United Nations Development Programme
Government of Egypt
Project Document

3748: Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management

Ministry of Water Resources and Irrigation,
Coastal Research Institute, the Egyptian Shore Protection Authority

Brief description

The dominant feature of Egypt's Northern Costal Zone is the low lying delta of the River Nile, with its large cities, industry, agriculture and tourism. The Delta and the narrow valley of the Nile comprise 5.5% of the total area of Egypt but over 95% of its people of which 25% live in the Low Elevation Coastal Zone (LECZ) areas. Due to the concentration of much of Egypt's infrastructure and development along the low coastal lands and the reliance on the Nile delta for prime agricultural land, coastal inundation or saline intrusion caused by anthropogenic climate change induced sea-level rise will have a direct and critical impact on Egypt's entire economy. In addition to the current trends, Egypt's Mediterranean coast and the Nile Delta have been identified as highly vulnerable to climate change induced Sea Level Rise (SLR). The proposed project aims to integrate the management of SLR risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta by strengthening the regulatory framework and institutional capacity to improve resilience of coastal settlements and development infrastructure, implement innovative and environmentally friendly measures that facilitate/promote adaptation in the Nile Delta, and establish a monitoring and assessment framework and knowledge management systems on adaptation.

United Nations Development Programme
Country: Egypt
Project Document

UNDAF Outcome(s): Regional human development disparities are reduced, including reducing the gender gap, and environmental sustainability improved.

Expected CP Outcome(s): Sustainable Management of environment and natural resources incorporated into poverty reduction strategies/key national development frameworks and sector strategies.

Expected CPAP Output(s): Enhanced capacity of central and local government to integrate sustainable development and environmental and natural resources management into national development frameworks and sector strategies

Implementing partner: Ministry of Water Resources and Irrigation

Responsible Parties: UNDP, Coastal Research Institute and Shore Protection Agency

Programme Period:	2009 - 2014
CPAP Programme Component:	Energy and Environment for Sustainable Development
Project Title:	Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management
Atlas Award ID:	00071359 **PIMS 3748**
Start date:	2009
End Date:	2014
PAC Meeting Date:	October 11, 2009

Total resources required	$16,838,060
Total allocated resources:	$16,838,060
• Regular	$200,000
• Other:	
- Global Environment Facility:	$4,000,000
- Government (parallel funding):	$8,000,000
In-kind Contributions:	
- Government	$4,000,000
- IDRC/DFID	$638,060

Agreed by:	**Name/Title**	**Date**	**Signature**
Executing Agency:	**H.E. Dr. Mohamed Nasr Allam, Minister, Ministry of Water Resources and Irrigation**		
Government:	**H.E. Amb. Bassem Khalil, Deputy Assistant Foreign Minister and Director of International Cooperation, Ministry of Foreign Affairs**		
UNDP	**Mr. Mounir Tabet, Country Director**		

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Acronyms

ALM	Adaptation Learning Mechanism
CC	Climate change
CCA	Common Country Assessment
CCRMP	Climate Change Risk Management Program
COP	Conference of the Parties
CoRI	Coastal Research Institute
CP	Country Programme
CZMC	Coastal Zone Management Committee
EEAA	Egyptian Environmental Affairs Agency
EHDR	Egypt Human Development Report
EIA	Environmental Impact Assessment
ESPA	Egyptian Shore Protection Authority
GCM	Global circulation models
GDP	Gross Domestic Product
GEF	Global Environment Facility
HDI	Human Development Index
ICZM	Integrated coastal zone management
INC	Initial national communication (to the UNFCCC)
IPS	Integrated Package of Services
IPCC	Intergovernmental Panel on Climate Change
Km	kilometer
km^2	square kilometer
LECZ	Low Elevation Coastal Zone
MAP	Mediterranean Action Plan
MDG	Millennium Development Goals
M&E	Monitoring & Evaluation
Mm	millimeter
MR	managed retreat
MWRI	Ministry of Water Resources and Irrigation
NAPCC	National Action Plan on Climate Change
NCICZM	National Committee for Integrated Coastal Zone Management
NCSA	National Capacity Self-Assessment
NDI	Nile Delta Initiative
NEAP	National Environmental Action Plan
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration (USA)
NWRC	National Water Research Center
OECD	Organization for Economic Co-operation and Development
PAP/RAC	Priority Actions Programme Regional Activity Centre
PMU	Project Management Unit
RRF	Results and Resource Framework
RSLR	Relative sea level rise
SCCF	Special Climate Change Fund
SLR	Sea level rise
SMAP	Short and Medium-term Priority Environmental Action Programme
SNC	Second National Communication
UK	United Kingdom
UNDP	United Nations Development Programme
UNDP-GEF	United Nations Development Programme/Global Environment Facility
UNEP	United Nations Environment Programme
UNDAF	United Nations Development Assistance Framework
UNFCCC	UN Framework Convention on Climate Change

SECTION I: Elaboration of the Narrative

PART I: Situation Analysis

1. The dominant feature of Egypt's Northern Coastal Zone is the low lying delta of the River Nile. One of the most certain consequences of global warming is a rise in mean sea level. As a result, coastal zones are regarded as one of the most vulnerable areas to climate change. The IPCC's Fourth Assessment Report (2007), posits an upper boundary for global sea-level rise by 2100 of 0.59 centimeters but that does not include ice-sheet dynamics. In the nearest term of coming decade 3.3% of total land area of the Nile Delta will be lost to the sea that includes submersion of approximately 16 km^2 of valuable currently cultivated land in the absence of adaptive action.(CoRI, 2009). In addition to the relative sea level rise (RSLR) and current subsidence trends, Egypt's Mediterranean coast and the Nile Delta have been identified as highly vulnerable to abrupt SLR, which is considered to be due to climate change.

2. The Nile Delta's coastal lagoons, or Lakes as they are sometimes referred to, are key ecosystems that act as a protective zone for inland economic activities. Lake Manzala, Burullus, Idku, and Maryut, however, are only separated from the Mediterranean by 0.5- 3km wide eroding and retreating sand belt and dune system. Rising seas would destroy parts of the protective offshore sand belt, which has already been weakened by reduced sediment flows after the construction of the Aswan Dam in 1964. The sediment belt protects the lagoons and low-lying reclaimed land. Without this sediment belt, water quality in coastal freshwater lagoons will be altered, groundwater will be salted and recreational tourism and beach facilities will be inundated.

3. The goal of the project is to enhance Egypt's resilience and reduce vulnerability to Climate Change impacts. The objective of the proposed projects is to integrate the management of sea level rise risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta by taking an "adaptive capacity approach" for both human and natural systems.

4. The project will have three major outcomes. First, the regulatory framework and institutional capacity to improve resilience of coastal settlements and infrastructure will be strengthened. Second, strategies and measures that facilitate adaptation to climate change impacts, with sea level rise (SLR) in particular, will be implemented in vulnerable coastal areas in the Nile Delta. And third, monitoring/assessment frameworks and knowledge management systems will be established to facilitate adaptive management in the face of unfolding climate change impacts.

5. The first and third major outcomes target the adaptive capacity of the institutions responsible for coastal zone management. The second outcome targets the implementation of proactive adaptation measures to enhance the resilience and adaptive capacity of coastal lagoons in the Nile Delta that are both highly productive and particularly vulnerable to future sea level rise and have been identified through stakeholder processes as environmental hotspots and priority areas for adaptation. The second outcome will be achieved through installation of a set of innovative shoreline protection strategies modeled after the "Living Shorelines Approach" in the Idku, Burullus, and Manzala coastal lagoons. The third outcome will capture key lessons and transfer through various national and international platforms for further replication of good practices and scaling up.

Country Context

6. Egypt is located in northern Africa, bordering the Mediterranean Sea between Libya and Gaza strip, and shares its southern border with Sudan. The country has a total area of more than 1 million km^2, but the populated area only reaches 78,990 km^2, representing 7.8% of the total area. The coastline extends for 3,500 kilometers, facing the Mediterranean Sea in the north, and the Red Sea in the east. The coastal zone of Egypt is situated at the northern margin of the large hot and dry sub-tropical desert area of the Sahara and the Arabian Deserts.

7. The dominant feature of the northern coastal zone is the low lying delta of the River Nile, with its large cities, industry, flourishing agriculture and tourism. The delta and the narrow valley of

the Nile comprise only 5.5% of Egypt's total area, but over 95% of its people and its agriculture. With the exception of small areas of cultivated land in the oases of the western desert, the coastlands west of the delta, and in Northern Sinai, the rest of Egypt is desert.

8. According to the 2006 Central Agency for Public Mobilization and Statistics (CPAMS) census figures, the population, (including those living abroad), is estimated to have reached 76.5 million at a growth rate of 37% over the 1996 figure of 59.3 million. United Nations projections indicate that the population will continue to grow to 95.6 million by 2026 and 114.8 million before it stabilizes in 2065. Population in urban areas increased by 40 % and is now at nearly 31 million people, and rural populations grew by 64% to roughly 41.6 million people. The rate of unemployment is estimated at 9.31%. CPAMS also estimates, in 2007, that 12 million people or ~16% of Egypt's population live in slum communities. UNSTATS (2000) also estimates that 17% of the population lives below the national poverty line.

Project area context: Egypt's Northern Coast

9. The Nile Delta is 100 miles long and 155 miles wide, with a coastline facing open water of about 1500 km to west and North West, 500 km across to Turkey in the North and 250 to 500 km in north-easterly directions. The western 50 km of the area, to the West from Al-Dikheila, is a part of a long curved sandy coast which starts near Al-Alamein. The adjacent 30 km, with the harbors and the city of Alexandria, between Al-Dikheila and Ras Abu Quir, are rocky. Parallel calcareous ridges form the high coastal zone to the West from Ras Abu Quir. The low sandy coast of the Nile Delta stretches with an arc between Ras Abu Quir and the Bay of Tinah, east from the Suez Canal. Two branches of the Nile have formed the promontories at Rosetta and Damietta; Cape Burullus and the Port Said area are other protruding parts of the Delta coast.

10. The northern part of the coastal delta zone is the site of Egypt's second largest city, Alexandria, with a population of 2.9 million in 1986, 3.3 million in 1996, and more than 4.1 million in 2006 (CAPMS 2006 Census). Alexandria is the main harbor of Egypt and has around 40% of the country's industrial capacity, in addition to being an important summer resort location. Other large cities in the northern, low-lying delta zone include the rapidly growing city of Damietta, and the old-established city of Rachid (Rosetta). Port Said and Suez are important regional and trading centers on the Suez Canal.

11. The Egyptian coastal lagoons are among the most productive natural systems in Egypt and they are internationally renowned for their abundant bird life. However, the northern part of the Nile delta, where the lagoons are located, is subject to severe coastal erosion and threatened by future sea level rise. Expected impacts of SLR on the Egyptian coastal lagoons include saline sea water intrusion farther into the northern delta, disappearance of weed swamps, adverse impacts on infrastructure facilities directly exposed to the sea, and reduction in fishery yields.

Development context: development indicators, economic growth, key economic sectors

12. Economic conditions in Egypt have improved considerably over the years. In 1990-/91, real GDP growth rate was 3.7%. By the end of fiscal year 1998, the growth rate reached 5%, fueled primarily by private sector investment through continued rapid privatization and institution building (Egypt INC). Results of the economic and financial performance indicated a great improvement during FY 2006/2007 and first quarter of FY 2007/2008. Egypt's economy achieved a growth rate of 7.1% which is the highest growth rate in the preceding 10-year period. However, despite these patterns, the failure to raise living standards for the average Egyptian has led to continued government subsidies for basic necessities and, consequently, sizeable budget deficit - roughly 7% of GDP in 2007-08 - a significant drain on the national economy.

13. Egypt's Human Development Report (2004) reports a positive response to concerted efforts by the GOE to reduce two major gaps: 1) the gender gap and 2) the gap between Lower and Upper Egypt. The gender gap reduction is clearly reflected in improvements in the education index; however, deficits in political empowerment and in economic participation still persist. The gap in Human Development Index (HDI) values between Lower Egypt and Upper Egypt remains

very large but has also started to narrow throughout the last decade. Key indicators of the HDI show progress between 1990 and 2002-including: increases in the national literacy Rate % (15+), the Basic and Secondary Education Enrollment Ratio, and Per Capita Income (US $ PPP); and decreases in infant mortality, under-five child mortality and maternal mortality. The question remains whether or not these improvement trickles down to close the gender gaps and the regional disparities mentioned previously.

14. The tourism, industry, agriculture, and service sectors are significant contributors to Egypt's economy. Tourism currently represents 11.3% of GDP, 40% of the total Egypt's non-commodity exports and 19.3% of Egypt's foreign currency revenues. The industrial sector's contribution to the GDP in 2006/07 was around 17.2%. The agriculture sector accounts for roughly 14.8 % of GDP. Also, agriculture contributes about 30% to Egypt's commodity exports, which makes it a major revenue-generator. And, of Egypt's overall labor force, 30% works in the agricultural sector, mostly in the Nile Delta.

15. An important aim of Egypt's development planning is economic, social and political transformation while safeguarding natural resources and ecological balance (EHDR 2005). Parts of these plans include major investments in coastal tourism infrastructure as a means for encouraging sustainable income generation from this sector. Clearly, any hopes for increases in this sector will need to ensure that climate change risks to planned infrastructure projects are adequately accounted for in such plans.

Climate change context

16. Egypt's climate is semi-desert characterized by hot dry summers and moderate winters. The sun shines during 60% (winter) and almost 90% (summer) of the astronomical window. The country has particularly good wind regimes with excellent sites along the Red Sea and Mediterranean coasts. Wind regimes are out of the NW with mean speeds slightly varying during the year. Air pressure and sea water temperature correlate well with the seasonal variation of the mean sea level over a range of 0.17 to 0.19 m.

17. Summer temperatures are extremely high, reaching 38°C to 43°C with extremes of 49°C in the southern and western deserts while the Mediterranean coast has cooler conditions with a high of 32°C. Egypt has experienced rising air temperatures in recent years with the main contributor due to the increase in nighttime temperatures which have been rising at higher rates than other daily periods. This upward trend has culminated in increase of +0.05 ˚C / year over the western part of Delta near the Mediterranean coast.

18. Egypt has one major source of water supply, the River Nile, which supplies over 95% of annual water needs. There is very little rainfall though there is some winter rain in the delta and along the Mediterranean coast, west of the delta. Mean annual rainfall is estimated at 18 mm/year, ranging from 0 mm/year in the desert to 200 mm/year in the northern delta region. Non-renewable underground fossil water supplies are accessible outside the Nile River valley, especially in the scattered oases. Consequently, agricultural development is closely linked to the River Nile and its management.

19. Given Egypt's growing population, its limited fertile land, its large desert areas, and the concentration of economic activities in coastal zones, the potential social and economic impact of climate change could be quite serious for the country's future. The most recent study of IPCC (2007) indicates that temperature might change with ranges between 1.8 °C to 4.0 °C by the year 2100. Studies (Wilson and Hansen, 1994), found on temperature trends over sub-regions show that there has been an average rise in surface air temperature by about +0.5°C in the period 1880-1940. This rise was followed by a fall of order –0.2 °C in the period 1940-1965. From 1965 to 1993, the temperature of the globe increased by +0.5 °C. In coming decades minimum temperatures will markedly increase over Egypt. An upward trend will cover most parts of Egypt except over a small area in Middle Egypt. The upward trend will culminate in increases of +0.1 ^{0}C / year over southern parts of Upper Egypt.

20. Notably, the climate in Egypt has been changing in phase with these global patterns, although with lower rates of variation. There is a downward trend in maximum temperature over the delta, over the northern part of Upper Egypt and over the extreme south of Upper Egypt. This downward trend has ranged from -0.02 ˚C to -0.06 ˚C / year. Minimum temperatures have markedly increased over Egypt. An upward trend has covered most parts of Egypt except over a small area in Middle Egypt. The upward trend has culminated in increases of +0.1 ˚C / year over southern parts of Upper Egypt.

Sea Level Rise in the Northern Coast

21. The dominant feature of Egypt's Northern Coastal Zone is the low lying delta of the River Nile. In addition to the relative sea level rise (RSLR) and subsidence current trends, Egypt's Mediterranean coast and the Nile Delta have been identified as highly vulnerable to abrupt SLR, which is considered to be due to climate change. In 1992, a study by Delft Hydraulics/CORI showed that a 0.3 meter rise of mean seal level would be sufficient to increase the frequency of flooding from the then-current estimate of a flood every ten years to ten floods per year. Several subsequent studies on the vulnerability of Alexandria, the second largest city in Egypt, indicated that a 0.3 meter SLR would inundate large parts of the city resulting in including damage to infrastructure worth billions of dollars, displacement of over half a million inhabitants, and a loss of about 70,000 jobs (Firhy et al, 1997, El-Raey et al 1999, El-Raey, 2004). Such concerns about future SLR are well-reflected in Egypt's Initial National Communication (GOE, 1999).

22. Observations confirm that sea-levels are already rising in the Nile delta due to a combination of factors including coastal subsidence and reduced sediment loads due to the construction of the High Aswan Dam upstream. Several researchers have shown that more than two thirds of the world's sandy coastlines have retreated during the last few decades, and only 10% have progressed (Gornitz, 1995; Misdrop, et al. (1991); Pennekamp, et al. (1992) and Claudio, (2005)). The projected impacts of SLR on the Nile delta such as coastal inundation or saline intrusion are consistent with the results of global vulnerability assessments of coastal areas. Land subsidence in the Delta is currently estimated at 1-5 mm/year (Emery et al., 1988; El Fishawi and Fanos, 1989).

23. Of particular concern are future impacts of increased flooding frequency, inundation of coastal areas, and saltwater intrusion to the groundwater table. OECD (2004) summarized and ranked the key climate change impacts and vulnerabilities in Egypt for sectors important to the national economy. The socio-economic impacts associated with saline intrusion and inundation are far-reaching and include migration, unemployment and possibly political unrest. The risks to the coastal zone are ranked 'most serious':

Table 1. Ranked the key climate change impacts and vulnerabilities in Egypt

– Resource/ risk ranking	– Certainty of impact	– Timing of impact	– Severity of impact	– Importance of resource
Coastal resources	High-medium	Medium-low	High	High
Water resources	Medium	Medium	High	High+
Agriculture (indirect impacts - mediated by sea level rise and water resource)	High-medium	Medium-low	High-Medium	High-medium
Agriculture (direct impacts-temperature, rainfall)	Low	Medium-low	Low	High-medium
Energy resources	Medium-low	Medium-low	Medium-low	Medium-low

24. The World Bank (2005) also highlights the present coastal erosion and retreat of the Delta, which are aggravated by human interventions such as reduced sediment input, groundwater extraction, and hard engineering work in coastal strip. Post-installation of Aswan Dam, for example, the delta coastline eroded much faster; the sea began encroaching upon low-lying areas of the delta; fertile silt no longer reached the delta; salt content of cultivated land rose; fish stocks in the lakes declined because of decreased nutrients reaching the coast; and water hyacinths choked canals and waterways. SLR will adversely impact weak parts of protective

sand belts, which are essential for the protection of coastal lagoons and low-lying reclaimed lands. While dykes and other "hard" coastal protection structures could possibly prevent the worst flooding up to a 50 cm sea level rise, coastal areas would still be subject to serious groundwater salinization and the impact of increasing wave action.

Underlying causes of current vulnerabilities and future risks

25. Egypt's large and densely packed population along the Nile Delta combined with current serious coastal erosion makes this region particularly vulnerable to climate change. The Delta and the narrow valley of the Nile comprise 5.5% of the area of Egypt but over 95% of its people of which 25% live in the Low Elevation Coastal Zone (LECZ) areas. Within the coastal areas of the Nile Delta are 30-40% of Egypt's agricultural production, half of Egypt's industrial production, and large urban population centers (mainly Alexandria, Damietta and Port Said).

26. Due to the concentration of much of Egypt's population, industry, agriculture and tourism infrastructure and development along the low coastal lands and the reliance on the Nile delta for prime agricultural land, climate change induced sea-level rise will have a direct and critical impact on Egypt's entire economy. To meet development requirements, poorly planned internal migration has led to high urban unemployment rates, and new, ad-hoc livelihoods strategies. Sporadic development has also contributed to the loss of local population's traditional knowledge and ethics, and undermined social networks that would otherwise contribute to the general population's capacity to adapt to climate change (Borhan, 2009). Approximately 15% of Egypt's GDP is generated from low-elevation coastal zones (World Bank, 2005) making the region economically vulnerable to sea level rise (SLR) associated with climate change.

27. Approximately 60% of Egypt's annual fish catch are from three main Delta lagoons, namely Idku, Burullus and Manzalla. Fishing is mainly done by trammel net and various primitive methods (e.g. catching by hand and collecting fishes under vegetation using a cone-shaped net). Aquaculture is the largest single source of fish supply in Egypt accounting for almost 51 percent of the total fish production of the country with over 98 percent produced from privately owned farms; most aquaculture activities are located in the Nile Delta Region with fish farms usually found clustered in the areas surrounding the four Delta lagoons. Fish hatcheries are also generally located in the vicinity of the fish farms. Pollution, reclamation, fragmentation, overfishing and illegal harvesting of fish fry are the major environmental issues threatening the fragile ecosystem of the northern lagoons.

28. Fisheries in these lagoons are already stressed due to overfishing, the use of illegal fishing methods, and fertilizer-based pollution from agricultural land runoff. Impact assessments of climate change on these lakes point to saline seawater intrusion- effectively altering the composition of lake ecosystems- as well as changes in lake boundaries, replacement of weed swamps with salt marshes and overall deterioration of water quality. Additional factors that contribute to the region's vulnerability are related to the fact that, despite intensive cultivation of the Nile Delta, Egypt does not currently produce enough food to feed its current population. With climate change, studies indicate that there will be decreases in wheat and maize annual yields (INC, 1999), resulting in an increased reliance on costly food imports to sustain its population.

29. Additional factors that contribute to the region's vulnerability are related to the importance of agriculture in the vicinity of the coastal lagoons. Agriculture contributes 17% of the country's GDP and is the largest source of employment, constituting 30% of the labor force. About three-fifths of the country's agricultural production is in the low-lying delta in close proximity to the Idku, Burullus and Manzalla lagoons (Agrawala, et al., 2004)[1]. Additionally, Egypt does not produce enough food to feed its current population. Its water resources are rather limited. Any loss of prime agricultural land in the Delta due to coastal inundation or to saline intrusion will

[1] Agrawala, et al. (2004). Development And Climate Change In Egypt: Focus On Coastal Resources And The Nile. OECD.

therefore have a direct impact on the livelihoods of nearly 30% of the labor force and negatively affect the national economy (Agrawala, et al., 2004).

Current adaptive capacity and key gaps and barriers:

30. The GOE began addressing coastal zone management issues in 1992, but, the proper addressing of Integrated Coastal Zone Management (ICZM) began in 1996 through issuing the Framework of ICZM by the Egyptian Environmental Affairs Agency (EEAA). The recent growing awareness of existing and potential coastal problems has been manifested in a number of legislative and institutional developments designed to improve adaptive capacity and enhance resilience of both coastal communities and institutions responsible for management coastal resource.

31. The Law for the Environment (Law No 4 for the year 1994) regulated protection of the marine environment; mandated environmental impact assessment (EIA) for any new project, authorized construction of coastal structures to protect some vulnerable coastal areas from erosion; established environmental monitoring networks; facilitated management and supervision of natural protectorates; called for integrated coastal zone management (ICZM); and established a Coastal Zone Management Committee (CZMC) for the proper management and coordination among concerned authorities (El-Raey, 2004). As the law establishes the Secretariat of this Committee under the Environment Management Sector of the EEAA, EEAA has the authority to engage with the concerned agencies and ministries in the preparation of a National Integrated Coastal Zone Management Plan for Egypt's Coastal Zone.

32. A subsequent important planning protocol was the development of the National Framework Toward Integrated Coastal Zone Management Planning in 1996. This framework was drafted by EEAA in collaboration with DANIDA and adopted by the steering National Coastal Zone Management Committee in the same year. This document provided a strategy for developing overall short-, medium- and long-term planning requirements. Accounting for the large differences in the nature of the challenges facing the range of coastal regions, the initial framework identified four national priorities that were relevant to each, namely shoreline protection, coastal land use, coastal marine water quality and marine resource preservation.

33. The following ministries and agencies, funded by the Government of Egypt (GoE) are responsible for coastal protection and management and engaged in the ICZM planning process are noted in the Table below. For some Ministries their annual funding levels in 2007 are denoted.

Table 2. GOE ministries and agencies having coastal protection responsibilities

Government Agency	Funding/ Investment level in 2007 (US$)	Institutional coastal protection and management mandate
The Ministry of Water Resources and Irrigation: Shore Protection Authority (SPA)	**10,700,000**	Responsible for managing the shoreline in coastal areas that have socioeconomic value or natural resource value that are threatened by erosion. It develops coastal zone management plans, designs projects for shore protection and all studies for shore protection, and issues license for projects located in the coastal zone area.
The Ministry of Water Resources and Irrigation: Coastal Research Institute (CoRI)	**500,000**	Responsible for investigating the coastal process along the Nile Delta as well as all the entire Egyptian coasts; monitor the evolution of the Egyptian coast, to study the dynamics of its shores and to find out efficient and cost-effective control methods to protect valuable coastal infrastructure from erosion.
The Egyptian Environmental Affairs Agency	-	According to Law No 4 for the year 1994, EEAA was given specifically the authority to .participate with the concerned agencies and ministries in the

		preparation of a National Integrated Coastal Zone Management Plan for the Mediterranean Sea and the Red Sea coasts and the responsibility of initiating and co-coordinating national ICZM activities. A National Committee for Integrated Coastal Zone Management (NCICZM) was set up, and the Secretariat of this Committee was established under the Environment Management Sector of the EEAA. One of the major tasks of the National Committee for ICZM is to develop a programme for the development of a national ICZM Plan. The role of EEAA in the Committee is to review the Environmental Impact Assessment reports and provide the environmental license for all projects located within the coastal zone area, develop coastal zone management guidelines as well as chairing the National Integrated Coastal Zone Management Committee (NICZMC).
Ministry of Housing: Urban Planning Authority, General Organization for Physical Planning (GOPP)	**10,500,000**	Responsible for developing guidelines for urban planning inside the coastal zone (and outside coastal zone); for any modification or extension or new project in the country; and provides assistance to any developer to prepare the Environmental Impact Assessment within and outside coastal zone areas.
Ministry of Agriculture: Fish Authority	**6,000,000**	No specific mandate for coastal zone management or shore protection but provides licenses for fish farms and fishing activities in the coastal lagoons and other coastal areas, and works closely with the Coastal Guard.
Ministry of Defense: Coast Guard Department	--	No specific mandate for coastal zone management; important for coastal zone protection in that it is responsible for checking licenses in coastal areas before any project can start and works closely with the Fish Authority to check fishing licenses.
Ministry of Tourism: Tourist Development Authority (TDA)	-	The TDA protects coastal zone areas from tourist activities- primarily along the Red Sea Coast. The TDA also provides assistance for Environmental Impact Assessment studies.
Ministry of Transportation: Marine Transportation Department in Alexandria	-	Responsible not only for marine transportation projects but also for providing assistance to developers and the Government in all aspects of marine transportation. It works closely with the Marine and Harbor Authority in the area of environmental protection and environmental impact assessment.
Ministry of Petroleum: Health, Safety and Environmental (HSE) Department	-	Responsible for all environmental studies and environmental license to on-shore and offshore activities in close collaboration with the EEAA, and provides guidance and assistance to all Egyptian and non-Egyptian developers. They check project EIA studies before sending it to EEAA.
Suez Canal Authority (SCA)	-	The SCA's Research Center has substantial facilities for shore protection work and it works independently for the Suez Canal in three different governorates - Suez, Ismailia and Port Said.

34. The INC and National Action Plan on Climate Change (NAPCC) include several proposed adaptation measures such as beach reinforcement and nourishment, construction of seawalls and breakwaters, tightening of legal regulations and enforcement of laws, adoption of integrated coastal zone management, change in land use and development of comprehensive monitoring

and decision support systems. The effort builds on current activities by the Shore Protection Authority for coastal projection and aims to enhance climate risk management and focuses investment decisions on strategic adaptation options.

35. The most recent effort to rejuvenate the ICZM planning process was in 2007. The Coastal Zone and Lake Management Division of EEAA proposed an updated framework for the national Integrated Coastal Zone Management Strategy, stakeholder meetings have been held in an attempt to clarify, expand, and finalize this version ever since. This 2007 daft of the ICZM plan introduces the following new regulatory concepts:

- Lines of no Development
  i. Set-back line is 200 m, its management is SPA & EEAA responsibility
  ii. No development line, 100 m. Its management is SPA responsibility.
- Protected Areas
  i. Define protectorate and buffering zone borders
  ii. Declare forbidden activities in buffering zones
  iii. Declare permissible activities to use resources of the protectorates and the limits.
- Urban, Tourism and Industrial Development
  i. EEAA to prepare and update the guidelines for development in the Coastal Zones.
- Recharge Dams, Roads and Bridges
  i. Minimize building roads parallel to the shoreline
  ii. Building recharge dams and roads shall be based on a proper assessment of its impact on the sediments reaching the shoreline and the sedimentation processes.
  iii. Do not block water runoff (wadies) and its catchments.
  iv. Limit un-organized land transportation and prepare contingency plans to deal with accidents.
- Integration of Environmental Concerns in Development plans
  i. Insure that all development projects, especially national projects, are implemented after a proper EIA.
  ii. Promote Strategic Environmental Assessment for all Development Plans in the Coastal Zones
  iii. Prepare, force and monitor the implementation of compliance plans for all sources of pollution.
  iv. Explore ways and means to finance compliance plans.
- Public Access to Beaches
  i. Law 4/94 stated that the setback line is 200 m and it is the responsibility of Egypt to protect this.
  ii. The setback line is the first line of defense of the Country. It represents the line of defense against the expected sea-level rise and any changes in the wave patterns.
  iii. The setback line is a public assess and its access to everyone shall be secured.
- Protection of the Coastal Sand Dunes
  i. Coastal sand dunes are valuable resource for sediments for neighboring shorelines.
  ii. Coastal sand dunes are valuable ecosystems that need to be protected.

36. As of this writing, the 2007 National ICZM Plan has not been finalized and management actions are lacking (World Bank, 2005). The coastal committee (CZMC) has been inactive for several years leading to a reduction in policy dialogue and consistency analysis between governmental stakeholders with different visions on the use of coastal areas. These delays in plan adoption, inability to reach objectives, and inactivity of the CZMC, can be attributed to several underlying causes.

37. First, implementation of the ICZM has the potential to adversely intersect with a number of vested and competing interests, both in the public and private sector. Second, there is an inadequate capacity/awareness framework to develop a climate-sensitive ICZM. Many of the activities in the ICZM require new or enhanced technical capacity (e.g., building recharge dams/roads based on impact assessment on shoreline sediments and sedimentation processes) enforcement mechanisms (e.g., insuring that all development projects are implemented only

after a proper EIA), better integration of climate change adaptation issues in national policies and programmes (e.g., a broad-based coastal adaptation strategy that evaluates/prioritizes a range of options, measures, and policies), and better local access to climate change information (e.g., public awareness campaigns that address education levels, poverty, and cultural barriers) that as yet are not in place.

38. Third, there is no consensus view on coordination across responsible ministries. Currently, there is a multiplicity of controls and consenting regimes and regulators in Egypt, with overlapping jurisdictions and without a lead or coordinating regulator. An integrated coordination of roles, objectives and responsibilities is a pre-requisite to successful ICZM implementation. Efforts are underway to overcome these barriers to ICZM implementation. There have been recent efforts to rejuvenate the operational capacity of the CZMC. Several meetings have been held by the coastal zone committee in an attempt to minimize the interest of individual stakeholders and to establish an appropriate mechanism for developing the national integrated coastal zone management. Specifically, several workshops have been held to identify the strategic objectives and to outline the roadmap for the compleition of the National ICZM plan for Egypt. The most recent workshop (April 2009) was attended by 41 participants, including: representatives of the Egyptian Environmental Affairs Agency (EEAA) and Priority Actions Programme Regional Activity Centre (PAP/RAC) of UNEP-MAP, the representatives of coastal Governorates, the National Committee for ICZM (NCICZM), relevant ministries and agencies, national experts and a team leader of SMAP participated at the Workshop

39. At the same time, the Egyptian Shore Protection Authority has been focusing only on construction of coastal protection structures including jetties, groins, seawalls, and breakwaters to combat beach erosion, and reduce shoaling processes in the lakes, and navigation channels in the Nile estuaries. The total cost of these activities is estimated at US$ 200 million over the last decade (World Bank, 2005). Only a small fraction of these infrastructural solutions have been implemented due to lack of financial resources and poor coordination across responsible entities; which, in turn, has led to the acceleration of beach erosion, degradation of recreational beach aesthetics, and impeding access to beaches. However, even if these measures were fully in place some of them may eventually prove to have negative impacts without a proper understanding of longer-term coastal dynamics associated with climate change. Therefore, more complex (mixed) approaches are required to increase robustness of the coast and ensure sustainable long-term adaptation.

40. Egypt's policy gaps with respect to response to sea level rise and coastal vulnerability are rooted in the lack of an active and enforceable national ICZM plan and consideration of climate change concerns and a responsible institution for overseeing its implementation. While drafted, the ICZM plan has not yet been implemented. Additionally, even though a National Coastal Zone Management Committee was established at one point, it is inactive and thus there has been a low level of coordination and lack of coordination of necessary strategies. Hence, the operational systems needed to implement effective policies and measures to build adaptive capacity to climate change threats across key agencies and institutions has not yet been established.

41. Four main barriers for the institutionalization of climate change related adaptation policies and measures in Egypt have been identified and summarized here (INC, 1999; El- Raey, 2004; OECD, 2004; World Bank, 2005; EEAA 2007; Borhan, 2009).

    - *Legal framework for coastal protection and management* has some remaining gaps and requires improvements;: there are several conceptual issues that are missing in the current Egyptian legal framework to ensure the holistic and effective protection of the coastal systems. With respect to the current project, the most relevant shortcoming of existing law is that there is a lack of integration of concerns related to adaptation to climate change (including coastal erosion and beach protection, sea-level rise, etc.), in accordance with the UN Framework Convention on Climate Change (UNFCCC), to which Egypt is a party. This can be partly attributed to the fact that, across the board, agencies responsible for coastal zone manage lack the climate risk assessment abilities needed to identify and integrate

climate risks and appropriate adaptation response measures into the legal framework for coastal zones. Laws, regulations and mandates needs to be strengthened and further elaborate the limits and responsibilities of individual agencies. Laws that are enacted to protect and manage coastal zones suffer from ad hoc enforcement regimes for managing coastal environments. In general, limited action has been taken to the implement a sustainable and integrated coastal zone planning framework such that the draft national ICZM plan has not been finalized or endorsed with clear budget allocations, responsible institutions or accountability system resulting in a lack of an integrated approach to address coastal threats.

- *A comprehensive institutional framework for coastal protection and management that addresses climate change risks is not in place:* It emerged from both recent studies and interviews with Egyptian authorities that one of the most prominent obstacles to an effective protection of the marine environment is the complex institutional framework for addressing marine pollution, as well as the limited cooperation among different agencies. The National Coastal Zone Management Committee was designed to serve this role but has been largely inactive, with Committee members lacking clear roles, resulting in a low level of cross–sectoral coordination that would be necessary to implement any ICZM measures and policies. While there have been strong initial steps to develop an integrated approach to coastal zone management and long-term coastal zone planning that could address sea level rise concerns, the situation today in Egypt is of a fractured group of implicated national/regional organizations lacking strong central leadership in the form of an national institutional "champion". This is exemplified by the fact that key entities under the Ministry of Water Resources and Irrigation (CoRI and SPA) have separate mandates over coastal zone and poor coordination of activities. CoRI is responsible for coastal processes, monitor the evolution of the Egyptian coast, and study the dynamics of its shores and to find out efficient and cost-effective control methods. The SPA is responsible for managing the shoreline in coastal areas by developing coastal zone management plans, designing, and implementing projects and all studies for shore protection. However, there is limited scope for CORI to provide substantive technical inputs and guidance to the SPA with respect to shore protection investments and management plans. This is currently an untapped institutional opportunity that the proposed project is going to further examine and utilize. Ostensibly, the "champion" organization should be the Egyptian Environmental Affairs Agency (EEAA) which was established by Law No 4 (1994) as the coordinating organization for ICZM planning and activities. Housed in Egypt's Ministry of State for Environmental Affairs, however, this agency has not been effective in leading the various state ministries to coalesce around efforts for a common and practical vision for integrated coastal zone management, let alone mainstreaming climate change considerations into this framework. This situation critically and adversely affects ongoing learning and the development of good coastal policy, reinforces chronic technical capacity and knowledge barriers, and is typified by the lack of an operational ICZM framework despite the passing of a dozen years since official enactment of the related statute.
- *Agencies responsible for coastal zone management do not have the technical capacity of necessary knowledge to address adaptation concerns:* The entrenched technical capacity and knowledge barriers that will need to be overcome are tri-fold. 1) Inadequate information exchange/coordination/facilitation among regional research centers and local governance councils. To date, insufficient mechanisms in place for data and information exchange have resulted in a potential mischaracterization of climate change related threats. Agencies need improved access to information and a knowledge-sharing mechanism on climate change impacts to coastal zones to ensure appropriate and effective coastal zone management strategies are developed and implemented. 2) National agencies do not have the technical capacity to monitor and address climate change risks (especially sea level rise), assess vulnerability, or implement adaptation measures. Low technical capacity has resulted in ongoing degradation of shoreline and marine habitats through erosion (especially those due to infrastructure and shoreline protection projects), loss of biodiversity, deterioration of fish

stock, marine pollution, and habitat destruction from human development. 3) Agencies need knowledge and awareness of effective, environmentally friendly, efficient, and economically viable coastal protection measures - like those proposed in Outcome 2 of project- for protection of the Mediterranean Coast and LECZ in the Delta to address climate change threats, such as SLR. More effective and forward-looking measures that would sustain development investments and would not turn into maladaptive, coastal area damaging practices are needed. Since awareness and knowledge are missing on these types of coastal protection measures that are critical in the face of climate change, these measures have not been adequately tested, resulting in a lack of adequate information systems on which to base policy decisions. The emergence of an effective institutional "champion" is essential to overcoming these obstacles.

- *There are no institutionalized mechanisms for public involvement to manage potential conflicts among multiples users of coastal resources*: No mechanism of including the public has contributed to low community awareness on matters related to the coastal lagoon management and protection. This also means that local concerns within national coastal management activities have been inadequately represented. Because the participatory approach has not been effectively implemented, the ICZM planning process also suffers from a delayed consensus due to a steady stream of new and unforeseen criticisms of the plan by stakeholders uninvolved in the process. The underlying basis for this barrier is the fact that there is currently no legal basis in Egyptian law for ensuring public access to information on the state of the marine environment and related health hazards; access to a conflict prevention and resolution mechanism; or participation in planning and decision-making about the marine environment.

Stakeholder analysis

42. There are several stakeholders that are implicated in the development of the ICZM plan and have been consulted during project preparation. National experts from the Egyptian Coastal Research Institute and Shore Protection Authority (within the Ministry of Water Resources and Irrigation) have been heavily involved from the outset in the development of the design of project activities. There were other key local stakeholders consulted for input in project design, including the relvant government agencies, the scientific research community and the final beneficieries. These are sumarized below together with their potential role in project implementation:

    - Ministry for Environmental Affaires' Egyptian Enviornmental Affairs Agency (EEAA). The EEAA is the initiator of the ICZM planning process and houses the Secretariat of the National Committee for Integrated Coastal Zone Management (NCICZM). The project's outcomes are expected to be direct inputs into the development of knowledge systems;
    - Ministry of Tourism (Tourist Development Authority): The project's outcomes are expected to be provide protection for potentail touristic activities;
    - Ministry of Housing (Urban Planning Authority, General Organization for Physical Planning);
    - Ministry of Transportation (Marine Transportation Department in Alexandria): The project's outcomes are expected to affect the continued viability of transport networks across the Delta;
    - Ministry of Agriculture (Fish Authority): The project's outcomes are expected to protect and enhance ecosystem function, particularly fisheries;
    - Ministry of Petroleum (Health, Safety and Environmental Department); and
    - Ministry of Defense (Coast Guard Department): The project's outcomes are expected to be provide protection from coastal erosion;

43. Preparatory activities include limited pre-feasibility studies for the proposed technical solutions to determine feasibility of and justify actions in terms of their cost-effectiveness as well as

clarification of the detailed execution and implementation arrangements of proposed interventions[2]. The identification and finalization of the preliminary design of the selected pilot projects, was agreed upon by the Coastal Research Institute in close consultation with experts from the Egyptian Shore Protection Authority, and vetted with a range of public and private sector stakeholders at a national workshop held on 8 June 2009.

Baseline analysis - Vulnerability of the Nile Delta to SLR

44. There are several types of anthropogenic threats to the coastal zone of the Nile Delta. As noted previously, Egypt's INC found the coastal zone of the Nile Delta to be vulnerable to the impacts of climate change, not only because of the impact of sea level rise, but also because of the impacts on water resources, agricultural resources, tourism and human settlements. Several studies have been undertaken, data and maps collected, and field visits and surveys were made to low land areas in Alexandria, Behaira, Port-Said and Damietta governorates.

45. The coastal area of the Nile delta is currently subjected to severe coastal erosion, even without accelerated sea level rise. Some parts along the Nile Delta coast have been protected by hard structures as well as artificial nourishment that have been applied at some sectors. The Nile delta area is extensively used for agriculture, in some places almost reaching out to the coastline. Near the coast, agriculture is confronted with salinity problems, partly caused by the reuse of drainage water for irrigation. Population densities vary between 400 and 1,200 people per km^2 (Aricon, 1989).

46. The gradual anthropogenic regulation of the flows of the Nile River since about 1900 has reduced the supply of sediments to the coast via the two existing branches. Before construction of the Aswan High Dam, water flooded annually from the Nile during August-October through its branches (Rosetta and Damietta). After dam construction, the mean annual amount of Nile water was reduced from 34 billion cubic meters to less than a third and the sediment load was reduced from 60-180 million tonnes per year to less than 15 million tonnes per year. Notably, sedimentation from Nile flooding was the main source of sediment accretion on the two promontories of Rosetta and Damietta where severe coastal erosion has been experienced (Sharaf El Din, 1977; Torab, M. Azab, 2007).

47. The role of the Aswan dam is tightly linked with coastal erosion. The current coastal sand belt in the Nile Delta is between 1 km and to 10 km wide. This narrow belt is what currently protects much of inland Egypt from coastal flooding. Since 1964, the dam has virtually blocked the transport of sediments and erosion of the Nile delta's protective sand belt has only accelerated since the Dam's completion in 1970. After installation of the Dam, the delta coastline eroded much faster; the sea began encroaching upon low-lying areas of the delta; fertile silt no longer reached the delta; salt content of cultivated land rose; fish stocks in the coastal lagoons declined because of decreased nutrients reaching the coast; and water hyacinths choked canals and waterways (Kalshian, 1993).

48. Further (and ongoing) erosion of the protective sand belt is of serious concern. SLR will deteriorate coastal wetlands, inundate low-lying agriculture, and exacerbate existing stress on fisheries in the coastal lagoons. Furthermore, SLR will also further change the offshore water current patterns resulting in changes to the shoreline which will have negative impact on touristic and economic activities (EL-Raey, 2004).

[2] An overall justification for cost-effectiveness of the proposed adaptation alternative is provided in the CEO endorsement request under the section of *cost effectiveness*. At the same time, the individual on-the ground measures designed under the project will also be scrutinized with cost-benefit analysis for identifying the low and no regret adaptation actions during the project implementation.

49. Historically, Egypt's agriculture system has thrived under favorable climatic conditions, fertile soil and access to irrigation via the Nile. To meet the demands of an ever growing population, Egyptian agriculture has expanded both towards desert as well as reclaiming waterlogged and salinized land in the Delta. As much as 12-15% of existing agricultural land in the Delta could be lost due to sea level rise; a widespread and vigorous intervention will be essential to ward off food shortages and an eventual food supply crisis (Kasperson and Kasperson, 2001). Changing land use exacerbates human exposure to weather-related climate change hazards. Initial settlements, while built on the most suitable areas, new development in Alexandria have had to occur on more hazardous ground in low-lying flood-prone areas (Klein et al, 2003). Table 1 summarizes a 1999 study of anticipated population displacement and sectoral employment losses. Current coastal vulnerability studies in Egypt confirm that coastal lagoons will be adversely impact by rising sea levels. To establish baseline conditions, El Shinnawy (2008) used measurements of tide gages for the last three decades to estimate the rate of average mean sea level rise in three locations of the Nile Delta coastal region. Statistical analysis of data coupled with spot land elevation surveys indicated that the average relative mean sea level rise differs across the Nile delta due to difference in land subsidence rates. Estimated trends for relative SLR at Alexandria, Al-Burullus, and Port Said are 1.6, 2.3, 5.3 mm/year, respectively. These values combine the effect of both SLR and land subsidence. The IPCC indicates that for the 20th century, global average sea level rose at a rate of about 1.7 mm/year. Notably, this value accounts only for the effects of thermal expansion of the oceans and the loss of land-based ice due to increased melting. This suggests that when the effect of local subsidence are accounted for, rates of sea level rise in areas east of Alexandria bring into sharp focus the potential vulnerability of these coastal areas.

Table 3. Area loss, population displaced and loss of employment in each sector due to a different SLR scenario in Alexandria governorate (El Raey, 1999)

	SLR (cm)		
	18 (2010)	30 (2025)	50 (2050)
Area loss (km^2)	11.4	19.0	31.7
Population displaced (×1000)	252	545	1512
Loss of employment			
Agriculture	1370	3205	8812
Tourism	5737	12323	33919
Industry	24400	54936	151200
Total loss of employment	32507	70465	195443

50. The study also confirmed that certain areas of the Nile will be adversely affected by future sea level rise in the absence of effective adaptation. Under optimistic estimates of near-term SLR (i.e., low levels of SLR by 2025 under the IPCC's low-emission B1 scenario), land area just West of Burullus Lake and south of Manzalah Lake show the greatest vulnerability (see Figure 1a). The red-shaded area just south of Idku Lake in the west indicates an area where the land elevation is actually below the sea level in 2025 yet is not inundated due to the shore protection afforded by the existing Mohamed Ali shoreline revetment. Altogether, approximately 16 km^2 of valuable currently cultivated land would be inundated in the absence of adaptive action.

51. Under pessimistic estimates of mid-term SLR (i.e., high levels of SLR by 2050 under the IPCC's high-emission A1F1 scenario), the land areas identified in the previous areas remain highly vulnerable and the extent of inundation increases (see Figure 1b). In addition, the current height of the Mohamed Ali revetment becomes inadequate to protect the low lying areas behind adjacent to the Idku Lagoon. However, for the most part, these areas are not designated as cultivated land. Approximately 59 km^2 of valuable agricultural land would be inundated in the absence of adaptive action under this scenario. Another 16 km^2 of low-lying area behind the Mohamed Ali revetment would also be inundated under this scenario.

52. Hence, the most recent study of SLR in the Nile confirms the essential conclusion of earlier vulnerability assessments that large areas of the Nile Delta are vulnerable to SLR relative to the range of plausible scenarios. In contrast to the earlier studies, the zones of acute vulnerability are now understood to be more limited due to a better representation of coastal protection structures in the spatial modeling framework.

53. To date, the productive coastal lagoons are at risk of serious impacts from sea level rise and

ability to manage the anticipated level of damage without additional investments in innovative coastal protection measures. Healthy coastal ecosystems, and their resilience in the face of climate change impacts, are important because they provide the life-supporting systems that sustain coastal societies. It can be argued that coastal economies are inherently more resilient because of the resilience of the ecosystems on which they depend (Adger 1997)[3]. There are three coastal lagoons considered to be vulnerable environmental hotspots in urgent need of adaptation measures: Lagoon Manzala, Lagoon Burullus, and Lagoon Idku. - effectively altering the composition of lagoon ecosystems- as well as changes in lagoon boundaries, weed swamps will disappear replaced with salt marshes, overall deterioration of water quality, proper functioning of infrastructure facilities directly exposed to the sea will be disrupted and the natural fry supply will be affected.

54. Lagoon Manzala is the largest of the Northern Delta lagoons. Because of land reclamation, the area of open water has actually decreased from 170,000 ha at the beginning of the 20th century to a 1983 measurement of 90,000 ha of open water and 68,800 ha salt marsh (48,000 ha of which, east of the Suez Canal, were below sea level) (Mepham et al., 1992). Most recent measurements suggest further reduction to 70,000 ha; the number of islands actually reduce the area of open water to less than 50,000 ha (Kraïem et al., 2009)[4]. The lagoon is 64km long with a maximum width of 49km and is connected to the Mediterranean through the Boughaz El Gamil and El Qabouti channels. Lagoon Manzala is the most productive lagoon in Egypt where the mean annual fish production from the lagoon is 60 thousand tons. An estimated 17,000 fisherman work the lagoon using 4,000 boats; and roughly 14,300 hectares of fish farm (*hosha*) enclosures are operating in the lake employing an additional 9,000 people (Mepham et al., 1992[5]). Fishing is artisanal with small fishing boats with oars and motor boats. Different fishing gears are used: principally trammel and gill nets, traps (nylon and spiral traps), hook lines and hand fishing in vegetation areas (Kraïem et al., 2009). The eastern part of Lake Manzala (Port Said and the northern part of the Suez Canal) is subsiding faster than any other region along the Nile Delta coast. SLR is expected to cause a landward shift of the salt wedge and to increase the rate of saline seepage to the topsoil of the delta. This may have a serious impact on local agriculture and drainage conditions, and potentially on available groundwater resources in the upper Nile (El Raey et al., 1999).

55. Lagoon Burullus, the second largest Delta lagoons, has a total area of about 70 thousand hectares with an average depth of 1.2 m though varies from 07 to 2.4m. It has a narrow mouth near the town of El Burg which opens it to the Mediterranean (Mepham et al., 1992). . There are also about 50 small islands scattered throughout its area. Commercial salt production and fish farming are carried on to the south of the lake where there are salt marshes[6]. The mean annual fish production from the lagoon is 48 thousand tons and sustains the livelihoods of about 20 000 fishermen and their families (Dumont and El-Shabrawy, 2007)[7]. Others estimate the population dependent solely on the lake for their livelihoods is closer to 50,000 fishermen (IRIN, 2009)[8].

56. Lagoon Idku is situated approximately 35 km east of Alexandria. It is a shallow eutrophic lagoon with an area of 10,400 hectares and rarely exceeds 1.5 m in depth. It is 16km long and has a maximum width of 10km (Mepham et al., 1992). The mean annual fish production from the lagoon is 9,000 tons and roughly 150,000 people (in the town of Idku) rely on the lagoon as the

[3] Adger, W.N. 1997. *Sustainability and Social Resilience in Coastal Resource Use.* Centre for Social and Economic Research on the Global Environment, University of East Anglia, Norwich, and University College London, London. Available at: http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1997_23.htm.

[4] Kraïem et al., (2009). The fish fauna of three North African lagoons: specific inventories, ecological status and production. *Hydrobiologia.* 622:133–146. DOI 10.1007/s10750-008-9679-3

[5] Mepham, R et al. (1992) A directory of African wetlands. IUCN.

[6] "Mediterranean Wetlands". Available: http://www.biomapegypt.org/biodiversity/Habitats/MWL.html

[7] Dumont and El-Shabrawy, 2007. Lake Burullus of the Nile Delta: A Short History and an Uncertain Future. *Ambio* Vol. 36, No. 8, December 2007

[8] IRIN, 2009. "EGYPT: New fish farm plan threatens environment, livelihoods – NGO**"** http://www.irinnews.org/report.aspx?ReportId=82720

primary source of livelihood. An FAO study (1985)[9] reports that employment in Lake Idku fishery is treated as a casual, part-time occupation by many of the fishermen with seasonal agricultural work supplementing their income.

57. Egypt's social sensitivity to sea level rise is particularly high. Climate change will produce varied impacts on the local lagoon population depending on how climate changes interact with, if not exacerbate, existing stresses e.g. population growth, poverty, poor nutrition, accumulating levels of atmospheric, land, and water pollution, ever growing gender and class inequalities. Similarly, the capacity of the population to adapt to climate change is directly linked to these existing stresses- the socio-economic condition of the communities and the climate-sensitivity of their main sources of livelihood. The impacts of sea level rise on lagoon settlements can be multiple: flood risks, incidence of storms, salt water intrusion, loss of recreational beach facilities and negative impact on tourism and local tourism-dependent livelihoods, loss of coastal infrastructure such as ports, waste water treatment plant, reduced productivity of coastal fisheries, flooding of costal agriculture areas and more. All the human settlements surrounding the coastal lagoons are potentially under increased threats of flooding and inundation depending how sea level rises over the coming century or so.

58. All three of the coastal lagoons face the following constraints with respect to ecosystem productivity and capacity to sustain commercially viable fishery and agricultural activities (Mehanna, undated):

- Degradation, habitat loss, filling up and drought which lead to decreasing the area of all Delta lagoons by more than 70% of their original areas;
- Pollution: Delta lakes are the most polluted areas in Egypt. They receive great amounts of industrial, municipal and agricultural wastewater without treatment;
- Spread of aquatic plants from these lagoons which have spread to cover large adjacent areas;
- Over-fishing, illegal fishing practices and illegal fish harvesting;
- Blockage of connections with the open sea;
- High levels of eutrophication resulting from the increased nutrient influx from agricultural drains carrying large amount of washed and leached fertilizers and pesticides; and
- Low awareness of fishermen about environmental issues and the importance of fisheries regulation measures.
- Low awareness of farmers about the impact of certain agricultural practices (fertilizer and pesticide use) on productivity of the coastal lagoons.

Baseline Analysis – Coastal Protection in the Nile Delta Area

59. As noted earlier, the Coastal Zone and Lake Management Division of EEAA proposed its update to the Framework of Integrated Coastal Zone Management Strategy in 2007. This was done based on the MAP Protocol and the EU Directives on ICZM (the implementation of integrated coastal management in Europe (2002/413/EC). EEAA is now coordinating with PAP/RAC of MAP to finalize the National Strategy; this project will aim to ensure that climate change risks are appropriately accounted for in the final version.

60. Up through the mid-1990s, government programmes and investments in protective measures along the Nile Delta coast have included an emphasis on "hard" coastal structures such as sea walls, jetties, and detached breakwaters, as summarized as follows (El-Raey, 1999):

- *West of Alexandria.* The new drain at the western Nobariya drain outlet is about 20 km to the west of Alexandria. Two jetties of 65 m length were constructed in 1986 to protect the exit from siltation, and they are functioning effectively.

[9] FAO (1985) Aquatic Weed Control In Relation To Fisheries Of Lake Edku And Barsik Fish Farm. Available: http://www.fao.org/docrep/field/003/R7346E/R7346E00.HTM.

- *Eastern harbor of Alexandria.* A 180 m extension of the existing west breakwater would narrow the gap between the west and central breakwaters from its existing 300 m width to 100 m (Tetratech 1986). This decrease in gap width would reduce wave heights along the critical area of the Corniche.
- *Abu Quir Bay.* The Abu Quir Sea wall was built in 1780 and has been maintained by placement of additional large concrete blocks. This wall was modified and reinforced in 1980 by constructing a sloping face (2:1) and placing 0.5 ton modified cubes as a layer of protection.
- *West of El Gamil regulator and inform of El Fardos village.* In 1994, construction of 4 detached breakwaters was begun in the area to protect it from erosion. Each breakwater is 250 m long and is constructed from a barge-mounted plant at a water depth of 4 m. The cost of these 4 breakwaters is US $3.5 million (Delft Hydraulics 1991).
- *El Gamil outlet.* Two jetties of 225 and 200 m length on the western and eastern sides of El Gamil outlet, respectively, were constructed to protect this outlet from siltation and migration. The cost of these 2 jetties was US $0.75 million (Delft Hydraulics 1991).
- *Highway near El Gamil airport.* A small bituminous dike, about 4 km in length, was constructed to protect the low parts of the coastal road near the airport from flooding. The cost was US $1.0 million (Delft Hydraulics 1991).

61. While less prominent, government programmes and investments in protective measures along the Nile Delta coast have also included “soft” beach nourishment measures. Specifically, such measures have been implemented for five Alexandria beaches, El Shatby, Stanley, Sidi Bishr, El Asafra, and El Mandra. These beaches were nourished by medium to coarse sand transported from the desert near Cairo.

62. There have also been government investments to protect public infrastructure. For example, the government invested in an international coastal road constructed along the northern sector of the delta and potentially provides a protective barrier against sea level rise. The road extends more or less parallel to the present shoreline at a distance of about 1 km from the shore. Notably, the completion of the road in 2002 has since encouraged investors and residents to develop the unused coastal lands.

63. Finally, there have also been private investments to protect private/industrial infrastructure. For example, factories for paper and fertilizer industries, electric power plants and natural gas refineries can be found placed on the western coast of Qbu Quir Bay, away from coastal erosion threats.

64. To date protecting coastal areas in Egypt has typically meant structures such as seawalls, groins, rip-rap, and levees. As understanding of natural shoreline function improves, there is a growing acceptance that structural solutions are also leading to unintended adverse outcomes. For example, while stabilizing the tip of the Damietta promontory with seawalls protects the properties behind it, sea walls have led to the scouring of the seafloor and steepening of the beach profile in front of the wall (El-Banna 2005). West of the seawall, the constructed breakwater system has affected the bathymetry of the seafloor in the area; with shoaling and submerged spits being formed in the shadow of each breakwater unit. The gaps between the breakwater units have attained deep depths and steep slopes (M. El-Banna 2006).

65. Emerging evidence suggests that these “hard” shoreline protections are expensive, can cause unexpected erosion to beaches and dunes, require costly ongoing maintenance, adversely affect adjacent areas/properties, and disrupt natural water flows. While "hard" structures continue to be used for shoreline defense e.g. seawalls, revetments, groins, breakwaters; "soft" stabilization methods are becoming more prevalent in coastal areas, either as the sole method of protection or in conjunction with "hard" stabilization practices. Advancements in shoreline protection strategies now recommend that whenever structural protection is pursued, hybrid technology (such as combinations of low-profile rock, cobble berms, and vegetative planting, or combinations of marsh plantings and coconut fiber rolls) should be implemented alongside hard

structures as a means of reducing the negative impacts of the structure. It is in light of this evidence that the proposed pilot adaptation measures prioritize "soft" shoreline protection measures as is explained in Part II: Strategy.

66. Despite ongoing investments in coastal protection measures and a long history of recognized shoreline vulnerability in Egypt, the additional cost posed climate change induced sea level rise requires GEF/SSCF funding. The GEF/SCCF intervention is essential to ensure that climate change concerns are addressed in the context of ICZM in Egypt. Without this support, traditional management approaches characterized by the absence of coordinated land use planning, short term orientated planning framework and limited response measures will continue to prevail. The implementation of the necessary strategy and policy changes at the institutional and political levels to address climate change concerns will be weaker (if any) in the absence of the GEF/SCCF intervention.

67. Absent adaptation measures that respond to the existing threat of coastal erosion, future SLR will likely adversely affect weak parts of the sand belt, which is essential for the protection of productive coastal lagoons and the low-lying agricultural lands. Without GEF financing, the benefits of innovative approaches to address climate change risks to coastal lagoons would not be fully understood. The project's added value lies in the fact that it will facilitate a knowledge transfer process in favor of Egypt by bringing in the most recent methods and models in the field of ICZM and adaptation to climate change.

PART II: Strategy

Institutional, sectoral and policy context

68. Based on the above situation and barrier analysis, the proposed project strategy is to take an "adaptive capacity approach". The adaptation process requires the capacity to learn from ongoing experiences to cope with current climate, and to apply these lessons to cope with future climate, including surprises. The adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation. The key component of adaptation in this approach, therefore, is capacity development aimed at expanding the coping range of the involved stakeholders given anticipated climate change risks to Egypt's Northern coastal zone.

69. The Special Climate Change Fund (SCCF) was established to finance four programs including Adaptation, which was given the highest priority at COP (Decision 7/CP.7). With respect to the SCCF adaptation program, the COP identified Integrated Coastal Zone Management as a priority intervention. The project meets the eligibility criteria of the SCCF. By promoting an ICZM plan that takes into account climate change risks, the project involves long term adaptation measures that allow for an increased resilience of coastal development as well as socio-economic sectors. This fits with the strategic objective of the SCCF which is to promote climate change resilient development.

70. SCCF financing will be used to finance the implementation of on-the-ground, innovative and environmentally friendly adaptation measures that will be monitored and evaluated in the framework of Nile Delta ICZM. The project will fit within the SCCF strategic objective by focusing on priority areas in terms of integrating SLR associated risks into coastal area land use planning and national development strategies, demonstrating the implementation of adaptation measures in the pilot sites and building the national and local capacities to deal with SLR consequences on human activities.

71. The GEF/SCCF intervention is required for supporting the development and demonstration of adaptive capacity, as well as the implementation of environment-friendly adaptation measures that would protect and increase resilience of the coastal zones in the Nile Delta. GEF/SCCF intervention will support the establishment of monitoring and decision support systems that will help implement necessary adaptation measures. In this context, the GEF/SCCF funds will serve

as a catalyst for revising the relatively large national and donor budget allocations for shore protection, to be planned to serve adaptation to climate change purposes within the framework of ICZM to reduce adverse social and economic impacts of SLR on the Nile Delta.

72. In particular, GEF/SCCF intervention will support the strengthening of capacity and improved mainstreaming of CC adaptation issues into coastal area and land use planning and development policies and plans. Without the SCCF intervention, Capacities to monitor and address climate change risks will remain largely untapped in an integrated way, resulting in an increasing adaptation deficit which might otherwise turn some of the baseline ongoing and planned investments into maladaptive and unsustainable practices in the face of climate change. It is clear that without the GEF/SCCF intervention, SLR pressures on Egyptian coastal areas will continue to increase vulnerability to climate change.

Project Rationale and Policy Conformity

73. Given the Nile Delta's vulnerability to climate change and sea level rise, it is clear that Egypt's challenges are compelling. The project's strategies for reducing vulnerability to climate change is to climate-proof proposed coastal development plans through the implementation of an ICZM framework and implement new and innovative pilot adaptation measures that complement existing structures to protect productive coastal lagoons under threat from future SLR. The overarching framework under which these measures will be implemented will be an updated Integrated Coastal Zone Management (ICZM) plan, fully supported by re-activated National Coastal Zone Management Committee (NCZMC) responsible for implementing and monitoring the plan. The NCZMC will also be working closely with the newly established Prime Minister's Climate Change Adaptation Unit, which has been tasked with coordinating climate change adaptation policies in Egypt and promoting a broad stakeholder dialogue and consensus over the adaptation strategies.

74. The project proposal is based on the findings and recommendations of the INC, SNC, and the NAPCC, is aligned with the National Environmental Action Plan (NEAP), and conforms to a stakeholder consensus. The proposed project will contribute significantly to the implementation of climate change adaptation measures proposed in the INC and NAPCC at local and national levels. The project also builds on the findings of the National Capacity Self-Assessment (NCSA) supported by the UNDP-GEF, and initiative launched in July 2005 which identified relevant capacity gaps and constraints in terms of adaptation to climate change in Egypt and were taken into account in the design of this project.

75. The project approach for any measures undertaken in the three lagoons is that they avoid hard structures, be innovative in nature, and provide flexibility for future adaptive activities in the region to augment project activities. Of the three major forms of coastal adaptation (i.e., abandon, protect, managed retreat), the mode of adaptation in the proposed project is lagoon protection through soft protection and innovative measures. The "Living Shorelines" approach meets these criteria and has been shown to be an effective strategy to control erosion and reduce land lost to sea level rise in other areas, including the Chesapeake Bay in the United States10. The "Living Shorelines" approach focuses on an innovative set of bank stabilization and habitat restoration techniques to reinforce the coastline, minimize coastal erosion, and maintain coastal processes while protecting, restoring, enhancing, and creating natural habitat for natural resources and livelihood activities

76. The project strategy focuses on an ICZM plan that includes soft shore protection strategies, a flood monitoring system, enhanced awareness among stakeholders, and the strengthening of

[10] Living shorelines use natural shoreline stabilization techniques as opposed to artificial "hard" shoreline protection measures like sea walls and revetments. What this means is that natural shoreline features preserve and build coastal habitats and act as natural buffer zones to absorb wave energy and reduces coastal erosion, .e.g. salt marshes, mangroves, seagrasses, other native plants and oyster reefs. It has been introduced throughout the United States of America, as well as European countries like UK, Germany, and the Netherlands. Annex E includes a detailed explanation of the Living Shoreline Approach.

institutional capabilities between parties to ensure effective collaboration. ICZM is emphasized because it represents an effective methodology to address the complex interactions between the multi-user, multi-resource nature of coastal zones. Pro-active planning through ICZM saves money relative to response measures, and sectoral planning, which has larger overall costs compared to integrated planning if one adds all costs involved in the planning of the separate sectors. As mentioned previously, the need for ICZM in the Nile Delta has already been recognized and even initiated by the government in the past to varying degrees of success.

Project Goal, Objective, Outcomes and Outputs/activities

77. The goal of the project is to enhance Egypt's resilience and reduce vulnerability to Climate Change impacts. The objective of the proposed projects is to integrate the management of SLR risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta. To minimize the likelihood of coastal disasters, the most effective adaptation policy options include a combination of (1) upgraded protection, (2) managing subsidence, and (3) land use planning, focusing new development away from the floodplain, and (worst case) (4) selective relocation away from vulnerable, existing city areas. The proposed project includes upgrading protection through the introduction of environmentally-friendly 'soft' shoreline protection, as well as modifications in regulatory framework and institutional capacity to ensure land use planning, zoning, to account for climate risks. As a contribution to the achievement of the objective, the three project outcomes and subsequent outputs are summarized in the following table and explained in further detail in the paragraphs that follow.

Table 4: Project Overview:

Project Components	**Expected Outcomes**	**Expected Outputs**
1. Regulatory Framework and Institutional Capacity	Enhanced capacity to improve resilience of coastal settlements and development infrastructure is strengthened	• Output 1.1 Coastal development legislation and regulations modified (focusing on ICZM and EIA); • Output 1.2 Institutional capacity of NCZMC strengthened; • Output 1.3 Information systems established that reflect climate change impacts/research on coastal zones • Output 1.4 Budgetary planning of Shore Protection Agency enacted to reflect climate change risks;
2. On the ground measures	Innovative and environmentally friendly adaptation measures enforced within the framework of Nile Delta ICZM.	• Output 2.1 Innovative adaptation pilot activities implemented to protect vulnerable coastal lagoons; • Output 2.2 Socio-economic assessment and adaptation option appraisal undertaken; • Output 2.3 Integration of climate risk assessment into the ICZM framework for the Nile Delta
3. Knowledge management	M&E framework and knowledge management system in place	• Output 3.1 M&E system with measureable indicators introduced; • Output 3.2 Lessons codified and disseminated through the Adaptation Learning Mechanism (ALM) • Output 3.3 Lessons disseminated throughout Egyptian Institutions.

78. Outcome #1: Enhanced capacity to improve resilience of coastal settlements and development infrastructure is strengthened.

- **Baseline**: The GOE began addressing coastal zone management issues in 1992, but, the proper addressing of Integrated Coastal Zone Management (ICZM) began in 1996 through issuing the Framework of ICZM by the Egyptian Environmental Affairs Agency (EEAA). The most recent effort to rejuvenate the ICZM planning process was in 2007, but as of this writing, the 2007 National ICZM Plan has not been finalized and management actions are lacking due in large part to the drawback of not having an institutional champion with an

empowered mandate. The draft versions of the ICZM in circulation have yet to adequately address climate change risks to the coastal zone. Numerous adaptation strategies have been proposed over the years, but none implemented. Without GEF support ad hoc and fragmented efforts will continue lacking institutional framework for adaptation policy decisions and dedicated resources for implementation. Currently, Ministry of Water Resources and Irrigation houses number of critical institutions such as National Water Research Centre that includes Coastal Research Institute, a technical arm that in principle should inform the Ministry's Shore Protection Agency (SPA) of key coastal risks and viable mix of coastal adaptation measures (combination of protection, retreat and management measures). However, the current set up does not allow for such institutional arrangement. Moreover, despite extensive knowledge material and technical expertise available at CoRI have not been fully utilized by the SPA that is largely spending its extensive budget on 'hard" protection infrastructure without any due account for current and anticipated risks of climate change on the Northern coasts of Egypt. Without the proposed project, even the existing knowledge of coastal risks will not be fully translated into the SPA coastal protection schemes. In recognition of the seriousness of threats posed to Egypt's shoreline by climate change and the urgent need to adapt, the Prime Minister (PM) issued a decree establishing a Climate Change Adaptation Unit (CCAU) to be associated with the PM's office. The CCAU's mandate is to coordinate climate change adaptation policies in Egypt and promote a broad stakeholder dialogue and consensus over the adaptation strategies. This definitely gives important political impetus for introducing GEF's adaptation alternative.

- **Adaptation alternative**: The CCAU is to become national institutional "champion" in Egypt and well help organize and coordinate the, until now, fractured group of implicated national/regional organizations responsible for coastal zone management. The CCAU will be supported by the establishment of virtual centre for integrated (cross-sectoral) research for climate change adaptation to foster climate data and information sharing. This type of centre inherently demands a more active cooperation of various scientific and research institutions in climate change related research, and will enable climate-sensitive policy formulation in coastal management. In contrast to the current situation where no coastal management entity has the capacity to adequately integrate climate change risks into policy, under this Outcome, training programmes will be implemented at various levels such that relevant agencies awareness of climate change risks are enhanced and incorporated into revised coastal management plans. Number of tools for coastal modeling, risk assessment and planning will be introduced and applied for improved climate-sensitive ICZM strategies (e.g. DIVA, COSMO, CVAT and MSP). Under this Outcome the project will improve legislative and institutional framework for adaptation policy decisions and implementation. NCZMC with appropriate government entities have clear mandates over different aspects of adaptation action; National Coastal Zone Management Committee (NCZMC) and relevant government agencies such as SPS will be trained to support the mainstreaming of climate risks and implementation of adaptation measures. Establishment of a virtual centre for integrated (cross-sectoral) research for climate change adaptation will foster climate data and information sharing that will inform coastal management policy formulation; monitoring networks, and relevant information systems on sea level rise will be used to inform NCZMC decision-making; and training programs on climate risk screening software tools for SPA agency staff will provide competency on key skill sets like coastal modeling and climate risk management for shore protection planning.
- Specific outputs associated with this outcome include:

79. *Output 1.1: Modified coastal development legislation and regulations (focusing on ICZM and EIA).* Climate change risk reduction strategies, policies and practices (measures) will be integrated into land use and national development plans such that, for example, future coastal projects require EIAs (that account for climate risks). The project will help to reinforce policy dialogue and coordination platforms (including National steering committee on CC, CCAU and

ICZM committee) to expand and activate climate change adaptation related policy dialogue and stakeholder consensus. The NCZMC will be given the necessary authority to implement and monitor ICZM and coastal zone decisions. To inform new legislation, this output will require additional studies on the potential impacts of climate changes on the issues itemized below.

- land and groundwater salinity
- on patterns of waves and currents
- erosion and accretion systems due to current and wind actions
- lakes ecosystems
- water resources and drainage systems
- fisheries due to changes expected in current patterns
- infrastructure and natural resources of the coastal zone of the Nile Delta coastal settlements and lagoon-dependent agricultural activities
- evaporation from oceans and seas open waters and their role in reducing SLR phyto-plankton role in absorbing CO2 and generating O2.

80. *Output 1.2: Strengthened institutional capacity of the NCIZMC and other key institutions to support the mainstreaming of climate risks and implementation of adaptation measures.* The project will build on current measures implemented by the government to reactivate the NCZMC (baseline) and work closely with the SPA and CoRI to strengthen their internal capacity to integrate measures to address climate risks into LECZ development and management, adopt strategies to adapt to climate change and implement appropriate adaptive measures. This includes technical trainings to increase the number of staff qualified in ICZM tools as well as awareness raising programs for stakeholders and decision-makers regarding the impacts of climate change on coastal zones. The project will support the Ministry of Water Resources and Irrigation to streamline the internal institutional processes for risk assessment, coastal adaptation planning and implementation. This will require clarifying the institutional roles and accountability structure among key entities such as National Water Research Centre and its Coastal Research Institute (CoRI) and Shore Protection Agency. The project will build capacity within the agency such that SPA staff both better understand current and future risks of climate change on their shore protection hard investments and have the analytical tools to "climate-proof" these investments. This includes capacity building workshop and trainings programs on climate risk screening software tools planned for SPA agency and CoRI staff, such as DIVA, COSMO, CVAT and MSP , to ensure competency on key skill sets like coastal modeling and climate risk management for shore protection planning. Strengthened institutional capacity also relates to the issue of coordination and communication across the sectors at the national level (horizontal) and at central, regional and local levels (vertical).

81. *Output 1.3: Information systems established that reflect climate change impacts on coastal zones*. To support ongoing coastal zone management decision-making processes, the project will establish the necessary observation and monitoring networks, and relevant information systems on sea level rise that will be used to inform Coastal Zone Management Committee decisions regarding risks and adaptation measures. Enhanced data management systems are an integral part of improved ICZM decision-making. An important component of this output is the elaboration of flood monitoring system capabilities and capacities that are informed by the latest evidence of rate of SLR in Mediterranean, local subsidence and other factors that render coastal areas vulnerable including possible storm paths. To strengthen communication, knowledge sharing, and more active cooperation among various scientific and research institutions in climate change related research across institutions, a virtual centre for integrated (cross-sectoral) research for climate change adaptation will be established. This virtual centre will foster climate data and information sharing that will inform coastal management policy formulation. There is a growing interest and consensus over the necessity for such research and information sharing platform among number of leading coastal experts in Egypt. The project will reinforce the existing efforts towards this end.

82. Output 1.4: Budgetary planning of Shore Protection Agency reflects adaptation needs. The project will coordinate with the SPA to ensure budgetary allocations are to finance a coastal protection investment package, enforcement and implementation of Regulations for Coastal Zone Development, and coastal adaptation measures are sufficiently understood. Climate change capacity and awareness raising workshops will ensure that agency staff understands current and future risks to existing and planning shore protection investments under anticipated sea level rise scenarios. As part of the approval process, the project will assist the SPA to introduce climate-screening of all protection proposals to ensure that any project a) includes measures that reduce known vulnerabilities in the shoreline, b) has an appropriate mix of hard and soft measures, with priority placed on flexible and innovative soft protection measures c) is consistent with the "adaptive capacity approach" in that the project is designed to build adaptive capacity of key stakeholders in the coastal regions. Adaptive capacity applies to both the institutions responsible for shoreline protection and sea level rise impact mitigation , the local communities who live and work near the lagoons, as well as of the ecosystems that are meant to act as natural protective structures as sea level rise threatens to undermine ecosystem functioning.

83. Outcome #2: Innovative and environmentally-friendly coastal zone adaptation measures enforced in the framework of Nile Delta ICZM.

- **Baseline**: Based on the CoRI study for the SNC, the Idku, Burullus, and Manzala coastal lagoons will experience increasing impacts from sea level rise. If sea level rise trends persist into the future as expected, each of these coastal lagoons will eventually be in need of protective measures in order to sustain their function as providers of numerous environmental services vitally important to the Nile Delta including the following: recharging groundwater, nutrient recycling, nutrient retention, water quality control, water flux control, erosion control, coastline stabilization, sediment retention, storm protection, and other. Absent the introduction of suitable adaptation measures, SLR will disrupt the provision of these vital ecosystem services that provide for coastal protection and undermine the livelihoods of the thousands that rely on these lagoons for food and income.
- **Adaptation alternative**: The Living shoreline approach (LSA), a 'soft' shoreline protection strategy, will be tested in a form of a number of concrete on-the-ground coastal adaptation pilots, implemented under the ICZM framework. The pilot projects will give a new impetus to updating the ICZM that will fully accommodate climate change risks to the coastal systems (Output 2.3) and also help influence SPA coastal protection budget - 600 million for the next 5 years (Output 1.4). The LSA will be fully customized to Egypt's shoreline context, including the use of local vegetation varieties where appropriate. Outcome 2 includes efforts to mobilize lagoon communities and engage them into the actual design of on-the-ground measures; this will ensure community ownership and buy-in of the strategy such that pilot "soft infrastructure" (vegetative buffers etc) projects are maintained. Communities will also be involved in the monitoring and evaluation schemes to gauge the actual effectiveness of the 'soft' coastal stabilization measures. Under this outcome the project will design "Living Shoreline" pilot adaptation projects are implemented in accretion areas to demonstrate effectiveness of 'soft' shoreline protection. This will be done under the ICZM framework, and introduce relevant shoreline protection entities of methods and practice for socio-economic evaluation of adaptation options. The project will introduce and institutionalize climate risk assessment into ICZM system for Nile Delta*:*
- Specific outputs associated with this outcome include:

84. *Output 2.1: Innovative adaptation pilot activities implemented to protect vulnerable coastal lagoons*. The underlying objective of this Output is to pilot a set of innovative shore protection activities focusing on "soft" measures/technologies that can sustain proper ecosystem functioning/productivity in each of the coastal lagoons through the preservation of existing wetlands and enhancement of their functionality. The activities also represent an important test of the suitability of "soft" protection measures given the geomorphologic, climatic, and development characteristics of the Nile Delta area. Based on the CoRI study for the SNC, the Idku, Burullus, and Manzala coastal lagoons will experience increasing impacts from sea level

rise. If sea level rise trends persist into the future as expected, each of these coastal lagoons will eventually be in need of protective measures in order to sustain their function as providers of numerous environmental services vitally important to the Nile Delta including the following: recharging groundwater, nutrient recycling, nutrient retention, water quality control, water flux control, erosion control, coastline stabilization, sediment retention, storm protection, and other.

85. Absent the introduction of suitable adaptation measures, SLR will disrupt the provision of these vital ecosystem services that provide for coastal protection, Hence, the underlying objective of this Output is to pilot a set of innovative shore protection activities focusing on "soft" measures/technologies that can sustain proper ecosystem functioning/productivity in each of the coastal lagoons through the preservation of existing wetlands and enhancement of their functionality. The activities also represent an important test of the suitability of "soft" protection measures given the geomorphologic, climatic, and development characteristics of the Nile Delta area.

86. "Soft" shore protection corresponds to mechanisms used to mitigate and prepare for the effects of SLR by utilizing the ambient environment without strong human intervention. It is a typically component of ICZM and has been used effectively in the past in Egypt as has been noted earlier. The specific framework adopted for the design and implementation of these measures is the "Living Shorelines" approach that has been adopted for protection of low-lying coastal areas in other parts of the world. The approach focuses on an innovative set of bank stabilization and habitat restoration techniques to reinforce the coastline, minimize coastal erosion, and maintain coastal processes while protecting, restoring, enhancing, and creating natural habitat for natural resources and productive activities (Burke Environmental Associates, 2005).

87. This approach has been dubbed "Living Shorelines" because it provides "living space" for riverine and coastal organisms, which is accomplished via the strategic placement of native vegetation, sand fill, organic materials, and, if necessary, a small amount of reinforcing rock (National Oceanic and Atmospheric Administration, 2009). These primarily non-structural shoreline stabilization methods create a vegetative buffer for the land and improve water quality. The approach has been shown to be an effective strategy to control erosion and reduce land loss to sea level rise in other areas, including the Chesapeake Bay in the United States (Maryland Department of Natural Resources, 2000)[11].

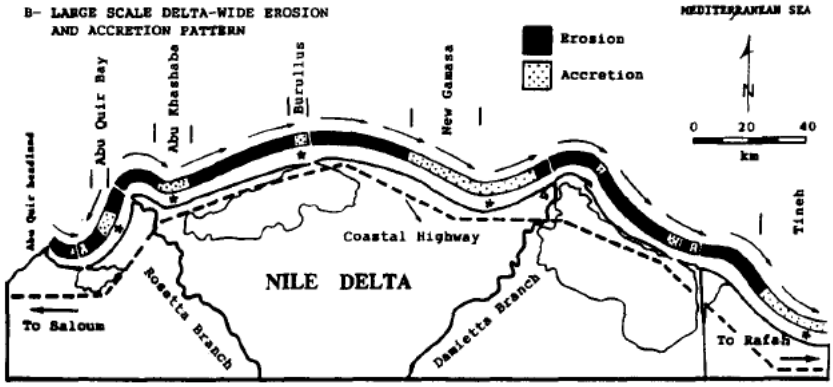
88. The "Living Shoreline" approach will be tested in a form of a number of specific on-the-ground coastal adaptation projects to be implemented under the ICZM framework. The actual measures to be implemented are on a pilot scale and focused on discrete stretches of coastline that have already been identified as areas of sand accretion due to the installation of hard coastal protection structures (see shaded accretion zones in Figure 2). The purpose of focusing pilot activities on such stretches is twofold. First, the unintended gains realized through up-current installation of hard structures will be consolidated by bank stabilization techniques that further reinforce the coastline in these areas and protect the nearby coastal lagoons. Secondly, these areas offer a strategic opportunity to monitor the adoption of innovative shoreline protection techniques in a relatively favorable environment and hence to evaluate the benefits of expanding the measures in the future to other shoreline areas along the Nile Delta.

[11] More details on the Living Shoreline approach can be found in Section IV: *Annex B: Explanation of the "Living Coasts" approach.*

89. The specific measures to be installed in these areas include planting suitable crops in coastal zone for coastal protection in a 'vegetative buffer' structure, re-nourishing beaches, reinforcing sand dune systems as a defense mechanism, revegetation to stabilize seabed sediment, reduction of nutrient loads from agriculture, and the establishment of conservation zones to preserve essential coastal habitats. Shoreline Approach will be fully customized to the context of Egypt's shoreline. For example, the vegetative buffers or plantations to stabilize coastal dunes, wherever appropriate, should use the local varieties; some 18 plant varieties exist in Egypt that can support dune systems without or very limited water requirements. The role of pre-feasibility studies scripted into the project design is to identify the most appropriate 'soft' protection strategies given the shorelines characteristics. Through these measures, ecosystems services provided by the coastal lagoons will be maintained and in some areas possibly restored, habitats will be preserved, water quality protected, and coastal lands preserved for consideration in future land use planning activities. The approach requires substantial planning and a different set of materials than used in conventional armoring approaches. Notably, conditions must be right for vegetative cover to survive (e.g., adequate sunlight for grasses) across seasonal changes. Finally, ongoing evaluation and maintenance of the installed measures will be essential to ensure their ongoing viability and provide lessons that could be built into the ICZM process.

90. A major part of Output 2.1 will be the engagement and mobilization of the local communities around the lagoons. These include farmers who have a stake in protecting agricultural lands from future sea level rise, as well as fisherman and whose current and future livelihoods are directly impacted by lagoon ecosystem health. The project will engage communities and NGOs throughout the project cycle; starting from the design/selection of the actual on-the-ground measures, proceeding to implementation activities, and including the development of monitoring and evaluation schemes to gauge the actual effectiveness of the 'soft' coastal stabilization measures. A high level of local engagement is critical to ensuring the ongoing viability of the pilot adaptation measures. It is also necessary to ensure community ownership and buy-in of the strategy such that the "soft infrastructure" (vegetative buffers etc) installations are maintained through the duration of the project and thereafter. The involvement of local NGOs will also include building their capcity to understand expected climate change effects on the local communities and how they can include the adapatation to climate change perspective into their programmes and activities.

Figure 2: Erosion and accretion patterns in the Nile Delta in front of the Idku, Burullus, and Manzala coastal lagoons (Frihy, 1999)



91. *Output 2.2: Socio-economic assessment and adaptation option appraisal:* The project will introduce the methods and practice for socio-economic evaluation of adaptation options as part of the ICZM framework. Workshops and trainings will be held for relevant agency staff to learn socio-economic assessment techniques with respect to adaptation options. Such assessment will be conducted to demonstrate effectiveness and efficiency of "soft" adaptation measures as opposed to conventional "hard" protective measures that is the main preferred practice in Egypt. The *Information and Decision Support Centre*, under the cabinet of ministers, is an important think tank that provides analytical inputs to policies and development plans. The proposed

project will work closely with this Centre to introduce the skill-sets and knowledge of socio-economic valuation of climate change impacts that need to be addressed in the policies and development plans, especially in coastal area development and investment decisions.

92. *Output 2.3: Introduction of climate risk assessment into ICZM system for Nile Delta:* A climate risk assessment process will be institutionalized within the final ICZM plan, and adopted by relevant government entities, e.g. Shore Protection Authority, General Organization of Physical Planning, Tourist Development Authority, Health, Safety and Environmental Department of the Ministry of Petroleum, and CoRI. This process represents a formal approach to the integration of climate change risks into ongoing coastal development planning. Several potential climate proofing tools that are being used in other contexts (e.g., ORCHID, CRiSTAL) will be evaluated and a suitable or adapted tool selected for Egypt. A number of tools for coastal modeling, risk assessment and planning (see output 1.4) will be introduced and applied for improved coastal management by the relevant entities. As these tools serve different purposes, they will complement and support the integration of coastal risk assessments into the ICZM system while ensuring climate sensitive ICZM strategies. The aim of this process is to identify suitable short-term measures to be undertaken as part of baseline development activities and be linked to long-term measures promoted through the GEF/SCCF funded project to ensure and integrated approach and avoid mal-adapted investment and coastal protection strategies.

93. Outcome 3: An enhanced M&E framework and knowledge management system in place.

- **Baseline**: No system in place to date. Lack of political involvement and the fact that there is no consensus view on coordination across responsible ministries means that knowledge capture and transfer across institutions is little to none. Currently, there is a multiplicity of controls and consenting regimes and regulators in Egypt, with overlapping jurisdictions and without a lead or coordinating regulator. An integrated coordination of roles, objectives and responsibilities is a pre-requisite to successful ICZM implementation including the key component of both horizontal and vertical knowledge transfer. Efforts are underway to overcome these barriers to ICZM implementation, coordination and knowledge sharing but have been unsuccessful so far. key drawbacks and / or improvements specific to each outcome?

- **Adaptation alternative:** Knowledge transfer is a key part of national capacity development to integrate climate risks into coastal zone management. The knowledge management system established for the project will facilitate the dissemination of both internal and external of lessons learned and the project is implemented in close synergy with UNDP's Adaptation Learning Mechanism (ALM), report informs ALM. Key deliverables include the establishment and introduction of a M&E system, lessons shared internationally through the ALM, and lessons disseminated nationally through Egyptian institutions.

- Specific outputs associated with this outcome include:

94. *Output 3.1: M&E system with measurable indicators introduced:* Results-based management and evaluation mechanisms will be systematically integrated into the management of all components of the proposed project. The proposed M&E system is explained in Part IV. UNDP's M&E framework for adaptation is used to track the project progress and adaptation benefits.

95. *Output 3.2: Lessons codified and disseminated through the ALM:* A knowledge management plan to capture lessons on SLR induced socio-economic impacts as well as best practices on integrating appropriate adaptation to climate change responses into national and local development policy will be formulated. The objective of the knowledge management plan is to disseminate lessons to relevant stakeholders on the national and international levels. Towards this end, linkages to UNDP-GEF's Adaptation Learning Mechanism will be established.

96. *Output 3.3: Lessons disseminated throughout Egyptian Institutions:* A program to build awareness within Egyptian institutions regarding emerging lessons from the application of the living shorelines approach. The objective of the knowledge management plan is to disseminate

lessons to relevant governmental stakeholders responsible for activities in coastal areas. Towards this end, linkages to the climate-proofed ICZM framework will be pursued. Once the knowledge sharing plan is developed, it will be implemented and institutionalized through the virtual centre for integrated (cross-sectoral) research for climate change adaptation established (output 1.2), which is to be the primary forum for information dissemination. This virtual centre in addition to fostering climate data and information sharing, will share lessons learned through project implementation to further inform coastal management policy.

Project Indicators, Risks and Assumptions

97. A major risk that might prevent the project objective(s) from being achieved is overcoming political challenges. The proposed project will require a substantial change within government agencies, NGOs and communities from reactive crisis management to proactive risk management, including emphasis on addressing issues of land use planning in the context of coastal management. The greatest risk is the slow pace of change within government agencies. Relative to this GEF/SCCF project, this risk however is likely to be minimized by the recognition that this project is an opportunity to catalyst those additional changes in baseline development programmes and projects.

98. The proposed project will require a substantial change within governments, NGOs and communities from reactive crisis management to proactive risk management, including emphasis on addressing issues of land use planning in the context of coastal management. Additional, risks that might affect the success of the project include the slow pace of policy modification such that identified policy changes that account for climate risks are not adopted in a timely fashion. The greatest risk in this regard is inertia within government agencies towards change. This risk however is likely to be minimized by impressing upon government that this GEF/SCCF project is an opportunity to catalyst those additional changes in baseline development programmes and projects.

99. Given the multitude of stakeholders involved at different levels in different societies, integrated communication and coordination will be the key to success, as well as continued buy in and support from all relevant stakeholders. This requires that all relevant parties are willing to share data/information promptly and freely. The project aims to address these potential risks by choosing pilot areas where there are existing ICZM initiatives with substantial community involvement. Discussions have already commenced with the SMAP III local project proponents. The mitigation strategy to address this risk involves early and consistent application of an awareness programme for policy makers, and engagement of senior levels of government in monitoring project implementation. Risks and assumptions, level of risk (low, medium or high) and plausible risk mitigation strategy are summarized in the Table that follows.

Risk	High	Medium	Low	Proposed Mitigation
Appropriate ministries and agencies are not willing to engage with project staff in creation of NCZMC		X		High level support of the project at key Ministries will be mobilized. Currently, overlapping mandates will be clarified and roles and responsibilities for coastal adaptation introduced based on wide consultation and consensus-based decisions. Existing stakeholder coordination platforms such as NCZMC will be reinforced.
Local stakeholders are not committed to implement adaptation measures on the ground; precluding systematic tracking of	X			Continuous stakeholder consultation and engagement will be employed by the project. This has been done already during the PPG and will continue in more strategic fashion during the FSP phase. Meetings with local stakeholders

development and adaptation benefits;				to explain project activities and enlist support. Community mobilization and participation in design, implementation and impact monitoring of on-the-ground adaptation measures will be a project methodology.
The government, at its high level is not sufficiently supportive of or engaged in the ICZM policy planning process.		X		Regular outreach to ministry contacts to explain progress and demonstrate benefits

Project additionality and adaptation benefits

100. Given the Nile Delta's vulnerability to climate change and sea level rise, it is clear that Egypt's challenges are compelling. The project's strategies for reducing vulnerability to climate change is to climate-proof proposed coastal development plans through the implementation of an ICZM framework and implement new and innovative pilot adaptation measures that complement existing protection structures. The overarching framework under which these measures will be implemented will be an updated Integrated Coastal Zone Management (ICZM) plan, fully supported by reactivated National Coastal Zone Management Committee responsible for implementing and monitoring the plan.

101. Through the project, Egyptian decision-makers responsible for managing vulnerable coastal zone resources will be better equipped to adapt to anticipated sea level changes and related climate change risks. Since current legsilation and regulations are insufficient and in some cases even maladpated to an Egyptian future with higher sea levels, the project ensures that Egypt's institutional and legislative capacities will be appropriately matched to the risks the country faces and that agencies have the requisite financial resources allocated to respond to these needs in a sustainable way. Additiionally, because climate risk assesment will be institutinoalized under the ICZM policy for all involved government entitites, agencies will be better equipped to move forward to identify vulnerability and build adaptive capacity and hopefully avoid the worst of potential impacts.

102. The investment in the amount of $4 million by the GEF/SCCF catalyzes three times that level of funding (i.e., $12 million) funds by directing coastal protection budgets of the Egyptian Shore Protection Authority into viable adaptation measures in the five year project timeframe. A rough approximation of baseline and expected budget outlays for the 10-year period following project completion are shown in the Table below indicating that GEF/SCCF funding is expected to lead to a two-fold return on the investment.

Table 6: Estimated baseline and additional costs for coastal protection in Egypt (million US$)

Activity	Baseline	Project-related
Shoreline protection measures	20	25
Climate proofing activities	0	2
ICZM processes	<1	5
Soft protection measures	<1	10
Climate risk assessments	0	2
Institutional coordination for sea level rise	<1	3
Development of seal level rise information systems, networking, and database management	0	5
Total	23	52

103. The introduction of innovative, soft-shoreline protection measures better equips Egypt to a rapidly changing shoreline situation. The "living shoreline" approach, can enable a coastal ecosystem to be resilient in the face of climate change by

- Reducing negative effects of armoring (downdrift erosion);

- maintains beach habitat;
- Allowing for shoreline migration where needed;
- Stabilizing sediment without requiring costly construction procedures;
- Providing protective barrier;
- Maintaining and often increasing habitat area;
- Protecting both the beach and inland residential and agricultural areas from sea level rise;
- Naturally protecting shorelines and marshes and inhibit erosion inshore of the reef; in some cases, can even induce sediment deposition
- Incorporating benefits of multiple systems; can address longer stretches of coastline

Country Ownership: Country Eligibility and Country Drivenness

104. The project is aligned with UNDP's Common Country Assessment (CCA) 2005 (CCA) and the United Nations Development Assistance Framework (UNDAF) (2007-2011) and the Country Programme Document 2007-2011(CPD) The vulnerability of the coastal zones and Nile Delta to climate change impacts has been highlighted in UNDP's CCA (2005). The project contributes to the new UNDAF Outcome on reducing regional human development disparities and improving environmental sustainability. In addition, the project contributes towards Country Programme (CP) Outcomes 3 and 4 on improving management of natural resources and institutional capacity building for environmental sustainability.

105. One of most important outcomes of Egypt's development plans is to set Egypt on the fast track for economic, social and political transformation while safeguarding Egypt's natural resources and ecological balance (EHDR 2005). Parts of these plans include major investments in coastal tourism infrastructure as a means for encouraging sector income generation. Clearly, any hopes for increases in this sector will need to ensure that climate change risks to planned infrastructure projects are adequately accounted for in plans. A key benefit of the project is that the ICZM focus to managing climate risks to Egypt's shorelines calls for management regimes that inherently address the multi-user, multi-function features of Egypt's coasts.

106. The project responds to critical priority of Nile Delta's vulnerability to sea level rise subsequent inundation of a significant amount of productive land. The latest IPCC reports and UNDP Human Development Report – "Fighting climate change: Human solidarity in a divided world"- identified the Nile Delta as a global vulnerability "hot spot". This is an urgent national priority identified by the National Communication and the project proposal is based on the findings and recommendations of both the INC and SNC.

107. According to the findings of a recent CoRI Delta vulnerability study, undertaken to support Egypt's Second National Communication, the general processes and policies have been proposed as follows sand dunes systems should be treated as the first defensive line for the Nile Delta Decision makers in coastal governorates as well as concerned ministers should be aware of the importance of sand dunes systems and their role in protecting the coastal zone of the Nile Delta. Coastal protection construction need regular maintenance and should be considered in any coastal zone management plans. Consideration should be paid to coastal lakes as one of the most appropriate locations in which to build adaptive capacity against sea level rise.

108. The project outcomes proposed and outline in the "Project Goal, Objective, Outcomes and Outputs/activities" section directly respond to these processes. Outcome 2, in particular, involves on the ground pilot adaptation measures for the coastal lake ensuring the ecosystem functionality and shorelines are resilient as sea level rises.

Sustainability

109. The Government of Egypt has made a substantial financial commitment to ensuring the protection of its shores the project's proposed development and adoption of a national ICZM policy, supported by an active Coastal Zone Management Committee that's responsible for the

oversight of the policy's implementation. Given the urgency of the risks from sea level rise that threaten the Nile Delta and its communities, the Management Committee cannot afford to return to its prior level of inactivity without incurring serious financial consequences. The widely recognized high cost of inaction is such that the Government agencies implicated in the ICZM policy understand the need for ongoing vigilance in the implementation of the projects throughout the project period and well into the future.

110. Additionally, the sustainability of the project results will be ensured through the internal capacity development within government agencies that are responsible for implementing the ICZM policy and adaptation measures, as well as with stakeholders in the local fishing and farming communities. Capacity development has been scripted into each of the project outcomes. And while previous versions of coastal management policies essentially created a vacuum of decision-making responsibilities and led to several years of inactivity, the new ICZM policy framework will include clear indications of stakeholder roles that ensure the policy and adaptation measures are implemented, and constantly monitored and evaluated. The SCCF/GEF funded project has relevant collaboration and synergistic possibilities that contribute to its sustainability. The project builds on the groundwork laid during the UNEP and EEAA Mediterranean Action Plan (MAP) development. Moreover, the project will operate in close synergy with the SMAP III initiative in Egypt, which provides support for the preparation of an ICZM plan for Port Said. Additionally, the project builds off and complements the Nile Delta Initiative (NDI) – partnership programmme of all riparian countries.

111. The project will be implemented in coordination with the UN Climate Change Risk Management Program (CCRMP) in Egypt, a Joint Programme launched in October 2008 and funded by the UNDP-Spanish MDG Achievement Fund that involves Six UN Agencies and four Government entities. The UN joint programme will develop a Regional Circulation Model for the River Nile that will forecast the impact of climate change on precipitation in the Basin. Part of the forecasting efforts include assessing adaptation mechanisms in response to SLR and providing tools to help policy makers to make strategic decisions regarding adaptation to climate change impacts and the CCRMP will also support the development of the Coastal Zone Adaptation strategy for the North Coast of Egypt.

Replicability

112. Scripted into each of the outcomes are strategies for documenting lessons learned, and training workshops and programs- once established- can easily be transferred to other locations. The first outcome, to strength capacity in coastal settlements and among policy makers to integrate climate risks into all activities in the coastal zone includes a set of workshops to raise awareness and educate that will be replicable across Egyptian coastal settlements and even used externally for other countries facing similar threats.

113. The second outcome of the project involves the implementation of pilot adaptation measures, including the testing of innovative long term adaptation measures for protection of Delta and Alexandria coastal zones within the context of ICZM. The implementation of long term measures will be monitored and evaluated and used to inform whether projects should be replicated elsewhere because the ongoing evaluation and maintenance of strategies is important to ensure success of any new management strategy. Examples of innovative soft shore protection appropriate in the Nile delta include planting suitable crops in coastal zone for coastal protection in a 'vegetative buffer' structure, re-nourishing current beaches, installing sand dune systems as a defense mechanism, and utilizing the coastal lakes as an adaptive measure to sea level rise where appropriate. Extension of similar projects to other locations will be done primarily by the State Government in collaboration with vulnerable groups.

114. The third outcome of the project is the establishment of a knowledge management system. The objective of the knowledge management plan is to disseminate lessons to relevant stakeholders on the national and international levels; this includes a better understanding of lessons learned and emerging best practices, captured and up-scaled at the national level. The lessons learned are

targeted for linkages to UNDP-GEF's Adaptation Learning Mechanism (ALM) where knowledge can be shared both internally within Egypt for other coastal vulnerable zones and externally for replication in other countries and areas should the implemented strategies prove successful.

PART III: MANAGEMENT ARRANGEMENTS

Implementing Agency

115. The United Nations Development Program (UNDP) will be the Implementing Agency for the project. The UNDP is well positioned to assist Egypt in design and implementation of the proposed project. With SSCF funds, UNDP will support capacity-building programs to implement climate risk management at various levels of management in the coastal zone. UNDP's strong presence and development network in the country and especially its current work aimed at reducing regional human development disparities and improving environmental sustainability will provide a solid platform for successful implementation of the project. UNDP will also bring in its experience in disaster risk and hazard reduction activities as well as its extensive knowledge of ICZM/ICAM practices through the GEF/SCCF portfolio, globally. UNDP's methods developed for Adaptation Policy Framework (APF) will be brought into the context of ICAM.

116. The proposed project complements on UNDP's existing in-country strategy elaborated in its United Nations Development Assistance Framework 2007-2011 (UNDAF), Country Programme Document 2007-2011(CPD) and Common Country Assessment 2005 (CCA). The proposed project is aligned with UNDP's comparative advantage in improving capacity building, providing technical and policy support as well as expertise in project design and implementation in relevant are such as sustainable land management and integrated coastal zone management (ICZM). Through its network of technical staff, in additional to operational expertise in designing similar GEF Council approved projects, UNDP is well positioned to assist Egypt to design and implement the proposed project.

117. In line with the UNDAF, UNDP will make its overarching objective in the programming cycle 2007-2011 the realization of the MDG-based vision espoused in the EHDR 2005 and the implementation of the MDGs Integrated Package of Services (IPS) framework. Part of achieving this objective includes the sustainable management of coastal zones and development of shoreline protection strategies in such a way that builds adaptive capacity of the most vulnerable populations in the delta—those most at risk, and on the front lines, of the country's battle with rising sea levels.

118. The project will be implemented in close coordination and collaboration with all relevant government institutions, local communities and NGOs, as well as with other related relevant projects in the region. The UNDP-CO will be an active partner in the project's implementation. It will support implementation by, contracting project personnel, experts and subcontractors, undertaking procurement, and providing other assistance upon request of the National Executing Agency. The UNDP-CO will also monitor the project's implementation and achievement of the project outcomes and outputs, and will ensure the proper use of UNDP/GEF funds. Financial transactions, reporting and annual auditing will be carried out in compliance with UNDP regulations for national project execution modality.

119. In order to accord proper acknowledgement to GEF for providing funding, a GEF logo will appear on all relevant GEF project publications, including, among others, project hardware purchased with GEF funds. Any citation on publications regarding this project will also accord proper acknowledgment to GEF. The UNDP logo will be more prominent (and separated from the GEF logo if possible), as UN visibility is important for security purposes.

Executing Arrangements

120. The project will be executed following established UNDP national execution (NEX) procedures.

Implementation arrangements seek to establish a bridge between national authorities responsible for formulating and integrating Climate Change policies, and national, regional and local authorities engaged directly in coastal zone management. Knowledge and information provided through monitoring institutions and best practices and lessons learned through the implementation of pilot projects will be the tools to ensure effective coordination and follow up among the institutions involved in the project.

121. The Executing Agency/Implementing Partner will be the Ministry of Water Resources and Irrigation through the collaboration between Coastal Research Institute (CoRI) and the Egyptian Shore Protection Authority (ESPA). The Executing Agency/Implementing Partner will appoint a National Project Director and will appoint jointly with UNDP CO and with GEF funding a Project Manager and an administrative/financial assistant. A summary of the roles and responsibilities of the National Project Director, the Project Manager, and the Administrative and Financial Assistant are provided below.

122. The National Project Director will be a high-level government official primarily responsible for overall implementation of the Project. This responsibility includes representing and supporting project objectives at high decision making levels within the Government of Egypt. The National Project Director also takes the primary responsibility for representing the Project to co-financiers, as well as for ensuring that the required government support to reach the milestones of the Project is available.

123. The Project Manager will assume overall responsibility for the successful implementation of project activities and the achievement of planned project outputs. S/he will work closely with the national and international experts hired under the project, as well as the Project Assistant, and will report to the National Project Director and to the UNDP Country Office. The Administrative and Financial Assistant will provide assistance to the Project Manager in the implementation of day-to-day project activities. S/he is responsible for all administrative (contractual, organizational and logistical) and accounting (disbursements, record-keeping, cash management) matters related to the project.

124. Project Management Unit (PMU): The day-to-day implementation and management of the project will be undertaken by the project management unit, under the overall guidance of a Project Board, which will be responsible for steering the activities of the PMU. Heading the project board will be the Ministry of Water Resources and Irrigation, and members will include the National Water Research Center, Shore Protection Agency, Coastal Research Institute , and UNDP CO representative. Additional members will be decided during the project inception phase. For the PMU, a full time project manager, technical, administrative and financial staff, will be selected jointly by the executing agency and UNDP, in consultation with the UNDP/GEF Regional Co-ordination Unit. The role of the PMU will be to: a) ensure overall project management and monitoring according to UNDP rules on managing UNDP/GEF projects, b) facilitate communication and networking among key stakeholders, and c) organize the meetings of the Project Board.

125. UNDP CO will play the role of Senior Supplier—being a GEF Implementing Agency represented in the country. Project quality assurance will be ensured by, UNDP CO together with the UNDP GEF RCU. The PB will monitor the project's implementation, provide guidance and advice, and facilitate communication, cooperation, and coordination among stakeholders and other project partners. At the initial stage of project implementation, the PMU may, if deemed advantageous, wish to meet more frequently to build common understanding and to ensure that the project is initiated properly. Further details on the PMU are provided in the monitoring and evaluation section of the document. The project will hire short-term national and international experts for specific project assignments (see Annex C for indicative scope of the assignment of key experts/ consultants). Project activities will be contracted out on a competitive basis through tenders.

PART IV: Monitoring and Evaluation Plan

126. Project monitoring and evaluation will be conducted in accordance with established UNDP and GEF procedures and will be provided by the project team and the UNDP Country Office (UNDP-CO) with support from UNDP/GEF. Results-based management mechanisms will be systematically integrated into the management of the project. The Strategic Results Framework Matrix in Section II provides performance and impact indicators for project implementation along with their corresponding means of verification. These will form the basis on which the project's Monitoring and Evaluation system will be built.

127. Day to day monitoring of implementation progress, including in the three project locations, will be the responsibility of the Project Manager (PM), and based on the project's Annual Work Plan and its indicators. Periodic monitoring of implementation progress will be undertaken by the UNDP-CO through quarterly meetings with the project proponent, or more frequently as deemed necessary. Annual monitoring will occur through the Tripartite Review (TPR) at least once every year. The terminal tripartite review (TTR) will be held in the last month of the project operations. Project Monitoring Reporting will take place at regular interval throughout the project. The Project Manager in conjunction with the UNDP-GEF extended team will be responsible for the preparation and submission of the following reports that form part of the monitoring process: a project inception report, annual project implementation reports, and a project terminal report.

128. The following sections outline the principle components of the Monitoring and Evaluation Plan and indicative cost estimates related to M&E activities. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Report following a collective fine-tuning of indicators, means of verification, and the full definition of project staff M&E responsibilities.

Monitoring and Reporting

129. A Project Inception Workshop will be conducted with the full project team, relevant government counterparts, co-financing partners, the UNDP-CO and representation from the UNDP-GEF Regional Coordinating Unit, as well as UNDP-GEF (HQs) as appropriate.

130. A fundamental objective of this Inception Workshop will be to assist the project team to understand and take ownership of the project's goals and objectives, as well as finalize preparation of the project's first annual work plan on the basis of the project's logframe matrix. This will include reviewing the logframe (indicators, means of verification, assumptions), imparting additional detail as needed, and on the basis of this exercise finalize the Annual Work Plan (AWP) with precise and measurable performance indicators, and in a manner consistent with the expected outcomes for the project.

131. Additionally, the purpose and objective of the Inception Workshop (IW) will be to: (i) introduce project staff with the UNDP-GEF expanded team which will support the project during its implementation, namely the CO and responsible Regional Coordinating Unit staff; (ii) detail the roles, support services and complementary responsibilities of UNDP-CO and RCU staff vis à vis the project team; (iii) provide a detailed overview of UNDP-GEF reporting and monitoring and evaluation (M&E) requirements, with particular emphasis on the Annual Project Implementation Reviews (PIRs) and related documentation, the Annual Project Report (APR), Tripartite Review Meetings, as well as mid-term and final evaluations. Equally, the IW will provide an opportunity to inform the project team on UNDP project related budgetary planning, budget reviews, and mandatory budget revisions.

132. The IW will also provide an opportunity for all parties to understand their roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and decision-making structures will be discussed again, as needed, in order to clarify for all, each party's responsibilities during the project's implementation phase.

133. Monitoring responsibilities and events: A detailed schedule of project reviews meetings will be developed by the project management, in consultation with project implementation partners and stakeholder representatives and incorporated in the Project Inception Report. Such a schedule will include: (i) tentative time frames for Tripartite Reviews, Steering Committee Meetings, (or relevant advisory and/or coordination mechanisms) and (ii) project related Monitoring and Evaluation activities.

134. Day to day monitoring of implementation progress will be the responsibility of the Project Manager based on the project's Annual Work Plan and its indicators. The Project Team will inform the UNDP-CO and MWRI of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion.

135. The Project Manager and the Project GEF Technical Advisor will fine-tune the progress and performance/impact indicators of the project in consultation with the full project team at the Inception Workshop with support from UNDP-CO and assisted by the UNDP-GEF Regional Coordinating Unit. Specific targets for the first year implementation progress indicators together with their means of verification will be developed at this Workshop. These will be used to assess whether implementation is proceeding at the intended pace and in the right direction and will form part of the Annual Work Plan. The local implementing agencies will also take part in the Inception Workshop in which a common vision of overall project goals will be established. Targets and indicators for subsequent years would be defined annually as part of the internal evaluation and planning processes undertaken by the project team.

136. Periodic monitoring of implementation progress will be undertaken by the UNDP-CO through regular meetings with Project Manager, or more frequently as deemed necessary. This will allow parties to take stock and to troubleshoot any problems pertaining to the project in a timely fashion to ensure smooth implementation of project activities.

137. UNDP Country Offices and UNDP-GEF RCUs as appropriate, will conduct yearly visits to projects that have field sites, or more often based on an agreed upon scheduled to be detailed in the project's Inception Report / Annual Work Plan to assess first hand project progress. Any other member of the Steering Committee can also accompany, as decided by the SC. A Field Visit Report will be prepared by the CO and circulated no less than one month after the visit to the project team, all SC members, and UNDP-GEF.

138. Annual Monitoring will occur through the Tripartite Review (TPR). This is the highest policy-level meeting of the parties directly involved in the implementation of a project. The project will be subject to Tripartite Review (TPR) at least once every year. The first such meeting will be held within the first twelve months of the start of full implementation. The Project Manager will prepare reports that will be compiled into APR/PIR by the PMU at least two weeks prior to the TPR for review and comments.

139. The APR/PIR will be used as one of the basic documents for discussions in the TPR meeting. The PMU will present the APR to the TPR, highlighting policy issues and recommendations for the decision of the TPR participants.

140. The terminal tripartite review (TTR) will be held in the last month of regional project operations. The PMU is responsible for coordination of the Terminal Report for all project activities and making sure it is submitted it to the UNDP-CO and GEF's Regional Coordinating Unit. It shall be prepared in draft at least two months in advance of the TTR in order to allow review, and will serve as the basis for discussions in the TTR. The terminal tripartite review considers the implementation of the project as a whole, paying particular attention to whether the project has achieved its stated objectives and contributed to the broader development objective. It decides whether any actions are still necessary, particularly in relation to sustainability of project results, and acts as a vehicle through which lessons learnt can be captured to feed into other projects under implementation of formulation The TPR has the authority to suspend disbursement if project performance benchmarks are not met. Benchmarks will be developed at the IW, based on

delivery rates, and qualitative assessments of achievements of outputs.

141. Project Monitoring Reporting: The Project Manager in conjunction with the UNDP-GEF extended team will be responsible for the preparation and submission of the following reports that form part of the monitoring process.

142. Inception Report: A Project IR will be prepared immediately following the IW. It will include a detailed First Year/ AWP divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the project. The Report will also include the detailed budget for the first full year of implementation, prepared on the basis of the AWP, and including any monitoring and evaluation requirements to effectively measure performance during the targeted 12 months time-frame. The IR will include a more detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to date on project establishment and start-up activities and an update of any changed external conditions that may affect project implementation.

143. Project Reviews: This is intended to be a monitoring process that combines the Annual Project Report (APR) and the Project Implementation Review (PIR). The purpose of these reviews is to reflect progress achieved in implementing the project and in meeting Annual Work Plan milestones regarding the performance of the project in contributing to intended outcomes through outputs and partnership work. The format of the project reviews is flexible but should include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome
- The constraints experienced in the progress towards results and the reasons for these
- The three (at most) major constraints to achievement of results
- Clear recommendations for future orientation in addressing key problems in lack of progress

144. Project Terminal Report: During the last three months of the project the project team will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, objectives met, or not achieved, and structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

Independent Evaluation

145. The project will be subjected to at least two independent external evaluations as follows:-

- *Mid-term Evaluation:* An independent Mid-Term Evaluation will be undertaken at the end of the second year of implementation. The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term evaluation will be prepared by the UNDP CO in collaboration with UNDP-GEF RCU.
- *Final Evaluation:* An independent Final Evaluation will take place three months prior to the terminal tripartite review meeting, and will focus on the same issues as the mid-term evaluation. The final evaluation will also look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. The Final Evaluation should also provide recommendations for

follow-up activities. The Terms of Reference for this evaluation will be prepared by the UNDP CO in collaboration with UNDP-GEF RCU Learning and Knowledge Sharing

146. Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums. In addition:

- The project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks, organized for Senior Personnel working on projects that share common characteristics. UNDP/GEF has established a number of networks that will largely function on the basis of an electronic platform to which this project's lessons learned will be contributed e.g. the Adaptation learning Mechanism.
- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned.
- The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identify and analyzing lessons learned is an on- going process, and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNDP/GEF shall provide a format and assist the project team in categorizing, documenting and reporting on lessons learned. To this end a percentage of project resources will need to be allocated for these activities.

PART V: Legal Context

147. This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of Egypt and the United Nations Development Programme, signed by the parties on [date]. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement.

148. The UNDP Resident Representative in Egypt is authorized to effect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto by the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

a) Revision of, or addition to, any of the annexes to the Project Document;

b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;

c) Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and

d) Inclusion of additional annexes and attachments only as set out here in this Project Document

SECTION II: STRATEGIC RESULTS FRAMEWORK (SRF)

Strategic Results Framework, SRF (formerly GEF Logical Framework) Analysis

149. The project has three major outcomes, encompassing numerous outputs, which resulted from initial scoping exercises undertaken during the various stages of the PPG phase as well as the development of the FSP. A summary table is provided below. An elaborated summary of each outcome of the project has been provided in the section entitled "Project Goal, Objective, Outcomes and Outputs/activities". Details regarding activities, success indicators, means of verification, risks/assumptions corresponding to each outcome are provided in the Strategic Results Framework in the following pages.

Project Overview:		
Project Components	Expected Outcomes	Expected Outputs
1. Regulatory Framework and Institutional Capacity	Capacity to improve resilience of coastal settlements and development infrastructure is strengthened	▪ Coastal development legislation and regulations modified (focusing on ICZM and EIA); ▪ Institutional capacity of NCZMC strengthened; ▪ Information systems established, including a virtual centre for climate change adaptation research ▪ Budgetary planning of Shore Protection Agency reflects adaptation needs;
2. On the ground measures	Innovative and environmentally friendly adaptation measures enforced in the framework of Nile Delta ICZM.	▪ Adaptation pilot projects implemented consistent with the "Living Shorelines" approach, including mobilization of communities around the lagoons ▪ Socio-economic assessment and adaptation option systems developed; ▪ Climate risk assessment into ICZM system for Nile Delta introduced
3. Knowledge management	M&A framework and knowledge management system in place	▪ M&E system with measurable indicators introduced; ▪ Lessons codified and disseminated through ALM ▪ Lessons disseminated throughout Egyptian institutions

Project Strategy	Indicator	Baseline value	Target	Sources of verification	Risks and Assumptions
Overall Goal: To enhance Egypt's resilience and reduce vulnerability to Climate Change impacts					
Objective: to integrate the management of SLR risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta	Enhanced resilience of Nile Delta coastal area on approximately 2,504 km^2 due to adaptation measures (e.g. beach nourishment, vegetative buffers, sand placement and dune stabilization) 10% of Shoreline protection agency's budget includes coastal stabilization measures designed by the project.	North coasts of Egypt are characterized by high vulnerability to impacts of SLR. SLR will inundate land and coastal infrastructure and will also result in seawater intrusion will also further change the offshore water current patterns resulting in beach erosion and change in the shoreline which has its negative impact on tourism. SLR will also deteriorate coastal Mediterranean wetlands and induce stress on fisheries in the coastal lagoons. Furthermore, SLR. The government has been investing in "hard" coastal protective measures that often diminish the robustness of the coast to anticipated SLR.	At least three types of resilience-enhancing measures employed by the project upon its completion in each of the three main coastal lagoons, (Idku, Burullus and Manzala coastal lagoons), covering 60% of coastal area of concern.	Pilot project reports; Project annual reports	The government remains committed to the coastal protection and willing to improve its current practices by introducing more innovative, environmentally friendly and cost-effective adaptation measures.
Outcome 1: strengthened Regulatory Framework and Institutional Capacity to improve resilience of coastal settlements and development infrastructure	A comprehensive regulatory and institutional framework for coastal adaptation built around ICZM principles and policies in place Enhanced data management systems to	Existing drafts of ICZM policies but don't account for sea level rise, and were never implemented; only certain specialized staff has knowledge of concrete adaptation measures. Information management systems reflect risks, but not climate-induced risks to CZ.	By end of the project national ICZM plan finalized, agency assigned to implement and carry out M&E By end of the project NCZMC re-activated and given necessary authority to implement and monitor ICZM and coastal zone decisions. Its members are	Government decisions; ICZM mandate; Meeting minutes and decision records; Project annual reports	Assumes policy makers are engaged and committed to finalizing the ICZM policy process Technical capacity to lead trainings and willingness of stakeholders to participate ; Decision makers and concerned

	improve ICZM decision-making in place SPA budget lines earmarked specifically for adaptive capacity	Existing budgetary allocations are insufficient to meet identified adaptation needs	engaged, committed with clear responsibilities and capacity to carry out responsibilities SPA has mandate, skills and tools to screen current and future investments for climate risk; At least 30 personnel from relevant institutions are trained in climate risk assessment and economic valuation methods; Within first year of project, information management system and data protocol established		ministers in coastal governorates are aware of the importance of adaptation and their role in coastal protection Assumes SPA staff are engaged and committed to including adaptation and that any turnover of staff does not negate the benefits of training and institutional capacity building with respect to familiarity with climate risk assessment and "climate proofing" investment strategies
Outcome 2. Strategies and measures that facilitate adaptation to climate change impacts, SLR in particular, are implemented on the ground in vulnerable coastal areas	Living Shoreline approach adopted to sustain functions and productivity in each of the vulnerable lagoons, in the face of sea level rise, through preserving existing wetlands and lagoon ecosystems and enhancing their functionality.	To date, shore protection has been dominated by hard protection measures; lagoon functionality and productivity is at risk due to predominantly non-climate factors. Wastewater discharge has changed pH and reduced lagoon productivity; depletion of fisheries As a result of the human activities and land reclamation projects, total area of El Burullus lagoon reduced during last century from 5,600 km3 (1925) to 317.2 km3 (1984) and now 197.8 km3 (2001); urban sewage and agriculture drainage has led to eutrophication.	Nourishment, plant/stone/sand fill placement allow for coast stabilization and ensure that lagoon borders are at least 2.0 m above lagoons water level Re-vegetation to stabilize seabed sediment (Idku lagoon) Beach nourishment, plant/stone/sand fill placement allow for coast stabilization and maintenance of lagoon border at least 2.5m above water level (Burullus lagoon). Beach nourishment, plant/stone/sand fill placement allow for coast stabilization and maintenance of lagoon border at least 2.5m above water level in both the lagoon and canal;	Project annual reports; M&E shows improvement from current deteriorated status as well as indications of resumed ecosystem functions e.g. groundwater recharge, nutrient recycling, water quality, erosion control, coast stabilization, sediment retention etc.	Assumes pre-feasibility studies confirm applicability of living shorelines (as implemented in the Chesapeake Bay) to Nile Delta; Assumes willingness of SPA and EEAA to introduce new, innovative shoreline management strategies

		The Manzala lagoon is the largest and most productive Lake in terms of its fisheries, estimated annual fish landings is roughly 60,000 tons. Since 1965, it has been receiving increasing amounts of agricultural runoff, industrial waste discharge, and sewage effluent that have led to eutrophication, decreased biodiversity, and reduced habitat for marine and avian species.	Erosion rate held constant and begins to decline to by .5 m/yr (Manzala lagoon); By end of the project methods and practice of climate riks assessment, socio-economic valuation (CBA) of adaptation options are established as part of the ICZM framework		
<u>Outcome 3.</u> Knowledge management: M&A framework and knowledge management system in place Output 3.1: Guidance documents for GEF and MWRI on climate change adaptation programming in the coastal zones provided	Knowledge and capacity for upscale and replication is in place LSA reflected in government entities' coastal management plans relevant to their unique mandate	No cases of best practices recorded Knowledge of adaptation measures in the context of coastal protection is very limited. There is no knowledge or awareness of the living shoreline approach (LSA) as an effective strategy for coastal adaptation	At the time of project completion, at least 3 examples of best practice generated through the project will be accessible through the ALM. Within 6 months of the start of implementation, a publicly accessible web-site will be created to share lessons and findings based on implementation. At the time of project completion, at least 3 examples of lessons learned a year have been compiled and disseminated a program to build awareness within Egyptian institutions regarding living shoreline approach; climate-proofed ICZM framework includes LSA as a national adaptation strategy	Website, Documentation, Knowledge products	ALM is operational and effective in time to document best practices from the project; Local stakeholders implement adaptation measures on the ground; systematic tracking of development and adaptation benefits; analysis and synthesis of lessons learned Acceptance and 'buy-in' by government agencies of LSA as alternative shoreline protection strategy to 'hard' infrastructure solutions
Implementing Partner (Executing Agency)			SPA and CoRI		

Annexes

Annex A: Detailed assessment of climate change risks on northern coast of Egypt

150. One of the most certain consequences of global climate change is a rise in mean sea level. Global models predict sea levels will rise about 0.01 to 0.22 meters by 2050, and from about 0.18 to 0.59 meters by 2100 (IPCC, 2007). The IPCC sea level rise scenarios in the 4th Assessment report are global averages that account for the effects thermal expansion of the oceans and the loss of land-based ice due to increased melting. That is, the IPCC estimates do not account for local land subsidence. Observations confirm that sea-levels are already rising in the Nile delta due to a combination of factors including coastal subduction and reduced sediment loads due to the construction of the High Aswan Dam upstream. Land subsidence is currently estimated at 1-5 mm/year (Emery et al., 1988; El Fishawi and Fanos, 1989).

151. The coastal area of the Nile delta is already subject to severe coastal erosion, even without accelerated sea level rise. The World Bank (2005) warns that the present coastal erosion and retreat of the Delta are aggravated by human interventions such as reduced sediment input, groundwater extraction, and hard engineering work in coastal strip. In addition to the current trends, Egypt's Mediterranean coast and the Nile Delta have been identified as highly vulnerable to climate change induced Sea Level Rise (SLR). Due to the concentration of much of Egypt's infrastructure and development along the low coastal lands and the reliance on the Nile delta for prime agricultural land, coastal inundation or saline intrusion caused by anthropogenic climate change induced sea-level rise will have a direct and critical impact on Egypt's entire economy.

152. The dominant feature of Egypt's Northern Coastal Zone is the low lying delta of the River Nile, with its large cities, industry, agriculture and tourism. The Delta and the narrow valley of the Nile comprise 5.5% of the area of Egypt but over 95% of its people of which 25% live in the Low Elevation Coastal Zone (LECZ) areas. In this context, the Nile Delta and Mediterranean Coast include 30-40% of Egypt's agricultural production, half of Egypt's industrial production, mainly Alexandria, Damietta and Port Said. The three main Delta lagoons are Idku, Burullus and Manzala produce over 60% Egypt's fish catch. In addition, Alexandria is known as the main summer resort in Egypt and the returns from the inbound tourism forms one of the main sources of income to the city. Approximately 15% of Egypt's GDP is generated in these LECZ (The World Bank, 2005).

153. The impact of sea level rise on the Egyptian coasts was studied through an EU-Funded project by CoRI and Delft Hydraulics in the period 1989-1992. The study defined the vulnerable areas and sectors as well as the mitigation measures required to reduce the impacts of sea level rise on the entire coasts of Egypt (3500 km). The study developed a numerical model to assess vulnerability of the coastal areas to SLR of 0.3 and 1 meter. The study revealed that a 0.3m SLR would be sufficient to increase flood frequency from the present estimate of one in ten year flood to ten times a year. Accordingly, the main goal of the current work is to assess the vulnerability of the Nile Delta coastal zone to climate change and to propose adaptation policy to cope with the expected impacts. The study focuses on the Nile Delta coastal zone as it is considered the main vulnerable area to sea level rise expected from climate change impacts. Another study was carried out by Delft Hydraulics and Coastal Research Institute (CoRI) in 1992 covers is available for more details about the impact of sea level rise on Egypt's coastal zones.

154. Much of the Nile Delta between Alexandria and Tineh is within 2 meters of mean sea level. Lagoons and reclaimed agricultural lands are bordered by 1-10 kilometers wide coastal sand belt of beaches, backshore plains, and dunes (El-Sayed, 2001). Erosion of the protective sand belt is a serious problem and has accelerated since the construction of the Aswan Dam. Post-installation of Aswan Dam, the delta coastline eroded much faster; the sea began encroaching upon low-lying areas of the delta; fertile silt no longer reached the delta; salt content of cultivated land rose; fish stocks in the lagoons declined because of decreased nutrients reaching

the coast; and water hyacinths choked canals and waterways12. SLR will destroy weak parts of the sand belt, which is essential for the protection of lagoons and the low-lying reclaimed lands. Dykes and protective measurements would probably prevent the worst flooding up to a 50 cm sea level rise but areas would still experience serious groundwater salination and the impact of increasing wave action would be serious13.

155. Several studies on the vulnerability of Alexandria, the second largest city in Egypt, indicated that a 0.3m SLR in Alexandria would inundate large parts of the city. This would result in land and property losses worth tens of billions of dollars, including damage to infrastructure, over half a million inhabitants to be relocated and approximately 70,000 lost jobs (Firhy et al, 1997, El-Raey et al 1999, El-Raey, 2004). Furthermore, the INC included another scenario with SLR exceeding 0.5 m over this century, that is predicted to result in devastating impact on Alexandria with an economic loss estimated of over US$ 35 billion including loss of 30% of the total area and 195,000 jobs, and relocation of more than 2 million people.

156. In Rosseta, which is another historical city that is already suffering from shoreline erosion, it is estimated that 0.5 m rise in sea level could affect one third of the city's jobs with significant economic losses reaching billions of dollars (INC, 1999 , El-Raey et al., 1997). Similarly, in Port Said, the INC indicates that a SLR of 0.5 m will lead to the loss of more than 6,000 jobs. In addition to land and coastal infrastructure inundation, SLR will also result in seawater intrusion thus shifting the salt water wedge into the Delta which will increase salinization of the productive soil profile, and increase groundwater salinity which consequently will damage the agricultural lands (Delft Hydraulics/CORI 1992; Frihy, 2003). SLR will also deteriorate coastal Mediterranean wetlands and induce stress on fisheries in the coastal lagoons. Furthermore, SLR will also further change the offshore water current patterns resulting in beach erosion and change in the shoreline which has its negative impact on tourism economic activities (EL-Raey, 2004).

157. Current coastal vulnerability studies in Egypt confirm that coastal lagoons will be adversely impact by rising sea levels. Most recently, CoRI, National Water Research Center (NWRC) and Ministry of Water Resources and Irrigation (MWRI) conducted a study entitled "Coastal Vulnerability to Climate Changes and Adaptation Assessment for Coastal Zones of Egypt" in support of Egypt's Second National Communication. To establish baseline conditions, El Shinnawy (2008) used measurements of tide gages for the last three decades to estimate the rate of average mean sea level rise in three locations of the Nile Delta coastal region. Statistical analysis of data coupled with spot land elevation surveys indicated that the average relative mean sea level rise differs across the Nile delta due to difference in land subsidence rates. Estimated trends for relative SLR at Alexandria, Al-Burullus, and Port Said are 1.6, 2.3, 5.3 mm/year, respectively. These values combine the effect of both SLR and land subsidence. The IPCC indicates that for the 20th century, global average sea level rose at a rate of about 1.7 mm/year. Notably, this value accounts only for the effects of thermal expansion of the oceans and the loss of land-based ice due to increased melting. This suggests that when the effect of local subsidence are accounted for, rates of sea level rise in areas east of Alexandria bring into sharp focus the potential vulnerability of these coastal areas.

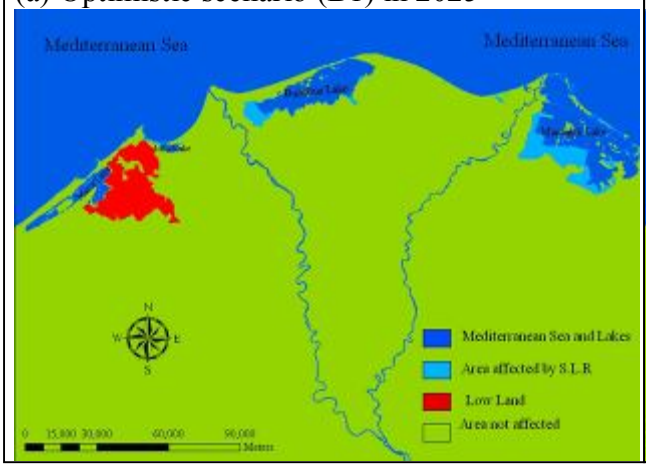
158. The study also confirmed that certain areas of the Nile will be adversely affected by future sea level rise in the absence of effective adaptation. Under optimistic estimates of near-term SLR (i.e., low levels of SLR by 2025 under the IPCC's low-emission B1 scenario), land area just West of Burullus Lake and south of Manzalah Lake show the greatest vulnerability (see Figure 1a). The red-shaded area just south of Idku Lake in the west indicates an area where the land elevation is actually below the sea level in 2025 yet is not inundated due to the shore protection afforded by the existing Mohamed Ali shoreline revetment. Altogether, approximately 16 km2 of valuable currently cultivated land would be inundated in the absence of adaptive action.

[12] http://www.indiaenvironmentportal.org.in/node/1487
[13] http://www.grida.no/publications/vg/africa/page/3117.aspx

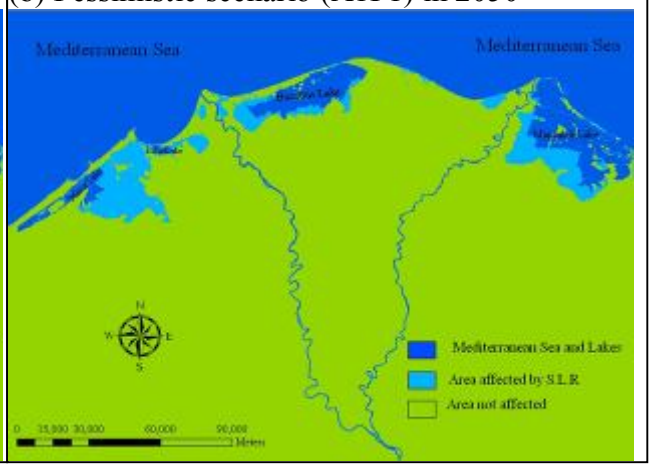
159. Under pessimistic estimates of mid-term SLR (i.e., high levels of SLR by 2050 under the IPCC's high-emission A1F1 scenario), the land areas identified in the previous areas remain highly vulnerable and the extent of inundation increases (see Figure 1b). In addition, the current height of the Mohamed Ali revetment becomes inadequate to protect the low lying areas behind adjacent to the Idku Lagoon. However, for the most part, these areas are not designated as cultivated land. Approximately 59 km2 of valuable agricultural land would be inundated in the absence of adaptive action under this scenario. Another 16 km2 of low-lying area behind the Mohamed Ali revetment would also be inundated under this scenario.

Figure 1: Areas affected by SLR under a range of scenarios (source: CoRI, 2008)

(a) Optimistic scenario (B1) in 2025



(b) Pessimistic scenario (A1F1) in 2050



160. Hence, the most recent study of SLR in the Nile confirms the essential conclusion of earlier vulnerability assessments that large areas of the Nile Delta are vulnerable to SLR relative to the range of plausible scenarios. In contrast to the earlier studies, the zones of acute vulnerability are now understood to be more limited due to a better representation of coastal protection structures in the spatial modeling framework.

Annex B: Explanation of the "Living Coasts" approach

161. In the past, protecting coastal shorelines often meant structural projects like seawalls, groins, rip-rap, and levees. As understanding of natural shoreline function improves, there is a growing acceptance that structural solutions frequently cause more problems than they solve. Bulkheads, stone revetments and seawalls hold back damaging waves but usually also alter, if not destroy, the natural habitat (Mitchell, 2008; NOAA, 2009). In response to existing erosion concerns, some parts along the Nile Delta coast have been protected by hard structures as well as artificial beach nourishment. For example, the tip of the Damietta promontory has been stabilized with seawalls to protect the properties behind it. The seawalls, however, have also led to the scouring of the seafloor and steepening of the beach profile in front of the wall (El-Banna 2005). West of the seawall, the constructed breakwater system has affected the bathymetry of the seafloor in the area. Shoaling and submerged spits have been formed in the shadow of each breakwater unit. The gaps between the breakwater units have attained deep depths and steep slopes (M. El-Banna 2006). Experts generally agree that these 'hard' shoreline protections:

    - Are expensive.
    - Cause erosion to beaches and dunes, leading to a loss of recreational and tourism resources and diminished storm damage protection.
    - Aren't permanent, in fact require costly maintenance to ensure that they continue to provide protection.
    - Divert stormwater and waves onto other properties.
    - Adversely affect other properties by starving beaches of needed sediment sources.
    - Create a false sense of security.
    - Disturb the land and disrupt natural water flows.

162. Given the drawbacks and the knowledge that it will be an ongoing expense and may increase overall damage to land, buildings, and other structures within the natural system of t flood and erosion control structures, there has been a shift in recent years toward non-structural shore stabilization techniques. Non-structural shore protection measures generally seek to enhance the natural ability of shorelines to absorb and dissipate storm energy without interfering with natural beach, dune, and bank processes. Additionally, whenever structural protection is pursued, hybrid technology (such as combinations of low-profile rock, cobble berms, and vegetative planting) should be considered as a means of reducing the negative impacts of the structure14. Because of the many problems with flood and erosion control structures, there has been a shift in recent years toward non-structural shore stabilization techniques. Non-structural shore protection measures generally seek to enhance the natural ability of shorelines to absorb and dissipate storm energy without interfering with natural beach, dune, and bank processes.

163. Several U.S. states and European countries, in recognition of the detriment that 'hard' structural protective measures have caused to coastal ecosystems have begun to adopt policies of de-polderisation or removing "hard" coastal protection to allow an area that was not previously exposed to flooding by the sea to become flooded. Replacing artificial 'hard' coastal defenses with soft' coastal landforms, can mean better protection for inland land by relying on natural defenses to absorb or dampen the force of waves. In the context of coastal erosion, de-polderisation (also referred to as managed retreat or managed realignment) has been applied in low lying estuarine areas and almost always involves flooding of land that has at some point in the past been claimed from the sea. Where the impacts of eustatic rise (global) are compounded with local subsidence, managed retreat has become a chosen response to sea level rise.

[14] Massachusetts Office of Coastal Zone Management, http://www.mass.gov/czm/stormsmart/mitigation/structural_shore_protection.htm

164. De-polderisation has also been used to mitigate for loss of intertidal habitat. When sediment supply is limited (Hulme 2005; Morris et al. 2004), as in the case of the Nile Delta, protective sea walls prevent the landward migration of saltmarsh and other estuary habitats in response to sea level rise. In the case of Egypt's coastal lakes, soft shore protection is introduced as the planned SLR adaptation strategy; rather than- as it has been introduced elsewhere- a reactive adaptation to degraded coastal zones in and around "hard" shoreline protective infrastructure.

165. The "living shorelines approach" embodies this type or soft shore protection has been used to mitigate and prepare for the effects of SLR. Living Shorelines utilize a suite of bank stabilization and habitat restoration techniques to reinforce the shoreline, minimize coastal erosion, and maintain coastal processes while protecting, restoring, enhancing, and creating natural habitat for NOAA trust resources. This technique was coined with the term "Living Shorelines" because it provides "living space" for riverine, estuarine, and coastal organisms, which is accomplished via the strategic placement of native vegetation, sand fill, organic materials, and, if necessary, a small amount of reinforcing rock seeded with oysters (NOAA, 2009).

166. The Maryland Department of Natural Resources first demonstrated the Living Shoreline as an alternative to hard protection measures for protecting local ecosystems/species about a decade ago at the "Hartley Shoreline" in Maryland (http://www.terrapininstitute.org/). Along the eastern seaboard of the US several other states have applied the approach including North Carolina (http://www.nccoast.org/Restoration/LivShore), Mississippi and Alabama (http://www.masgc.org/pdf/masgp/07-027.pdf), Florida (http://www.dep.state.fl.us/COASTAL/news/articles/0812_Shorelines.htm), Delaware (http://www.delawareestuary.org/science_projects_living_shoreline.asp) and Maryland. North Carolina has over 30 demonstration sites and as a Natural Resource Planner with the Alabama Department of Conservation and Natural Resources explains, "All resource agencies would like to see folks starting to use living shorelines [but] that change in mind-set and regulations is slow to come" (Mitchell, 2008).

167. Intertidal habitats can respond to SLR by accreting upward and migrating inland, however, in England and Germany, flood defenses have removed most opportunities for landward migration of intertidal habitats (e.g., Nicholls and Wilson, 2001). Germany and England have a long history of protecting the coastal floodplain with hard measures such as dikes and embankments, but recently, both countries have started introducing the managed realignment approach, and are compared in Rupp-Armstrong and Nicholls (2007). Both countries have adopted the approach with other objective to promote the creation of intertidal habitats, and salt marshes in particular.

168. In the UK, the first managed retreat (MR) site was an area of 8,000 square metres at Northey Island in Essex flooded in 1991, followed by larger sites at Tollesbury and Orplands (1995), Freiston Shore (2001) and Abbott's Hall Farm, at Great Wigborough in the Blackwater Estuary, it is one of the largest managed retreat schemes in Europe. At present approximately 6 km² of saltmarsh have been restored by MR in the UK (Mossman et al. In prep). One of the major reasons cited for the slow pace of current saltmarsh restoration in the UK is the uncertainty associated with the practice (Morris et al., 2004).

169. Examples of soft shore protection appropriate in the Nile delta include planting suitable crops in coastal zone for coastal protection in a 'vegetative buffer' structure, re-nourishing current beaches, installing sand dune systems as a defense mechanism, and utilizing the coastal lakes as an adaptive measure to sea level rise where appropriate. Nichols et al. (2006) recommend using sand dunes, marshes, dikes (as a last resort), pumped drainage, combining upgraded protection, managing subsidence, land use planning, and selective relocation; in addition to strengthening adaptive management and important partnerships. Brochier et al. (2001) make similar recommendations of planting suitable plant species in coastal zone, temporary wood fences to stabilize dunes, sand nourishment of beaches particularly regular nourishment of tourist beaches, installing a flood monitoring system, pollution recovery and restoration, improved water quality, hard engineering intervention. And even goes further to recommend managed retreat where

necessary. For the Nile specifically, El-Raey suggests beach nourishment, sand dune fixation, improving awareness, building institutional capacities.

170. Summarized here are potential non-structural shore protection techniques included as part of a Living Shorelines approach:

- Protecting, nourishing (and renourishing), or constructing beaches and dunes.
- Sand nourishment is a strategy that can mitigate erosion by upraising soil, increasing water table depth, reducing flooding influence, and growing different crops (Nichols).
- sand nourishment for beaches and lands can be used for shoreline protection and upraising land soils to increase water-table depth, reduce the influence of flooding, and support the practice of different crops (G. F. Soliman et al)
- Stabilizing dunes with fences and vegetation. (This approach may be prohibited in endangered species habitat). Be sure to avoid invasive species, which may create their own problems.
- Re-vegetating/stabilizing shorelines and/or riparian (river) corridors with native plants
- Coastal vegetative buffers--those land areas that provide a vegetated transition zone between a waterway and developed land--serve many functions, including the protection of coastal lands during flooding, erosion control, and the protection of coastal water quality15
- Creating or restoring wetlands
- Prohibiting or more stringently restricting the infill of wetlands.
- Utilizing the coastal lakes as a mechanism for adaptive management protection
- Restrict development in 'hot spots' or zones with erosion taking place
- Engage nearby community members to take a proactive stance towards environmental education and action

Considerations in the application of a Living Shoreline

171. With respect to de-polderisation, the actual replacement of hard structures with soft protection strategies would lead to a certain amount of (reclaimed) deltaic land inevitably lost in this process while beaches are being built up resulting in settlements, farmland and other property being destroyed. Because of this, managed retreat is often not a socially acceptable plan and may invoke the need for compensation to land-owners. Intertidal sites are often a rich archaeological resource and the loss of heritage is a factor to weigh in managed retreat projects.

172. That said, in surveys conducted in the UK, much of the public discomfort with "de-polderisation" policy is related to poor understanding of the role of 'natural' shoreline ecosystems in inland protection from sea level rise, wave action etc.. As Goeldner-Gianella (2007) explains, better "social management" of the policy through clear communication from those responsible for policy implementation to the public could improve awareness and subsequently change perceptions regarding "soft" shoreline approaches.

173. The pilot adaptation strategies planned in the proposed pilot projects merely introduces innovative soft protection strategies and does not entirely advocate for a de-polderisation policy for the Northern coastline yet. Such a policy could be recommended once M&E for the project shows evidence that new 'soft' shoreline protection measures have reduced vulnerability,

[15] URI Metro Bay Special Area Management Plan "Urban Coastal Greenways Policy" (2005 workshop "Coastal Vegetative Buffer Policy: Innovative Approaches in Urban/Suburban Environments" (http://seagrant.gso.uri.edu/buffer/).

increased ecosystem health and made the shoreline more resilient in the face of new threats due to climate change-induced sea level rise.

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