Climate Change Adaptation: Renewable Energy and Climate Actions in Cities to Mitigate Climate Change and Enhance Liveability – A Diagnostic and Strategic Study

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1 Introduction

Climate change (CC) has no borders or boundaries since it has been manifested globally in most of the cities [1, 2]. Many cities across the world suffer from CC risks and impacts; it is clear that no single city is safe from CC risks [3–5]. The increase in urbanisation and CC impacts has a direct effect on the increase of urban temperature [6]. The urbanisation sprawl in cities coupled with some impacts of climate change (CC) is leading to the emergence of urban microclimates [7–10]. According to the Climate Change Resilience Index (CCRI), a new framework was established by the Economist Intelligence Unit (The EIU). Based on a study of the World's 82 largest economies and measure their ability to conform CC, the global economy will be 3 per cent smaller by 2050 due to CC impacts [11].

Between 2011 and 2018, the European Union (EU) initiated a major policy design project "Cleaner Energy Saving Mediterranean Cities" (CES-MED), under the European Neighbourhood and Partnership Instrument (ENPI), to support South Mediterranean countries to develop sustainable energy and climate action plans (SECAPs) [12]. A recent study on the concepts and methodologies for measuring the sustainability of cities reviewed synthesises the recent development in methods being exploited to the impacts of cities on environmental sustainability [13]. Incidentally, better data and methods are becoming available for understanding the complex and woven functioning of cities and their impact on sustainability [14].

COP 21 and Paris Agreement on Climate Change have added impetus to the necessity for pragmatic approaches in boosting the climate change adaptation (CCA), in order to increase measures and actions towards strengthening climate resilience [15, 16]. The evolving know-how of experts from European financing institutions and the European Commission (EC) offers insights into how these climate issues can be best integrated into projects' development and implementation [17]. The CES-MED project is a clear manifestation of such development that is aiming to assist governorates in developing sustainable energy action plans (SEAPs) (SECAPs) and adapting to CC risks [13]. Within this framework, the "Integrating Climate Change Information and Adaptation in Project Development: Emerging Experience from Practitioners" has been developed to provide assistance to aid practitioners assess climate change risks and vulnerabilities and integrate adaptation measures into project planning, design, and implementation [18, 19].

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A. Sayigh (ed.), *Sustainable Energy Development and Innovation*, Innovative Renewable Energy,
https://doi.org/10.1007/978-3-030-76221-6_45

2 Objective

The objective of this work focuses on the strategic renewable energy and climate action plans with emphasis on two seaside cities in Egypt where the SEAPs and SECAPs were conducted, applied, and implemented based on each city's strategy in 2030, and its clean energy capacity. The SECAPs for both the city of Hurghada and the city of Luxor were developed as part of the CES-MED project, funded by the European Union between 2011 and 2018. In this paper, the SECAP for the city of Hurghada is highlighted and discussed.

3 Methodology

The SECAP is considered as a strategic manifesto and an operational tool [12, 13]. It defines a global framework, with quantifiable objectives to be reached by 2030, based on the emissions' reference inventory (baseline emission inventory (BEI)) and the detailed assessment of energy consumption [12, 20–23]. Diagnostic studies were carried out to identify the gap in each city in terms of climate change and renewable energy. In this paper, the focus is given to SECAP of the city of Hurghada, prior to providing a detailed account of the concrete measures undertaken to reduce GHG emissions and promote the development of sustainable energy. The national and regional strategies on climate change adaptation (CCA), the renewable energy capacity, and future needs were assessed to draw the gap at the local government level. In terms of vulnerability, climate change risks (CCRs) by sectors have been assessed and presented. To conduct the SEACP, it was vital to understand and address the four main issues, respectively, to achieve the set mission (Fig. 1).

3.1 *The Steps of the Sustainable Energy and Climate Action Plan (SECAP)*

The SECAP for the city of Hurghada encompasses five main phases. Figure 2 illustrates these five phases, including the SECAP report, CCA and analysis, and priority action plans [12, 14, 21].

3.2 *National and Regional Strategies on Climate Change Adaptation*

To craft and develop the sustainable energy and Climate Action Plan – SECAP for the city of Hurghada, it was imperative to get a solid and comprehensive understanding of the national and regional strategies on climate change adaptation (CCA) as well as sectoral policies. Figures 3 and 4 illustrate the regional CCA strategies and sectoral policies in brief. Nevertheless,

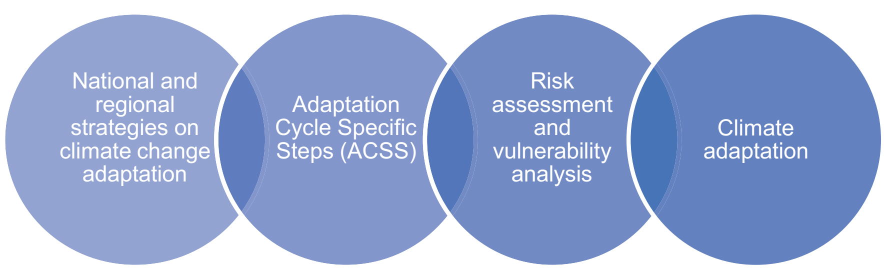

Fig. 1 Main sections of the SECAP methodology

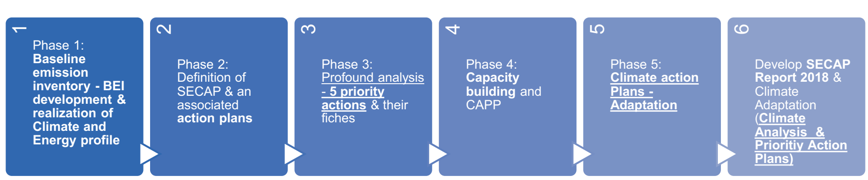

Fig. 2 Steps for sustainable energy and climate action plans. (Source: http://publications.jrc.ec.europa.eu/repository/handle/JRC93697)

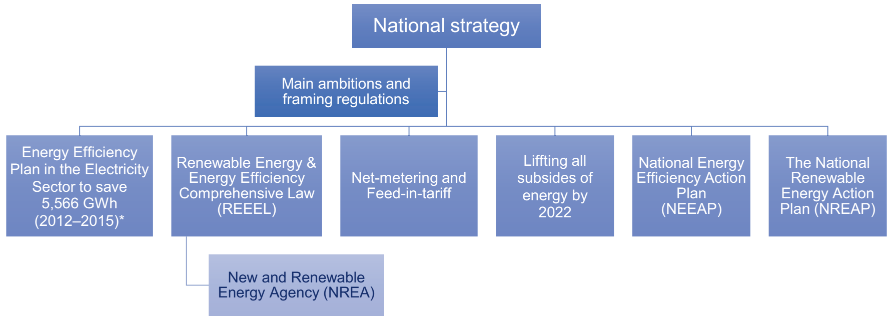

Fig. 3 National strategies on climate change adaptation, Egypt. (Source: http://www.ces-med.eu/publications/egypt-municipality-hurghada-sustainable-energy-and-climate-action-plan-secap/)

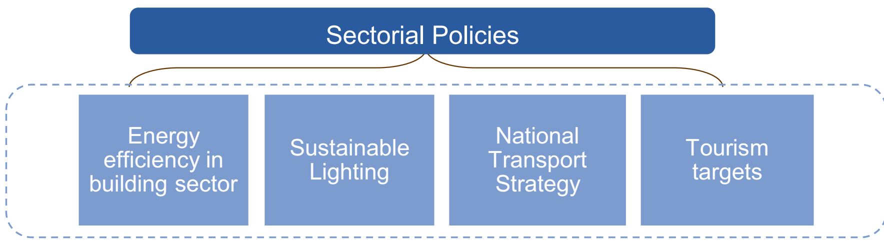

Fig. 4 National sectoral policies on climate change adaptation – CCA. (Source: http://www.ces-med.eu/publications/egypt-municipality-hurghada-sustainable-energy-and-climate-action-plan-secap)

since the completion of the CES-MED project, more strategies on CCA have been developed and executed [24–26]. The most recent CCA strategies were developed and implemented in March 2020, during and after the devastating severe storm that hit Egypt between 9 and 12 March 2020 [27].

3.3 The Case Study and Considered Scope

In developing the SEACP, it was importantly needed to determine the administrative areas of the city of Hurghada, where the SECAP and its sections will be implemented. Thus, the following areas are presented below after consultation with the senior officials of the Governorate of Red Sea. Figure 5 presents the administrative areas of the City of Hurghada for climate risks' assessment, climate adaptation action (CAA), and vulnerability analysis.

4 Sustainable Energy and Climate Objectives: City of Hurghada

Keeping in mind its specific values and the local context, the City of Hurghada develops a strategy consistent with Egypt's Vision 2030, energy strategy 2035, and the Sustainable Development Strategy – SDS 2030 [28–31]. This strategy is structured around two levels, as shown in Fig. 6. In 2019, the Governorate of Red Sea, nonetheless, reported that three green buildings were developed in the city of Hurghada, where green roofs were implemented, and renewable energy was integrated [32]. However; the SECAP study indicated that more measures were to be taken for climate change adaption (CCA) [20, 21].

The city of Hurghada plan encompasses short- and medium- to long-term strategic objectives:

Short-term objectives in 2020:

- Reduce energy consumption across the board by around 10 per cent to 15 per cent
- Mitigate GHG emissions by 10 per cent in 2020, compared to the business as usual (BaU) scenario of the 2015 baseline [21]

Fig. 5 The administrative areas of the City of Hurghada for climate adaptation and vulnerability analysis. (Image source: https://satellites.pro/Hurghada_map.Egypt)

Fig. 6 Actions taken by the City of Hurghada (municipality) to reduce energy use in all sectors. (Image source: https://www.egypttoday.com/Article/1/52769/In-pics-Egypt%E2%80%99s-rooftops-going-green)

Medium-term and long-term objectives in 2030:

- Boost efforts to reduce energy consumption and improve efficiency, resulting in a continuous trend of improvement in energy intensity (energy consumption compared to the gross domestic product (GDP)).
- Continue reducing the GHG emission with the objective of reaching at least a reduction of 27 per cent by 2030 and if possible, going to a 30 per cent reduction, compared to the BaU scenario. Such an effort will place the city of Hurghada in the appropriate trajectory to match the collective target agreed at COP 21 end of 2015 and that of Paris Agreement.
- Improve the quality of life in Hurghada and optimise service delivery to inhabitants and all stakeholders in order to speed up the energy transition towards sustainable development,
- Develop renewable energy production capacities in and around the city as well as in the southern region of the Governorate, as presented in Fig. 7 [21].

Prior to the climate adaptation actions (CAAs), it was necessary to calculate the baseline emission inventory (BEI), which is part of the preparation for SECAP of the city of Hurghada. The BEI is based on the calculation of greenhouse gas emissions (not a measure) and covers eight sectors: (a) residential buildings; (b) tertiary buildings and public lighting; (c) industry; (d) transport; (e) waste and water management; (f) agriculture (crops, animal production, and fishing); (g) tourism; and (h) renewable energy [20, 21]. The scope and methodological principles of the GHG emissions are based on the data collection and BaU scenario forecasts for the city can be found in the CES-MED publications of the SECAP documents [20, 21].

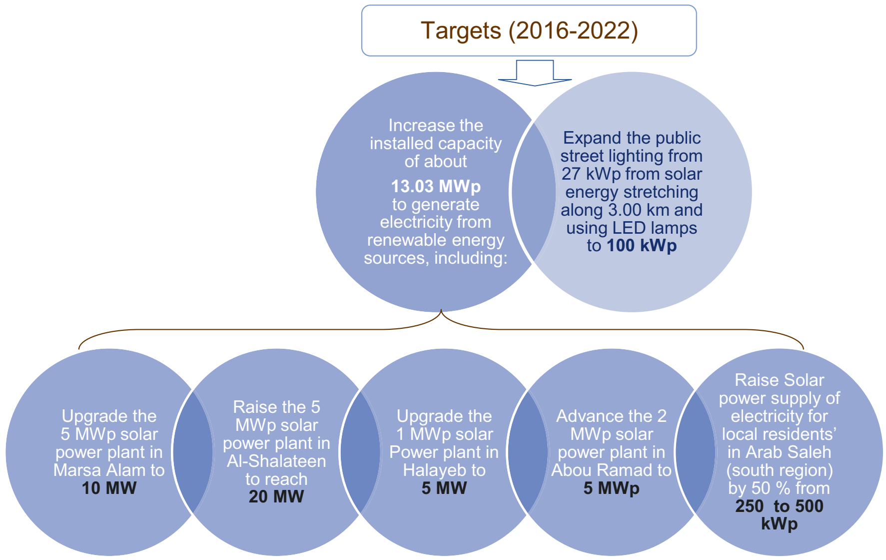

Fig. 7 Anticipated renewable energy needed capacities in the city of Hurghada and south Region of the Governorate of Red Sea. (Source: Developed by authors based on official meetings with Hurghada's municipality senior staff)

5 SECAP Development: Case Study

5.1 Adaptation Cycle-Specific Steps (ACSS)

It is imperative to develop the adaptation scoreboard of the Adaptation Cycle-Specific Steps for the city of Hurghada. This scoreboard was based on the European Commission Joint Research Centre (EC-JRC) guidelines that include six steps utilised to assess the city's climate actions [33, 34].

5.2 Risk Assessment and Vulnerability Analysis

The risk assessment and vulnerability analysis, which are based on the Future Cities Adaptation Compass Tool (FCACT) [35, 36], Governors' (Mayors) Adapt [37], and European Climate Adaptation Platform (ECAP) [38, 39], were conducted using a set of parameters and interviews with local government officials.

5.3 Climate Adaptation

In SECAP planning, a whole study and methodology of climate adaptation action (CAA) of the city of Hurghada was conducted based on the city's vulnerability to CC, climate risk assessment, and CAA adopted. The structure of this section has been developed based on the extensive literature review. Also, introduction to CC impacts, particularly in Mediterranean countries with emphasis on Egypt, mainly urban areas, costal zones, agriculture, water and ecosystems, health, and tourism is presented in [21]. This section focuses on the climate overview in Hurghada; highlighting climate trends [21]. The adopted national and regional strategies on CCA are followed by a subsection dedicated to climate data and projections feeding in estimations of the climate change impacts in the future presented in the SECAP documents [21]. The following section addresses the adaptation scoreboard, including a self-assessment from the Governorate of Red Sea against the standard adaptation scoreboard in the SECAP. The CCRs by sectors in the city of Hurghada and the Governorate's score in the adaptation cycle-specific steps are highlighted. The risk analysis, vulnerability assessment, and risks' assessment template are based on the Future Cities Adaptation Compass tool. They also depict the national CCA, and mitigation measures, including the climate change action plan (CCAP), and adopted measures within the framework of the INDCs (Intended Nationally Determined Contributions) based on adaptation challenges in the studied four sectors. Furthermore, this section sheds lights on the national adaptation action plan, mainly in coastal zones, water resources, irrigation as well as agricultural, health, tourism, building, and energy sectors. Finally, it highlights the adaptation actions in the city of Hurghada in terms of strategic actions [20, 21].

In this study, the ranking of climate change vulnerabilities (CCVs) in Egypt, based on that of the OECD, was exploited to identify the risk in terms of three criteria: (a) certainty of impact; (b) severity of impact; and (c) the importance of resources [21]. These factors were applied to the city's resources and risk ranking, including: costal, water, agriculture, and energy resources. The assessment was set on five sets of ranking scale (High, High-medium, Medium, Medium-low, and Low). Table 1 shows the results of CCV in Egypt.

For the climate change risk (CCR) by sectors in the city, a set of indicators (High exposure, Exposed, and Low exposure) were developed. The climate change risks by six sectors (agriculture and food security; water stress and drought; ecosystems; tourism; urban; and health) was mapped against vulnerability. Table 3 (Appendix 1) presents the vulnerability of city sectors by CCR.

Table 1 Ranking of climate change vulnerabilities in Egypt (OECD)

Resources/ risk ranking	Risk	Certainty of impact	Severity of impact	Importance of resources
Coastal resources	SLR (sea level rise) Coastal erosion and soil salinisation	High-medium	High	High
Water resources	Decreased Nile flow Low precipitation / salt water intrusion / decreased Nile flow Low precipitation Salt water intrusion	Medium	High	High
Agriculture	SLR Soil salinisation High temperature	Medium-low	Medium-low	High-medium
Energy resources	High temperature Decreased Nile flow	Medium-low	Medium-low	Medium-low

Table 2 Governorate's (Municipality's) score in the adaptation cycle-specific steps (SECAP template and JRC guidelines) – City of Hurghada, Governorate of Red Sea

Adaptation cycle steps	Actions	Grades (A–D)
Step 1: Preparing the ground for adaptation	Adaptation commitments defined/integrated into the local climate policy	A
	Human, technical, and financial resources identified	B
	Adaptation team (officer) appointed within the municipal administration and clear responsibilities assigned	D
	Horizontal (e.g. across departments) coordination mechanisms in place	A
	Vertical (e.g. across governance levels) coordination mechanisms in place	A–B
	Consultative and participatory mechanisms set up, fostering the multistakeholder engagement in the adaptation process	B
	Continuous communication process in place	A
Step 2: Assessing risks and vulnerabilities to climate change	Mapping of the possible methods and data sources for carrying out a risk and vulnerability assessment	A
	Assessment of climate risks and vulnerabilities undertaken	D
	Possible sectors of actions identified and prioritised	C
	Available knowledge periodically reviewed and new findings integrated	B
Steps 3 and 4: Identifying, assessing, and selecting adaptation options	Full portfolio of adaptation actions compiled, documented, and assessed	D
	Possibilities of mainstreaming adaptation in existing policies and plans assessed, possible synergies and conflicts identified	B
	Adaptation actions developed and adopted	C–B
Step 5: Implementation	Implementation framework set up with a clear milestones	C
	Adaptation actions implemented and mainstreamed as defined in the SECAP document*	N/A
	Coordinated actions between adaptation and mitigation set of measures	C
Step 6: Monitoring and evaluation	Monitoring framework in place for adaptation actions	C–D
	Appropriate monitoring and evaluation indicators identified	C–B
	Regular monitoring of the progress and reporting to the relevant decision-makers	A
	Adaptation strategy and/or action plan updated, revised, and readjusted according to the findings of the monitoring and evaluation procedure	D

Table 3 Climate change risks by sectors – City of Hurghada, Governorate of Red Sea

Climate change risks by sectors	Vulnerability
Agriculture and food security	
Global and regional studies indicate generally deficits and decline in crops' yields for wheat, rice, and maize.	Not applicable
National-scale studies agree with each other that crop yields in Egypt could decline with climate change impacts.	Not applicable
Increasing pressures on food security as a result of climate change.	Low exposure
Water stress and drought	
Water stress could increase with climate change.	Exposed
Mean precipitation patterns could decrease with climate change.	Exposed
Groundwater could experience increase of salinity due to SLR or droughts.	Low exposure
Ecosystems	
Coral reefs' growth suffered from underwater activities – a decline in growth by 40% during 1987–2000. A drastic decline of ~49% and 45% between 2000 and 2013, respectively. Also, coral reef bleaching in the sea areas will increase 80% by 2060.	Exposed
Water acidification, which affects and treats mangroves in sea biodiversity, could include over 1000 species.	Exposed
Tourism	
Heat waves will affect attractiveness and tourism movement in Egypt.	Exposed
Loss in beaches' tourism due to coral reefs' bleaching in the Red Sea area.	Exposed
Urban	
Increases thermal discomfort and heat strokes, particularly in urban areas due to high temperatures and pollutions.	Exposed
Infrastructure failure due to storms and resulted floods.	Exposed
Air quality in cities decreases due to climate change.	Exposed
Health	
Higher temperatures, water stress, and malnutrition increase rift valley fever, avian influenza, and diarrhoea.	Exposed
Dust and sand storms affect patients with respiratory history and problems.	Exposed
Heat waves and higher temperatures increase cases of heat strokes and death in elderly citizens.	Exposed

5.4 *Adaptation Scoreboard*

The adaptation scoreboard is part of the SECAP developed by the Joint Research Center (JRC) of the European Commission [13, 23]. The city of Hurghada has realised a self-assessment of its adaptation status, setting a grade from A to D, in line with its progress regarding the Adaptation Cycle Steps, based on meetings and interviews with the Coordinator of Planning Department, Governorate of Red Sea (July and August 2017). More specifically:

- "A", corresponds to completion level of 75–100%
- "B", corresponds to completion level of 50–75%
- "C", corresponds to completion level of 25–50%
- "D", corresponds to completion level of 0–25%

The city of Hurghada (Municipality) has developed a score based on grades ranging from A to D, according to the above four grades to each one of the adaptation cycle-specific steps, as presented in the following Table 2. Nonetheless, in the age of coronavirus (COVID-19), there are parameters in some sectors that might be reviewed, such as urban sector (air quality in cities decreases due to CC), as well as health sector (dust and sand storms affect patients with respiratory problems). Since the social distancing and confinement measures reduced air pollution in most of the cities globally, that may help the patients with respiratory problems [40, 41]. However, this may all be temporarily depending on governments' policies, regulations, and measures developed/or to be developed during and post COVID-19.

6 Mapping Climate Change Risks by Sectors Against Vulnerability

6.1 *Risk Assessment and Vulnerability Analysis*

In order to conduct a risk assessment and vulnerability analysis, as a first step, the climate hazard types should be identified. These hazard types in general for the Maghreb and Mashreq countries, in particular including Egypt, are presented in Table 4 (Appendix 1). The Governorate of Red Sea (municipality) was called in to assess the impact that each climate hazard type

Table 4 Climate hazard types

General climate hazard types	Applicable for Maghreb and Mashreq regions, Governorate of the Red Sea, Egypt
Extreme heat	√
Extreme cold	
Landslides	
Storms[a]	√
Droughts	√
Sea level rise[b]	√
Floods	√
Extreme precipitation	
Forest fires	
Ice and snow	Took place in Cairo, Egypt in December 2013 after 112 years and in Alexandria in 2015 and 2016

[a]Took place in the Governorate of the Red Sea, mainly in Ras Ghareb in October 2016
[b]The Red Sea has very little waves and SLR is not comparable to that of Mediterranean

has on a series of vulnerable/impacted sectors, such as: (a) population (public health), (b) infrastructure (transport, energy, water, and social), (c) built environment (building stock and materials), (d) economy (tourist and agriculture), and (e) biodiversity (coastal zone ecosystems and green zones/forests).

These sectors have been identified as the most relevant for the Maghreb/Mashreq region, utilising information from the Future Cities Adaptation Compass Tool, Governors' (Mayors) Adapt, as well as the European Climate Adaptation Platform website and Covenant of Mayors' (CoM's) recommendations for the SECAPs [35–39]. Table 5 in Appendix 2 presents the results of the risk assessment analysis which were used to conduct the vulnerability analysis formulated by the City of Hurghada (municipality).

This exercise is based on sources such as the Future Cities Adaptation Compass Tool [35] and the United Nations Framework Convention on Climate Change (UNFCCC). Hence, the vulnerability analysis was carried out. In order to elaborate on the risk assessment, all date and information in Tables 4 and 5 were developed and realised based on six meetings' interviews with the Coordinator of Governorate of Red Sea. The impact of each risk is identified in the scale of High/Medium/Low; where specific climate projections are available, a risk analysis combining probability and impact was realised; additional information can be found in [21]. This is given in Table 5 (Appendix 2).

7 Results and Discussions

The ranking of CC vulnerabilities in Egypt was measured by five indicators (Low, Medium-low, Medium, Medium-high, and High). It is clear from Table 1 that the ranking of CC vulnerabilities indicates that the coastal resources, in terms of certainty of impact, severity of impact, and importance of resources, are High-medium and High. For water resources, these are medium and high for the three criteria. Regarding agriculture and energy resources, these are Medium-low, except for the importance of resources; it is High-medium for energy resources. It can be deduced from Table 3 that for the CCRs of the city of Hurghada in terms of Vulnerability; Ecosystems, Tourism, Urban, and Health sectors are exposed to CCR but agriculture and food security, and water stress are at low exposure to exposed. The adaptation actions by sectors, energy supply and renewable energy development, and project's fiche can be found in the SECAP document, pages 106–109 and 160–170 [21].

8 Conclusions

The SECAP for the City of Hurghada, Governorate of Red Sea was developed as part of the CES-MED project, funded by the European Union. The CES-MED project provided policy design support for the Municipality and the City of Hurghada in developing the SECAP, which has been pursued and coordinated with the National Committee of the Ministry of Foreign Affairs (National Focal Point) in collaboration with the Ministry of Local Development and in close coordination with the Governorate of Red Sea. The SECAP structure has been crafted, including four sections: (i) Governorate Climate and Energy

Table 5 Risk assessment of the city of Hurghada

	Receptors	Weather sensitivity	Future risk	Impact/ risk	Impact
Population	Public health	Extreme heat	Increased number of deaths	Low	Low-medium
			Reinforcement of heat stress	Medium	
			Increased infectious diseases	Low	
			Altered allergic patterns	Low	
		Droughts	Increased allergic incidents	Low	Low-medium
			Decreased air quality	Low	
			More respiratory problems	Medium	
		Sea level rise (significantly fewer waves due to coral reef)	Increased incidents of asthma and pneumonia	Low	Low
			Increased waterborne diseases	Low	
			Limitations to the healthcare access	Low	
		Storms	Limitations to the healthcare access	Low	Low
			Increased numbers of injuries and deaths	Low	
		Floods	Limitations to the healthcare access	N/A	N/A
			Increased numbers of injuries and deaths	N/A	
Infrastructure	Transport	Extreme heat	Damages on roads	Low	Low
			Modification of transport frequency and means	Low	
			Air quality problems	Low	
			Higher maintenance costs	Low	
		Droughts	Difficult transport of bulk material	Low	Low
		Sea level rise (Significantly fewer waves due to coral reef)	Damages	N/A	N/A
		Storms	Damages	Low	Low
			Mobility problems	Low	
		Floods	Damages	Low	Low
			Mobility problems	Low	
	Energy	Extreme heat	Blackouts and inability to cover demand load	N/A	N/A
			Damages, especially in the thermal power plants	N/A	
		Droughts	Blackouts and inability to cover demand load	N/A	N/A
			Higher maintenance costs	N/A	
			Cooling problems in power plants	N/A	
		Sea level rise (Significantly fewer waves due to coral reef)	Damages	Low	Low
			Shutdown of power plants near rivers, etc.	Low	
			Operational difficulties	Low	
			Higher maintenance cost	Low	
		Storms	Damages/failures in the production facilities and distribution grid/power cuts	Low	Low
		Floods	Damages/power cuts	Medium	Medium
	Water	Extreme heat	Water scarcity (desalinated water)	Low	Low
			Water quality issues (bottled water)	Low	
		Droughts	Water scarcity (desalinated water)	N/A	N/A

(continued)

Table 5 (continued)

	Receptors	Weather sensitivity	Future risk	Impact/ risk	Impact
			Water quality issues (desalinated water)	N/A	
		Sea level rise (Significantly fewer waves due to coral reef)	Increased underground water salinity	Low	Low
			Water management issues	Low	
			Damages	Low	
			Water quality issues	Low	
			Higher maintenance costs	Low	
		Storms	Increased damages and related maintenance costs	Low	Medium
			Water management issues	Medium	
		Floods	Increased damages and related maintenance costs	Low	Low
			Water management issues	Low	
			Water quality issues	Low	
	Social	Extreme heat	Increased need for air-conditioned public spaces	Medium	Medium
		Droughts	Increased numbers of people presenting respiratory problems and burdening the healthcare facilities	Low	Low
			Inability to cover the water demand	Low	
			Difficulties in the operation of certain facilities due to lack of water (e.g. swimming pools)	Low	
		Sea level rise (Significantly fewer waves due to coral reef)	Potential damages in the coastal area facilities	Low	Low
			Loss of coastal public spaces (beaches)	Low	
		Storms	Damages	Low	Low
			Increased maintenance costs	Low	
		Floods	Damages	Low	Low
			Increased maintenance costs	Low	Low
			Flooding at the city level of the afflicted public building infrastructure (schools, hospitals, etc.) – Difficulties in providing the envisaged services	Low	
Built environment	Buildings' stock and materials	Extreme heat	Concrete's damages	High	High
			Increased cooling demands	High	
			Higher maintenance costs	High	
			Urban heat island effect	High	
		Droughts	Higher water demand	Medium	Medium
		Sea level rise (Significantly fewer waves due to coral reef)	Sinkholes collapse	Low	Low
			Extensive damages/loss of property	Low	
			Impact on coastal zone economy	Low	
		Storms	Damages	Low	Low
			Increased maintenance costs	Low	
		Floods	Damages	Low	Low
			Increased maintenance costs	Low	

	Receptors	Weather sensitivity	Future risk	Impact/ risk	Impact
Economy	Tourism	Extreme heat	Change of the tourism season – lower touristic flows	Medium	Medium
			Reduction of the tourism-related economy	Medium	
		Droughts	Increased water supply costs	Low	Low
			Potential increase of indirect costs for the tourists (infrastructure related) and reduction of touristic flows	Low	
		Sea level rise (Significantly fewer waves due to coral reef)	Damages and even complete destruction of touristic infrastructure, nearby coastal areas and deltas	Medium	Medium
		Storms	Damages to touristic facilities	Medium	Medium
		Floods	Damages to touristic facilities	Medium	Medium
			Potential effects on the touristic flows, in areas with flooding history	Medium	
	Agriculture	Extreme heat	Changes in growth cycle	N/A	N/A
			Damages/loss of harvest	N/A	
			Livestock loss and impacts on health	N/A	
			Lower crop yields	N/A	
			Increased fire risks	N/A	
		Droughts	Damages/loss of harvest	N/A	N/A
			Lower crop yields	N/A	
			Livestock loss and impacts on health	N/A	
			Land degradation	N/A	
			Increased fire risks	N/A	N/A
		Sea level rise (Significantly fewer waves due to coral reef)	Damages/loss of harvest in areas near delta, sea etc.	N/A	N/A
			Increased water salinity will result in existing crops' long-term destruction	N/A	
		Storms	Damages/loss of harvest in afflicted areas	N/A	N/A
			Surface soil erosion	N/A	
		Floods	Damages/loss of harvest in afflicted areas	N/A	N/A
			Livestock loss	N/A	
			Surface soil erosion	N/A	
Biodiversity	Coastal zone eco-systems	Extreme heat	Loss of specific species (fish, etc.)	Medium	Medium
		Droughts	Increase of coastal water salinity	Low	Low
		Sea level rise (Significantly fewer waves due to coral reef)	Loss of specific species (fish, etc.)	Medium	Medium
			Soil erosion	Medium	
			Water salinisation	Medium	
		Storms	Soil erosion	Medium	Medium
		Floods	Soil erosion	Medium	Medium
	Green zones/ forests	Extreme heat	Fires and destruction of the ecosystem, flora and fauna	N/A	N/A
		Droughts	Fires and destruction of the ecosystem, flora and fauna	N/A	N/A
		Sea level rise (Very less waves due to coral reef)	Increase of underground water salinity and destruction of the ecosystem	Low	Low
		Storms	Destruction of trees and other damages	N/A	N/A
		Floods	Destruction of trees and other damages	N/A	N/A

Strategy [21]; (ii) BEI [20, 21]; (iii) Actions Planned Section [20, 21]; and (iv) Climate Adaptation. However, the CCA suggested that more actions are needed, especially in the time of COVID-19.

Acknowledgments Authors would like to thank the European Union; ENPI-South, EuropeAid/132360/C/SER/Multi; Contract No.: ENPI 2012/309-311 for funding the CES-MED Project. We also thank the Directorate-General for Neighbourhood and Enlargement Negotiations (DG-NEAR) for supervising this project and to CES-MED Team Leader, Transitions and Energies Demain teams for developing the SECAP with me and for their hard work, support, and cooperation throughout of this ongoing project. We express our sincere thanks to H.E. General Ahmed Abdullah, former Governor of Red Sea and General Abdelfattah Tamam, Secretary General – Governorate of Red Sea, and Dr. Mohamed Badr, former Governor of Luxor for their support and cooperation. Thanks go to Eng. Ayman Sultan Planning Department – Governorate of Red Sea and Dr. Ramdan Seddik, Director of Environmental Affairs – Governorate of Luxor for their assistance and collaboration in project. We are thankful to Ambassador Abu Bakr Hefny Mahmoud and Ambassador Adel Ibrahim, former Deputy Assistant Minister for EU Affairs and Counsellor Mohamed El-gammal, Ministry of Foreign Affairs – Egypt for their endless support and follow-up during the period from May 2016 to April 2018. Last but not least, we are grateful to Dr. Ahmed Azzam for facilitating the CES-MED project (2015–2018).

Appendices

Appendix 1

Appendix 2

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