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Christian Achrainer and David Bosold (eds.)

14th New Faces Conference

"The Impact of Climate Change on the Middle East – Converging and Diverging Perceptions of Development and Human Security"

Amman, 25–28 November 2010
International Forum on Strategic Thinking
German Council on Foreign Relations
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Climate Change as a Security Threat? Linking Global Warming and Security

by Christian Achrainer and David Bosold

With the awarding of the Nobel Peace Price to Al Gore and the International Panel on Climate Change (IPCC) in 2007, the Norwegian Nobel Committee highlighted the existence of an admittedly intricate connection between climate change and peace. The CNA Corporation, a group of former US Army generals and admirals who investigated the implications of climate change on the national security of the USA on behalf of the US Navy in 2007, came to a similar conclusion and called climate change a "threat multiplier for instability."[1] In addition, with the United Nations Security Council discussing the security implications of climate change for the first time in the spring of 2007 and the European Commission following suit and declaring climate change a security threat for Europe in March 2008,[2] by now everyone should have realized that climate change has ultimately become part of the security agenda.

That climate change is occurring and that it will have a significant impact on human life is nowadays hardly contested, a fact which made Idean Salehyan state that "even governments and corporations that were once skeptical about climate research have come to the conclusion that something must be done to mitigate potentially disastrous consequences."[3] Depending on the scenario, most predictions expect an average temperature rise between 1.5 and 5.0 degrees Celsius until 2100, compared to the pre-industrial era.[4] A global warming of 2.0 or more degrees is commonly recognized as being critical. Already the last 100 years have seen an increase of the average temperature of the earth by 0.74 degrees and even if the carbon emissions were to be stopped completely today another 0.6 degrees rise would be likely. Hence, the critical level is close and, regarding the situation today, is most likely to be reached in the coming decades.[5]

1 Cf. CNA Corporation, National security and the threat of climate change, Alexandria, VA, 2007, p. 1.

2 Cf. European Commission, Climate change and international security, Brussels 2008, <http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/reports/99387.pdf> (11/04/2011).

3 Idean Salehyan, From Climate Change to Conflict? No Consensus Yet, in: Journal of Peace Research 3/2008, pp. 315–326, here p. 315.

4 Cf. Chris Abbott, Paul Rogers, John Sloboda, Global responses to global threats. Sustainable security for the 21st century, Oxford 2006, p. 7.

5 Cf. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Klimawandel und Sicherheit. Herausforderungen für die deutsche Entwicklungszusammenarbeit, Eschborn 2008, pp. 7 & 15.

But in how far will climate change be a security threat? The answer to this question highly depends on the security concept that is applied. The scientific debate about the relationship between climate change and the traditional concepts of security as national or international security is discussed controversially. Some authors, such as Kent Butts for example, suggest that climate change will ultimately lead to violent conflicts. He predicts so called water-wars and argues that drinking water shortages, which will occur because of climate change in some areas, will lead to violent conflict over water.[6] Hence, Butts uses the popular argument which goes along the lines that global warming will lead to resource scarcity, especially with respect to land and water, and hence, will trigger violent intra- and interstate conflicts. Resource scarcity as well as sea level rise or the growing number of natural disasters might also raise the number of so-called environmental migrants. And since migration can intensify existing conflicts and tensions, it might become another security threat.[7]

Some authors describe the current conflict in Darfur as the first war resulting from climate change, because they see the conflict between nomads and herdsmen being rooted in the competition for arable land which has become scarce as a result of desertification processes.[8] Still, most authors doubt a mono-causal link between climate change and war. Instead they regard climate change as one of many variables, which are leading to violent conflict if being present together.[9] Therefore, Buhaug, Gleditsch and Theisen conclude that "contrasting common wisdom and the attention given in the media, very few scholars actually claim that there is a direct link between scarcity of renewable resources and armed conflict."[10]

Less contested are security implications of climate change if one looks at broader definitions of security. One of the most prominent concepts is the concept of human security. It goes back to the United Nations Development Program's 1994 Human Development Report, is people-centered and places the well-being of

6 Cf. Kent Butts, The strategic importance of water, in: Parameters, Spring 1997, pp. 65–83, <http://web.macam.ac.il/~arnon/Int-ME/water/The%20Strategic%20Importance%20of%20Water.htm> (27/05/2011).

7 Cf. Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU), Welt im Wandel – Sicherheitsrisiko Klimawandel. Zusammenfassung für Entscheidungsträger, Berlin 2007; Harald Welzer, Krieg und Gewalt im Zeitalter des Klimawandels, in: Günter Altner et al. (eds.), Umwälzung der Erde. Konflikte um Ressourcen, Stuttgart 2009, pp. 53–60.

8 Cf. Ulrich Schlie, Benedikta von Seherr-Toß, Bundesverteidigungsministerium: Klimwandel und Sicherheit, in: Josef Braml et al. (eds.), Weltverträgliche Energiesicherheitspolitik. Jahrbuch Internationale Politik 2005/2006, Munich 2008, pp. 54–59, here p. 55; Harald Welzer, Klimakriege, in: Blätter für deutsche und internationale Politik 5/2008, pp. 31–47, here p. 31.

9 Cf. Thomas Homer-Dixon, Environment, Scarcity and Violence, Princeton 1999, p. 16; Christian Achrainer, A Climate of Conflict? Klimawandel und Gewaltkonflikte (FRP Working Paper 08/2010), September 2010, <http://www.regensburger-politikwissenschaftler.de/frp_working_paper_08_2010.pdf> (11/04/2011).

10 Halvard Buhaug, Nils-Petter Gleditsch, Ole Magnus Theisen, Implications of Climate Change for armed Conflict. (Paper presented at a World Bank Workshop in Washington, DC, 5–6 March 2008), p. 18.

the individual at the center of political consideration, rather than the survival of nation states. The concept therefore expands the focus and puts an emphasis on development and well-being.[11] Today it is hardly contested that global warming already has and will increasingly have a significant impact on how secure human beings can pursue their everyday life. According to the estimates of the IPCC the Mashreq region and North Africa will be the regions most severely affected by climate change in the coming decades.[12] Hence, from a human security perspective, climate change ultimately poses a security threat. Besides, other security concepts have gained currency in recent years, such as energy security, food security or environmental security. It is evident, that these security aspects are closely related to and might eventually become threatened by climate change.

Against this background, the German Council on Foreign Relations (DGAP), the Heinrich Böll Stiftung's Arab Middle East Office Ramallah and The Royal Marine Conservation Society of Jordan (JREDS) jointly hosted an international conference on "The Impact of Climate Change on the Middle East—Challenges and Opportunities for Development and Human Security" in Amman in November 2010. The conference aimed to address the impact of climate change in the region along three thematic clusters, namely (1) climate change and energy, (2) climate change and water and (3) climate change and food production/economic development.[13]

In a first step, each participant presented an input statement in one of the three panels. Afterwards the various impacts of climate change in the Middle East and the security aspects of these changes were discussed in working groups, while each working group focused on implications within its respective thematic cluster. Finally, possible adaptation and mitigation strategies were worked out. The results of the working group sessions have been summarized in three Papers which are published in this Report.

The first paper by Jens Klawitter, Christine Parthemore, Katarina Uherova Hasbani, Adriana Valencia, Marcel Viëtor and Ahmed Zahran discusses implications of climate change on energy security in the MENA region. Its argument is threefold: At first the authors work out general impacts of climate change on energy in the region. Then the paper focuses explicitly on security implications of the general impacts on energy. Finally, the authors work out some policy recommendations for mitigation and adaptation measures.

11 Cf. United Nations Development Program (UNDP), Human Development Report 1994, New Dimensions of Human Security, New York, NY, 1994.

12 Cf. International Panel on Climate Change (IPCC), Climate change 2007. Synthesis report, Geneva 2007.

13 These clusters are overlapping and analytically not fully separable, but reflect the key academic debates on the topic.

The second paper by Ghadeer Jubeh, Taiseer Aljazzar, Franziska Piontek and Marwan Alraggad discusses water-related implications of climate change. It begins with an overview of the current situation in respect to water in the Middle East, followed by a discussion of possible effects of climate change. By providing two case studies the paper then exemplifies possible security impacts. One case study illustrates possible implications in respect to a narrower understanding of security (transboundary security), while the other case study focuses on implications for human security. Afterwards, the authors introduce an index for the vulnerability of different countries and discuss mitigation as well as adaptation measures. The paper concludes by formulating some policy recommendations.

The final paper by Salam Hantash, Hoda Mansour and Nada Omeira discusses implications of climate change on food security in the MENA region. In a first step, the authors highlight possible security implications of climate change, with a special emphasis on food security. Afterwards, they identify several challenges and obstacles for ensuring food security in the Middle East before the paper turns to different possible agricultural adaptation strategies to overcome those challenges. Finally, the paper discusses a number of economic incentives which the authors regard as necessary to secure agricultural development. In the conclusion, some policy recommendations are proposed.

Implications of Climate Change on Energy and Security in the MENA Region

by Jens Klawitter, Christine Parthemore, Katarina Uherova Hasbani, Adriana Valencia, Marcel Viëtor, and Ahmed Zahran[1]


Jens Klawitter


Christine Parthemore


Katarina Uherova Hasbani


Adriana Valencia

1. Introduction

Global climate change is expected to have severe effects on world energy production and consumption. Specific security implications will arise for the Middle East and North Africa (MENA).[2] These effects will impact international and national security, in addition to affecting economic and social security within countries. This paper will first explore the direct effects of climate change on energy in MENA countries (para 2), followed by a brief analysis of its potential security implications (para 3). Finally, the paper recommends adaptation and mitigation measures to address some of the challenges on energy systems presented by climate change (para 4).

2. Impacts of Climate Change on Energy in the MENA Region

Below, the authors identify some of the most important impacts of climate change on energy, followed by what the authors regard as necessary mitigation and adaptation measures for MENA countries. In general, MENA societies may have to adapt to considerable changes in weather patterns associated to climate change. While the authors provide initial observations, further effects of climate change are being identified every day.

2.1. Changes in Energy Demand

Climate change has already started influencing energy demand patterns in most countries of the MENA region. Peak hour patterns, air conditioning intensity, and need for water desalination are among daily life processes that have changed to cope with increasingly extreme temperature variations. Several examples are already happening today. Nevertheless, it is important to note that greater changes in demand may result from future effects of climate change. Energy supply will be affected as the global climate is altered.

1 This article represents the authors' own viewpoints and not that of any institutions they are affiliated with or have been affiliated with in the past.

2 In the context of this paper, we define the MENA region as the Southern and Eastern Mediterranean countries. Additionally, we define energy security as stable, reliable, and sustainable supplies of energy at affordable prices.

Marcel Viëtor

Ahmed Zahran

First, countries are forced to rely more on energy intensive methods of providing sufficient water supplies, such as desalination and underground water pumping when precipitation declines and evaporation from waterways increases.[3] This effect of climate change therefore drives an increasing energy demand and elevates costs that MENA countries must account for. Second, agriculture practices are affected by temperature changes as farmers become more dependent on more energy-intensive methods (e.g. by crops requiring more fertilizers, different irrigation methods, and more varied harvesting patterns) in order to maintain productivity levels. Finally, productivity habits are changing in the region as higher temperatures decrease the ability of laborers to work healthily in open-air conditions. Hours of operation for some businesses are therefore changing, for example to earlier or later hours in the day. This change in productivity hours (apart from changing peak hours of energy demand) may lead to growing overall energy consumption, if hotter weather drives increases in demand for air conditioning.[4]

2.2. Changes in Energy Supply

Energy supply has been negatively affected by changing weather patterns. One case in point relates directly to changing water availability. As water levels decrease due to lower precipitation and increased evaporation, capacity for electricity production (e.g. from hydropower and other water-intensive generation technologies) may decline.[5] Decreasing water availability can also negatively affect cooling and cleaning systems required for Concentrated Solar Power (CSP), nuclear power, and various other thermal generation technologies.

Stress on existing energy production facilities, which may lead to higher energy prices and outages, is a concern, too. Pressure on the available production capacities is making it critical that MENA countries examine options like enhancing energy efficiency, shifting away from the current centralized energy production models, and allowing more players from the private sector to participate in energy production in order to mitigate supply disruptions.[6] It is worth noting that not all changes in temperature and weather result solely in negative effects on energy supply. Some opportunities seem to have arisen, for example, in some parts of the region where there have been more sunny days than before, which

3 For example and according to an interview with Dr. Hafez Salmawy, the head of the Egyptian Electricity Regulatory Authority, conducted on the 8/11/2010, the energy consumption of underground water pumping has grown to consume around 28% of the electricity provided by the Beheira Electricity distribution company (responsible for electricity distribution for most of the north-western part of Egypt).

4 In the same interview with Dr. Salmawy he indicated that farmers are now shifting a good part of their irrigation to take part during the night to avoid the evaporation associated with increased temperatures which means higher energy demand at new times of the day.

5 Taking an example from South America, in 2008 droughts have caused major electricity shortages in Chile, which relies on hydropower for almost two thirds of its electricity generation capacity.

6 Chapter 4 of this paper ("Mitigation and Adaptation") focuses on some of the available options.

can increase the productivity of solar technologies and make solar farms more economically viable.[7]

2.3. Impact on Infrastructure

The existing energy infrastructure in the MENA region was not designed to cope with the effects of climate change and as a result increasing risks of system failures are being manifested in growing numbers of energy outages. Developers will increasingly need to account for the changes described above—especially the impacts of decreasing water supplies—in building and managing energy infrastructure in the MENA region. It is important to note that many necessary changes to energy infrastructure require considerable lead times under business-as-usual scenarios, which may augment challenges for energy infrustructure. However, with the increased energy demand pressure in many countries in the region, this lead time is expected to increase while the window of opportunity to avoid short term energy shortages is decreasing. For example, nuclear power plants would need several years or even decades to be built from the day the policy decision about their construction is made—currently, eight years is the global average.[8] As climate change coincides with with increasing populations and general growth in energy demand, adopting lower-carbon energy technologies that minimize lag time will be critical.

2.4. Impact on Transport

The transport sector is one of the main energy-consuming sectors in any society (globally it consumes around 26% of total energy demand and represents 25% of the global CO_2 footprint)[9] and it directly affects the daily lives of people. The existing transport infrastructure in MENA is currently not designed to address the challenges of climate change[10] and is not adequate for meeting the expected increasing needs of its societies. Any future incentives for mitigating climate-changing greenhouse gas emissions, such as carbon pricing or MENA countries signing international climate agreements, will require major changes in the region's transport sector.

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7 Note, however, that continous increases in temperature (translated into days with ambient air temperatures higher than 37.7 degrees Centigrade, or "hot days") could negatively affect CSP production, resulting in lowered plan efficiencies.

8 Cf. Prognos AG, Renaissance der Kernenergie? Analyse der Bedingungen für den weltweiten Ausbau der Kernenergie gemäß den Plänen der Nuklearindustrie und den verschiedenen Szenarien der Nuklearenergieagentur der OECD, Berlin/Basel 2009, p. 110.

9 Cf. Worldwide Trends in Energy Use and Efficiency, IEA, 2008.

10 Cf. Hamed Assaf, Infrastructure, in: Mostafa K. Tolba and Najib W. Saab (eds.), Arab Environment: Climate Change: Impact of Climate Change on Arab Countries (AFED Report), Beirut 2009, p. 113–120, <http://www.afedonline.org/afedreport09/Full%20English%20Report.pdf>.

2.5. Impact on Construction Sector

Climate change is also resulting in important changes in the housing sector in MENA as increasing temperatures, particularly in summer months, are also increasing the demand for air conditioning. Strongly related to that sector is the fact that 29% of global energy demand comes from households which are responsible for 26% of global CO_2 emissions. That said, any improvements in this sector would have a substantial impact on global energy and CO_2 footprints.[11] Therefore some initiatives are being developed to increase the energy efficiency of buildings and to reduce related energy requirements. However, the necessary paradigm shift in household energy conservation and efficiency remains a distant goal that requires more demand side management. Yet MENA is still in the phase of expanding urbanization, with large numbers of new construction projects, which creates a unique opportunity for more sustainable development.

2.6. Other Economic Impacts

There is an array of additional impacts on the general energy economy that MENA countries must account for. Government budgets dedicated to energy subsidies will now have to deal with more extreme changes of energy consumption. In Egypt, for example, the government is facing new opportunity costs and difficult choices. Household energy consumption, which is highly subsidized by the government, is increasing. At the same time, demand by businesses is increasing as private industries seek to expand or as new, often energy-intensive, industries are created. This competition for energy supplies between households and businesses has direct implications on government revenues, as the government must choose (or strike a balance) between taxing industries on energy use to gain revenues, and paying subsidies to households for their energy consumption.[12] This is creating social tensions which are further exacerbated by the dramatic growth in household energy demand. As a result, energy (e.g. petrol) subsidies in Egypt increased from around 10 Billion EGP in fiscal year 2001 to 40 Billion EGP in 2006 to an expected 67 Billion EGP in fiscal year 2010/2011.[13] This increasing transfer of subsidies to households is creating major opportunity costs for the government, further reducing its capability to provide reliable energy supplies for the existing industries (due to increased outages) which has negative effects on the industry's hardware. Similar developments are common across the whole region, as governments are facing difficult choices about the future of their subsidy-based energy systems. A positive effect is that the region is cur-

11 Worldwide Trends in Energy Use and Efficiency, IEA, 2008.

12 Of course governments can always have varying taxing schemes that benefit the poorest members of society more and that impose higher taxes on users or industries that exceed energy cielings, but this also requires planning and time for implementation and enforcement.

13 According to Al Youm Al Sabe'e newspaper on the 07/11/2010.

rently witnessing the creation of smaller energy companies that are challenging the existing incumbent big public players. This has the potential for distributing the energy supply risk among a bigger number of energy suppliers and allows for more adapted local solutions. This provides just one example of how seemingly minor changes in the energy system driven by climate change impacts do have the potential to drive extensive changes in social and economic dynamics.

3. Security impacts

As we have illustrated above, climate change will create new dynamics in the energy sector across the MENA region. These changes might exacerbate or create new security concerns at the international and national levels, in addition to affecting domestic security and stability within MENA countries. Depending on the energy choices that countries make in addressing the threat of global climate change, transitioning to more sustainable energy sources could also produce positive security effects.

3.1. International aspects

Changes in regional energy demand, including growing competition for reliable sources of conventional energy (oil and natural gas resources in particular), are creating several concerns. The finite nature of cheap fossil fuel resources could create supply and demand imbalances, with the potential to drive price increases for poorer populations within MENA. Additionally, decisions by MENA governments to use available sources for exports rather than domestic consumption (in Morocco and Egypt for example) could create new social and political tensions. On the other hand, international cooperation among countries could create security benefits if cooperation on renewable energy is developed between MENA and non-MENA countries or within the MENA region. For example, the governments of Qatar and the United States signed a Memorandum of Understanding on Renewable and Alternative Energy in early 2010 that will lead to knowledge exchanges and potentially joint funding for research and development in MENA; the U.S. government signed an additional agreement with the government of Saudi Arabia to increase energy-related exchanges.[14] Business relationships centered on clean energy can likewise create economic opportunities and promote international cooperation while drawing foreign direct investment in infrastructure and water projects—all with the potential for bolstering country-level and regional stability and prosperity.

Additional implications include indirect effects resulting from shifting international relations and geopolitics as global energy demand and supply change and

14 Cf. John Pratap, Qatar, US sign deal for energy research, in: Gulf Times, 26/02/2010.

affect MENA and its role as the world's primary energy exporter.[15] Also, increasing global demand and competition for raw materials, components and qualified human capital related to alternative or new energy technologies (nuclear, solar / CSP, wind turbines, etc.) can result in increased costs and lead times for building new energy generation capacity, which subsequently can lead to a lack of perceived energy security.

3.2. National aspects

At the national level, social and domestic stability could be challenged by insufficient generation capacity and hence inadequate energy supply. For example, in the summer of 2010 when temperatures were high in the region, Egypt was exporting gas based on existing contractual obligations despite pressing domestic needs. However, possible synergies could arise, as increasing domestic demand pushes for further regional cooperation such as increased regional connectivity of electric grids (e.g., using the different peak times and the available load capacities to supplement each others energy needs). This type of interdependence can stimulate greater cooperation among countries.

Additionally, there is a potential for public instability and tensions resulting from shortages of energy and water. This could also hinder economic development and access to basic needs of the population. Depending on the choice of the energy mix, human development could be hindered and health conditions deteriorated, resulting in further economic and social pressure on the governments in the whole region.

On the economic security side, inadequate energy supplies could inhibit business growth (e.g. according to the World Bank,[16] problems in access to electricity services constrain businesses opportunities in Lebanon). The lack of government action represents possible security implications as policy actions do not respond adequately to changing energy patterns.[17]

Governments' decisions about where to devote financial resources for energy subsidies, tax policies, and other government support can have a broad range of implications for social, economic, and national security.

15 As US, EU and other historical fossil fuel importers reduce imports as they mitigate emissions and adopt renewable energy sources, energy demand growth in China, India etc. is creating stronger trade relationships among those countries and the MENA region.

16 World Bank (International Bank for Reconstruction And Development & International Finance Corporation), Country Partnership Strategy for Lebanese Republic for the Period FY11-FY14, 28/07/2010.

17 Government is not addressing demand issues adequately (varies by country), government involvement in regulation / restricting ability of businesses to secure their own energy supplies. Governments releasing themselves of the responsibility to secure adequate supplies.

3.3. Types of energy

The changing patterns of energy supply present several security risks based on the adoption of specific source of energy. Nuclear energy presents potential proliferation concerns, economic and security risks, and huge potential costs to society (such as insurance costs not covered in the official costs of potential accidents in the initial cost assessment). The increased use of natural gas could result in additional competition for access to the available supplies among countries in the region and with regard to their gas export policies. The potential exploitation of unconventional fossil fuel supplies, such as shale oil, also presents risks to water supplies and environmental damage. With respect to renewable energy sources, potential security benefits could include increased reliance on domestic sources of energy supply and reduced environmental and climate risks compared to other energy sources. Increasing interdependence through electricity interconnections and trade among countries and regions could contribute towards improving relations.

3.4. Infrastructure

Economic and social stability issues may arise with a possible mismatch between extreme weather conditions (i. e., temperature extremes) and the existing energy infrastructure as energy demand soars or fluctuates. In the summer of 2010, for instance, the sudden increase in temperature / extended heatwave in the MENA region exposed the bottlenecks and inadequacies of the existing infrastructure to handle these conditions, e. g. for accommodating peak demand.[18] This could be made worse by the inadequacies in how countries plan for future demand and the related energy infrastructure.

3.5. Possible benefits

There are also potential security benefits of energy portfolio diversification, technology cooperation and development through improved national research and development (R&D) policies, encouraging private sector investment in R&D and enhanced cooperation among countries, for example for renewable energy. In addition, energy diversification, increasing competition, and environmental benefits can all enhance societal stability and bring further security benefits.

4. Mitigation and Adaptation

A wide variety of mitigation and / or adaptive actions may be taken to lessen or overcome adverse effects of climate change on energy. Both mitigation (reduc-

18 As a result of failing electricity grids, insufficient electricity generation capacity or lack of feedstock for electricity generation, major electricity shortages occurred throughout the region during the summer heat-waves of 2010. In Egypt, Iraq and Lebanon they resulted in public protests.

ing the contributions that lead to an increased carbon footprint) and adaptation measures (taking steps to reduce the negative impacts of climate change on energy security) will be important for coping with these security concerns and for leveraging potential security benefits. These measures could include international cooperation, national policies, and measures that apply to both levels.

– International cooperation will be critical to addressing climate change-related issues in energy sectors across the MENA region. This should include cooperation among countries on energy demand management, for example in enhancing efficiency and energy savings / conservation. It will also be important for MENA countries to develop cooperation with the EU and United States on renewable / clean energy research, development, and deployment. In this context, it will be important for technology cooperation to include research and development conducted within MENA, rather than simply transferring technology developed abroad into the region. There is also potential for regional cooperation among MENA countries in order to leverage shared infrastructure, including electricity interconnections for increasing regional power trading.

– At the national / state level, it will be important for countries to shift to renewable energy sources in their energy mix in order to reduce demand competition for non-renewable sources such as fossil fuels. Governments should pay special attention to improving energy infrastructure management and improving planning to cope with the impacts of climate change. This will also require appropriate policies and regulatory frameworks that incentivize energy efficiency, a diversified energy mix and behavioral change. In particular, governments will need to encourage small businesses' activities in the energy sector, for example by enacting policies that support local-level development of renewable energy sources. Additionally, governments can develop and implement higher, more environmentally friendly fuel standards while managing the potential social and economic implications of changes in their transport sector on low income groups among citizens.

It is important to mention that there is plenty of room for the region to make further advances when it comes to efficiency improvements. According to an ESMAP report,[19] MENA energy intensity was some 60 percent higher in 2009 than that of OECD countries and 40 percent above the world's average. As a

19 Tapping a Hidden Resource, Energy Efficiency in the Middle East and North Africa. Energy Sector Management Assistance Program, The International Bank for Reconstruction and Development, The World Bank Group, February 2009.

matter of fact the MENA region is one of the worst performer when it comes to energy intensity worldwide.[20]

Finally, many measures will apply to both the international community and the national governments in the MENA region. Incorporating likely climate change effects into energy forecasts and planning will be critical for all countries and for international institutions. A good example is ensuring that energy plans account for increased sensitivity to water supply changes. For instance, CSP developers have to give greater considerations to hybrid and dry cooling technologies to conserve water. They should also combine renewable energy projects with desalination technologies in order to maximize energy production and efficiency in water consumption. As CSP projects may be funded and developed nationally or by international consortiums, adequate planning for climate change impacts on water and energy must be both national and international.

All countries could define feasible targets / policy goals and develop instruments for the implementation of the above while being conscious of security risks in designing these policies. In this context, governments will need to ensure timely implementation of the above measures and make sure the results are delivered for the benefit of their citizens and businesses. Strengthening cooperation among the public sector, the private sector and academia could be critical for this process, including through appropriate measures to enhance education, training and capacity building. Planning and budgeting for the immediate and long-term impacts of climate change should become a priority for the energy sector.

5. Conclusion

Implementing the above measures and accounting for the potential security concerns resulting from climate change impacts on the energy sector will continue to be challenging. Remaining obstacles in the MENA region include the need to drive the public debate on climate change and energy, governmental capacity to implement major shifts in policies, and public education. This transition is going to take some time. However, given that the effects of climate change are already visible today, there are various mitigation and adaptation measures that will have to start immediately. The longer the wait, the more pressing the challenges will become for the region, especially for the poorest, who have the least ability to adapt.

20 Cf. World Resource Institiute, <http://earthtrends.wri.org/text/energy-resources/variable-668.html>.

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Water Resources and Security under the Stress of Climate Change in the Middle East

by Ghadeer Jubeh, Taiseer Aljazzar, Franziska Piontek, and Marwan Alraggad[1]

Abstract

Water resources in Middle Eastern countries are limited, due to climatic conditions in the area, which can be classified as arid or semi-arid. The climate in the Middle East is generally characterized by low precipitation and high evaporation rates, very limited surface water and over-used groundwater resources. Moreover, the area is politically unstable, and shared water resources among countries can contribute to this instability. Climate change will further increase the problem of water resources as it affects temperature, rates of precipitation and evaporation, and the amount of water replenishing the groundwater system. Consequently, the region will be harmed by a declining amount of good-quality water resources and resulting political and human insecurities. This paper draws on different backgrounds to attempt to cover the most critical points related to the impacts of climate change on water resources in the Middle East. It points out impacts on water resources as well as resulting security impacts, and suggests some adaptation and mitigation measures.

1. Introduction

This paper aims at providing an overview of the impact of climate change on water resources in the Middle East. It focuses specifically on Egypt, Palestine, Jordan, Lebanon, Israel and Syria. The main goal is to assess the current situation and the vulnerability of different countries in the region, but the paper also focuses on security impacts of climate change. Thereby, two concepts of security will be considered: 1) the concept of human security, which focuses on the individual human being, and rests on two pillars, the "freedom from want" perspective including aspects like food, health and water security, and the "freedom from fear" dimension which focuses on the provision of stability,[2] 2) the concept of interstate security and stability, particularly among countries sharing water resources in so called trans-boundary basins (surface water or groundwater).

The paper begins with an assessment of the current situation regarding water resources in the Middle East and possible impacts of climate change (paras 2 & 3).

1 This article represents the authors' own viewpoints and not that of any institutions they are affiliated with or have been affiliated with in the past.

2 Cf. UNDP, Human Development Report 1994, New York, NY, 1994.

Afterwards, we present two brief case studies to exemplify possible water-related security implications of climate change (para 4). In para 5, we present the Governance Climate Vulnerability Index (GCVI) with which the most vulnerable countries can be identified. This is followed by a discussion of possible mitigation and adaptation measures (paras 6 & 7). In the conclusion (para 8), we briefly summarize our arguments and will formulate a number of policy recommendations.

2. Current Situation

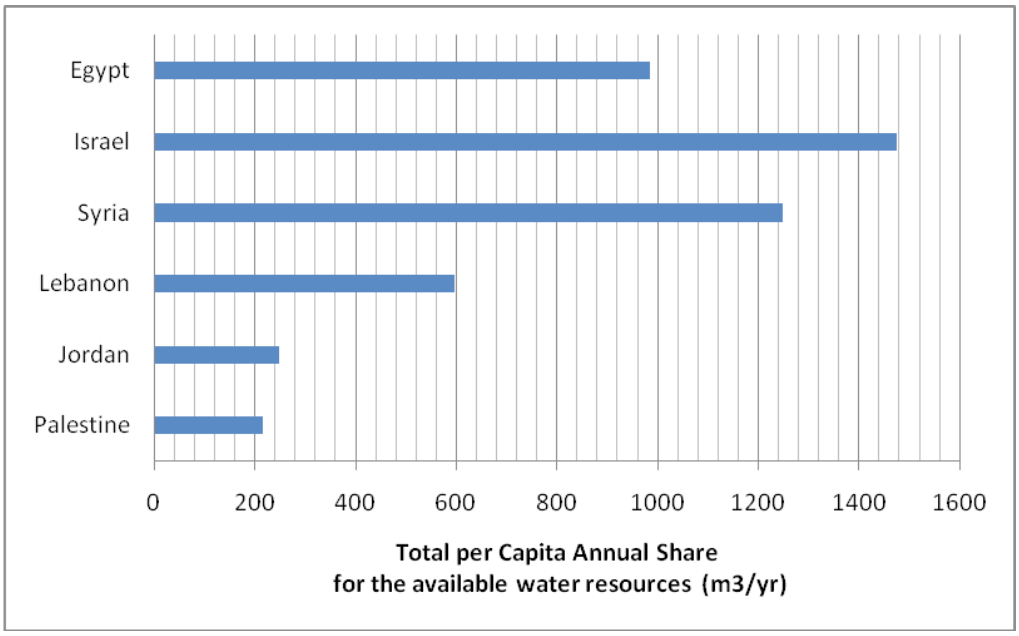
The global climate is changing continuously, but the rapidity and scope of the current climatic changes are unprecedented in recent human history. Hence, what we call climate change today is a real phenomenon that will inevitably affect human populations in the coming decades. As water is involved in all components of the climate system (atmosphere, hydrosphere, land surface and biosphere), climate change will directly affect water availability, quantity and quality. Impacts of climate change on water resources will also depend on anthropogenic factors such as land cover change. Investigating response of water resources to future climate change is a challenging process as water is directly dependent on climate changing parameters such as temperature and precipitation. In the Middle East, already today water resources are under an enormous stress, due to population growth and the extensive use that currently exceeds available water resources by far. Clearly, a more sustainable approach to water management as well as equitable and ecologically sensitive strategies of water allocation and use can reduce the vulnerability of countries exposed additionally to climatic changes.[3]

The Middle East is an arid to semi-arid area where livelihood is to a significant degree influenced by the availability of water. Permanent rivers are the main source of surface water in the region, followed by springs, riverbeds, and seasonal rivers. The total amount of available renewable water in the Middle East is estimated at 230 billion cubic meters per year, mainly surface water. Egypt, Mauritania, Iraq, Syria, Kuwait and Bahrain depend strongly on external water resources flowing in from other countries, with dependence ratios between 54 and 100%.[4] Figure 1 shows the annual share per capita of water resources in Egypt, Israel, Syria, Lebanon, Jordan and Palestine.

3 Cf. Caroline A. Sullivan, Calculating a Water Poverty Index, in: World Development 7/2002, pp. 1195–1210.

4 Cf. FAO, Water Resources in the Near East. Facts and Figures, Cairo, 2010.

Fig. 1: Water resources in Egypt, Israel, Syria, Lebanon, Jordan and Palestine



Source: ESCWA, ESCWA Water Development Report 2, New York 2007.

Climate change will further increase the stress on water resources in the Middle East, since it has significant effects on environment, societies and economies. Those effects and possible responses will be discussed in the following paragraphs.

3. Expected Effects of Climate Change in the Middle East

Generally, under climate change the Middle East is expected to experience shorter winters, longer and hotter summers, more frequent heat waves and more extreme weather events such as floods and droughts.[5]

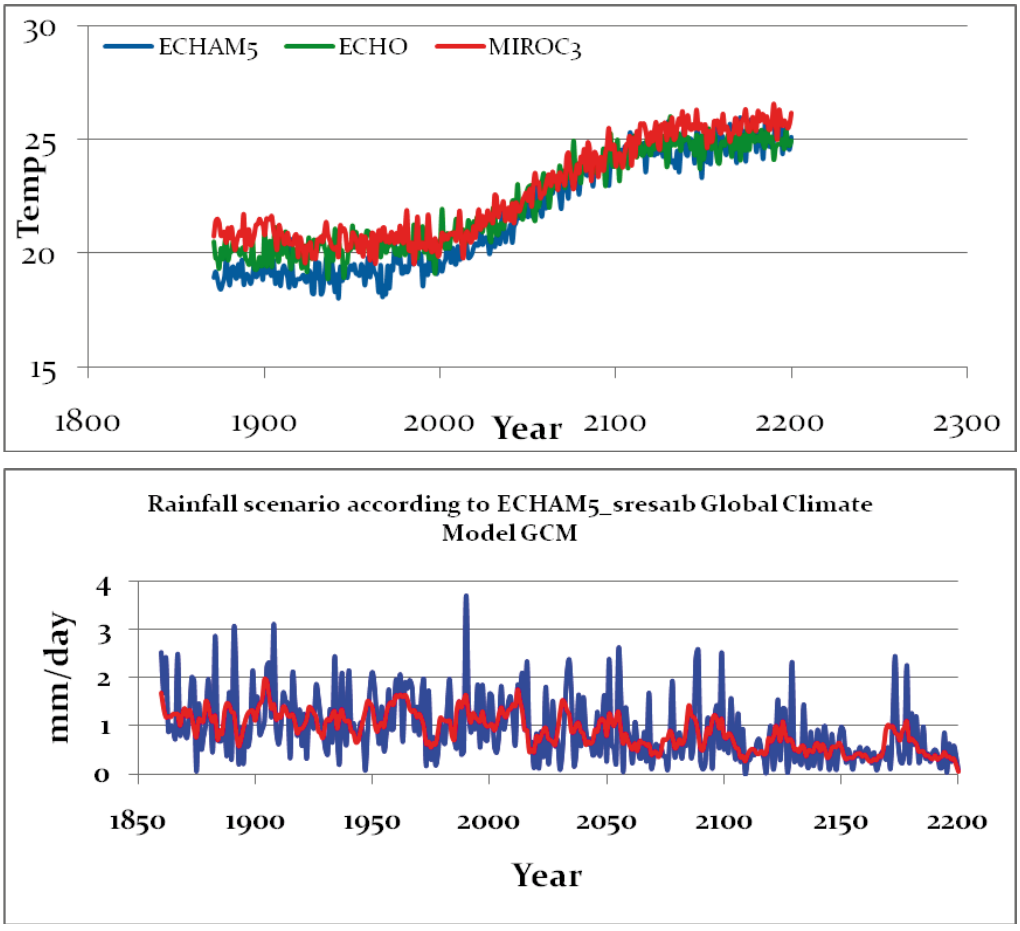
Figure 2 illustrates trends and predictions for temperature and precipitation in the region, based on the use of Global Circulation Models (GCMs). There is a high degree of uncertainty in these trends and predictions, due to a lack of hydro-meteorological observation stations in the region, as well as the lack of small-scale regional climate models. Nevertheless, models generally forecast that the region will experience rising temperatures—most predictions suggest a rise of two to five degrees until the end of the century—especially in the hot summer months.[6] This will result in greater degrees of evaporation on open water sources, like lakes, dam storage reservoirs and irrigation canals.

5 Cf. Mostafa K. Tolba, Najib W. Saab, Arab Environment: Future Challenges, Report of the Arab Forum for Environment and Development, Beirut 2008.

6 Cf. Jens Hesselbjerg Christensen et al., Regional Climate Projections, in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge 2007.

Rising temperatures will be accompanied by decreasing precipitation. In the north-western part of Syria for instance, reductions of up to -70 mm/year are expected by the end of the century. Only slightly smaller reductions are predicted for other areas.[7] In combination with increased evaporation this results in a strong decrease of already scarce available renewable water resources such as river runoffs, lake levels and ground water levels. An exception might be the Nile basin, where some models predict flow increases, due to increased precipitation in the source regions, especially the Ethiopian highlands.[8]

Fig. 2: Climatic Developments and Predictions for the Middle East for different Global Circulation Models under emission scenario SRESA1B.



Source: KNMI Climate Explorer, 2010, <http://climexp.knmi.nl/start.cgi?someone@somewhere> (11/04/2011).

7 However, the level of uncertainty is high and some models even predict precipitation increases (Cf. Jason P. Evans, 21st Century Climate Change in the Middle East, in: Climatic Change 3–4/2009, pp. 417–432).

8 Cf. TazebeBeyene, Dennis P. Lettenmaier, Pavel Kabat, Hydrologic impacts of climate change on the Nile River Basin: Implications of the 2007 IPCC scenarios, in: Climatic Change 3–4/2010, pp. 433–461; Mohamed E. Elshamy, Mohamed A. A. Sayed, Bakr Badawy, Impacts of Climate Change on the Nile Flows at Dongola Using Statistical Downscaled GCM Scenarios, in: Nile Basin Water Engineering Scientific Magazine 2/2009.

Another expected impact of climate change is sea level rise. In the Middle East, the area with the highest vulnerability to sea level rise is the Nile delta in Egypt, due to its high population density and its importance for the agriculture and industry of the country.[9] Coastal areas in general are also threatened by salt water intrusion into coastal aquifers and freshwater systems. This is already a problem in the Gaza Strip, Lebanon and in the Nile delta, and will intensify with increasing sea level rise.

Among the multitude of secondary effects of climate change, the most important ones in relation to water are impacts on the viability of agriculture (through the change of total water availability as well as timing of precipitation), on the availability of water for human consumption (accompanied by a rising population, with strong effects on sanitation and water quality and possible effects on tourism), on energy supply (e.g. through effects on the efficiency of hydropower plants or the availability of cooling water for power plants), and on freshwater ecosystems (especially wetlands with their high importance for water management).

4. Security Implications of Climate Change in the Middle East: Two Case Studies

In recent years, climate change has increasingly been regarded as a security threat, both in terms of a more traditional understanding of security (national security, international security etc.) as well as a broader understanding (human security, food security, etc.). Below we will present two case studies to exemplify possible security implications. While the first case study is concerned with international conflict, the second case study focuses on human security implications.

4.1. The Nile Basin—A case of transboundary Water Conflict[10]

Ten countries share the water of the Nile,[11] with a river basin characterized by large differences in terms of water availability, economic and human development, food security and environmental conditions. Egypt, the most downstream riparian country, depends to 98% on Nile water and maintains historic control of the major share of the river flow, preventing development of the water resources in the upstream countries. Despite cooperative efforts in the framework of the Nile Basin Initiative over the last ten years, especially through common technical projects, negotiations on a Cooperative Framework Agreement over Nile waters

9 Cf. Shardul Agrawala et al., Development and Climate Change in Egypt: Focus on Coastal Resources and the Nile, Paris 2004.

10 For a detailed discussion see Franziska Piontek, The Impact of Climate Change on Conflict and Cooperation in the Nile Basin, Master's Thesis, University of Hamburg 2010.

11 Egypt, Sudan, Ethiopia, Eritrea, Uganda, Rwanda, Burundi, Kenya, Tanzania and the Democratic Republic of Congo. In the summer of 2011 the new country of South Sudan will increase this number to 11.

have so far not been successful. On the contrary, a recent one-sided opening of the signature process by the upstream states has increased tensions.

While climate change will most likely increase the variability of river flow and the frequency and severity of extreme weather events like floods and droughts, the impact on river flow in total is subject to a very high degree of uncertainty and either an increase or a decrease is possible. This might affect interstate security in the basin, especially in case the flow would decrease or droughts became more prolonged and frequent. Hence, maintaining the current status quo of water distribution might lead to mounting tensions or even armed conflict, and could prove very costly for Egypt. On the other hand, incentives for cooperation are increasing in order to reach highest possible efficiency in the use of lessened flow, but also to manage higher variability or accommodate increasing flows through an efficient basin-wide operation of dam and irrigation infrastructure.

Other transboundary surface water systems in the region are the Jordan River, the Yarmouk River or the Euphrates. Also underground aquifers can be transboundary and might therefore be or become subject to interstate security concerns and conflict settings as well. One prominent example is the Mountain aquifer shared by Israel and Palestine.

4.2. Droughts in Syria and Floods in Saudi Arabia—Climate Change and Human Security[12]

Syria currently experiences the most severe drought in 40 years, affecting almost one million people in the east of the country. Farmers are hit by loss of cattle and loss of crop harvests, resulting in large or total loss of livelihoods. The only option left to many is to migrate to cities, causing one of the "largest internal displacements in the Middle East in recent years."[13]

In the Saudi Arabian city of Jeddah, in 2009 more than 150 people were killed and more than 8000 homes were damaged during a rain storm dropping an amount equivalent to twice the average yearly rainfall within four hours. Additional risk arose from a dangerous rise of water levels in an upstream sewage water dumping lake, creating a large threat for public health in the city. While this remained a threat in Jeddah, it became reality in northern Gaza in 2007, when a sewage overspill related to strong rainfall affected a large number of people.

12 Cf. Mohamed El-Ashry, Najib Saab, Bashar Zeitoon (eds.), Arab Environment: Water. Sustainable Management of a Scarce Resource, 2010 Report of the Arab Forum for Environment and Development, Beirut 2010.

13 Report of UN OCHA, quoted from El-Ashry, Arab Environment, op. cit. (Fn. 12), p. 33.

While neither of the described events is directly linked to climate change, their frequency will increase under climate change and they provide an illustration of challenges to existing infrastructure, which is often not climate-proof. This results in possible threats to human well-being in the areas of food security, basic livelihoods and health, caused by the impacts on water availability by both long-term trends and extreme events likely to occur under climate change. Impacts for both aspects of human security follow. The human well-being—freedom from want—can be severely limited, affecting especially the poorest parts of society and threatening development efforts and the achievement of the Millennium Development Goals. At the same time, this can lead to threats to the internal stability of society and nations, for example through large-scale urbanization and migration, and hence, affecting the freedom from fear.

Both case studies provided above illustrate the high potential for climate change's water-related implications on human as well as interstate security. This has to be assessed in the context of vulnerability of the countries, which is the "degree, to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. [...] Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity."[14] A tool to measure and compare vulnerability is described in the following section.

5. Governance and Climate Vulnerability of Middle Eastern Countries

The study of the vulnerability of human and natural systems to climate change, and of their ability to adapt to changes in climate hazards, is a relatively new field of research. In general, developing countries tend to be more vulnerable to these changes than other countries, both because of higher exposure and less capacity to develop adaptation measures.

Prior to developing strategies for adaptation, it is necessary to make reliable and consistent assessments of vulnerability. This needs to be done in a holistic way and on an appropriate scale. A wide range of relevant factors has to be integrated, taking into account social, physical, economical, environmental, political and climatic aspects in order to outline an integrated structural framework.

On the one hand, several natural or climatic factors such as access to water resources have an impact on climate vulnerability.[15] On the other hand, also gover-

14 International Panel on Climate Change (IPCC), Climate Change Impacts, Adaptation and Vulnerability, Working Group II, Summary for Policymakers, Geneva 2007.

15 Cf. Caroline A. Sullivan, Jeremy R. Meigh, Targeting Attention on Local Vulnerabilities Using an Integrated Index Approach: the Example of the Climate Vulnerability Index, in: Water Science & Technology 5/2005, pp. 69–78.

nance within the different countries is influencing climate vulnerability, since the development and application of adaptation strategies highly depends on a government's performance and the efficiency in applying policies, legislation and managerial plans towards decreasing poverty. Governance may incorporate several factors such as accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption.[16] The Governance and Climate Vulnerability Index (GCVI) is taking into account all these factors by combining a Governance Index (GI) and a Climate Variability Index (CVI). Hence, by applying the GCVI it is possible to compare the vulnerability of countries/communities with respect to climate change. In table 1 the GCVI has been applied to five Middle Eastern countries. The lower the combined or respective figure of an index, the more vulnerable a country is to climate change.

Table 1: CVI, GI and GCVI of Palestine, Jordan, Lebanon, Syria and Israel

Country	CVI	GI	GCVI
Palestine	24.9	25.3	25.1
Jordan	30.2	50.3	39.4
Lebanon	33.6	32.6	33.1
Syria	48.2	29.6	38.2
Israel	52.9	57.3	55.0

Source: GhadeerJubeh, Ziad Mimi, Governance and Climate Vulnerability Index—Five Case Studies, Institute of Water and Environmental Studies, Birzeit University 2010.

The GCVI establishes a comparative method and allows to rank countries taking into account physical, governance, environmental and socio-economic factors associated with water scarcity. The GCVI enables decision makers, who are concerned with water provision, to identify the most vulnerable countries or communities. Hence, the GCVI indicates how urgently adaptation and / or mitigation measures are needed. Some possible mitigation and adaptation strategies are discussed in the following sections.

6. Mitigation Measures in the Middle East

Mitigation refers to efforts to reduce greenhouse gas emissions and to capture greenhouse gases through land use changes such as forestation or carbon capture and storage in deep geological formations, in order to reduce amount of greenhouse gases in the atmosphere. Policies and measures to reduce greenhouse gas emissions include improving energy efficiency, switching to low or zero carbon fuels—i. e. by substituting oil with natural gas—and using renewable energy sources such as solar and wind energy.

16 Cf. World Bank, A Decade of Measuring the Quality of Governance. Governance Matters 2006, Worldwide Governance Indicators, 1996–2007,. Washington, DC, 2006.

There are several factors contributing to a significant increase of CO_2 in the atmosphere, the consumption of enormous amounts of fossil fuel being a major factor of CO_2 emissions. The uncontrolled land use change—i. e. urbanization and deforestation—represents an additional factor. Therefore, searching for alternative energy sources to replace or minimize the parameters that could adversely contribute to climate change is an environmental imperative.

Arab countries are not considered major contributors to greenhouse gas emission and hence, to climate change. However, there should be a local as well as a regional policy in the Middle East, supporting such mitigation efforts. Mitigation measures should focus on using renewable resources as well as improving land use management. Arab countries will have to undertake such mitigation measures as a part of the global action towards lowering greenhouse gas emissions.

Reviewing mitigation measures applied in the Middle East shows that there are different measures already being implemented, encompassing both measures to reduce anthropogenic greenhouse gas emissions as well as efforts to enhance carbon sinks. Specific examples in the Arab world are the commercialization of wind energy in Egypt, the widespread use of solar heating in Palestine, Tunisia and Morocco, the introduction of compressed natural gas as a transport fuel in Egypt, the first concentrated solar power projects in Egypt, Tunisia, Morocco and Algeria, and the first three Arab green building councils in Jordan, the UAE and Egypt. The massive forestation program in the UAE, Masdar, the first zero-carbon city in Abu Dhabi, the pioneering carbon capture and storage project in Algeria, and Jordan's introduction of duty and tax exemptions to encourage the import of hybrid cars are further examples.

However, most of these initiatives are fragmented and do not appear to have been implemented as part of a comprehensive policy framework at the national or regional level. In a particularly promising development, the newly established International Renewable Energy Agency (IRENA) has chosen Masdar City in Abu Dhabi as the agency's first headquarters. This is not only very important for the developing world as a whole but will hopefully lead to significant research and investments into renewable energy in the region.

7. Adaptation Measures in the Middle East

According to the International Panel on Climate Change, adaptation is the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportuni-

ties."[17] The Stern Review Report of 2006 recognized that adaptation to climate change, in contrast to mitigation, will in most cases provide local benefits (including economic benefits), brought about without long delays. Adaptation strategies should be integrated into development policy and planning at every level. As Stern reminds us: "ignoring climate change is not a viable option—inaction will be far more costly than adaptation."[18] The UN Economic Commission for Europe also highlights the need for action by stating: "The world needs to adapt to climate change in water management without delay, and uncertainty should never be a reason for inaction."[19]

Within their adaptation strategies, the Middle Eastern countries should consider water availability in terms of quality and quantity, as well as droughts, floods, and sea level rise. For instance, new technologies are needed to reduce water consumption. In addition, new species need to be introduced such as drought and salinity tolerant crops and cash crops. Also the reuse of treated wastewater can be an efficient solution for irrigation and can support local communities and especially farmers. Besides, high population growth rates will lead to urbanization and adversely affect the ecosystem services. Therefore, also a shift from Integrated Water Resources Management (IWRM) to Integrated Water Resources and Land Management (IWRLM) is urgently needed to secure current local needs and the needs of future generations.

One major adaptation measure in respect to water quantity is groundwater recharge. Before thinking about such measures, an assessment of groundwater vulnerability is necessary. The modified DRASTIC index, which uses a laboratory setup and has been tested in Germany, will be applicable to assess groundwater vulnerability in specific areas and for different pollutants.[20] Hence it can provide a basis for integrated water management in the region.

Groundwater represents a major source for fresh water supply, especially in the northern part of the Middle East. But groundwater resources are subjected to over-pumping while groundwater recharge rates are decreasing because of draughts and climatic changes. Declining groundwater levels lead to deterioration in water quality and loss of ecosystem services, like springs, as well as socio-economic problems in the domain of irrigated agriculture. Hence, groundwater resources should be replenished artificially to support the recovery of the natural

17 IPCC, Climate Change Impacts, op. cit. (Fn. 14).

18 Nicholas Stern, Stern Review on the Economics of Climate Change, HM Treasury 2006.

19 UN Economic Commission for Europe, Guidance on Water and Adaptation to Climate Change, 2009.

20 Cf. TaiseerAljazzar, Adjustment of DRASTIC Index to Assess Groundwater Vulnerability to Nitrate Contamination Using the Advection Diffusion Cell, PhD Thesis, RWTH Aachen University 2010.

system. In the domain of artificial recharge, Managed Aquifer Recharge (MAR) can provide a source for fresh water supply and contributes to the prevention of soil erosion at the same time.

MAR is based on a computer model and aims at choosing suitable sites for groundwater recharge by analyzing natural conditions. It has proved to be efficient in arid and semi-arid areas to 1) increase the amount of stored groundwater, 2) reduce the effect of climate change on groundwater resources, 3) improve the quality of groundwater, 4) limit the salt water intrusion in local areas and prevent any subsidence that may be caused by over pumping,[21] 5) reduce loss of fresh surface water due to evaporation, and 6) reduce soil erosion and storm runoff.[22]

8. Conclusion and Recommendations

The Middle East is already one of the most water scarce regions in the world, while climate change is adding a new dimension of stress on the available water resources in the region and will affect them in terms of quality and quantity. Therefore, mitigation as well as adaptation measures are urgently needed. Based on the discussion in this paper, it is possible to identify policy recommendations. Along these lines we recommended to:

- establish a regional center for climate change studies to be responsible for a) climate data base, b) climatic modeling, c) scientific research, d) climate change monitoring, and e) developing methods to address uncertainties;
- establish transparency in data exchange between countries who share common water sources;
- reduce the gap between science and policy making;
- implement pilot projects to assess and implement the different adaptation technologies like MAR;
- raise public awareness to reduce water consumption and pollution;
- include environmental and climate change awareness into the education system;
- mainstream climate change into water infrastructure planning processes;
- develop and implement legislations to provide incentives for mitigation and adaptation.

21 Cf. M. Rapp, Evaluation of Potential Sites for Managed Aquifer Recharge via Surface Infiltration in NW-Jordan, Diploma thesis, University of Karlsruhe 2008.

22 Cf. Ian Gale, Strategies for Managed Aquifer Recharge (MAR) in Semi-Arid Areas, UNESCO's International Hydrological Programme (IHP), Paris 2005.

Climate Change and Food Security: Challenges and Opportunities within the MENA Region

by Salam Hantash, Hoda Mansour, and Nada Omeira[1]


Salam Hantash


Hoda Mansour


Nada Omeira

1. Background

This article highlights the impacts of climate change on agriculture and food security in the MENA Region, and puts emphasis on the consequent need for adaptation policies that ensure food self-reliance and the resilience of the most vulnerable in rural and urban areas. Security as a concept can be defined in many different ways. This paper uses a rights-based approach, which defines food security as the right of all people to healthy and culturally appropriate food produced according to their own food and agriculture systems and through ecologically sound and sustainable methods.[2]

In a first step, possible security implications of the challenge of climate change are discussed, with a special emphasis on food security (para 2). Afterwards, we identify additionall challenges and obstacles for ensuring food security in the Middle East (para 3), before presenting different possible agricultural adaptation strategies to overcome those challenges and ensure food security (para 4). In para 5, we discuss a number of economic incentives which we regard as necessary to secure agricultural development and food security. We conclude with a number of policy recommendations (para 6).

2. Security Implications of Climate Change

Already today, the Middle East is the world's driest region and "per capita water availability is predicted to halve by 2050 even without the effects of climate change."[3] Climate change will further worsen the situation and has been recognized as a threat multiplier for instability in some of the most volatile regions of the world, including the Middle East, which is considered to be particularly vulnerable to climate change induced desertification processes and severe water stress.[4] Hence, climate change may affect security in many ways. For instance, ten-

1 This article represents the authors' own viewpoints and not that of any institutions they are affiliated with or have been affiliated with in the past.

2 Cf. Forum for Food Sovereignty, Declaration of Nyéléni, Sélingué 2007.

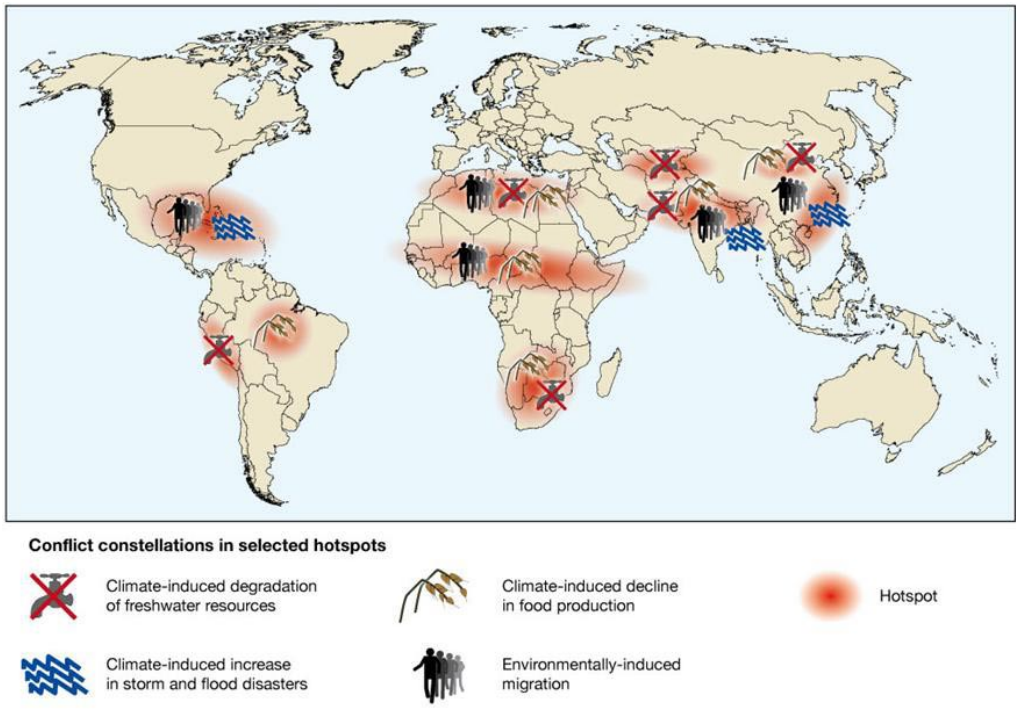
3 World Bank, Regional Vulnerability to Climate Change, 2010, <http://go.worldbank.org/TEDWNYJT30> (10/04/2011).

4 Cf. Bryson Bates et al., Climate Change and Water (Technical Paper of the Intergovernmental Panel on Climate Change), Geneva 2008.

sions and competition for scarce natural resources are likely to increase, as well as further restricted access to land and water resources. The control over natural resources may become a key dimension for national security and may, hence, lead to militarization efforts. By intensifying food insecurity and hindering economic growth, climate change might also trigger immense migration movements. This in turn might destabilize the whole region.[5]

Figure (1) below illustrates possible climate change-related security risks in different world regions. According to the German Advisory Council on Global Change, the Middle East will mainly be exposed to a degradation of freshwater resources, a decline in food production and to increased migration.[6]

Fig. 1: Security risks associated with climate change



Source: WBGU, World in Transition, op. cit. (Fn. 6).

The degree of vulnerability within the region highly depends on the adaptive capacities of states and communities, which in turn depend on national and local institutional resources as well as governance effectiveness. The severe drought which struck the eastern part of the MENA region during the past few years pro-

5 Cf. Oli Brown, Alec Crawford, Rising Temperatures, Rising Tensions. Climate change and the risk of violent conflict in the Middle East, Winnipeg 2009.

6 Cf. German Advisory Council on Global Change (WBGU), World in Transition. Climate Change as a Security Threat. Summary for Policy-Makers, 2007, <http://eeac.hscglab.nl/files/D-WBGU_ClimateChangeRisk_Jun07.pdf> (10/04/2011).

vides an example of the interactions between climatic circumstances and adaptive capacities. It revealed the fragility of rural areas in several countries, in which local as well as national governments were not able to overcome insufficient rainfall and hence, could not sustain local agricultural production.[7]

In respect to food security in the Middle East, agriculture plays a major role but is already today facing tremendous challenges like a growing population, increased scarcity of available land and water resources, recurrent droughts and soaring food prices. Agriculture is the main source of income for the majority of the poor in the region. For instance, 20 per cent of the Syrian GDP and 25 to 30 per cent of total formal employment in Syria can be attributed to agriculture.[8] Moreover, agricultural production saves household expenditures on food and increases the purchasing power since low income families generally spend a substantial portion of their income (50 to 70%) on food.

As Gerald Nelson, an agricultural economist with the International Food Policy Research Institute (IFPRI), points out: "Of all human economic activities, agriculture is by far the most vulnerable to climate change."[9] Agricultural productivity is likely to suffer severe losses because of high temperature, severe droughts, and soil degradation. This might lead to an increase in prices of agricultural products, and hence, worsen the conditions of the already vulnerable and insecure populations in developing countries. Accordingly, John Reilly states that "those who are currently poor, malnourished and dependent on local production for food are the most vulnerable to climate change in terms of hunger and malnutrition."[10] Poor farmers in developing countries are particularly susceptible to climate change impacts due to their geographic exposure, limited assets and greater reliance on agriculture for livelihoods.[11] This is confirmed by recent modeling studies which suggest that climate change will slow down or even reverse the poverty-reducing impact of agriculture.[12]

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7 Cf. Jeannie Sowers, Erika Weinthal, Climate Change Adaptation in the Middle East and North Africa: Challenges and Opportunities (The Dubai Initiative, Working Paper No. 2), September 2010, <http://belfercenter.ksg.harvard.edu/files/Sowers-Weinthal_DI_Working-Paper-2.PDF> (10/04/2011).

8 Cf. Food and Agriculture Organization of the United Nations (FAO), Country Briefs: Syrian Arab Republic, May 2010, <http://www.fao.org/countries/55528/en/syr/> (10/04/2011).

9 Cited from Stepehen Leahay, Food supply hangs in the balance, in: IPS news, 02/10/2009, <http://ipsnews.net/news.asp?idnews=48689> (10/04/2011).

10 John Reilly, Climate change, global agriculture and regional vulnerability, in: Fakhri Bazzaz and Wim Sombroek (eds.), Global climate change and agricultural production, Rome 1996. See also Gerald C. Nelson et al., Climate change: impact on agriculture and costs of adaptation, Washington, DC, 2009.

11 Cf. Miguel A. Altieri, Parviz Koohafkan, Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities, Penang 2008.

12 Cf. Rachel Slater et al., Climate change, agricultural policy and poverty reduction—how much do we know?, September 2007, <http://www.odi.org.uk/resources/download/1231.pdf> (10/04/2011).

Despite the diversity of its ecosystems and the cultural importance of agriculture in the region, the Middle East is the world's largest net importer of food. Since it is also the largest net exporter of oil, the region has been deeply affected by the triple crisis of food, fuel and finance.[13] According to a statement issued by Arab ministers responsible for agriculture in 2008, the Arab food gap has steadily risen over the past years as a result of population growth, poor investment in the farming sector and soaring food prices. The Arab food gap is estimated to surge to 71 billion Dollar in 2030. The predicted global decrease in crop production and related increase in global food prices as a result of climate change, speculation, and the global shift towards agrofuels could therefore heavily impact the economies of the region and the access to food. It could also seriously aggravate political tensions in the region.[14]

Due to the existing conditions in the region and the predicted impacts of climate change, the concept of food self-reliance at a primarily national and regional level should be considered as a solution to secure food for the population of the region, including the poor. Food self-reliance means that enough food is produced locally to satisfy the per capita minimum of food requirement, particularly relying on strategic crops. Each country has to maintain a particular level of domestic food production while building up capacities to import the balance of food needs by generating wealth through other mechanisms or through exporting other products. Self-reliance thus improves a country's resilience to external shocks, notably global fluctuations of food and oil prices. In a recent speech held at the 30th FAO Regional conference for the Near East, the Director General of the FAO, Jacques Diouf, warned against the increasing deficit in cereals in the region and the vulnerability to shocks in international and domestic markets. Essentially, Diouf called for an increased investment in agriculture and trade.[15]

3. Challenges and Obstacles for Ensuring Food Security in the Region

There are various challenges and barriers to addressing food security within the context of sustainable agricultural practices and food self-reliance in the countries of the MENA region. Some of the most pressing ones will be discussed below. They will need to be addressed or at least taken into account when considering solutions to protecting vulnerable groups from food insecurity and the impacts of climate change.

13 Cf. World Bank, Global Economic Prospects: Crisis, Finance, and Growth, Washington, DC, 2010.

14 Cf. Brown, Crawford, Rising Temperatures, op. cit. (Fn. 5).

15 Cf. <http://www.un-foodsecurity.org/node/966> (10/04/2010).

- On a policy level, food security can be challenged by national, regional and international policymaking as well as bilateral and multilateral agreements, strategies and regulations. Regional cooperation and strategic planning are still very far from reaching their potential, due to the absence of a unified political will, a lack of long-term vision and insufficient market information. For instance, accession to the World Trade Organization (WTO) on the one hand provides an opportunity for economic growth, but on the other hand might also entail detrimental effects on local food production and food security.
- Rule of law and governance are still among the major challenges in most of the region. Accordingly, the latest Transparency International Corruption Index 2010 ranked most Middle Eastern countries as belonging to the most corrupt states in the world.[16] The chain of revolts that are currently witnessed in the region can be partly attributed to the high levels of corruption, poor governance, and the increasing food insecurity.
- Agriculture and food production are generally not considered by decision-makers as key sectors for development. This is witnessed, for instance, by the lack of formal agricultural education. Also research about possible effects of climate change on food security, including changes in precipitation patterns and varieties of diseases, pests and weeds in the region, is lacking sufficient support.
- Another key challenge is the lack of funding for food production. Most financial investments in the region are not geared towards sustainable development, but focus instead on revenue generation in projects such as real estate development. There is a fundamental tension between short-term profit generation and long-term development and food security. The poorest share of the population faces additional challenges to benefit from possible sources of funding, including credit facilities, also due to low level of financial literacy. This is compounded by the creation of a donor-dependency which also directs donor specific choices.

4. Agricultural Adaptation Strategies to Ensure Food Security

Complex biophysical and socioeconomic processes, including poverty and marginalization, often entail vulnerability to climate change. The mismanagement of natural resources and inappropriate policy-making exacerbate vulnerability to the impacts of climate change and to food insecurity. Therefore, comprehensive strategies and actions are required amidst the existing political and economic challenges, to ensure mitigation and adaptation to climate change as well as effective food security. For instance, policy actions in the region should seek to guar-

16 Cf. <http://www.transparency.org/policy_research/surveys_indices/cpi/2010> (10/04/2011).

antee the sustainability of local livelihoods and suitable welfare conditions for the most vulnerable share of the population, particularly farmers.

Effective agricultural adaptation measures could answer key challenges in respect to food security, since agricultural development requires strategies to ensure conservation and preparedness for extreme events. As a result, many proactive measures to adapt to climate change can be encompassed within existing policies for the water and agriculture sectors. These include structural measures such as upgrading and extending water harvesting and storage infrastructures, and non-structural adaptation measures such as improving demand management of water and agricultural efficiencies and fostering local and provincial capacities to grapple with existing water/agricultural problems.

4.1. Nonstructural Adaptation Measures

Several aspects have to be considered when thinking about nonstructural agricultural adaptation measures. In general, comprehensive strategies should encompass:

- Agricultural education, extension (transfer of knowledge, capacity building etc.) and research—public or private—to address current needs and meet future challenges. Agricultural extension services should be developed and tailored according to specific needs and ensure farmers' access to land, water and funding. Technically, there is need to combine indigenous agricultural knowledge with scientific knowledge to reach locally-specific adaptation measures to climate change keeping in mind that farmers have evolved and adapted to changing environments by developing diverse and resilient farming systems.[17]
- Early-warning systems and protection measures to inform farmers about and protect them from natural disasters (droughts, floods, disease outbreaks etc.).
- Efforts to raise awareness among decision-makers to recognize and fulfill the right of the individual to adequate food. This might lead to an increase of public expenditure in agriculture and rural areas to ensure the resilience of local communities and access to basic services such as education, health and basic infrastructures.[18] It should be one of the priorities to enhance national production for national markets. Besides, investment in agriculture should be increased.

17 Cf. Altieri, Koohafkan, Enduring Farms, op. cit. (Fn. 11).

18 Cf. Slater et al., Climate change, op. cit. (Fn. 12); Peter Rosset, Moving Forward: Agrarian Reform as a Part of Food Sovereignty, Promised Land: Competing Visions of Agrarian Reform, Chapter 16, 2006, <www.foodfirst.org/files/bookstore/pdf/promisedland/16.pdf> (10/04/2011).

- Efforts to improve access to land and land tenure. The needed policy changes include the implementation of a people-led land and agrarian reform that secures tenures and/or access rights for long-term food security for families and communities. The rights of pastoralists to access common natural resources should also be guaranteed, in accordance with local customary law and tradition.[19]
- Incentives and support for the organization of food producing-communities into production groups to organize production and improve the efficient use of the limited existing resources.
- A careful revision of trade and development policies.
- Efforts to improve post-harvesting techniques (storage, packaging, labeling etc.).
- Efforts to improve access to markets.
- More efficient agricultural marketing and distribution through the promotion of public and private investment in market research, market information systems and improved regional linkages between producers, distributors and consumers.
- Efforts to improve transboundary water agreements that take climate change into account and prevent future conflicts over water resources.

4.2. Structural Adaptation Measures

In terms of structural strategies, there is need to secure the transfer of sustainable practices to adapt to climate change, including the shift to using renewable energy sources. These structural strategies include:

- Efforts to improve water availability and accessibility for irrigation, to adapt to the fluctuating quantities and qualities of water supply. This can be achieved through: 1) supplemental irrigation, which means the addition of small amounts of water to rain-fed crops during times of insufficient rainfall; 2) promotion and development of rainwater and runoff harvesting through community water conservation programs, the construction of dams and agricultural reservoirs/ponds and introducing wastewater reuse systems (small-scales to larger scales); 3) use of water-efficient irrigation systems such as drip irrigation; 4) expansion of small-scale community-managed irrigation systems.
- Soil Management to improve soil structure and capacity for water retention and decrease water evaporation by the application of conservation techniques such as: 1) low or zero tillage; 2) maintenance of a permanent soil cover and fertility (proper crop rotations); 3) better crop residue and weed

19 Cf. Rosset, Moving Forward, op. cit. (Fn. 18).

management and the enhancement of residual soil moisture through land conservation techniques.

– Crop management and the promotion of sustainable farming systems to ensure the soil sequestration of carbon, the diversification of income sources and an appropriate and rational pest and disease control. Bio-diverse farms appear to be more resilient than monoculture farms, which are more vulnerable to pest and pathogen outbreaks. When applicable, the selection of suitable local varieties and the implementation of plant breeding programs to develop locally-adapted drought resistant varieties, in addition to seed protection, should be considered. Moreover, attention should be paid to crop selection and an increase in production capacity by considering agricultural diversification and more intercropping. Intercropping is used traditionally by farmers "to provide local communities with added food security and income through livelihood diversification, while at the same time reducing deforestation and desertification."[20]

5. Economic Incentives for Agricultural Development

In order to support the necessary agricultural development we recommend that economic incentives should be better utilized. The challenge is to identify opportunities that facilitate sustainable agricultural development by making use of existing mechanisms and developing new ones to support vulnerable populations. Strategies for supporting economic incentives ought to incorporate access to appropriate technologies, information and financing.

There is a variety of financial incentives that could be used as part of a comprehensive approach. This approach should recognize that no economic instrument exists in isolation and that there is interdependency between different incentive structures; especially the interaction between the public and private sector. Possible incentives include:

– Subsidies for agricultural production aligned with national and regional food security strategies.
– Increased access to cheaper loans and credit (from micro-financing upwards) targeted at supporting sustainable agricultural improvements (land, farming methods and production).

20 Erika Spanger-Siegfried et al., Methodological Framework. An internal scoping report of the project Strategies for Increasing Human Resilience in Sudan: Lessons for Climate Change Adaptation in North and East Africa (AIACC Working Paper No. 18), August 2005, <http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP_No018.pdf> (10/04/2011).

- Provision of grants for different target groups to assist agricultural development, like grants for entrepreneurial sustainable agricultural activities or for civil society advocacy.
- Venture Capital, i. e. for investment in new environmental technologies or businesses from the private sector, in accordance with health, environmental and cultural rights of people.
- Foreign Direct Investment in businesses that serve agriculture, providing equipment, seeds, chemicals, processing, support in marketing and other services. Where foreign direct investment is linked to development agencies or international financial institutions environmental and social aspects must be addressed to receive financing.
- Environmental and social requirements can potentially support the creation of new alternative markets. For example, these could take the form of organic or fair trade products.

A major way to increase the pool of funds available for agriculture is to create incentives for farmers to invest their own money. Even with conflict within the region some individuals and more extended families (clans and tribes) still have financial means. Attracting them to agriculture, however, requires not only that farmers believe that they have a reasonable chance to make a profit, but also ensuring improved property rights in land, equipment, and produce.

This is why it is recommended that a starting point for improving sustainable agriculture would be a collaborative partnership between public, private, international and inter-governmental organizations to improve both the access to financial mechanisms as well as their breadth. Although the focus here is to support sustainable agriculture these mechanisms could arguably be applied equally well to other sectors towards the same end of addressing the long-term risks that climate change presents.

6. Conclusion and Recommendations

In conclusion of the above, the following recommendations are proposed:

- Climate change intensifies and exacerbates already existing problems of water availability and use, agriculture, drought, migration, urban planning and rural livelihoods. Hence, for the most vulnerable sectors and populations,

national action plans must be put into place to adapt to greater uncertainty in national and regional climate variability.[21]

- Agricultural strategies need to be reconsidered, policies reoriented and institutional arrangements and services developed with the aim of achieving food security and increasing the resilience of the most vulnerable in urban and rural areas (drought preparedness, climate change adaptation, etc.).
- To enhance resilience in the agricultural sector, agricultural policies and property regimes should be revised by the governments. Strategies need to be developed to achieve food security while supporting small-scale farmers in a participatory process of collaboration.
- Research, education and extension opportunities should be reviewed within a wider agricultural innovation system perspective, including all stakeholders along the agricultural value chain (including farmers, civil-society organizations, academic and research institutions, private sector companies, governmental entities etc.). Governments should support combinations of local knowledge and modern technologies, building on existing experiences in the region that can be adapted to serve small-scale farmers. Policies for a pluralistic research and education and extension system need to be defined along with participatory communication strategies and services addressing small-scale farmers.
- Mechanisms for wide stakeholder coordination must be developed to establish a common framework in which all actors can operate. Similarly, regional networks for knowledge and experience sharing among research and civil society organizations should be established and empowered.
- The impacts and adaptation to climate change must be considered in the development plans and priorities for international cooperation.

21 Cf. Jeannie Sowers, Erika Weinthal, Climate Change Adaptation in the Middle East and North Africa: Challenges and Opportunities (The Dubai Initiative, Working Paper 2), September 2010, <http://belfercenter.ksg.harvard.edu/files/Sowers-Weinthal_DI_Working-Paper-2.PDF> (10/04/2011).

Organizing Institutions

German Council on Foreign Relations (DGAP)

The German Council on Foreign Relations (DGAP) is the national network for German foreign policy. As an independent, non-partisan and non-profit organization, it actively takes part in the political decision-making process and promotes understanding of German foreign policy and international relations. More than 2000 members—among them renowned representatives from politics, business, academia, and the media—as well as more than 70 companies and foundations support the work of the DGAP. The DGAP comprises the research institute, the journal IP and its Global Edition, the library and documentation center, the platform Young DGAP and the thematic web portal <www.aussenpolitik.net>.

The DGAP's research institute works at the junction between politics, the economy and academia. It works interdisciplinary, policy-oriented and in all areas of German foreign policy, which are anything but static in a globalizing world: security and supply risks, international competition, integration and network issues.

IP Global Edition is the bimonthly English-language magazine of the German Council on Foreign Relations. It brings the missing European voice on global issues to readers across the world and is essential reading for everyone who is working in the field of politics and global economic issues.

The DGAP Library and Documentation Center (BiDok) is one of the oldest and most significant specialized libraries in Germany open to the public. It holds substantial collections on German foreign and security policy.

The Young DGAP is a new initiative for members of the DGAP under the age of 40. The Young DGAP aims at encouraging more young people to take an active interest in foreign and security policy through innovative events such as controversial debates and discussions with decision-makers in a relatively private setting.

The web page www.aussenpolitik.net is DGAP's thematic web-portal. It provides well-grounded background information and analyses about the research institute's current work. It thereby contributes to the professional and public debates about international politics.

Heinrich Böll Stiftung (hbs)

The Heinrich Böll Stiftung (hbs) is part of the Green political movement that has developed globally as a response to the traditional politics of socialism, liberalism, and conservatism. The hbs seeks to encourage and facilitate cross-border initiatives and regional cooperation. Its activities are guided by the fundamental political values of universal human rights, ecology, democracy, solidarity, and non-violence.

As a non-profit organization the Heinrich Böll Stiftung is affiliated with the German party Alliance 90/The Greens. Financial support is mainly provided by the German Ministry of Development and Economic Co-operation (BMZ). The Heinrich Böll Stiftung's head office is located in Berlin. The Heinrich Böll Stiftung established the Arab Middle East Office (AMEO) in Ramallah in 1999. Other offices are located in Tel Aviv and in Beirut.

In close cooperation with partner organizations in the occupied Palestinian territory, Egypt, and Jordan the hbs focuses on

- Strengthening Civil Society and Democratic Participation,
- Women's Rights and Gender Democracy,
- Environmental Justice and Sustainable Development, and
- International Politics and Dialogue.

In addition to joint cooperation programs the hbs organizes visitor programs to enhance dialogue and networking among civil society organizations in the region and on a global level.

Democratic Participation

The hbs Democratic Participation Program contributes to the ongoing debate on reform, democratization, human rights and the rule of law in the three project countries.

Gender Democracy

Gender democracy is one of the main fields of work for the hbs AMEO. Since Middle Eastern women are still restricted in their life-choices, hbs's Gender Democracy Program aims to enhance the legal, political and social position of

women and to improve opportunities for their participation in decision-making processes.

Freedom of Expression and Media Diversity

Most of the Arab countries in the region still try to control journalists. As the rise of digital activism proves, it is not only important to strengthen the education of journalists, but also necessary to support new ways of reporting.

The Royal Marine Conservation Society of Jordan (JREDS)

The Royal Marine Conservation Society of Jordan (JREDS) is a "World-class" organization in marine conservation for future generations in Jordan, with the mission to contribute to the conservation and sustainable use of the marine environment in Jordan through its conservation program, outreach and advocacy program as well as the sustainable development program.

Background

JREDS was established in 1993, upon an initiative by HRH Princess Basma bint Ali, translating Her Highness' vision on conservation of Jordan's maritime heritage and treasures.

The initiative developed into an independent non-governmental organization (NGO) in 1995, when it was officially registered as a non-profit non-governmental organization at the Ministry of Interior. JREDS is the first and the sole organization dedicated to protecting and preserving marine life in Jordan. JREDS follows sustainable management techniques of marine natural resources, in addition to encouraging interaction with the local community and disseminating awareness among the various segments of the community.

JREDS first took off as an independent NGO in the Kingdom after obtaining financial and technical support from the Global Environment Facility/Small Grants Programme, implemented by the United Nations Development Program (UNDP).

Since its establishment, JREDS has developed in terms of quality and quantity of its institutional work and in terms of its impact on Aqaba‹s sustainable development. In general several projects have been implemented in coordination with local, regional and international partners. JREDS has also grown regionally through working with the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden—PERSGA, as well as with several other regional institutions.

Skills development and capacity building were the most important elements of the project "Rehabilitation and Preservation of Coral Reefs in the Gulf of Aqaba", which was carried out by JREDS. JREDS has been hosting the GEF Small Grants Programme at Amman office since 2004.

Throughout its development, JREDS has focused on training its employees; building their potentials and upgrading their performance in different technical and administrative areas. This has had a large impact on the development of their skills in project management, drawing on the support of the local community and spreading environmental awareness.

Programs

JREDS' recent programs are the fruit of one year of work in developing a 4-year strategy and revisiting the organization's vision and mission.

JREDS is adopting a comprehensive approach to recognize its vision and mission through three program areas: Conservation, Outreach and Advocacy as well as the Sustainable Development Program.

The projects and activities under the three programs connect the needs of people and investments for a sustainable use of the fragile marine resources for future generations.

JREDS also involves hundreds of volunteers in its programs and works closely with all the related local and international organizations to conserve the marine heritage.