MODULE ON

CLIMATE CHANGE ADAPTATION AND ECONOMIC DEVELOPMENT USING INTEGRATED WATER RESOURCE MANAGEMENT TOOLS

DRAFT FOR DISCUSSION

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INTRODUCTION

Climate change adaptation in the water scarce Arab region is largely achieved through integrated water resources management, and economic development is largely dependent upon the water sector. In order to properly plan for adaptation, specific information needs to be gathered. This is achieved in three phases:

1. Exploring the interaction between climate change adaptation and economic development needs to be clarified. This is necessary because:
    a. The impact of climate change will affect multi-sectoral development (**Section 0**), both at the macroeconomic level and the level of specific sectors;
    b. Climate change is likely to exacerbate natural resource scarcity and generate socio-economic and environmental costs and impacts;
    c. The structure of those impacts will largely define how climate change impacts economic development and what adaptation measures are needed (**Section 0**). This is done by:
        i. Drawing upon economic models that take into consideration climate projections (**Section I6**), the impact of extreme weather events (**Section I7**) and associated climate change assessment tools for informing decision-making.
        ii. Enhancing the capacity of policy makers to develop informed policies that promote climate change adaptation (**Section 0**).
        iii. Benefiting from climate financing and investment tools.
2. Mapping the vulnerability of the Arab region to climate change (**Section II**).
3. Planning for adaptation (**Section III**) by:
    a. Determining what *can* be done (**Section 0**) based on an assessment of the interactions between climate and the economy, an understanding of the institutional framework through which action can be pursued, and the use of national strategies, plans and development goals. This step leads to the:
        i. This step leads to the setup of an adaptation team that can carry out vulnerability assessments and climate risk mapping, outline how to incorporate Integrated Water Resource Management (IWRM**)** tools in adaptation strategies **(Section III3**), and identify existing sources available for climate financing (**Section III4).**
    b. Proposing what *needs* to be done **(Section III4**). A "Climate Proofing" methodology is offered to help define the scope of the adaptation measures proposed and outline the Options for Action (**Section III7**).
    c. Preparing an adaptation matrix and adaptation plans (**Section 0**). Those plans will draw upon best practices and include recommendations for improved governance for climate change adaptation (**Section III9**) for achieving sustainable economic development.

I ECONOMIC DEVELOPMENT AND NATURAL RESOURCE MANAGEMENT

Economic development is strongly linked to natural resource availability, and is facilitated by an understanding of climate variability. This is especially true in the context of a changing climate and the increasing pressures on natural resources, namely water, energy and land.

Economic Development faces three challenges:

1. The first two challenges comes from the changing climate itself, which adds new risks and uncertainties, and thus adds to the costs to doing business. Those costs are related to climate change that can be forecasted, or the harder to foresee costs of climatic surprises:
    a. The forecasted change in climate is set to **change the underlying conditions** under which businesses operate. While it is true that, in addition to new risks, climate brings about new opportunities, businesses still need to adapt to both. This adaptation brings about a need for additional investments, and thus increases the cost of doing business.
    b. Additional costs will also come from the **greater weather variability**, as the changing climate pushes global weather patterns to increasingly deviate from the previous stable patterns of the past. This increases risks, and thus magnifies the cost of doing business. As the risk of Rapid Climate Change Events (RCCE) increases, the need to ensure against them would add costs to doing business.
2. Those changes are taking place in a context where **resources are under increasing pressure**. This is particularly the case of the water resources of the Arab region.

For this reason, Sustainable Development cannot be approached outside economic growth and a good understanding of climate change. On the long run, economic growth will depend on an increasingly complex and integrated world, with towns and cities relying on an inter-related network that provides them with services such as regular agricultural supplies, reliable energy, and readily available freshwater resources.

Future economic development should therefore be guided by the need for climate change mitigation and adaptation.

1. At the global level, mitigation is carried out to diminish the "forcings" that exacerbate climate change. Those forcings are due to the cumulative effect of past human emissions in the larger economies. In the Arab region, mitigation will have little effect since the region's contribution to those cumulative emissions is insignificant.
2. Adaptation is needed to address the impacts of climate change, particularly in regions where resources are limited. This is the case of the Arab region, an arid to semi-arid that where water is already scarce.

(Box 1) Circular Economy

A Circular Economy is an economy which balances economic development with environmental and resource protection. It places emphasis on the most efficient use and recycling of resources, and environmental protection. A circular economy features low consumption of energy, low emission of pollutants and high efficiency. It involves applying cleaner production practices in companies, eco-industrial park development and integrated resource-based planning for development in industry, agriculture and urban areas.

MULTI-SECTORAL DEVELOPMENT

The impacts of climate change will affect the economies in the Arab Region at various levels. Impacts can be seen at (1) the macro-economic level, and (2) for each of the various sectors in agriculture, productive sectors of industry, trade and services, in addition to households.

1 Macro-Economic Impacts

Economic impacts of climate change on the Arab region are related to variations in three key climatic parameters; temperature, precipitation, and the expected change in sea level. The economy is sensitive to (1) the magnitude of the change in climatic parameters; (2) the rate at which this change happens; and (3) the Increase in their variability.

1. The magnitude of the change is represented by both the (1) the extent of warming, and (2) the pattern of warming expressed.
    a. The extent of warming is forecasted by Climate Models, and represented by changes in the amount of rainfall and average temperatures.
    b. The pattern of warming expressed as expected variations in temperature and rainfall distributions.
    c. Of those two parameters, it appears that temperature has the larger effect on the short to medium term. The developing world, and particularly the Arab region, appears to be extremely sensitive to variations in temperature, as its economies experience "large, negative effects of higher temperatures on growth[1]". Particularly impacted would be Bahrain, Palestine, Jordan, Kuwait, Libya, Oman, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen. Those countries are primarily concerned with investments to alleviate the pressures of hyper-aridity, such as better management of groundwater resources, and securing additional sources of water, be it from fossil water or desalination.
2. The increase in the variability in climatic parameters is likely to have major destabilizing effects on developing countries' economy. Arid regions are especially vulnerable to variability in precipitation, particularly during droughts, when they experience unexpected and prolonged periods of abnormally low rainfall. In the Arab region, the resulting shortages of water appears linked to social instability and even conflict[2].
    a. This is a major issue for countries where renewable water supply is adequate, but where there are geographic variations among their different areas. This is the case of Algeria, Lebanon, Morocco, Tunisia, and Palestine. The primary concern for these countries is the investments needed to secure internal distribution across the various areas, and to smooth out the year-to-year variations in supply.
    b. Egypt, Iraq, and Syria appear to have adequate supply, but their main sources of supply are from transboundary sources. Their climate change adaptation strategy depends on investment decisions made upstream.
3. The rate of climate change, depending on its pace, may have widespread effects. Adaptation strategies would differ depending on whether the change in temperature, precipitation, or sea level rise is rapid, or slow. This is an aspect of climate change that affects all Arab countries equally.

Detailed estimates of the economic impacts of those factors are harder to obtain for the Arab Region because of a lack of systematic estimates at the regional level. The main benchmark studies (Mendelsohn and others, 2000; Nordhaus and Boyer, 2000; and Tol, 2002; and the Stern Literature review of 2007) have tended to focus more on mitigation at the global level. Their estimates varied widely, ranging from 0% to 3% for an average warming of 3°C above the average for the period from 1990 to 2000.

[1] Dell et al., 2008, p.2.
[2] Dell et al., 2008.

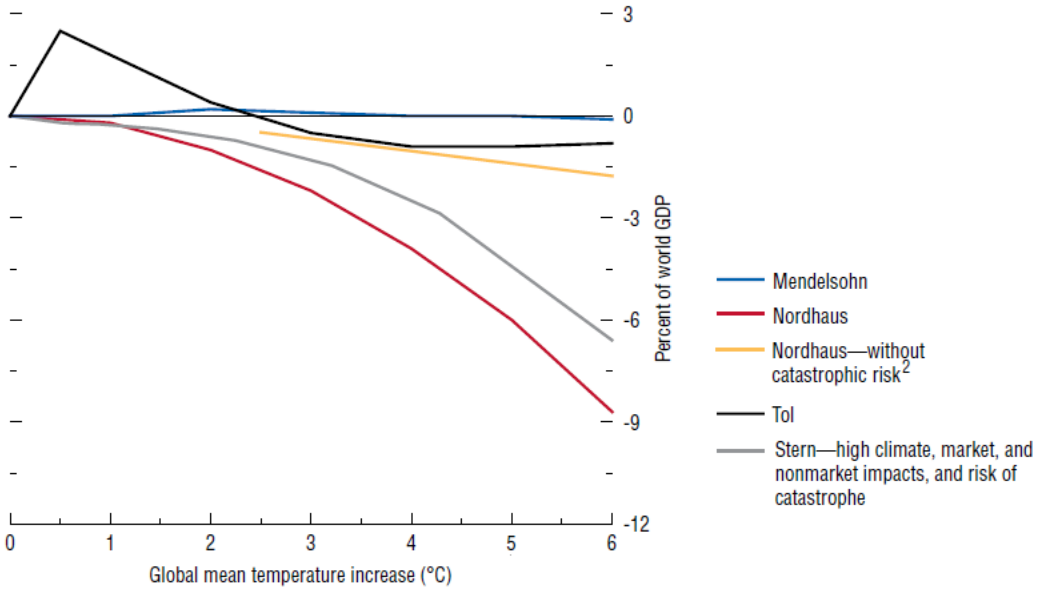


Figure 1. Mean GDP Changes at Various Levels of Warming[3].

The differences are due in part because of how their different "damage functions" relate economic parameters (GDP losses) to key climactic parameters (changes in average temperature). In the damage function, the economic costs are determined for both "market impacts" that can be easily priced. Those studies, however, may underestimate economic impacts, as they both undervalue "non market impacts" for which a dollar value is harder to assign, and do not account for the impact of extreme events[4].

(Box 2) Extreme Events and Natural Hazards

An extreme event is not natural hazard:

- Extreme events are defined in statistical terms; they are events that deviate strikingly from the statistical mean.
- Natural hazards are defined in terms of impacts such as losses, damages, casualties, etc.

Their assessment is done differently. For example, hydrological models would determine the potential extent of flooding, while economic models would determine their economic impact.

2 Impacts across Sectors

Climate change would result in impacts on various sectors. The most obviously impacted sector is agriculture, since agricultural production is the most closely linked to water availability and temperature. However, there will also be economic impacts of climate change on other sectors because of the implications of climate change for energy and infrastructure, as well as the essential service of water supply and water treatment.

1. Climate change will have a different impact on agriculture in industrialized nations than in developing countries. By 2080, it is expected that agricultural potential could increase by 8% in developed countries, primarily as a result of longer growing seasons, but fall in the developing world by 9%, because of lower water availability and higher temperatures. Agricultural yields in rain-fed areas are even more exposed to the effects of climate change.
2. The Energy sector will be affected, at the very least, due to increased demand for cooling, and because of the effect of higher temperatures.

[3] Adapted from IMF, 2008, Figure 4.3, p.4.5.
[4] IMF, 2008.

3. Some Infrastructure will need to be redone to account for these effects such as Sea level rise. Even a small increase in sea levels, will impact mostly coastal areas, affecting not only vulnerable groundwater aquifer, but also coastal settlements.
4. The Water sector, particularly supply and treatment, will require significant investments to adapt to the changing climate.

It should be noted that, the full economic cost of climate change may extend beyond what can be computed directly. This is because of additional costs that will add up the value of the true economic impact of climate change, both directly and indirectly. Many of the direct adaptation costs of climate change are generally non-obvious and thus hidden, and are related to such diverse adaptation actions as infrastructure replacement, transportation changes, productivity losses, relocation, training, etc. In addition, the increased level of uncertainty and risk brought about by climate change will add indirect costs on business activity related to the banking and insurance sectors, the need for planning...

NATURAL RESOURCES AND ECONOMIC DEVELOPMENT IN THE ARAB REGION

In the Arab World, climate change will affect the key pillars of sustainable economic development by increasing pressure on the key resources of water and energy. Both those sectors water and energy are closely linked through economic activity. Water-dependent sectors need energy for pumping, food production, heating and cooling, desalination, and treatment. Energy-dependent sectors are also dependent on water for power generation and extraction.

The future development of the Arab Region will therefore be intractably linked to the development of those resources in a context of climate change.

3 Natural Resources Management and Services in the Arab Region

a Water Resources and Water Demand

The water sector of the Arab Region is already feeling the dual pressure from both climate change and increased human activity. Arab countries now find themselves in a high risk situation, with high population growth, rising urbanization rates, and increasing demands on natural resources. It is a context where "climate change is contributing to the depletion and degradation of water and soil resources and putting further pressure on agricultural zones and biodiversity". The region's built environment and its natural ecosystems are now already witnessing "a higher frequency and intensity of floods, droughts and extreme weather events[5]".

Those issues poses unique development challenges in the water sector: (1) enhancing people's access to water and sanitation; (2) ensuring a secure water supply; and (3) maintaining the protection of vital ecosystems. Addressing those issues need a cross-sector focus.

1. The need for enhancing people's access to water and sanitation comes at a time when the region's urban population is projected to grow to 75% by 2050, up from 57% today[6].
    a. Many Arab countries are focusing on expanding water storage and conveyance networks, and increasing dam capacity. However, this strategy alone is limited in confronting climate change; most of the dams are already below full capacity, with high evapotranspiration rates.
    b. One of the adaptation responses will come through desalination, which is expected to expand five-fold by 2025. However, this is an expensive technological solution that will be limited to the energy-exporting states in the Gulf.
    c. Arab countries are expanding the use of treated wastewater. In the Gulf, about 40% of treated wastewater is used for animal fodder, and irrigation of non-food crops and landscaping. In Jordan, treated wastewater is mixed with freshwater to provide about 20% of irrigation water needs.

[5] ESCWA, 2015, p.1.
[6] UNDP-RBAS, 2013.

2. While it is already in water-deficit, the region needs to secure water supply to ensure needs of key development are met. In aggregate, the Arab Region is already using a far higher share of its renewable water resources compared than other regions.
3. Vital ecosystems are now under increasing threat from the overexploitation and pollution of many of the region's watersheds and aquifers.

Current management practices generally struggles to ensure the sustainability of water supply, from both a financial and an environmental perspective. The different countries in the region fare differently with respect to (1) the financial sustainability of water supply services, through some form of cost recovery, and (2) the sustainable management of the renewable water resource base (Table 1 below).

Table 1. SUSTAINABILITY AND WATER RESOURCE MANAGEMENT IN THE ARAB REGION[7].

		Environmental Sustainability	
		Yes	**No**
Financial sustainability	**Yes**	Morocco	Iraq Egypt Syria
	No	Jordan Lebanon Tunisia GCC	Yemen

In general, it appears that countries that rely on surface water (Iraq, Egypt, Syria) tend to environmentally manage their resources better than those that depend on groundwater. This may be because groundwater is comparatively easier to over-exploit and more difficult to control. However, they all struggle to achieve both financial and environmental sustainability, as long as public water agencies continue to try to efficiently manage the water sector alone. There are two main reasons for this: (1) the excessive focus on a single sector, and (2) the fact that water-use choice often depend on reasons that even a cross-sectoral focus could miss.

1. Public water agencies tend to be centralized agencies, with a sector-centric top-down approach. They and other agencies struggle with management practices that remain focus on a single sector, especially when water is often shared among many departments, each with its own focus. For example, agricultural departments are usually more interested in promoting irrigation and food production, while other ministries are generally more concerned with improving drinking water supplies and sanitation. More than ever, what is needed in dealing with those complex issues is a comprehensive approach that is coordinated across various sectors.
2. The impact of overall economic diversification and trade can often be far bigger than policies that deal exclusively with agriculture or energy. For example, while the choice of crop is a key determinant of water use in agriculture, it is far more related to the return a farmer can expect for their harvest than to the cost of either water or the energy. This market price is itself dependent of various factors such as trade. or ?access to financing and markets.

b Energy Resources and Energy Demand

In addition to the water sector, climate change can affect the energy sector through its effect on temperature and precipitation. This effect will be particularly pronounced in the Arab Region, because of the expected rise in temperatures and increased frequency of droughts. Higher temperatures will affect both energy demand and generation, and water shortages may affect production/extraction.

[7] Adapted from the World Bank, 2009, Figure 1.2, p.5.

1. Cooling and air conditioning demand alone would increase, at the very least, by more than 20% by 2050, reaching a 40% to 50% increase by 2100[8]. The increase may be even higher in practice, as the efficiency of many cooling systems decreases in warmer weather. Furthermore, higher than average ambient temperatures may also have a negative effect on the efficiency of electrical transmission lines, thus further adding to the demand for power generation.
    a. Power plants will have to work harder to meet the increased electricity demand. Both hydropower and thermal power plants will require even more water, whether they rely on.
        (1) The effectiveness of hydropower systems will be further undermined by the related increased frequency of droughts. Low reservoir levels will not only affect electrical power production, but they could also lead to (1) more conflict either among sectors (industry, tourism, and agriculture) or within sectors (irrigators and pastoralists), and (2) diminished flows into environmentally sensitive areas;
        (2) Thermal power plants will require redesign or retrofitting with new cooling towers, to maintain their efficiency in higher temperature environments.
        (3) Some types of renewable power plants would also be affected, particularly Concentrated Solar Power (CSP) systems as they need water for steam and for cooling. Typical CSP Plants need about 3,500 liters for each Megawatt hour (MWh) generated, compared to 1,000 liters/MWh for natural gas combined cycle power plants.
    b. In some of areas most affected by the increase in ambient temperature, power transmission networks may need to be redesigned or upgraded. In those areas with high ambient temperatures, just as the temperatures of the wires increase under those high transmission loads, there could be:
        (1) More power losses in the lines. This will either have to be compensated for by increased production, or it will require the installation of additional power lines;
        (2) Increase sag in the line, beyond safe limits. This happens when the temperature of power lines is too high. This will have to be compensated for by either replacement of existing lines, or the installation of additional power lines.
2. With decreased precipitation, there will be less water available, thus creating competition for water among households and economic sectors in agriculture and industry. This will be particularly critical during periods of drought.
3. Hydrocarbon extraction is also, in principle, extreme/ely water hungry. However, this is not a major issue in most of the oil-producing Arab states, as their oil and gas industry often relies on treated seawater rather than freshwater.

In general, energy policies tend to be sector specific, and may lack an appreciation of water resources. They also often fail to take into account the impact of other sector's environmental performance on energy production. For example, in the case of hydropower, policies rarely take into account the impacts of poor agricultural and land management on erosion and sediment transport, which are the primary cause of dam siltation and turbine wear. A wider multi-sectoral outlook is also needed in the energy management policy.

4 Integrated Water Resources Management

Meeting the multifaceted challenge of climate change requires a comprehensive approach to water management that takes into account the needs of various sectors vital to economic development. This concerns all sectors related to economic activity; households, agriculture and livelihoods, industry and productive sectors, as well energy generation and extraction (Table 2).

[8] Issacs and van Vuuren, 2009, Shanks and Nezamifar, 2013.

Table 2. CROSS-CUTTING ISSUES IN THE ARAB WORLD AFFECTED BY CLIMATE CHANGE.

Development Challenge	Sectoral Challenge	Climate Change Challenge			
		Precipitation Decrease	**Temperature Increase**	**Sea Level Rise**	**Extreme Events**
Households: water and sanitation	Regular provision of safe water; Desalination & Water Storage; Wastewater collection, treatment and reuse	Freshwater	Cooling; greater demand	Coastal Settlements; Desalination plant intakes	Livelihoods
Human Health	Vector-borne diseases; pests; Vulnerable groups	Vector-borne diseases and pests	Heat stress Vector-borne diseases		Floods
Transport and Trade	Air traffic; Ports/storage/testing facilities; Road/Bridges	Dust storms	Warming of Seas & Wind Currents	Storm surges; Coastal installations	Winds, Floods
Agriculture: Irrigation	Improvements in Irrigation Water-saving technologies	Freshwater	Wilting points	Salinity of coastal aquifers	Floods Drought
Agriculture: Livestock	Water & feed supply; Grazing land availability	Freshwater Desertification	Heat stress		Drought
Agriculture: Crops	Rainfed agriculture productivity losses; Food security	Freshwater Land degradation	Wilting points	Salinity	Floods, Droughts
Industry: Various Processes	Regular supply of water; Water treatment at source	Water	Cooling	Coastal Businesses	Business Uncertainty
Electricity: Power Plant	Cooling efficiency	Water Availability	Retrofit for Cooling	Coastal Power plants	Demand Uncertainty
Electricity: Hydropower	Balancing needs for power & irrigation	Freshwater; Energy Generation	Evaporation Losses		Demand Uncertainty
Electricity: Renewables	Use in dusty & hot environments; Water saving systems	Water Availability	Diminished Efficiency		Demand Uncertainty
Electricity: Power Transmission	Expansion of power grid, Enhanced power supply and delivery		Diminished Efficiency		

To be effective, the approach should strive to equitably maximize both economic and social welfare without compromising vital ecosystems. The process should be sustainable, one that promotes coordinated development and management of water, as well as land and related resources. In addition, to contributing to more effective and efficient water management, the approach should also ensure the sustainability of ecosystems. Water development therefore needs to ensure (1) social equity; (2) economic efficiency; and (3) ecological sustainability.

1. Focusing on **Social Equity** would ensures that water management emphasis not only capacity building amongst the users of the resource, but also the interests of women, men and vulnerable groups, such as children and the elderly, who depend on freshwater resources;
2. The need of **Economic Efficiency** encourages inter-disciplinary management of water resources across sectors. The contribution of water to development differs among the various sectors in agriculture, industry (productive sectors), domestic use, and services.
3. A wider perspective is provided by focusing on **Ecological Sustainability**, as this would takes into account all natural resources that affects water resources and the local hydrologic cycle; soils, surface water and groundwater and water quantity.

The need for this approach is illustrated by the case of agriculture in the Arab Region. It is the largest user of water in Arab States, often accounting for more than 70% of the total water demand, and reaching as high as 90% in Iraq, Oman, the Syrian Arab Republic and Yemen.

1. An exclusive focus on Economic Efficiency would suggest that this is inefficient, as the region largely remains a net importer of food.
2. However, a social equity perspective would reveal that agriculture is a key livelihood issue, especially in rural areas, home to 42% of the population of Arab Countries.
3. Furthermore, in order to ensure ecological sustainability, a way should be found to manage water differently, especially as climate change is now causing decreased water availability, while the region's population is continuing to grow.

Integrated Water Resources Management (IWRM) systems can address those concerns, and also incorporate consultative and inclusive governance structures in the process. The IPCC states that, "'sustainable' water resources management is generally sought to be achieved by Integrated Water Resources Management[9]". IWRM is characterized by its unique focus, implementation, and decision-making process:

1. The focus of IWRM departs from the traditional sector-centric approach, and considers a cross-cutting perspective that involves all water-related economic sectors;
2. The IWRM implementation is generally centered on a watersheds rather than single water courses.
    a. This is because, when dealing with an issue that involves many diverse sectors, it is best to focus on the well-defined resources that they share. For freshwater, the shared resource would be the bounded hydrologic system represented by a watershed.
    b. Within the watershed, all the water coming into the area goes to the same watercourse or groundwater system. In this area, all living things, and all human activity, tend to be inextricably linked. For this reason, IWRM focuses on the watershed, in which it promotes the coordinated development and management of water, land and related resources.
3. Decision-making strives to be participatory, involving all stakeholders from beyond the narrow professional and managerial realm.
    a. This participatory approach is key to the success of IWRM, particularly in very complex situations, that require consideration of different priorities and interests represented by women and men. Household, agriculture and industrial needs and interests need also be considered and balanced related to one another, especially under the increased variability and unpredictability due to climate change. For example, in cases where water transfers and infrastructure investments are being considered to transport water from one watershed to another, or expanded desalination capacity is under consideration.

In this manner, and unlike traditional sector-focused approaches, IWRM recognizes the fact that water is a scarce natural resource with many interdependent users. This allows it to optimize water management under a changing climate by taking into account both (1) the technical, economical and environmental aspects of water management, and (2) the different needs and interests of various stakeholders.

CLIMATE CHANGE IMPLICATIONS FOR ECONOMIC DEVELOPMENT

Climate change is impacting economic development in the Arab region, and is expected to continue to affect economic development unless appropriate adaptation strategies and plans are put int place. A general picture of this outlook can be determined on the basis of existing benchmark studies. However, a more detailed economic assessment will need to be carried out using computer models that take better into account the data from Regional Climate Modeling.

[9] Bates et al., 2008, p.60.

5 *Impacts of Climate Change on Arab Economic Development*

The Arab Economic outlook will be largely be defined by the economic impact of climate change, both at the regional level and the global level:

1. The economic impact of the projected variation in regional climate temperature, precipitation, and sea level rise. At the regional level, the Arab economic outlook will be affected by the combined effect of the magnitude of the change in climatic parameters, their rate of variation, and the increase in their variability.
2. The effects of climate change on the global scale. Those impacts will have a regional effect on the Arab economic outlook as well, because of the influence of both (1) global climatic systems on the regional climate, and (2) the responses to climate change of the wider economy, and their effect on the region's economies.

The combination of those effects will result in three types of economic impacts; (1) direct, related to the adverse effects of temperature increases and precipitation; (2) indirect, related to the various Response Measures triggered, and (3) deferred or cumulative.

The **direct impact** of climate change on the Arab Region will be felt by changes in temperature and precipitation patterns, and the frequency of extreme weather events.

1. A **decrease in precipitation** would stress already scarce water resources.
    a. At the very least, this risks distorting the market and creating competition among the various sectors, most notably between the industrial and service sector, an essential driver of economic expansion and development, and the agricultural sectors, an essential element of sustainability and livelihoods. This will, in turn, have repercussions on the energy sector, a key driver of the economy.
    b. At most, perturbation in water supply may affect social stability and promote conflict. The latest example appears to be the 2007−2010 in Syria, which experience "the worst drought in the instrumental record". As it caused "widespread crop failure and a mass migration of farming families to urban centers", it is possible this "drought had a catalytic effect, contributing to political unrest[10]".
2. Economic studies suggest **increase in temperature** would adversely affect growth, but the impacts will not be equally felt, with developing countries fairing worse than industrialized nations[11]:
    a. In industrialized countries, there appears to be no discernible link between GDP and changes in temperature or precipitation.
    b. In developing countries, it appears that temperature has an effect on GPD, as shown in Figure 2 below. This may be linked to the fact that, in developing countries, there are known linkages between increased temperatures and decreased productivity, increased crime and mortality.
        i. It is estimated that, when average temperature increases by 1°C in any given year, economic growth in developing countries decreases by 1.1%.
        ii. Based on studies that show a 1.1% decrease in GDP for a 1°C in temperature, the project average rate of warming of 0.2°C per decade will lead to a net decrease in the GDP growth of about 0.2% over that same period, or 0.02% decrease per year.
3. Climate change may render **extreme events** such as cyclones more frequent. Those events can have significant economic impacts in the Arab region, as in the case of 2010, when the Arabian sea witnessed the second-largest tropical cyclone on record. Damages in Oman amounted to USD 700 Million in damages, with 44 deaths.

[10] Kelley et al., 2015, p. 3241.
[11] Dell et al., 2008.

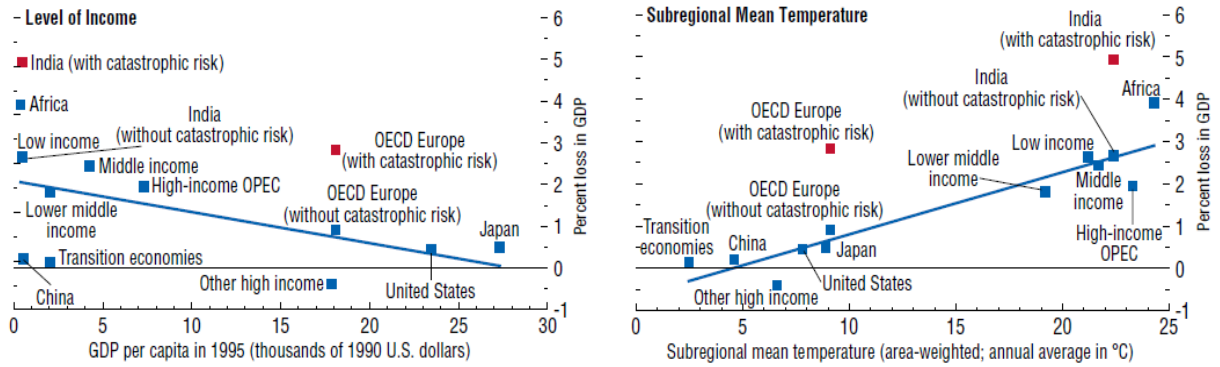


Figure 2. Damages from 2.5°C Warming by Region[12].

The Arab Region may also feel **Indirect impacts**, most of which may from Response Measures (RM) undertaken either as part of either other adaptation measures outside the region, or mitigation in industrialized countries.

1. In theory, adverse impacts of RM should not result from policies, since the Rio Declaration enjoins states to "enact effective environmental legislation "while recognizing that some standards "applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries[13]".

Finally, it is also likely that the region may feel **Deferred Impacts**, or cumulative impacts. This is because, compared to other domains, climate is more exposed to an accumulation of impacts due to "induced" actions that may occur as part of society's reaction. Indeed, the urgency of the problem may often require prompt action before a complete scientific understanding is developed.

1. Impacts due to **induced actions** can be of two types:
    a. Generally foreseeable impacts, caused by the combination of past, present and “reasonably foreseeable” future actions.
    b. Unforeseeable Impacts that result from unexpected consequences of either RM, or poorly understood inter-relations between climatic and socio-economic systems.

2. **Cumulative effects** may result from long term negative effect of temperatures on the growth rate, particularly if increase in high temperature days persists over time. This is particularly relevant for the Arab World, where 5 countries saw temperature records in 2010, the hottest year on record since climate data collection. In that year, temperatures in Kuwait had reached 52.6°C, only to be followed by 53.5°C in 2011[14].

(Box 3) : Long Term Mitigation and Short term Adaptation

Climate change poses a potentially high cost on economic development, but one in which the distribution of causes and effects unevenly spread globally across both (1) generations and (2) countries.

1. To those investigating mitigation policies, the focus is on the **long term costs of climate** change impacts on **future generations**. However, because the analysis of climate change and its links to human activity are subject to wide margins of error, there is disagreement on the **discount rates** used to estimate long term future costs and to increase the present value of very long term benefits.
2. For purposes of adaptation, this debate is **not relevant in the short to medium term**, and especially so in the case of **developing countries** that are disproportionally exposed to the effect of climate change. The negative effects of climate change are already being felt in many areas such as the Arab Region, where it is exacerbating the prevailing arid conditions.

Therefore, for purposes of **adaptation to climate change in the Arab Region**, it is best to focus on the needs for **the short to medium** term, especially since some of the negative economic impacts are already being felt.

[12] Adapted from IMF, 2008, Figure 4.4, p.4.6.
[13] Rio Declaration on Environment and Development
[14] Verner and Breisinger, 2013.

6 *Integrated Economic Assessments of Climate Change*

The economic evaluation of the impacts of climate change on the Arab Region need to take into account both the linkages between climate and development, and how the various sectors of the economy will respond. At the global level, the IPCC identified various approaches to that can be followed to carry it out[15], which can be grouped in two broad categories:

1. **Qualitative Assessments** based on limited and heterogeneous data and built from existing experience and expertise;
2. **Quantitative Assessments** from socio-economic impact studies, depending on the scale of the problem:
    a. At the larger scale, **Shared Socio-economic Pathways** (SSPs) provide a picture that can help policy makers understand the regional implications of the interaction between socio-economic systems and the Earth's changing climate. They are used to develop representations of how the future might unfold. Under development since 2010, SPPs now serve as a basis for computer modeling of the climate.
    b. At the smaller scale, computer modeling is used to represent the interrelationships and feedbacks of various socio-economic systems. Those **Integrated Assessment Models** (IAMs) remain largely a work in progress, in spite of much development effort. However, they can still offer policy makers with insights as to the evolution of socio-economic systems under climate change.

The appropriate type of Integrated Assessments of Climate Change will depend on both (1) the objectives of the policy, and (2) the sectors targeted. For purposes of adaptation policy in the Arab Region, the most relevant approach is a quantitative approach. Only such a method can show the result of the effect of climate change on the region's various economic sectors.

Using the quantitative approach, the economic impacts can be evaluated in two ways:

1. In the "**statistical approach**", in which the physical effects of climate change are related to observed variations, either across regions or within a single country. This method, however, is necessarily backward-looking in that it cannot easily take into account the results of Climate Models.
2. It is the "**enumerative method**" that is best adapted to support policy making in estimating the economic impacts of climate change. In this method, an economic cost is assigned to each of the physical effects forecasted by Climate Models.
    a. The main advantage of this approach is that it relies directly on the results from Climate Models.
    b. However, it risks misestimating the cost of climate change because of the need to extrapolate economic values in three critical ways:
        (1) From one sector into another (some of which may not have associated market values);
        (2) From one region into another (which may have different adaptive capacity),
        (3) From one time (the past) period into another (the future).

The economic costs or impacts are used differently in either Integrated Assessment Model (IAM) or RICCAR's **Integrated Vulnerability Assessment**[16] (VA).

1. In the IAMs, they are added up to come up with a total economic cost.
2. In RICCAR's VA, they are combined with a vulnerability assessment and GIS representation to provide a visual representation of the vulnerability of climate change.

Both have their limitations and advantages.

[15] IPCC, 2001.
[16] ESCWA, 2015.

a Integrated Assessment Models (IAMs)

Integrated assessment models (IAMs) are computer models that determine the economic costs of climate change impacts by "integrating" multiple parameters that represent economic, social, and environmental factors. Over time, IAMs have evolved in two critical ways. They:

1. Include parameters such as adaptation/technological change, land use changes and “non-market” items such as biodiversity and ecosystem services, (including urbanization).
2. Allow to take into account alternatives to discounting assumptions; demographic, political and macroeconomic processes; changing value systems; or "surprises" to social systems[17]

This means that IAMs strive to "price" the effect of climate change impacts. Those factors are of two types; (1) those that have a obvious cost associated to them, and (2) those that don't.

1. In case when cost estimates can be made, IAMs express them in either of ways; estimates of total economic costs, or Marginal Cost Estimates.
    a. Estimates of the **Total Economic Cost** of climate change are well suited to determining the impacts that can be assigned a direct a monetary value. Those costs are directly linked to market transactions, and therefore directly affect Gross Domestic Product (GDP). However, this method may not be comprehensive enough to reflect the real cost of climate change.
    b. A more limited approach is to "**aggregate** impacts" by adding up the total impact of climate change across various sectors or regions. While such **Marginal Cost Estimates** are still limited to estimating those costs that can be directly linked to economic transactions, it has the advantage of providing a more focused cost estimate. In spite of "large gaps in current research on this topic", this method remains best suited for "economists thinking about policy design[18]".
2. The main challenge for IAMs is how to take into account "non-market" impacts for which, by definition, no cost estimate can be established. The computations are often based on several quantities that are, by their nature, unknowable, or to which costs are very hard to associate. Examples of those are numerical measurement of human welfare, monetary value of both current and anticipated climate damages, or relative worth of future versus present benefits.

There are currently many subtle differences in the way IAMs differ. They differ in two ciritical ways; (1) their "focus", or the question they are trying to answer, and (2) their structure.

1. IAMs differ on how they try to address a problem where the parameters are interlinked. On one hand, the economic sector results in forcings that affect the climate. On the other hand, climate change has a direct effect on the economic sector and the resulting forcings. Their focus is therefore on Economic modeling that is desgined to support either:
    a. Climate modeling and mitigation analysis. Those IAMs explore "a range of different technological, socio-economic and policy futures that could lead to a particular concentration pathway and magnitude of climate change[19]".
    b. Adaptation strategies. Those IAMs strive to evaluate the impacts of climate change on various technological, socio-economic and policy futures.
2. The structure of IAMs depends on their perspective. In theory, IAMs should be structured to identify the "optimal" policy that maximizes long-term human welfare, they differ in how they try to. However, they differ in the perspective they take, and each resulting structure "provides a different perspective on the decisions that

[17] Schneider, 1997.
[18] Tol, 2009, p.30.
[19] vanVuuren et al., 2011, p.7.

are necessary for setting climate and development policy[20]". Those structures generally fall into four broad categories:

a. The most complex models are **Equilibrium models**. They represent the economy is as a system of linked economic sectors that they try to "solve" by searching for a set of prices that will reach an equilibrium. Their main shortcoming is that they can grow to become extremely complex and intricate, without this resulting in enhanced performance;

b. **Simulation** models are based on forecasts about future emissions and climate conditions, and try to link climate outcomes to economic model of production, damages, consumption, investment and abatement costs. They are primarily used in mitigation studies to estimate the cost of various likely future emission paths, and not generally well suited for adaptation studies;

c. The focus of **Cost Minimization** models is to identify the most cost-effective solution that would be most compatible with a specific objective. Recent versions of those models explicitly include or link to a computer Climate Model (CM);

d. The simpler models are **welfare optimization** models. As shown in Figure 3 below, they are useful for purposes of adaptation analysis, as they can use computer Climate Model (CM) and use climate parameters to estimate, via a "damage function", the socio-economic impacts of climate change. In addition, they may allow for speculative values to be assigned to non-market "goods".

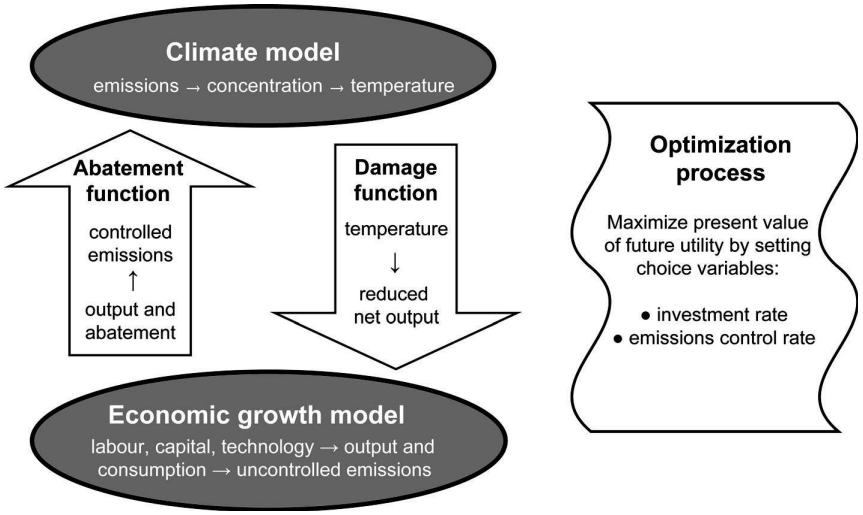


Figure 3. Schematic representation of a welfare optimizing IAM[21].

At this stage of development, IAMs could still offer general insights as to the reaction of the Arab Region's economies to the projected regional impacts of climate change. Ideally, it is the simpler welfare optimization IAM that would be best suited for purposes of climate change adaptation in the Arab region. However, two main issues need to be kept in mind before the actual implementation of IAMs:

1. Care must be taken, however, to ensure that their design is well documented, to clarify the approximations made. There are fundamental challenges that IAMs have to contend with in the economic valuation of the effects of climate change. This is vital to ensure that the conclusions reached by the IAM properly inform the adaptation strategy.

2. Yet, as of 2015, there were no implementation of Integrated Assessment Models (IAMs) in the region that could provide detailed analysis of economic impacts based on the climate change impacts generated by

[20] Stanton et al., 2009, p.167.
[21] Adapted from Stanton et al., 2009, Figure 1, p.168.

Regional Climate Modeling (RCM) such as RICCAR. The Integrated Vulnerability Assessment proposed by RICCAR may be the most applicable at this stage.

b Limitations of Integrated Assessment Models (IAMs)

The differences among IAMs can have significant consequences, as it leads some to reach conclusions that contradict scientific literature, while others appear to implicitly ignore some key imbalances[22]. The differences in model design and computations can lead to significant estimates in the economic costs of climate change, as dramatic as those shown by the studies carried out by Nordhaus and Stern which ones?.

The main reason is that the implementation of IAMs has to contend with significant fundamental challenges in the economic valuation of the effects of climate change. This challenge is related to (1) the difficulty in associating real costs to the variety of impacts; (2) applying the appropriate "discount rate"; or (3) properly understanding the correct functional forms for some of the key relationships.

1. It is not always evident how **real costs** can be associated to the climate change impacts. Indeed, There are impacts of climate change that affect activities in which there are no established markets or for which there is no established pricing mechanism.
    a. Since they cannot be measured by market prices or revenues, it is extremely difficult to obtain a reasonable measure for those impacts. They affect such sectors are changes to the type of economic activity, effects human health linked to the varying spread of infectious diseases, or ecosystem losses and decrease in biodiversity.
    b. This is relevant for developing countries, where such non-market impacts are estimated to have a significant negative effect[23]. Those impacts may contribute substantially to the total costs of climate change, as shown by studies that have included health impacts[24].
    a. Even when there are methodologies to estimate costs, there may be an additional problem caused by the lack of economic data, particularly in developing countries, and especially since many socio-economic parameters may not be uniformly distributed over a country's territory. This is further compounded by the inability to:
        i. Estimate the future level of adaptive capacity, as it will affect the future cost of climate change impacts;
        ii. Forecast the evolution of Socio-Economic trends with relation to climate change.
2. There way IAMs apply a **discount rate** remains another point on which there is little agreement in the literature. This has significant consequences, as "different rates will yield wildly different estimates of" such important parameters as "the social cost of carbon and the optimal amount of abatement that any IAM generates". It is such differences that explain largely the large discrepancies "regarding optimal abatement" between two of the most cited IAM based analyses, the research by Nordhaus and Stern[25] which resulted in difference in results and widely divergent policy recommendations[26].
3. Much research still needs to be done to establish the correct **functional forms** for some of the key relationships between parameters that describe climate and socio-economic systems.
    a. An example is the "damage function" that relates temperature variations to either Gross Domestic Product (GDP) or its growth rate. Since "there is no theory and no data that we can draw from" to back up this relationship, it remains a concept over which "we know virtually nothing", and IAM

[22] Stanton et al., 2009.
[23] Smith et al., 2001. p 942.
[24] Confalonieri, 2007. p 415.
[25] Nordhaus, 2008; Stern, 2007.
[26] Pindyck, 2015, p.1.

developers appear to "simply make up arbitrary functional forms and corresponding parameter values[27]".

b. This inaccuracy is compounded by the fact that the probability distributions of various socio-economic parameters remain still poorly understood. This may create significant variability as "different distributions – even if they all have the same mean and variance – can yield very different results for expected outcomes[28]", and thus for policy recommendations.

c. Some models "incorporate simplified representations of the climate system, ecosystems, and in some cases, climate impacts", which then need to be "calibrated against more complex climate and impact models[29]". This may be a source of additional uncertainty, as it creates its own set of approximations.

(Box 4) The Discount Rate

Climate change is a cross-generational issue; just as the emissions of past generations have contributed to today's climate change, today's mitigation actions will affect the welfare of future generations. The necessary investments will therefore depend the relative value of **present benefits** (money today) over **future costs** (money in the future).

- A **low discount rate** (0.1%) is chosen by those who consider that catastrophic climate change may drastically affect future generations, and may even lead to the downfall of civilization, as it has happened many times in the past.
- However, the needs of today's development lead others to prefer a **higher discount rate** (3%), and consider that catastrophic climate change is far less likely to cause the downfall of advanced civilizations who can develop the technologies necessary to overcome future challenges.

The heart of the debate remains an inherently ethical judgment about comparing the well-being of different generations; today's and those alive in a 100 years.

In the development of IAMs, those diverse challenges are met in a variety of ways, which results in a diversity of models that often lack transparency. For the long run, this has to be addressed to ensure a greater integration and standardization of. However, it remains difficult in establishing "agreed upon standards for how to approach and implement integrated assessment". This difficulty is exacerbated by a "systemic challenge that hinders effective and meaningful inter-office or inter-Agency collaboration". Such "Stove-Piping" please use different wording here? results in a system in which the data is often presented without proper context, and analyzed differently by specialized research groups who find it hard to easily share or communicate information[30].

7 *Economic Implications of Extreme Events*

Extreme weather events can have severe economic consequences. The effect of extreme weather events are both on the short term, when damages occur and have to be repaired, and on the medium to long term, if the impacted country cannot recover from them.

Natural disasters are known to have significant economic impacts in the **short term**, particularly on developing countries. In the period between 1990 and 2000, disasters caused damage representing between 2% and 15% of an exposed country's annual GDP. However, the data is less clear regarding the **long term** effect of disasters on developing countries. The main reasons is confusion between extreme weather events and other types of disasters.

1. While disasters such as earthquakes are cataclysmic, they are also infrequent, and "frequently succeeded by higher growth rates". In many cases, they are "a temporary disruption of the development process" with no long-term impacts[31].

[27] Pindyck, 2015, p.2.
[28] Pindyck, 2015, p.5.
[29] Moss et al., 2010, p 750.
[30] EPA: http://www.epa.gov/sustainability/analytics/integrated-assessment.htm
[31] IEG, 2007, p. 5.

2. This is not the case of the extreme weather events that result from climate change. The forecasted extreme events that are more protracted, or persistent.
    a. Protracted and persistent extreme events such as droughts can last over multi-year periods, and can have lasting impacts;
    b. Extreme events can also be shorter lived, but theycome with increased frequency, such as heatwaves, storm surges, flash floods.

In those cases, there are many ways in which extreme events can negatively affect economic development:

1. The stock of physical capital and human resources may no longer be present after the onset of the extreme event:
    a. This is the case of Syria's northeastern region, which was hardest hit by the 2006-2011 drought, when the country experience the worst such extreme event in 40 years. By 2009, three years into the protracted drought, 300,000 families were negatively affected as farmers and herders lost their livelihoods[32]. The majority of those families had little choice but to permanently leave the area; between 1.25 Million and 1.5 Million people and resettle in the eastern part of the country[33]. Due to this loss of physical capital and human resources, by 2008, the agricultural share of GDP in Syria fell to 17%, down from 25% in 2003.
2. The increased frequency of extreme events will contribute to an atmosphere of uncertainty that will discourage any available private capital. Public funding would struggle to make up the shortfall:
    a. The extreme event would have caused a reallocation of funds from other planned investment. In addition, the increase in public spending could lead to higher fiscal deficits and cause inflation.
    b. In cases when repair or recovery is funded by aid, this aid may not be entirely additional. Donors tend to advance commitments within existing multiyear country programs and budget envelopes. As a result, the amount of aid provided following the natural disaster is diverted from development aid flows.
3. Extreme climate events may also increase the risk of conflict, particularly in countries where livelihoods are heavily dependent on agricultural activity are vulnerable to extreme climate events. As those countries experience a negative growth shock as a result of the extreme event, the likelihood of conflict the year following its onset would increase significantly[34].

CLIMATE FINANCE

The technologies needed for climate change adaptation are diverse, and their costs significant. The 2009 UNFCCC "Expert Group on Technology Transfer" identified 165 adaptation technologies and 147 mitigation technologies that were needed for developing countries. At the global level, a sector-by-sector analysis carried out by the UNFCCC estimated that implementation of those various technologies for adaptation needs alone would amount to be at least in the range of USD 49 to 171 Billion a year[35]. However, it should be noted that this study excluded some key economic sectors (mining, manufacturing, energy, retail, finance, and tourism), and did not account for the cost to protect/revive ecosystems, which may alone amount to USD 65-300 Billion a year[36]. Adding all these cost suggests that adaptation costs may reach USD380 Million a year at least?[37].

Regardless of the exact amount, no single funding channel can easily deal with such large amounts, and cover such diverse needs. For this reason, a variety of funding channels are needed. In principle, adaptation to climate change would

[32] FAO, 2009.
[33] IRN, 2009.
[34] Miguel et al., 2004.
[35] UNFCCC, 2007.
[36] Parry et al., 2009.
[37] Montes, 2013.

depend on specific financing that transfers the necessary funds to the ones who need it most. This financing reflects the fact that the current change is related to the cumulative effect of human activities, most of which occurred in developed countries. Developing countries are now faced with a dual burden; while they need to grow their economies while at the same time adapting to climate change.

The principles and criteria of climate finance recognize this. In principle, this financing would have three characteristics: (1) a structure to transfer adaptation funds from developed countries to developing countries, (2) a distinction from conventional Official Development Assistance (ODA), (3) a focus on both sustainable development and adaptation.

However, in practice, the global finance architecture is not completely structured on this basis. The focus is more on financing "clean development" (mitigation), with a lesser focus on funding other adaptation actions. This is particularly the case in the Arab Region.

8 Principles and Criteria of Climate Finance

For the Arab region, the source of such "Climate Finance" would be support mechanisms and financial aid to help countries implement strategies specifically targeted at climate change adaptation, with eventual mitigation co-benefits. This funding has therefore a dual focus:

1. Adaptation, through projects that support policies to deal with the negative impacts of climate change on economic development and thus promote "climate-resilient" growth
2. Mitigation, through:
    a. Either actions and projects that promote Clean Development, without additional economic burden compared to traditional schemes.
    b. Or projects that promote adaptation and economic development, and have co-benefits of mitigation, through the implementation of appropriate low carbon technologies;

Formally, the UN Framework Convention on Climate Change (UNFCCC) has provisions to provide for financing such needs. Some of the key principles relevant to the financial interaction between developing and developed countries were further clarified during the Kyoto Protocol and follow-up agreements and decisions by the Conference of the Parties (COP).

1. Article 4.3 commits developed countries to provide funding for "agreed full incremental costs" of adaptation to climate change in developing countries, in a way as to ensure "adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties".
    a. The convention also specifies that funding should be "new and additional"; provided in addition to existing target for 0.7% of Gross National Income (GNI) of the Official Development Assistance (ODA) by developed countries. This is necessary to ensure that finance is not diverted from funding for development needs.
        (1) In practice, however, there is yet no agreement on indicators that could help distinguish between ODA and non-ODA national contributions.
        (2) This lack of clarirty has real financial implications, as shown by data on disasters in developing countries over the period 1987-2003. In those cases, donor aid "covered less than 10 per cent of the financing" needed, and "was generally used for emergency relief and not reconstruction"[38].
    b. The predictability of funding is necessary to ensure a sustained flow of climate finance from year to year, to allow developing countries to develop adequate investment program planning. The funding period is estimated to be about 3 to 5 years, in line with medium-term funding cycles.

[38] Montes, 2013, p.4

2. Article 2 commits the parties to take climate action "the basis of equity and in accordance with their Common But Differentiated Responsibilities and Respective Capabilities" (CBDRRC). This principle has two aspects; the "Polluter Pays" principle and the concept of "Respective Capabilities".
    a. The "Polluter Pays" principle is relevant to climate finance because it would imply that Climate Finance to be distinctly different from aid flows. This concept relates to the fact that the current change in climate is due to the cumulative effect of GHG emissions, most of which have been done in developed countries. This principle serves as a normative guidance to determine the level of climate finance contributions of individual polluting countries. In practice, two aspects still need to be clarified:
        (1) The baseline year, as this will define how to include historical cumulative emissions;
        (2) The effect of current emissions.
    b. The concept of "Respective Capabilities" suggests that contributions should relate to a measure of national wealth, taking into account the right to sustainable development referred to Article 3.4 of the convention. However, there is yet no agreement on whether this should be correlated with a sustainable and universally accepted living standard for each of its citizens, or what the baseline year for this would be for this.
3. Actual funding disbursement is guided by some key principles to ensure that the funds are used effectively and efficiently, and benefit those most in need. Fund disbursement mechanisms should ensure (1) subsidiarity and national/local ownership, and that the actual spending is done in a (2) precautionary manner and (3) appropriately:
    a. The requirement for subsidiarity and national/local ownership is to ensure that (1) funding priorities are decided in coordination with the "target audience", to ensure no "donor define" agenda is set, and (2) actual disbursements meet actual adaptation spending needs.
    b. A precautionary approach is needed because policy makers need to undertake adaptation actions in a context where the scientific knowledge is still formative. Because of the importance to act fast, they often cannot wait to make sure all the scientific information is settled. For this reason, they still need to ensure that the funded adaptation action first "causes no harm".
    c. Appropriate climate funding is one that does not place extra burdens on recipient countries. Funded adaptation actions need to be compatible with national strategies and with the long-term objectives of sustainable development.

In the run up to the Paris COP meeting of December 2015, there was still no full agreement about the precise meaning of these principles, and how to implement them. While those principles serve collectively as a normative guidance, there is still no coherent framework for new defining funding mechanisms and commitments. It is hoped the ongoing debate and discussions on those principles will help lead to the new universal legally binding global climate agreement.

Table 3. SOME PRINCIPLES AND CRITERIA FOR CLIMATE CHANGE FUNDING FOR ADAPTATION[39]

Funding Phase	Principle	Criteria
Mobilization	Transparency & Accountability	Public and timely disclosure of (1) financial contributions by individual countries, international organizations, and agencies, (2) their composition and sources
	Polluter Pays	Financial contributions correlate with cumulative emissions.
	Respective Capability	Financial contributions are correlated with (existing) national wealth and the right to both (future) sustainable development and universally accepted minimum living standards for citizens.
	Additionality	Funds to be provided in addition to existing national ODA commitments.
	Predictability	Funding is known and secure over a multi-year, medium-term cycle

[39] Adapted from Schalatek and Bird, 2014.

Administration & Governance	Transparency & Accountability	Availability of accurate and timely information on a (1) mechanism's funding structure, (2) its financial data, (3) the structure of its board, (4) identity of its board members, (5) a description of its decision making process, (6) the actual funding decisions, (7) disbursements made, (8) the implementation results achieved, (9) as well as redress mechanism or processes and their outcomes.
	Equitable Representation	Ensuring that member countries' board seats are not dependent on financial contributions, and inclusion of relevant stakeholders.
Disbursement & Delivery	Transparency & Accountability	Disclosure of funding decisions according to publicly disclosed funding criteria and guidelines and the disbursements made; duty to monitor and evaluate implementation of funding; existence of a redress mechanism or process.
	Subsidiarity & Ownership	Funding decisions to be made by taking into account both (1) National strategies and (2) the knowledge and needs at the lowest possible and appropriate political and institutional level
	Precaution & Timeliness	Absence of scientific certainty should not delay swift disbursement of funding when required
	Appropriateness	The funding modality should not impose an additional burden or injustice on the recipient country
	Do No Harm	Climate finance investment decisions should not (1) imperil long-term sustainable development objectives of a country, (2) contradict national priorities and strategies, or (3) violate basic human rights
	Direct Access & Vulnerability Focus	Financing, technology and capacity building to be made available to the most vulnerable countries internationally and population groups within countries as directly as possible, ensuing that technology transfer is in line with national priorities and strategies.

9 The Global Climate Finance Architecture

The structure of global climate finance is still evolving. It remains hard to define and monitor, not least because there is yet no clearly agreed upon definition of what constitutes climate finance. As a result, the global climate finance architecture is becoming increasingly complex, with funds flowing through a multitude of channels; (1) formal multilateral financing mechanisms both within and without the United Nations Framework Convention on Climate Change (UNFCCC); (2) bilateral channels; (3) national climate change funds in developing countries[40].

1. Formal multilateral financing mechanisms within the UNFCCC. Such channels are not, in theory, contributor country-dominated, and thus afford developing countries greater input in decision-making. Non-governmental stakeholders are also often observers to fund meetings, and allowed varying degrees of active participation opportunities.
    a. The Global Environment Facility (GEF) was established in 1991 as an operating entity of the financial mechanism of the UNFCCC. It allocates resources on according to the effectiveness of the spending on environmental outcomes, while still ensuring that all developing countries have a share of the funding.
        (1) For the period 2015-2018, the GEF is expected to have USD 3 Billion for climate change.
        (2) The GEF also administers two other funds; the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), both of which support national adaptation plan development and their implementation, with a a country ceiling for funding of USD 20 Million.
    b. The Adaptation Fund (AF) is also linked to the UNFCCC and has been operational since 2009. Financed through a 2% levy on the sale of emission credits from the Clean Development Mechanism of the Kyoto Protocol, it has a total capitalization of USD 642 Million.

[40] Nakhooda et al., 2014.

c. The Green Climate Fund (GCF) agreed upon at the UNFCCC COP-17 in Durban is tasked with funding climate-resilient and "low-carbon development" in developing countries, and it is thus more focused on mitigation than adaptation. It began to fund programmes and projects in late 2015, and has USD 2.30 Billion. pledged to it to date.

2. Outside the UNFCCC framework, there is a substantial volume of climate finance. Such channels are more likely to be contributor country-dominated. But they still afford developing countries some input in decision-making.

   a. The Climate Investment Funds (CIFs) that finance "programmatic interventions" in developing countries. Established in 2008 and administered by the World Bank in partnership with regional development banks such as the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank (IDB). By 2015, the CIFs had a total pledge of USD 7.52 billion, including:

      (1) The USD 5.2 billion Clean Technology Fund;

      (2) The USD 1.16 Billion Pilot Program for Climate Resilience (PPCR);

      (3) The USD 0.6 Billion Forest Investment Program (FIP);

      (4) And the USD 0.5 billion Scaling-Up Renewable Energy Program for Low Income Countries (SREP)

   b. Multilateral Development Banks (MDBs) such as the World Bank play a prominent role in delivering multilateral climate finance, as many have incorporated climate change considerations into their lending programs. Most MDBs now administrate climate finance initiatives with a regional or thematic scope:

      (1) The World Bank's carbon finance unit has established the Forest Carbon Partnership Facility (FCPF) related to the REDD+ effort.

      (2) The African Development Bank administers the Congo Basin Forest Fund (CBFF)

      (3) The European Investment Bank administers the EU Global Energy Efficiency and Renewable Energy Fund (GEEREF), as well as the Africa Climate Change Fund (ACCF)

3. Bilateral channels are effectively contributor country-dominated structures. Many were set-up by several developed countries that either (1) have established climate finance initiatives, or (2) are channeling climate finance through their existing bilateral development assistance institutions.

   a. In 2014, it is estimated that USD 12 billion was directed through bilateral finance institutions[41]. However, this

Climate Finance Commitments in Global Negotiations

Climate finance is significantly referred to in the Zero draft Outcome Document of the 2016 ECOSOC Forum on Financing for Development Follow-up (FFdF), representing one dedicated paragraph out of a 17 paragraph statement.

The draft welcomes the Paris Agreement on Climate Change adopted in December 2015 and reiterates the developed countries' intention to mobilize US$ 100 billion per year until 2025, following the coming into force of the Paris Agreement. The forum also welcomed the decision taken on 6 November 2015 by the Board of the Green Climate Fund to approve 8 projects worth $624 million for climate financing to developing countries.

[41] Buchner et al., 2014.

is hard to ascertain for sure, as these channels have limited transparency and consistency, as they rely on self-classifying and self-reporting by donor countries of what constitutes climate-relevant financial flows.

b. It appears that most of those channels tend to focus more on climate change mitigation in developing countries rather than adaptation. An example is the facility Nationally Appropriate Mitigation Actions (NAMAs) in developing countries, contributed to by both the UK and Germany.

c. The main channels are: Germany's International Climate Initiative; The UK's International Climate Fund; Norway's International Forest Climate Initiative; Australia's International Forest Carbon Initiative[42] (IFCI). Japan's Fast Track Finance (FSF) initiative is also active in the area. However, it is not strictly a Climate Fund as its funds, while targeted for both adaptation and mitigation activities, are channeled as part of its ODA.

4. National climate change funds have been established in developing countries to receive climate finance and channel it to fund projects. Those funds have structures of governance, and modes of operation, and they differ in their assigned strategic objective, and in some cases, the United Nations Development Program (UNDP) have been asked to act as administrator. Those funds channel climate finance through a variety of means, from grants and concessional loans, to guarantees and private equity, but there is little available data on their activity.

Table 4. MAJOR MULTILATERAL FUNDS AND INITIATIVES[43]

Fund	Name and Description
AF	Adaptation Fund (GEF acts as secretariat and WB as trustee)
ACCF	Africa Climate Change Fund
ASAP	Adaptation for Smallholder Agriculture Programme
CBFF	Congo Basin Forest Fund (hosted by AfDB)
CDM	Clean Development Mechanism (implemented under the Kyoto Protocol)
CIF	Climate Investment Funds (implemented through WB, ADB, AfDB, EBRD, and IADB)
CTF	Clean Technology Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GEF	Global Environment Facility
GEEREF	Global Energy Efficiency and Renewable Energy Fund (hosted by EIB)
JI	Joint Implementation (implemented under the Kyoto Protocol)
LDCF	Least Developed Countries Fund (hosted by the GEF)
PMR	Partnership for Market Readiness
PPCR	Pilot Program on Climate Resilience (implemented through World Bank, ADB, AfDB, EBRD, and IADB)
SCCF	Special Climate Change Fund (hosted by the GEF)
SCF	Strategic Climate Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
SREP	Scaling Up Renewable Energy Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
UNREDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation

The formal architecture of global climate finance is in Figure 4 below. It details the flows from contributor countries through both formal multilateral Financing mechanisms (both within and without the UNFCCC) and bilateral channels. It

[42] Terminated in 2012.
[43] Adapted from; Nakhooda et al., 2014.

is through those channels that funds would reach recipient countries, either directly or through formal national climate change funds in developing countries.

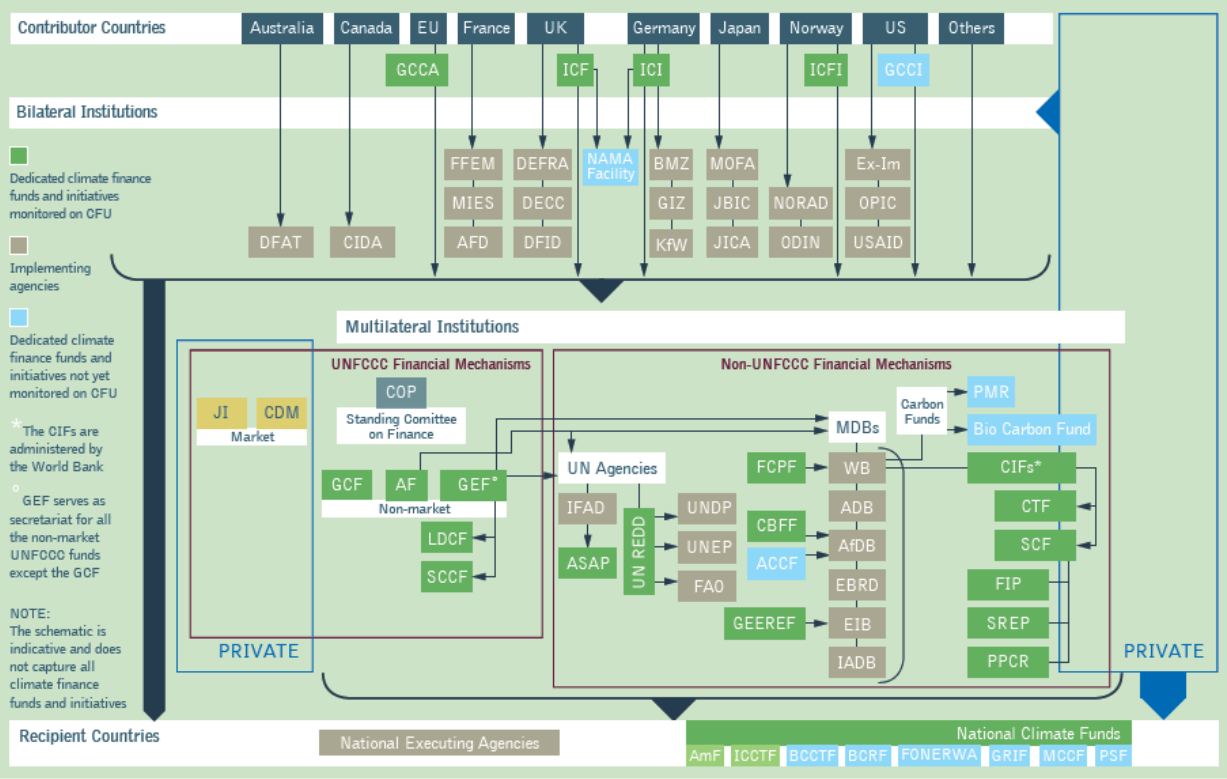


Figure 4. The Architecture of Global Climate Finance[44]

It should be noted that, of all those channels, the multilateral financing mechanisms appear to be the most transparent. There is little detailed information on bilateral initiatives, and most of it comes from "self reporting" of donor countries. In general, because of both the multitude of funding channels and the lack of agreement on a definition of what constitutes climate finance, the current system has two major shortcomings:

1. One cannot effectively Monitor, Report, and Verify (MRV) climate finance, and ensure that the funds are used effectively and equitably, and thus robust reporting is sought;
2. Fit is hard to ensure that the funding is actually "new and additional" to traditional overseas donor assistance (ODA) grants and projects, as specified by the convention.

The Paris Agreement adopted at UNFCCC COP-21 in December 2015 spells out additional provisions for ensuring access to climate finance for small island states and least developed countries. In doing so, it also makes provisions for countries to pursue measures in line with their national capacities and priorities, with due consideration paid to their economic development. Arab States can draw upon these measures when submitting their Nationally Determined Contributions (NDCs), which include both mitigation and adaptation commitments and goals to achieve at the country-level.

Excepts on Adaptation from the Paris Agreement

"Parties hereby establish the **global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change**, with a view to contributing to sustainable development and ensuring and adequate adaptation response in the context of the temperature goal referred to in Article 2." (Article 7.1)

Each Party should, as appropriate, submit and update periodically an **adaptation communication**, which may include its priorities, implementation and support needs, plans and actions, without creating any additional burden for developing country Parties. (Article 7.10)

[44] Ad

II VULNERABILITY OUTLOOK OF THE ARAB REGION

(Still under development)

III ADAPTATION TO CLIMATE CHANGE

Adaptation refers to enabling policies, strategies, actions, and processes that allow a country or region to cope with, manage, and adjust to changing climatic conditions.

There are two considerations for the adaptation of socioeconomic systems to climate change; the type of adaptation, and the technology for adaptation.

First, the type of adaptation can be either (1) reactive or autonomous, occurring after the impacts of climate change have become evident, or (2) anticipatory, taking place before they are apparent (Table 5 below). The majority of adaptation measures tend to occur spontaneously, as nature and society adjust to changing conditions. Planned adaptation measures can be undertaken whenever there is increased awareness that conditions are changing, and there are reliable forecasts of the changes.

Table 5. TYPES OF ADAPTATION STRATEGIES.

		Anticipatory Adaptation	Reactive Adaptation
Natural Systems			• Changes in Growth; • Ecosystem Change; • Migration.
Human Systems	**Public Sector**	• Insurance; • Reconstruction; • Redesign	• Change in Business/Farm Practice; • New Insurance Premiums; • New Equipment Purchases.
	Private Sector	• Early Warning Systems; • Codes, Standards; • Incentives relative to Adaptation.	• Disaster Compensation; • Enforcement of Rules, Codes; • Emergency Reconstruction.

Second, the technologies for adaptation can be either (1) soft, or (2) hard. Soft technologies are those based on technical knowledge and skills, such as insurance, crop rotation and setback zones, as well as technical knowledge about adaptation techniques. Hard technologies are based on physical tools and equipment, such as seawalls, drought-resistant seed varieties, and irrigation channels.

In the past, society has been able to get by through autonomous adaption. This is not a sufficient option anymore, because of the complexity of modern societies and the extent of the climate change challenge. A better option would be to prioritize anticipatory adaptation, using a mix of both hard or soft techniques such as (1) robust policies; (2) technological and structural measures; and (3) risk-sharing.

1. Technological and structural measures such as increasing the ability of infrastructure to resist impacts of climate change; Increasing the flexibility of vulnerable systems;
2. Robust policies to reduce stresses on vulnerable natural systems and enhancing the adaptability of;
3. Risk-sharing that strives to reversing trends that increase vulnerability.

All these approaches can be promoted and enhanced through public awareness raising and preparedness. By the time of the 2007 AR4, there was a lot of awareness among policy makers of the need for adaptation, particularly in developing countries. Based on national communications submitted by developing countries, it was estimated that[45], by 2030, between USD 28 Billion and USD 67 Billion would be needed to enable their adaptation efforts, equivalent to about 0.2% to 0.8% of global investment flows. Among the socio-economic sectors, the submitted documents focused mostly on

[45] UNFCCC, 2007.

water resources, as well as agriculture and food security. It is therefore necessary that any climate change adaptation strategy have, at its core, Integrated Water Management (Table 6).

Table 6. MAIN ADAPTATION STRATEGIES PER SOCIO-ECONOMIC SECTOR[46]

	Anticipatory Adaptation	Reactive Adaptation
Water resources	• Better use of recycled water • Conservation of catchment areas • Improved water management system • Water policy reform (pricing, irrigation policies) • Flood control, drought monitoring	• Protection of groundwater resources • Improved management/maintenance water supply systems • Protection of catchments • Improved water supply • Ground- and rainwater harvesting, desalinization
Agriculture and food security	• Development of tolerant/resistant crops • Research and development • Soil-water management • Diversification/intensification of food/plantation crops • Policy measures (tax incentives, subsidies, free markets) • Early warning systems	• Erosion control • Dams for irrigation • Fertilizer use and application • Introducing new crops • Soil fertility maintenance • Planting and harvesting times • Different cultivars • Education and outreach on soil/water conservation and management

The adaptation approaches presented here, in Table 6 above, are centered on anticipatory adaptation, using both hard and soft techniques determined based on the concept of Integrated Water Management and "Climate Proofing".

1. For the developing countries, the impact of climate change on water resources appears to be an essential concern. Any adaptation strategy for the developing world therefore requires that climate issues be mainstreamed into national water management policy. This is best done through an Integrated Water Management approach.

2. As part of a "Climate Proofing[47]" strategy, adaptation is conceived to be integrated into planning, to enhance adaptation and ensure sustainable development. The integration is done as part of planning, not only at the national level, but also at "finer grained" sub-national and local level, as well as at the sectoral level. Such an approach is very relevant for the Arab Countries, whose arid to semi-arid environment makes themvery vulnerable to climate change. This is especially the case since the impacts of climate change will largely manifest themselves "as changes in the frequency and consequences of extreme events and inter-annual and similar variations, rather than as long-term trends in average conditions[48]".

In any policy setting, the first step in any adaptation strategy is to establish an adaptation team (Section 1). The team can then focus on the key elements of the adaptation strategy, by establishing the risks (Section2), and the adaptation matrix (Section **Error! Reference source not found.**), including an investment plan for implementation of the strategy.

The adaptation team can the proceed to elaborate the strategy appraised of the Integrated Water Management (Section **Error! Reference source not found.**), and then following standardized evidence-based decision-support process to implement an Climate Proofed adaptation framework(Section **Error! Reference source not found.**). Through this process, policy makers can identify clear Options for Action (OA). The implementation of a policy can then proceed, with an integrated strategy for its implementation that includes provisions for monitoring and evaluation.

[46] Adapted from UNFCCC, 2007.
[47] GIZ, 2011, 2012.
[48] ADB, 2005, p.xxiv.

WHAT CAN BE DONE: PREPARING FOR ADAPTATION

When society is confronted with the impacts of climate change, it has to adapt and thus work limit any resulting negative effects on its economic system. This is especially important for the Arab Region, since they are already feeling the brunt of the effects of climatic change.

Because of the diversity of socio-economic systems affected by climate change, adaptation plans have to take into account a variety of factors that reduce a society's vulnerability. Adaptation will therefore have to address both the system's:

1. Exposure to climate change, by minimizing any adverse changes in socio-economic variables that are affected by climatic impacts;
2. Sensitivity to climate change, by minimizing the relative change in those same socio-economic variables.

Only then can a system have moderated potential damages of climate change, and therefore adapted. Ideally, adaptation may also allow a system to take advantage of any new opportunities offered by climate change. However, determining this adaptive capacity is not limited to obtaining forecasts from computer models. Indeed, effective adaptation requires a prioritization of resources. This is especially important in the Arab Region where resources are already limited.

The implementation of any adaptation framework therefore requires an understanding of the parameters and the impacts involved, the risks associated with them, and the means of implementation, both in terms of finances and human capacity.

1 Setting Up an Adaptation Team

The complexity of the climate challenge elicits adaptation responses that are just as complex, and that involve a wide and diverse group of stakeholders. This is why it may be recommended to develop an Adaptation Management Team (AMT), a multi-stakeholder team to help better inform policy making. The primary responsibility of the AMT would be to understand, analyze and review the challenges paused by climate change impacts and their associated socio-economic effects. This will serve to support the elaboration of policy, and to determine protocols for follow-up actions as well as monitoring and evaluation.

The **AMT** is actually structured as two teams; (1) a Strategic Planning Team whose focus is policy formulation, and (2) a Technical Team whose focus is the evaluation of impacts and risks. Both teams are coordinated by an Adaptation Coordinator.

1. The **Strategic Planning Team** is focused on policy formulation. Its focus is therefore on broader Sustainable Development issues, to ensure that Adaptation policies are in line with National Priorities, and that they take into account existing policies. This team also evaluates policy-specific risks.
2. The **Technical Team** assists the Strategic Planning Team by carrying out the technical evaluation of climate change impacts obtained by Computer Climate Models (CMs) and their related socio-economic effects through Integrated Assessment Models (IAMs). They also identify specific risks associated with those impacts, as well as the associated vulnerabilities.
3. The **Adaptation Coordinator** supports both the Strategic Planning Team and the Technical Team. The coordinator assembles and coordinates the Technical Team, and advises the Strategic Planning Team on adaptation planning and policy.

2 Adaptation Risk Management

Risk is the result of the "Uncertainty of Outcome", determined as the product of the probability of a given event with its impact, or cost. In the context of climate change, a policy that takes into account risks would allow for better prioritization among events, since the magnitude of the negative impacts would not be the only determining parameter. An assessment of risk is informed by the conduct of a vulnerability assessment to identify the hotspots and parameters considered for risk analysis and management.

A risk-based approach will thus provide policy Makers with a wider focus that takes into account not only the impacts of events, but also their probability of occurrence. This is the best approach to policy making in a context of climate change, especially since "the 'knowledge base; in this domain is still 'formative', as "the knowable remains undetected because of the assumptions that frame the question or methods of analysis[49]". From a perspective of policy making, Risks have two aspects.

1. The first aspect is related to the effect of uncertainty on policy objectives, which has two aspects: a (1) Risk to achieving objectives, and (2) the possibility of unintended consequences:
    a. The **risk to achieving objectives** is faced when policy, program or project fails to achieve its intended objective.
    b. In some cases, there is a risk that policy, program or project will have an **unintended consequence**.
2. The second aspect of risks results directly from impacts of climate change and their effects on socio-economic systems can be categorised in either of two types:
    a. **Manageable Risks**. Those are cases where the probabilities of occurrence are known, or where the impact is affordable. In this case, analysis tools can help water managers carry out the necessary cost-benefit analysis and undertake the proper adaptation measures.
    b. **Unmanageable Risks**. Those are cases when, regardless of how low the probability of occurrence is estimated to be, the impact is unaffordable. In those cases, water managers need to develop proper hedges

Those aspects are summarized in Table 7 below.

Table 7. THE TYPES OF RISK

	Low Exposure/Affordable Impact	**High Exposure/Unaffordable Impact**
Low Likelihood	Adaptation Affordable Risk	High cost of Adaptation Manageable Risk
High/Unknown Likelihood	Adaptation Potentially Expensive Risk	Adaptation may not be possible **Unaffordable Risk**

Risks are difficult to readily identify. For this reason, one of the most reliable methods to identify those risks is to follow a standard process. Such a process is centered around a "group analysis" technique, an integrated tool similar to the Enterprise Risk Management (ERM) technique. This technique focuses on identifying various risk factors that can add to those associated with the socio-economic systems impacted by climate change, through a multistep process to::

1. Identifying existing adaptation options. This is centered on indentifying, in sequence the:
    a. Risks to socio-economic systems due to climate change impacts;
    b. Causes of those risks,
    c. Controls that are already in place to reduce the likelihood of the event or to minimize its impact.
2. Establish the "Risk Matrix", based on a rating, likelihood, and consequence descriptors, as shown in 0. At this stage the Risk Rating Descriptors should be already established, clarifying what is meant when (1) a likelihood is Rare, Unlikely, Possible, Likely, or Very likely, or (2) an impact that is Negligible, Minor, Moderate, Significant, or Severe.
3. Additional controls may be needed for risks that are rated as High or Extreme, in order to help reduce them to an acceptable level.

The risks can then be ranked and classified in a matrix, as shown in 0 below. Once those risks are classified, decision making can then be better informed as it moves to implementing the climate change adaptation framework.

[49] ESCWA, 2009a..

Table 8. RISK MATRIX: RISK RANKING.

	Impact				
Likelihood	**Negligible**	**Minor**	**Moderate**	**Significant**	**Severe**
Rare	Low	Low	Low/Medium	Medium	Medium
Unlikely	Low	Low/Medium	Low/Medium	Medium	Medium/High
Possible	Low	Low/Medium	Medium	Medium/High	Medium/High
Likely	Low	Low/Medium	Medium	Medium/High	High
Very likely	Low/Medium	Medium	Medium/High	High	High

3 Integrated Water Resource Management (IWRM)

The Integrated Water Resource Management (IWRM) considers collectively the cross-cutting goals of social, economic and environmental sustainability, and ensures that water management decisions consider the impact of each sectoral use on the other sectors. This moves the focus away from a sector-centric approach, and allows the elaboration of coherent, coordinated cross-sectoral policies. Such an approach makes IWRM a very useful tool for climate change adaptation. This is especially the case since climate change raises issues and challenges that are essentially cross-sectoral. The method has the following characteristics:

1. It depends on the shared adoption of key concepts and principles;
2. It follows an iterative approach in which decision making is shared among the various technical departments concerned and the relevant stakeholders;
3. The method cannot be partially implemented, as shown by cases where it failed to produce results. The implementation should concern all the functions of water resources management: Water allocation; Pollution control; Monitoring; Financial management; Flood and drought management; Information management; Basin planning; and Stakeholder participation.

a Key IWRM Concepts and Principles

IWRM is based on key concepts and principles. The three main concepts are:

1. Fresh water is **critical to sustain life**. It is a finite and vulnerable resource that not only essential to sustain life, but also vital for the needs of development and the protection of the environment.
    a. The amount of freshwater available within any given watershed is, on average, finite. The hydrological cycle only renews a fixed quantity of water per period. This quantity cannot be significantly increased by human actions without either (1) large expenditures of energy, as in desalination projects, or (2) displacing the shortage to other watersheds, as in cross-basin transfers.
    b. As a resource, water is both critical for life and essential for development. Yet water is also vulnerable to the side-effects of human settlement and economic development. For this reason, any effective management of water resources needs to consider land and water use as part of a continuum, in which social and economic development with the protection of natural ecosystems.
2. Water is **both** an **economic good** and a **social good**, since it has an economic value for many of its competing uses.
    a. When considering the vital need for life and thus for households, water is viewed as a **Social Good**. This ensures that water allocation in those cases is designed with the aim to meeting the social goals of equity, poverty alleviation and safeguarding health. In addition, environmental security and protection are also considered;

b. For purposes of allocation among competing economic sectors, water is viewed as an **Economic Good**. Allocation and Investment decisions are then guided by the relative economic value of alternative water uses, and thus help formulate and adjust national development strategies.

3. **Everyone is a stakeholder** when it comes to water. This leads to a development and management practice that is based on a participatory approach, involving all concerned stakeholders in both information gathering and decision making; users in all sectors, planners and policy makers. The objective of this participation is to:

   a. Emphasize involvement in decision-making at the earliest stages, the level where it is most feasible to bring in consultation and input from the wider possible sources of inputs;

   b. Enhance increase transparency and accountability in decision-making, and thus ensure wider acceptance and thus more successful projects in terms of scale, design, operation and maintenance;

   c. Protect environmental resources and local cultural values, while ensuring development needs are met;

   d. Improve cost recovery, a key factor in generating revenue and financing both water management activities and investment projects.

b Overview of IWRM tools

The IWRM implementation begins by considering the that the interactions with any specific watershed is defined by two types of systems:

1. The Biophysical system, define by all the biological and physical parameters of the water basin, such as; climate, topography, land cover, surface water, hydrology, groundwater hydrology, soils, water quality and ecosystems;
2. The socio-economic system, defined by the stakeholders that need to store, allocate, regulate and deliver water. The action of those stakeholders can be confined to the watershed, or extend beyond its boundaries.

The IWRM implementation then involves managers from various sectors and stakeholders from beyond the narrow professional and managerial realm to bring in a cross-cutting perspective to water management. Rather than being centered on any given sector, the analysis focuses on a watershed, and relies on an enabling environment of institutional structures and management instruments. As shown in Figure 5 below, the implementation then promotes the coordinated development and management of water, land and related resources, and an iterative process that: (1) starts with an assessment of water resources which then; (2) forms the basis of the establishment of policies and strategies. Then, (3) the development of an IRWM implementation plan can then be based on those policies and strategies; and (4) leads to actions that are (5) monitored and its progress evaluated over the course of the implementation.

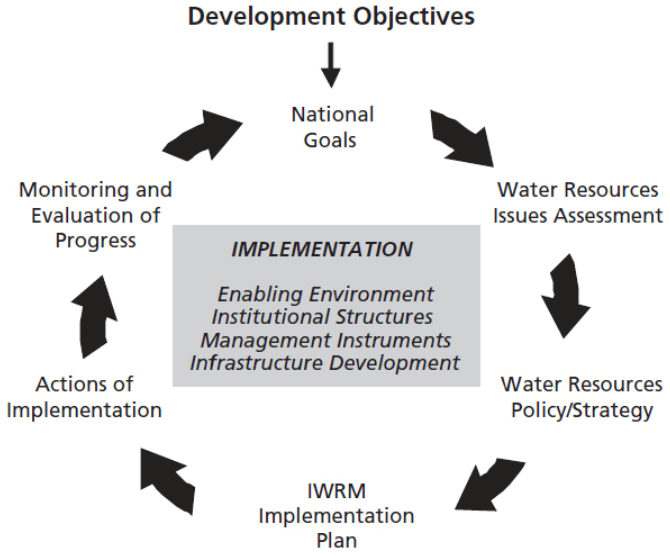


Figure 5. Stages in IWRM planning and implementation

c Importance of IWRM for adaptation to climate change

Water is the resource the most impacted by climate change. This is because the intensity of the hydrological cycle within any watershed will be dramatically affected by the forecasted changes in precipitation, temperature, and the expected increase in climate variability and the frequency and intensity of extreme weather events.

In this context, it is Integrated Water Resources Management (IWRM) that "provides an important framework to achieve adaptation measures across socio-economic, environmental and administrative systems[50]". IWRM can help wider acceptance and implementation of climate change adaptation measures.

1. Climate change adaptation is dealt with strategies that focus both on demand-side and supply-side:
    a. Measures at the **demand side** include those that improve water-use efficiency" such as water recycling, expanded use of economic incentives to allocate water across economic sectors, while still ensuring that the needs of social equity are met;
    b. At the **supply side**, investments could be targeted depending on the forecasted climate impact, be it increases in storage capacity or changes in water abstraction methods and patterns;
2. Adaptation should be carried out across multiple sectors, since most are water-dependent in one form or another. Indeed, water resource management often has implications on many other policy areas.

d Limitations of IWRM

When applied properly, the well established IWRM methodology can very appropriately complement climate change adaptation efforts. However, the evidence from surveys and regional assessments carried out by the World Bank[51] suggests that the implementation of IWRM has not always been effective at addressing the challenge of adaptation to climate change, especially in cases where:

1. The implementation has been piecemeal, with principles being selectively adopted and applied.
    a. There is a need for greater harmonization across the water sector, to ensure a wider implementation of IWRM. By definition, an integrated approach to water management, cannot be carried out by the water agency alone. It requires the involvement of all water-dependent sectors.
2. Environmental considerations have not traditionally linked with decisions about water allocation.
    a. Water-sector policies should be supported by environmental assessments that show "the linkages between environmental health, human health, and economic growth[52]". This is done in coordination among concerned agencies to ensure that there are not duplicate requirements and procedures;
    b. In this respect, the implementation of IWRM remains slow at the regional and local levels in developing countries, and remains to be formalized in developed countries. In developed countries, few nations have, like Germany, adopted a formal policy of environmental management.
3. Stakeholders are not well appraised of the impacts of climate change and their extent.
    a. Public involvement in water management is essential, particularly the involvement of professional and public drivers. This is done in an environment that promotes greater inclusion of local stakeholders in decisions through public disclosure and active participation.
    b. The involvement of a third party can often help facilitate and overcome initial skepticism. This is especially necessary in cases where development has let water to be shared across watersheds.

[50] Bates et al., 2008, p. 6.
[51] The World Bank, 2007-b.
[52] The World Bank, 2007-b, p. 67.

The ultimate success of IWRM implementation requires a long-term commitment. It will take years to see a measurable impact on water sector reforms. Many investments will also be needed over the course of those years, to help a basin move from a sector-based approach to an integrated approach that is best suited for climate change adaptation.

4 Mapping Existing Climate Funding

The Arab region has many pressing adaptation needs in the sectors of water, energy, food security and livelihoods, health, as well as general infrastructure and human settlements. However, the climate funds active in the Arab region are far more focused on mitigation than on adaptation, through a few power generation projects. As a result, most adaptation funding in the Arab region is local.

a Climate Funds: Largely Focus on Mitigation

As of 2014, there were 12 funds active in the Arab Region; 11 multilateral funds and 1 bilateral fund (Table 9 below).

1. Of the 11 Multilateral funds, the largest contributions come from the Clean Technology Fund (CTF), and concentrated on a small number of large projects in the form of loans or concessional loans in a few of countries. The CTF has approved a total of USD 725 Million for 5 projects in Morocco and Egypt, mostly as concessional loans. In addition, the CTF's Pilot Program for Climate Resilience (PPCR) has approved USD 20.50 Million for 2 projects.
2. The bilateral fund active in the region is Germany's International Climate Initiative, which has approved USD 32.46 Million for 7 projects.

Table 9. MULTILATERAL FUNDS ACTIVE IN THE ARAB REGION[53]

Fund	Amount Approved (USD Million)	Number of Projects
Adaptation for Smallholder Agriculture Programme (ASAP)	18.00	3
Adaptation Fund (AF)	19.42	3
Clean Technology Fund (CTF)	725.00	5
Global Environment Facility-Strategic Priority on Adaptation (GEF-SPA)	55.04	1
Global Environment Facility - 2006 -2010 Funding Period (GEF4)	4.62	16
Global Environment Facility - 2011 – 2014 Funding Period (GEF5)	33.85	13
Global Climate Change Alliance (GCCA	4.05	1
Least Developed Countries Fund (LDCF)	34.56	8
MDG Achievement Fund (MGF-F)	8.00	2
CTF Pilot Program for Climate Resilience (PPCR)	20.50	2
Special Climate Change Fund (SCCF)	38.01	7

By 2014, it appears that 68 projects were funded for a total of USD 993 million, 84% of which were for mitigation activities. Most of the funding was in the form of loans or concessional loans (USD 723 Million). Egypt and Morocco have been granted concessional loans for large-scale wind and Concentrated Solar Power (CSP)[54] which represent the largest share of the total approved climate finance. Such loans constitute, by far, the largest share of Climate Finance, and are targeted for mitigation projects in those countries.

b National Funds: Support Focus on Adaptation

By 2015, most of the adaptation funding in the Arab Region has been largely local, with very little involvement from global climate funds. Because of the impacts of climate change on water scarcity, much of the adaptation effort in the Arab has been focused on the water sector.

[53] Adapted from Barnard et al., 2014.
[54] Barnard et al., 2014.

In the water sector, the available funding has been focusing on the key needs highlighted in Section **Error! Reference source not found.**; (1) enhancing people's access to water and sanitation; (2) ensuring a secure water supply. Less funds are directly being invested in (3) maintaining the protection of vital ecosystems. The Islamic Development Bank (IDB) estimates that the water sector alone will require an estimated USD 200 Billion over 10 year across the region just to meet growing demand[55].

1. Significant investments were made for enhancing people's access to water and sanitation.
    a. Some Arab countries are expanding the waste collection and water treatment, while others have yet to find the necessary funds. In Saudi Arabia, USD 40 Billion are planned, to be spent on water distribution (38%), as well as sewage collection and water treatment (62%).
2. The need to secure the water supply will require significant efforts to help ensure the Arab Region does not continue to overuse its renewable water resources. In addition to better management practices, investments will be needed to enhanced water treatment, improved infrastructure, and increased supply[56].
    a. Most of the necessary investment in infrastructure is focused on a key aspect of adaptation in the water sector; the need to expand water storage and conveyance networks to help smooth out variations in water availability.
    b. In the Gulf, domestic water supply is expected to expand five-fold by 2025 under heavy investments in desalination. By 2020, new funding for desalination plants will be installed in Saudi Arabia (USD 56 Billion), Kuwait (USD 7 Billion needed by 2025) and the United Arab Emirates (USD 10 Billion).

In general, most Arab countries will struggle to make the necessary investments. In theory, most funding sources to those countries are financed through grants, loans from external public donors, or private sources through Build-Operate Transfer (BOT) projects. However, in practice, the amounts required are too high for many Arab countries to fund by themselves. As an example, Jordan's water strategy called for investing USD 8.24 Billion over the 2009-2022 period, corresponding to more than 160% of its 2013 of its GDP.

Without climate financing, the adaptation efforts of Arab countries are likely to be limited in scope. Between 2000 and 2010, when the water sector represented 20% to 30% of government expenditures in Algeria, Egypt and Yemen, the average level of investment in the region varied between 1.7% and 3.6% of GDP. In comparison, meeting the challenge of climate change would require sustained investment in the water sector estimated at about 4.5% of GDP[57].

What Needs to be Done: Climate Proofing

The Climate Proofing approach is an integral part of adaptation that takes place, within the national level, at three "lower" levels; (1) at the local level where communities strive to respond to the impacts of climate change, (2) at the sectoral level, and (3) at the national level of policy and planning. National adaptation strategies therefore need to be elaborate to account for both specific national intentions and local needs.

The methodology is based on a determination of impacts, both bio-physical of climate change and their associated socio-economic costs. While it integrates risk management, it is not limited to an evaluation of risks, but it also evaluates any opportunities that may come as a result of climate change. In this manner, it allows policy makers to plan while giving due considerations to the implications of environmental change.

Climate Proofing is divided into three phases:

1. Identification of the appropriate level. The integration of climate change adaptation into planning may occur at different levels; (1) national, (2) sectoral; (3) local; and (4) project.

[55] UNDP-RBAS, 2013.
[56] UNDP-RBAS, 2013.
[57] Fay and Yepes, 2003.

2. Identification of entry points. Integrating climate change adaptation at different levels implies the need to identify appropriate entry points along the project or policy cycle. These entry points enable climate-related action to be incorporated into planning even if this had not originally been envisaged.
3. Applying a climate lens. The application of a climate lens requires investigation of the extent to which a measure might be affected by climate change impacts, these impacts are considered in the planning, adaptation is required to address climate challenges and opportunities.

The climate proofing methodology is implemented into four steps; (1) Scope and Preparation; (2) Analysis and Assessment; (3) Options for Action; and (4) Integration. At each step in this framework process, it is important to ensure the involvement Adaptation Management Team, and to ascertain whether it has the appropriate individuals, technical capabilities and resources.

5 Step 1: Scope and Preparation

The Preparation phase consists of all the preliminary work necessary to ensure that key risks and opportunities are identified at earliest possible moment, in line with National Needs and Sustainable Development Objectives. This phase aims to ask four questions:

- *What are the current strategies, policies and programs for climate change adaptation?*
- *What is the effect of current policies and programs on key ecosystem services and socio-economic sectors? How is this affecting national priorities and sustainable development?*
- *What is the expected effect of climate change impacts on those relevant socio economic sectors? How is will this affect national priorities and sustainable development?*
- *Given the desired adaptation outcome, what is the scope of the current assessment?*

a Process

This phase is both technical and financial in nature, and it is divided in two broad phases; (1) initiation, and (2) preparation.

First, the objective of the **initiation phase** is to ensure that the climate proofing methodology is applicable in the case considered. This is because, while climate change is indeed a cross-cutting issue, it does not necessarily affect all plans. It is therefore necessary to ensure that the Climate Proofing methodology is applicable for the context under consideration (Table 10).

Table 10. KEY QUESTIONS[58].

Key Questions	Example
Do climatic trends, such as increasing temperatures or sea level rise, potentially have an impact on planning? If so, specify.	Low impact Medium impact
Is the time horizon of the planning relevant to these climatic trends?	Short-term planning horizon: high relevance Long-term planning horizon: medium relevance
Does the planning refer to elements (exposure units) which are particularly affected by climate change?	Sectors, policy aspects, geographic area, specific target group in Agriculture; Energy production policy; Coastal zones; Dry land regions; Mountain regions; Fishermen,

The second phase comes after the need for the methodology has been validated. In this **technical** phase, specific preparation activities need to be undertaken. This phase includes a series of systematic activities that aim to ensure that (1) risks are well understood; (2) objectives are well outlined and the expected outcomes clearly defined; and that (3) resources are utilized optimally and allocated appropriately. Typical preparation activities include[59]:

1. The identification of **trends**;

[58] Adapated from GIZ, 2011, p.14.
[59] GIZ, 2012.

a. Current and future climatic trends (temperature, precipitation, sea level)

b. Current and future socio-economic trends;

2. Vision and objectives of **National Sustainable Development Strategies**;
    a. Overall objectives;
    b. Expected outcomes with well defined metrics.
3. Overall assessment to determine the of climate change on sustainable development goals:
    a. The ways in which Sustainable Development goals can be affected by climate change. Example: "Increase and diversify agricultural production and rural incomes in rural areas".
    b. The areas and sectors that are most at risk. Example: "Rain-fed agricultural production depends on predictable crop yields which are affected by temperature and rainfall, and this will have a negative effect on rural incomes".
    c. An identification and consultation of The **stakeholders** at the national (agencies) and local (private sector) level, in order to ascertain and initiate participative planning, if applicable
4. Funding availability and sources;
5. Concept validation and design:
    a. Project concept development;
    b. Suitability of the policies considered;
    c. Preliminary design or outline.
6. Cost and Capital estimates, including operational costs.

When they undertake this phase, public sector agencies often do not have all the personnel able to undertake all the activities required for project preparation, and they often require the assistance of outside consultants or specialized agencies. It is therefore necessary that, even at this early stage, the adequate resources are secured to properly carry out this step. This will allow for more savings down the road.

b Expected Outcomes

The expected outcome of the Scope and Preparation phase should be:

1. A "scope statement" document that (1) outlines the goals of the Adaptation plan or policy; (2) describes how it fits in with Sustainable Development goals and National Priorities; (3) lists its expected outcomes; and (4) sets the timeline for its implementation and review period.
2. A summary "master list" of the socio-economic sectors that are expected to be impacted by climate change.
3. Two summary tables of the (1) climate change impacts and their (2) associated socio-economic effects.

6 Step 2: Analysis and Assessment

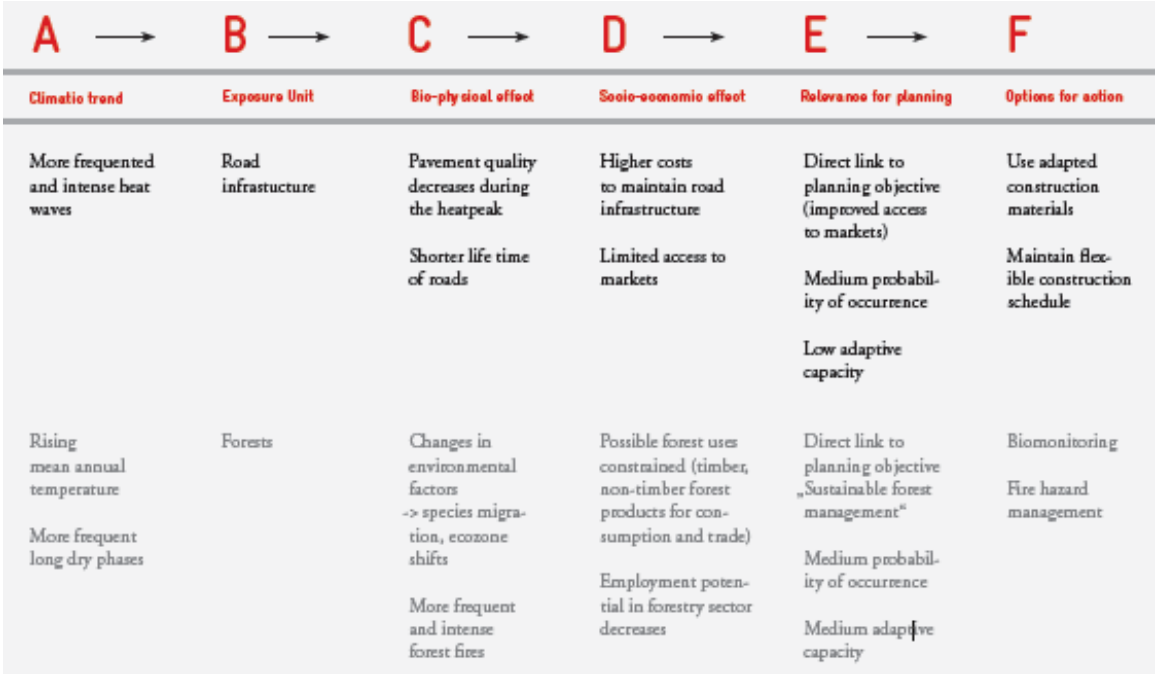
The Analysis and Assessment step aims to ask a two-part question regarding (1) Vulnerability and (2) Risk:

- *Where is the vulnerability to changes in climate?*
- *Among those vulnerable sectors or systems, what are the actual risks that need to be addressed?*

a Process

The analysis is based on the concept of a "chain of events", and has two components; (1) the determination of the Chain of Events from Climatic Trends to Socio-Economic Effects, and (2) the evaluation of the sensitivity of specific socio-economic systems to climate change.

First, the determination of the chain of events is carried out. As shown in Figure 6 below, it is a chain that starts with an understanding of (A) climatic trend, before moving on to understand the (B) exposure unit, that feels the (C) bio-physical effect, and (D) the related socio-economic effect that may or may not be manifested, then the (E) relevance for planning is verified.



A → Climatic trend	B → Exposure Unit	C → Bio-physical effect	D → Socio-economic effect	E → Relevance for planning	F Options for action
More frequented and intense heat waves	Road infrastucture	Pavement quality decreases during the heatpeak Shorter life time of roads	Higher costs to maintain road infrastructure Limited access to markets	Direct link to planning objective (improved access to markets) Medium probability of occurrence Low adaptive capacity	Use adapted construction materials Maintain flexible construction schedule
Rising mean annual temperature More frequent long dry phases	Forests	Changes in environmental factors -> species migration, ecozone shifts More frequent and intense forest fires	Possible forest uses constrained (timber, non-timber forest products for consumption and trade) Employment potential in forestry sector decreases	Direct link to planning objective „Sustainable forest management“ Medium probability of occurrence Medium adaptive capacity	Biomonitoring Fire hazard management

Figure 6. Example of Summarized Chain of Events for Analysis[60]

In the evaluation of the effects of climate change, both biophysical and socio-economic effects are considered. This step is important to determine the linkage between climate change impacts and their effect on Development. The approach suggested here is a "one-way" information flow, a valid approach for evaluation projects (1) at scales limited to the regional, national, or local level; and (2) for limited, well-defined time frames.

The approach centers on evaluating the effect of climatic trends on each exposure unit, to establish a "probable chains of effects for climate change[61]", from:

1. The Biophysical impacts (C) that relate to physical phenomena resulting from climate change, based on the Data obtained from computer Climate Models (CMs). This evaluation determines;
    a. What is the data available, and from what sources. Example: "RICCAR projections for rainfall change from 2020 to 2050";
    b. What the data "says", i.e., what are the available interpretation for the data. Example: "RICCAR projections show a hotter, longer dry season and wetter, shorter rainy season";
    c. What other data sources are needed to devise adaptation strategies, and how they can be obtained.
2. The Socio-economic effects (D) that relate to economic phenomena, and can be either:
    a. Caused by the Biophysical effect. Example: "In rural areas, decreased productivity of rain-fed agriculture because of the hotter, longer dry season, and increased risk of flooding during wetter, shorter rainy season".

[60] Adapated from GIZ, 2011, p.16.
[61] GIZ, 2011, p.15.

b. The direct result of the Climatic Trend. Example: "In rural areas, decreased income due to lower rain-fed agricultural productivity, and increased damages and expenses due to increased flooding".

For each element in the chain of events, the relevance of the Biophysical and Socio-Economic effects need to be ascertained. This relevance is assessed with regards to the:

1. Probability of the effects occurring;
2. Impact of the effects on project objectives;
3. Ability of institutions and groups to adapt to the changes without external support.

Second comes the analysis of the sensitivity of specific socio-economic sectors to the effect of climate change, as shown in Table 11 below. This step is necessary to highlight, among those systems already experiencing stress, which ones are likely to experience worsening adverse effects due to changing climate conditions. A qualitative ranking is given to current stressors, and to the new stressors that are expected as a result of climate change. However, because the ranking may involve a degree of subjectivity, it is important that this phase be extensively documented to show how rankings were obtained.

Table 11. SENSITIVITY MATRIX: SENSITIVITY RANKING[62].

			Potential Stress		
Existing Stress	**Minor**	**Low**	**Moderate**	**Significant**	**High**
Minor	Low	Low	Low/Medium	Medium	Medium
Low	Low	Low/Medium	Low/Medium	Medium	Medium/High
Moderate	Low	Low/Medium	Medium	Medium/High	Medium/High
Significant	Low	Low/Medium	Medium	Medium/High	High
High	Low/Medium	Medium	Medium/High	High	High

b Expected Outcome

The expected outcome of the Analysis and Assessment phase should be:

1. An evaluation of the Vulnerability of the system, including:
   a. An analysis of the exposure and sensitivity of key socio-economic sectors to climate change impacts (Table 11 above). This analysis evaluates, for each relevant sector or system of interest, the current climate variability that affects it and its related current sensitivity, and its current adaptive capacity.
   b. A summary table of expected socio-economic effects, as shown in Table 12 below;
   c. An evaluation of existing adaptive capacity;
   d. A list of existing vulnerabilities
2. An updated assessment of Risks, including:
   a. An updated Risk Matrix for the various risks (0 above);
   b. A prioritized list of risks to use as input for identifying adaptation options;

Table 12. SOCIO-ECONOMIC EFFECT[63].

	Economic Damage	
Major	Low Medium High	Low Medium High

[62] Adapated from GIZ, 2011, p.16.
[63] Adapated from GIZ, 2011, p.17.*

Minor	Low Medium High	Low Medium High
	Might Happen	**Likely to happen**
	Bio-Physical Effect in Time Period	

7 *Step 3: Options for Action (OA)*

Once the analysis is complete and the chain of events established, policy makers need to know their Options for Action (OA). The main question to answer is therefore:

- *What are the potential adaptation options that reduce vulnerability and potentially provide new benefits?*

a Process

The process has two objectives; (1) to highlight the appropriate adaptation actions, and to (2) indentify any eventual opportunities that may be presented by climate change. The main criteria for selecting an appropriate Option for Action (OA) are as follows:

1. National needs and priorities can help determine both the OA's Strategic Relevance and its Economic Aspects.
    a. The **Strategic relevance** of the OA, as they can highlight whether it (1) concerns severely affected and vulnerable regions or fields of action; (2) has a reliable and long-term, goal-oriented effect (i.e. risk reduction); and (3) Prevents irreversible and dramatic damages;
    b. An OA's **Economic Aspects** are determined based on (1) the medium or long-term benefit of the option is greater compared to its costs (including non-monetary aspects); and (2) how efficient is the use of resources.
2. The **Urgency** of the action that needs to be taken. This depends on whether (1) Climatic trends are either already occurring or will occur in the near future; and if (2) decisions about long-term investments and development paths are taken;
3. The OA needs to be validated with respect to any negative **Side effects** it may have on (1) National needs and priorities; as well as on (2) the objectives of sustainable development and biodiversity. It should be noted that not all side effects are negative, and they can be minimized.
    a. It is possible the OA may also engender positive effects that can benefit sustainability, and thus create new opportunities. This is defined as "**No Regrets**" because any investments the OA would have required would still generate economic benefits even if the Climate impact did not occur;
    b. In order to minimize negative Side effects, the OA should offer a level of **Flexibility**, to allow it to be (1) Modified; (2) further developed; or even (3) reversed if and the situation changes or new conditions appear.
4. The OA's **Political and social acceptance** is finally determined based on a "Window of Opportunity", the favorable timeframe for implementing it.

(Box 5) "No-Regret', 'Low-Regret' and 'Win-Win' Adaptation Actions

When undertaking **adaptation actions**, there is a concern that, if the adverse effect of climate change do not materialize, the money invested would have been wasted.

- **No-Regret** actions are adaptation actions that impose no burden. They are (1) cost-effective under current conditions, (2) do not pose any addition risks, (3) nor force trade-offs with other policy objectives;
- **Low-Regret** adaptation actions impose only very low costs compared to the potential benefits;
- **Win-win** actions are achieved are when adaptation actions bring in associated benefits, such as job creation or

improved gender equity.

Examples of such actions in the **water sector**, the risk of water shortages could be reduced by improvements in water efficiency, improvements in water utility infrastructure that reduces losses through leakage... In the **agricultural sector**, the risk of flooding could be reduced by the construction of holding ditches for excess run-off, planting of trees and shrubs to reduce run-off...

The selection of OA instruments is then carried out in coordination with stakeholders in the various sectors, to ensure they take into co-benefits such as: the creation of employment opportunities, the improvement of water availability, and the enhancement of environmental health conditions. They are then prioritized according to the specific possibilities (Table 13).

Table 13. PRIORITISATION OF OPTIONS FOR OPTIONS FOR ACTION (OA)[64].

Criteria	Scores for selected OA (1=very much; 5=not at all)		
	OA 1	**OA 2**	**OA 3**
Do the benefits from this OA promote climate change adaptation?			
Compared to the benefits, are the additional costs reasonable?			
Taking into account the costs and benefits, are the required funds available to implement this option? If not, are additional funding available?			
Would the benefits of this option for action also occur in the long-term?			
Is the planning horizon for the option for action in line with the planning horizon for the climatic trends?			
Do the required technical skills to implement the option for action exist? If not, which skills have to be acquired?			

b Expected Outcome

At the end of this step the OAs to be integrated are selected by the stakeholders on the basis of these criteria. In general, it is best to identify a limited number of options per category, and categorize them according to priority. This will form the basis an adaptation plan. The expected outcome of this process is therefore:

In many cases (e.g. often three per category below) are identified and categorized.

1. Actions at the start of the project;
2. Actions to be planned for the implementation period;
3. Adjustments to the objectives, indicators or the Monitoring and Evaluation system.

8 Next Steps

The Climate Proofing Adaptation Framework needs to be complemented by an implementation strategic planning process. This is where the selected Options for Action (OAs) would be integrated into planning documents, with clear monitoring and evaluation processes. The various stakeholders who work to implement the Climate Proofing framework work to "define, adapt or redesign the respective planning, including planned policy or strategy formulations and/or national, sectoral, local or project development plans[65]".

As they do so, they aim to answer the following key questions:

- *How can the option for action be integrated into the planning (e.g. by slightly modifying the activity)?*
- *Is it necessary to modify the original planning to integrate the option for action?*
- *If so, how?*

[64] Adapated from GIZ, 2011, p.18.
[65] GIZ, 2011, p.20.

- *Which additional technical skills / funds are required to implement the option for action?*

a Implementation

The next steps are therefore: (1) to develop an implementable adaptation plan with (2) a clear monitoring mechanisms.

1. Whenever possible, the plan would be tested on a "pilot" implementation to test its implementation and the monitoring mechanisms, and thus ensure against unforeseen consequences. Once validated, the implementation plan would act as a "compass" by defining specific implementation mechanisms and key performance indicators to measure progress. The expected structure of an implementation plan would be:
    a. An overall policy and strategic direction supported by detailed implementation plans that clearly defines when and what is the "entry point" for initiating the implementation;
    b. An overall framework for ensuring that results remain in line with National Priorities and the Sustainable Development priorities;
    c. A documented baseline to measure implementation progress that takes into account extent to which risks and management options are incorporated into current policies;
    d. Mechanisms to (1) measure progress and verify the efficacy of the policy, and (2) ensure transparency and stakeholder input.
1. Mechanisms are needed to provide feedback or ensure adequate monitoring, to ensure the process is self-sustaining. A successful self-sustained process is not only a "dynamic, evolving process that can adjust to changing information and circumstances over time[66]", but also one that is perceived as such by the various stakeholders involved. The success of the adaptation initiatives therefore depends on:
    a. Procedures for monitoring and evaluating changes in risk;
    b. Benchmarks to (1) measure and evaluate the success and failures of adaptation initiatives, and (2) allow stakeholders to continuously monitor progress towards the overall goals

The success of this Climate Proofing Framework depends on those factors to ensure that Adaptation remains integrative, participatory and flexible. The approach rests on the variety of perspectives, and is based on the evaluation of climate change impacts and their related socio-economic effects.

ADAPTATION MATRIX

Adaptation priorities are established by the adaptation team, through workshops to review a consolidated list of potential impacts, risks, and associated adaptation actions. The focus of the adaptation matrix is the national policy level, to help frame the Climate Proofing Framework for Adaptation.

The matrix is established through a brainstorming exercise that involves the Adaptation Team and relevant stakeholders from specific sectors or regions. This is done through an iterative process:

1. At the beginning of any brainstorming workshop, the **focus** is defined, and the planned activities agreed upon.
2. The workshop begins with a **review of the current situation**, with a discussion of the driving forces of current development to establish:
    a. The key drivers of climate change;
    b. The region/area where those drivers are to be considered;
    c. The key economic sectors of greatest concern

[66] ADB, 2005, p.97.

3. A **vision of the future** is then developed for the drivers; the relevant regions; and the key economic sectors under consideration. This stage does not necessarily rely on specific consideration of climate change, but is mostly informed by the participants' knowledge and experience of the region or sector under consideration;
4. The established vision is **challenged with boundary conditions**. Those are obtained from forecasts of: (1) the evolution of the climate change impacts obtained from computer Climate Modeling work such as RICCAR, and (2) the related effects socio-economic systems obtained from either Integrated Assessment Models (IAMs) or Vulnerability Assessments (VAs). This is done to:
    a. Test the vision of the future against the forecasts and thus establish specific, credible scenarios;
    b. Develop **impact chains** for each of the selected climate futures, or scenarios.?
5. Then the participants move to **identify, review and evaluate** impacts and adaptation options. Under the constraints presented by the boundary conditions, they will consider the medium-to-Long term planning horizons associated with such computer climate modeling efforts as RICCAR; up to 2050, with shorter term horizon for the next 15 to 20 years (up to 2030). Participants work on:
    a. Refining the various impact chains;
    b. Developing recommended adaptation options, classifying them as either "hard" and "soft".
6. The development of **adaptation pathways** can then proceed. Based on the various adaptation options identified, a series of actions that are deemed crucial to enhance future adaptive capacity for each of the scenarios, will constitute an "adaptation matrix". The actions in the adaptation matrix are then ranked in order of importance, and associated actions such as "must do", "monitor" or "investigate further":
    a. Actions marked "must do" actions would be further prioritized for implementation;
    b. Those marked as "monitor" are those that can wait to be implemented till a certain threshold of climate change is reached;
    c. Actions for which there are no clear cost/benefit rations are classified as "investigate further", and need more consideration till they are decided.

The result of this process is a summary table that lists the various adaptation options. Within each category of adaptation option, they can be classified according to priority (Table 14).

Table 14. SAMPLE ADAPTATION ACTION EVALUATION CRITERIA.

		Priority		
Category	**Criteria**	**low**	**medium**	**high**
Sustainability	Mitigation co-benefits	Decreased GHG Emission	No change to GHG Emission	Increased GHG Emission
	Water Security	Increased Water waste	No effect on water usage	Reduced water waste
	Equity	Benefits few	Benefits many	Significant benefits to many
	Implementation Cost (Relative to cost of inaction)	High	Moderate	Low
Effectiveness	Robustness	Effective for a narrow range of plausible futures	Effective across many plausible futures	Effective across a wide range of plausible futures
Risk & Uncertainty	Urgency	Impact likelihood: longer term	Impact likelihood: near to medium term	Impact already occurring
Opportunity	Ancillary benefits (Contribution to National Strategy)	None or Little	Some	Significant
	No Regret	None or Little Benefit	Some Benefit	Significant Benefit

	(If climate change impacts do not occur)			
	Window of Opportunity to implement	Not currently	Could be created	Exists
Implementation	Funding Sources	External funding sources required but not identified	External funding sources required and likely to be secured	Funding is available externally or internally
	Institutional (Implementation)	Requires coordination with/action by other jurisdictions	Requires External approval	Within local control

ADAPTATION PLANS

9 Governance

Governance is the essential enabler of adaptation to climate change. Good governance needs to rely on formal rules and procedures to allow for (1) the evaluation of the necessary decisions in light of national needs and vision, and (2) for their implementation over time, and across the various economic sectors.

1. The evaluation of necessary decisions requires governance that can take on board **new knowledge**. Because of the ever-evolving nature of adaptation needs, this requires transparency of information, in a participatory environment.
    a. **Transparency** can be enhanced by formal reporting requirements, and mandated scrutiny by local stakeholders.
    b. A **participatory environment** would ensure that adaptation measures apply to local needs and conditions.
2. The implementation of adaptation measures needs to be carried out with a long-term outlook, in which governance would need to allocate resources among various sectors, mediate among stakeholders, and create and maintain key relationships.
    a. A **participatory environment** is vital to strengthen **national strategies**, as it would allow for "bottom-up" input that incorporates local knowledge and experience, and thus enhances their effectiveness and applicability.

(Box 6) Participation is more than Consultation

Participation means that stakeholders at all levels of the social structure have an impact on decisions at the different levels of management. This means that:

- **Consultative mechanisms** should be designed to allow stakeholders to (1) participate in the decision making, (2) question, and (3) potentially change previous decisions.
- Stakeholder meetings should not necessary focus on **consensus**. Provisions should be made to have in place conflict resolution mechanisms such as arbitration.
- **Participatory capacity** should be created and nurtured, particularly seeking out marginalized groups. This extends beyond simple awareness raising, confidence building and education, to (1) the establishment of reliable information channels, and the (2) provision of the necessary resources to facilitate participation.

In many regions of Arab countries where traditional structures of local coordination remain in place, they can be leveraged effectively towards ensuring a good implementation of adaptation measures. By providing local knowledge, they can effectively complement and support the work of central institutions. However, this still requires (1) the necessary transparency and accountability, with (2) institutions that have managerial competence and technical capacity (3) that nurture an environment of reliability and predictability of the rule of law.

1. Institutions should implement recognized standards of **transparency and accountability** because climate change adaptation funds are derived from a variety of sources, from the private sector, to national and global funding entities. At the global level, this will ensure that national interests are well equitably represented in climate funding decisions. Contrary to traditional ODA delivery mechanisms, climate funds need to be governed based on equitable representation. This requires that all participants "talk" the same language and have comparable technical capacities.
    a. Securing **Transparency** in the administration of public climate funding will ensure that information is publicly available regarding both (1) a mechanism's funding structure, its financial data, the structure of its board, its decision making-process, and (2) details on any actual funding decisions and disbursements that are made, as well as on the implementation results. This information is to be made in an accurate and timely fashion.
    b. **Accountability** would be strengthened by ensuring broad stakeholder participation and representation in the administration of climate funding. This requires that existence of mechanisms and institutions to ensure both (1) procedural rights to challenge climate funding decisions or climate finance project implementation, and (2) clear oversight to document decisions taken and their results.
2. The need is not merely to *ensure* **Technical and Managerial Competence**, but also to *maintain* it. This is particularly critical in the context of climate change, where new skills need to complement past experience, as new knowledge comes along and rapid changes appear. Having skilled staff is no sufficient, and institutions need to:
    a. Be **structured** in such a way as to make good use of these skills.
        i. In cases where the main issue is **delayed action and slow decision-making**, this is done by avoiding excessive centralization, by providing managers and staff with more autonomy on operational issues. In return, they have more accountability for performance, with an evaluation system that focuses more on measurable achievable results.
        ii. However, in cases where delayed action is caused by a **lack of reliability and organizational discipline**, the focus would be on strengthening the basic management systems of government. To a certain extent, this may bring in increased bureaucratization to both ensure processes are followed, and document reasons for delays at all levels of the organization.
    b. Link career advancement to a program of **continuous education and training**. It is also necessary for this ongoing capacity building activity to include local stakeholders whenever possible, to better facilitate future cooperation and implementation of adaptation actions.
3. Any successful implementation will depend on the **Reliability and Predictability of the Rule of Law**. This does not necessarily mean that more detailed and specific regulations are needed; indeed, excessive specifications can even be counter-productive. What is needed is a measure of balancing between;
    a. On one hand, **discretion** to ensure a flexible and speedy application of new rules and regulation,
    b. On the other, administrative **procedures** and external oversight for the speedy review and **appeal of decisions** and provide **accountability** (appeal mechanisms, judicial review, ombudsmen, etc.).

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