Watt Botvood	M	CNMC	
16	Ly Vuthy	M	FiA	089 343 025
17	Sok Phanna	M	FACT	095 671 672
18	Savan Pheakdey	M	WCW	012 475 121
19	T.S. SHETTY	M	UNIDO	
20	PEL Samnang	M	FiA	012 945 547
21	Thuch Panha	M	FiA	panha_tuch@yahoo.com
22	Sin Kang	M	UNIDO	

List of stakeholders consulted with their affiliation and contact details for the SEA

No.	Names	Title and Organisations	Interests	Date	Time
1	Mr. Aymeric ROUSSEL	EU-Attache Aymeric.ROUSSEL@eeas.europa.eu	Fisheries and EU-support programme	24/Nov/2016	9:30AM
2	Mr. Thay Somany	Director of Aquaculture Dept./FiA and EU-CapFish/Fisheries Focus Point 012 829 971 monyangkor@gmail.com	Fisheries and EU-support programme	24/Nov/2016	9:30AM
3	H.E. Hell Tony	General Directorate of Tonle Sap Authority/MOWRAM 012 883 783 h.tony75@gmail.com hell.tony@tonlesap.gov.kh	Deforestation, sedimentation, pollution, mining	24/Nov/2016	15:30 PM
4	Mr. Om Savath	FACT-Director 016 855 190 savath@fact.org.kh	Food security, poor management of fisheries, deforestation, pollution	25/Nov/2016	8:30 AM
5	Phay Somany	Conservation Manager/WWF 088 768 6868/017 81 83 82 somany.phay@wwfgreatermekong.org	Deforestation, sedimentation, pollution, mining, hydroelectric dams	25/Nov/2016	10:00 AM
6	Mr. Huong Sunthan	Director of Water Resource Management and Conservation/MOWRAM 011 659 437 huong_sunthan@yahoo.com	Water Management and Conservation	25/Nov/2016	14:00 PM
7	Ouk Vibol	Director of Fisheries Conservation Dept.,/FiA 012 908 121 ouk.vibol123@gmail.com	Fisheries Conservation-zoning and	Monday 28 November 2016	3:00PM

No.	Names	Title and Organisations	Interests	Date	Time
			mapping, species, and climate treats on fisheries		
8	Touch Bunthang	Fisheries/IFreDI 078 206 917 Bunthangtouch@yahoo.com	Food security and poor mgt. of fisheries	29/Nov/2016	10:00 AM
9	Chan Sokheng	Senior Researcher-Fisheries Biology/IFreDI 012 883 228 Chan_sokheng@yahoo.com	Unregulated fish and fry	29/Nov/2016	8:30 AM
10	Togo Uchida	JICA-Environmental Specialist uchida.togo@jica.go.jp	Unregulated fish and fry	29/Nov/2016	11:45 AM
11	Prum Phally	Director of Fish Seedling Production Station No1 012 916 575 Promphally1123@gmail.com	Seedling, fingerling production and supply	29/Nov/2016	3:00PM
12	Seng Bunra	CI-Country Director b.seng@conservation.org 023 214 627	Deforestation, sedimentation, hydroelectric dams	29/Nov/2016	Afternoon
13	Dr. Eric Baran	WordFish 012 449 703 E.Baran@cgiar.org	Fish biology and hydrology dam	30/Nov/2016	9:30 AM
14	Mr. Chan Danith	TWG-Fisheries/FiA 012 966 157 ch.danith@gmail.com	Fisheries Policy	30/Nov/2016	10:00AM
15	Ms. Nhim Sophea	Deputy Director of Hydrology and River Works-Water Quality Specialist/MOWRAM 012 524 925 nsophea@yahoo.com	Pollution, mining	30/Nov/2016	2:30PM
16	Pelle	Sci-CAP	Dams and	30/Nov/20	3:00PM

No.	Names	Title and Organisations	Interests	Date	Time
	Gatke	012 655 024 pgatke@gmail.com	deforestation issues	16	
17	Mr. Tek Vannara	Executive Director/NGO-Forum 012 793 489 vannara@ngoforum.org.kh	Pollution and mining	1/Dec/2016	9:00AM
18	Mr. Srey Vuthy	Director of Planning &Statistics Dept./MAFF 012 845 918 sreyvuthy.maff@gmail.com	Agricultural Policy	01/Dec/2016	11:00AM
19	Mr. Chan Sopha	Deputy Director General of Institute of Standard of Cambodia (ISC)/MIH 092 144 431 Sopha077@gmail.com	Pollution, mining	01/Dec/2016	2:00PM
20	Touch Sovanna	Director of Renewable Energy and Nuclear Dept../MME Touchsovanna168@gmail.com 017 856 927	Policy and Strategic Plan on Renewable Energy and Dam	02/Dec/2016	10:30AM
21	Etienne Careme	FAO-Operations Coordinator 092 339 684 Etienne.Careme@fao.org	Pollution, mining, and food security	02/Dec/2016	2:30PM
22	Dr. Kao Sochivi	Deputy Director General/FiA 012 202 805 kaosochivi@yahoo.com	Climate Change	02/Dec/2016	4:00PM
23	Ms. Kaing Khim	Deputy Director General/FiA 017 988 911 kaingkhim@online.com.kh	Fisheries policy, food security and poor management of fisheries	05/Dec/2016	9:30AM
24	H.E Kol Vatana	Deputy Directorate of CNMC/MoWRAM 012 578 338 088 8575 798 vathanakol@gmail.com	Hydrology, hydropower dam, mining and	05/Dec/2016	11:00AM

No.	Names	Title and Organisations	Interests	Date	Time
25	Sum Thy	Director of Climate Change Dept.,/MoE 016 907 764 097 790 7764 cceap@online.com.kh	Climate Change Strategic Plan and Policy	06/Dec/2016	8:00AM
26	Mr. Thay Somany	Director of Aquaculture Dept./FiA 012 829 971 monyangkor@gmail.com	Fisheries Policy-Aquaculture (including unregulated fish and fry)	06/Dec/2016	2:PM
27	Mr. David Ashwell	MoE/EU Consultant 012 819115 david@ecosystems.info	Deforestation and conservation	6/Dec/2016	12:00
28	Mr. Richard Stanger	President of Cambodian Association for Mining and Exploration Companies (CAMEC) 012 846 946/ 015 846 946 richardstanger@libminco.com	Mining	06/Dec/2016	5:00PM
29	Mr. Hong Khemhean	Forestry Administration 012 927 896	Deforestation, sedimentation	07/Dec/2016	Afternoon
30	Mr. Kong Khimsreng	Director of Terrestrial Protected Area Conservation 012 888 847 kksreng@gmail.com	Deforestation, sedimentation	07/Dec/2016	10:AM
31	Mr. Jeff Silverman,	Senior Technical Advisor/WCS Phone: 012 807 455 and emial: jsilverman@wcs.org	Deforestation, sedimentation	07/Dec/2016	PM
32	Mr. Yeang Donal,	REDD+ Technical Adviser/WCS Phone: 012 300 921 and email: dyeang@wcs.org	Deforestation, sedimentation	07/Dec/2016	PM
33	Mr Kimhean Hong	Forestry Administration Kimhean-hong@hotmail.com	Deforestation, sedimentation	08/Dec/2016	10:AM