Coping with Water Scarcity under Changing Climate Conditions
Best Practices and Innovations on Trial
Water and climate change are two key topics in dealing with the Middle East and North Africa (MENA) region, and they will remain essential for the foreseeable future. The challenge is tremendous: Millions of people in the MENA region are already suffering from water shortages, but how can we sustain the 570 million people expected in 2050, which is 190 million more than today? Water security poses a crucial challenge to sustainable development and stability in arid areas such as the MENA region. Climate change has already made the region hotter and drier – how will agriculture and the domestic and industrial sectors cope with the even stronger impacts of climate change in future? Countries in the region are preparing to respond to these new climate challenges. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) already started dealing with these topics decades ago on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) and more recently also on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). Numerous cooperation programmes and projects for its different clients within German development cooperation are currently committed to finding solutions to the most pressing problems associated with water and climate change.

The water programmes of the MENA region are establishing a working group for peer counseling and knowledge management within the Mediterranean Environmental Network – Réseau Environnemental Méditerranéen (MEN-REM), aiming for sustainable economic development in the Middle East and North Africa. Some of their recent innovations have been compiled in this present ‘digital chapter’ in order to share them with other stakeholder networks in this region and colleagues in similar climatic conditions.

This initiative was spearheaded by the regional programme Adaptation to Climate Change in the Water Sector in the MENA Region (ACCWaM), which aims at sharing knowledge and experience in order to scale it up across the member states of the Arab League.

Our partners are ministries, administrative bodies at various levels, national and international agencies and NGOs, industry, research institutions, schools, universities and mosques. The target groups are found at different levels and sectors of governance, such as the Arab Ministerial Water Council of the Arab League, which is advised by ACCWaM programme, the heads of water utilities in Egypt, religious leaders in Jordan and poor dwellers in informal settlements in Cairo.

Water is needed in all aspects of life and there is hardly any sector of the economy not hit by the impacts of climate change. In order to offer region-specific advice to these universal problems, the relevant programmes and projects of GIZ are addressing a wide array of topics, for example ‘seawater intrusion in Beirut’, ‘forest ecosystems-based climate change adaptation’ and ‘adaptation of the industrial sector in Morocco to climate change’.

Fifteen case studies are compiled in a ‘digital chapter’ and listed in Table 1 for easy reference. They were selected from a large number of relevant programmes and projects according to their message. These messages are based either on their success – which we then call a ‘Best Practice’ – or on their inspiring, innovative ideas, which we then call an ‘Innovation on Trial’. The conditions required for replication and scaling up are discussed for each best practice. With this we hope to move from successful case studies to a development model that prepares the region for climate change adaptation challenges in key development sectors in the Arab region.
There are definitely more than 15 ‘Best Practices’ or ‘Innovations on Trial’ among the relevant GIZ programmes and projects, but we have made a start and more good examples may be added in future.

To adapt to water scarcity under changing climate conditions we must leave no stone unturned. Our partners are looking into all kinds of adaptation and mitigation options, which means that the range of examples is wide.

Water scarcity has been persisting for a long time in the region and we can thus learn a lot from traditional adaptation measures. But since the demand for water is increasing substantially due to population growth and economic development and the climate change impacts as a significant stressor on our entire habitat, we are increasingly dependent on modern, highly intensive and efficient production systems making use of every drop and any new idea.

We also must stretch the social and cultural boundaries in which water management is fenced. We are therefore venturing into social innovations which bear significant transformative developmental potential. The Water Wise Woman initiative in Jordan is an encouraging example.

Holistic systems need extended institutional landscapes that are open to neighbouring domains and compatible with their complex interdependencies. Managing this institutional network to maximise resource efficiencies, human securities and minimise trade-offs entails a complex cluster of innovations defined as the nexus approach.

You will find elements of each cluster of innovations in this digital chapter. If you find that some are lacking, we would gladly receive these elements from you, underpinned by an instructive example. The contact person for each best practice is mentioned at the end of each brief.

In the outlook section of the case studies, we have indicated their relevance for other locations in the region, the level of transferability and some key messages for decision makers. They are by no means exhaustive and serve to trigger further discussion. It should not be regarded as a ‘cookbook’, as conditions differ so much within MENA region, but it does show some experiences and conclusions from innovations being tested in the delicate field of ‘water and climate change mitigation and adaptation’. These examples will be developed further, yield new experiences and may be cross-pollinated by feedback received from the networks where they are published.

To seize our opportunities to adapt, let us learn from the past, be encouraged by constantly advancing best practices and stimulate curiosity and ambitions through innovative ideas in all arenas of our modest human influence.

**Dr. Matthias Bartels**

MEN-REM Task Force Climate

Eschborn, Germany, 01.03.2016
<table>
<thead>
<tr>
<th>No.</th>
<th>Title of Best Practice / Innovation on Trial</th>
<th>Country</th>
<th>Contact</th>
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</thead>
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<tr>
<td>1</td>
<td>Adapting Forest Policy Conditions to Climate Change</td>
<td>MENA region</td>
<td><a href="mailto:reinhard.kastl@giz.de">reinhard.kastl@giz.de</a></td>
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<tr>
<td>2</td>
<td>Development of Organic Agriculture</td>
<td>Saudi Arabia</td>
<td><a href="mailto:felix.ruhand@giz.de">felix.ruhand@giz.de</a></td>
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<td></td>
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<td></td>
<td><a href="mailto:marco.hartmann@giz.de">marco.hartmann@giz.de</a></td>
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<td>3</td>
<td>Urban Agriculture in the Greater Cairo Region. An Example of Rooftop Farming</td>
<td>Egypt</td>
<td><a href="mailto:carl-philipp.schuck@giz.de">carl-philipp.schuck@giz.de</a></td>
</tr>
<tr>
<td>4</td>
<td>Adaptation to Climate Change by Protecting Genetic Resources and Retaining their Fair Use</td>
<td>Morocco</td>
<td><a href="mailto:michael.gajo@giz.de">michael.gajo@giz.de</a></td>
</tr>
<tr>
<td>5</td>
<td>National Competence Centre for Climate Change Mitigation and Adaptation in Morocco</td>
<td>Morocco</td>
<td><a href="mailto:elke.westenberger@giz.de">elke.westenberger@giz.de</a></td>
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<td><a href="mailto:mohamed.boussaid@giz.de">mohamed.boussaid@giz.de</a></td>
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<tr>
<td>6</td>
<td>Increasing Water Efficiency through Agricultural Drainage Water Reuse</td>
<td>Egypt</td>
<td><a href="mailto:matthias.bartels@giz.de">matthias.bartels@giz.de</a></td>
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<td>7</td>
<td>Preventing Seawater Intrusion in Greater Beirut Area</td>
<td>Lebanon</td>
<td><a href="mailto:matthias.bartels@giz.de">matthias.bartels@giz.de</a></td>
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<td>8</td>
<td>Improved Management of Water Resources</td>
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<td>9</td>
<td>Water Wise Plumbers</td>
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<td>10</td>
<td>Water Wise Women – Female Agents of Change</td>
<td>Jordan</td>
<td><a href="mailto:juliana.turjman@giz.de">juliana.turjman@giz.de</a></td>
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<td>11</td>
<td>Water Abstraction Through Bank Filtration to Improve Drinking Water Supply in Upper Egypt</td>
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<td>12</td>
<td>From Irrigated Agriculture to Solar Energy Farming</td>
<td>Jordan</td>
<td><a href="mailto:matthias.bartels@giz.de">matthias.bartels@giz.de</a></td>
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<td>13</td>
<td>Energy Efficient Water Pumping in Jordan</td>
<td>Jordan</td>
<td><a href="mailto:bassam.hayek@giz.de">bassam.hayek@giz.de</a></td>
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<td>14</td>
<td>Adaptation to Climate Change in Industrial Areas – Focus on the Agro- and Fishing Industry</td>
<td>Morocco</td>
<td><a href="mailto:angelika.frei-oldenburg@giz.de">angelika.frei-oldenburg@giz.de</a></td>
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<td>15</td>
<td>Communal Water Efficiency through Cooperation with Religious Authorities</td>
<td>Jordan</td>
<td><a href="mailto:bjoern.zimprich@giz.de">bjoern.zimprich@giz.de</a></td>
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Capacity Development for Forest Ecosystem-based Adaptation to Climate Change

Summary

Mediterranean forests provide important goods and services for the well-being of urban and rural populations, and they deliver valuable services – often unaccounted for – to other sectors. Due to the vast biodiversity and richness in endemic species, the ecosystems of the Mediterranean basin figure among the world’s biodiversity hotspots. As the Mediterranean region will very likely be badly affected by climate change, there is a need to secure livelihoods, and forest ecosystems can provide important adaptation solutions. However, this ‘adaptation through forests’ also requires ‘adaptation of forests’. Consequently, valorising the potential of forest resources for sustainable development requires capacity development for cross-sectoral approaches to adaptation. The GIZ regional project ‘Capacity Development for Forest Ecosystem-based Adaptation to Climate Change (FEbA)’ is dealing with these issues. It works within the framework of the Collaborative Partnership on Mediterranean Forests with the countries Algeria, Lebanon, Morocco, Tunisia, Turkey (and Syria) (Fig. 1). Its activities strive to (a) strengthen the capacity for systematically assessing adaptation needs and opportunities for action across sectors; and at the same time (b) promote forest ecosystem-based adaptation solutions as part of comprehensive adaptation strategies.

Challenge

Mediterranean forests provide a wide range of goods and services, such as watershed protection, erosion control, pasture, biodiversity shelter, carbon storage, wood energy and multiple non-timber forest products (aromatic and medicinal plants, honey, etc.). A large part of the population in the Middle East and North Africa (MENA) countries lives in rural areas and their livelihoods are built mainly on agriculture, livestock husbandry and the use and commercialisation of natural resources. Thus, forest landscapes contribute to poverty alleviation, the socio-economic development of rural areas and the food security of local people. In addition, various other sectors, in particular water, agriculture, tourism and energy, depend strongly on the goods and services provided by forests. Consequently, tapping the potential of forest resources for sustainable development requires a cross-sectoral approach.

With respect to the projected impacts of climate change, the Mediterranean basin, in particular its Southern and Eastern rims, is considered as one of the most affected regions worldwide. Climate projections indicate a continuous rise in average temperatures, frequency and intensity of extreme weather events with an overall decrease in annual precipitation. Subsequently the risk of droughts, floods, landslides and forest fires (Fig. 2) are expected to increase – effects that particularly relate to alterations in the water cycle, the degradation of agricultural land and the erosion of biological diversity. The overexploitation of forests in the region, overgrazing, forest fires, rapid urbanisation, etc., are already endangering forest functions. At the bottom of those human-induced pressures are frequently insufficient legal frameworks and policies that result in participation, access and
tenure issues, adding to insufficient financial and human capacities. Stress factors attributed to climate change exacerbate those existing anthropogenic pressures on forests, thereby putting the provision of forest goods and services at risk and increasing the vulnerability of ecosystems and society. There is no doubt that forest ecosystems can provide important adaptation solutions. However, this ‘adaptation through forests’ also requires ‘adaptation of forests’.

Setup

The GIZ regional Capacity Development for Forest Ecosystem-based Adaptation to Climate Change (FEbA) project works within the framework of the Collaborative Partnership on Mediterranean Forests with the countries Algeria, Lebanon, Morocco, Tunisia, Turkey (and Syria). It collaborates in those countries with the respective ministries, but also with stakeholders in other sectors outside of forestry.

Some facts on three of the five pilot regions:

Lebanon: The Tannourine Cedar Forest Nature Reserve in the Lebanese Mountains is 625 hectares, including its buffer zone, and is famous for hosting the largest cedar forest complex in Lebanon. Weather data shows a trend of increasing mean temperatures and extended summer droughts. IPCC forecasts a shift from the present humid climate to a semi-arid bioclimate, severely affecting the forest ecosystems.

Morocco: The Souss-Massa-Drâa Region covers 10% of Morocco and stretches from the Atlantic coast to the Sahara. Its ecosystems are fragile and the forests are already suffering from climate change impacts. On the other hand, their economic and ecosystem values are higher than in many other parts of the MENA region (Fig. 3).

Turkey: The Seyhan Watershed is located in the east of the Mediterranean region of southern Turkey. The total area of the watershed is 21,741 km² and the total population is 2.4 million. The vegetation in the southern part of the basin is dominated by maquis formation, the mountainous part by coniferous forests, and the northern parts are mainly dry steppe. According to climate projections for Seyhan watershed for the year 2070 the air temperature is expected to rise by 2–3.5 °C, and precipitation is expected to decrease by 25–35%.

At all those sites, there are many open questions regarding (1) the utilisation and protection of forest resources and (2) ‘adaptation through forests’ and ‘adaptation of forests’ to climate change and other changes.

Opportunities

While the forest management institutions are key players, efficiency and effectiveness are limited in cases where the management is carried out without participation of those benefitting from ecosystem services or bearing the consequences of the loss of ecosystem services. Likewise, planners in other sectors do not necessarily recognise the potential role of forests in reducing societal vulnerability and the benefits drawn from forest ecosystem goods and services.

Fig. 2: Forest Fire

Fig. 3 (l): The bark of the cork oak is a valuable product of the Souss-Massa-Drâa region

Fig. 4 (r): Forest reserve ‘De Bentael’ in the Lebanese Mountains, still intact due to highly motivated and well trained rangers

Photos: © FAO, GIZ Morocco, Dieter Prinz
Adaptation planning thus has to link non-forest actors with those engaged in forest management. Action is needed on a local, regional, national and MENA level to promote and enhance the valorisation of forest ecosystems goods and services for reducing vulnerability to climate change.

Capacity development: In order to mainstream the FEbA-concept in the policies and strategies of the forest administrations and their partner sectors and strengthen the inter-sectoral cooperation, the project is supporting a capacity development process targeting decision makers from the forest administrations and their partner sectors with several steps:

1. assessment of training needs;
2. field missions in selected regions;
3. training workshops (4-day workshops at regional and national level) and
4. promotion of FEbA by:
   a) developing a brochure on FEbA opportunities;
   b) implementing measures in some regions; and
   c) establishing a ‘community of practice’ at MENA level for the exchange of lessons learned.

The trainings are based on the Integrating Climate Change Adaptation into Development Planning practitioner’s training measure, developed in 2011 by GIZ in cooperation with the Organisation for Economic Co-operation and Development with funding from the German Federal Ministry for Economic Cooperation and Development.

<table>
<thead>
<tr>
<th>Partner sector</th>
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<tr>
<td>Tourism</td>
<td>Leisure and potential for Ecotourism; Biodiversity: emblematic species</td>
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<tr>
<td>Agriculture</td>
<td>Pasture; Erosion prevention; Reduction in dams sedimentation</td>
</tr>
<tr>
<td>Economy and Trade</td>
<td>Biodiversity: Non-timber Forest Products, AMP, Construction wood, paper</td>
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<tr>
<td>Energy</td>
<td>Reduction in dams sedimentation; Energy biomass</td>
</tr>
<tr>
<td>Environment, Water &amp; Climate</td>
<td>Adaptation to climate change; Climate regulation; Carbon storage; Water purification; Watershed protection</td>
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</table>
Lessons learned: With regard to climate change, forests provide important services, such as climate regulation, carbon storage and watershed protection. However, the constant threats to the existing forest areas in the MENA region will not diminish; they will intensify in future. It will be a hard and not always successful fight to preserve the forests and their biodiversity. Capacity development and cross-sectoral approaches are the keys to valorise the potential of forest resources for sustainable development. The capacity development activities have to strive to
a) strengthen the climate change adaptation capacities in general and
b) promote forest ecosystem-based adaptation solutions. Both elements should be part of a comprehensive climate change adaptation strategy.

For decision makers, capacity development for forest-related adaptation to climate change will remain an obligation for many decades to come.

Transferability: The general concept of forest ecosystem-based adaptation can be applied in all MENA countries, but the specific regional socio-economic, natural (including the impacts of climate change) and governmental conditions have to be taken into account.
Development of Organic Agriculture in Saudi Arabia

Summary

In 2005 the Saudi Ministry of Agriculture (MoA) commissioned International Services of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to support the development of organic agriculture within the Kingdom of Saudi Arabia. The overall mission of the Organic Farming Project (OFP) was to establish a functioning and sustainable organic agriculture sector in Saudi Arabia, boost the organic market, support sector stakeholders (Fig 1) and raise awareness of organic food among consumers. Within a mere seven years, the project has turned organic agriculture in Saudi Arabia into a success story. The MoA aims to fulfil several different objectives contributing to sustainable and sound sector development. These include mainly (a) support for small scale farmers by creating alternative and profitable income opportunities (organic agriculture); (b) production of healthy food; (c) conservation of natural resources and (d) contribution to the improvement of irrigation water efficiency. The latter two elements contribute to climate change adaptation in Saudi Arabia.

Challenge

At the beginning of this millennium, it became clear that intensive agricultural production practices for staple food production, namely wheat, could only be maintained with high consumption of production inputs and at the expense of fossil water (Fig. 2). The continuation of these practices would cause a serious drain on Saudi Arabia’s water resources, which are drawn mainly from non-renewable aquifers. In the context of Saudi Arabia’s accession to the World Trade Organization, the government committed to phase out irrigated wheat production by 2016. Saudi Arabia is now focusing on and promoting the sustainable production of higher economic value crops, such as fruits and vegetables, for the domestic market. An important component of this strategy was the promotion of modern water-saving technologies, particularly drip irrigation. Organic agriculture can be regarded as an interesting approach to the careful, more sustainable management of the natural resources, particularly of the scarce resource water. For this reason it serves as an element of climate change adaptation.

Setup

The implementation of the OFP is a joint effort between the Ministry of Agriculture and GIZ International Services. The first phase was dedicated to the establishment of organic pilot farms and the development of technical know-how. The pilot farmers were intensively trained in all relevant topics, including soil, plant and animal production, irrigation water management, and marketing (Figs. 3 and 4). From 2007 onwards, the project’s focus was on the creation of support services and governmental structures to expand organic production and sustain the further development of this sector.

In 2007 GIZ International Services supported the founding of the Saudi Organic Farming Association in order to strengthen the private sector’s involvement in the organic sector. The establishment of the Department of Organic Agriculture (DOA) within the Ministry of Agriculture was initiated by the OFP one year later (2008). As the competent authority, the DOA is responsible for the monitoring and surveillance of the entire organic sector. In 2011 the first organic farms were certified in accordance with
the former Saudi Arabia’s initial national organic regulation and standards. Three years later (2014) Saudi Arabia introduced an organic agriculture law for the first time. In 2015 the law was supplemented by an organic agriculture bylaw replacing the previous regulation and standards.

**Opportunities**

More than 120 Saudi organic farms were certified by mid-2015, and new farmers are continually converting their production systems to organic farming. These farms are located all over Saudi Arabia, representing the core agricultural production areas such as the Qassim, Kharj, Al-Jouf and Eastern Provinces. Organic producers can be found in particular around Jeddah, Riyadh and Dammam, where demand is highest.

**Benefits of Organic Agriculture**

<table>
<thead>
<tr>
<th>Benefits to 'organic farmers'</th>
<th>Benefits to consumers</th>
<th>Benefits to the public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced yields as a result of long-term soil fertility improvements</td>
<td>Guaranteed pesticide-free foods</td>
<td>Decreased soil and water pollution</td>
</tr>
<tr>
<td>Cost savings due to reduced input use</td>
<td>Guaranteed genetical-ly modified organism (GMO)-free foods</td>
<td>Enhancement of biodiversity</td>
</tr>
<tr>
<td>Preservation and improvement of animal health</td>
<td>Certified, high-quality products</td>
<td>Contribution to water saving</td>
</tr>
<tr>
<td>Increase of water retention in the soil</td>
<td>Reduction of health risks</td>
<td>Securing of water quality</td>
</tr>
<tr>
<td>Increase and preservation of agrobiodiversity</td>
<td>Reduction of health risks for producers and consumers</td>
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</tbody>
</table>

The success is based on the implementation of numerous measures, including awareness-raising among farmers and the public, training and monitoring of organic production, adapted research, marketing, certification, and legislation and policy development. Here are some examples:

1. Numerous **workshops and training** courses in relevant fields in organic agriculture have been provided not only to pilot farmers and organic farmers, but also to conventional farmers who are interested in learning about organic agriculture for the first time. In addition, the extension officers in the 13 regional directorates provided information and training on all relevant aspects of organic farming via workshops and participation in conferences.

2. The **Organic Farming Research and Development Center** in Qassim was designated to serve as a national platform for applied research as well as a ‘learning centre’ for all stakeholders in the organic agriculture sector (Fig. 5). Its main fields are (a) plant nutrition and fertilisation management; (b) compost management; (c) sustainable water management; (d) plant protection, biological control and disease prevention; and (e) agriculture extension.

3. A comprehensive **organic market development programme** has been set up over recent years. The programme includes the establishment of platforms that bring together stakeholders from the public as well as the private organic sector. Regional marketing working groups have been introduced in Jeddah, Riyadh and Dammam (Fig. 6). In 2014, as initiated by the OFP and under the patronage of the Ministry of Agriculture, the two biggest Saudi supermarket chains partnered up with organic farmers in order to promote domestic organic products in a nationwide public awareness campaign.
4. The Saudi Organic Agriculture Law, permitting relevant competent authorities to penalise abuses resulting from infringements of the Saudi Organic Agriculture Bylaw, was approved in 2014. A national organic action plan (NOAP) was developed based on an organic agriculture policy concept. The NOAP defines concrete measures for achieving the objectives of the organic agricultural policy and is currently being assessed and reviewed by the competent authority. Saudi Arabia is the first country within the Gulf and Middle East and North Africa region that developed a national organic agriculture support policy.

**Outlook**

**Lessons learned:** The active promotion and countrywide dissemination of organic agriculture provides a sound and promising basis for the country’s further development. This growing demand for organic food in Saudi Arabia will contribute to a more efficient use of natural resources, particularly of good quality water. The use of water-saving irrigation methods and the production in greenhouses reinforces the climate change adaptation capacity (Fig. 7).

**Transferability:** Transferring the successful Saudi Arabian example (in its full dimension) requires a functioning institutional framework, a solid governmental organic support policy and especially an existing demand potential. However, small-scale organic farming is feasible even without any state support; a precondition for market production is the availability of a financially strong segment of society that is ready to pay more for healthy food.

For decision makers, this project can serve as an outstanding example of how a new segment of the economy can be implemented, including its legal, economic, managerial, awareness-raising, technical and research aspects.
Urban Agriculture in the Greater Cairo Region
An Example of Rooftop Farming

Summary

Climate Change will impact urban areas in the Arab world by heat waves and an increased “heat island effect”, by worsening living conditions (such as a decreasing water quality, lowering air quality, etc.) and affecting human health e.g. by ground ozone formation.

Rooftop farming has shown in a number of locations in the Arab World to improve living conditions and to generate income, proving that it is a sound measure for climate change adaptation.

In informal settlements of Greater Cairo a pilot rooftop farming project was started in spring 2014, supported by GIZ. The results were promising, but many technical and managerial problems still have to be solved. This project belongs to the group of ‘Innovations on Trial’; i.e. it should spark new ideas based on the preliminary findings.

Challenge

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (2014) presents amongst its key findings that many emerging climate change risks are concentrated in urban areas and that climate change impacts on cities are increasing. Amongst others, key issues include rising temperatures, heat and air pollution stress, health problems, flooding and urban food insecurity.

The Arab region is one of the most urbanized regions in the world: Between 1970 and 2010 the region experienced 400% urban growth; during the next 40 years a growth of 200% is expected. Whereas in 2010 about 56% of the total population lived in cities, in 2050 the percentage will have risen to 68%. Cairo will remain the largest city of the Arab region, growing to 16 million inhabitants in 2050 (Fig. 1).

The mean annual air temperature in the Greater Cairo Region has been steadily rising and will rise further. Electricity-based cooling solutions (using air conditioners) are counterproductive in regard of mitigating climate change and over-stress the electricity grid each summer.

The fast-growing population and the failing government approaches to housing and spatial planning policies contributed to the growth of informal settlements within and around the center. For example, 8 million Egyptian live in informal settlements in Cairo with problems of unemployment, pollution, transportation, inadequate drainage and sewerage, and lack of usable urban open spaces. In Cairo, the amount of green space per inhabitant is roughly equivalent to 0.33 square meters per person (3.5 square feet), one of the lowest proportions in the world (Attia 2014).

Rooftop farming as a measure for climate change adaptation has shown in a number of locations in the Arab World to improve living conditions and to generate income. The prevailing flat rooftops provide a good condition for such a use.

Fig. 1: Cairo suburb
Setup

**GIZ**, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ), cooperated with two NGOs and one private company when implementing the project “Urban Agriculture in the Greater Cairo Region – The Example of Rooftop Farming in Informal Settlements”:

1. The ‘Participatory Development Programme in Urban Areas’ (PDP), which aims at enhancing community-based adaptation and resilience to climate change in Greater Cairo,
2. The Research Center on Urban Agriculture and Food Security (RUAF), which is a not-for-profit organisation registered in the Netherlands and
3. the Schaduf Company, the main partner for implementation. Schaduf was established in 2010 as an Egyptian rooftop farming enterprise designed to empower and sustain Cairo’s low-income communities.

Opportunities

Urban agriculture is increasingly recognized for its potential to provide a better food supply, an additional source of income, social and environmental benefits and also possibilities for a better adaptation to climate change, with special regard to the urban microclimate. Rooftop farming as one element of urban agriculture is the more needed, the higher the housing density is.

For that reason, a **pilot project** on urban rooftop farming was implemented in the Informal Settlement Ezbet el-Nasr, Greater Cairo region, in 2014. The implementation started with the selection of participants, followed by training and the technical setup. In order to be able to cover the costs for the technical installations, the low-income families received repayable loans (by Schaduf Company), which were repaid by monthly crop sales. Farmers were typically able to repay the loans within one year. Families kept roughly 10 percent of the crops grown for personal consumption; Schaduf Company purchased the remaining produce, reselling it to local markets with profit for the farmers.

A **hydroponic system** of waterbeds was proposed and installed by Schaduf Company directly on the rooftops (Fig. 2). The model consisted of 3–4 water beds (of 3.75 m² each) on each rooftop. The complete model costs around 1,575 EGP (175 €) for 3 beds. The costs include fertilizers, seeds and technical support for six months. The forecasted income was about 300 EGP (33 €) per month per 15 m², yet in reality turned out to be less. The hydroponic waterbeds were made of wooden frames, plastic sheets, foam panels and cups filled with peat moss and pyralite substrate. The 15 cm deep water is supplied by a water pipe through an electricity connection from downstairs and maintained by a water pump and water filter.

The **crops grown** were gargeer (*Eruca sativa*, ‘Rucola’, Fig. 3), mint (*Mentha spicata*), molokheya (*Corchorus sp.*), onion, cherry tomatoes, strawberries and flowers. During the cultivation period the project was technically supported and monitored, but not intensively enough.
A preliminary evaluation produced the following results:

1. A broader and more deep-going **capacity building and training** appears to be crucial relating to specific knowledge about rooftop farming. Capacity building should target the participants themselves as well as possible partners (NGOs) and have the form of so-called urban producer field schools (capacity building workshops on-site).

2. **More information** (e.g. about financial costs of the installation and operational aspects) would enable residents to participate better in the whole project and finally lead to their full empowerment as responsible actors within the project.

3. **Monitoring** should start from selecting the residents and evaluating the training sessions until the end of the production circle (costs, consumption, harvest, etc.).

**Outlook**

**Lessons Learned:** Rooftop farming (as well as other types of urban agriculture) has a positive impact on microclimate and environment, food security and income, economic development as well as community participation. It bears great potential for the integration of marginalized groups, e.g. women and youth and can be regarded as an option for adaptation to climate change in urban environments. The remaining technical bottlenecks have to be tackled by on-site experimentation. Cooperation with other rooftop farming projects e.g. in Tunisia or the West Bank is recommended.

**Transferability:** Precondition for any transfer is the availability of an agency, a NGO or a socially oriented enterprise (or a combination of all) with a good background in rooftop farming.

4. On the technical side there are several **options to cultivate the crops.** Aside of the hydroponic system mentioned (waterbeds on the floor), a hydroponic system on tables and a soil-based system on tables (Fig. 4) were tested. But many more options have been tried in other locations (Fig. 5) and all of them have their pros and cons and more tests are needed to find the most suitable one.

5. The biggest challenges for the rooftop farmers were **irregular water supply and electricity cuts** and the increasing heat stress in the city.

6. The main driver of motivation is **income generation.** Micro-credits and micro-insurances could ease the implementation of rooftop farming.

7. In general, the pilot project for rooftop farming in informal settlements does offer some very valid lessons for a future development and upgrading of rooftop farming in Arab cities which creates the framework conditions, including micro-finance, micro-insurance, input-supply, marketing and monitoring. In regard to marketing, the production for niche markets should be considered, offering special rooftop farming products “pesticide-free”, which will fetch higher prices.

**Recommendations for decision makers:** Community and institutional stakeholders have to be identified, training needs and participatory capacity building have to be assessed and (micro-) financing and micro-insurance models should be investigated. Funds have to be secured in case the agencies involved will not cover the costs. Women and youth should be specifically targeted. Marketing strategies based on a prior market and value chain analysis have to be developed.

**Literature:** Attia, Sh. (2014). Green Roof Potential in Arab Cities. ecoMENA. http://www.ecomena.org/green-roof-arab/
Adaptation to Climate Change in Morocco by Protecting Genetic Resources and Retaining their Fair Use

Summary
Morocco’s geographical position provides it with an exceptional range of very diverse bioclimates and hence a great diversity of ecosystems, species and genetic resources. These are important for the livelihoods of rural communities and the country’s economic development. Many ecosystem services are being over-utilised or degraded, and their potential for use is increasingly threatened by the impacts of climate change.

The Government of Morocco is making extensive political and strategic efforts to conserve natural resources, namely biodiversity. The Government is being supported by a GIZ project that aims to assist state institutions in introducing methods and instruments for environmental protection and the sustainable and efficient use of ecosystem services. The risks associated with climate change have been duly taken into account.

Challenge
The Kingdom of Morocco is home to a great diversity of ecosystems, species and genetic resources, which constitute an important basis for the livelihoods of rural communities and the country’s economic development. But in Morocco there is a general trend toward biodiversity degradation and loss caused by both human interference and climate change (Fig. 1). At present, over 600 endangered species have been identified throughout the country, and of the 7,000 taxa comprising Morocco’s fauna, more than 1,700 are considered as rare and/or threatened according to a national study on biodiversity, representing a potential loss of 24% of plant diversity (Convention on Biological Diversity, 2010).

The economic potential of ecosystem services, such as natural products, genetic resources, and water purification, regulation and recharge, are currently being inadequately or unsustainably used. Many ecosystem services are being overutilised or degraded, and their potential for use is being increasingly threatened by the impacts of climate change.

The Government of Morocco is making extensive political and strategic efforts to conserve these resources, particularly biodiversity, taking into account climate risks in the development of affected sectors, including agriculture, nature conservation and tourism (Fig. 2). However, the responsible state institutions have thus far lacked the appropriate instruments for promoting the sustainable use of ecosystem services.

Setup
GIZ has been working in Morocco on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) since 1975. The GIZ project ‘Adaptation to Climate Change/Implementation of the Nagoya Protocol (ACCN)’ was launched in order to assist Morocco’s state institutions in creating environmental instruments for adaptation to the impacts of climate change. The lead executing agencies are the Ministry Delegate to the Ministry of Energy, Mines, Water and Environment responsible for the environment and the High Commission
for Waters, Forests and Combating Desertification. The project shall last through June 2016. To consolidate the previous results of the ACCN project in the field of climate change adaptation, biodiversity and ecosystem services, a follow-up GIZ programme is planned on behalf of BMZ entitled ‘Environmental and Climate Governance’ (January 2016–December 2018).

Opportunities

Since 2013 the government has been supported by a GIZ project which aims at assisting state institutions in introducing methods and instruments for the sustainable and efficient use of ecosystem services. The risks associated with climate change must be duly taken into account. The programme's capacity development measures are focused on three areas of action:

1. safeguarding and sustainable use of ecosystem services with the consideration of climate risks;
2. expansion of a regional monitoring and advisory system for climate change adaptation and biodiversity management;
3. development of a legal and institutional framework for the access and benefit-sharing mechanism (Nagoya Protocol) and consideration of ecosystem services and climate change adaptation in national strategies and programmes.

Across all three areas of action, the programme is placing a particular focus on promoting cross-sectoral coordination and cooperation. It is concentrating its efforts on the southern region of Souss-Massa (Agadir) as well as Beni Mellal-Khénifra in the Middle Atlas. The programme efforts complement other German and multilateral development cooperation activities.

Nagoya Protocol

‘The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity is a supplementary agreement to the Convention on Biological Diversity. It provides a transparent legal framework for the effective implementation of one of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources. The Nagoya Protocol on ABS was adopted on 29 October 2010 in Nagoya, Japan and entered into force on 12 October 2014’.

https://www.cbd.int/abs/about/

The Nagoya Protocol has been ratified by Morocco. It shall preserve local communities’ access to local genetic resources and prevent international biopiracy.

As part of the project, a capacity development programme was developed for incorporating ecosystem services and climate change adaptation into regional and municipal development plans and is currently being implemented. Those involved in the Regional Observatories for Environment and Sustainable Development (OREDD) from the regional authorities and municipalities in the pilot regions are receiving support to strengthen their roles and responsibilities related to climate change adaptation.

Sustainability standards were developed for local ecotourism in the Souss-Massa pilot region, particularly for protected areas as well as the argan forest and its products (Fig. 3). The basic groundwork for certification was created among Moroccan eco-tourism providers.
The programme is helping to **improve regional environmental governance**. A monitoring system for climate change adaptation was established for the OREDD in the pilot regions. In cooperation with the stakeholders and all regional actors, the programme developed and agreed upon indicators for climate change adaptation and **biodiversity management**. The programme laid down obligations regarding roles and responsibilities for the collection and provision of **climate and biodiversity data**.

The **Observatoire National de l’Environnement et du Développement Durable** (National Observatory for the Environment and Sustainable Development) decided to apply this innovation across all of Morocco’s 16 regions (wilayas), integrate the collected data into the **Regional Environmental Information System (SIRE)** and incorporate this into municipal planning processes.

**Outlook**

**Lessons learned:** Achieving goals such as protecting the environment, preserving biodiversity or adapting to climate change requires much more than just appealing to decision makers or the public. The GIZ ACCN project shows the way. It includes (a) the development of the legal and institutional framework in support of the Moroccan Government; (b) awareness raising; (c) incorporation of ecosystem services and climate change adaptation into regional and municipal development plans; (d) improved environmental monitoring; (e) assistance in making use of Morocco’s biological resources; and many other aspects. This holistic approach is the basis for the success of the project.

**Upscaling:** Until now the project is concentrating its efforts on the southern region of Souss-Massa-Drâa and Tadla Azilal in the Middle Atlas. A next step could be expanding to all wilayas of the country.

Along with its Moroccan partners from the academic and private sectors, the programme has begun developing **the legal and institutional framework** for access and benefit-sharing (ABS). An initial draft of the legislation for implementing the Nagoya Protocol in Morocco has been drawn up and made available for first reading. In addition, a development partnership was agreed upon with a European cosmetics company on the use of Morocco’s biological resources and their exploitation for cosmetics in accordance with the ABS certification mechanism.

A cofinancing agreement was concluded with Morocco’s highway authority (Société Nationale des Autoroute du Maroc), the National Institute for Agricultural Research (INRA) and the Dresden-based engineering company IPROconsult. Climate change adaptation measures (erosion protection) should be implemented along stretches of highway that are threatened by heavy rainfall and erosion.

**Transferability:** Cooperation between the representatives of a more conservative society and staff members of an internationally operating agency is never without friction, but it seems to be feasible, and as this example shows, for the best of society and the environment. The concept has a wide scope, including creating legal frameworks, helping to improve regional environmental governance, collecting data, developing partnerships (e.g. with a cosmetics company) and protecting the highway as climate change adaptation measures. It is a convincing concept based on a trusting partnership that is well adaptable to the conditions in other countries.

This project seems to be a suitable case study for political decision-makers in other Arab countries for how to achieve legal and practical protection for natural resources and the fair use of environmental services.
Establishment of a National Competence Centre for Climate Change Mitigation and Adaptation in Morocco (4C Maroc)

Summary

Due to its geography, Morocco is very vulnerable to the impacts of climate change. It signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and intends to remain a low-level emitter of greenhouse gas emissions despite rapid economic growth. A climate competence centre has been set up in order to establish a climate change mitigation and adaptation structure. Through the establishment of this National Competence Centre for Climate Change Mitigation and Adaptation in Morocco (4C Maroc), Morocco is in a better position to implement and further develop its national climate policy. This case study can be regarded as an ‘Innovation on Trial’.

Challenge

As Morocco is very vulnerable to the impacts of climate change, the government decided to contribute actively to mitigating climate change and adapting to its impacts. Morocco signed the UNFCCC in 1992 and completed its first national greenhouse gas inventory in 1994. Its national plan for combating global warming (PNRC), which was presented by Morocco’s delegation in Copenhagen in 2009, reflects the country’s intention to remain a low-level emitter of greenhouse gases despite rapid economic growth. A climate competence centre was established to bring Morocco into a better position to implement and further develop its national climate policy.

Setup

Following a long process of dialogue between stakeholders, key ministries, representatives of public administrations, the private and the semi-public sector, civil society and training and research organisations, ‘4C Maroc’ finally held its constitutive general assembly meeting in October 2015 (Fig. 1). It commenced its activities in 2015, but action had already been taken within the framework of Project 4C, which supported the establishment of 4C Maroc. Project 4C is being implemented by GIZ on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety within the scope of the International Climate Initiative. The national lead executing agency is the Ministerial Delegate to the Minister of Energy, Mining, Water and Environment responsible for environment. The GIZ project started in 2013 and will last until 2017.
Opportunities

The implementation of these ambitious plans to reduce GHG emissions requires an unprecedented mobilisation of Moroccan society and international partners. To facilitate this mobilisation, Morocco set up 4C Maroc, which provides a capacity-building and information-sharing platform on climate change. The platform is available to various stakeholders and has a regional and African outreach.

Morocco set ambitious targets to limit greenhouse gas (GHG) emissions. These depend to a great extent on a major transformation of the energy sector. The main objectives are:

- achieving over 50% of installed electricity production capacity from renewable sources by 2025;
- reducing energy consumption by 15% by 2030;
- substantially reducing fossil fuel subsidies and increasing the use of natural gas.

Outside the energy sector, the following programmes are being carried out:

- National Waste Recovery Program
- National Liquid Sanitation and Wastewater Treatment Programme
- Morocco’s Green Plan (for the modernisation of the agricultural sector and the promotion of natural resources and their sustainable management)
- Preservation and Sustainable Forest Management Strategy.

The GIZ project aims to define the roles and tasks of the climate competence centre at regional and national level through consultation with the relevant partners. It assesses demand and provides support in the training of experts, along with any necessary equipment. To ensure Moroccan institutions can systematically assess, document and disseminate successful measures already in place, the project shares examples of good practice with them and provides detailed information on methodologies, costs and results. In addition, instruments are being developed that will help to establish a sustainable knowledge management system in the field of greenhouse gases and adaptation to climate change. This work includes (Fig. 2):

- developing vulnerability indicators and identifying vulnerability ‘hotspots’;
- establishing a climate database;
- identifying, processing and disseminating data and tools which can be used for training in the field of climate (climate-proofing, nationally appropriate mitigation actions (NAMAs), etc.);
- drawing up a list of contacts who are responsible for ensuring climate risks are taken into account in territorial and sectoral planning;
- developing an information system to facilitate the systematic development of greenhouse gas inventories and therefore make it easier to draft the national reports;
- developing a ‘Green Investment Plan’;
- preparing the members of the Moroccan delegations for the international climate talks so they can effectively represent Morocco’s interests in international climate dialogue or negotiations;
- creating and regularly updating a website for 4C Maroc.

Fig. 2: © GIZ Morocco

The centre ‘4C Maroc’ brings together government and public administration, the private and semi-private sector, research and expertise, and civil society. This composition is unique in the Arab World when dealing with climate change.
The aim is to train at least 20 national experts, whose role it will be to disseminate information on Moroccan climate policy, potential adaptation and mitigation measures, and services provided by 4C Maroc. Officials from the relevant ministries, including those operating at regional and local level, are to receive training to inform them of developments in these areas. An awareness-raising campaign is being carried out that targets decision-makers operating at local level as well as private sector companies, civil society and the media.

At international level, the project supports climate policy dialogue with other Maghreb countries, Germany and the European Union, and ensures that the private sector, the research community and civil society are brought on board. A partnership agreement is to be signed that will include provisions for cooperation with at least one similar centre in Europe.

Outlook

Lessons Learned: 4C Maroc provides a capacity-building and information-sharing platform on climate change. It can serve an example on how to create a multi-stakeholder framework with an integrated work plan that other countries can adapt and adopt.

Transferability: In the Maghreb region, Morocco is on the cutting edge regarding climate change mitigation and adaptation efforts, similar to Jordan in Mashrek region. It will need the strong will of the government, a high level of awareness within civil society and a far-sighted private sector to establish such a centre. Non-governmental organisations and foreign agencies can be extremely helpful in catalysing the process, supporting it financially and mediating in the negotiations.

Assertive but flexible decision makers at all levels are a prerequisite for success in the establishment of such an entity and for giving it a transformative role for economy and society.

Increasing Water Efficiency through Agricultural Drainage Water Reuse

Summary

The Egyptian Government has developed a national climate change adaptation strategy. One of the most expedient measures is the reuse of agricultural drainage water. Farmers in the Beheira Governorate in the northern part of the Nile Delta (Fig. 1) suffer from a lack of irrigation water.

A pilot measure by the GIZ regional programme “Adaptation to Climate Change in the Water Sector in the MENA Region (ACCWaM*)”, implemented in the northern Nile Delta, focuses on increasing water efficiency through agricultural drainage water reuse. The main aim is to improve irrigation water availability, particularly during the summer, by mixing fresh irrigation water with drainage water under controlled conditions.

The process is operated by the Ministry of Water Resources and Irrigation (WRI) in partnership with the local water community. Special attention is given to the needs of women farmers. The pilot measure demonstrates an innovative option for climate change adaptation.

Challenge

Egypt faces the challenge of meeting an increasing demand for water due to high population growth with a limited volume of freshwater. The population, which is estimated to be 89 million in 2015, is expected to increase to 105 million in 2030 – a further 16 million people in 15 years who need to be supplied with water and food – and jobs. The country relies on the Nile River as its main and almost exclusive source of fresh water (Fig. 2). The Nile valley and the Nile Delta are the most important agricultural production areas and as such, population density is extremely high, estimated at 1,540 inhabitants per km² (2015). Farmers try to boost their production, but irrigation water is in short supply, mainly during the summer season. Climate change exacerbates the vulnerability that results from water scarcity. To overcome this problem, farmers often pump (polluted and lower quality) water directly from the agricultural drainage canals to irrigate their lands, unaware of potential harms.

Setup

In its National Climate Change Adaptation Strategy, Egypt identified the reuse of agricultural drainage water as one of its most promising options. The GIZ pilot measure “Increasing Water Efficiency through Agricultural Drainage Water Reuse” aims to improve the availability of irrigation water, particularly during the summer, by mixing fresh irrigation water with drainage water under controlled conditions. The pilot measure, located in the Mahmoudia District of Beheira Governorate, was implemented via the delivery of a mobile pumping unit in July 2013.

Impacts are being monitored according to an agreement signed between GIZ–ACCWaM and the Ministry of Water Resources and Irrigation (MWRI). It stipulates that between May and September every year the pump shall be used exclusively in the pilot area for the purpose of alleviating water shortage and mitigating climate change-related impacts.

* ACCWaM = Adaptation to climate change in the water sector in the MENA region

Fig. 1 (l): Location of the project site in the northwest corner of the Nile Delta
Fig. 2 (r): El-Menshaweya Canal transfers Nile water into the GIZ pilot area in Damanhour in Beheira Governorate

Photo: © Dalia Gouda
While GIZ provided the pumping unit, MWRI’s role is to ensure its functioning, the allocation of the mobile pumping unit, and regular water quality monitoring. MWRI, ACCWaM and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) cooperate in the evaluation, monitoring and documentation of the project and the dissemination of lessons learned.

Opportunities

The main objective of this pilot measure is the reuse of agricultural drainage water through the purchase and use of a mobile pumping unit to help the local community by mixing it with irrigation water during the period of high water demand [May – September (Fig. 3 and 5)]. Fortunately, in the pilot area available drainage water is not polluted by village or industrial effluents. The main crops are rice (Fig. 4), wheat, maize, clover and vegetables.

Socio-economic features: The pilot covers an area of about 6,000 feddan¹, cultivated by 3,000 farmers and organised in three Water User Associations (WUAs). 30% of WUA members are women (Fig. 6). In the Pilot Measure area, the farmers are constrained by a shortage of irrigation water, and, in response, drainage water is pumped for irrigation privately by local farmers. This implies water quality problems (e.g. salinisation) and high energy consumption.

The increasing involvement of WUAs and local MWRI staff and the use of technical and socio-economic studies is expected to ensure the sustainability of the project.

The controlled mixing of drainage water with fresh irrigation water through the pilot’s single mobile pump saves much energy and reduces the cost to farmers that do not have to operate many individually-owned smaller and often inefficient pumps. In addition, regular water quality monitoring eases concerns over food safety.

Increasing the discharge in the irrigation canals through reuse reduces farmers’ vulnerabilities and contributes to allocative equity. A mobile pumping unit has the advantage that it can serve those fields that suffer the most from irrigation water scarcity (e.g. at the tail end of a canal). On the other hand, the economical use of a mobile pump unit requires the proximity of a feeder and drainage canal.

The technical preconditions for the successful operation of the unit are (a) a regular monitoring of the water quality; (b) protection of the drainage water from domestic and other pollution (including garbage disposal); (c) regular maintenance and uninterrupted energy supply of the pump; and (d) demand-driven operation and a steady, reliable water availability. The risks involved are the slow and gradual salinisation of the irrigated lands, an accumulation of hazardous chemical substances (if drainwater is polluted) and hygienic problems (if drainwater is contaminated with human excreta).

Stakeholder involvement in the pilot area for decision making and the operation and maintenance of the mobile pumping unit is intensifying. One important element is the fruitful and constructive partnership between MWRI and GIZ/ACCWaM through operational planning workshops. The experiences, benefits and impacts of the pilot measure are shared with water user associations, irrigators and focal groups.

The selection of the programme counterpart at central level (Cairo) and at local level (governorate and district) do have a direct impact on the success of the project activities. Guidelines for the further upscaling of agricultural drainage water reuse based on monitoring and additional studies have have been developed.

¹ 1 feddan = 0.42 hectares; 6,000 feddan = 2,520 hectares.
Outlook

Lessons learned: As an arid country, Egypt faces the challenge of meeting an increasing demand for water resources with a limited availability of freshwater. Climate change, with its higher temperatures and corresponding higher evapotranspiration, aggravates this problem. The controlled mixing of agricultural drainage and fresh water by a mobile pumping unit can reduce the pressure and hence contribute to climate change adaptation. The achievements of the pilot measure in the Nile Delta are:

- increasing the water supply;
- safeguarding the required level of water quality;
- improving water use efficiency and
- reducing energy consumption.

The reuse of agricultural drainage water will become more widespread in future, and, therefore, guidelines have to be developed and complied with.

Preconditions for the safe application using a mobile pumping unit are:

- existing legal framework and a strong partnership with the country’s water ministry;
- close partnership between national and local-level water authorities, the beneficiaries and the funding agency for the implementation, operation and maintenance of the system;
- an acceptable quality of drainage water plus an ample quantity of irrigation water;
- regular monitoring of water and soil quality, which demands adequate laboratory facilities and
- training of farmers and pump operators.
How to Prevent Seawater Intrusion in the Beirut Area in Lebanon
Can an Integrated Water Resources Management Approach Offer a Solution?

Summary

As is the case with many other coastal aquifers around the Mediterranean basin, the aquifer below the Greater Beirut area in Lebanon (Fig. 1) is suffering from overexploitation, seawater intrusion and hence deteriorating water quality. The national water strategy of Lebanon considers managed aquifer recharge as an option for increasing groundwater resources. In order to explore the potential of managed aquifer recharge using an appropriate integrated water resources management (IWRM) approach, a project feasibility study was commissioned by the GIZ regional programme ‘Adaptation to Climate Change in the Water Sector in the MENA region’ (ACCWaM) in 2013. A team from the American University in Beirut submitted its interesting findings in 2015. All activities are carried out in close cooperation with the Ministry of Energy and Water in Beirut. As the study has not yet been implemented, this description refers to an ‘Innovation on Trial’.

Challenge

Lebanon is already witnessing signs of decreasing precipitation and increasing drought and desertification as a result of climate change. Rapid and uncontrolled urban expansion over the past decades have led to serious degradation of the environment and impaired water quality in much of the country (Fig. 2). It is expected that the country will be unable to meet its local water demand by 2025.

Another concern is seawater intrusion in coastal areas that is caused by overexploitation of coastal aquifers and sea-level rise.

Due to high salinity concentrations, the groundwater has very limited use for domestic, industrial or agricultural purposes. The coastal aquifer below the Greater Beirut area is just one example of this phenomenon:

1. Population growth, urbanisation, refugee influx and climate change resulted in overpumping (mainly by illegal wells) and seawater intrusion into the aquifer. In 2010 the groundwater pumping in the Greater Beirut area was estimated by the Ministry of Energy and Water (MoEW) at 705 MCM/year.

2. The expansion of settlements, deforestation and further surface sealing by roads, etc. in the upper watershed led to reduced natural aquifer recharge, aggravated by the impacts of climate change (Fig. 3). Simultaneously, the magnitude of flash floods was rising, causing heavy floods in Beirut and other coastal cities. This water can potentially be used for groundwater recharge of the coastal aquifer.

Groundwater pollution in the Lebanese Mountains and the Greater Beirut area due to illegal practices by industry, households and fuel stations, etc., is another growing problem.

Setup

In order to explore the opportunities to stop further seawater intrusion into the local aquifer using an IWRM approach, a project feasibility study was commissioned by the ACCWaM programme in 2013. In June 2015, a well-founded study, authored by Dr. Mutasem El-Fadel and his team of American University in Beirut, was submitted.
Opportunities

The national water strategy of Lebanon considers managed aquifer recharge as a measure to increase groundwater resources. However, there are many obstacles, for example the karstic geologic structure in combination with faults in many parts of Lebanon, including the Greater Beirut area. Furthermore, the fast urbanisation in the area and the limited resources of the Government do not allow the existing infrastructure (water supply, wastewater collection, storm water drainage, etc.) to be kept up as required. With regard to the public water supply there has been a growing water deficit in Greater Beirut up till now, resulting from limited supply and a steadily increasing demand. Without securing new sources, the unsustainable extraction of groundwater in coastal urban areas will continue and seawater intrusion will inevitably accelerate.

The Awali Water Conveyor and Bisri Dam, which are sponsored through loans from the World Bank, are two examples of ongoing governmental projects aimed at reducing the water deficits in Beirut. When completed, these two projects, coupled with awareness-raising campaigns, water metering, tariff restructuring and a new water distribution system, are expected to meet the water deficit. Whether it will stop or at least significantly reduce the pumping from the local aquifer is still an open question; it will depend on the costs per unit of public water in relation to the costs of pumping, among other things.

There are a number of measures and techniques available for reducing groundwater abstraction and implementing aquifer recharge when applying the IWRM approach to tackle this problem (Fig. 4).

We can distinguish between (1) measures to be applied within the urban areas of Greater Beirut; and (2) measures to be put into practice in the upper watershed (e.g. of Beirut River), which can contribute to groundwater recharge in this region.
There are again two sets of measures which contribute to a **reduction in groundwater abstraction**:

1. **Water demand measures**, which comprise all facets of water conservation, for example in public buildings and other public facilities, industrial or commercial enterprises, and private homes, including garden areas;

2. **Water supply measures**: This covers various kinds of water supply, including improved public supply with piped water, reuse of treated wastewater, use of greywater and (rooftop) water harvesting.

**Aquifer recharge** can be accomplished through a variety of measures which are either suitable to be applied within the urban areas or outside in the middle and upper reaches of the watershed, for example in the Lebanese Mountains. The direct and indirect recharge measures can be applied in the Greater Beirut area, for example:

- injection of surplus water in the rainy season (which is already being done);
- injection of treated wastewater (which is planned following the construction of two large treatment plants);
- use of rain-permeable pavements for improved infiltration;
- construction of basins for stormwater infiltration and percolation;
- protection and enlargement of green spaces (parks, lawns);
- restrictions on the sealing of surfaces (bituminised or concrete) for streets, highways, parking lots, etc.;
- promotion of rainwater harvesting for aquifer recharge.

In the middle and upper reaches of the watershed in question (or the equivalent reaches of the respective aquifer supplying water to the coastal aquifer system), the following further measures for aquifer recharge can be conducted:

- protection of natural vegetation and planted forests which serve as hydrological buffers;
- land-use planning to minimise interference in the landscape and the encroachment of settlements in areas suitable for infiltration and recharge (Fig. 5);
- minimisation of surface sealing in road construction, planning of shopping centres and settlements, etc. (Fig. 6);
- avoidance of point and non-point water pollution by agriculture, industry and petrol stations, etc., in water recharge areas (Fig. 7);
- a cascade of check dams in tributaries and the main river in order to slow down water flow and allow water to percolate (Fig. 8);
- diversion of flood flows in the lower reaches of the river into percolation reservoirs;
- more water storage in reservoirs and basins in general, wherever it is feasible.

All measures have their pros and cons and the **prerequisites** have to be well known when planning any aquifer recharge project. If extraction from coastal aquifer continues, at least the **same volume of water** that has been extracted has to be added through groundwater recharge (good-quality surface and rainwater in order to stop further intrusion of seawater). The process of aquifer recharge has to be repeated regularly until an equilibrium has been reached between groundwater extraction in the coastal aquifer and groundwater delivery from upstream.
Outlook

Lessons Learned: Any success of ‘Managed Groundwater Recharge’ will depend on close cooperation between state organs, non-governmental organisations, financial bodies, research institutions/universities and the public. The IWRM solutions will include awareness-raising, water demand- and supply-side measures, structural interventions and legal/policy/administrative actions. The progressing impacts of climate change, including the rising sea levels, will aggravate the already existing problems.

In any case, the approach to a solution must cover a fairly large area in order to be efficient. In a strongly segregated country like Lebanon, a holistic approach has to include many target groups and institutions in addition to considering hydrogeological diversity.

Transferability: The IWRM approach can be transferred to other densely populated coastal areas in MENA region, but the specific conditions of each site (regarding topography, climate, geology, land use, population, settlement structure, etc.) have to be taken into account. The high costs involved will in many cases call for the involvement of an international donor.

Decision makers, when dealing with a seawater intrusion situation, are normally confronted with a pile of problems with a paucity of data. Scientists of numerous disciplines have to work together to implement an IWRM approach – but this effort is unavoidable for a sustainable solution.
Improved Management of Water Resources in Jordan

Summary

The current overexploitation of water resources in Jordan poses a serious threat to a sustainable water supply for the population, industry and agriculture. Strong population growth and the influx of refugees from neighbouring conflict areas are causing an increasingly difficult situation, which is exacerbated by the impacts of climate change.

The GIZ ‘Management of Water Resources in Jordan’ programme is an excellent example of an integrated, holistic approach aimed at the sustainable and efficient use of available freshwater and marginal water resources and a fair resolution of interests between households, industry and agriculture. The programme is not merely technically focused; it also provides educational material for schools, training courses for utility managers and suitable preaching books for imams.

The programme provides strategic, specialist and technical support for Jordan’s water institutions, thereby making a key contribution to more efficient water resources management and hence climate change adaptation.

The wide scope of the programme is reflected by the following component projects: (a) Improved Water Resources for Low-income Communities; (b) Training for Water and Energy Efficiency; (c) Water Wise Plumbers in Host Communities; (d) Decentralised Wastewater Management for Adaptation to Climate Change; (e) Decentralised Integrated Sludge Management; (f) the regional Sustainable Water Integrated Management (SWIM) project; (g) WASH in Schools (WASH is an UNICEF programme in the area of Water, Sanitation and Hygiene); (h) Water Cooperation with Religious Authorities and (i) Participatory Resource Management.

The results have been remarkable:
- The water supply for roughly six million people has improved.
- Around 30% of farmers in the Jordan Valley have been trained in using treated wastewater for irrigation farming.
- Irrigation efficiency increased by 20%.

Challenge

With less than 150 cubic metres of water available per capita each year, Jordan ranks among the world’s most water-poor countries. This situation is exacerbated by the impacts of climate change and the in-migration of more than 800,000 refugees. To satisfy the demands of agriculture, industry and people alike seems all but impossible.

Setup

On behalf of the German Federal Ministry for Economic Cooperation and Development, GIZ is implementing the Management of Water Resources in Jordan programme in partnership with KfW Development Bank, the German Federal Institute for Geosciences and Natural Resources and the Centre for International Migration and Development. Several German companies are involved through development partnerships with the private sector. The programme activities started in 2006 and are on going. Main programme partner on the Jordanian side is the Ministry of Water and Irrigation.

Fig. 1: Water consumption in Jordan by economic sector [in million cubic metres (MCM)/year]
Opportunities

Since 2003, the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), the predecessor of GIZ, concentrated its activities on the safe application of marginal water sources, mainly treated wastewater, for irrigation. GTZ:GIZ pursues the idea that ‘water reuse is Jordan’s option for bridging the gap between water supply and demand’. The majority of Jordan’s water resources is used for agricultural purposes. In the Jordan Valley, farmers increasingly have to use reclaimed water in order to irrigate their fields. The use of treated wastewater, however, requires a certain conduct to assure safe use in order to meet the needs of the crops and safeguard the health of the consumers, and to dissipate people’s concerns. Within the framework of German–Jordanian ‘Management of Water Resources’ programme, guidelines were developed for the use of reclaimed water in close collaboration with the Jordanian authorities.

Farmers in the Jordan Valley were trained through workshops on the use of treated wastewater, plant nutrition and soil fertility, as well as on general topics like water scarcity and water conservation in Jordan (Fig. 3).

Mikhled Mohamed Sulayman Ad-Dayyat, a father of seven children, had been a truck driver. Now he owns 42 plastic greenhouses in which he grows different crops (Fig. 2). He started the adventure, as he calls it, because ‘the Jordanian farmers are fighters who are always looking for innovations in order to improve their living conditions’. The adventure was worth it: By following the advice he received on fertigation, he was able to reduce the amount of applied fertiliser by up to 60%, which led to an increase in his net profit of around 20%.

The present programme has a much wider scope than the original GTZ project for the following reasons:
- The programme provides strategic, specialist and technical support for Jordan’s water institutions, thereby making a key contribution to more efficient water resources management (Fig. 4).
- The programme is also supporting Jordan’s water utilities as they reduce water losses, compile complete customer and consumption data, take actions to cover costs, train skilled workers and managers, and create more efficient organisational structures and processes.
The programme works directly with water users, especially farmers. Farmers receive assistance so that they can use more treated wastewater and deploy more efficient irrigation techniques. Another key objective is to reduce illegal groundwater extraction.

It supports initiatives such as the Water Wise Women Initiative and the Water Wise Plumbers Initiative, which target a nationwide network of female and male water professionals and enable them to perform repairs in homes and educate communities.

It supports a variety of other activities to raise awareness on water scarcity and water conservation, such as the Cooperation with Religious Leaders programme or the provision of information material to schools and media.

The programme presently comprises the following projects:
(a) Improved Water Resources for Low Income Communities;
(b) Training for Water and Energy Efficiency;
(c) Water Wise Plumbers in Host Communities;
(d) Decentralised Wastewater Management for Adaptation to Climate Change;
(e) Decentralised Integrated Sludge Management;
(f) the regional Sustainable Water Integrated Management (SWIM) project;
(g) WASH in Schools (WASH is a UNICEF programme in the area of Water, Sanitation and Hygiene);
(h) Water Cooperation with Religious Authorities; and
(i) Participatory Resource Management.

The ‘Best Practices’ of four of these projects are incorporated in this ‘Digital Chapter’.

Results achieved so far by the GIZ programme
The results achieved are remarkable:
- The water supply for roughly six million people has improved;
- The partner ministry in Jordan has noticeably improved its management skills as a result of the strategic advice and support in water framework planning;
- Today water utilities are operating as decentralised, semi-autonomous companies with private sector participation in six governorates. The quality and quantity of water provided to roughly six million people has improved (Fig. 5). Private sector involvement has improved water utilities’ financial situation and service for consumers, especially in the middle governorates between the north and south of the country;
- The Highland Water Forum, a platform for participatory groundwater management in the highlands, is working to reduce groundwater extraction and make more efficient use of the available water resources.
- Water distribution has become more reliable and farm yields have risen thanks to the establishment of water user associations that now cover about 40% of farmers in the Jordan Valley.
- Scarce water resources are now used more efficiently; irrigation efficiency was raised by 20% and farmers have become more willing to pay water tariffs that cover costs. About 30% of farmers in the Jordan Valley have been trained in using treated wastewater for irrigation farming (Fig. 6).
- In agricultural use, fresh surface water is being replaced more and more by treated wastewater to allow the freshwater to cover urban water demand.
Outlook

Lessons learned: The major reasons behind the success of the Management of Water Resources in Jordan programme in solving water-related problems in an extremely difficult environment has been its multi-faceted holistic, integrated approach with regard to:

- the different water resources covered (renewable and fossil water, surface and groundwater, rainwater and wastewater, etc.) and the water-energy-nexus;
- the intervention levels (from legal advice down to the field operations);
- the support given (lab equipment, applied research results, guidelines, handouts, technical information leaflets, etc.);
- the care for all three economic sectors (domestic, industry, agriculture) alike;
- raising awareness on water among school children, ordinary men and women, religious leaders, refugees, etc.;
- the coupling of water management with professional training and job creation (example: Water Wise Plumbers).

Another reason for the success is definitely the commitment of all staff members to their work, their ability to cooperate and their readiness to find compromises.

Transferability: As far as the transferability is concerned, there are differences to other MENA countries such as:

- Annual precipitation and renewable water resources per capita are less than in most other MENA countries.
- Agriculture uses only 57% of the total water resources in Jordan, whereas municipalities use as much as 39%; these values are quite different in comparison with most other MENA countries (with the exception of Gulf States).
- 97% of Jordanians have access to an improved water source and 93% have access to improved sanitation. This is one of the highest rates in the MENA area.
- The percentage of wastewater collection is also very high and there are a number of wastewater treatment plants delivering treated wastewater of acceptable quality.
- The impacts of climate change are already extreme; Jordan has been a pioneer in preparing climate change adaptation plans.

In general the results achieved by the programme are transferable, or at least well adaptable, to other MENA countries.

Political decision makers can learn a lot from this programme’s achievements, not least how to optimise the use of scarce water resources and how to adapt society to the consequences of climate change in the water sector and beyond.
Summary

Raising water efficiency is an important element in climate change adaptation. Sometimes it is necessary to tread a new path to reach this goal, for example through professional training in traditional trades. The GIZ project ‘Support for Jordanian Communities in Response to the Syrian Refugee Crisis through Water Wise Plumbers’ represents such an example. Its goal is to help to contain water losses in private households in the governorates of Amman and Irbid by training female and male plumbers. This training is to be made available to Syrian refugees as well. The training of female students not only increases the acceptance and awareness of women in the skilled trades, but also strengthens the effectiveness of the measure as female plumbers, in contrast to their male colleagues, can enter a client’s home without the presence of a male family member. In addition, the project is providing support for media campaigns to draw the public’s attention to high water losses in private households and motivate people to take appropriate action. All of these activities reduce vulnerability and help Jordan improve its adaptation to climate change. Main project partners are the Ministry of Water and Irrigation (MWI) and the Vocational Training Corporation (VTC) (Fig. 1).

Challenge

Jordan is one of the world’s most arid countries in terms of the amount of water available per capita. This situation is aggravated by the impacts of climate change and the influx of refugees from Iraq and Syria. The refugee crisis means that these scant water resources have to meet the needs of even more people every day. This country of 6.3 million residents has now accepted over 800,000 Syrian refugees. About 80% of these refugees live in Jordan’s towns, cities and communities. The already inadequate infrastructure providing the public with energy, education, health care and, above all, water is reaching its breaking point. With over 300,000 Syrian refugees currently registered in the governorates of Amman and Irbid, local water resources in particular are under much greater pressure. Virtually all directly available water resources have been tapped, but they are often only used to a limited degree or very inefficiently. Estimates indicate that up to 40% of the water transported by pipe is lost. Water connections and pipeline infrastructure that have been improperly installed and repaired and the shortage of qualified plumbers are also leading to water losses in residential buildings.

In many cases, water leaks are not dealt with promptly. Conservative values prohibit women from interacting with men without a male family member present. Since plumbers are traditionally men, housewives are forced to wait for a male relative to arrive to deal with the leak. It was estimated that 80% of households suffer sustained leaks because of this problem, leading to additional water losses.
Setup

Key implementing partners of this GIZ project include the Vocational Training Corporation (VTC) and several vocational training institutes in the governorates of Amman and Irbid. VTC is the nationwide executing agency for all vocational training institutes. GIZ provides financing to train up to 150 apprentices. This approach ensures that training is needs-based and gender-sensitive. The project is partnering with the Ministry of Water and Irrigation’s public relations department. It is also providing targeted support for media campaigns to draw the public’s attention to high water losses in private households and motivate people to take appropriate action.

Opportunities

GIZ approached VTC to establish plumbing training courses for women and men, which would enable them to solve problems in their own home and work as professional plumbers (Fig. 2). The GIZ Water Wise Plumbers programme will help contain water losses in private households in the governorates of Amman and Irbid by training plumbers, including Syrian refugees, which account for 40% of students. Half of the students are women. The training enables the participants to be certified as semi-skilled plumbers capable of opening and running their own businesses. However, the proposal was initially met with some misgivings; VTC was concerned that people might not accept the new idea and raised practical issues, such as male plumbers teaching female students. To allay these concerns, GIZ invited Brigitte Schlichting, a female plumber from Berlin, to teach the pilot courses, assisted by members of a female plumbers’ cooperative (Fig. 3).

‘We were surprised by how well people accepted the idea and by the demand for the course’, says Ahmad al-Shatnawi, director of the VTC institute in Hakama, where plumbing courses are taught. ‘We’ve had to refuse many applicants who wanted to join and put them on a waiting list in case the course is organised again’. In 2015, seven courses were running, three for women and four for men at various vocational schools. The project goal is to have 150 plumbers trained and at least 5,000 households benefitting from the plumbing services, resulting in a 10% reduction in water losses at household level. Furthermore, the 75 female plumbers will secure an extra source of income and are enabled to participate in public affairs (Fig. 4).
Outlook

**Lessons learned:** Raising water efficiency is an important element of climate change adaptation. It is often necessary to break new ground to reach this goal, for example through professional training in traditional trades. The GIZ project ‘Support for Jordanian Communities in Response to the Syrian Refugee Crisis through Water Wise Plumbers’ represents such an example.

**Upscaling:** As the demand is continuously high, further courses are being planned and even a ‘master’ course (i.e. ‘skilled level course’) is envisaged. There are future plans to procure tool cases for the plumbers-in-training and training materials for the workshops at the vocational schools.

**Transferability:** The success of such an initiative depends on (1) the readiness of the partners to venture into social innovations; (2) enthusiasm of the initiator(s); and (3) financial means to conduct the training courses, supply the tool kits and supervise/support the trainees after the end of the training.

**Decision makers** should be aware of the multitude of benefits that such courses offer (see below):

- a reduction in water losses and higher water use efficiency in urban areas/settlements due to better repair and maintenance of water infrastructure and devices;
- the lowering of stress on water resources, which reduces vulnerability and helps in adapting to climate change;
- public awareness-raising on water scarcity and water conservation;
- training of people to start their own business, i.e. income generation;
- integration of refugees into the programme, reducing social tensions;
- more skilled people who are enabled to participate in public affairs.
Jordan: Water Wise Women – Female Agents of Change

Summary

The water situation in Jordan is already precarious, and is being aggravated by climate change and the influx of refugees. Adaptation is feasible only if Jordan strives for the highest possible water efficiency, which can also be achieved by breaking new ground in the cultural and social arena. The Water Wise Women Initiative (WWWI) can serve as a good example of the successful application of this thesis. The Initiative was started in 2007, initially covering five local communities in Jordan. It gradually expanded to new locations and eventually reached twelve local communities throughout the country. The initiative was built on the efforts of volunteers organised in 50 community development centres supported by the Jordanian Hashemite Fund for Human Development (JOHUD), GIZ, the German Federal Institute for Geosciences and Natural Resources and the Jordanian Ministry of Water and Irrigation (MWI)/Water Authority of Jordan (WAJ).

Female volunteers are trained as ‘change pioneers’, also known as ‘Water Wise Women’, on topics such as water-saving techniques, rainwater harvesting, communication and cooperation with water providers, plumbing, hygiene, and water use for home gardening. The initiative thus provides a good information background and promotes housewives’ changes in attitude. It also provides opportunities for women to generate income and reduce expenses, such as fees for hired plumbers. In addition, the initiative reaches out to schoolgirls and children.

Challenge

Jordan is ‘haven of peace’ in a region of political instability and military conflict, but it finds itself facing an ongoing crisis of a different kind. It is among the poorest and least secure countries in the world in terms of water. According to the Food and Agriculture Organization of the United Nations, each resident of Jordan gets an average of only 128 cubic metres of fresh water per year – by comparison, the average European has access to nearly 9,000 cubic metres per year.

Jordan’s already precarious water situation is aggravated by climate change and the influx of more than 800,000 refugees over recent years. This problem can be managed only when striving for the highest possible level of water efficiency, which can only be achieved with the active participation of the people. The Government of Jordan as well as various non-governmental organisations (NGOs) have been making efforts to increase public awareness of water scarcity and encourage water conservation.

Setup

WWWI was launched in October 2007 as a partnership between JOHUD, the Deutsche Gesellschaft für Technische Zusammenarbeit (now GIZ), the German Federal Institute for Geosciences and Natural Resources (BGR) and the German Hanns Seidel Foundation. However, in November 2011 BGR and the Hanns Seidel Foundation pulled out, and GIZ decided to proceed with the Initiative together with JOHUD. MWI provided governmental support from the very beginning while WAJ joined the Initiative in its second phase. The United Nations University International Leadership Institute provided logistical support during the launch of the Initiative.
Opportunities

The idea for WWWI evolved out of the shortcomings of earlier development efforts on water awareness and because of the central role that women play in water management in their households and communities. Women are perceived as guardians of the next generation in Jordan. Any sustainable behavioural change in water use has to start at the level of Jordanian families and schools.

The WWWI is establishing a community-based pool of knowledge on efficient and protective water management at household and community level (Fig. 1). Women of all ages and educational backgrounds have been qualified to become ‘change agents’ in water use and water protection, providing concrete, appropriate and workable advice to fellow women and other relevant members in their communities (Fig. 2 & 3).

Achievements

- 12 local communities are aware of the WWWI concept (Fig. 4).
- 180 Water Wise Women serving as ‘multipliers’ have been trained by five core trainers.
- 4,500 housewives have been trained by the Water Wise Women and manage water in their households more efficiently.
- 22,500 people became aware of the scarce water situation in Jordan through WWWI.
- At national level Water Wise Women are now regarded by political decision makers as an important voice of society and respected as stakeholders.
- Water Wise Women are now regarded by water utilities as a crucial link to the community on domestic water issues.

Water Wise Women from nine locations decided to form local non-governmental organisations/community-based organisations to combine their efforts, sustain the WWWI concept, promote the prioritisation of water issues at national level and educate local communities on water-saving methods.

One of the Initiative’s indirect main achievements is introducing the concept of a professional ‘woman plumber’ to Jordan.

A ‘Training of Trainers’ manual has been developed covering eight fields of action:
1. Household hygiene and health (prepared by GIZ)
2. Water saving and its efficient use at the household level (prepared by GIZ)
3. Relationship of water users with governmental, non-governmental and private sector providers (prepared by GIZ)
4. Greywater reuse and rainwater harvesting (prepared by GIZ)
5. Water for house gardening and agriculture (prepared by JOHUD)
6. Water protection (BGR)
7. Plumbing and water storage (prepared by BGR)
8. Marketing and communications (prepared by JOHUD).

Interested women have the opportunity to take a plumbing course and receive a repair kit with the required tools.

The WWWI is also serving as a link to the governmental institutions, water providers, donors that support water initiatives at community and household level, and private providers of water-saving devices.
Outlook

Lessons learned: Adaptation to climate change under conditions of extreme water scarcity is only feasible if Jordan strives for the highest possible level of water efficiency, which can also be achieved by breaking new ground in the cultural and social arena. The WWWI can serve as a good example of a successful application of this thesis.

Upscaling: In pursuit of sustainability and to emphasise the fact that the WWWI will remain an essential part in the communities when the partners (GIZ and JOHUD) have pulled out, a non-governmental association called the Water Wise Women Association (WWWA) has been established and covers nine Water Wise Women communities. Through this association, the Water Wise Women try to create a non-monetary incentive system that will keep the Water Wise Women actively involved and positively influencing their community’s water issues. This will be achieved by strengthening their position and linkage with the decision makers and enhancing their involvement in water-related issues within the communities. The WWWA helps the Water Wise Women act as partners.

Transferability: The success of such an initiative depends on the awareness of (at least) some of the WWWA members/Water Wise Women, the enthusiasm of the initiator(s), financial means for the WWWA to (1) achieve its goals in reaching out to communities and supporting MWI and water providers; (2) supply the tool kits; and (3) supervise/support the members in contacting and raising awareness among housewives and ensuring changes in their behaviour.

It is recommended that political decision makers support these initiatives, if already available, or promote their establishment. These initiatives offer great opportunities to Governments and agencies to create awareness on pressing problems such as water scarcity or adaptation to climate change.
Summary

Egypt’s climate is predominantly arid and the Nile River is the major source of water for all purposes. Egypt’s rapidly growing population and developing economy demand more and more water of adequate quality. The situation is worsened by rising temperatures due to climate change. Responding to Egypt’s efforts to reform the water sector, GIZ is currently implementing the BMZ-financed Water and Wastewater Management Programme (WWMP) to improve Egypt’s water supply and sanitation services. One task is the gradual consolidation of the newly established utilities for the water supply and wastewater management. One element of the programme is handling the drinking water supply in Upper Egypt within the general scope of improving water services for the underprivileged population in that area.

Investigations revealed that the use of riverbank filtrates could be an interesting option to secure water supplies for a number of cities and villages along the Nile, which presently use surface water for their domestic water supply. Surveys indicate significantly higher water quality of bank filtrates when compared to water abstracted directly from the river. The installation and operating costs are considerably lower than those of the widely-used ‘compact units’. Supplying water at lower cost and of better quality to the people under the conditions of increasing temperatures and rising water demand can be regarded as a climate change adaptation measure.

Challenge

Since time immemorial people living along the Nile River have been taking their water directly from the river, and even today you may find numerous pumping stations for drinking and irrigation water along the river at its shore (Fig. 1). The water required for irrigation is delivered untreated, whereas the water destined for drinking and domestic purposes is normally treated (Fig. 2).

The increasing demand for water by agriculture, people and industry, aggravated by climate change and the progressing water pollution (including of the Nile), demands changes in water extraction and processing.

Setup

In the context of Egypt’s water sector reform, the responsibility for providing water and sanitation services was transferred in the governorates to new utilities for water supply and wastewater management. These utilities have been consolidated step-by-step under the umbrella of the Holding Company for Water and Wastewater (HCWW), which was founded in 2004.

The Water and Wastewater Management Programme (WWMP), which was commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), was launched in 2007. The lead executing agency is the Egyptian Ministry of Housing, Utilities and Urban Communities (MoHUUC). The objective of the programme is to improve the conditions for an efficient and sustainable water supply and wastewater management services in Egypt.

Fig. 1 (l): Floating pumping station at River Nile funded by Japan
Fig. 2 (r): Water quality analysis

Photos: © Dieter Prinz, Jahn Bosch
Opportunities

Climate Change: The Egyptian Government has already taken the first steps to counteract the impacts of climate change. Strategies have been drafted and a national committee for climate change has been set up. In 2010, the Government carried out a National Environment, Economy and Development Study (NEEDS) and submitted its second national communication to the United Nations Framework Convention on Climate Change (UNFCCC). Improved water services play a distinctive role in this framework.

Institutional Issues: The GIZ programme is supporting Egypt’s efforts to reform the water sector in three areas:

- at the national and ministerial level;
- in the water and wastewater utilities of the governorates;
- in the informal urban settlements and underserved rural areas.

At the level of the HCWW, the programme continuously supports the enhancement of personnel and institutional capacities as part of its mandate (Fig. 3). Furthermore, good practices in technical and commercial measures are to be scaled up to other regional companies. The objective is to professionalise and increase efficiency in the management of the utilities as well as align the enterprises with economic criteria.

Innovation: Bank filtration has been used for many decades in Europe to provide drinking water to communities located near surface water bodies, typically rivers. In Egypt, the further development of bank filtration has the potential to provide drinking water to many villages and towns located along the upper Nile River and possibly along canals (Fig. 4 & 5). These are currently using surface water for their domestic water supply at high treatment cost.

Bank filtrates from a few sites monitored in recent years have shown a significantly higher quality when compared to water abstracted directly from surface water sources (Fig. 6 & 7). The water treatment costs are therefore much lower.

While bank filtration has historically been used at only a few locations in Egypt, concerted efforts are required to put in practice the full potential of bank filtration and understand and scientifically document the processes involved.
Outlook

Lessons learned: Bank filtration systems are seen as having great potential for improving both the quantity and quality of water supplies to towns and cities built alongside perennial rivers and canals. The water treatment costs will be lower than for direct extraction. Bank filtration can be regarded as a climate change adaptation measure. However, there are a number of feasibility issues that must be considered regarding the sustainability of such systems (see below).

Upscaling: Hydrogeological conditions in several Egyptian cities seem to indicate that these cities would be suitable for the successful implementation of bank filtration systems.

Transferability: Bank filtration is a suitable technique for water extraction along permanent rivers and canals. Preconditions are: (1) suitable underground media (gravel, coarse sand) at the river bank; (2) permanent water supply from the river; (3) low clogging risk of pumps/filters; (4) no industrial wastewater influx (or other grave pollution sources) upstream and (5) laboratory facilities to monitor water quality and decide on the type of water treatment.
From Irrigated Agriculture to Solar Energy Farming in the Azraq Basin, Jordan

Summary

The centre of the Azraq Basin (Fig. 1) in the northeastern part of Jordan was covered by vast wetlands until the early 1990s, but both man-made and natural impacts, such as climate change, caused a severe depletion of this basin. The GIZ regional programme ‘Adaptation to Climate Change in the Water Sector in the MENA Region’ (ACCWaM) is venturing into the possibility to substitute irrigated agriculture with solar energy-based power generation as an income generating activity, ultimately reducing groundwater abstraction. The innovation is called ‘solar energy farming’. Solar energy farming is environmentally friendly as it (a) contributes to increasing the share of renewable energies, hence reducing CO2 emissions; (b) preserves groundwater resources as it creates sources of income other than irrigated farming and (c) is an important element in climate change adaptation. This innovation is intensively researched and consulted with the different actors, e.g. the Ministry of Water and Irrigation (MWI) and the Ministry of Energy and Mineral Resources (MEMR), before it will be implemented on a pilot scale.

Challenge

Jordan has 12 groundwater basins, 10 of which are strongly overused beyond their replenishment rates. Jordan is heavily dependent on its groundwater resources, which comprise 57% of the total supply and depend on rainwater for replenishment (surface flow or base flow). Incidentally, agriculture is the largest water-consuming sector, accounting for 64% of total demand according to Jordan’s National Water Strategy.
The *Azraq Basin* is located in the northeastern part of Jordan. Until the early 1990s the centre of this basin was covered by vast wetlands (Fig. 2), but man-made impacts (e.g. groundwater abstraction for irrigation and the capital Amman and climate change) caused severe depletion of this basin. In the absence of sufficient precipitation, total abstraction is twice the natural recharge rate.

Surveys among farmers in the Azraq Basin came to the conclusion that many farmers suffer from water supply problems and are therefore interested in alternatives to irrigated agriculture.

**Setup**

The Jordanian Ministry of Water and Irrigation and the Ministry of Energy and Mineral Resources are the main partners in this innovative adaptation measure. Planning, implementation and monitoring are supported by the GIZ ACCWaM programme as a learning case. The planned activities related to energy farming are part of the Azraq Groundwater Management Action Plan, which was endorsed by the Ministry of Water and Irrigation in February 2014. This Action Plan was developed by the Azraq Basin Committee, a body within the Highland Water Forum which was established in 2010 (Fig. 3). In its role as technical advisor to the Arab Ministerial Water Council, the Arab Center for the Studies of Arid Zones and Dry Lands will help upscale the measure within the Arab countries.

**Opportunities**

The ACCWaM Pilot Measure in Jordan is targeting three urgent issues:

1. reducing the further lowering of the groundwater table of the Azraq aquifer;
2. offering solar energy farming as a source of income to farmers in that area [a water-friendly alternative to agriculture (Fig. 4)];
3. generating electricity, which is high in demand in Jordan, by making use of intensive solar radiation.

In their January 2012 meeting, the Highland Water Forum agreed on solar energy farming as a high-priority adaptation (Fig. 5) measure to reduce groundwater abstraction. When farmers agree to abstain from irrigated farming, they can be provided with loans to install photovoltaic systems that would generate income for the farmers.

The key points of the innovation are:

- **Economies of small scale**: A farmer installs a 100 kWp photovoltaic power plant on one Jordanian dunum of farm land. This equals 1,000 square metres, or one tenth of a hectare.

- **Power generation**: 180,000 kWh per year, which is produced by the 100 kWp solar energy power plant.

- **Gross earnings**: EUR 24,000 per year with a feed-in tariff of EUR 0.13 per kWh over 20 years.

- **Opportunity cost**: EUR 250 (average loss of annual agricultural net profit).

- **Investment**: EUR 150,000, which is the turnkey cost of the 100 kW photovoltaic plant at today’s prices and includes the costs of connection to the public grid.

- **Net income**: Depending on the project finance terms and assuming 100% project financing at a 5% interest rate over 10 years, net income is at least EUR 1,000 per year over the first 10 years (i.e. the payback period for investments), and many more times higher for the remaining lifetime of the plant.

A larger sized plant can be installed depending on a farmer’s energy appetite and the parameters of the respective grid.

Assuming a high average net income from agriculture in the Azraq area of EUR 250/1,000 m², the farmer can earn at least four times as much annually when switching from agriculture to solar farming. After the payback, period earnings will go up even more.

*Fig. 4 (l): Photovoltaic plant Fig. 5 (r): Officials from the Ministry of Water and Irrigation discuss water management issues with farmers in Azraq Basin*

Photos: © Mustakbal Clean Tech; GIZ
Further areas that benefit from solar energy farming are:

- **Drinking water**: The year-round irrigation of annual crops requires on average one cubic metre of water per square metre of land (Fig. 6). When shifting to solar energy farming, 1,000 cubic metres of groundwater per year can be saved on a 1,000 m² area, a volume which can cover the demand for drinking water of 1,000 people per year.
- **Water security**: Solar farming reduces groundwater abstraction, thus saving the country’s strategic water reserve for future generations.
- **Energy security**: Solar farming eases Jordan’s heavy dependence on fossil fuel and gas imports.

### Outlook

**Lessons learned:** There are many good environmental and economic reasons for implementing solar energy farming in Jordan, such as serving as a climate change adaptation measure. However, the objective ‘reducing the further lowering of the groundwater table of the Azraq aquifer’ can be achieved only if (1) the ‘energy farmers’ really reduce their area under irrigated agriculture; and (2) the water left in the ground is not extracted by somebody else. This calls for strict regulations and their enforcement by authorities.

**Sustainability concerns:** In general, solar energy farming can be a sustainable alternative to irrigated agriculture experiencing water shortage in (semi-)arid areas. Farmers can stay on their land, maintaining the installations and enjoying a secure income.

However, there are still uncertainties insofar as the amortisation period of the investments runs for 20 years – a long time span in a fragile natural and political environment.

**Transferability:** The preconditions for transferability are:

1. contracts between the grid operators and the farmers, which fix an acceptable price for feeding energy into the national power grid;
2. access to loans (with regard to bank security, land ownership, etc.) and financial support;
3. access to technical services for implementation and maintenance;
4. widespread information distribution on the pros and cons of ‘energy farming’ and later on the training of ‘energy farmers’.

### Food security

Solar farming contributes to food security at the household level because it provides stable income and allows people to continue to live on their land. At the national level, it frees foreign currency to pay for food imports, money which is otherwise needed to pay for fuel and gas imports for power generation.

### Green economy

Jordan’s solar farmers shift from fossil fuel energy consumers (water pumping) to clean energy producers (photovoltaics).

### Adaptation to climate change

Solar farming helps rural households cope with climate change impacts in the water sector.
Water Pumping in Jordan
Improvement of Energy Efficiency of the Water Authority of Jordan

Summary

Electricity generation and energy supply are challenges in Jordan as energy is short in supply and mainly based on imported fossil energy sources. Energy cuts are a part of everyday life. The Water Authority of Jordan (WAJ) is the largest electricity consumer in the country, using about 15% of total electricity generation. A major part of this consumption goes to water pumping. Pumping inefficiency results in high costs and increased greenhouse gas emissions. Therefore, an eco-efficient and sustainable model for water pumping is crucial.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in cooperation with the International Climate Initiative of the German Government, launched a project aimed at mitigating greenhouse gas emissions and promoting a climate-friendly and resource-efficient economy. Moreover, it developed a business model which allows the involvement of the private sector in financing energy-efficient infrastructure for pumping stations. Through the development of what are known as ‘energy-contracting models’ for the water sector, a new market segment has been developed where energy service companies can cooperate with traditional water utilities. Efficient pumping systems now sustain a more reliable water supply and operate more cost-effectively. Lead executing agency is the Water Authority of Jordan, Amman; a further important partner is the Ministry of Energy and Mineral Resources, Amman.

Challenge

In Jordan, energy security, reliable water supplies and the fight against climate change are closely interlinked. Electricity generation is a challenge in Jordan as it is mainly based on imported fossil energy resources. The water sector consumes about 15% of Jordan’s electric power, and a major part of this consumption goes to water pumping. In Jordan, fresh surface water has to be pumped around 800 to 1,400 metres from the Jordan Valley up to consumers in the cities (Fig. 1). In addition, Jordan relies on groundwater abstraction to cover the demand for water for different uses. Thus water pumping from well fields, water conveyance and distribution by network pumping stations is energy-intensive (Fig. 2 and 3). To reduce the high electricity consumption of the water sector, there is an urgent need to tap power-saving potentials with WAJ. This will free additional capacity for households and industry, and thus promote the economic development of the country. Pumping inefficiency results not only in high costs but also in increased greenhouse gas emissions. Therefore, an eco-efficient and sustainable model for water pumping is crucial.

Setup and project aim

The project is being implemented within the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). Since 2008, the BMUB has been financing climate projects in developing and newly industrialised countries.

Fig 1 (l): Amman, a city of more than 4 million inhabitants, is located at 700–1,100 MASL.
Fig 2 (r): Pumping station in Jordan
The project aims at mitigating greenhouse gas emissions and promoting a climate friendly and resource-efficient economy (i.e. climate change adaptation); moreover, it uses an innovative financing mechanism for mobilising public and private investors. In cooperation with the International Climate Initiative, GIZ developed this business model which allows the involvement of the private sector in financing energy-efficient infrastructure for pumping stations. Through the development of what are known as ‘energy-contracting models’ for the water sector, a new market segment has been developed where energy service companies cooperate with traditional water utilities.

**Approach**

- A first step was the assessment of energy-saving potentials in water pumping in all major stations in Jordan.
- A second step was an energy audit of the major electricity consumers in the three governorates of Balqa, Madaba and Zarqa.
- A third step was the identification of the pumping stations in Wala and Lib, which are close to Madaba, as pilot sites.

Finally, a number of technical pilot measures were implemented in these pumping stations to reduce electricity consumption. Efficient pumping systems now sustain a more reliable water supply, operate more cost-effectively and contribute to climate change mitigation and adaptation (Fig. 4 & 5).

Each of the pumping stations has been equipped with four highly efficient pumps (replacing five old ones). A proper monitoring and control system has been put in place to assess the operation and pump efficiency. In addition, 15 damaged air relief valves have been replaced along the water pipeline to ensure smooth operation and avoid damage from trapped air. The new pumps can be equipped with variable speed drives allowing adaptation to new pumping requirements (expansion or reduction in water demand) while maintaining efficiency.

**Results and impacts** can be summarised as follows:

- efficient pumping adapted to hydraulic conditions;
- increased water supply security for uninterrupted drinking water supply as well as commercial and industrial uses;
- lower maintenance costs due to much lower maintenance requirements compared with the old pumps;
- improved work conditions with new pumps with relatively lower noise levels;
- performance-based contracting is piloted successfully to finance energy-saving projects in Jordan’s water sector;
- development of local knowledge in implementing performance-based projects;
- reduced energy consumption: 3.6 GWh per year;
- reduced energy consumption and costs by around 20% or EUR 280,000 per year;
- reduced emissions: 2,500 t CO2 per year. In one of the pilot pumping stations, energy consumption was reduced by more than 30%. Greenhouse gas emissions could likewise be
Financing: The investment of EUR 725,000 is being covered by the private consortium with financial support from GIZ (25%). The investment will be refinanced through energy savings. The savings are estimated at an average of EUR 280,000 per year and will be shared with Miyahuna (a Jordanian water company) through a performance-based contract; Miyahuna will pay 75% of the accrued savings to ESCo for five years.

ESCo is expected to recover its direct investment in the third year based on its performance. Thereafter, Miyahuna payments will be made as a direct profit for ESCo. After five years of operation, the assets will be transferred to Miyahuna* (Build - Operate -Transfer (BOT) model).

Outlook

Lessons learned: In this model the resource ‘water’ remains under State control, energy providers and water utilities cooperate, the private sector contributes operational expertise and finance, and an internationally operating agency coordinates the various activities. This example is showing that cost reduction and water supply security can go hand-in-hand with climate change mitigation and adaptation.

The success of the pilot measures has resulted in considerable interest among other development partners in using similar approaches. As such, the project is having a beacon effect far beyond Jordan, as it shows that taking care of the environment can also have economic advantages.

As far as the upscaling potential is concerned, there are 10 well fields and 15 network pumping stations in Jordan where a similar approach could be implemented. This would result in the following savings:

- reduced energy consumption: 42.1 GWh per year
- reduced energy cost: EUR 3.2 million per year
- reduced emissions: 30,600 t CO2 per year.

When using renewable energy sources (such as solar energy) instead of fossil fuels, the environmental benefits could be even higher.
→ Outlook

Transferability: A precondition for transferability is the effective and efficient cooperation between government, water utilities, energy supplier(s), and private partners for equipment supply and/or financing. A consortium of private investors and/or a local or an international agency might be needed to finance the initial steps and investment costs.

Decision makers: There are three levels in decision-making:

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>MAIN ACTOR(S)</th>
<th>SUPP. ACTOR(S)</th>
</tr>
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<tbody>
<tr>
<td><strong>Macro-level: Decisions on strategy and policy</strong></td>
<td>Government (Ministry of Water and Energy, Ministry of Planning and International Cooperation)</td>
<td>International agency, e.g. GIZ</td>
</tr>
<tr>
<td><strong>Meso-level: Decisions on auditing, selection of plants, mode of financing investment costs</strong></td>
<td>Head of national water authority (e.g. Water Authority of Jordan), heads of water utilities</td>
<td>Heads of energy suppliers, public and private investors, national (and international) agencies, local administrations</td>
</tr>
<tr>
<td><strong>Micro-level: Decisions on type of equipment to order for pilot projects, timing of activities, monitoring, maintenance, etc.</strong></td>
<td>Heads of water utilities, technical staff</td>
<td>Staff of water utilities, staff of energy suppliers, manufacturers of equipment</td>
</tr>
</tbody>
</table>
Summary

Rising temperatures, erratic rainfall, excessive floods and falling groundwater tables are the most pressing climate change impacts in Morocco. These phenomena not only put the region’s agriculture and fisheries in danger, but also pose a threat to the associated industrial sector. The GIZ-ASPCC (Adaptation du Secteur Privé au Changement Climatique) pilot project in the region Souss-Massa-Drâa in Morocco is tackling these urgent issues. The project aims to raise awareness among the private sector about the risks and opportunities associated with climate change and boost the adaptation capacities of industrial areas, making them more resilient. This project belongs to the group of ‘Innovations on Trial’.

Challenge

Climate change can have a direct impact on businesses in the form of damage to buildings or disruptions to production processes, for example machines overheating or staff falling ill more frequently. It can also affect firms indirectly as resources such as water and energy become scarce or more expensive, supply chains are disrupted, and sales markets change.

Production processes, procurement and sales policies, business strategies and investment decisions are all being adversely affected by subtle changes in the climate and the increasing frequency in extreme weather events. Erratic rainfall, excessive floods, rising temperatures, and falling groundwater tables are the most pressing consequences of climate change in Morocco (Fig. 1, 3 & 4). They significantly affect the region’s agriculture and fisheries, but also pose a threat to the associated industrial sector. Raising awareness of the scarcity of water, a resource that is directly and indirectly required for both the industrial processing of agricultural products and their cultivation/production, presents a major challenge for the region, heavily affecting its overall economic and environmental welfare. The vast majority of employment and income-generating opportunities are offered by small and medium-sized enterprises (SMEs) in the retail and manufacturing industries. These SMEs also play a key role in supplying goods and services to the population.
The GIZ programme Strengthening Private Sector Capacity to Adapt to Climate Change (PSACC) works together with GIZ field projects to further develop instruments for awareness-raising and advisory services for the private sector, adapt these to different sectors and actors, and test them out. The project is developing instruments in the following areas to help the private sector adapt to climate change:

a. **Raising awareness**: One of the greatest hurdles in the adaptation process is a lack of awareness of the impact that climate change has on individual enterprises. Consequently, the project is putting together public relations materials such as films and publications.

b. **Advising the private sector on adaptation**: The project is developing manuals and training concepts and training mediators and multipliers such as chambers of commerce, business associations and private-sector service providers on how to offer the same kind of training and advisory services themselves.

c. **Providing advisory services on adaptation financing**: Adapting to climate change requires investment and brings with it financial challenges for companies. Consequently, advisory concepts are being developed for the private sector covering the use of financial and insurance products in the adaptation process.

d. **Disseminating knowledge**: The project is working to strengthen dialogue and cooperation in effective approaches.

### Setup

The global GIZ programme PSACC, together with the Association of Investors for the Industrial Zone of Ait Melloul (ADIZIA), the Regional Centre for Investment of Souss-Massa-Drâa (CRI-SMR) and the Regional Observatories for Environment and Sustainable Development (OREDD), is participating in the pilot project (Fig. 3). The project commenced in 2014 and project activities will be conducted until 2017. It collaborates closely with the GIZ project in Morocco ‘Adaptation to Climate Change/Implementation of the Nagoya Protocol (ACCN)’.

GIZ is implementing PSACC on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The goal of the programme is to assist SMEs in partner countries in assessing climate-related risks and opportunities more effectively and developing adaptation strategies (see box).

### Opportunities

**Adaptation to climate change** is a huge challenge for SMEs in the Middle East and North Africa (MENA) region. These firms have few resources and limited expertise and are unaware of both the risks and opportunities of the phenomenon. In most cases, chambers of commerce, business associations, consultancy firms and state institutions are not able to advise SMEs on adaptation measures. If SMEs in MENA countries are left exposed to the risks of climate change, then these already weak nations will become even more vulnerable, jeopardising the development progress they have already made.
The GIZ PSACC pilot project in the region Souss-Massa-Drâa in Morocco is targeting these urgent issues. Souss-Massa-Drâa extends over 360 kilometres of coastline and therefore plays an important role in the country’s fisheries (Fig. 5); it also provides 40% of the national production of citrus fruits (Fig. 6).

The project aims to raise awareness among the private sector about the risks and opportunities associated with climate change and boost adaptation capacities in industrial areas, making them more resilient. A first step is a climate change risk analysis and the exploration of adaptation measures, particularly to find solutions to tackle water scarcity.

Outlook

Lessons learned: The private sector in many MENA countries is facing the impacts of climate change and looking for suitable adaptation measures. The goal of the GIZ project in Morocco is to provide information, build capacity and implement measures to improve the resilience of the private sector in the face of climate change. This includes resource efficiency, protection against calamities and improved competitiveness.

Approaches and instruments that prove particularly effective are made available to stakeholders in the industrial sector in other MENA countries as well as to German and international development cooperation actors, for example via the interactive online portal www.climate-expert.in.

Decision makers in MENA countries dealing with adaptation of the private sector to climate change impacts are invited to make use of the range of tools developed for this purpose by GIZ or turn directly to the PSACC programme for advice.
Cooperation with Religious Authorities to Save Water

Summary

Aridity, population growth, refugee problems and climate change – Jordan’s water-related problems are immense. What can be done to ease this water crisis?

As the majority of people in the Middle East are Muslims and religious leaders are accepted as moral authorities by the society, the project sought the help of these leaders to motivate people towards a more rational use of the limited water resources.

The aim of the ‘Improvement of Communal Water Efficiency through Cooperation with Religious Authorities’ project, which is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), is to spread the message of water awareness and water conservation in cooperation with religious authorities at a national, institutional and local level.

Imams and ‘female preachers’, which are known as waithat, will be trained as water ambassadors to raise water awareness and learn how to best include water awareness in preaching and moral instruction at mosques. The project will cooperate with the Ministry of Education to develop a teaching unit for religious instruction in secondary schools. Around three million people attend the weekly Friday sermons at Jordan’s mosques (Fig. 1). This audience will be reached through sermons developed and issued by the Ministry of Awqaf and Islamic Affairs and Holy Places (MoIA), which explains the need to save water from a religious standpoint. In addition, public awareness campaigns on different media channels shall be synchronised with the above-mentioned religious activities to achieve the maximum possible public outreach. The project also launched the ‘Blue Mosques Initiative’ in Jordan to convert mosques into ‘blue mosques’. These mosques will combine rainwater harvesting, water reuse and the installation of water-saving devices to serve as good water practices.

Challenge

Jordan is one of the most arid countries in the world. The scarcity of water resources is aggravated through strong population growth, economic development, the in-migration of more than 800,000 Syrian and Iraqi refugees and the impacts of climate change.

The strong increase in the number of refugees has a significant impact on drinking water supplies and wastewater disposal for the entire population. Communities located close to the Syrian border in the Northern and Middle Governorates are particularly affected. Water utilities are facing difficulties in providing water to the increased number of people and responding to the needs of the affected communities. Water scarcity is considered as a potential source of conflict between refugees and host communities.

According to personal interview surveys, a majority of Jordanians (52 %) and Syrian refugees (58 %) consider the water problem in Jordan as ‘critical’. However this perception has hardly been converted into concrete action. In the same survey, only 30 % of respondents stated that they are regularly using simple water saving methods in their households.

Photos: © Dieter Prinz, GIZ

Fig. 1 (l): Mosque in Amman
Fig. 2 (r): Imam Dr Rabiah Al Aide preaching at Al-Hamshari Mosque, Khalda, Amman
The central question was therefore how to reach the hearts of the people in order to motivate them to act in an ethically and rationally sound manner.

More than 95% of the Jordanian population and Syrian refugees in Jordan are Muslims and religious leaders have a great influence on the formation of public opinion (Fig. 2).

A new approach of this project was therefore to achieve behavioural change with regard to water among the Jordanian population and Syrian refugees alike, using religious argumentation and preaching. The common Islamic beliefs of the host communities and Syrian refugees provide a framework for addressing both groups at the same time, regardless of personal background, through the same religious channels, for example mosques.

The project team and the University of Jordan are developing teaching units for universities to explain the Islamic perspective on water and the religious value of water conservation. These units will help future imams and waithat to learn about the important aspects of water efficiency for local communities (Fig. 3).

There is growing interest among Islamic scholars to deal with the topic of water scarcity because water plays a central role in Islam. It is part of creation, guarantees the ritual purity of Muslims for prayers and is an important resource that secures survival and therefore must be protected.

Setup

This project aims at fostering cooperation between the Ministry of Water and Irrigation, the Water Authority of Jordan and the water utilities on the one side, and the MoIA on the other. Teams comprising members from the water sector and the MoIA are working together on the training material for imams and waithat. This material, which combines scientific argumentation supported by a religious perspective as well as practical water-saving solutions, will generate more impact than any of those elements alone.

The same approach is also applied in the development of awareness material and messages in information campaigns to be held during Ramadan, religious feasts or important seasons for the water sector. For instance, a large awareness campaign was launched at the beginning of the rainy season in the host communities to remind people of the traditional technique of rainwater harvesting. Social media, including the most famous social network in Jordan (Facebook), plays a special role in the awareness approach. Awareness is being raised in a very cost-effective manner through interactive solutions using the media and other channels. The largest public audience in the Middle East gathers at the weekly Friday sermons. In Jordan around 3 million people attend these Friday sermons at Jordan’s mosques. This audience will be reached through six sermons developed and issued by MoIA during the project, which explain the necessity of water conservation from a religious standpoint.

To ensure the social participation of women, the project works with female Islamic scholars, or waithat. Waithat are in direct contact with women at the local level. Strengthening the role of these female religious scholars as mediators in dealing with the Syrian refugees as well as water ambassadors will improve the social participation of women in the community.
Opportunities

Many people can be sensitised in mosques and during religious instruction by drawing on their beliefs and religious perceptions on resources and water conservation. Mosques are the ideal place to spread water awareness to significant portions of the Jordanian population.

In addition mosques have great potential to save or harvest water for the benefit of the people in Jordan. Water is used in mosques mainly for ablution. Ablution is obligatory in Islam and must be carried out prior to the five daily prayers for Muslims (Fig. 4). Many believers in Jordan keep the faucet open while doing ablution and in doing so they use up to 25 litres each time. The annual water consumption of the mosques in greater Amman is above 500,000,000 litres, which means there is great potential for water savings.

Outlook

Lessons Learned: The project “Improvement of Communal Water Efficiency through Cooperation with Religious Authorities” is demonstrating, that it is possible to spread the message of water awareness and water saving in addressing religious authorities at national, institutional and local level.

Transferability: This example of a ‘best practice’ is definitely well transferable to most Arab countries. The teaching material and the material developed for public awareness campaigns can be used (after adaptation to local/national conditions) in other Arab countries. Two preconditions are (1) the readiness of the respective ministries to collaborate; and (2) the willingness of the imams and waqf to include these messages in their sermons.

Decision makers in the relevant ministries should take the initiative to come together, discuss the local/national frameworks for implementation and try to put the decisions into practice. Collaboration with civil society, the media (TV, radio, print media, social networks), non-governmental organisations (NGOs) and international agencies is advisable to form a broader, solid basis for implementation.

Therefore, on 11 November 2015 the project started the ‘Blue Mosques Initiative’, with the aim of saving water in Jordanian mosques. The initiative is supported by His Royal Highness El Hassan bin Talal, who counts among the leading intellectual figures in the Middle East and is active in the field of environmental concerns.

The aim of the initiative is to disseminate the idea of water-efficient ‘blue mosques’ in the region. In Jordan, this concept, which is a combination of rainwater harvesting, greywater reuse, behavioural change during ablution, and the installation of water-saving devices, can reduce water consumption at mosques by 60%. The project also aims to retrofit selected mosques into water-plus mosques, which harvest enough rainwater and use it efficiently so that they can operate independently from the utility water supplies. These mosques will serve as ‘best practices’ in water conservation and will help to disseminate the idea of water-saving techniques to believers, which they can then apply in their own households.