Ministry of Foreign Affairs

Climate Change Profile

Jordan

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Introduction

This climate change profile is designed to help integrate climate actions into development activities. It complements the publication 'Climate-smart = Future-Proof! – Guidelines for Integrating climate-smart actions into development policies and activities' and provides answers to some of the questions that are raised in the step-by-step approach in these guidelines.

The current and expected effects of climate change differ locally, nationally and regionally. The impacts of climate change effects on livelihoods, food and water security, ecosystems, infrastructure etc. differ per country and region as well as community and individual, with gender a particularly important vulnerability factor. This profile aims to give insight in the climate change effects and impacts in Jordan, with particular attention for food security and water. It also sheds light on the policies, priorities and commitments of the government in responding to climate change and important climate-relevant activities that are being implemented, including activities being internationally financed.

Summary

A middle-income country located in the heart of the Middle East, Jordan is one of the driest countries in the world. Water scarcity impacts on every aspect of Jordanian life and is its greatest challenge to economic growth and development. The demand for water and energy by the large number of refugees is an important element in current and future water scarcity and energy concerns. Climate change will act as a threat multiplier[1] aggravating already existing water problems by decreasing water availability and putting further pressure on groundwater aquifers where recharge rates have already been exceeded. The combined effects of climate change and population growth (including migration) is anticipated to put more pressure on limited land and water resources and to increase the challenge of sustainable development in Jordan.

Overall ranking

Jordan has an emission ranking of 80 out of 220 countries and regions[2] contributing about 0.07% of global GHG emissions (2013 estimate)[3] [4]. Jordan has a ranking of 81 out of 181 countries in the ND-GAIN index[5] for climate vulnerability (ranking 1 being the least vulnerable). Jordan is the 50th least vulnerable country and the 84th least ready country. *Vulnerability* measures the exposure, sensitivity, and ability to cope with climate related hazards by accounting for the overall status of food, water, environment, health, and infrastructure within a country. *Readiness* measures a country's ability to leverage investments and convert them to adaptation actions by looking at the country's economic, governance and social readiness. Globally, relative to other countries its current vulnerabilities are manageable but improvements in readiness will help it better adapt to future climate challenges.

Biophysical Vulnerability

Jordan is situated in the eastern Mediterranean region with an altitude that ranges from less than -400m at the Dead Sea surface (lowest point on earth) up to 1,750m. The typical climate pattern for this region are winters of heavy rainfall from December-March which are followed by hot-dry summers from April-November. Jordan is divided into three climatic regions[6] (see Maps 1 and 2):

- the Jordan Valley (also referred to as the Ghor or lowlands) is part of the Great Rift Valley with a length of about 400 kilometers extending from north to south with a width of approximately 15 kilometers in the north expanding gradually to about 30 kilometers in the south. It forms a narrow strip located 200-400 meters below sea level[7]. The Jordan Valley experiences warm winters (19-22°C) and hot summers (38-39°C) with average annual rainfall ranging between 102-300 mm (see Maps 3 and 4).
- the Highlands which extends north-south to the east of the Jordan Valley. Within the highlands zone there are two sub-regions: a mountainous region which extends from the Yarmouk River in the north to Ras El-Naqab in the south; the marginal steep area which stretches from north to the southeast of the mountainous region, from

[1] Ministry of Water and Irrigation (2016) Climate Change Policy for a Resilient Water Sector available at http://extwprlegs1.fao.org/docs/pdf/jor165863.pdf see also World Bank (2014): Turn Down the Heat available at http://www.worldbank.org/en/topic/climatechange/publication/turn-down-the-heat

[2] http://www.globalcarbonatlas.org/en/CO2-emissions

[3] Climate Analysis Indicators Tool (CAIT) Version 2.0. (Washington, DC: World Resources Institute, 2016);

[4] https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-jordan

[5] GAIN index summarizes a country's vulnerability to climate change and other global challenges in combination with readiness to improve resilience. http://gain.nd.edu/our-work/country-index/rankings/

[6] Jordan's Third National Communication on Climate Change(TNC) (2014). Available at http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

[7] TNC (2014); USAID (2017).

the Syrian borders in the north to Ras Al-Naqab in the south highlands. Temperatures range from 9–13°C in the winter to 26-29°C in the summer.
- the Badia and Desert region[8], which covers an estimate 80% of Jordan. This is an arid and semi-arid area extending north-south from the foot of the Highlands eastward with an elevation of about 600-750 m. The annual rainfall of the Badia ranges from 50 to 100 millimeters. The south-east of the Badia region is the true desert with an annual rainfall of less than 35 millimeters. Temperatures range from 14-16°C in winter to 35-37°C in summer.

Being primarily arid to semi-arid, Jordan is characterized by very low annual precipitation, averaging less than 220 millimeters. The rainy season extends from around October to May of the next year with 80% of the seasonal rainfall occurring through the months of December to March, reaching a maximum average during the month of January. The annual total precipitation varies sharply from one climatic region to another, from a minimum of 28 mm at the southern Badia region to a maximum of 570 mm at the upper northern highlands region of Ras Muneef. Along the Jordan Valley region, the annual precipitation may reach 280 mm at Deir-Alla in the north and decreases towards the south to 71 mm at Ghor Safi[9] (see Map 3).

Aridity and water scarcity make Jordan environmentally sensitive to climate change. More than 80% of the country is unpopulated due to desert conditions, where annual precipitation fall under 50 millimeters (see Map 3). Water availability is mainly dependent on rainfall which can vary greatly from year to year. Surface water in the Jordan River and its tributaries, Yarmouk and Zarga are saline and primarily used for irrigation, while underground aquifers are used as sources of drinking water (see Map 4).

Flooding often follows heavy rainfall events during the winter destroying agricultural land and infrastructure and claiming lives. Indirect impact of droughts includes increased migration to the urban areas.

Trends

While there is some difference in the analysis of trends, there is convergence that the *frequency* of drought is increasing and that this trend will continue. The results of an analysis by ICARDA for the period 1901-2010 indicates that annual precipitation has been declining for a long time and that this trend is significant in all of Jordan (see Map 6[10]).

Trends since the 1960s include[11]:
- Rise in annual maximum temperature of 0.3-1.8°C and rise in annual minimum temperature of 0.4–2.8°C across all regions (minimum temperatures rose at a faster pace than maximum temperatures).
- Increase in the average number of heat waves across the country, particularly in the desert.
- Increase in the number of consecutive dry days nationwide (highest in the desert, followed by the highlands and then the Jordan Valley).
- Decline in the annual precipitation by 5-20 percent across the country, except in Ras Muneef in the highlands and Ruwaished in the Badia, where rainfall has increased by 5-10 percent.

Projections

Prevalent in the analysis of climate change in Jordan and Middle East is the use of the relative concentration pathways (RCP) that were utilized in the IPCC/UNFCCC reports[12]. In the medium term (2050)[13], while there is some disparity there is overall agreement that Jordan will become warmer with more frequent heat waves and fewer frost days. It is anticipated that in in the eastern and southern areas of the Badia and in the northern and southern areas of the Highlands there is an increase in precipitation during the rainy season up to the year 2050, with a decrease for the rest of the country which could reach up to 50% in the North of Aqaba[14] (see Map 7). The country will also become drier with projected trends indicating that the annual precipitation tends to decrease significantly with time[15]. Rainfall intensity is expected to increase. Runoff (precipitation minus evapotranspiration, a measure of water availability) is projected to decrease.

8 Badia is an Arabic word describing the open rangeland inhabited by Bedouins (nomads)

9 TNC (2014).

10 ICARDA (2015)

11 USAID (2017).

12 The RCPs are consistent with a wide range of possible changes in future anthropogenic (i.e., human) greenhouse gas (GHG) emissions, and aim to represent their atmospheric concentrations. RCP 2.6 assumes that global annual GHG emissions (measured in CO_2-equivalents) peak between 2010-2020, with emissions declining substantially thereafter. Emissions in RCP 4.5 peak around 2040, then decline. In RCP 6, emissions peak around 2080, then decline. In RCP 8.5, emissions continue to rise throughout the 21st century. The moderate (RCP 4.5) projections are used in the Profile, reflecting that a peaking of emissions is now considered likely around 2040 (after 2030). Global emissions would need to peak in 2020 to meet the two-degree global temperature target. See http://www.wri.org/blog/2017/11/turning-point-which-countries-ghg-emissions-have-peaked-which-will-future

13 Section drawn from USAID (2017); World Bank Climate Change Knowledge Portal, Jordan (2017) at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCode=JOR

14 TNC (2014) utilizing RICCAR data

15 Kingdom of Jordan's INDC (2015), submitted as its First NDC in 2016. Available at http://www4.unfccc.int/ndcregistry/PublishedDocuments/Jordan%20First/Jordan%20INDCs%20Final.pdf

Long-term projections (2100)

The CORDEX RICCAR Initiative[16] results (based on a broad range of global and regional climate and impact models) show that climate pressures and their water sector impact will intensify over time with the decrease in water availability projected to get particularly severe after the year 2040[17]. The Third National Communication on Climate Change (2014) using earlier RICCAR analysis suggest that by 2100 (end of century) (see Maps 7 and 8):

- Mean and maximum temperature will be 2-4°C higher for (all]) Jordan;
- Precipitation will be 15-20 % lower and potential evapotranspiration about 150 mm higher;

For Amman, some models suggest by the end of the century an increase in dry years (years with <200 mm precipitation) from once every three years to once every two years, about 30 days longer dry season, and a reduction in precipitation by ca. 10-15%[18].

The water sector will be the most heavily affected by climate change with anticipated consequences including:

- reduced water availability
- less reliable seasonal rainfall
- increased intensity of droughts during which reservoirs are not refilled, groundwater is not recharged, and rain fed agriculture suffers damages
- increased intensity of flood events during which water and other infrastructure experiences overflows and damages,
- higher irrigation water demand because of higher evaporation due to increased temperature.

However, Jordan, as a downstream nation dependent on transboundary river basins, is also extremely susceptible to the cascading impacts of climate change (see Map 9) basins. For example, climate change in the upstream country Syria can have both a direct effect in Jordan due to diminishing river flow by lower rainfall in Syria, and an indirect effect of increasing irrigation demand [in Syria] due to drought[19].

Socio-economic Vulnerability

GDP (PPP) per capita (2016)[20]:	USD 9065.3
Population (est. July 2018)[21]:	9,903,802
Projected population (2050)[22]:	17,319,000
Population density per km² (2016)[23]:	107
Population Growth Rate[24]:	3.2%
Human Development Index (2016)[25]:	86 out of 188 countries
Corruption Perceptions Index (2016)[26]:	57 out of 176 countries
Gender Inequality Index (2016)[27]:	111 out 188 countries
Adult literacy (2015)[28]:	93% (male 96%; female 89%)

Approximately 90% of Jordan's population is situated in the northwestern region, where rainfall is highest, and water is most accessible. Reflecting its limited water and other natural resources, Jordan's economy is heavily dependent on donor assistance, international loans, foreign remittances (which contribute an estimated 20% of the GDP) and trade. Population growth is driven by large inflows of refugees from the Palestinian Territories, Iraq and Syria which puts even greater pressure on food, water resources, energy, infrastructure and social services[29]. Migration movements from, to and through Jordan have played a key role in shaping its demographic situation as well as its economic and political structure[30].

Jordan is already one of the most water-constrained countries in the world. Water availability levels are already at less than 100 m³ per person/year[31], which is far below the standard water poverty threshold of 500 m³ per capita per

16 CORDEX is a consortium of leading climate modelers, the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) analysis was extensively used for the MWI Climate Change Policy for a Resilient Water Sector (2016). The RICCAR report (2017) is available at https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report

17 MWI (2016); RICCAR (2017).

18 MWI (2016), citing Abdulla (2015): 21st century projections for precipitation and temperature change in Jordan, report to MWI.

19 D. Rajsekhar, S. M. Gorelick, Increasing drought in Jordan: Climate change and cascading Syrian land-use impacts on reducing transboundary flow. Sci. Adv. 3, e1700581 (2017) available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5576883/pdf/1700581.pdf

20 World Bank Data – GDP per capita, PPP. http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

21 World Population Review – Benin, http://worldpopulationreview.com/countries/benin-population/

22 UNDESA (2017): *World Population Prospects: The 2017 Revision, Key Findings and Advance Tables.* Working Paper No. ESA/P/WP/248. https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf

23 World Bank Data – Population density, https://data.worldbank.org/indicator/EN.POP.DNST

24 https://data.worldbank.org/indicator/SP.POP.GROW?locations=JO

25 UNDP (2017) Human Development Report 2016: Human Development for Everyone. Table 1. http://hdr.undp.org/en/content/human-development-index-hdi

26 Transparency International (2017) Corruption Perceptions Index. https://www.transparency.org/whatwedo/publication/corruption_perceptions_index_2016

27 UNDP (2017) Human Development Report 2016. Table 5. http://hdr.undp.org/en/content/human-development-index-hdi

28 UNICEF (2017, - 2010 UNESCO data) https://data.unicef.org/topic/education/literacy/

29 USAID (2017);

30 TNC (2014).

31 Ministry of Water and Irrigation (MWI) (2016). Climate Change Policy for a Resilient Water Sector. Available at http://extwprlegs1.fao.org/docs/pdf/jor165863.pdf

year and will continue to decrease further with population growth (including arrival of refugees) and climate change[32].

The impact of climate change and climate vulnerability will further complicate the management of shared water resources[33]. Jordan is dependent on most of its surface waters from Syria and Israel via the transboundary Yarmouk-Jordan Rivers (see Map 9). Both Syria and Israel have retained significant control over the headwaters of the Jordan and Yarmouk Rivers resulting in Jordan being affected by unilateral water development projects by Syria in the upper Yarmouk basin as well as by Israel in the Upper Jordan river and Golan Heights[34]. Transboundary river agreements with Syria and Israel are not being observed, leaving Jordan with less than 10 percent of the total flow of the Upper Jordan and Yarmouk Rivers, increasing the possibility of further destabilization and conflict in the region[35].

The contribution of agriculture to GDP has declined in relative terms from 20% in 1974 to less than 2.9% in 2011 while its contribution in absolute terms has increased (e.g. from JD 57 million in 1974 to JD 598.3 million in 2011[36]). A key issue in the agriculture sector is that while it only provides 19% of the Jordan's food requirements and employs only 1.8% of Jordan's workforce, it withdraws 65% of Jordan's freshwater resources[37].

The dominance of arid conditions and irregular rainfall distribution are the main limiting factors affecting agricultural production. Only 10 percent of the land, predominately in the Highlands and the Jordan valley, is considered suitable for agricultural production (see Map 10). The rainfed agricultural zone is in areas where rainfall exceeds 250 mm although significant production of cereals does occur in some areas where rainfall is between 200-250 mm. In the western highlands, fruit trees and cereals are cultivated and in parts of the steppe (areas between western highlands and the Badia), barley is cultivated to support grazing herds of sheep and goats[38]. However, the land best suited for agriculture is also the area of rapid urbanization due to population growth, in-migration from rural areas and international population flow. This competition over land use has pushed agriculture to marginal areas in the Badia region in the east and south which currently suffer from drought and soil degradation and will be under further stress from climate change[39].

The anticipated impact of climate change on agriculture includes crop loss or crop failure as a result of less rainfall; increased water demand of crops in response to rising temperatures but reduced water available for irrigation; shortened growing season; and desertification and degradation of arable land. Wheat and barley, the primary staple crops in Jordan, are especially susceptible to changing climate patterns. Barley yields in the Yarmouk Basin are projected to decrease 5-50 percent by 2050 due to reduced rainfall and higher temperatures. Decline in the production and yields of these primary staple crops raises concern about food security and malnutrition, especially since Jordan currently imports over 80 percent of its domestic food requirements. Although irrigated land accounts for only 33 percent of total cultivated area, agriculture consumes as noted above around 65% percent of total available water resources - production of water intensive exports crops such as fresh fruits and animal products will be put at risk. Projected economic impact of climate change in agriculture include loss of income from inability to cultivate export crops and increase in food imports as well as the decline in access to affordable, nutritious foods. Climate change will exacerbate the current negative effect that armed conflicts in Syria and Iraq are having on the cross-border trade of agricultural products.

The impact of climate change on livestock is related to the decline of water and food resources due to recurrent droughts, degradation of rangelands and desertification. Cattle are the most affected by climate change followed by goats and sheep[40]. Livestock comprises 58% of agricultural GDP revenue, is the second largest export by both volume and value and provides food and income for more than 250,000 Jordanians. Declining rainfall levels and rising temperatures have reduced the availability of drinking water and pasturelands for grazing. Barley yields, traditionally used as the dominant fodder for sheep, goats and other small ruminants, have fallen and with the decline in pasturelands have led to a shortage of feed by as much as 77%. This trend is projected to continue[41].

32 Assumption: Each individual needs 2 to 5 liters of drinking water, 20-400 liters of water for daily household use and about 2000-5000 liters of water for food production, depending on how productive their agriculture is and what kind of food they eat. J.T. Al-Bakri, M. Salahat, A.A. Suleiman, M. Suifan, M.R. Hamdan, S Khresat, and Tarek Kandakji, Impact of climate and land-use changes on water and food security in Jordan: Implication for transcending ' The Tragedy of the Commons" Sustainability 2013, 5, 724-748; doi: 10.3390/su5020724. Available at http://www.eldis.org/document/A64515

33 RICCAR (2017)

34 D. Rajsekhar and S. M. Gorelick (2017)

35 USAID (2017)

36 TNC (2014)

37 Ministry of Environment (2017), A National Green Growth Plan for Jordan, Amman, Hashemite Kingdom of Jordan. Available at http://www.moenv.gov.jo/AR/Documents/report2017/%D8%A7%D9%84%D8%AE%D8%B7%D8%A9%20%D8%A7%D9%84%D9%88%D8%B7%D9%86%D9%8A%D8%A9%20%D9%84%D9%84%D9%86%D9%85%D9%88%20%D8%A7%D9%84%D8%A3%D8%AE%D8%B6%D8%B1.pdf

38 Al-Bakri et al (2013).

39 MWI (2016); USAID (2017)

40 RICCAR (2017).

41 USAID (2017)

The majority of the rural population depend either directly or indirectly on agriculture for their livelihoods. The rural poor are expected to face the most severe consequences of climate change because of their greater dependence on agriculture, their relatively lower ability to adapt and the high share of income they spend on food. Climate change could undermine the progress that has been made in poverty reduction and negatively impact on food security and economic opportunities for vulnerable rural populations[42] [43]. The negative impacts of climate change will be heavily felt by women[44] [45]. The role of women in the rural economy is substantial. Women are traditionally responsible for the household economy and are active in agriculture as well. Women make crucial contributions in agriculture and rural enterprises in drylands as farmers, animal caretakers, workers and entrepreneurs. For rural women and men, land is the most important asset to support production and provide for food, nutrition and income security. However, while having the legal right to own land, social norms diminish women's access to land by favoring male inheritance and providing disincentives for women to purchase land[46].

Jordan has become the destination of several waves of migrants from Palestine and recently Iraq and Syria. Jordan hosts the second highest number (89) of refugees per 1000 in the world[47]. Jordan anticipates refugee influxes to continue as the Syrian conflict has 'no foreseeable solution.'[48] The total number of Syrian refugees in Jordan is an estimated at 1.4 million persons[49]. UNHCR reports that of the refugees of Syrian nationality, 93 percent are living under the poverty line. Most refugees registered with UNHCR live in urban areas where competition for resources and services with Jordan communities is most intense[50]. The influx of Syrian refugees has increased the demand for energy and electricity and total residential energy consumption has risen significantly[51].

42 TNC (2014).

43 First Nationally Determined Contribution (NDC) 2016) http://www4.unfccc.int/ndcregistry/PublishedDocuments/Jordan%20First/Jordan%20INDCs%20Final.pdf

44 MOE (2014).

45 International Union for Conservation of Nature (IUCN), Global Gender and Climate Alliance(GGCA), Ministry of Environment (MOE) (2010) Programme for mainstreaming gender in climate change efforts in Jordan. Available at https://portals.iucn.org/union/sites/union/files/doc/jordan.pdf

46 M. Sweiden (2016). A gender perspective on measuring asset ownership for sustainable development in Jordan. Available at https://unstats.un.org/unsd/gender/Finland_Oct2016/Documents/Jordan_paper.pdf

47 UNHCR (June 2017) Jordan Factsheet. Available at https://reliefweb.int/sites/reliefweb.int/files/resources/Jordan%20Fact%20Sheet%20June%202017-%20FINAL.pdf

48 NDC (2016).

49 NDC (2016) noted that there were 750,000 unregistered Syrian people in Jordan while the registered number with UNHCR was 650,000. UNHCR reported in June 2017 a total of 736,396 refugees of which 90% (656,00) were from Syria. https://reliefweb.int/sites/reliefweb.int/files/resources/Jordan%20Fact%20Sheet%20June%202017-%20FINAL.pdf

50 UNHCR (2017)

51 NDC (2016).

National government strategies and policies

The Ministry of Environment (MOE) is primarily responsible for overseeing the policy and legal frameworks that guide climate change mitigation and adaptation efforts of the country, including the development of the Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC) and the Intended Nationally Determined Contributions (INDC). The MOE works closely with the Ministry of Agriculture, the Ministry of Health and the Ministry of Water and Irrigation, which is responsible for managing water resources by implementing irrigation policy, determining water allocation, constricting water infrastructure and establishing water conservation programs.

Jordan was the first Non-Annex I country to produce an Initial National Communication (INC) (1997) and has been an active member in almost all Climate Change and other UN Conventions' global treaties, partnerships and programmes. Jordan signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, ratified it in 1993 and acceded to the Kyoto Protocol as non-Annex-I country in 2003. It signed the Paris Agreement on climate change in April 2016 and ratified the agreement in November 2016 with entry into force in December 2016.

Jordan has prepared climate strategies, communications to the UNFCCC, and action plans:

- Initial National Communication (1999)
- Second National Communication (2009)
- Third National Communication (2014)
- National Strategy and Action Plan to Combat Desertification (2015-2020)
- National Climate Change Policy and Sector Strategic Guidance Framework (2013-2020)
- Climate Change Adaptation and Low Emission Development Strategy (2013)
- Water for Life: Jordan's Water Strategy (2008-2022)
- Climate Change Policy for a Resilient Water Sector (2016)
- Intended Nationally Determined Contribution (INDC) 2015, submitted as its First NDC in November 2016.
- A National Green Growth Plan for Jordan (2017)[52]

52 Ministry of Environment (2017), A National Green Growth Plan for Jordan, Amman, Hashemite Kingdom of Jordan. Available at http://www.moenv.gov.jo/AR/Documents/report2017/%D8%A7%D9%84%D8%AE%D8%B7%D8%A9%20%D8%A7%D9%84%D9%88%D8%B7%D9%86%D9%8A%D8%A9%20%D9%84%D9%84%D9%86%D9%85%D9%88%20%D8%A7%D9%84%D8%A3%D8%AE%D8%B6%D8%B1.pdf

The National Climate Change Policy (2013-2020)[53] is a key document with subsequent strategies and plan aligned and consistent with its objectives and proposed actions. The objective is to achieve a pro-active, climate risk-resilient Jordan, to remain with a low carbon but growing economy, with healthy, sustainable, and resilient communities, sustainable water and agricultural resources, and thriving and productive ecosystems in the path towards sustainable development[54]. The purpose of the Policy is to provide an overarching (umbrella/high level) guidance for the Government of Jordan to implement the climate change objectives of national priority related to adaptation and mitigation of GHG emissions. It focuses on short-term (2013-2020) actions with the objectives:

- to build the adaptive capacity of communities and institutions in Jordan, with consideration for gender and addressing the needs of vulnerable groups, to increase the resilience of natural ecosystems and water as well as agricultural resources to climate change, and to optimize mitigation opportunities.
- The national priorities and the pillars of the Climate Change Policy are adaptation to climate change and mitigation of greenhouse emissions, with an emphasis on adaptation as the imperative track.

The Policy provides an overview of Jordan's strategies to combat climate change across various sectors and details the strategic actions that the country will implement in the coming years, particularly the priority sectors that are directly linked with main developmental challenges in Jordan and present the highest exposure risks (e.g. water and agriculture). Special attention is given to "vulnerable groups" that stand to disproportionately suffer from the negative effects of climate change, as well as strategies to address gender imbalances between men and women (Jordan was the first Arab country to include gender considerations in its national climate change policies). The policy also details how it will be monitored from a policy implementation perspective as well as institutional arrangements that will encourage adoption of climate change perspective in ministries outside of those directly involved with environmental management[55].

The National Committee on Climate Change (NCCC), which includes representative of several Ministries and partners in civil, private and academic sectors, has the main role in the supervision of the climate policy implementation. Within the NCCC, the MoE has a special responsibility as Chair of the NCCC and as its Secretariat[56].

Jordan's NDC noted that the Climate Policy will be extended to 2030 (from the current 2020) to align and serve as an overarching umbrella guiding and monitoring the implementation of the GHG emission reduction activities until 2030 (see below).

Third National Communication (TNC) (2014)[57] builds on the objectives and proposed actions of the Climate Policy. The TNC includes projected impacts of climate change on Jordan, as well as a comprehensive mitigation assessment and a detailed inventory of GHG emissions. Using downscaling projection models, it reports that Jordan will be highly vulnerable to climate change impacts, especially the projected decrease in precipitation and increase in temperature and dry spells. It notes that this is an extreme concern for a country that is among the poorest in availability of water resources in the world and facing a huge challenge of accommodating the massive influx of refugees from neighboring countries. The TNC contains comprehensive vulnerability assessments for major sectors in Jordan, including assessments of four rural communities, and identifies opportunities for mitigation and adaptations that Jordan will pursue with support of the international community.

Adaptation actions proposed for the water sector include: rainwater harvesting, wastewater treatment, desalination, increasing efficiency of irrigation technologies, grey water reuse, and [increasing] public awareness. For the agricultural sector, adaptation measures include: modification of cropping patterns, modification of crop calendar including planting and harvesting dates; implementation of supplemental irrigation and water harvesting techniques, improve water use efficiency, use of different crop varieties and modification of policies and implementation of action plans.

Based on the socio-economic analysis of four villages in the Amman-Zarqa Basin, proposed measures to enhance the **adaptive capacity in communities** include: increasing women's skill development and capacity building opportunities through training in community and political participation skills and linking them to general literacy and education initiatives; increasing the labor productivity of rural women through improved access to training, extension services and technology; prioritizing inclusive economic growth of the rural poor to improve well-being and reduce rural poverty; mainstreaming the role of media in climate change and support NGOs and community based organizations (CBOs) to spearhead awareness raising efforts in different community segments. The TNC also noted the need to conduct a pilot study on vulnerability to food

53 Ministry of Environment (2013) [supported by GEF and UNDP] available at https://www.un.org/press/en/2018/sc13189.doc.htm

54 TNC (2014)

55 http://www.lse.ac.uk/GranthamInstitute/law/the-national-climate-change-policy-of-the-hashemite-kingdom-of-jordan-2013-2020/

56 MOE (2013)

57 Jordan's Third National Communication on Climate Change(TNC) (2014). Available at http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

security due to climate change, including an analytical chain of logical events, regarding the impacts of climate change for farm households.

Climate Change Policy for Resilient Water Sector (2016)[58]
The purpose of the policy is to provide a framework and methodology for strengthening the resilience of the Jordanian water sector, based on existing IWRM approaches, and enabling the mainstreaming of climate adaptation and (mitigation) into the existing institutional framework. Rather than developing new stand-along activities, the policy builds upon and adds value to existing strategies, policies and plans of the water related sectors, and will be modified as required from a climate change perspective. The policy notes that coordination with relevant institutions as well as policy coherence (including the international policy context, e.g. the Paris agreement on climate change) will be important for developing solutions and building resilience for sustainable development. The water-related solutions include: water storage (using all options); new water (from water harvesting , water transfers, wastewater collection/treatment); desalination (for climate mitigation purposes to be based on renewable energy); water quality protection and improvement; virtual water through imports of water-intensive products; integrated water and land planning/management /zoning, water smart land use; economic incentives for reducing water (and energy) use and for using more renewable energy in the water sector; water and energy demand management; improved water use efficiency; improved climate data collection monitoring and early warning systems; training and capacity development. The policy notes that given the anticipated decrease in water availability that climate change would bring, emphasis needs to be on reducing demand.

Nationally Determined Contributions (NDC)[59]

Jordan submitted its First NDC to the UNFCCC in November 2016. In its NDC Jordan determines to reduce its greenhouse gas emissions (GHG) by 14% until 2030. Of the 14%:

- a maximum of 1.5% will be unconditional and fulfilled by its own means compared to a business-as-usual scenario (BAU).
- Conditional and subject to availability of international financial aid and support to means of implementation, Jordan commits to reduce its GHGs emission by an additional, at least, 12.5% by 2030.

The estimated cost to reach the 14% target is USD 5.7 billion of which the GoJ has already secured USD 542.75 million of its own means to meet the unconditional target; it will need an additional USD 5.157 billion to fulfill its conditional target.

To reach its target the NDC proposes 70+ projects (43 of which were included in the TNC with an additional 27 projects identified after the preparation of the TNC). The implementation of the 70+ projects to achieve the 14% emission reduction will be guided by the National Climate Change Policy (see above).

Mitigation actions include national-level actions (e.g. the National Green Growth Plan, which was completed in 2017) and sectoral actions for energy, transports, waste management, industries, water and agriculture. The **energy sector** actions include expanding the development of renewable energy projects and encouraging investment in renewable energy; encouraging the use of solar energy for water heating; implementation of green building codes; energy efficiency; attracting private sector investment to the renewable energy sector; diversifying the sources and kinds of energy and diversifying sources of natural gas import; and expanding the use for solar cooling in commercial and industrial facilities. **Water sector** actions focus on energy efficiency and renewable energy. The agriculture sector action is afforestation of 25% of barren forest areas (on which precipitation exceeds 300 mm).

Adaptation actions included in the NDC are primarily proposed actions in the National Climate Change Policy (which is to be revised for post-2020). Adaptation actions are proposed for the water sector; health sector; biodiversity, eco-systems, and protected areas; agriculture and food security; and sustainable development-oriented socioeconomic adaptation. Total costs associated for adaptation actions are not provided, but there are estimates for some of the sectors. Water sector action are grouped under groundwater protection (e.g. sustainable extraction rates); surface water development (e.g. surface and sub-surface storage; modernizing and upgrading systems and dams); demand management (e.g. mobilization of additional water resources and reduce water consumption); and water resources monitoring (quantity and quality). The water sector investment needs are estimated (10 years until 2025) at USD 4 billion.

Agriculture/food security adaptation actions focus on addressing the expected impacts of climate change, particularly reduced agriculture productivity and water availability. The actions are similar to those proposed in the TNC (e.g. water storage and efficiency; crop diversification, tolerant crop varieties). The government own means for implementation (pre-2020) was estimated at USD 160 million on adaptation projects and activities. The amount of additional funding (post-2020), is not presented.

[58] Ministry of Water and Irrigation (2016) Climate Change Policy for a Resilient Water Sector available at http://extwprlegs1.fao.org/docs/pdf/jor165863.pdf

[59] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Jordan%20First/Jordan%20INDCs%20Final.pdf

Climate Finance

For Jordan the climate related risks to water availability and food production are significant. Jordan has committed funds for adaptation (as for agriculture noted above) and mitigation (as detailed in its NDC). Most climate initiatives and projects in Jordan are still donor driven and the pledged emissions reductions will require substantial international financial support and a shift in national planning and budgeting that includes the allocation of domestic resources for mitigation and adaptation[60]. Jordan is proactively seeking international climate funds. It established a National Designated Authority (NDA), the Ministry of Environment, for the Adaptation Fund and the Green Climate Fund (GCF) and has received approval of an Adaptation Fund project[61] and a GCF grant to strengthen its readiness to prepare a proposal for the GCF. [62]

Jordan has submitted nine NAMAs (National appropriate mitigation actions) to the UNFCCC for support[63]. Six proposals are for support for the preparation of projects for rehabilitation of landfill, fuels and emissions savings, energy efficiency in the water sector, and mitigation actions for industrial sector and national domestic waste management. Three proposals are seeking support for implementation of projects for energy efficiency in the water sector, a thermal power station, and a waste water treatment plant.

Jordan received support from GEF (Global Environment Facility) and UNDP for the preparation of its Third National Communication on Climate Change (TNC). Its INDC development process was supported by GIZ though the Global GIZ project supporting INDC preparation (International Climate Initiative).

Climate Change Projects

International and bilateral funding for Jordan is primarily focused on refugee and humanitarian support. The Jordan Response Platform (JRP) for the Syrian Crisis[64], for example, seeks to compensate Jordan for hosting the refugees and aims to secure sufficient grants and concessional financing to address the general budget needs over the next three years for humanitarian assistance and to build the resilience of Jordanian communities. The JRP has received an endorsement of 7.3 billion in February 2018 from the international community.

Although the refugee crisis is receiving most of international and national attention, Jordan has also been successful in obtaining finance for climate projects from international and multilateral funds. See Table 1 for climate projects.

Table 1: International and multilateral climate projects.

Main sources Climate Funds Update (2017)[65]: and World Bank (2017) [66]

Name of Project	Fund	Amount of Funding Approved (USD millions)	Disbursed (USD millions)	Dates
Increasing the resilience of poor and vulnerable communities to climate change impacts in Jordan through implementing innovative projects in water and agriculture in support of adaptation to climate change	Adaptation Fund	9.2	1.87	2015
Readiness and Preparatory Support	Green Climate Fund	.3	.15	2017
Solar energy project (private sector) (national component of MENA program)	Clean Technology Fund/ Climate Investment Funds	50		2015
A Systemic Approach to Sustainable Urbanization and Resource Efficiency in Greater Amman Municipality (GAM)	GEF 6	2.64		2016
First Biennial Report [to be submitted to UNFCCC]	GEF 6	.352	.352	2015
Ozone depleting substances HCFC Phase out [Phase 2}	World Bank	2.49		2017

60 NDC (2016).

61 https://www.adaptation-fund.org/project/increasing-the-resilience-of-poor-and-vulnerable-communities-to-climate-change-impacts-in-jordan-through-implementing-innovative-projects-in-water-and-agriculture-in-support-of-adaptation-to-climate-4/

62 http://www.greenclimate.fund/documents/20182/953917/GCF_B.19_15_-_Readiness_and_Preparatory_Support_Programme__progress_report.pdf/414f9c0d-7e09-4085-aa15-b975dfdf951e

63 http://www4.unfccc.int/sites/nama/SitePages/Country.aspx?CountryId=88

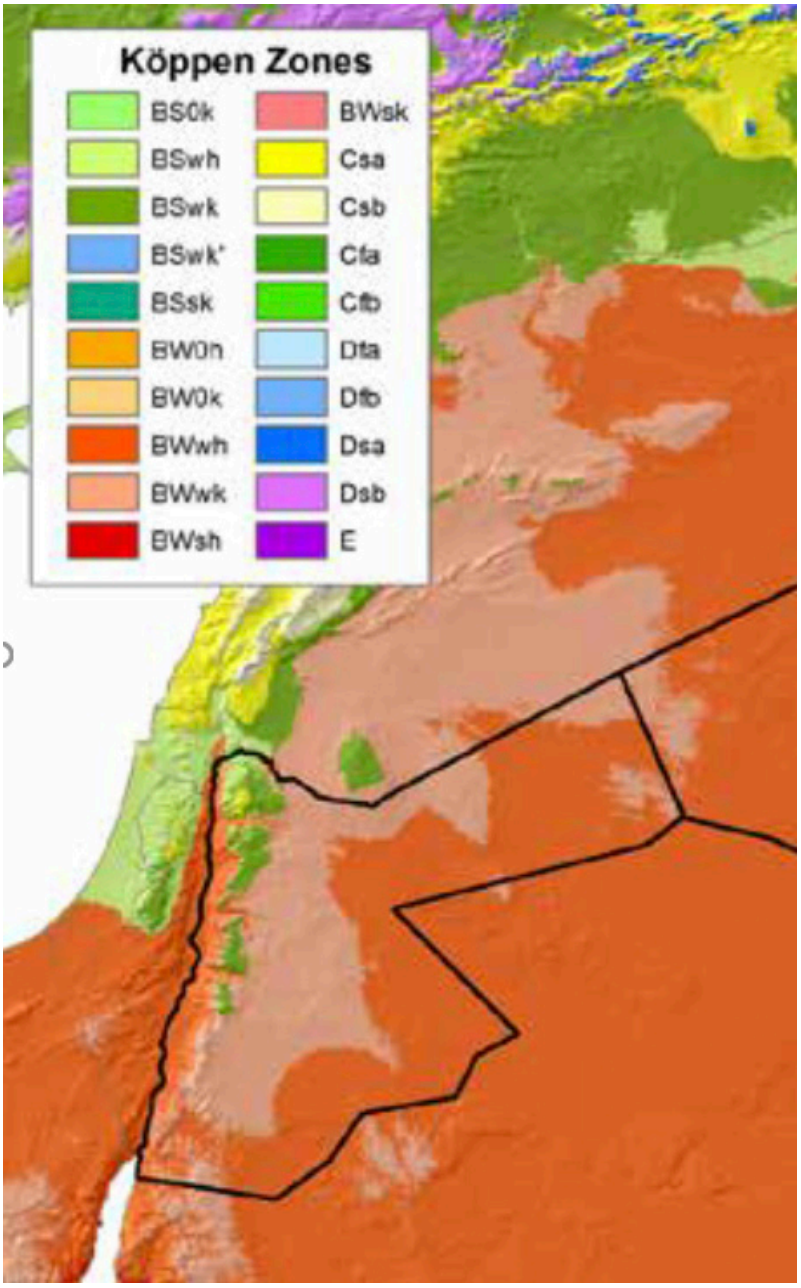
64 http://www.jrpsc.org/

65 http://www.climatefundsupdate.org/data

66 http://www.worldbank.org/en/country/ethiopia/projects/all

Maps

Map 1 Prevalence of (%) Koppen climatic zones



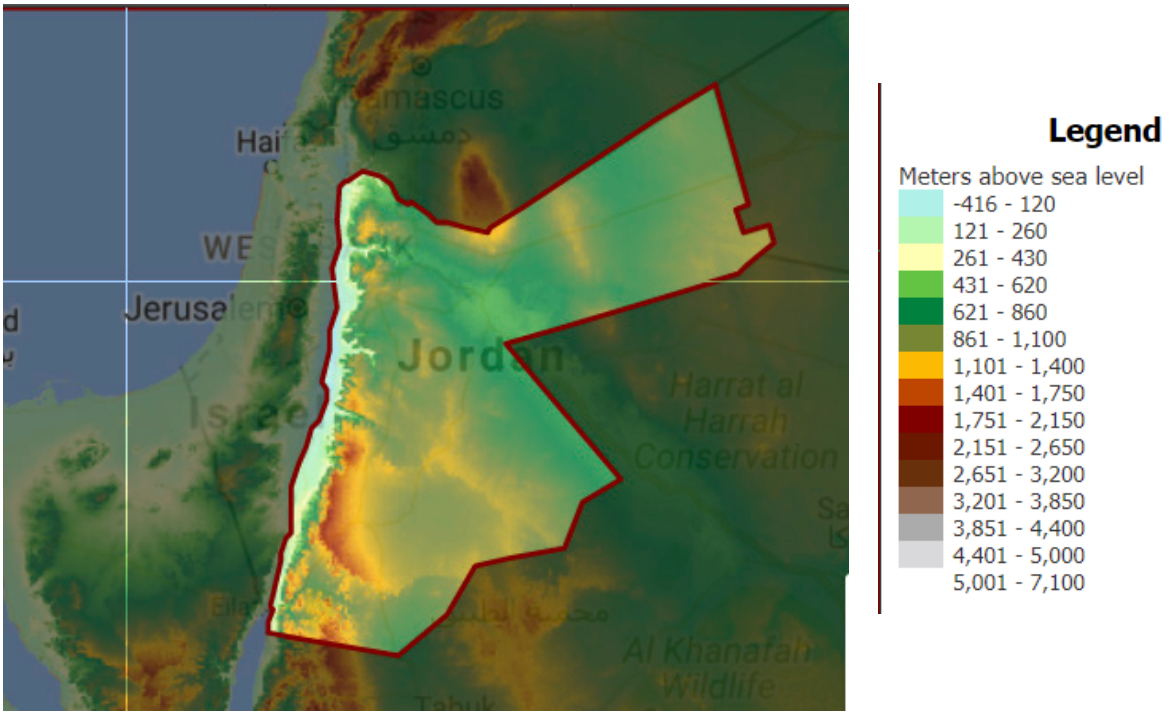
Prevalence of Koppen climatic zones in Jordan

Zone	Description	% (prevalence)
BSwh	Hot semi-arid (steppe) climate, winter precipitation	1.0
BSwk	Cool semi-arid (steppe), climate winter precipitation	3.7
BWwh	Hot arid (desert) climate, winter precipitation	57.2
BWwk	Cool arid (desert) climate, winter precipitation	37.8
Csa	Warm temperature rainy climate with dry and hot summer	0.3

Source: ICARDA (2015)

https://apps.icarda.org/wsInternet/wsInternet.asmx/DownloadFileToLocal?filePath=Working_Paper_Series/working_paper27.pdf&fileName=working_paper27.pdf

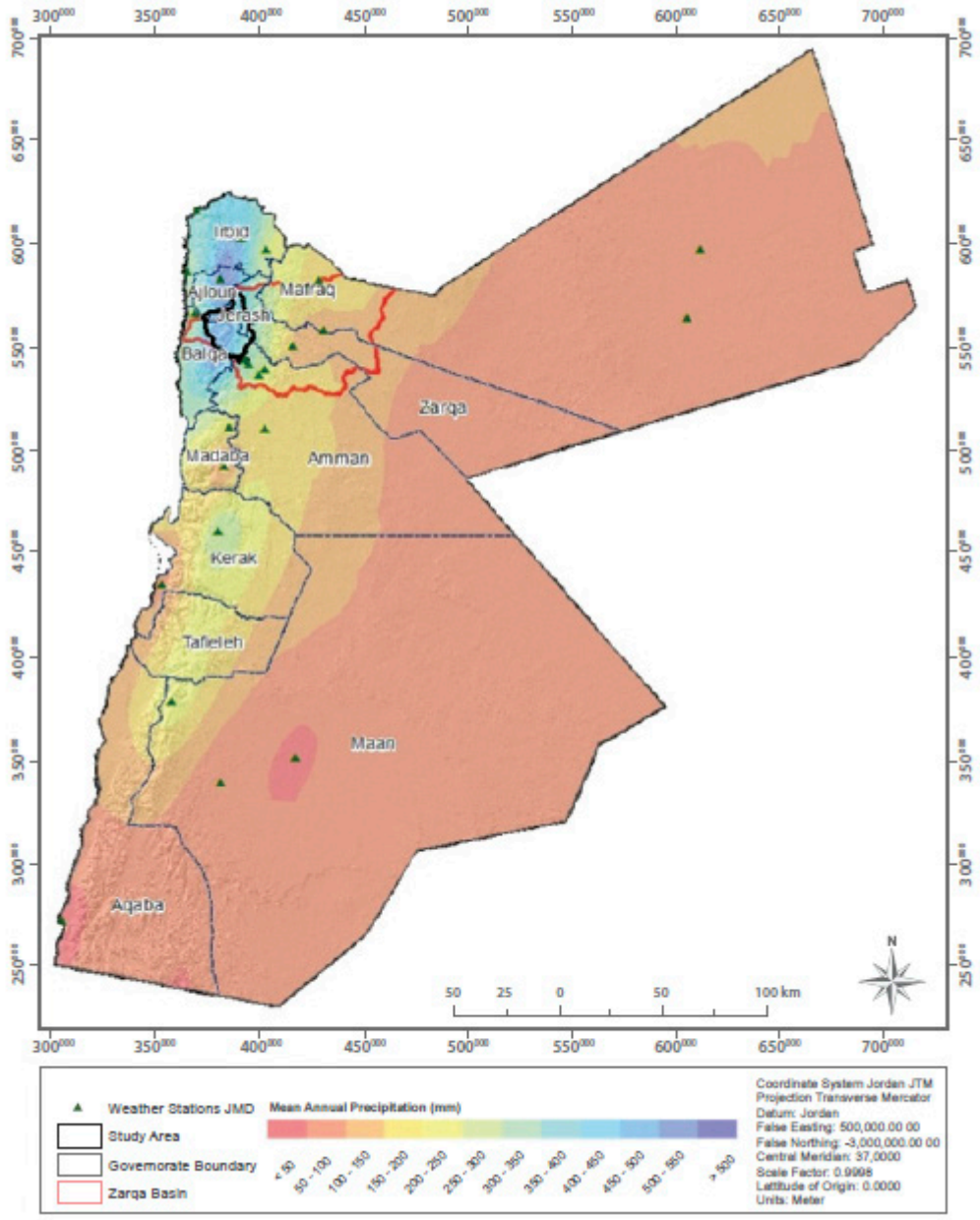
Map 2 Elevation



Source: World Bank Climate Knowledge Portal (2017)

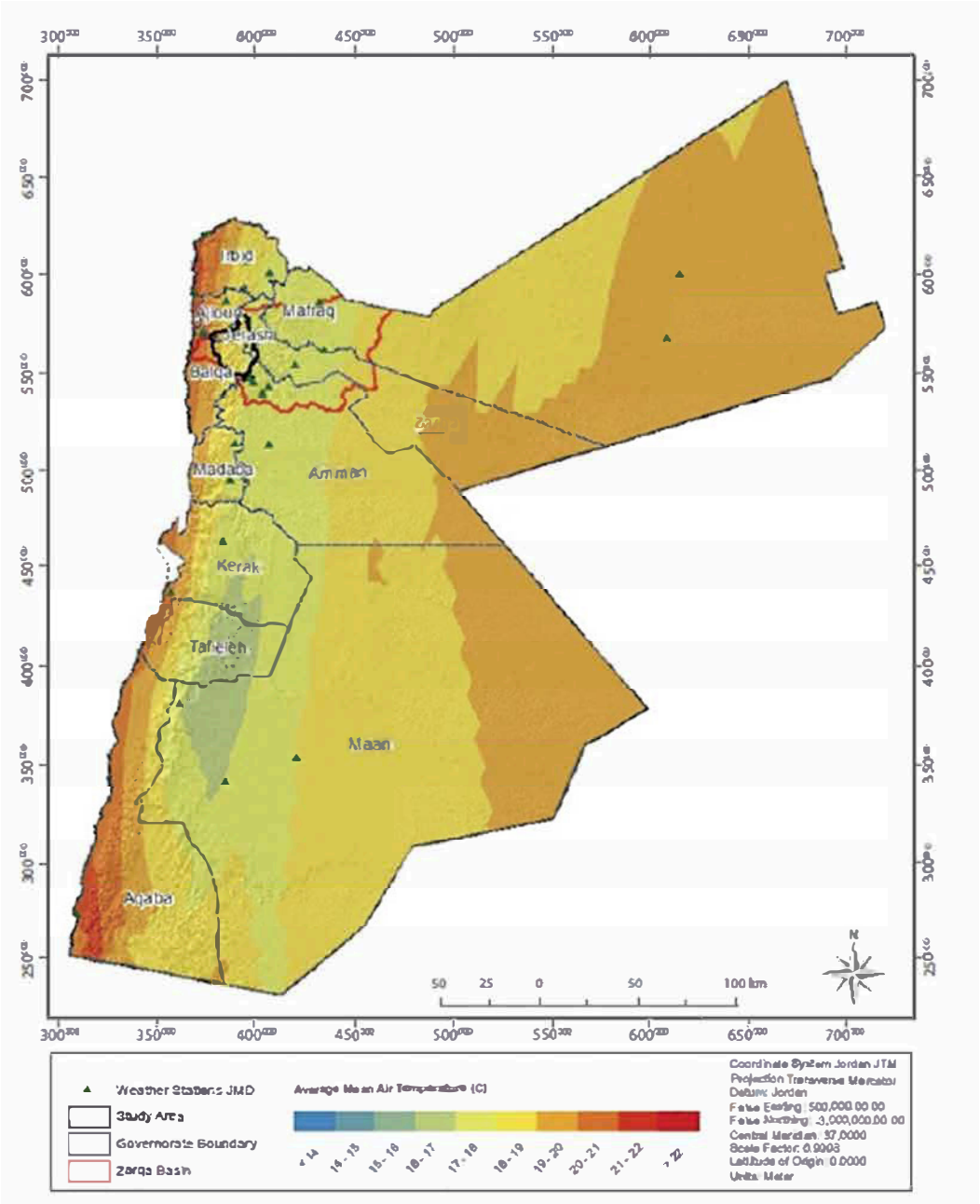
http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisRegion=Asia&ThisCCode=JOR

Map 3 Mean annual precipitation (mm)



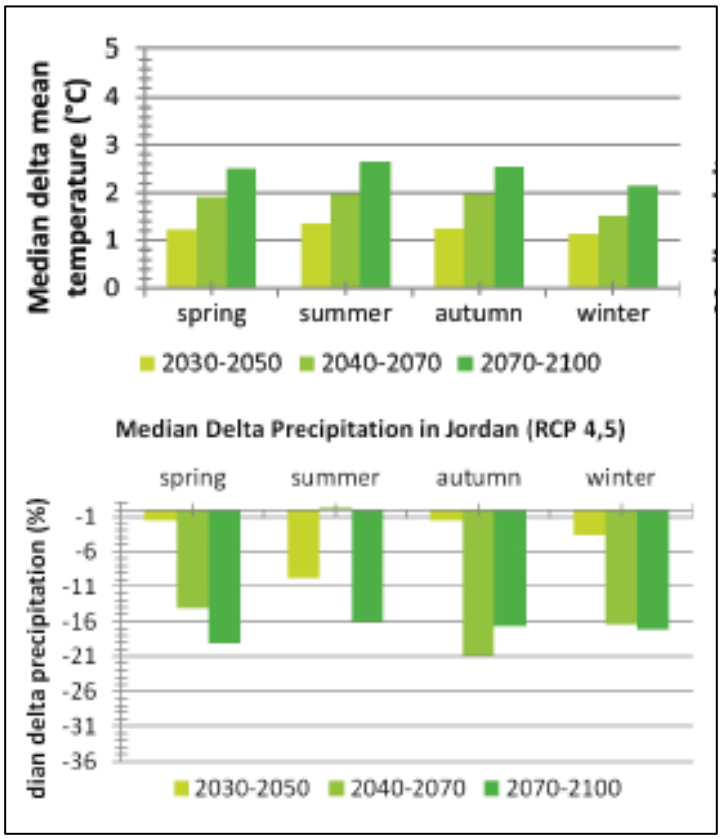
Source: Jordan's Third National Communication on Climate Change(TNC) (2014). Available at http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

Map 4 Average mean temperature (°C)



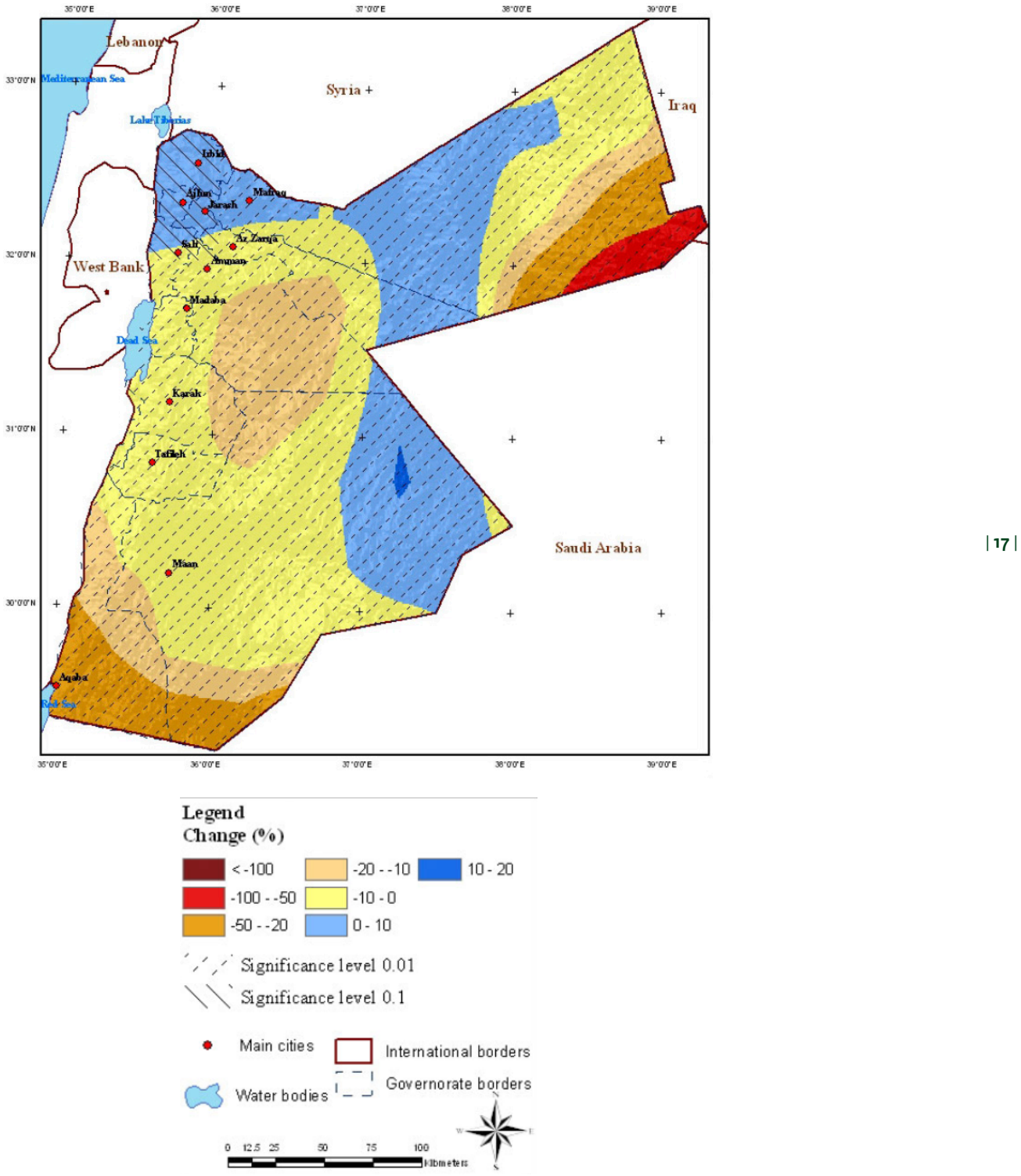
Source: Jordan's Third National Communication on Climate Change(TNC) (2014). Available at http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

Map 5 Projected changes in seasonal mean temperature (°C)



Source: RICCAR (2017) Available at
https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report

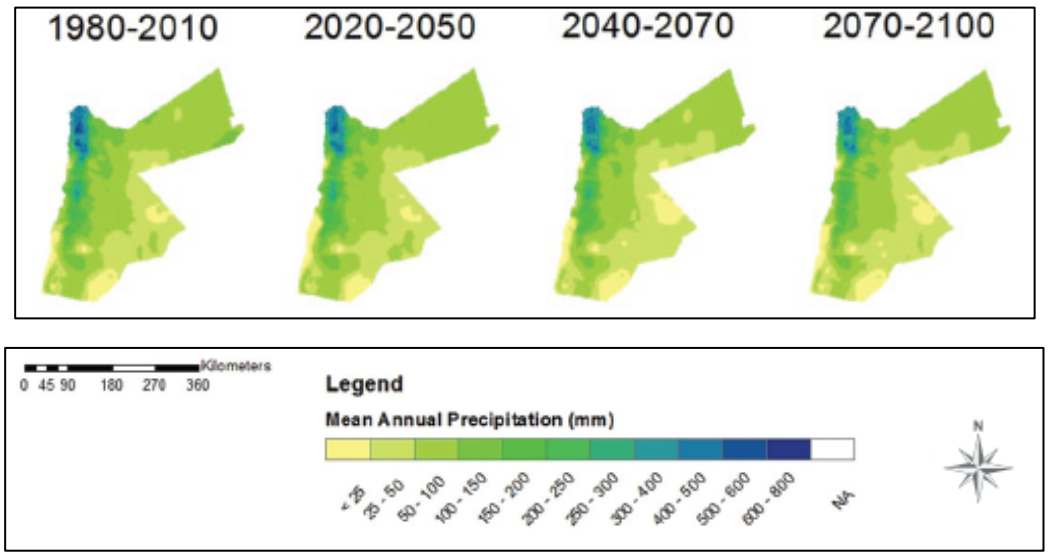
Map 6 Trend of precipitation 1901-2010



Source: ICARDA (2015)

https://apps.icarda.org/wsInternet/wsInternet.asmx/DownloadFileToLocal?filePath=Working_Paper_Series/working_paper27.pdf&fileName=working_paper27.pdf

Map 7 Projections of mean annual precipitation (mm)
(Moderate reference model RCP 4.5)

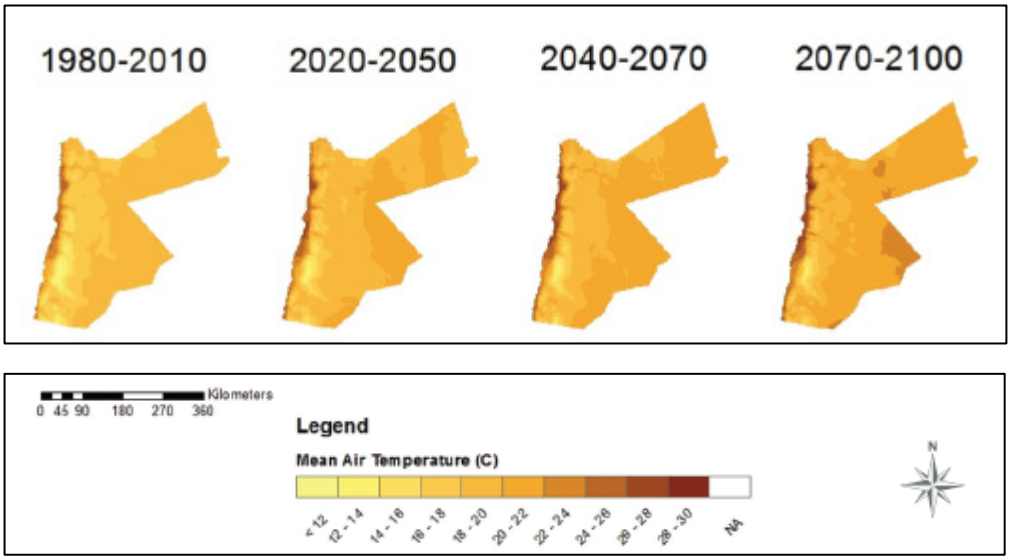


The model projection is that there is an increase in precipitation up to the year 2050 on the Eastern and Southern Badia regions and at the Northern and Southern highlands, with a decrease for the rest of the country which could reach up to 50% in the North of Aqaba. Until 2100, the projection is a decrease in precipitation will cover the whole country except for the northeastern part. Median precipitation will decrease by 20% by 2055. After 2055, the decrease in precipitation becomes quite constant and reaches values of -16% by 2085.

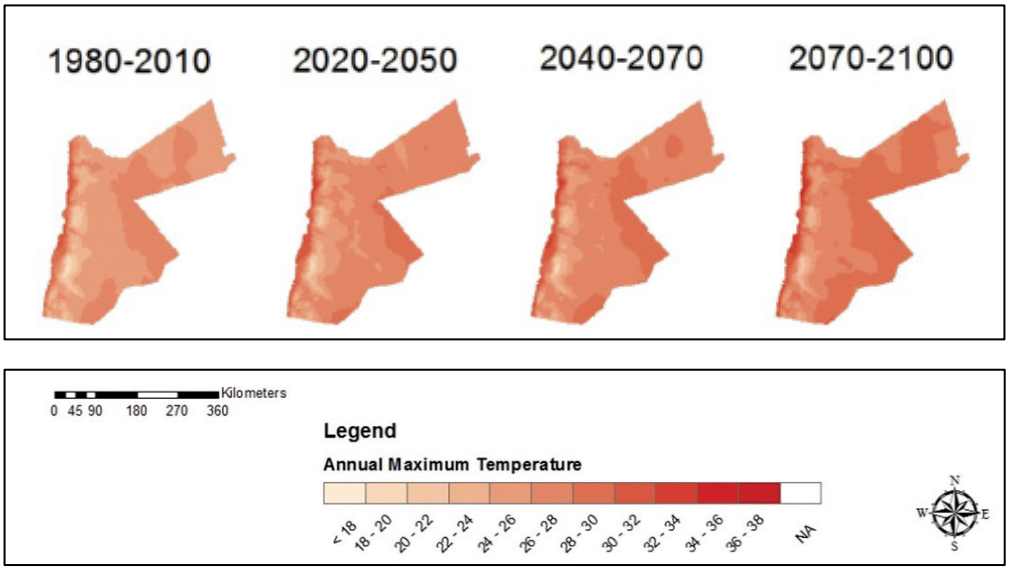
Source: Jordan's Third National Communication on Climate Change(TNC) (2014). Available at
http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

Map 8 Projected average mean and maximum temperature (°C)
(Moderate reference model RCP 4.5 with a projection of increase up to 3.1 °C by 2100)

Mean Temperature

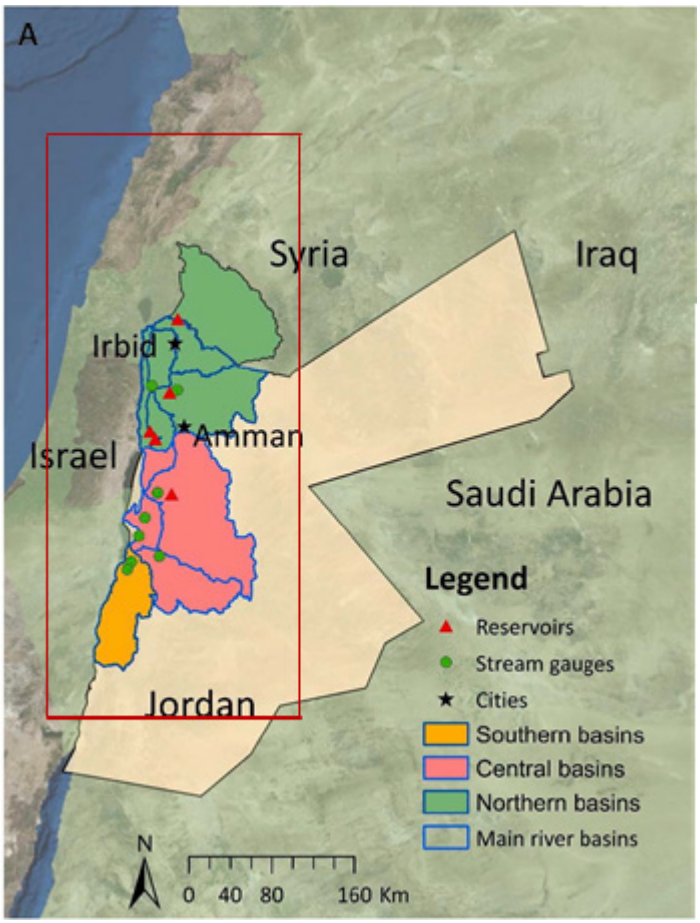


Maximum Temperature



Source: Jordan's Third National Communication on Climate Change(TNC) (2014). Available at
http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7772#beg

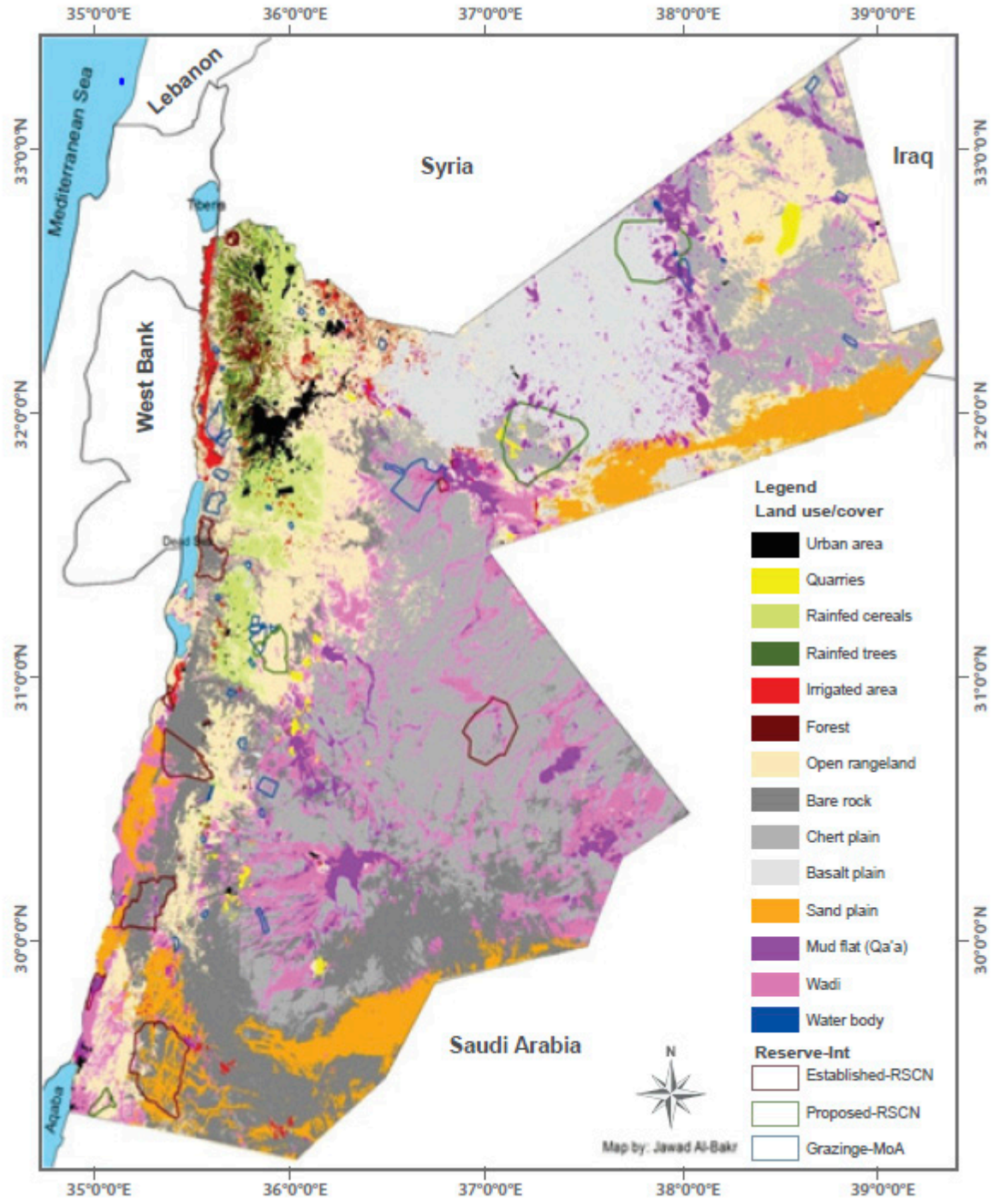
Map 9 Major river basins in Jordan



Map of Jordon with the major surface water basins color coded according to the regional basin groups they belong to and locations of the major cities, reservoirs, and stream gauges.

Source: D. Rajsekhar, S. M. Gorelick, Increasing drought in Jordan: Climate change and cascading Syrian land-use impacts on reducing transboundary flow. Sci. Adv. 3, e1700581 (2017) available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5576883/pdf/1700581.pdf

Map 10 Existing land use/cover of Jordan



Source: TNC (2014), citing Al-Bakri J.T., Suleiman A., Abdulla F. and Ayad J. 2010. Potential impacts of climate change on the rainfed agriculture of a semi-arid basin in Jordan. Physics and Chemistry of the Earth.

http://www.ukm.my/ipi/wp-content/uploads/2013/07/22.2010Potential-impact-of-climate-change-on-rainfed-agriculture-of-a-semi-arid.pdf

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