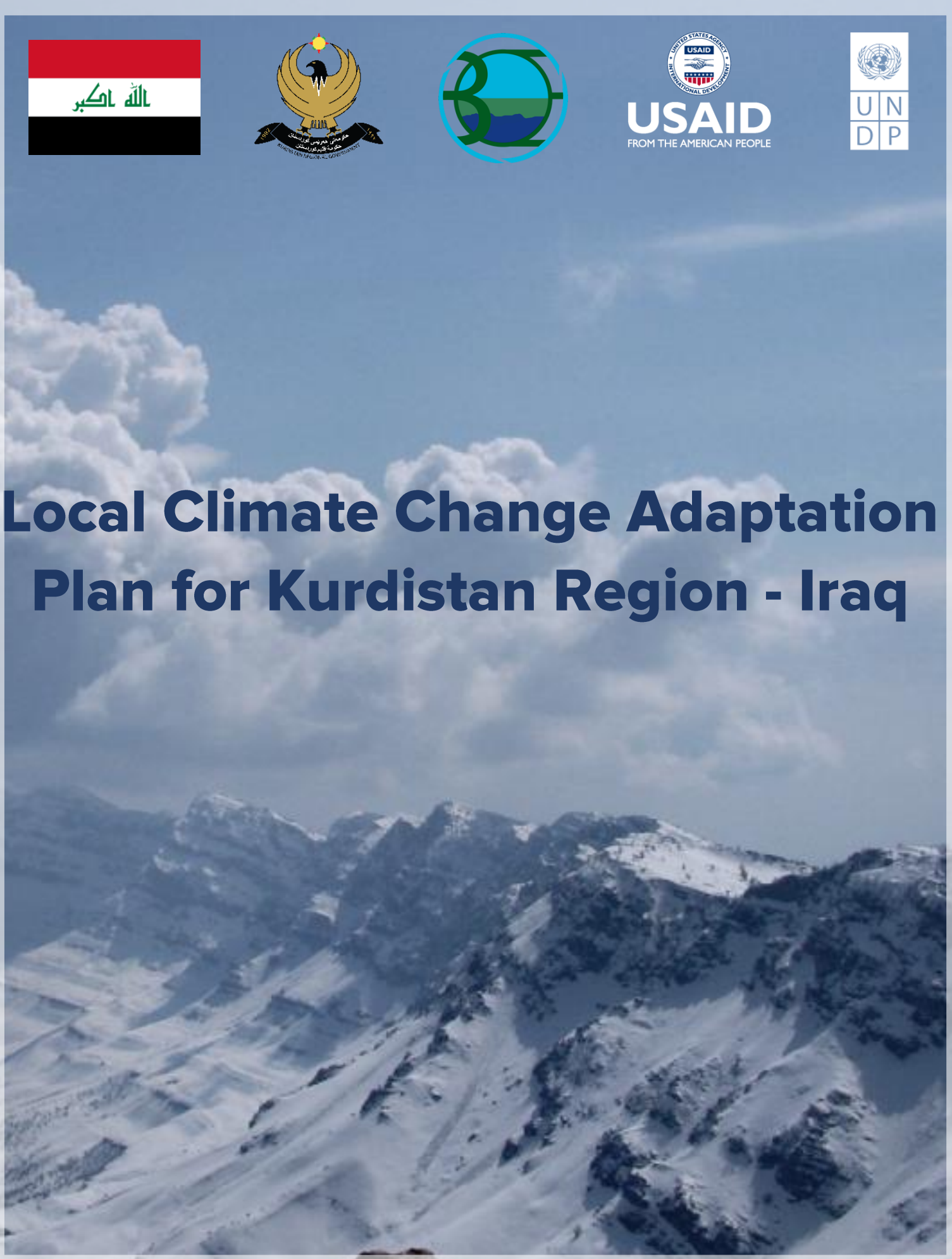

Local Climate Change Adaptation Plan for Kurdistan Region - Iraq

Document Information

Document Title:	Local Climate Change Adaptation Plan for Kurdistan Region – Iraq
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Forward

In the face of a changing climate, adaptation is not merely an option; it is a necessity. The Kurdistan Region of Iraq, like many other regions around the world, is confronted with the impacts of climate change that affect the livelihoods and well-being of its people.

The "Local Climate Change Adaptation Plan for Kurdistan Region - Iraq," is a testament to our commitment to fostering resilience in the face of climatic challenges. This comprehensive plan represents the collective efforts of stakeholders, and local and regional experts who have come together to address the pressing issues posed by climate change.

Kurdistan Region's unique environmental, social, and economic landscape calls for tailored solutions, and this adaptation plan is designed to do just that. By combining the knowledge and expertise of the UNDP with the insights and aspirations of the local experts, we aim to chart a sustainable and climate-resilient future for this region.

As we navigate the challenges of climate change, we must remember that adaptation is not just about responding to threats; it is an opportunity to build a more sustainable, equitable, and prosperous future. We believe that this adaptation plan will serve as a valuable resource for policymakers, community leaders, and all those committed to safeguarding the well-being of the people in the Kurdistan Region.

It is our hope that the "Local Climate Change Adaptation Plan for Kurdistan Region - Iraq" will inspire collaborative action, resilience, and innovation. Together, we can forge a path toward a more sustainable and climate-resilient future for all.

Abdulrahman Sedeeq

Head of the Environmental Protection and Improvement Board (EPIB) - KRG

Acknowledgments

The successful development of the "Local Climate Change Adaptation Plan for Kurdistan Region - Iraq" would not have been possible without the dedication and collaboration of numerous individuals and organizations. We wish to extend our heartfelt thanks to all those who contributed their time, expertise, and unwavering support to this crucial initiative.

We express our deepest gratitude to:

- The Government of the Kurdistan Region of Iraq for its commitment to addressing climate change and its partnership in making this plan a reality (names of KRG staff contributed to the development of this plan are provided in Appendix 2).
- The local stakeholders whose valuable insights and input have informed the development of this plan.
- The United Nations Development Programme (UNDP) staff, experts, and partners for their tireless efforts in researching, designing, and implementing this adaptation plan.
- International organizations and donors who provided funding, technical assistance, and knowledge sharing.
- The dedicated environmental and climate scientists, researchers, and experts whose data and findings have been instrumental in our planning.
- All individuals who have been involved in consultations, workshops, and public engagement activities.

The realization of this adaptation plan is a testament to the collective strength of our efforts and the determination to build a more climate-resilient Kurdistan Region. Together, we have taken a significant step toward safeguarding the environment, the well-being of our communities, and the prosperity of the region in the face of climate change.

Your contributions, expertise, and unwavering commitment to this vital endeavor have been indispensable, and we express our sincere appreciation for your dedication.

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List of Abbreviations

CC	Climate Change
EPIB	Environmental Protection and Improvement Board
UNDP	United Nations Development Programme
LAP	Local Adaptation Plan
NAP	National Adaptation Plan
CVA	Climate Vulnerability Assessment
MRL	Monitoring, Review and Learning
NDC	Nationally Determined Contribution
UNEP	United Nations Environment Programme
CCA	Climate Change Adaptation
COP	Conference of the Parties
GCF	Green Climate Fund
GEF	Global Environment Facility
UNFCCC	United Nations Framework Convention on Climate Change
LDCs	Least Developed Countries
LEG	Least Developed Countries Expert Group
SDGs	Sustainable Development Goals
TWG	Technical Working Group
CMIP	Climate Model Intercomparison Project
IPCC	Intergovernmental Panel on Climate Change
SSP	socio-economic pathway
GHG	Greenhouse Gases
KRG	Kurdistan Regional Government
NGOs	Non-Governmental Organization
KPIs	key performance indicators

Executive Summary

Background

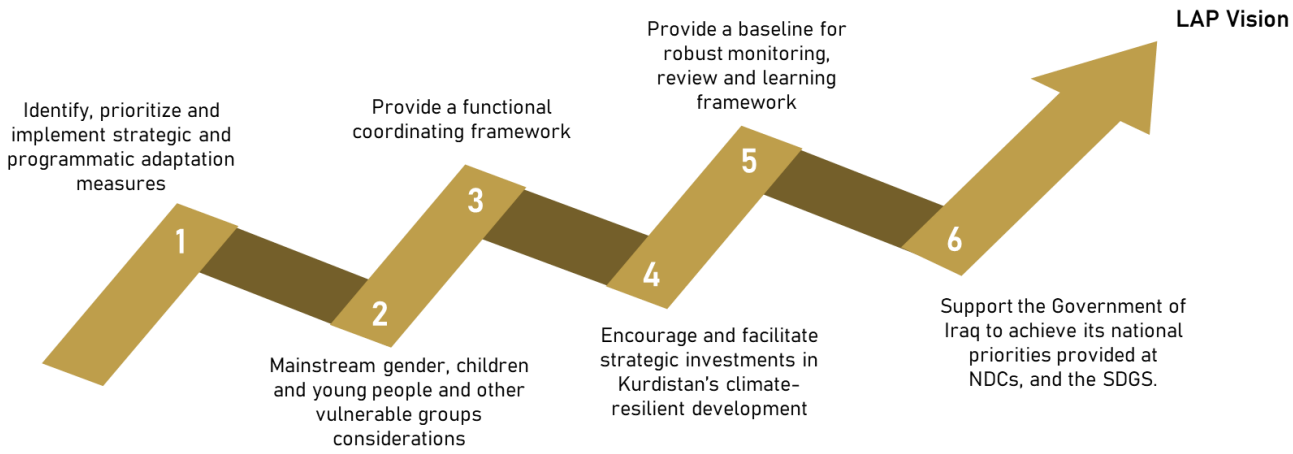
Climate change has become the most common threat to human development and adapting to Climate Change (CC) is becoming an essential component of any planning processes, at any time and at all levels. The Environmental Protection and Improvement Board (EPIB) together with the United National Development Programme (UNDP) launched an initiative aimed at designing Local Adaptation Plan (LAP) to enhance national adaptive capacity and resilience in Kurdistan region to reduce vulnerability to the impacts of climate change.

This report forms part of the country's activities to comply with international environmental agreements. It includes analysis of baseline scenarios and analysis of projected climate change scenarios and their impact on specific sectors in different provinces of Kurdistan, Iraq. The report presents a blueprint of the actions needed to adapt to climate change in Kurdistan.

While Iraq's federal government has committed to national climate policies and initiated plans for adaptation and resilience, there's a need for more focused attention on local driven climate adaptation measures. The National Adaptation Plan (NAP) for Iraq aims to avoid and reduce climate impacts, and in this context the Kurdistan region LAP aligns with national objectives. These local plans are crucial, as they cater to region-specific challenges, engage stakeholders, allocate resources effectively, ensure sustainability, and facilitate both support from the federal government and international agencies.

Strategic Framework

The Kurdistan, Iraq LAP process used a participatory approach where local sectoral experts (Technical Working Group (TWG)) participated in the Vulnerability Assessment and designing adaptation programs and measures. The Kurdistan region CCLAP vision is to build a climate-resilient region through effective adaptation strategies to foster a robust society and ecosystems and stimulate sustainable economic growth. Five objectives were set to achieve this vision.



Historic and Future Climatic Status

To understand how climate change will affect the Kurdistan region, a holistic view of both historical records and future climatic projections. The historical climate data of Kurdistan region shows an increase trend of annual mean and minimum temperature in all provinces. While a slight decrease trend in annual mean precipitation in all provinces.

The future climate scenarios and projections for Kurdistan region can be summarized as follow:

Mean temperature	Mean temperature in Kurdistan provinces is expected to increase from current averages in the range between 1.0 to 5.0 ℃, 1.0 to 6.0 ℃, and 0.5 to 5.0 ℃, in Erbil, Sulaymaniyah and Halabja, and Dohuk.
Minimum temperature	Minimum temperature in Kurdistan provinces is expected to increase from current averages in the range between 0.5 to 5.5 ℃, 1.0 to 5.0 ℃, and 1.0 to 5.0 ℃, in Erbil, Sulaymaniyah and Halabja, and Dohuk.
Precipitation	Precipitation in Kurdistan provinces show no major decline trend (except in Dohuk with decline of 10 mm to 20 mm) with average precipitation 240 mm, 220 mm, and 320 mm, in Erbil, Sulaymaniyah and Halabja, and Dohuk.
Number of hot days >40℃	Number of days with temperature exceeding 40℃ in Kurdistan provinces is expected to increase from 15 to 54 days, 14 to 53 days, and 20 to 60 days, in Erbil, Sulaymaniyah and Halabja, and Dohuk.
Largest 1 day precipitation	The highest precipitation in one day in Kurdistan provinces is expected to increase from current averages in the range between 7 to 11 mm, 10.5 to 14 mm, and 0.11 to 7 mm, in Erbil, Sulaymaniyah and Halabja, and Dohuk.

Climate Hazards and Vulnerability Analysis

Kurdistan LAP was set based on a Climate Vulnerability Assessment (CVA) at provinces level targeting the main three sectors. Those sectors are water resources, agriculture, and food security, as well as biodiversity and ecosystem. Kurdistan CVA's objectives are to identify and understand historical and projected climate risks at the regional level, to evaluate sectoral climate vulnerability to inform sector planning on province level.

The sectoral vulnerability assessment conducted in Kurdistan region shows that, the ecosystem sector is the most vulnerable, primarily due to the intricate interplay between climate shifts and the region's sensitive natural habitats. Ecosystems, including forests, wetlands, and grasslands, are highly sensitive to changes in temperature, precipitation, and extreme weather events, which can have cascading effects on biodiversity and ecological health. The water sector is the second most vulnerable due to the region's reliance on limited water supplies, making it susceptible to changing climate patterns, impacting water availability and quality. Agriculture is the third most vulnerable sector, as it heavily depends on stable climate conditions for successful crop cultivation and livestock management, and changes in temperature, precipitation, and growing seasons can significantly affect agricultural output and food security.

The vulnerability assessment of Kurdistan's provinces reveals disparities across different sectors. Sulaymaniyah is particularly vulnerable in the water sector due to its unique hydrological characteristics and dependence on limited water sources. Changes in precipitation and temperature could strain already scarce water supplies, impacting agriculture and human consumption. Dohuk is the most vulnerable province in the agriculture sector, primarily because of its reliance on rain-fed agriculture, making it sensitive to shifts in precipitation patterns and affecting crop yields and livelihoods. In the ecosystem sector, Halabja and Dohuk exhibit high vulnerability due to their diverse ecosystems and the lack of nature conservation programs. Climate changes can disrupt these ecosystems, impacting biodiversity and natural environments in the region.

Adaptation Action Plan

A set of adaptation programs and measures are proposed in the LAP. In addition to the three main sectors, two cross cutting programs on Social-Responsive Adaptation and Ecosystem Based Adaptation. For all programs timeframe, budget, and finance strategy were identified.

Sector	Program
Water Resources	1. Development of water infrastructure, including reservoirs, dams, and water treatment facilities. 2. Develop a comprehensive flood management system that includes early warning systems, floodplain mapping, and flood-resistant infrastructure. 3. Implementation of water conservation practices, such as drip irrigation systems and rainwater harvesting. 4. Develop and implement water demand management strategies to balance supply and demand, ensuring continuous access. 5. Promotion of community awareness and education on efficient water use.
Agriculture and Food Security	1. Introduce climate-smart agricultural techniques, including crop diversification, agroforestry, and sustainable land management practices. 2. Provide training and capacity-building programs for farmers on climate-resilient farming techniques.

Sector	Program
	3. Establish early warning systems for droughts and floods to support timely agricultural interventions. 4. Conservation agriculture
Biodiversity and Ecosystems	1. Establish protected areas and wildlife corridors to conserve biodiversity and support ecosystem services. 2. Implement reforestation and afforestation programs to restore degraded landscapes and enhance carbon sequestration. 3. Promote sustainable land and forest management practices, including community-led conservation initiatives.
Cross Cutting: Ecosystem-Based Adaptation	Water Resilience Enhancement through nature-based solutions
Cross-Cutting Social-Responsive Adaptation	Strengthening Gender-Responsive Adaptation in Water, Agriculture, and Ecosystems for a Resilient Kurdistan Iraq

These were divided into three timeframe categories; short-term initiatives to be implemented in one to three years; medium term-initiatives to be implemented in more than three years, and long-term initiatives those need more than five years to be accomplished. In total, 29 adaptation measures/initiatives were proposed. For each measure location, indicators, priority, budget, and responsibility for implementation were identified.

Implementation Strategy

Moreover, the LAP investigated the key facilitators and enablers essential for the successful execution of the planned adaptation programs and measures. These enablers encompassed three primary areas, each of which was thoroughly examined and detailed: i) policy mainstreaming, the LAP outlined a strategic approach for integrating the plan into existing policies, with a clear timeline for implementation. This involved a step-by-step roadmap to ensure that adaptation measures were seamlessly incorporated into broader policy frameworks. ii) financing strategy, the LAP identified the framework for designing the finance strategy. iii) communication strategy, Lastly, the LAP addressed the importance of effective communication by identifying the necessary steps and components for crafting a robust communication strategy. This strategy aimed to engage stakeholders, raise awareness, and promote transparency, ensuring that the plan's objectives were well understood and supported by the broader community.

Monitoring, Review and Learning Framework

The LAP document also highlighted and defined the requirements and components of the Monitoring, Review and Learning (MRL) Framework in Kurdistan. The future MRL program structure should include the following components: objectives, KPIs and indicators at different levels (sectoral, program and projects), data collection and management mechanisms, periodic evaluations, learning, and knowledge sharing mechanisms, stakeholder engagement plan, adaptive management and finally, reporting and communication mechanisms.

Finally, the LAP suggested an emerging institutional arrangement for adaptation MRL in Kurdistan region (Chapter VI).

CHAPTER I

Introduction

Chapter I: Introduction

Context

Considered one of the Arab region's most vulnerable countries to climate change, Iraq faces a unique set of environmental challenges. The impacts of changing weather patterns have already been felt in recent years, with a higher frequency and intensity of extreme weather events and rising environmental degradation throughout the country. As demographic growth puts further strain on natural resources that are themselves ever scarcer, the Government's capacity to devise and implement the necessary adaptation and mitigation policies is undermined by a daunting context of post-conflict reconstruction (National Vulnerability Assessment Report, 2022).

The Government of Iraq finalized its updated Nationally Determined Contribution (NDC) in 2021 and provides the umbrella policy for climate change work in Iraq. While the commitments in the NDC are commendable, climate migration is not addressed, which undermines the allocation of resources and actionable commitments to mitigate and address climate migration.

In 2020, the Government of Iraq, in partnership with the UN Environment Programme (UNEP), has launched a process to develop a National Adaptation Plan (NAP) to build the country's resilience to climate change. The NAP process aims to reduce vulnerability to the negative impacts of climate change, especially in developing countries, through strategic planning based on projections of future climate change. NAPs are seen as one of the most important mechanisms for adapting to climate change.

The Kurdistan government, in collaboration with the UNDP, has formulated the "Local Climate Change Adaptation Plan for Kurdistan Region" to address the specific needs of the region. This comprehensive document aims to tackle climate change challenges, while also aligning its objectives with the national adaptation plan goals and targets at the broader national level. Through this concerted effort, the plan strives to ensure effective adaptation measures tailored to the unique circumstances of Kurdistan, while contributing to the overall success of the country's adaptation initiatives. Additionally, the LAP will also take into consideration the institutional gaps, unclear climate change roles and responsibilities at the institutional and regulatory levels.

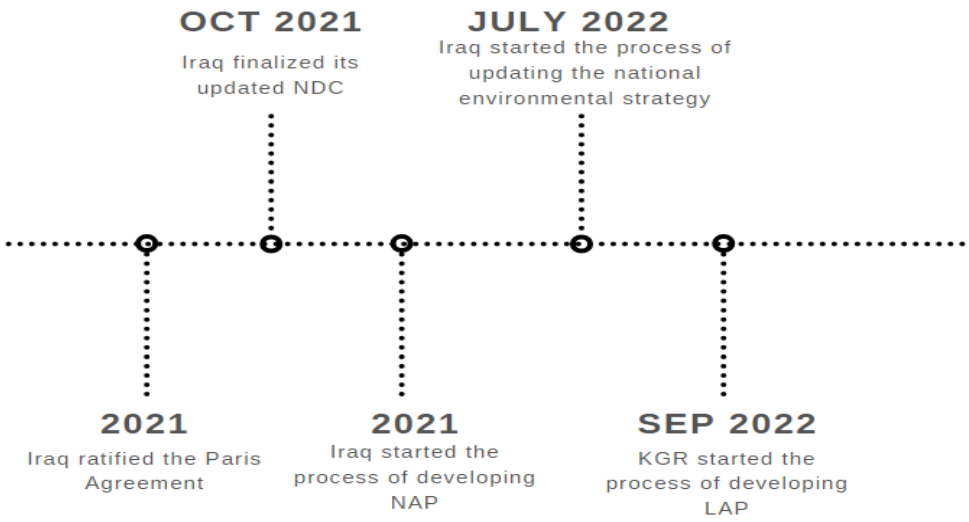


Figure 1: Climate change effort in Iraq and Kurdistan

Developing a local climate change adaptation plan for Kurdistan, Iraq is crucial to effectively address the region's specific climate change challenges, build resilience, engage stakeholders, allocate resources, promote sustainability, and access international support. It enables proactive and targeted action to protect communities, ecosystems, and the economy from the impacts of climate change.

Developing a local climate change adaptation plan addresses the region-specific challenges; Kurdistan, Iraq faces unique climate change challenges that may differ from other regions of the country. Developing a local adaptation plan allows for a tailored approach to address the specific impacts and vulnerabilities of the region. It enables a better understanding of the local climate patterns, risks, and opportunities for adaptation. Resilience Building where local adaptation plans help build resilience in the face of climate change impacts. By identifying and implementing specific adaptation measures, Kurdistan can enhance its capacity to withstand and recover from climate-related events such as droughts, floods, or extreme temperatures. This can protect critical infrastructure, ecosystems, and livelihoods in the region.

- Stakeholder Engagement: Developing a local adaptation plan involves engaging stakeholders from various sectors, including government agencies, local communities, businesses, and civil society organizations. This inclusive process encourages collaboration, participation, and ownership of adaptation actions. It ensures that the plan reflects the needs and priorities of the local population, promoting effective implementation and sustainability.
- Resource Allocation and Prioritization: A local adaptation plan helps allocate resources effectively by identifying priority areas and interventions. It allows for strategic planning, considering the specific vulnerabilities, capacities, and constraints of Kurdistan. By having

a plan in place, policymakers and authorities can make informed decisions on allocating funds, implementing projects, and monitoring progress.

- Long-term Sustainability: Climate change is a long-term challenge that requires sustained efforts. A local adaptation plan provides a framework for long-term planning and action, enabling continuous monitoring, evaluation, and adjustment of adaptation strategies. It ensures that climate change considerations are integrated into development plans, policies, and regulations, promoting sustainable development practices. furthermore, the LAP provides a tool to priorities and facilitate the support of the federal government to the region.
- International Cooperation and Funding: Developing a local adaptation plan can also facilitate international cooperation and access to climate finance. By aligning with national and international climate goals and frameworks, Kurdistan can attract funding, technical assistance, and expertise to support its adaptation efforts. It enhances the region's visibility and credibility in international climate change forums.

Effective medium- and long-term adaptation strategies are crucial to reducing negative climate impacts and providing a viable path towards resilience. Planning for a future development trajectory necessitates addressing medium- and long-term climate adversities and their simultaneous mainstreaming into national planning. The current drive towards planning and implementation is thus more focused on medium and long-term climate change adaptation along with concrete strategies for governance and climate financing.

Addressing medium- and long-term climate change impacts further requires a coordinated strategy document for implementing climate change adaptation. This would ensure collaborative efforts to reduce climate risks and vulnerabilities, increase resilience and minimize maladaptation, while paying heed to both soft and hard adaptation limits. This would increase capacity and resilience, bring about transformation and system transitions, take measures to uphold sustainable human and ecosystem health and gender-inclusive socioeconomic well-being, and reduce losses and damages.

LAP Foundation

COP16 in 2010 emphasized enhanced action on adaptation through the Cancun framework by establishing the National Adaptation Plan (NAP) process, which will facilitate effective adaptation planning, resources mobilization and integration of Climate Change Adaptation (CCA) in the national development process. The framework prioritizes medium- to long-term adaptation through strategic and programmatic approaches over ad hoc, short-term initiatives, towards making people, places, ecosystems and economies more resilient to the impacts of climate change. COP16 also established the Green Climate Fund (GCF) as an operating entity of the financial mechanism of the UNFCCC. The GCF was launched at COP18, which requested its board to balance allocations of resources between adaptation and mitigation activities. COP18 in Doha in 2012

highlighted the need for developing NAPs in LDCs and developing countries. The Least Developed Countries Expert Group (LEG) prepared a technical guideline for NAPs in 2012.

The Paris Agreement, adopted at COP21, reinforced adaptation planning processes as vital to social and economic development and central to the global response to climate change. Article 7 of the Paris Agreement calls on all Parties to engage in adaptation planning, including to formulate and implement NAPs and improve the "effectiveness and durability" of adaptation actions. To date, 72% of Paris Agreement 190 signatories have adopted at least one national-level adaptation instrument (a plan, strategy, policy, or law), while a small fraction does not currently have such an instrument in place or are in the process of developing one. Most developing countries have started formulating NAPs as a key mechanism, yet they can be at very different stages of this process.

This NAP comprises structured and persistent pathways for transformation in climate change adaptation and climate resilient development. It will act as the important tool for climate negotiation to manage climate finance as per Article 7 and Article 9 of the Paris Agreement (2015). It will elaborate strategies to communicate adaptation status and best practices globally, recognizing stress in COP26 (2021) on all countries to produce an 'Adaptation Communication'. It will monitor and evaluate progress towards setting adaptation goals.

Vision and Goals

The Kurdistan Government intends within its LAP development to contribute to achieving a pro-active, climate risk-resilient region, that assures an increased resilience of its communities and institutions, natural ecosystems, water, and agricultural resources in the path towards sustainable and climate-resilient development.

Kurdistan LAP vision
Building a climate-resilient region through effective adaptation strategies to foster a robust society and ecosystems and stimulate sustainable economic growth

The LAP sets goals to achieve its vision while considering diverse issues in different thematic sectors to address climate change adaptation.

- Identify, prioritize, and implement strategic and programmatic adaptation measures to enhance Kurdistan's resilience and adaptation planning process that are mainstreamed into sectoral planning and budgeting systems.
- Mainstream gender, children and young people and other vulnerable groups considerations, to increase their adaptive capacity and strengthen the economic stability of the most affected populations in Kurdistan.
- Provide a functional coordinating framework to guide national stakeholders and development partners through climate resilient decision-making processes.

- Encourage and facilitate strategic investments in Kurdistan's climate-resilient development including the mobilization of national, international, public, and private finance through a flexible financing strategy.
- Provide a baseline for robust monitoring, review and learning framework to ensure that expected outputs, outcomes, and impacts are achieved, and the LAP process is adjusted through the integration of lessons learnt.
- Support the Government of Iraq to achieve its national priorities provided at Nationally Determined Contributions (NDCs), and the Sustainable Development Goals (SDGs).

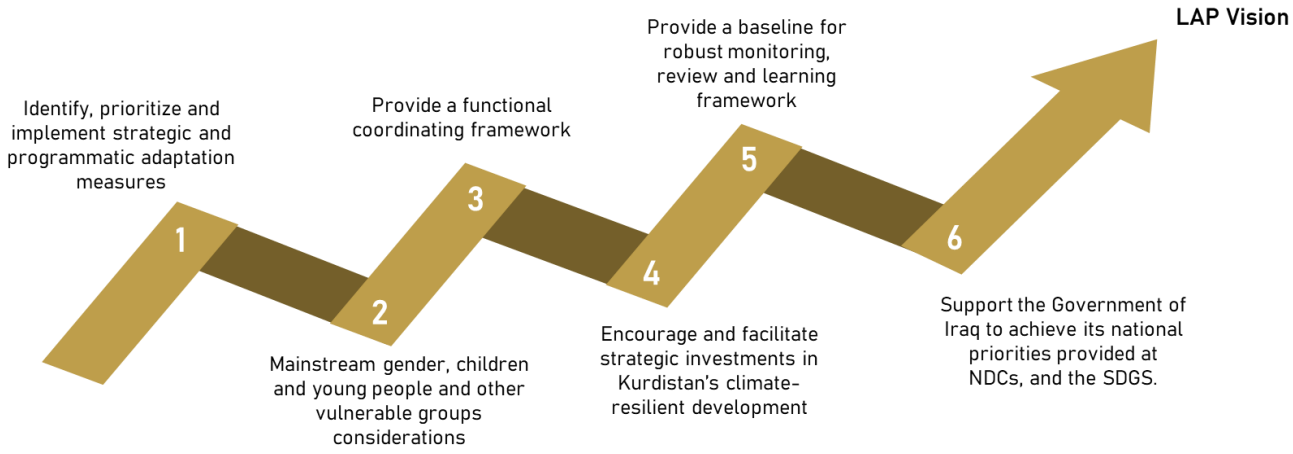


Figure 2: Kurdistan CC LAP objectives

Devising Sectoral Boundaries

The initial conceptualization of the LAP emphasized water resources, agriculture, and biodiversity & ecosystems as the priority sectors for adaptation.

The LAP thus focuses on these three sectors and their subsectors, along with other critical cross cutting issues, such as women and gender equality, youth, persons with disabilities, the private sector, infrastructure, and health-to identify appropriate strategies.

LAP Approach

The LAP process was guided by the UNFCCC 'Technical guidelines for the national adaptation plan process". The process of preparing the LAP document went through a number of steps to ensure the effective participation of various institutions and experts and under the leadership of The Board of Environmental Protection and Improvement in Kurdistan Region as it is the competent and responsible authority for climate change in Kurdistan region.

A Technical Working Group (TWG) was created which involved representatives from the key institutions that are addressing climate adaptation challenges in Kurdistan region as well as experts from the different sectors.

The main activities and steps conducted within the LAP process were the following:

- Stocktaking of adaptation in Kurdistan region aiming at identifying the baseline for the elaboration and implementation of the LAP process in Kurdistan.
- Data gathering for climatic parameters, social, demographic, and economic factors.
- Stakeholders consultations on Vulnerabilty Assessment methodolgy, boundaries, sectors of focus and framework. Designning the vulnerabilty indicators to be assessed by the team.
- Conducting the vulnerabilty assessment for Kurdistan, Iraq in consultation with stakeholders.
- Design the adaptation programs and work together with the TWG on adaptation measures in consultation with stakeholders.

CHAPTER II

Climate Change and Related Risks

Chapter II: Climate Change and Related Risks

Historical Climate Trends in Kurdistan

The climate of the Kurdistan Region is semi-arid continental; hot and dry in summer, and cold and wet in winter. The region is cooler compared to the central and southern parts of Iraq. In the mountains, the climate is considerably wetter but only marginally cooler than the steppe. Rainfall in the mountains varies by location, but ranges from 400 mm to more than 1,000 mm, falling mostly between November and March.

Summers are hot and dry, with high average temperatures ranging from 35 °C in the cooler northernmost areas to blistering 40 °C in the southwest, with lows around 21 °C to 24 °C. Winter is dramatically cooler than the rest of Iraq, with highs averaging between 9 °C and 11 °C and with lows hovering around 3 °C in some areas and freezing in others, dipping to −2 °C and 0 °C on average.

Kurdistan, Iraq, has witnessed notable climate changes since the 1950s, with key trends indicating shifts in temperature and rainfall patterns. Over the years, there has been a steady rise in mean annual temperature, with an estimated rate of around 0.7°C per century. Moreover, changes in annual rainfall have been observed, particularly in the northeast region, where there has been an increase at a rate of about 2.4 mm per month per century. These changes in temperature and precipitation are crucial factors shaping the region's climate and environment, prompting the need for comprehensive analysis and adaptation strategies to cope with the evolving climatic conditions and their potential impacts on various sectors in Kurdistan, Iraq. Recorded changes and trend in mean temperature, minimum temperature, and precipitation in Kurdistan, Iraq provinces are illustrated in the figures below.

Mean Temperature

Historical change in annual mean temperature in Kurdistan, Iraq shows an increase trend in all provinces, and illustrated in the figures 2,3 and 4 below.

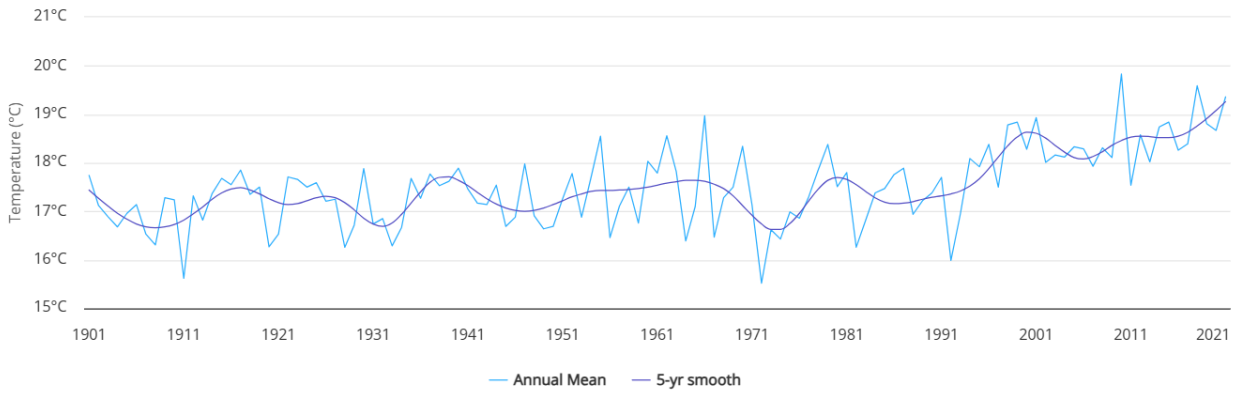


Figure 3: Observed average annual mean-temperature in Erbil (1901-2021)

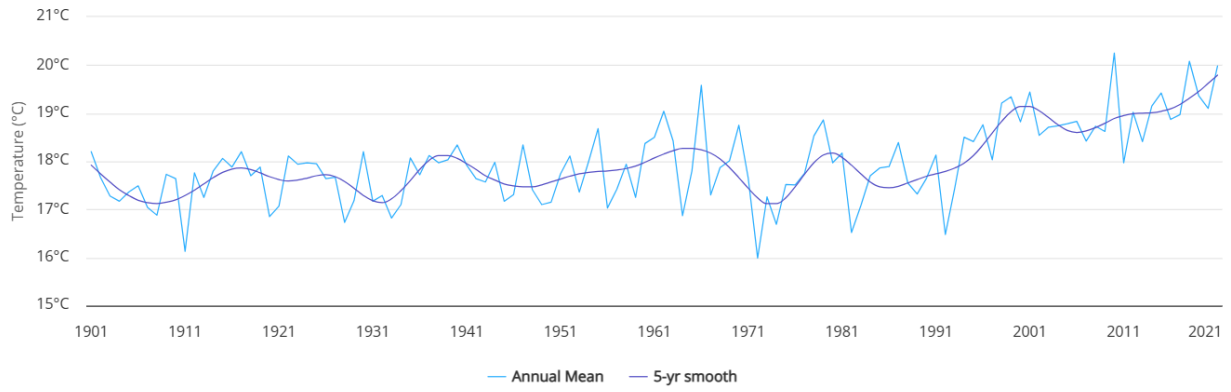


Figure 4: Observed average annual mean-temperature in Sulaymaniyah and Halabja (1901-2021)

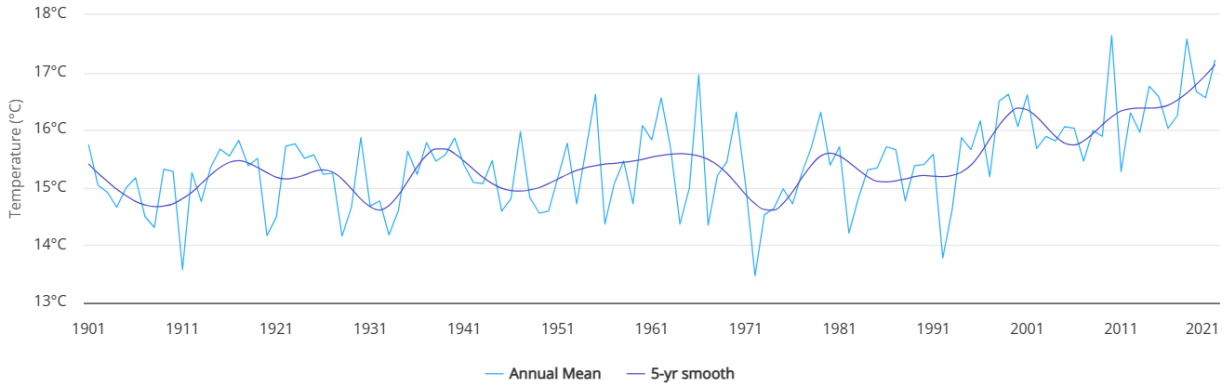


Figure 5: Observed average annual mean-temperature in Dohuk (1901-2021)

Minimum Temperature

Historical change in annual minimum temperature in Kurdistan, Iraq shows an increase trend in all provinces, and illustrated in the figures 5,6 and 7 below.

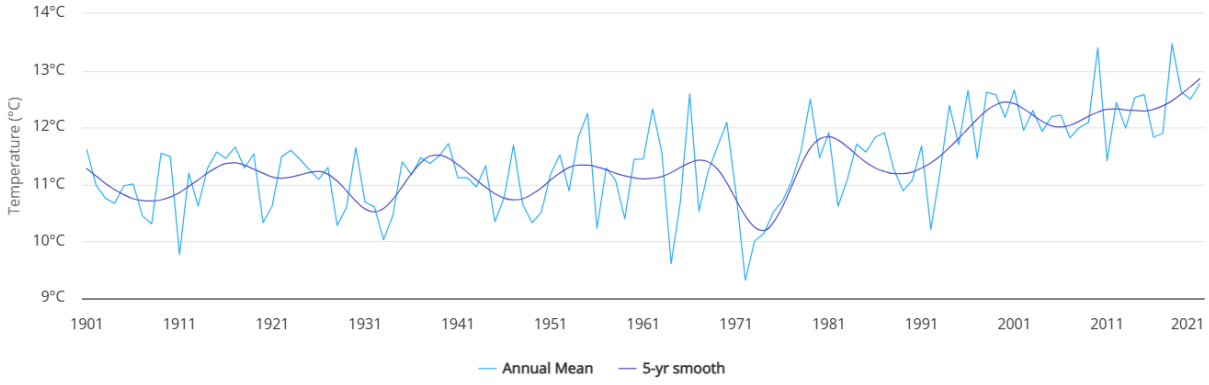


Figure 6: Observed average annual min-temperature in Erbil (1901-2021)

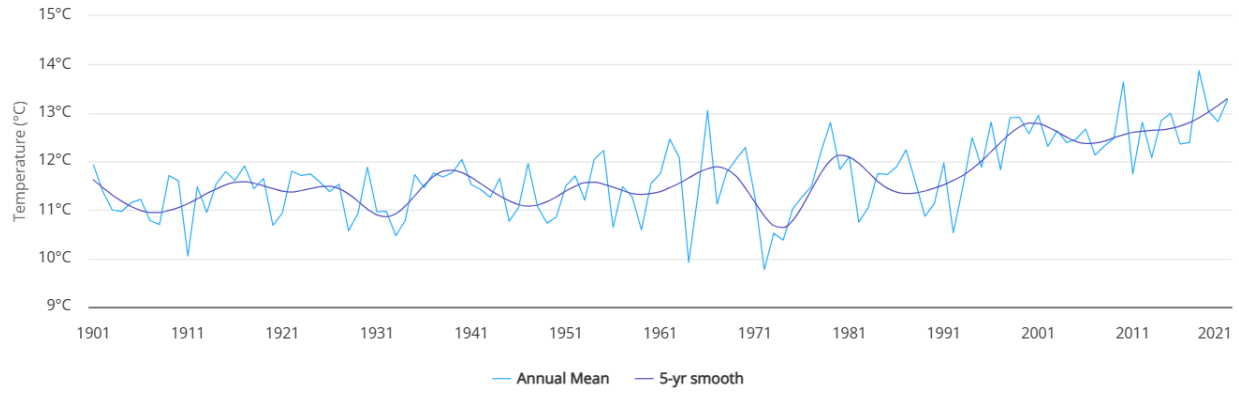


Figure 7: Observed average annual min-temperature in Sulaymaniyah and Halabja (1901-2021)

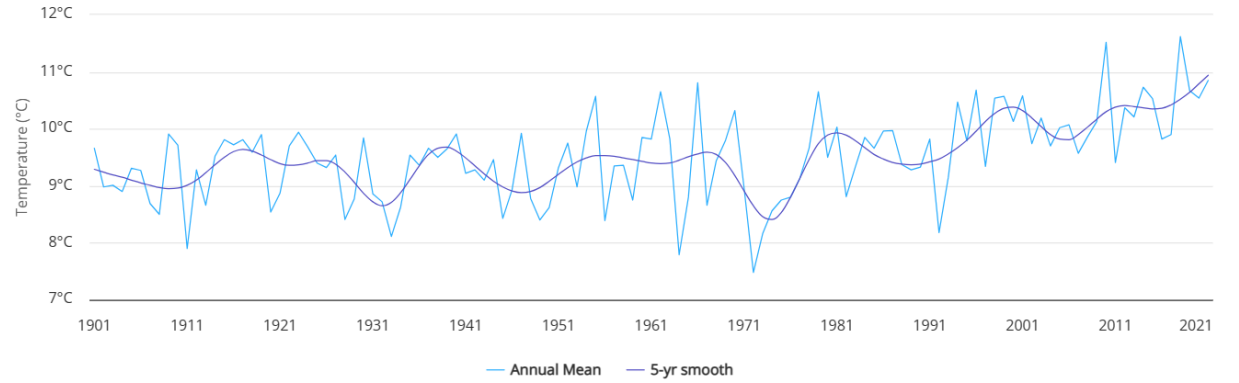


Figure 8: Observed average annual min-temperature in Dohuk (1901-2021)

Precipitation variability

Historical change in annual mean precipitation in Kurdistan, Iraq shows a slight decrease trend in all provinces, and illustrated in the figures 8,9 and 10 below.

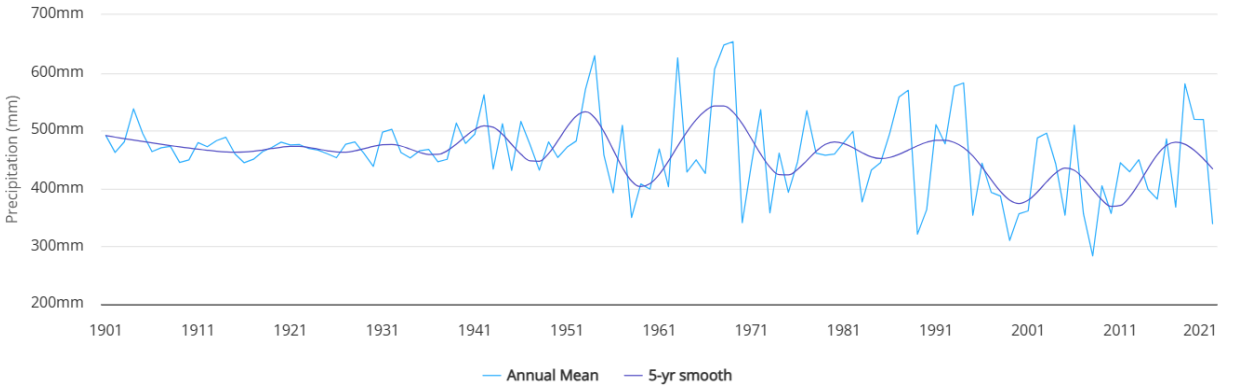


Figure 9: Observed average annual precipitation in Erbil (1901-2021)

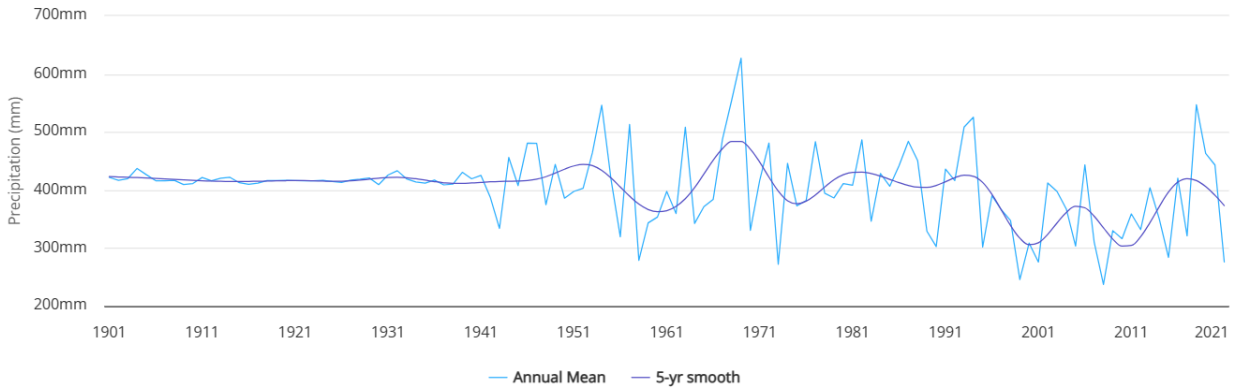


Figure 10: Observed average annual precipitation in Sulaymaniyah and Halabja (1901-2021)

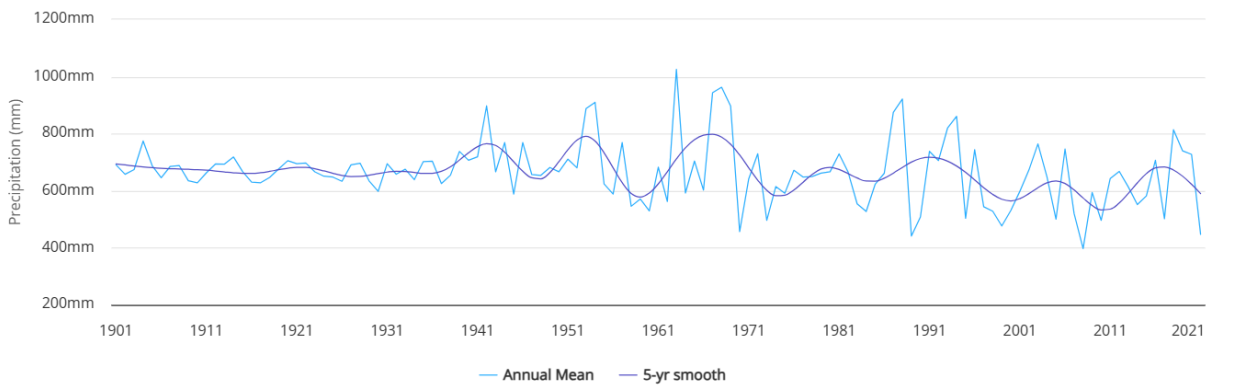


Figure 11: Observed average annual precipitation in Dohuk (1901-2021)

Future Climate Scenarios

Climate projection data is modeled data from the global climate model compilations of the Climate Model Intercomparison Project Phase 6. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report. Multi Model ensemble was used in the projections of future climate scenarios, Models from multiple climate research institutes used are listed in table 1 below.

Table 1: Models from multiple climate research institutes used

Model Name	Research Institute/Organization
access-cm2	Australian Community Climate and Earth System Simulator (ACCESS)
access-esm1-5	The Australian Community Climate and Earth System Simulator (ACCESS); Earth System Model 1.5 (ESM1.5)
awi-cm-1-1-mr	The Alfred Wegener Institute Climate Model (AWI-CM)
bcc-csm2-mr	Beijing Climate Center
cams-csm1-0	Chinese Academy of Meteorological Sciences (CAMS)
canesm5	The Canadian Earth System Model version 5
cesm2	Community Earth System Model 2
cmcc-cm2-sr5	Centro Euro-Mediterraneo sui Cambiamenti Climatici, Italy

cmcc-esm2	
cnrm-cm6-1 cnrm-esm2-1	National Center for Meteorological Research, Météo-France and CNRS laboratory, France
ec-earth3 ec-earth3-veg	Earth Consortium -EC3, Europe
fgoals-g3	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
gfdl-esm4	Geophysical Fluid Dynamics Laboratory/NOAA, USA
hadgem3-gc31-ll	Met Office Hadley Centre, UK
inm-cm4-8 inm-cm5-0	Institute of Numerical Mathematics (INM), Russia
ipsl-cm6a-lr	The Institut Pierre Simon Laplace (IPSL), Europe
kace-1-0-g	National Institute of Meteorological Sciences-Korea Met. Administration, Korea
kiost-esm	Korea Institute of Ocean Science & Technology (KIOST), Korea
miroc-es21 miroc6	Japan Agency for Marine-Earth Science and Technology, National Institute for Environmental Studies, Japan
mpi-esm1-2-hr mpi-esm1-2-lr	Max-Planck-Institut fuer Meteorologie, Germany
mri-esm2-0	Meteorological Research Institute, Japan
nesm3	Nanjing University of Information Science & Technology, China
noresm2-lm noresm2-mm	Norwegian Earth System Model, Norwegian Meteorological Institute,NORCE Norwegian Research Centre, Norway
taiesm1	Taiwan Earth System Model, the Research Center for Environmental Changes Academia Sinica, Taiwan
ukesm1-0-11	Met Office Hadley Centre, Natural Environment Research Council, UK

The Sixth Assessment Report of the IPCC (IPCC, 2021) updated future climate projections with new shared socio-economic pathway (SSP) scenarios based on five narratives describing broad socioeconomic trends. These unfold the range of plausible future scenarios. According to the IPCC, SSP1-2.6 represents low future greenhouse gas emissions (GHG), while SSP5-8.5 is the very high emissions scenario.

In the context of assessing the potential impacts of climate change in the Kurdistan Region, it is essential to consider a wide range of possible future scenarios and to ensure a robust and comprehensive assessment, the Kurdistan Region has taken into account the two specific SSPs from the IPCC AR6: SSP1-2.6 and SSP5-8.5. By considering both scenarios, decision-makers and researchers can evaluate a spectrum of potential outcomes, ranging from a low-emission, sustainable future (SSP1-2.6) to a high-emission, high-warming scenario (SSP5-8.5).

The adoption of these two scenarios enables policymakers in the Kurdistan Region to assess the vulnerabilities and risks associated with various climate trajectories. SSP1-2.6 represents a future pathway where ambitious climate mitigation efforts and sustainable development lead to low

greenhouse gas emissions and limited global warming. On the other hand, SSP5-8.5 portrays a future characterized by high emissions and significant climate change impacts.

By examining both scenarios, decision-makers can make informed choices about adaptation (and mitigation in a separate context) strategies, considering a wide range of potential future climate conditions. This approach allows for more comprehensive planning and preparedness to address the challenges posed by climate change in the Kurdistan Region. Ultimately, utilizing the insights from these two scenarios from the IPCC AR6 ensures that climate policies and actions are tailored to suit the specific needs and circumstances of the region while considering the full spectrum of potential climate outcomes.

In the context of assessing the potential impacts of climate change in Kurdistan, Iraq, five climate indicators have been selected to determine the exposure level in each province: Mean temperature, Minimum temperature, Number of days with more than 40℃ temperature, Precipitation, and Largest 1-day precipitation combined with return period.

For the water sector, changes in precipitation patterns play a significant role as they directly impact water availability and the replenishment of water sources. These changes can affect water supply for agricultural irrigation, drinking water, and the overall health of ecosystems. Additionally, the indicator of Largest 1-day precipitation combined with return period is crucial for understanding extreme rainfall events, which can lead to flash floods, waterlogging, erosion, and damage to water infrastructure.

In the agriculture sector, Mean temperature and Minimum temperature are vital indicators for assessing overall temperature conditions in the region. They influence crop growth, phenology, and yield, while extreme temperatures can impact crop stress and water requirements for irrigation. Moreover, the Number of days with more than 40℃ temperature is significant in evaluating the frequency of extremely hot days, which can pose challenges for crop productivity, increase water demand for irrigation, and potentially lead to heat stress in livestock.

In the biodiversity and ecosystems sector, changes in Mean temperature and Minimum temperature can directly impact species distribution, migration patterns, and phenological events, thereby affecting biodiversity and ecosystem dynamics. Alterations in Precipitation patterns can also impact ecosystems by influencing vegetation growth, species composition, and water availability in critical habitats. Furthermore, the indicator of Largest 1-day precipitation combined with return period is crucial in understanding extreme precipitation events that may disrupt ecosystems, causing flooding, soil erosion, and habitat destruction.

The following part illustrates the projected changes for the five climate indicators by the end of the century using Multi Model ensemble to ensure covering the variety of model results (shaded area in the figures below) and minimize uncertainty.

Mean Temperature

Mean temperature in Kurdistan provinces is expected to increase from current averages in the range between 1.0 to 5.0 ℃, 1.0 to 6.0 ℃, and 0.5 to 5.0 ℃, in Erbil, Sulaymaniyah and Halabja, and Dohuk under SSP1-2.6 and SSP5-8.5, respectively compared to the reference period from 1995 to 2014.

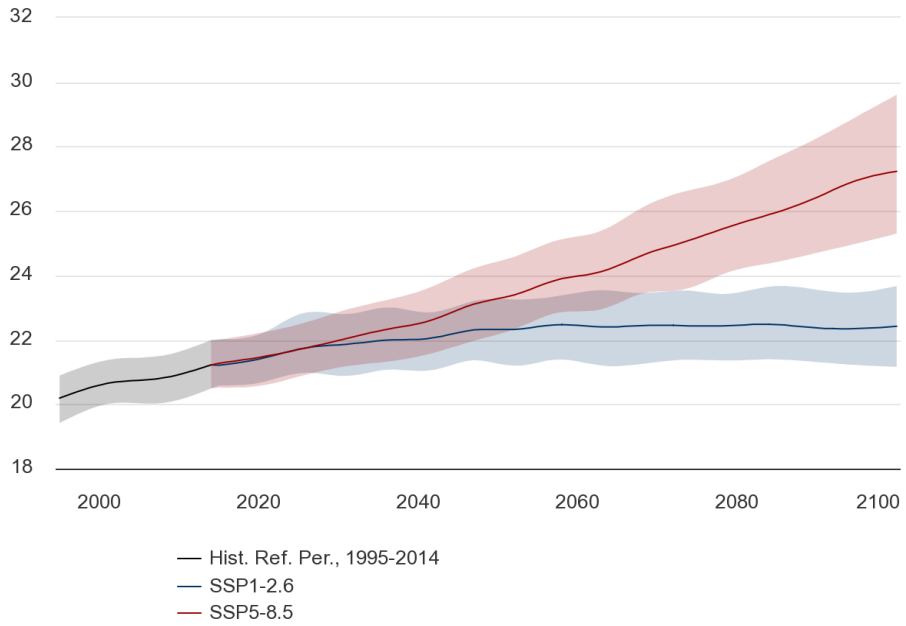


Figure 12: Projection mean temperature for Erbil (Ref year 1995:2014), Multi Model ensemble

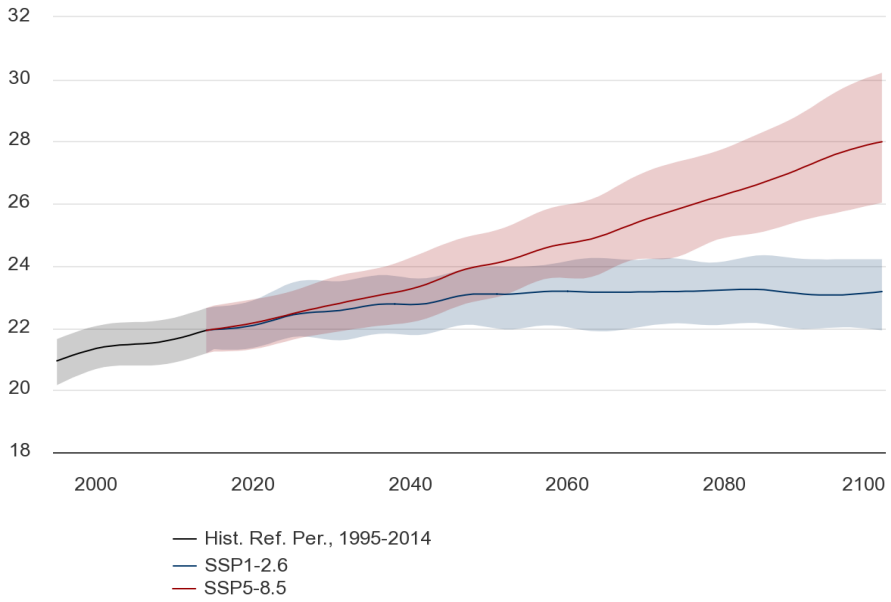


Figure 13: Projection mean temperature for Sulaymaniyah and Halabja (Ref year 1995:2014), Multi Model ensemble

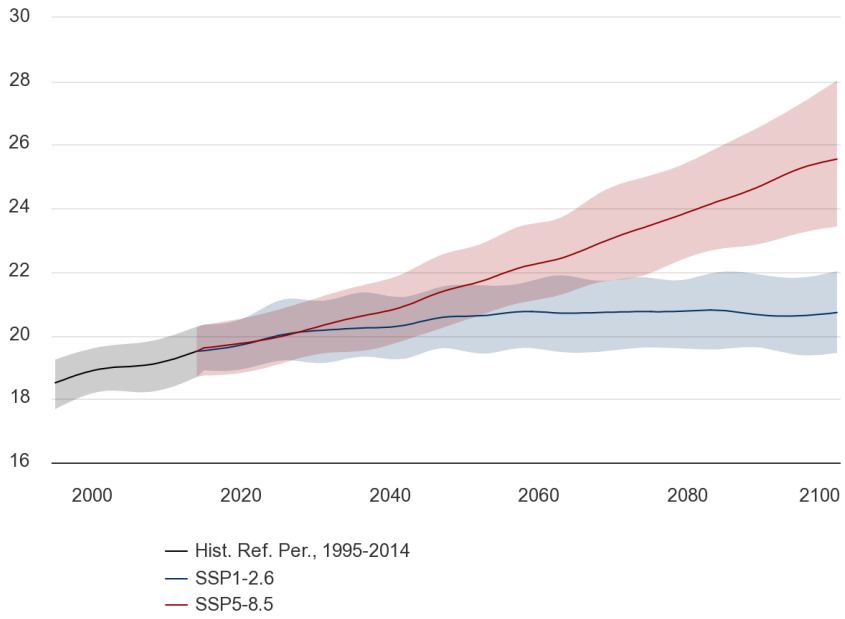


Figure 14: Projection mean temperature for Dohuk (Ref year 1995:2014), Multi Model ensemble

Minimum Temperature

Minimum temperature in Kurdistan provinces is expected to increase from current averages in the range between 0.5 to 5.5 ℃, 1.0 to 5.0 ℃, and 1.0 to 5.0 ℃, in Erbil, Sulaymaniyah and Halabja, and Dohuk under SSP1-2.6 and SSP5-8.5, respectively compared to the reference period from 1995 to 2014.

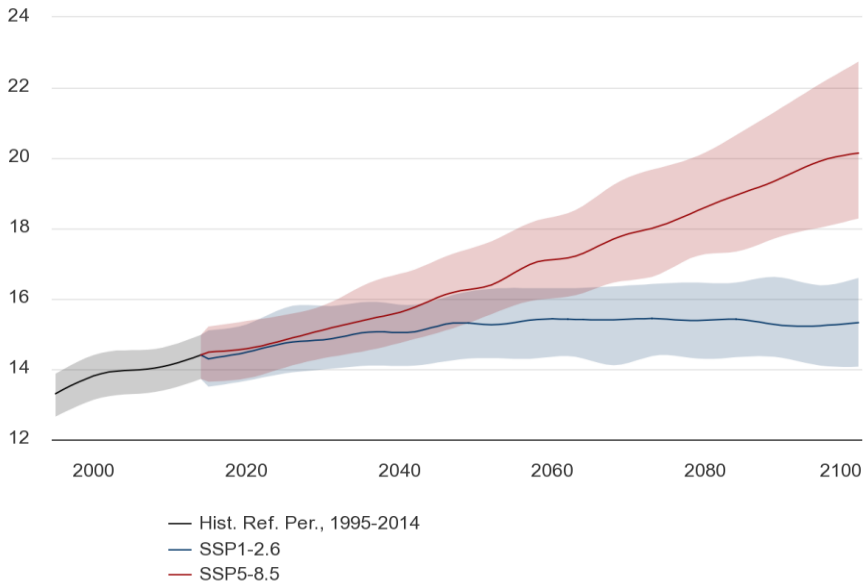


Figure 15: Projection Min-temperature for Erbil (Ref year 1995:2014), Multi Model ensemble

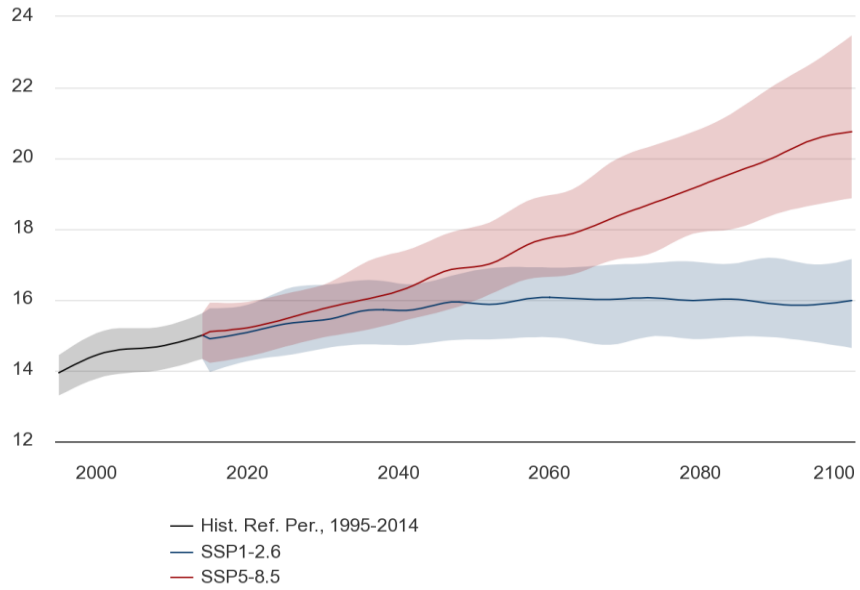


Figure 16: Projection Min-temperature for Sulaymaniyah and Halabja (Ref year 1995:2014), Multi Model ensemble

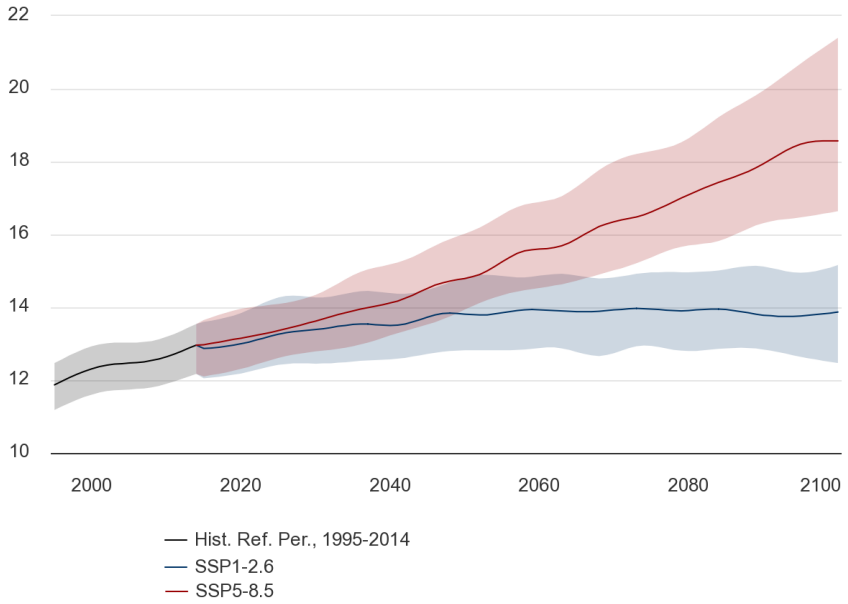


Figure 17: Projection Min-temperature for Dohuk (Ref year 1995:2014), Multi Model ensemble

Precipitation

Precipitation in Kurdistan provinces show no major decline trend (except in Dohuk with decline of 10 mm to 20 mm) with average precipitation 240 mm, 220 mm, and 320 mm, in Erbil, Sulaymaniyah and Halabja, and Dohuk under SSP1-2.6 and SSP5-8.5, respectively compared to the reference period from 1995 to 2014.

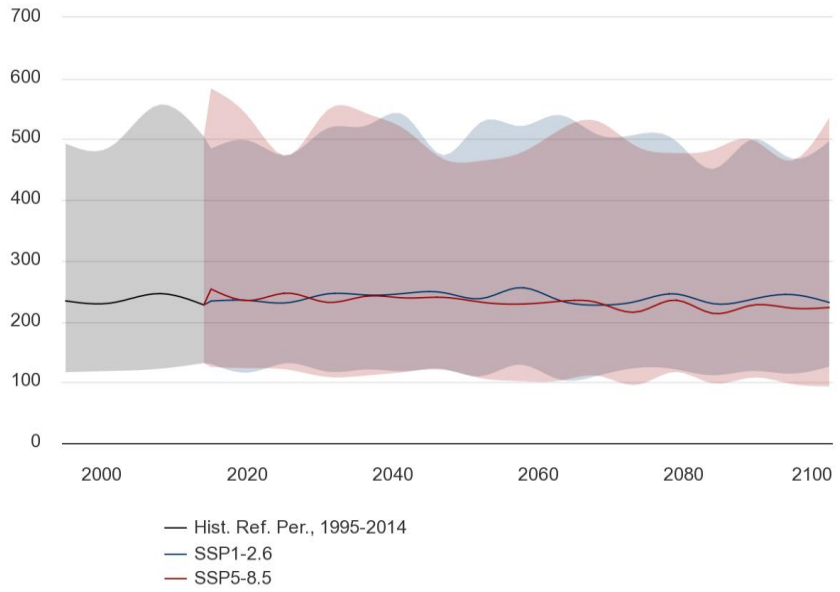


Figure 18: Projected precipitation for Erbil (Ref year 1995:2014), Multi Model ensemble

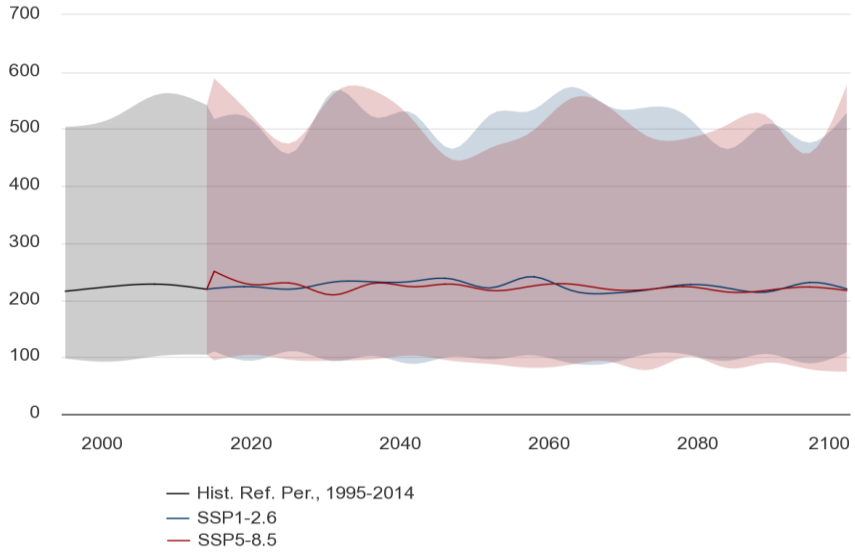


Figure 19: Projected precipitation for Sulaymaniyah and Halabja (Ref year 1995:2014), Multi Model ensemble

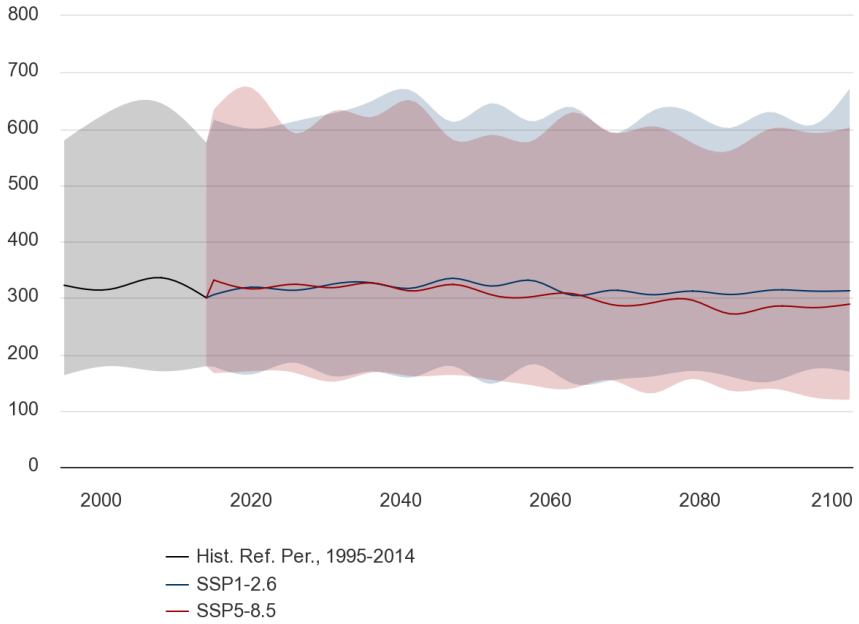


Figure 20: Projected precipitation for Dohuk (Ref year 1995:2014), Multi Model ensemble

Number of hot days > 40℃

Number of days with temperature exceeding 40℃ in Kurdistan provinces is expected to increase from 15 to 54 days, 14 to 53 days, and 20 to 60 days, in Erbil, Sulaymaniyah and Halabja, and Dohuk under SSP1-2.6 and SSP5-8.5, respectively compared to the reference period from 1995 to 2014.

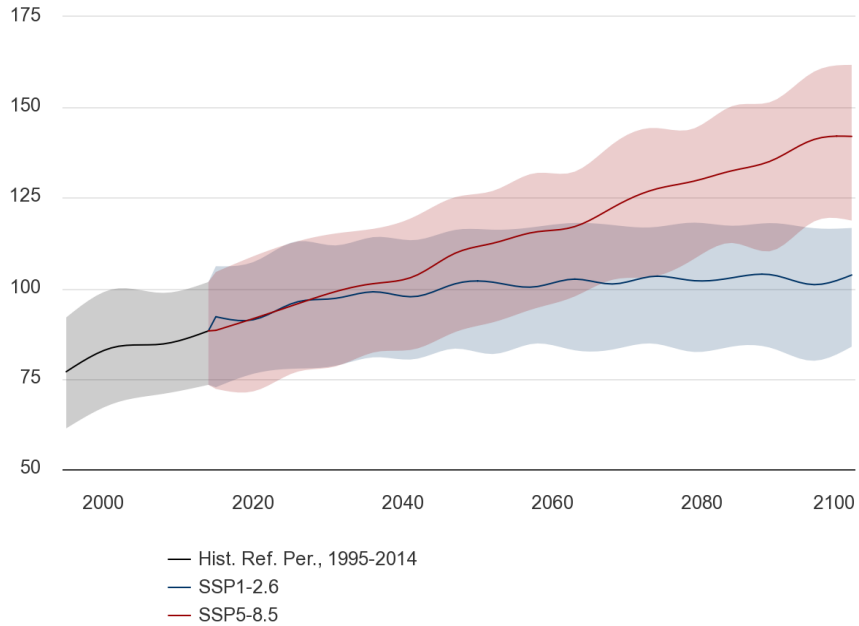


Figure 21: Projected number of hot days (Tmax > 40℃) for Erbil (Ref year 1995:2014), Multi Model ensemble

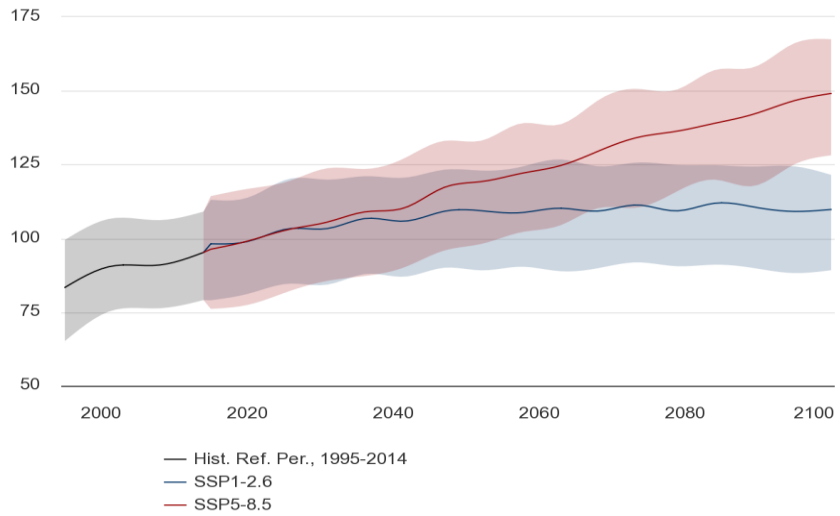


Figure 22: Projected number of hot days (Tmax > 40℃) for Sulaymaniyah and Halabja (Ref year 1995:2014), Multi Model ensemble

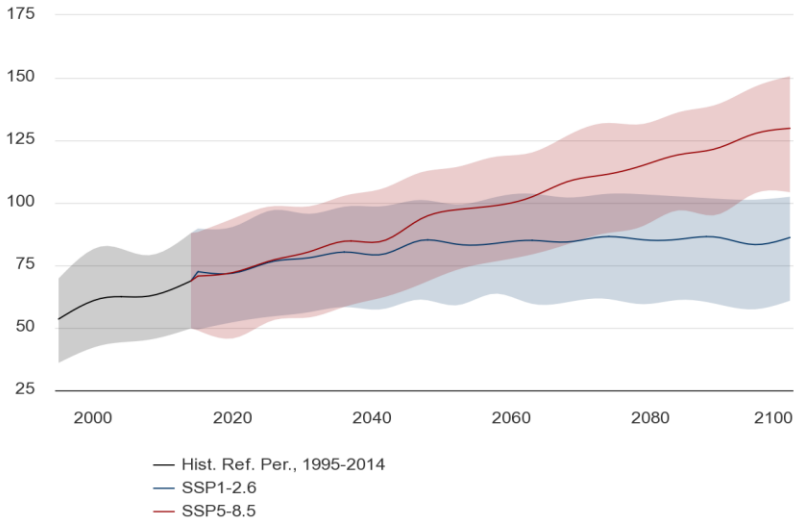


Figure 23: Projected number of hot days (Tmax > 40℃) for Dohuk (Ref year 1995:2014), Multi Model ensemble

Largest 1 day precipitation

The highest precipitation in one day in Kurdistan provinces is expected to increase from current averages in the range between 7 to 11 mm, 10.5 to 14 mm, and 0.11 to 7 mm, in Erbil , Sulaymaniyah and Halabja, and Dohuk under SSP1-2.6 and SSP5-8.5, respectively compared to the reference period from 1995 to 2014.

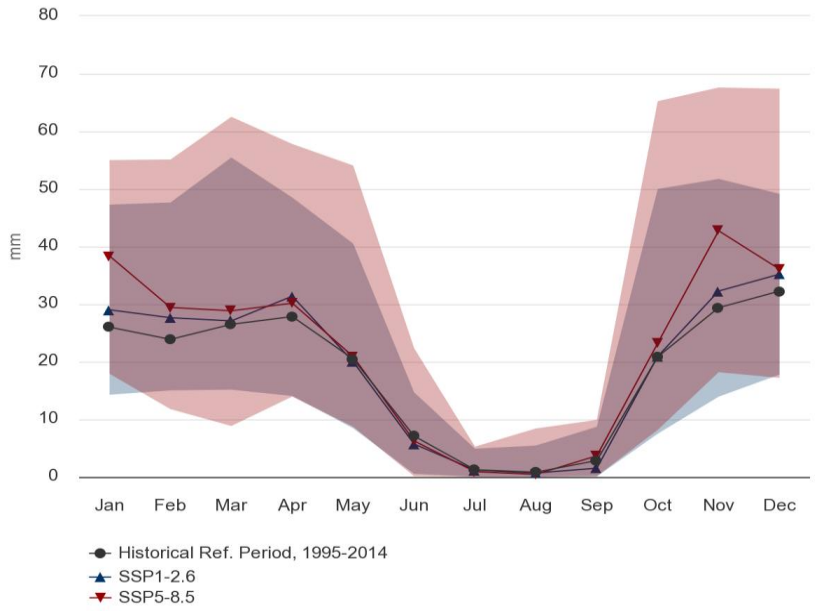


Figure 24: Largest 1 day precipitation for Erbil (Ref year 1995:2014) in the period 2080-2099, Multi Model ensemble

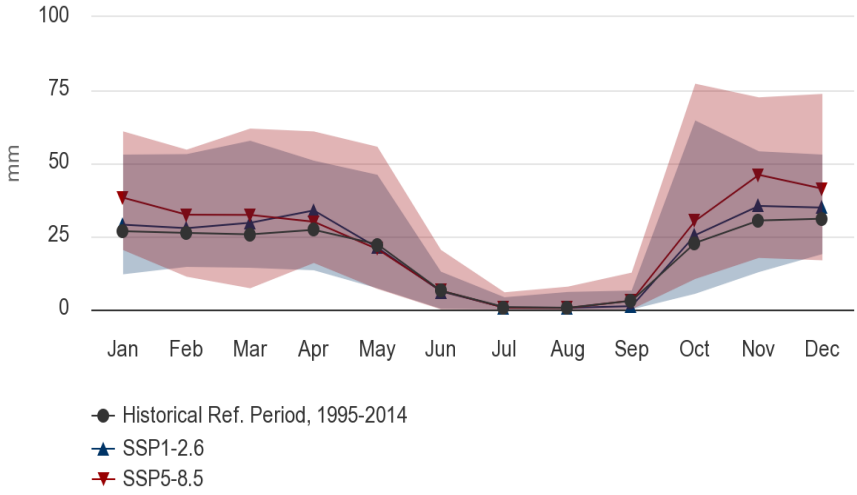


Figure 25: Largest 1 day precipitation for Sulaymaniyah and Halabja (Ref year 1995:2014) in the period 2080-2099, Multi Model ensemble

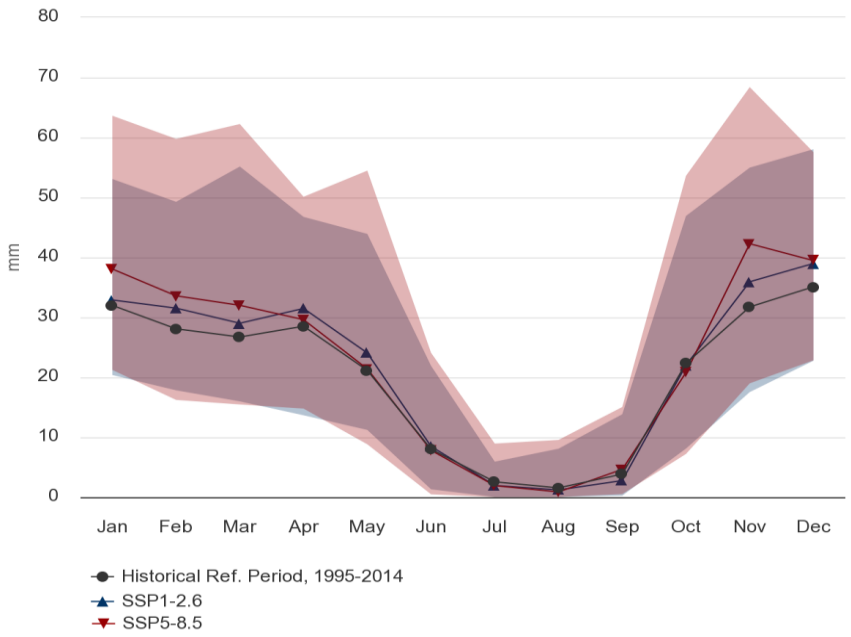


Figure 26: Largest 1 day precipitation for Dohuk (Ref year 1995:2014) in the period 2080-2099, Multi Model ensemble

Future Climate Risks and Vulnerabilities

The Kurdistan Region of Iraq stands at a critical juncture in its development trajectory, with a burgeoning population and expanding economic activities that are increasingly intertwined with its unique natural environment. Yet, as global climate patterns continue to evolve, the region faces a growing array of future climate risks and vulnerabilities that pose significant challenges to its sustainable development and well-being.

The undeniable impacts of climate change, including rising temperatures, altered precipitation patterns, and extreme weather events, are already being felt in Kurdistan. These changes are not only affecting the region's physical landscape but are also impacting its socio-economic fabric. While Kurdistan is known for its resilience and adaptive capacity, the intensification and unpredictability of climate-related hazards present a complex set of challenges that demand a proactive and comprehensive response.

This section provides an overview of the emerging climate risks and vulnerabilities facing Kurdistan, emphasizing the need for a holistic approach to climate adaptation. It will delve into the key sectors and communities most at risk, highlighting the potential consequences of inaction and the opportunities for resilience-building strategies in the face of an uncertain climate future.

Climate stress at the province level

The assessment of climate stress at the province level is an essential tool for understanding the localized impacts of climate change within a region as diverse as Kurdistan, Iraq. Table 2 below

provides a comprehensive overview of climate hazards, offering a perspective on how different provinces within Kurdistan are experiencing the effects of a changing climate.

Table 2: Overview of climate hazards in Kurdistan provinces

Provinces	Area (Km^2)*	Population (million)*	Population living in urban agglomerates*	Prominence of climate hazards**
Dohuk	10,956	1.65	74%	· Wildfires · Landslides · Extreme heat · Desertification · Water scarcity
Erbil	14,872	2.25	83%	· Extreme heat · Water scarcity (Groundwater decline, Water loss, precipitation decline) · Biodiversity loss
Sulaymaniyah	20,144	2.27	85%	· Wildfires · Landslides · Extreme heat · Water scarcity · Biodiversity loss · Desertification
Halabja	1,600	0.2457	85%	· Wildfires · Landslides · Extreme heat · Water scarcity · Desertification

*Central Statistics Organization Iraq
**Results of LAP validation workshop

Risks and vulnerabilities of different sectors

This section digs into the complex relationship between climate change and three critical areas in Kurdistan: Water resources, Agriculture and Food Security, as well as Biodiversity and Ecosystems. It investigates how changing climate patterns, altered precipitation patterns, and temperature extremes are upending existing standards and offering unexpected difficulties. Furthermore, it highlights the sector's inherent vulnerabilities, shining light on the potential implications of inaction.

As the risks and vulnerabilities were investigated in various sectors, it became clear that the effects of climate change were not uniform. Different communities, ecosystems, and economic

activities are affected in different ways, necessitating specialized adaptation solutions. This section explores the complexities of these difficulties and underline the importance of preserving the essential resources and ecosystems that underpin Kurdistan's long-term viability.

Water Resources

Due to the absence of proper national water management regulations, Iraq has a water withdrawal rate that is about twice as high as the global average. Long-lasting droughts, which are also anticipated to get worse, have been partially attributed to yearly unpredictability in river flow. The water quality of the rivers has also been harmed by the drought and poor rainfall, leaving the shallower waterways more vulnerable to pollution from sources like wastewater and petroleum industrial waste.

The water sector in Kurdistan, Iraq, faces significant risks and vulnerabilities due to the impacts of climate change. With changing climatic patterns and increasing temperatures, the region is encountering several challenges that threaten its water resources and overall water security.

- Water Scarcity: Climate change exacerbates water scarcity in Kurdistan, leading to reduced water availability for various purposes, including agriculture, industry, and domestic use. Prolonged droughts and irregular rainfall patterns further strain the already limited water resources. The region experiences water scarcity due to various factors, including limited water resources, population growth, and climate change. The availability of freshwater sources, such as rivers and underground aquifers, is insufficient to meet the increasing demand for water.
- Decreasing Water Quality: Water pollution is a significant concern in the region. Industrial activities, agriculture, and inadequate wastewater treatment systems contribute to the contamination of rivers and groundwater sources. This pollution not only affects the availability of safe drinking water but also harms aquatic ecosystems and agricultural productivity. Increased water temperatures and reduced flows can lead to the growth of harmful algal blooms and the spread of waterborne diseases.
- Increased Frequency of Extreme Events: Kurdistan is witnessing an increase in extreme weather events, such as floods and droughts. These events disrupt water supply and distribution systems, causing significant damage to infrastructure and livelihoods.
- Impacts on Agriculture: Climate change affects agricultural productivity in the region, as changing precipitation patterns and water availability impact crop growth and irrigation practices.
- Unequal distribution and Water-Conflict Nexus: There is an imbalance in the distribution of water resources within the Kurdistan Region. Some areas have better access to water infrastructure and supplies, while others suffer from inadequate or unreliable water sources. This inequality exacerbates social and economic disparities between different

regions. Water scarcity and competition for limited water resources can lead to conflicts among different stakeholders, exacerbating social tensions.

- Dam construction and transboundary water issues: The construction of dams and water infrastructure in the Kurdistan Region can have transboundary implications. The region shares water resources with neighboring countries like Turkey, Iran, and Syria. Disputes and lack of effective cooperation in managing these shared water sources can lead to conflicts and negatively impact the region's water security.
- Aging infrastructure and inadequate management: The water infrastructure in the Kurdistan Region, including dams, reservoirs, and distribution networks, often suffers from aging, inadequate maintenance, and inefficient management. This results in water losses through leakages, inefficient water use practices, and ineffective water resource management.
- Impact on Ecosystems: Climate change affects the region's ecosystems, including wetlands and river habitats, disrupting the delicate balance of biodiversity and ecological services.

Addressing these risks and vulnerabilities requires urgent and coordinated efforts from federal government, KRG authorities, local communities, and international partners. Implementing sustainable water management practices, investing in climate-resilient infrastructure, promoting water conservation measures, and fostering community engagement are critical steps in building resilience in Kurdistan's water sector amidst the challenges posed by climate change.

By recognizing and proactively addressing these risks, Kurdistan can reduce the impacts of climate change on its water resources, safeguard water security, and contribute to sustainable development in the region.

Agriculture and Food Security

Agriculture in Kurdistan, Iraq is characterized by small-scale farms that are mostly rain-fed in the north. Wheat and barley are the main crops, with fruit trees serving as a cash crop and Livestock playing a crucial role in farming systems, especially in the northern rain-fed regions. Rain-fed crops in the north have suffered as a result of a protracted drought, which has destroyed nearly 50% of northern agricultural fields and rendered animals extinct between 2008 and 2009. The output of cattle, which is already constrained by a lack of feed, is anticipated to be considerably impacted by the drought. Iraq's ongoing problem with food insecurity is made worse by climate change's effects on agricultural output and water availability. Approximately 1.9 million Iraqis, or 5.2% of the population, go without food, while 4 million Iraqis, or 11% of the population, are food insecure.

The agriculture sector in Kurdistan, Iraq is highly susceptible to the impacts of climate change, posing significant risks and vulnerabilities that threaten food security and livelihoods. As the region experiences shifts in climatic patterns, it faces several challenges that require urgent attention and adaptation strategies.

- Water Scarcity and Irregular Rainfall: Climate change contributes to reduced water availability and irregular rainfall patterns, impacting irrigation practices and crop production. Prolonged droughts further strain agricultural water resources, leading to lower crop yields and increased water stress.
- Land degradation: Soil erosion, improper land management practices, deforestation, and overgrazing contribute to land degradation in the region. Degraded soil has reduced fertility, which affects crop yields and agricultural sustainability. Soil conservation measures, reforestation efforts, and sustainable land management practices are essential to address this challenge.
- Lack of modern agricultural techniques: Many farmers in the Kurdistan Region still rely on traditional farming methods, which often lead to lower productivity and inefficiency. Limited access to modern agricultural technologies, machinery, quality seeds, and fertilizers hinders agricultural advancement. Promoting the adoption of modern farming techniques, providing training and support to farmers, and improving access to agricultural inputs are crucial for boosting agricultural productivity.
- Lack of agricultural diversification: Agriculture in the Kurdistan Region is often dominated by a few crops, leading to a lack of diversification. Over-reliance on specific crops makes the agriculture sector vulnerable to market fluctuations and pest outbreaks. Encouraging crop diversification, promoting high-value crops, and supporting agricultural value chains can enhance the resilience of the agricultural sector.
- Extreme weather events: Kurdistan witnesses an increase in extreme weather events, such as floods and storms, which can cause extensive damage to crops, infrastructure, and agricultural lands. Climate change impacts, including irregular rainfall patterns, increased temperatures, and more frequent droughts and floods, pose significant challenges to agriculture. Changes in weather patterns affect crop growth, water availability, and pest management. Rising temperatures affect plant growth and development, leading to heat stress for crops. High temperatures can reduce crop productivity, affect flowering and fruiting, and increase the risk of pests and diseases. I
- Changing Growing Seasons: Climate change alters the timing and duration of growing seasons, disrupting traditional planting and harvesting schedules. Farmers may face challenges in adjusting to the new growing conditions, affecting crop choices and agricultural planning.
- Impact on Livestock: Climate change affects livestock health and productivity. Heat stress can lead to reduced milk production and weight loss in animals, impacting the livelihoods of pastoral communities.
- Water Quality Issues: Climate change can exacerbate water pollution, affecting the quality of irrigation water and livestock drinking water. Contaminated water sources pose health risks to crops and animals.

- Loss of Biodiversity and Ecosystem Services: Climate change impacts on ecosystems can affect biodiversity and ecological services essential for agriculture, such as pollination and natural pest control.
- Food Insecurity: The cumulative impacts of climate change on agriculture may lead to food insecurity and reduced access to nutritious food, affecting vulnerable populations.
- Limited access to credit and market opportunities: Farmers in the Kurdistan Region often face challenges in accessing credit and market opportunities. Insufficient financial support and limited market linkages impede agricultural development and discourage farmers from investing in modern farming practices. Expanding access to credit, improving market infrastructure, and facilitating market connections for farmers are vital to overcome these challenges.

To address these risks and vulnerabilities, Kurdistan's agriculture sector requires comprehensive and adaptive strategies. Priority actions may include promoting climate-resilient crop varieties, adopting efficient irrigation techniques, enhancing water management practices, and investing in climate-smart agricultural infrastructure. Implementing climate-resilient farming practices, promoting drought-tolerant crop varieties, and enhancing early warning systems can help mitigate the adverse effects of climate change on agriculture.

Additionally, capacity building for farmers, supporting sustainable land use practices, and establishing early warning systems for extreme weather events are crucial components of climate change adaptation in the agriculture sector.

By prioritizing resilience-building measures and fostering collaboration among stakeholders, Kurdistan can enhance the adaptive capacity of its agriculture sector, ensuring food security and sustainable livelihoods in the face of climate change challenges.

Biodiversity and Ecosystems

The biodiversity and ecosystems of Kurdistan, Iraq face significant risks and vulnerabilities as a result of climate change. The region's unique and diverse natural habitats are experiencing numerous challenges that threaten the delicate balance of its ecosystems and the species that depend on them.

- Habitat Loss and Fragmentation: Urbanization, agricultural expansion, infrastructure development, and deforestation contribute to habitat loss and fragmentation in the region. These activities result in the destruction and fragmentation of natural habitats, leading to the loss of biodiversity and disrupting ecological processes. Moreover, climate change impacts, such as rising temperatures and altered precipitation patterns, contribute to habitat loss and fragmentation. This disrupts the distribution of species and can lead to isolated populations that are more vulnerable to extinction.
- Threatened and endangered species: The Kurdistan Region is home to various plant and animal species that are classified as threatened or endangered. Factors such as habitat

degradation, illegal hunting, overexploitation, and inadequate conservation measures pose risks to the survival of these species. Conservation efforts are needed to protect and restore their populations.

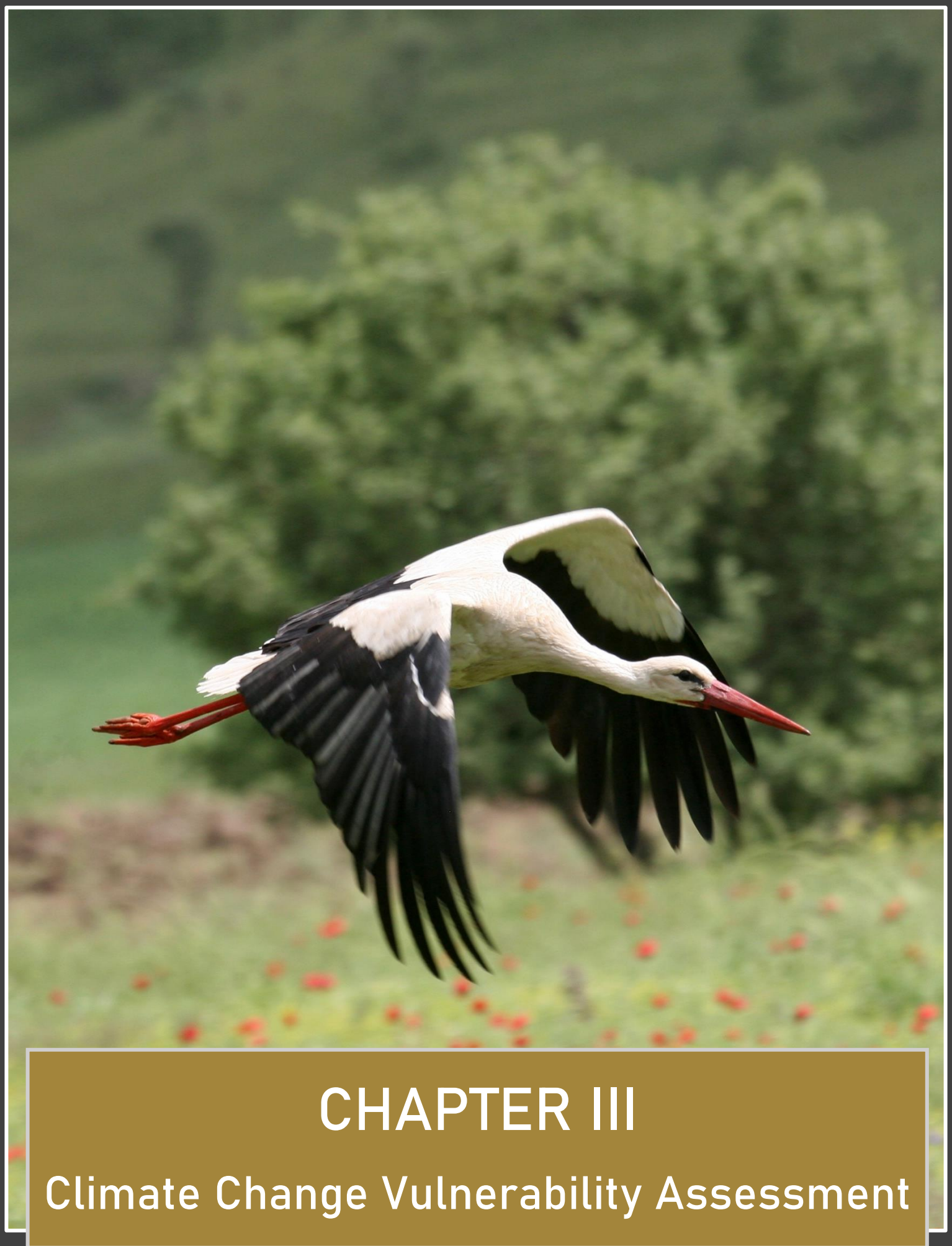
- Fire Risk from Climate Change: In addition to the challenges mentioned earlier, the escalating threat of wildfires resulting from climate change poses a critical risk to Kurdistan's biodiversity and ecosystems. Rising temperatures, prolonged droughts, and altered precipitation patterns contribute to increased fire susceptibility in the region. Wildfires not only directly impact habitats and species but also exacerbate habitat loss and fragmentation, disrupting ecosystems and further intensifying the challenges faced.
- Invasive species: Invasive plant and animal species pose a significant challenge to the native biodiversity of the Kurdistan Region. These invasive species outcompete native species for resources, disrupt ecosystems, and alter natural habitats. Managing and controlling invasive species is crucial to safeguarding the region's biodiversity.
- Pollution and water quality: Pollution from industrial activities, agriculture, and inadequate wastewater management systems negatively impact the region's water bodies and ecosystems. Contaminated water sources harm aquatic species, disrupt food chains, and degrade overall ecosystem health. Implementing effective pollution control measures and promoting proper waste management are essential to protect biodiversity.
- Lack of awareness and conservation measures: Limited public awareness about the importance of biodiversity and ecosystems contributes to the challenges faced in the Kurdistan Region. Insufficient conservation measures, including protected areas, wildlife management, and biodiversity monitoring programs, hinder the preservation of natural habitats and biodiversity. Strengthening conservation efforts, promoting environmental education, and enhancing public participation are crucial for biodiversity conservation.
- Impact on Keystone Species: Climate change can disproportionately affect keystone species, which play crucial roles in maintaining ecosystem health and balance. The loss of keystone species can trigger cascading impacts on the entire ecosystem.
- Shifts in Species Distribution: Changing climatic conditions may force species to move to more suitable habitats, leading to shifts in their distribution patterns. Some species may struggle to adapt, resulting in decreased biodiversity in certain areas.
- Altered Phenology: Climate change affects the timing of natural events, such as flowering, migration, and breeding, known as phenology. Desynchronized phenological events can have cascading effects on species interactions and ecosystem functioning.
- Increased Frequency of Extreme Events: Kurdistan is experiencing a higher frequency of extreme weather events, including floods, wildfires, and droughts. These events can cause immediate and long-term damage to ecosystems, jeopardizing the survival of many species.
- Threats to Ecosystem Services: Climate change can disrupt ecosystem services that benefit human populations, such as water purification, pollination, and carbon sequestration. The loss of these services can impact local communities' well-being and livelihoods.

- Vulnerability of Endemic Species: Kurdistan is home to several endemic species, meaning they are found only in this region. These species are particularly vulnerable to the changing climate and may face a higher risk of extinction.

To address these risks and vulnerabilities, it is essential for Kurdistan to implement proactive conservation and adaptation strategies. Some key actions include:

- Establishing protected areas and wildlife corridors to preserve critical habitats and facilitate species movement.
- Implementing habitat restoration and reforestation projects to enhance ecosystem resilience.
- Conducting research and monitoring to better understand the impacts of climate change on biodiversity.
- Integrating climate change considerations into biodiversity conservation and management plans.
- Promoting sustainable land and water management practices to reduce human-induced stress on ecosystems.
- Enhancing public awareness and education about the importance of biodiversity conservation and climate change adaptation.

By prioritizing these actions and fostering collaboration among federal government, KRG agencies, local communities, and international partners, Kurdistan can safeguard its precious biodiversity and ecosystems in the face of climate change challenges. This concerted effort will not only benefit the region's unique wildlife but also contribute to the well-being and sustainable development of its people.



CHAPTER III

Climate Change Vulnerability Assessment

Chapter III: Climate Change Vulnerability Assessment

The purpose of the "Vulnerability Assessment" chapter is to contribute to developing and updating the Local knowledge on climate conditions based on Kurdistan, Iraq past, present and future climate scenarios and their resulting impacts on key human and natural systems. This analysis has focused on the sectors that were considered by Iraq First National Communication to the UNFCCC, to be highly at risk from climate change: such as Water resources, Agriculture and Food Security, as well as Biodiversity and Ecosystems. The assessment focus also on local consequences of climate change at local/province level, aiming that decision makers are able to link the regional and national conditions with global conditions, thus hampering their ability to take the most appropriate planning decisions in terms of vulnerability and adaptation. For this reason, the assessment of the priority sectors has focused on provinces of Kurdistan, Iraq; Dohuk, Erbil, Sulaymaniyah, and Halabja. This chapter includes the basic results of the participatory assessment carried out at national and targeted geographic regions of Kurdistan, Iraq.

Methodological Framework

The assessment applied a robust methodological framework that relies on two main pillars: 1. A qualitative and quantitative climate change impact and vulnerability assessment 2. Identification and prioritization of adaptation for all the prioritized provinces and sectors. Climate change impact and vulnerability assessment In line with the official IPCC's definition, the methodology has considered that the vulnerability of a particular system is highly contingent upon three main components: the magnitude of its exposure to climate change hazards, its degree of sensitivity to the hazard, (both formulate the amount of impact), and its level of adaptive capacity. The relationship between these dimensions, illustrated in Figure 27 below, is commonly expressed by the following conceptual formula: Vulnerability = [exposure to climate stimuli x Sensitivity = impact] / adaptive capacity.

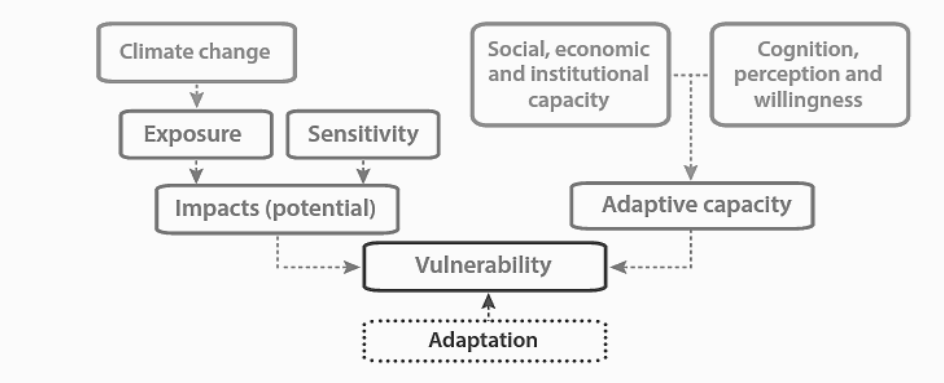


Figure 27: The Vulnerability Conceptual Framework (Schröter et al., 2004)

Vulnerability Assessment Results

This section unveils the findings of a comprehensive vulnerability assessment, offering critical insights into the various facets of Kurdistan's vulnerability landscape. These findings shed light on the complex interaction of factors influencing Kurdistan's resilience.

Exposure

The purpose of this section is to present the findings of a comprehensive assessment of climate exposure indicators in Kurdistan, Iraq. Exposure results are extracted from future climate projections presented in section 2.2 and ranking indicators on a scale from 1 to 5, where 1 indicates low exposure and 5 denotes high exposure. The assessment focused on Kurdistan Iraq provinces exposure for five indicators which are changes in Mean temperature, Minimum Temperature, Precipitation, Number of days exceeding 40 degrees Celsius, and the Largest one-day precipitation considering changes in its probability.

The Local Adaptation Plan for Kurdistan, Iraq, is crucially dependent on the evaluation of exposure to the effects of climate change. Exposure indicators have been used as useful instruments to fully assess the region's susceptibility to various climatic conditions. The systematic assessment method and quantification of variations in each exposure indicator—important variables in assessing the level of exposure-are explained in the part below.

Changes in Temperature:

The examination of temperature (for both Mean and Minimum temperature) shifts in relation to the local average within each province has been a key determinant in assessing exposure. Notably, a more pronounced increase in temperature compared to the province's historical average signifies heightened exposure. The analysis emphasizes the significance of temperature fluctuations as a precursor to potential climate-related impacts.

Score Segments for both Mean and Minimum temperature:

- Increase 1 to 1.5°C = 1
- Increase 1.6-2.5°C = 2
- Increase 2.6-3.5°C = 3
- Increase 3.6-4.5°C = 4
- Increase above 4.5°C = 5

Changes in Precipitation:

Similarly, the analysis of precipitation alterations relative to the provincial average has been a focal point. A reduced level of precipitation in comparison to historical averages suggests a higher degree of exposure. The correlation between decreased precipitation and augmented exposure

underscores the potential implications for various sectors dependent on adequate water resources.

Score Segments:

- Increase 30% = 1
- Increase 10% = 2
- Decrease 10% = 3
- Decrease 20% = 4
- Decrease more than 20% = 5

Increased High-Temperature Days:

An increase in the number of days with temperatures exceeding 40°C, as contrasted with the provincial average, offers valuable insights into heightened exposure levels. This indicator highlights the heightened frequency of extreme heat events, which can have far-reaching ramifications on public health, infrastructure, and agricultural productivity.

Score Segments:

- Number of days less than 20 = 1
- Number of days between 21 and 30 = 2
- Number of days between 31 and 50 = 3
- Number of days between 51 and 80 = 4
- Number of days more than 80 = 5

Elevated Peak Precipitation:

Monitoring the escalation in the highest recorded amount of precipitation in a single day relative to previous records in each province provides a critical perspective on exposure. An augmented peak precipitation level indicates increased vulnerability to intense rainfall events, which can trigger flooding, erosion, and infrastructure damage.

Score Segments:

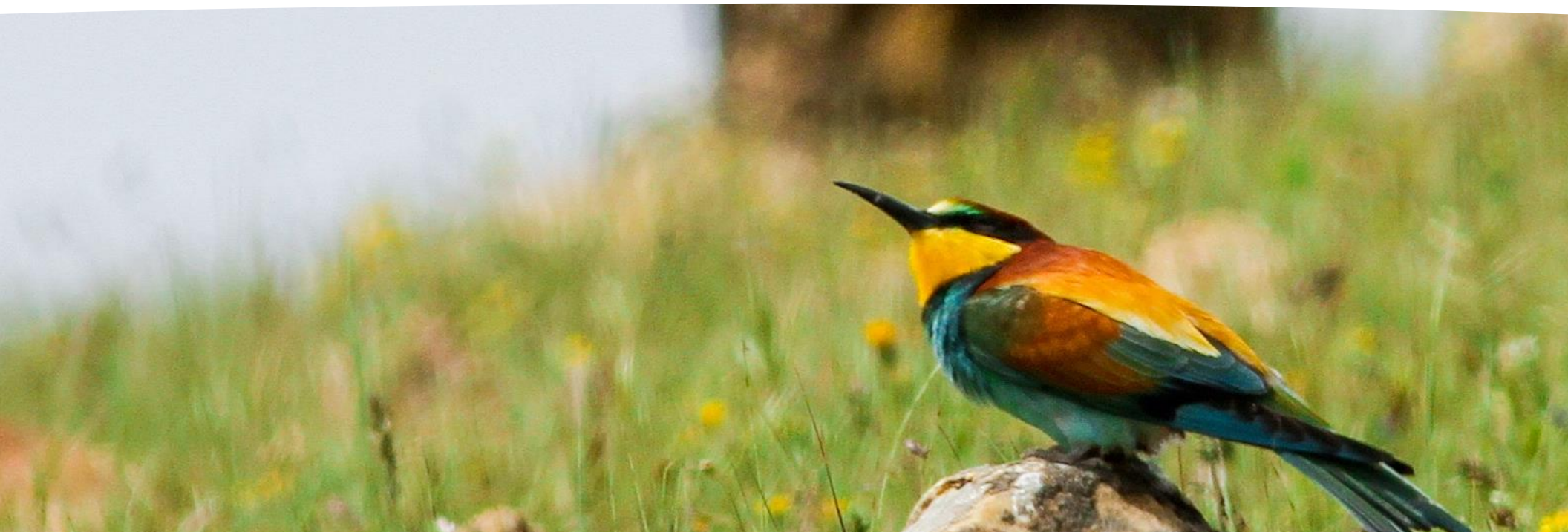
- Very high increase of precipitation amounts more than 60% = 5
- High increase between 45% and 60% = 4
- Moderate increase between 31% and 44% = 3
- Low increase between 16% and 30% = 2
- Very Low increase (less than 15%) = 1

Province	Mean Temperature			Minimum Temperature			Precipitation			Number of Hot days ≥40 C°	Largest 1 day Precipitation +Return period			Actual Largest 1 day Precipitation +Return period
	Lowest Monthly Anomaly (SSP1-2.6/SSP5-8.5)÷2	Highest Monthly Anomaly (SSP1-2.6/SSP5-8.5)÷2	Average change	Lowest Monthly Anomaly SSP1-2.6/SSP5-8.5	Highest Monthly Anomaly SSP1-2.6/SSP5-8.5	Average change	SSP1-2.6	SSP5-8.5	Average change	SSP1-2.6/SSP5-8.5	SSP1-2.6 Yearly anomaly (mm) / Frequency (years)	SSP5-8.5 Yearly anomaly (mm) / Frequency (years)	Average change (%)	
Dohuk	3	4.6	3.8	2.65	4.4	3.5	-0.74	-24.24	-12.49	17.37-61.04	0.11 3.84	7.29 3.28	14.8	25
Erbil	3	4.6	3.8	2.46	4.3	3.38	0.98	-19.1	-9.06	15.45-53.77	7.14 3.88	10.99 2.84	22.6625	40
Sulaymaniyah	2.9	4.6	3.75	2.3	4.3	3.3	-5.52	5.16	-0.18	14.35-53.5	10.49 3.88	13.71 2.57	55	22
Halabja	2.9	4.6	3.75	2.3	4.3	3.3	-5.52	5.16	-0.18	14.35-53.5	10.49 3.88	13.71 2.57	55	22

	Scale				
Temp anomaly change	0 – 0.5	0.6 - 1.0	1.1 - 2.0	2.1 - 3.5	3.6 - 5
	Very low	Low	Moderate	High	Very High
Prec % change	30%	10%	-10%	-20%	-30%
	Very low	Low	Moderate	High	Very High
Number of hot days above ≥40 C°	5 to 15	16-25	26-35	36-45	≥ 46
	Very low	Low	Moderate	High	Very High
Largest 1 day Precipitation anomaly	-30	-21	16-40	41-60	61-85
	Very low	Low	Moderate	High	Very High

Province	Mean Temperature	Minimum Temperature	Precipitation	Number of Hot days ≥40 C°	Largest 1 day Precipitation +Return period	Overall Exposure
Dohuk	Very High	High	Moderate	Very High	Very Low	3.8 High
Erbil	Very High	High	Moderate	Very High	Low	3.6 High
Sulaymaniyah	Very High	High	Moderate	Very High	High	4.2 High
Halabja	Very High	High	Moderate	Very High	High	4.2 High

Scale	1 – 1.5	1.6 - 2.5	2.6 - 3.5	3.6 - 4.5	4.5 - 5
Result	Very low	Low	Moderate	High	Very High



Sensitivity Assessment

The purpose of this section is to present the findings of a comprehensive assessment of sensitivity indicators in Kurdistan, Iraq. Expert groups were tasked with conducting a weighting exercise, ranking indicators on a scale from 1 to 5, where 1 indicates low sensitivity and 5 denotes high sensitivity. The assessment focused on three critical sectors: Water, Agriculture and Food Security, and Biodiversity and Ecosystems. This section highlights the identified sensitivity indicators and their corresponding sensitivity levels in each sector. Below are the sensitivity indicators.

Table 3: sensitivity indicators for each sector

Water Sector	Agriculture and Food Security	Biodiversity and Ecosystems
Groundwater level decline and recharge ability	Number of cropping systems	Number and area of natural ecosystems
Groundwater quality deterioration	Livestock production (numbers)	Level of fragmentation
Water demand for both domestic and irrigation	Food security level	Rarity of the ecosystem in Iraq
Water infrastructure (network, pumping stations, etc.) condition	Percentage of rainfed area to irrigated crops area	Level of non-climatic anthropogenic pressures
Population of each sub-district	Percentage of agroforestry and rangeland areas	Number of Endemic species

Sensitivity scores for Kurdistan, Iraq provinces and sectors are as follows:

Table 4: Sensitivity scores for Kurdistan, Iraq provinces and sectors

Province	Sensitivity by Sector			Overall Sensitivity
	Water	Agriculture	Ecosystems	
Dohuk	3.2	3.6	4	3.6 out of 5
Erbil	3.2	3.2	4	3.5 out of 5
Sulaymaniyah	3.6	2.8	4	3.5 out of 5
Halabja	2.8	2.8	4	3.2 out of 5
Kurdistan Sensitivity Total	3.2	3.1	4	

Table 5: Sensitivity ranking for Kurdistan, Iraq provinces and sectors

Province	Sensitivity by Sector			Overall sensitivity
	Water	Agriculture	Ecosystems	
Dohuk				High
Erbil				Moderate
Sulaymaniyah				Moderate
Halabja				Moderate
Kurdistan Sensitivity total	Moderate	Moderate	High	
1 – 1.5	1.6 - 2.5	2.6 - 3.5	3.6 - 4.5	4.5 - 5
Very low	Low	Moderate	High	Very High

In the context of climate sensitivity indicators for the water sector, Duhok, Erbil, Halabja, and Sulaymaniyah each received scores of 3.2, 3.2, 3.8, and 3.8 out of 5, respectively. These scores highlight the regions' vulnerability to climate-related changes affecting water resources.

Halabja and Sulaymaniyah obtained higher scores due to their challenges with low water quality. The degradation of water quality impacts both provinces, posing significant threats to human health and the environment. The higher scores suggest that these regions need urgent attention and interventions to safeguard their water sources and implement measures to improve water quality.

Addressing the climate sensitivity indicators in Duhok, Erbil, Halabja, and Sulaymaniyah requires a comprehensive approach, including efficient water management practices, water quality improvement initiatives, and long-term climate adaptation strategies.

In the agriculture sector, Duhok stands out as the most sensitive province in the Kurdistan Region due to its extensive agroforestry areas, which are more vulnerable to climate-related changes compared to other provinces. However, the entire region requires a transformative shift in cropping systems, agricultural practices, and heightened awareness to combat climate challenges effectively.

Changing cropping systems, adopting climate-resilient agricultural practices, and promoting awareness are essential steps to build agricultural resilience in the Kurdistan Region. Transitioning to more sustainable practices will enhance the region's capacity to cope with climate impacts and ensure long-term food security.

Moreover, reducing the use of pesticides is of paramount importance to safeguard the environment, human health, and ecosystem balance. Emphasizing integrated pest management and eco-friendly alternatives can contribute significantly to the region's sustainable agricultural growth and climate adaptation efforts. By collectively addressing these issues, the Kurdistan Region can foster a more resilient and sustainable agricultural sector that thrives amidst climate uncertainties.

All provinces in the Kurdistan Region face a shared challenge with the ecosystems, receiving the same score due to the adverse impacts of hunting, logging, and overgrazing, leading to habitat destruction and biodiversity loss. Additionally, the lack of law enforcement and implementation of protective regulations further exacerbates the situation, undermining conservation efforts. Moreover, political conflicts near the borders contribute to ecosystem degradation, causing displacement and resource exploitation. Addressing these threats demands robust political will, cross-border cooperation, and effective enforcement of environmental laws. Strengthening conservation measures, promoting sustainable practices, and fostering regional cooperation are vital to safeguard the precious biodiversity and ecological balance of the Kurdistan Region's ecosystems.

Adaptive Capacity Assessment

The purpose of this section is to give the results of a thorough evaluation of adaptive capability indicators in Iraq's Kurdistan. Expert groups were tasked with assessing indicators on a scale of 1 to 5, where 1 represents low adaptable capacity and 5 implies great adaptive capacity, as part of a weighted exercise. Three crucial sectors—water, agriculture and food security, biodiversity and ecosystems—were the focus of the review. In each sector and province in Kurdistan, Iraq, this section highlights the adaptable capacity indicators and their related adaptive capacity levels.

Table 6: adaptive capacity indicators

Water Sector	Agriculture and Food Security	Biodiversity and Ecosystems
Accessibility to water sources	Sector economic capability	Protection of major ecosystems
Poverty levels	Social capital	Economic resources availability for ecosystem conservation
Availability of financial capital for infrastructure projects	Physical infrastructure (the possible expansion in surface water development)	Technology and innovation created or available for ecosystem conservation
Existing springs and wells capacity for development	Institutional capacity and governance structures of the sector	Infrastructure availability to support ecosystem conservation

Governance structures of the sector	Available ground and surface water resources, and the treated wastewater resources.	Institutional capacity and governance structures

Recognizing the severity of the water crisis, the Kurdistan Regional Government has allocated funds to establish a water treatment plant in Erbil. However, without comprehensive and sustainable water management strategies, the region may face severe consequences in the future, including reduced agricultural productivity and potential conflicts over water resources.

The adaptive capacity of provinces in the Kurdistan Region, Iraq, exhibits significant variation. Dohuk, for instance, demonstrates relatively low adaptive capacity due to limited spending capabilities on agriculture projects. Its reliance on rain-fed agriculture presents challenges in optimizing agricultural productivity. Additionally, the region faces a scarcity of human resources, with the agriculture workforce comprising only about 3.1%. Low awareness and adoption of advanced agricultural practices further hinder Dohuk's ability to adapt effectively.

In contrast, Halabjah stands out with a higher adaptive capacity. The province's predominantly mountainous terrain provides access to various water sources, leading to a more stable water supply compared to other regions.

However, Halabja still faces challenges in its adaptive capacity, primarily related to ecosystem conservation. The percentage of ecosystems covered in conserved areas, including protected areas, remains inadequate, leaving many diverse ecosystems vulnerable to environmental changes. Limited economic resources allocated for ecosystem conservation hinder the establishment and maintenance of essential projects, hampering the region's ability to adapt effectively. Furthermore, Halabja lacks access to crucial technological means, such as remote sensing and genetic profiling lab testing, hindering data-driven conservation efforts and innovation. The absence of vital infrastructure, such as fire monitoring towers, early warning systems, and well-equipped ranger bases, further undermines timely responses to ecosystem deterioration and wildlife protection. Lastly, the region faces challenges in its institutional capacity and governance structures dedicated to ecosystem conservation, contributing to continued illegal hunting and habitat degradation.

Table 7: adaptive capacity scores for Kurdistan, Iraq provinces and sectors

Province	Adaptive Capacity by Sector			Overall Adaptive Capacity
	Water	Agriculture	Ecosystems	
Dohuk	2.8	2.4	2.4	2.5 out of 5
Erbil	2.6	2.6	2.6	2.6 out of 5
Sulaymaniyah	2.6	2.8	3	2.8 out of 5
Halabja	2.6	3.4	1.8	2.6 out of 5

Kurdistan Adaptive Capacity Total	2.65	2.8	2.45	

Table 8: adaptive capacity ranking for Kurdistan, Iraq provinces and sector

Province	Adaptive Capacity by Sector			Overall Adaptive Capacity
	Water	Agriculture	Ecosystems	
Dohuk				Low
Erbil				Moderate
Sulaymaniyah				Moderate
Halabja				Moderate
Kurdistan Adaptive Capacity total	Moderate	Moderate	Low	
4.5 - 5	3.6 - 4.5	2.6 - 3.5	1.6 - 2.5	1 – 1.5
Very High	High	Moderate	Low	Very low

Vulnerability Assessment:

The purpose of this section is to present the findings of a comprehensive assessment of Vulnerability in Kurdistan, Iraq. Using the methodology in section 3.1 above the resulting Vulnerability scores and values of sectors and provinces in Kurdistan, Iraq illustrated in the table below.

Table 9: vulnerability assessment scores for Kurdistan, Iraq provinces and sectors

Province	Vulnerability by Sector			Overall Vulnerability
	Water	Agriculture	Ecosystems	
Dohuk	4.3	5.7	6.3	5.46
Erbil	4.4	4.4	5.5	4.80
Sulaymaniyah	5.8	4.2	5.6	5.21
Halabja	4.5	3.5	9.3	5.77
Kurdistan Vulnerability Total	4.8	4.4	6.5	

Table 10: vulnerability ranking for Kurdistan, Iraq provinces and sectors.

Province	Vulnerability by Sector			Overall Province Vulnerability
	Water	Agriculture	Ecosystems	
Dohuk		*		High*
Erbil				High
Sulaymaniyah	*			High
Halabja			*	High
Kurdistan Vulnerability total	Moderate	Moderate	Very High	

≤0.9	1 - 2.4	2.5 - 4.9	5- 6.4	≥6.5
Very low	Low	Moderate	High	Very High

The vulnerabilities of several sectors within the provinces were systematically examined with the comprehensive climate change vulnerability assessment for Kurdistan Iraq. To give a thorough knowledge of the potential implications of climate change, the evaluation analyzed a wide range of issues, including environmental, social, and economic elements.

Sectoral Vulnerability Ranking

The ecosystem sector exhibits the highest vulnerability among the sectors analyzed. This outcome is a result of the intricate interdependencies between climatic shifts and the delicate balance of Kurdistan's natural habitats and species. This is a result of having the highest sensitivity among all sectors and the lowest adaptive capacity. Ecosystems, ranging from forests and wetlands to grasslands, are inherently sensitive to alterations in temperature, precipitation, and extreme weather events. The potential disruptions to these ecosystems could trigger cascading impacts on the region's biodiversity, species interactions, and overall ecological health.

The water sector follows as the second most vulnerable sector. This is due to the region's reliance on limited water supplies, which are very vulnerable to changing climatic patterns. Water availability and distribution are particularly vulnerable to changes in precipitation, temperature, and runoff dynamics. The potential worsening of water scarcity and quality issues, combined with the rising frequency of extreme events such as floods and droughts, makes the water industry extremely susceptible.

Agriculture emerges as the third most vulnerable sector. Agricultural activities are sensitive to climatic fluctuations since they rely on stable climate conditions for good crop cultivation and livestock management. Temperature, precipitation, and growing season changes might have a considerable influence on agricultural output, food security, and lives.

Provinces Vulnerability Ranking

Province's disparities in vulnerability further enrich the assessment findings. Specifically, Sulaymaniyah demonstrates the highest vulnerability within the water sector. The Sulaymaniyah region's peculiar hydrological characteristics, combined with its dependency on restricted water sources, make it extremely vulnerable to changes in precipitation and temperature. These changes have the potential to put additional demand on already scarce water supplies, aggravating current issues and affecting water-dependent activities such as agriculture and human consumption.

In the agriculture sector, Dohuk emerges as the most vulnerable province. This vulnerability is partly due to the subregion's reliance on rain-fed agriculture, which renders it extremely vulnerable to changes in precipitation patterns. Variations in rainfall distribution and intensity may have an immediate impact on crop yields and agricultural sustainability, affecting the livelihoods of those reliant on this industry.

In the ecosystem sector, Halabja exhibits the highest vulnerability with Dohuk showing very high vulnerability as well. This result reflects the intricate ecological diversity and richness of these areas, with the absence of proper nature conservation programs in those provinces. The delicate interplay of numerous ecosystems, ranging from highland forests to wetlands, is set to be significantly disrupted by changing climate conditions. Temperature increases, precipitation shifts, and changing species distributions may all contribute to ecological imbalances that endanger the region's biodiversity and natural environments.

CHAPTER IV

Priority Adaptation Programs & Measures

Chapter IV: Priority Adaptation Programs and Measures

Based on the vulnerability assessment conducted and best available knowledge of Kurdistan Iraq provinces, and after consultation with stakeholders and relevant institutions in Iraq, a set of adaptation programs and measures are recommended.

Adaptation Programs for the Local Adaptation Plan in Kurdistan, Iraq

This section presents the adaptation programs for the Water resources sector, Agriculture and Food Security sector as well as Biodiversity and Ecosystem sector. In addition to that two cross cutting programs on Gender and Ecosystem Based Adaptation. Table 9 below illustrates all adaptation programs and defines the timeframe, budget, and finance strategy for each.

For the purpose of the adaptation program, the following planning periods were suggested:

- Short term 1-3 years,
- Medium term 3-5 years,
- long term < 5 years

Table 11: adaptation programs

Sector	Objective	Program Title	Timeframe	Finance Strategy
WATER RESOURCES	**Enhance water resource management and conservation to address water scarcity and climate change impacts.**	**Development of water infrastructure, including reservoirs, dams, and water treatment facilities.**	Medium term	**Allocate funds for the construction of water infrastructure projects through a combination of government budgets and international climate funds.** **· Seek partnerships with private sector entities for investment in water conservation technologies and initiatives.** **· Implement cost-recovery mechanisms, such as water tariffs, to generate revenue for ongoing maintenance and operation of water management projects.**
		Develop a comprehensive flood management system that includes early warning systems, floodplain mapping, and flood-resistant infrastructure.	Short term	
		Implementation of water conservation practices, such as drip irrigation systems and rainwater harvesting.	Short term	
		Develop and implement water demand management strategies to balance supply and demand, ensuring continuous access.	Medium term	
		Promotion of community awareness and education on efficient water use.	Short term	
AGRICULTURE AND FOOD SECURITY	**Promote climate-resilient agricultural practices and ensure food security in the face of changing climatic conditions.**	Introduce climate-smart agricultural techniques, including crop diversification, agroforestry, and sustainable land management practices.	Short term	**· Allocate funds for agricultural extension services, farmer training programs, and the dissemination of climate-**

		Provide training and capacity-building programs for farmers on climate-resilient farming techniques.	Medium term	resilient agricultural practices. • Explore public-private partnerships for investment in agricultural infrastructure, such as irrigation systems and cold storage facilities. • Access international climate funds and grants dedicated to sustainable agriculture and food security.
		Establish early warning systems for droughts and floods to support timely agricultural interventions.	Short term	
		Conservation agriculture	Long term	
BIODIVERSITY CONSERVATION AND ECOSYSTEM	**Protect and restore biodiversity-rich ecosystems to enhance their resilience and contribute to climate change adaptation.**	Establish protected areas and wildlife corridors to conserve biodiversity and support ecosystem services.	Medium term	• Access international funding mechanisms and grants dedicated to biodiversity conservation and ecosystem restoration. • Seek partnerships with non-governmental organizations and environmental agencies for technical assistance and financial support. • Explore mechanisms for payments for ecosystem services to generate
		Implement reforestation and afforestation programs to restore degraded landscapes and enhance carbon sequestration.	Short term	
		Promote sustainable land and forest management practices, including community-led conservation initiatives.	Short term	

				revenue for community-based conservation efforts.
Cross Cutting Enhancing Resilience Through Nature-Based and Ecosystem-Based Adaptation in Kurdistan Iraq	Strengthen the resilience of Kurdistan Iraq's vulnerable sectors by implementing integrated nature-based and ecosystem-based adaptation strategies. By leveraging the inherent capacity of ecosystems, this program aims to enhance water resource management, bolster agricultural sustainability, and safeguard biodiversity and ecosystems against the impacts of climate change	Water Resilience Enhancement through nature-based solutions	Short term	The financing for this program will be secured through a combination of domestic and international funding sources, including government allocations, grants from international organizations, private sector partnerships, and community contributions.

Cross-Cutting Gender-Responsive Adaptation Program for Kurdistan Iraq: Empowering Women in Water, Agriculture, and Ecosystem Resilience	Enhance gender equality and women's participation in climate adaptation efforts across water, agriculture, and ecosystem sectors. By prioritizing the empowerment of women, this program aims to build resilient communities that effectively respond to climate change impacts and ensure equitable access to resources, opportunities, and decision-making processes.	Strengthening Gender-Responsive Adaptation in Water, Agriculture, and Ecosystems for a Resilient Kurdistan Iraq	Medium term	The financing for this program will be secured through a combination of government funding, grants from international organizations, partnerships with women's empowerment initiatives, and community contributions.

Adaptation Measures for the Local Adaptation Plan in Kurdistan, Iraq

This section presents the adaptation measures under programs presented in section 4.1 for the Water resources sector, Agriculture and Food Security sector as well as Biodiversity and Ecosystem sector. In addition to that two cross cutting programs on Gender and Ecosystem Based Adaptation. The full adaptation measures and interventions including method, indicators, priorities, budget, and responsibilities are presented in table 10 below.

Table 12:adaptation measures and interventions

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
Water resources management	Construction of reservoirs and dams to enhance water storage capacity.	All Kurdistan Region, Iraq (provinces, districts, and sub-districts). Specific locations could be found in Appendix 3	There are master plans to construct dams and ponds based on feasible proposals.	Percentage increase in water storage capacity.	6	$500 million To 1 billion dollars	Ministry of agriculture and water resources and NGOs Investment commission
	Implementation of drip irrigation systems and efficient irrigation techniques.	All Kurdistan Region, Iraq.	Financial and technical support from KRG, Iraqi government, NGOs, and international organizations.	Reduction in water consumption per unit of agricultural production.	5	$ 100,000/20 dunam	Ministry of agriculture and water resources Investment commission (PPP)
	Promotion of water-saving practices in agriculture and households.	All Kurdistan Region, Iraq.	Raising awareness through media and education programs with the help from local government, NGOs, and international organizations. For example, educating farmers on water scarcity in KRI.	Number of households adopting water-saving practices.	3	$ 1000,000	Ministry of agriculture and water resources

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Rehabilitation and maintenance of existing water infrastructure.	All Kurdistan Region, Iraq.	Through supplying financial and technical support.	Reduction in water losses	7	$ 30,000 to $ 10,000,000	Ministry of agriculture and water resources
	Education and awareness programs on water conservation.	All Kurdistan Region, Iraq.	Education programs designed for specific groups, such as farmers, with a focus on teaching them how to use new irrigation systems and technology	Increase in public awareness on water conservation.	1	$ 5000,000/year	Ministry of agriculture and water resources, EPIB, and NGOs
	Strengthen early warning systems for floods and droughts, leveraging ecosystem monitoring and data analysis.	All Kurdistan Region, Iraq.	By installing a monitoring network system for ground and surface water.	the percentage of alerts or warnings that incorporate ecosystem data and analysis, providing a straightforward measure of progress in strengthening early warning systems through ecosystem integration	1	$ 12,000,000 to $ 100,000,000 per one system	Ministry of agriculture and water resources

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
Agriculture and Food Security	Promotion of climate-resilient farming practices, such as agroforestry and conservation agriculture.	Agriculture area in Sulaimanyah and Halabja governorates cities' outskirts and sub city (Penjwen, Sharbazher, Dokan, Bakrajo, Bazyan, Ranya,Garmyan). (Serwan, Khormal, Beyara, and Bamo).	Establishing adaptive orchard project for climate-change like olive tree, pistachio, concentrate agriculture way. Training, capacity-building programs provided for farmers and environmental activists	Adoption rate of climate-resilient farming practices.	6	$ 20 million to $ 25 million	Ministry of Agriculture and Water Resources (KRG and Iraq), International Agencies, NGOs.
	Distribution of drought-tolerant crop varieties and improved seeds.	Agriculture area in Sulaimanyah and Halabja governorates city's cities' outskirts and sub city (Penjwen, Sharbazher, Dokan, Bakrajo, Bazyan, Ranya, Garmyan). And the nurseries of (Bazyan, KaniPanka, Bakrajo, Ranya, Nalparez, and Sarchinar) (Serwan, Khormal, Beyara, and Bamo).	Producing seedling and seeds of drought-tolerant crop varieties and importing from another country. Establish botanical garden and seed/gene bank. Use new biotechnology approaches.	Increase in crop diversification and adoption of drought-tolerant varieties.	3	$ 25 million to $ 30 million	Ministry of Agriculture and Water Resources (KRG and Iraq), International Agencies, NGOs.

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Training programs on sustainable soil management and conservation and integrated pest management to raise awareness among farmers about sustainable land management practices, erosion control, and reforestation.	Agriculture area in Sulaimanyah and Halabja governorates city's cities' outskirts and sub city (Penjwen, Sharbazher, Dokan, Bakrajo, Bazyan, Ranya, Garmyan). (Serwan, Khormal, Beyara, and Bamo)	Training program theoretical and practice about management of pesticides and fertilizer. Reduce or eliminate the use of chemical fertilizers and pesticide. Agricultural programs (ex. Using biological controls instead of pesticides)	Yield improvements and reduction in crop losses due to climate change.	5	$ 10 million to $ 15 million	Ministry of Agriculture and Water Resources (KRG and Iraq), International Agencies, NGOs.
	Establishment of farmer cooperatives and market linkages for better access to resources and markets.	City center and crop production province.	Establishment of farmer cooperative and market linkages.	Number of farmers trained in sustainable agriculture practices.	9	$ 30 million to $ 35 million	Ministry of Agriculture and Water Resources (KRG and Iraq), investment commission in the KRG, International Agencies, NGOs.
	Development of climate-smart agricultural extension services.	Agriculture area in Sulaimanyah and Halabja governorates cities' outskirts and sub city (Dokan, Bakrajo, Bazyan, Ranya, Garmyan). (Serwan, Khormal, Beyara, and Bamo).	Knowledge exchange: Learning from the countries which are succeeded of this technic in agriculture by sending agriculture technical employs to those countries. Training local farmers and technical staffs.	Increase in income and food security among farming communities.	8	$ 250 million to $ 350 million	Ministry of Agriculture and Water Resources (KRG and Iraq), International Agencies, NGOs.

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
Biodiversity and Ecosystems	Establishment of protected areas and biodiversity corridors.	Piramagroon, Barzan,Qara Dagh, Halgurd-Sakran National Park.	Using the IUCN guidelines and National laws and regulations form managing and monitoring the protected areas. Establishing a committee from different relevant departments and entities such as ministry of agriculture, board of environmental protection, NGOs.	Increase in the size and connectivity of protected areas and biodiversity corridors.	6	$ 30 million	Ministry of agriculture and water resources, Ministry of Environment, EPIB, and NGOs Investment commission
	Reforestation and afforestation initiatives to restore degraded landscapes.	All Kurdistan (ex: According to the investigation, climate change has affected 20% of the forests in Rania (Kewa Rash), Dukan, and Halabja)	Getting funds from the loss and damage programme, enforcing laws and use the native plant species.	Area of land restored through reforestation and afforestation initiatives.	4	$ 15 million	Ministry of agriculture and water resources, Ministry of Interior (forestry police)
	Development of forests fire contingency plans in each province	All Kurdistan Region, Iraq	Using technologies such as satellite image and remote-sensing (there are some studies on which areas are more susceptible to fires). Establishing towers to monitor the forests. Special taskforce (fire extinguishers) and provide them with equipment. Raising awareness and capacity-building for locals. Trimming and cutting the dead branches. Providing planes.	Area of forests fire saved implementing the forests fire contingency plans	3	$ 2 million	Ministry of agriculture and water resources, EPIB, Iraqi Ministry of Environment, Ministry of Higher Education, and NGOs

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Conservation and restoration of wetlands, and coastal ecosystems.	All Kurdistan Region, Iraq	Raising awareness and train locals on constructing ponds and sustainable wetlands. Monitoring and managing these wetlands by locals.	Rehabilitation of wetlands and coastal ecosystems.	5	$ 10 million	Ministry of agriculture and water resources, and NGOs
	Implementation of sustainable land and forest management practices.	All Kurdistan Region, Iraq	Law enforcements and implementation of the regulations. Implementing sustainable approaches such as coppicing and involve locals and train them.	Adoption of sustainable land and forest management practices in land use and Urban planning.	6	$ 10 million	Ministry of agriculture and water resources, Ministry of Interior, and NGOs
	Community-led conservation programs and sustainable livelihood initiatives.	All Kurdistan Region, Iraq	Community based approaches and give roles to the locals- Raising awareness on sustainable development. Promote eco-tourism.	Participation and engagement of local communities in conservation efforts.	7	$ 1 million	Ministry of agriculture and water resources, Ministry of Education, EPIB, and NGOs, local stakeholders
Ecosystem based Adaptation	Implement nature-based solutions such as watershed restoration, restore wetlands, river habitats, natural buffers, reforestation, and green infrastructure projects to enhance water retention and quality.	All Kurdistan Region, Iraq	Constructing dams and ponds. Implementing and enforcing the laws and regulations. Controlled grazing. Preventing water pollution. Management programs and monitoring.	Reduced Flooding: Track the reduction in flood frequency, intensity, or damage within the project area because of improved water retention in nature-based solutions.	2	$ 25 million	Ministry of agriculture and water resources, Ministry of Interior, and NGOs
	Establish community-based water management systems to optimize water allocation and distribution.	All Kurdistan Region, Iraq	Engage the community to understand their water needs and priorities. Assess available water resources and their variations.	Measure the percentage increase in efficient water allocation within the community compared	3	$ 100 million	Ministry of agriculture and water resources, Ministry Municipality, NGOs

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
			Form local committees representing different sectors. Collaboratively create water allocation plans. Implement monitoring systems to track water usage and quality. Promote water conservation and efficiency. Respect traditional knowledge. Ensure legal compliance and conflict resolution mechanisms Build local capacity through training. Periodically review and adapt plans. Conduct public awareness campaigns to involve the community.	to previous practices, considering factors like equitable distribution and reduced wastage. Assess the level of community involvement in decision-making related to water management, reflecting the degree of ownership and sustainability of the system.			
	Ecotourism projects in (1) Sakran Halkurd National Park project (2) Rishin Pond (3) Lake Dukan Corniche	Erbil, Soran District	(1) Supporting the National Park Sakran - Halkurd project financially in the fields of tourism, environment, and natural reserves, especially since we know that there are many rare trees found only in these areas, and the reserve is also considered a safe haven for many animals, birds, and fish. Promote ecotourism as a means of improving environmental protection in the area.	Number of visitors Key stone species population increase	4	150 million USD	Ministry of Agriculture and Water Resources Ministry of Municipalities and Tourism Environmental Protection and Improvement Authority General Directorate of Tourism, Soran Administration General Directorate of Agriculture/Forestry, Soran Administration Soran Administration Ministry of Peshmerga Environmental Protection Unit Board National Park Halgurd – Sakran

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
		Halbaja Province	(2) Creating a small pond on the Rishin water source and greening and planting the surrounding areas with an area of approximately 10 dunams.		7	700,000 USD	Ministry of Agriculture and Water Resources Ministry of Municipalities and Tourism Ministry of Finance Ministry of Electricity Environmental Protection and Improvement Authority General Directorate of Dams General Directorate of Halabja Tourism General Directorate of Agriculture / and Forests Halabja Agricultural tourism Investment commission
		Sulaymaniyah Province	(3) Construction and design of the Corniche Eco-Touristic Road within the borders of Rania district on the coast of Lake Dukan, approximately 5 kilometers long across the lake's coast.		5	100 million USD	Ministry of Agriculture and Water Resources Ministry of Municipalities and Tourism - Environmental Protection and Improvement Authority General Directorate of Tourism, Rabah Rin Administration General Directorate of Agriculture/Forestry, Rabh Rin Administration Rabh Rin Administration, NGOs Investment commission

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Agrotourism projects in the banks of rivers (1) Great Zab River (2) Khabur River	Erbil Province	(1) Rehabilitating and refining the beaches of the Great Zab River in Khabat District and creating a green belt with a length of not less than (10) km on the riverside, along with establishing a contemporary tourism project for water sports.		7	200 million USD	Ministry of Agriculture and Water Resources Ministry of Municipalities and Tourism Environmental Protection and Improvement Authority General Directorate of Erbil Tourism General Directorate of Agriculture/Forests Erbil Erbil Governorate NGOs/Agritourism Security Investment commission
		Dohuk Province	(2) The project to establish the second phase of the Corniche on the Khabur River, which includes 70% green spaces, entertainment places, and walkways.		6	13 million USD	Ministry of Agriculture and Water Resources Ministry of Municipalities and Tourism Environmental Protection and Improvement Authority General Directorate of Tourism in Dohuk General Directorate of Agriculture / Forestry Dohuk Dohuk Governorate Investment commission

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Promote sustainable land-use planning and zoning to mitigate habitat fragmentation and degradation.	All Kurdistan Region, Iraq	Protect the areas which are suitable for agriculture (considering biodiversity). Promote agroforestry. Implement the new approach which is developed by the ministry of agriculture as classified the provinces to areas where the residentials, green zones, and agriculture should be.	Adoption of sustainable land and forest management practices in land use and Urban planning. .	7	$ 5 million	Ministry of agriculture and water resources, Ministry of Interior, and NGOs
	Water Resilience Enhancement through nature-based solutions	All Kurdistan Region, Iraq	Reforestation and Wetlands: Planting trees, restoring wetlands, and preserving natural habitats for better water quality and flood control. Green Infrastructure: Using permeable surfaces and green spaces in urban areas to manage stormwater and prevent flooding. Sustainable Agriculture: Implementing eco-friendly farming practices to reduce runoff and protect water quality. Community Engagement: Involving communities in NBS planning and implementation for better results and support.	Monitor changes in the health and sustainability of local water sources, including groundwater levels, surface water flow, and aquifer recharge rates The level of community preparedness and response following early warnings, measured by factors such as evacuation time, resource mobilization, and casualties avoided.	2	$ 25 million	Ministry of agriculture and water resources, Ministry of Interior, and NGOs

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Conduct scientific research to enhance understanding of the interactions between ecosystems, climate change, and vulnerability.	All Kurdistan Region, Iraq	Database Establishment and Data Collection: Define research objectives and gather data sources. Collect climate and ecosystem data. Analysis and Modeling: - Vulnerability Assessment: - Evaluate vulnerability based on collected data. Adaptation and Mitigation Strategies: Identify strategies for reducing vulnerability. Collaboration and Communication: Collaborate and secure funding.	Assess the accuracy of flood and drought predictions by comparing forecasted events to actual occurrences.	5	$ 30 million	Ministry of agriculture and water resources, Ministry of Higher Education, Ministry of Planning

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
	Establish a comprehensive monitoring system to track the effectiveness of adaptation interventions and assess the resilience of targeted sectors.	All Kurdistan Region, Iraq	Setting clear objectives and selecting relevant indicators. Data collection and baseline establishment are crucial. Regular assessments inform adjustments, with stakeholder involvement and effective reporting guiding future actions and policies. This adaptable system enhances resilience and intervention effectiveness across various sectors.	· Quantity of water saved or utilized from unconventional sources (e.g., water harvesting, treated wastewater reuse, and graywater use) · Reduced number of recorded human injuries due to climate extreme events Measure the time it takes for the community to respond to changing water demands, reflecting the system's ability to optimize allocation promptly.	5	$ 60 million	Ministry of agriculture and water resources, Ministry of Higher Education, Ministry of Planning, NGOs

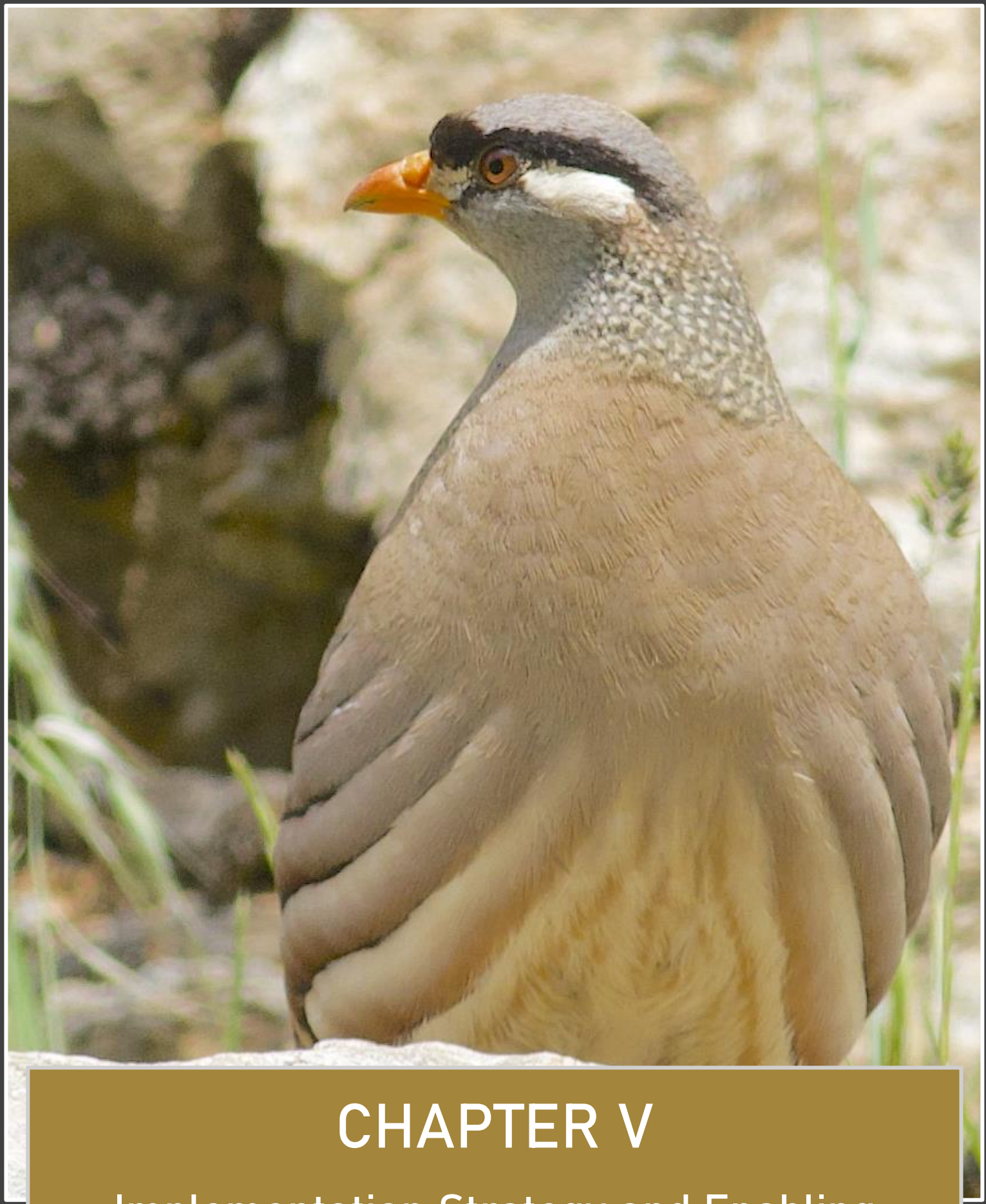
Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
Social-Responsive Adaptation Program	Conduct Social-specific assessments of sectorial vulnerabilities.	All Kurdistan Region, Iraq	Structured research process that focuses on understanding how climate change impacts individuals of different groups within various sectors. This may include data collection, surveys, interviews, and analysis to identify gender-based vulnerabilities in specific areas like agriculture, water resources, or healthcare. The methodology aims to uncover disparities and unique challenges faced by different groups in relation to climate change, helping to inform more targeted and equitable adaptation strategies.	The completion or progress of gender-specific vulnerability assessments within various sectors. It can be tracked as a percentage of assessments conducted or completed over a specified period.	6	$50,000 to $200,000	Iraq Ministry of Labour and Social Affairs, Ministry of Planning, NGOs Academic Institutions International Development Organizations

	Establish women-led natural resources user committees to ensure inclusive water management.	All Kurdistan Region, Iraq	Community Engagement: Begin by engaging with local communities, particularly women, to understand their needs and concerns related to water management. Identification of Women Leaders: Identify and empower women leaders from these communities who are willing to take on leadership roles. Capacity Building: Provide training and capacity-building programs for these women leaders, focusing on water resource management, sustainable practices, and leadership skills. Committee Formation: Facilitate the formation of women-led natural resources user committees within the communities. Ensure these committees have representation from diverse stakeholders, including women from different backgrounds and age groups. Regular Meetings: Encourage regular meetings and consultations among committee members to discuss water management strategies, distribute responsibilities, and ensure an inclusive approach. Awareness and Advocacy: Promote awareness and advocacy efforts to highlight the importance of women's involvement in water management and the benefits of gender-inclusive approaches. Monitoring and Evaluation: Establish mechanisms for monitoring the	The number of Women-Led User Committees Established	7	500,000 USD	Governmental Bodies NGOs Community Leaders and Influencers International Development Agencies

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
			effectiveness of the committees, track their contributions, and evaluate their impact on water management.				

	Provide training to women on water-efficient practices, agricultural best practices, and water quality monitoring.	All Kurdistan Region, Iraq	Needs Assessment: Start with a comprehensive needs assessment to understand the specific requirements and challenges of the target communities. Customized Training Programs: Develop training programs tailored to the needs of women in the communities. These programs should focus on water-efficient practices, sustainable agriculture, and water quality monitoring. Training Workshops: Conduct training workshops in collaboration with local experts, agricultural specialists, and environmental professionals. The training can include both theoretical and practical components. Hands-On Learning: Provide hands-on learning experiences, such as demonstrations of water-efficient irrigation techniques, organic farming methods, and water quality testing. Use of Local Resources: Encourage women to make use of local resources and sustainable farming methods to minimize water usage and improve agricultural productivity. Follow-Up and Feedback: Maintain continuous engagement with participants, offer follow-up sessions, and gather feedback to ensure that the training meets their needs and leads to practical improvements. Empowerment: Empower women to take leadership roles in implementing water-	The number of trained women or the percentage of trained women who successfully implement water-efficient practices.	5	300,000 USD	Ministry of agriculture and water resources, EPIB, and NGOs, local stakeholders

Sector	Adaptation measures and interventions	Locations	Method	Indicators	Priority	Budget	Responsibility
			efficient and sustainable practices in their communities.				
	Establish women-led conservation groups to contribute to habitat restoration and protection.	All Kurdistan Region, Iraq	Community Engagement: Begin by engaging with the local community, particularly women, to raise awareness of the importance of habitat restoration and protection. Identify Potential Leaders: Identify women within the community who are passionate about environmental conservation and are willing to take leadership roles. Formation of Conservation Groups: Facilitate the formation of women-led conservation groups, ensuring they have the necessary training and resources. Habitat Restoration Activities: Organize habitat restoration activities such as reforestation, cleanup campaigns, and wildlife protection efforts. Monitoring and Reporting: Encourage group members to monitor the health of local habitats and report any issues, including illegal logging, poaching, or pollution.	The total number of conservation groups formed and led by women.	4	200,000 USD	Government and Local Authorities, Environmental Organizations, NGOs, Community Leaders, and local stakeholders



CHAPTER V

Implementation Strategy and Enabling Factors for LAP Implementation

Chapter V: Implementation Strategy and Enabling Factors for LAP Implementation

LAP Policy Mainstreaming

A critical step in ensuring the successful integration and use of climate change adaptation measures in Kurdistan, Iraq, is mainstreaming the Local Adaptation Plan (LAP) into national policy. The area may gain the full backing of the government, make cross-sector coordination easier, and guarantee the long-term sustainability of adaptation activities by coordinating the Local NAP with national policies, strategies, and plans. This section focuses on the significance of mainstreaming, important factors to take into account, and suggested actions for incorporating the Local NAP into national policy.

The Kurdistan region can promote policy coherence, achieve political commitment, strengthen the legal framework, and maximize resource allocation by aligning the Local NAP with national policies, strategies, and plans. The mainstreaming process can assure Kurdistan's long-term sustainability and resilience in the face of climate change through thorough analysis, revision, capacity building, and monitoring.

Importance of Mainstreaming

- Policy Coherence and Integration: Mainstreaming the Local NAP in national policy facilitates coherence and integration across various sectors and policy domains. It ensures that climate change adaptation is considered and incorporated into existing policies, plans, and strategies, including those related to water resources, agriculture, infrastructure development, health, and biodiversity conservation. This integration reduces duplication of efforts, optimizes resource allocation, and enhances overall effectiveness.
- Political Commitment and Support: Aligning the Local NAP with national policy signals strong political commitment to climate change adaptation at the highest level. It fosters a supportive policy environment, enabling the allocation of financial resources, institutional backing, and coordination mechanisms necessary for successful implementation. Mainstreaming also enhances the visibility of adaptation efforts, attracting domestic and international investments and partnerships.
- Legal Framework and Enforcement: Mainstreaming the Local NAP in national policy provides a legal basis for implementing and enforcing adaptation measures. It enables the development of climate-resilient laws, regulations, and standards that govern various sectors. Incorporating adaptation considerations into national legislation ensures compliance and accountability and strengthens the legal framework for climate change adaptation.

Considerations for Mainstreaming

- Policy Alignment and Consistency: Ensure that the goals, objectives, and strategies outlined in the Local NAP align with the broader national policy framework. Identify existing national policies, plans, and strategies relevant to adaptation and assess their compatibility with the Local NAP. Identify any gaps or conflicts and develop strategies to address them through policy revision or formulation.
- Institutional Arrangements and Coordination: Establish clear institutional arrangements and coordination mechanisms for mainstreaming the Local NAP. Identify the lead agency responsible for overseeing adaptation activities and ensure effective coordination across relevant ministries, departments, and stakeholders. Strengthen inter-ministerial collaboration and establish mechanisms for sharing information, coordinating actions, and monitoring progress.
- Resource Mobilization: Address the financial and resource implications of mainstreaming the Local NAP in national policy. Identify potential funding sources, including government budgets, climate finance mechanisms, international grants, and private sector investments. Develop strategies to leverage these resources and integrate them into national budgeting processes to support the implementation of adaptation measures.

Steps for Mainstreaming

- Policy Analysis and Gap Assessment: Conduct a comprehensive analysis of existing national policies, plans, and strategies to identify gaps and opportunities for mainstreaming adaptation. Assess the compatibility of these policies with the Local NAP and identify areas for revision or development.
- Policy Revision and Formulation: Revise or develop policies, laws, and regulations to incorporate adaptation considerations. Integrate climate change adaptation into sector-specific policies and strategies, ensuring coherence and consistency with the Local NAP. Involve relevant stakeholders, including government agencies, civil society organizations, and private sector entities, in the policy revision and formulation processes.
- Institutional Strengthening and Capacity Building: Strengthen institutional capacities for mainstreaming adaptation through training programs, workshops, and technical assistance. Build the capacity of relevant government agencies, local authorities, and other stakeholders to implement and monitor adaptation policies effectively. Enhance their understanding of climate change impacts, adaptation options, and the integration of adaptation into existing policies and practices.
- Communication and Awareness: Develop communication strategies to raise awareness and foster understanding of the importance of mainstreaming adaptation in national policy. Engage with policymakers, legislators, and other stakeholders to highlight the benefits and opportunities of mainstreaming. Foster dialogue and exchange of information to ensure broad support and ownership of the mainstreaming process.

- Monitoring and Evaluation: Establish mechanisms for monitoring and evaluating the mainstreaming process. Develop indicators to track the integration of adaptation considerations into national policies, the progress of implementation, and the effectiveness of mainstreaming efforts. Regularly assess the outcomes and impacts of mainstreaming to inform adaptive management and identify areas for improvement.

LAP Financing Strategy Framework

Designing a finance strategy for the Local Adaptation Plan in Kurdistan, Iraq requires careful consideration of the region's specific needs, available resources, and the goals outlined in the adaptation plan. Here is a framework for designing the finance strategy:

- Assess Financial Needs: Conduct a comprehensive assessment of the financial requirements for implementing the Local Adaptation Plan. Identify key projects, initiatives, and activities that require funding, considering their priority, urgency, and potential impact on climate resilience. This assessment should cover various sectors, such as water management, agriculture, infrastructure development, public health, and community engagement.
- Identify Funding Sources: Explore and identify potential funding sources that align with the objectives of the Local Adaptation Plan. These sources may include government budgets, international climate funds, multilateral development banks, private sector investments, grants, and partnerships with non-governmental organizations and development agencies. Additionally, consider the potential for leveraging public-private partnerships to secure financial support.
- Climate Finance Mechanisms: Gain a thorough understanding of climate finance mechanisms and international funds that support climate adaptation efforts. This includes mechanisms such as the Green Climate Fund (GCF), Global Environment Facility (GEF), and Adaptation Fund. Explore the requirements and procedures for accessing these funds and develop strategies to meet their criteria, including project design, proposal development, and project implementation frameworks.
- Capacity Building: Invest in capacity building initiatives to strengthen the financial management capabilities of local institutions responsible for implementing the Local Adaptation Plan. Provide training programs and technical assistance to government officials, finance professionals, and project managers to enhance their understanding of climate finance, project financing, risk assessment, and financial management practices. This will improve the region's ability to effectively manage and utilize financial resources.
- Public-Private Partnerships: Promote partnerships between the public and private sectors to mobilize additional financial resources for adaptation projects. Explore opportunities for private sector investments, public-private partnerships, and innovative financing mechanisms, such as green bonds and impact investment funds. Encourage collaboration

with local businesses, industries, and financial institutions to foster sustainable economic growth and climate resilience.

- Study the collaborative insurance policies and funds to support groups affected by climate change by establishing model residential complexes in the affected areas that rely on renewable energy, providing water sources, smart agriculture, and promoting sustainable development.
- Monitoring and Reporting: Establish robust monitoring and reporting systems to track the allocation and utilization of financial resources within the Local Adaptation Plan. Develop key performance indicators (KPIs) and establish clear reporting mechanisms to evaluate the financial effectiveness and impact of adaptation projects. Regularly communicate progress, challenges, and financial accountability to stakeholders, including government entities, international donors, and the public.
- Risk Management: Integrate risk management strategies into the finance strategy to address potential financial risks and uncertainties. Identify potential risks associated with project financing, currency fluctuations, budget constraints, and changes in funding availability. Develop contingency plans, risk mitigation measures, and mechanisms for financial resilience to ensure the continued implementation of the adaptation plan in the face of unforeseen challenges.
- Stakeholder Engagement: Engage stakeholders from government agencies, civil society organizations, academia, private sector entities, and local communities throughout the finance strategy development process. Seek input, feedback, and collaboration to ensure a holistic approach that addresses the diverse needs and priorities of stakeholders. Foster partnerships and collaboration to leverage additional financial resources and promote ownership of the Local Adaptation Plan.

The finance strategy should be flexible and adaptable, allowing for adjustments based on evolving financial landscapes, emerging opportunities, and lessons learned during implementation. Regular reviews and updates of the finance strategy will ensure its alignment with changing financial dynamics and the evolving needs of Kurdistan's adaptation efforts.

LAP Communication Strategy

By implementing this comprehensive communication strategy, the Kurdistan, Iraq Local NAP can effectively engage stakeholders, raise awareness, foster ownership, and mobilize support for climate change adaptation efforts in the region. The communication strategy for the Kurdistan, Iraq Local NAP would be achieved through the following steps:

Define Communication Objectives

- Raise awareness about the importance of climate change adaptation and the Local NAP among stakeholders, including government agencies, civil society organizations, communities, and the general public.

- Foster understanding of the goals, objectives, and strategies outlined in the Local NAP.
- Encourage engagement, participation, and ownership of the Local NAP among stakeholders.
- Mobilize support, resources, and partnerships for the implementation of the Local NAP.

Identify Target Audiences:

- Government Agencies: Policy makers, government officials, and technical staff involved in climate change and relevant sectors. Highlight the policy implications, institutional arrangements, and actions required for effective implementation of the Local NAP.
- Civil Society Organizations: NGOs, community-based organizations, research institutions, and advocacy groups. Emphasize the role of civil society in supporting adaptation efforts, fostering community resilience, and advocating for climate action.
- Communities: Local communities, vulnerable groups, and indigenous populations. Tailor messages to address specific local concerns, highlight the benefits of adaptation at the community level, and promote community-led adaptation initiatives.
- Private Sector: Businesses, industry associations, and investors. Showcase the business case for climate change adaptation, including the opportunities for innovation, market growth, and risk reduction.
- General Public: Media, educators, and the wider public. Communicate the relevance of climate change adaptation to everyday life, emphasizing personal and collective actions for a more resilient future.

Tailor Key Messages

Develop clear and concise key messages that convey the purpose, goals, and benefits of the Local NAP. Messages should be tailored to specific target audiences while maintaining consistency and coherence. Emphasize the importance of adaptation, its relevance to local contexts, and the role of stakeholders in achieving climate resilience. Key messages could include:

- Climate change is already impacting Kurdistan, and adaptation is crucial to protect our communities, resources, and future generations.
- The Local NAP provides a roadmap for building climate resilience, integrating adaptation into policies, and ensuring a sustainable future for Kurdistan.
- Everyone has a role to play in climate change adaptation – government, civil society, communities, and the private sector.
- By implementing the Local NAP, we can reduce vulnerabilities, enhance preparedness, and seize opportunities for sustainable development.

Select Communication Channels

- Stakeholder Engagement Workshops: Organize workshops and consultations to engage with relevant stakeholders, provide updates on the Local NAP, and gather feedback. Encourage open dialogue, address concerns, and foster a sense of ownership.
- Website and Online Platforms: Establish a dedicated website or webpage with information about the Local NAP, including key documents, progress updates, and contact information. Regularly update the website with news, success stories, and resources.
- Social Media: Utilize social media platforms to disseminate key messages, share success stories, and engage with the public. Consider platforms such as Facebook, Twitter, LinkedIn, and Instagram. Use visuals, infographics, and videos to increase engagement and reach a wider audience.
- Press Releases and Media Engagement: Issue press releases and organize media briefings to raise awareness about the Local NAP and highlight significant milestones or events. Develop relationships with journalists and media outlets to secure media coverage and interviews.
- Print Materials: Develop brochures, fact sheets, and pamphlets that provide concise information on the Local NAP for distribution at events, meetings, and targeted locations. Translate materials into local languages for wider accessibility.
- Multimedia: Develop videos, infographics, and animations to visually communicate key messages and make complex information more accessible. Share these multimedia resources on social media, websites, and during stakeholder engagements.
- Public Events: Participate in climate-related events, fairs, and exhibitions to showcase the Local NAP and engage with diverse audiences. Organize information booths, presentations, and interactive activities to educate and involve participants.
- Educational Programs: Collaborate with educational institutions to incorporate climate change adaptation and the Local NAP into curricula. Conduct educational campaigns, workshops, and training sessions for students and educators.

Stakeholder Engagement and Participation

- Establish regular communication channels to engage stakeholders, including newsletters, email updates, and online forums for discussion and feedback. Solicit input and suggestions from stakeholders, ensuring their perspectives are considered in the implementation of the Local NAP.
- Conduct targeted outreach activities to specific stakeholder groups, such as workshops, focus group discussions, and training sessions. Tailor the content and approach to address their unique needs, concerns, and opportunities for engagement.
- Encourage participation and involvement of stakeholders in the development and implementation of adaptation actions and initiatives. Foster partnerships and collaboration with stakeholders to leverage resources, expertise, and support for the Local NAP.

Capacity Building and Training

- Conduct capacity-building programs to enhance understanding of climate change adaptation concepts and the Local NAP among stakeholders. Provide training sessions on specific topics related to adaptation, including vulnerability assessments, climate-resilient practices, and monitoring and evaluation.
- Facilitate knowledge sharing and learning opportunities through webinars, seminars, and workshops, featuring national and international experts. Foster peer-to-peer learning and exchange of best practices among stakeholders to build collective knowledge and expertise.

Monitoring and Evaluation of Communication Activities

- Regularly monitor and evaluate the effectiveness of communication activities to assess their reach, impact, and alignment with communication objectives. Utilize feedback mechanisms, surveys, and focus group discussions to gather stakeholder perspectives and assess the communication strategy's effectiveness.
- Adjust communication activities based on lessons learned and feedback to improve the strategy's overall impact. Continuously evaluate the communication channels, messages, and activities to ensure they are responsive to the needs and preferences of the target audiences.

Partnership and Resource Mobilization

- Collaborate with development agencies, international organizations, and donors to mobilize resources and technical support for communication activities. Seek partnerships with media outlets, influencers, and communication experts to amplify the reach and impact of the communication strategy.
- Leverage existing networks and platforms to maximize the dissemination of key messages and engage with diverse stakeholders. Develop partnerships with private sector entities to support communication activities and tap into their communication networks and expertise.

Continuous Improvement and Adaptation

- Regularly review and update the communication strategy to ensure its alignment with evolving needs, emerging challenges, and lessons learned. Incorporate feedback from stakeholders and evaluate the effectiveness of the strategy in achieving its objectives.
- Stay informed about new communication tools, platforms, and technologies that can enhance the reach and impact of communication activities. Continuously innovate and adapt the communication approach to stay relevant and resonate with target audiences.
- Embrace a culture of learning and knowledge sharing within the communication team. Encourage the exchange of experiences, best practices, and lessons learned to continuously improve the effectiveness and efficiency of communication efforts.

CHAPTER VI

LAP Monitoring, Review and Learning (MRL) Framework

Chapter VI: LAP Monitoring, Review and Learning (MRL) Framework

Proposed LAP Monitoring, Review and Learning (MRL) Framework in Kurdistan

The key function of the MRL framework is to determine the extent to which the LAP overarching objective of reducing vulnerability, increasing resilience and adaptive capacity is being achieved. The MRL framework should also assess progress on the strategic objectives relating to institutions, governance, capacity, finance and data. In this context, the MRL system needs to:

- Monitor the effectiveness of adaptation mainstreaming/integration in development planning at different scales (sectoral, sub-sectoral, thematic and program);
- Monitor changes in vulnerability, resilience and adaptive capacity at appropriate scales (sector, sub-sector, thematic and program);
- Monitor the institutions, governance mechanisms, socioeconomics and finance that determine the enabling environments in which adaptation actions are designed, implemented, and assessed.
- Monitor progress in implementing actions specified in the LAP and that support the LAP at the sub-national, sector, and program levels, including development and implementation of policies, strategies, programs and projects.
- Review information and learning generated by monitoring activities to improve adaptation planning, design and implementation.

Sectors are responsible for reporting progress on adaptation and are expected to collate data on adaptation programs implemented in a sector annually. Regional agencies within the Kurdistan region are expected to collect data for reporting on overall adaptation progress. Sectoral monitoring and reporting agencies provide information on adaptation progress to the Environmental Board, which will specify the periodicity of sector level reporting.

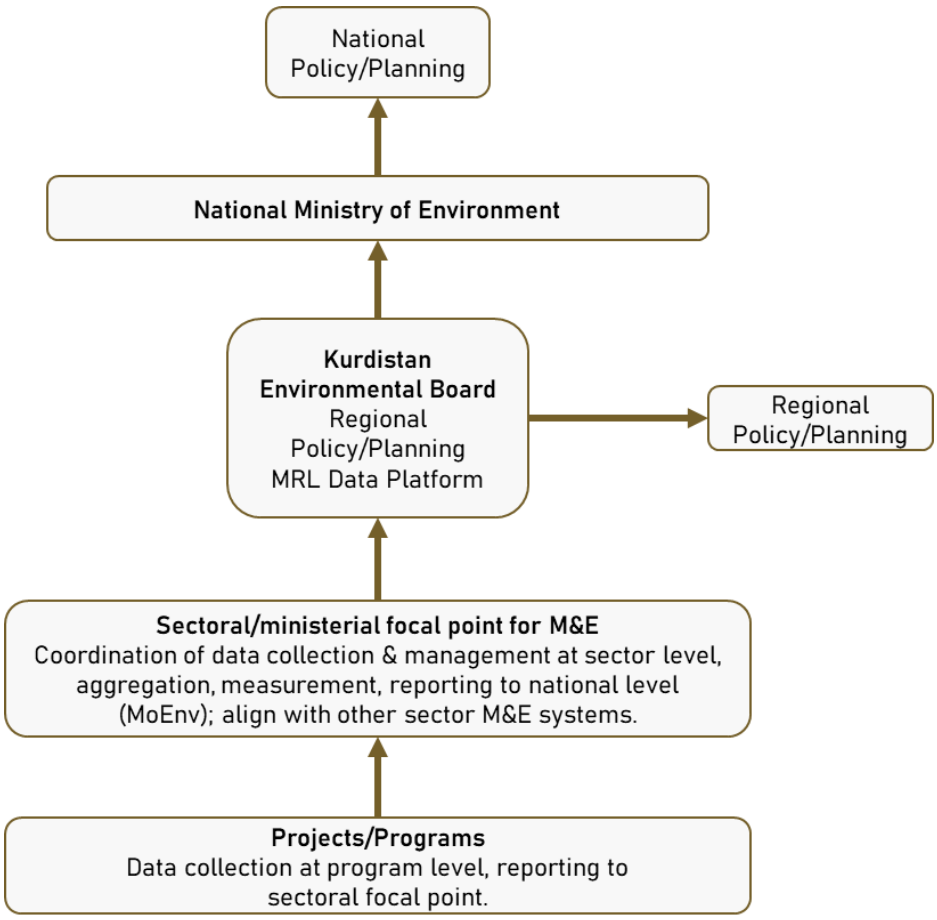


Figure 28: Emerging institutional arrangements for adaptation MRL in Kurdistan

Components of MRL System

Stakeholders can systematically track the development, assess the efficacy, and promote learning within the Local Adaptation Plan in Kurdistan, Iraq, by putting in place a well-structured MRL program. This will make it possible to make informed decisions and practice adaptive management, which will improve the results of efforts to adapt to climate change.

Monitoring, Review, and Learning (MRL) Program Structure

- Program Objectives: Clearly define the objectives of the MRL program, which include monitoring the progress and effectiveness of adaptation programs, evaluating their impact, and promoting a culture of learning and adaptive management.
- Key Performance Indicators (KPIs): Develop a set of KPIs aligned with the objectives of the Local Adaptation Plan and the specific adaptation programs. These KPIs should be measurable, time-bound, and reflect the desired outcomes of the programs and interventions.

- Data Collection and Management: Establish mechanisms for systematic data collection, including both qualitative and quantitative data, related to adaptation programs and interventions. This may involve surveys, interviews, field observations, and documentation of key outcomes and outputs. Ensure data quality and integrity through appropriate data management systems.
- Monitoring: Regularly monitor the implementation of adaptation programs and interventions to track progress, identify challenges, and ensure compliance with the set targets. Develop monitoring tools, checklists, and reporting templates to facilitate consistent and structured monitoring processes.
- Evaluation: Conduct periodic evaluations to assess the effectiveness, efficiency, relevance, and sustainability of the adaptation programs. Use evaluation methods such as impact assessments, cost-benefit analysis, and stakeholder feedback to gather comprehensive insights. Evaluate the alignment of the programs with the original goals and objectives of the Local Adaptation Plan.
- Learning and Knowledge Sharing: Promote a culture of learning and knowledge sharing within the MRL program. Encourage regular reflection on monitoring and evaluation findings to identify lessons learned, best practices, and areas for improvement. Facilitate knowledge exchange through workshops, seminars, and reports to ensure continuous improvement and foster innovation.
- Stakeholder Engagement: Involve relevant stakeholders, including government agencies, local communities, civil society organizations, and experts, in the MRL process. Seek their input and feedback during program design, monitoring, and evaluation stages. Foster participatory approaches that empower stakeholders and facilitate ownership of the Local Adaptation Plan.
- Reporting and Communication: Develop clear reporting mechanisms to ensure timely dissemination of monitoring and evaluation findings. Prepare concise and accessible reports that highlight key achievements, challenges, and recommendations. Communicate findings to relevant stakeholders, policymakers, and the public to enhance transparency and accountability.
- Adaptive Management: Use the MRL findings to inform adaptive management within the Local Adaptation Plan. Utilize the lessons learned and recommendations to make informed decisions, adjust program strategies, and allocate resources effectively. Foster a culture of flexibility and responsiveness to address emerging challenges and changing priorities.
- Review and Continuous Improvement: Regularly review and refine the MRL program structure based on feedback, emerging needs, and advancements in monitoring and evaluation methodologies. Incorporate feedback from stakeholders and make necessary adjustments to enhance the effectiveness and relevance of the MRL processes.

The following should be noted in each sector.

Water Management and Conservation

MONITORING
• Regularly monitor the progress of water infrastructure projects, including the construction of reservoirs and dams. • Conduct surveys and measurements to track water consumption patterns and the adoption of water-saving practices. • Document the maintenance activities and improvements made to water infrastructure.
EVALUATION
• Assess the effectiveness of drip irrigation systems and efficient irrigation techniques in reducing water consumption and improving crop yields. • Evaluate the impact of education and awareness programs on water conservation behavior among households and farmers. • Conduct cost-benefit analysis to measure the economic efficiency of water management interventions.
LEARNING AND KNOWLEDGE SHARING
• Organize workshops and knowledge-sharing sessions to disseminate best practices and lessons learned in water management and conservation. • Facilitate the exchange of experiences and success stories among stakeholders involved in water-related programs. • Foster collaboration between researchers, practitioners, and policymakers to address emerging challenges and improve water management strategies

Sustainable Agriculture and Food Security

MONITORING
• Monitor the adoption of climate-resilient farming practices and the distribution of improved seeds and crop varieties. • Conduct field observations to assess the implementation of sustainable soil management and integrated pest management techniques. • Track the establishment and performance of farmer cooperatives and market linkages.
EVALUATION
• Evaluate the impact of climate-smart agricultural practices on farmers' income, food security, and resilience to climate change impacts. • Assess the contribution of sustainable agriculture programs to environmental sustainability, such as soil health improvement and reduced pesticide use. • Measure the effectiveness of farmer training programs in enhancing knowledge and skills related to climate-resilient farming.
LEARNING AND KNOWLEDGE SHARING

- Facilitate participatory evaluations and learning sessions to gather feedback from farmers and stakeholders on the effectiveness of agricultural interventions.
- Disseminate research findings, case studies, and success stories on sustainable agriculture practices through reports, workshops, and online platforms.
- Encourage collaboration between farmers, researchers, and extension services to share experiences and innovations in climate-smart agriculture.

Infrastructure Resilience

MONITORING
• Monitor the progress of infrastructure retrofitting and upgrades to withstand climate-related hazards. • Conduct regular inspections and assessments of infrastructure systems' resilience and functionality. • Track the implementation of early warning systems and the effectiveness of emergency response plans.
EVALUATION
• Assess the resilience of critical infrastructure sectors by conducting vulnerability assessments and cost-benefit analyses. • Evaluate the reduction in infrastructure damage and disruption during extreme weather events. • Measure the effectiveness of drainage systems and flood protection measures in mitigating flood risks.
LEARNING AND KNOWLEDGE SHARING
• Organize workshops and forums to share experiences and lessons learned in infrastructure resilience. • Establish a platform for exchange between infrastructure managers, engineers, and experts to discuss best practices and emerging trends. • Document case studies on successful infrastructure resilience projects to guide future interventions.

Biodiversity Conservation and Ecosystem Restoration

MONITORING
• Monitor the establishment and expansion of protected areas and biodiversity corridors. • Conduct regular assessments of reforestation and afforestation initiatives and track the restoration of degraded landscapes. • Monitor community participation and engagement in conservation activities.
EVALUATION

• Evaluate the impact of protected areas on biodiversity conservation and ecosystem services. • Assess the carbon sequestration potential of reforestation and afforestation programs. • Measure the social and economic benefits derived from sustainable land and forest management practices.
LEARNING AND KNOWLEDGE SHARING
• Organize knowledge-sharing events to share experiences and best practices in biodiversity conservation and ecosystem restoration. • Collaborate with local communities and indigenous groups to integrate traditional knowledge into conservation efforts. • Develop guidelines and manuals based on successful case studies to support community-led conservation initiatives.

Public Health and Climate Change Adaptation

MONITORING
• Monitor the implementation of heatwave and extreme weather preparedness plans. • Collect data on climate-related health risks and incidents, such as vector-borne diseases and heat-related illnesses. • Track improvements in access to clean water, sanitation facilities, and healthcare services.
EVALUATION
• Evaluate the effectiveness of early warning systems and response mechanisms in reducing climate-related health risks. • Assess the impact of improved water and sanitation infrastructure on public health outcomes. • Measure the effectiveness of awareness campaigns in promoting behavior change and preventive measures.
LEARNING AND KNOWLEDGE SHARING
• Organize workshops and seminars to share knowledge on climate change and health impacts. • Foster collaboration between health professionals, researchers, and policymakers to exchange experiences and evidence-based practices. • Document case studies on successful public health interventions to guide future adaptation efforts.

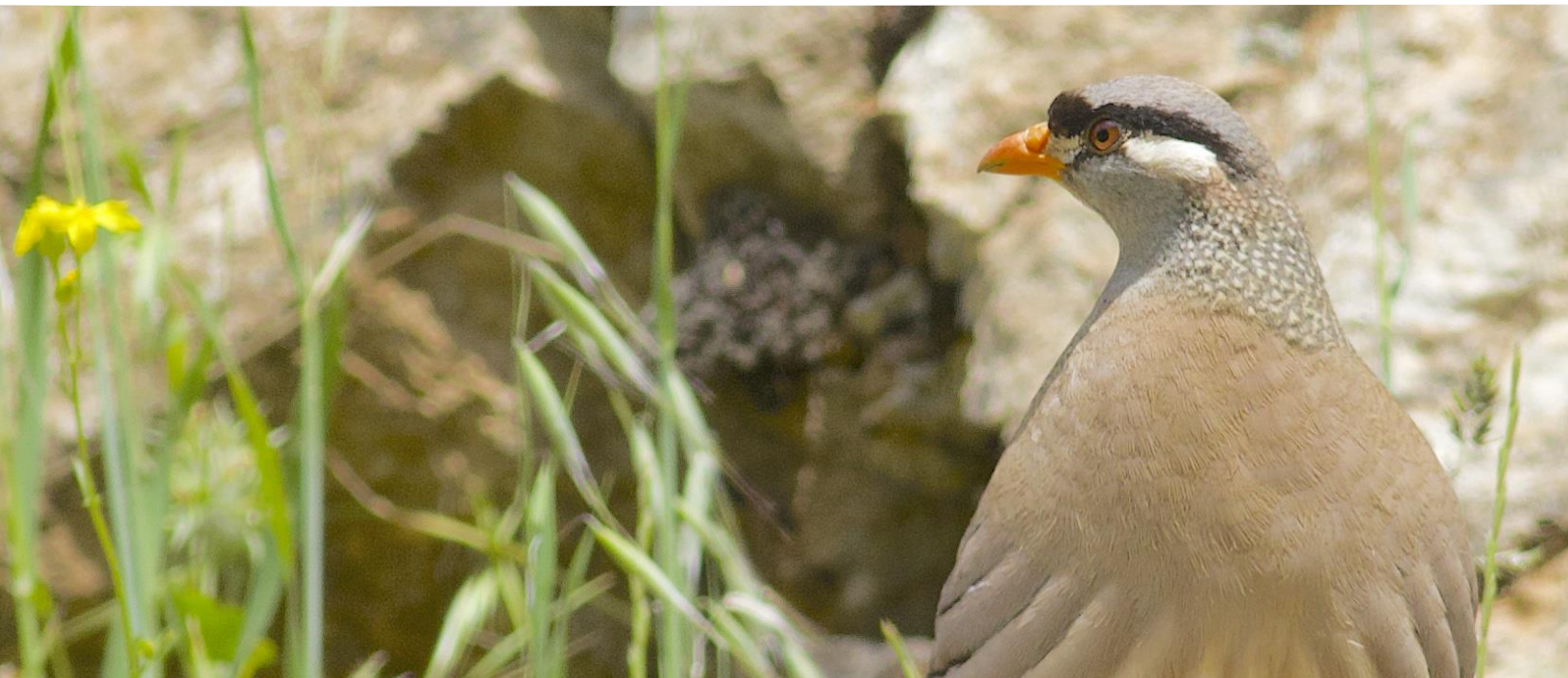
References

- First Nationally Determined Contribution (NDC) of Iraq, submitted to UNFCCC in October 2021.
- Iraq's Initial National Communication to the UNFCCC, 2016.
- Climate Change Profile Iraq, Ministry of Foreign Affairs of the Netherlands, 2018.
- 6TH National Report to the Convention on Biological Diversity, Iraq, 2018.
- National Strategy of Environmental Pollution Reduction and Action Plan (2022-2030).
- National Biodiversity Strategy and Action Plan, 2015-2020.
- KRG Ministry of Planning, Kurdistan Region of Iraq 2020: A Vision for the Future, 2013.
- The National Strategy of Environmental Pollution Reduction and action plan for Iraq (NSEPRAP 2022-2030).
- World Bank, The Kurdistan Region of Iraq: Assessing the Economic and Social Impact of the Syrian Conflict and ISIS, 2015.
- BirdLife International (2023) Country profile: Iraq. Available from http://datazone.birdlife.org/country/iraq. Downloaded: 2023-01-27
- Skelton M., Competing Over the Tigris: The Politics of Water Governance in Iraq, Institute of Regional and International Studies (IRIS), November 2022.
- Bachmann et. al., Tigris-Euphrates River Ecosystem: A Status Report Paper for the Mesopotamia Water Forum 2019, Sulaymaniyah, Kurdistan Region of Iraq.
- Al-Ani et. al., Assessment of Water Quality in the Selected Sites on the Tigris River, Baghdad-Iraq, International Journal of Advanced Research (2014), Volume 2, Issue 5, 1125-1131.
- https://www.rudaw.net/english/opinion/01012021
- Tinti A., Water Resources Management in the Kurdistan Region of Iraq, A POLICY REPORT by, Institute of Regional and International Studies (IRIS), The American University of Iraq, Sulaimani, 2017
- FAO, AQUASTAT database, 2003.
- UNDP, Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, 2010.
- CSO, KRSO & UNICEF, Knowledge, Attitudes and Practices of Society on the Use of Water and Environmental Aspects in Iraq, 2016
- KRG Ministry of Planning & UNDP, Building the Kurdistan Region of Iraq: The Socio-Economic Infrastructures, 2012.
- Heshmati, Almas, Integrated Water Resource Management in the Kurdistan Region, 2009
- UNDP, Post-Conflict Impact Assessment on Environment in Kurdistan Region of Iraq, 2015

Appendices

Appendix 1: List of Stakeholders

Stakeholders
Ministry of Agriculture and Water Resources - KRG
Environmental Protection and Improvement Board - KRG
Ministry of Electricity - KRG
Ministry of Health - KRG
Ministry of Planning - KRG
Investment Committee - KRG
Ministry of Transport - KRG
Ministry of Construction and housing - KRG
Ministry of Environment - Federal
Ministry of Municipalities and Tourism - KGR
Ministry of Natural Resources - KGR
Ministry of Education – KGR
Ministry of Higher Education and Scientific Research - KGR
Department of Media and Information
Department of Coordination and Follow-Up - KGR
Department of Information Technology - KGR
Department of Non-Governmental Organization - KGR
High Council for Women and Development - KGR
Academic and Research Institutions in the region
International NGOs and donors
Local NGOs in the region
Local communities and CBOs in the region
Media and Advocacy Groups in the region (Media outlets, environmental journalists, etc.)
Emergency and Disaster Management Agencies



Appendix 2: List of Contributors

#	Name	Position	Entity
1.	AbdulRahman Sadeeq	Head of Environment Authority	Environmental Authority
2.	Ahmed Mohammed Mawlood	Office Manager of Environment Authority	Environmental Authority
3.	Azad Nouri Oula	Head of Technical dep.	Environmental Authority
4.	Haval Ahmed Mohammed	Head Climate Change Directorate	Environmental Authority
5.	Herish Saber	Water Management Strategy Expert	Environmental Authority
6.	Mohanned Ayoub Mustafa	Adaptation and Mitigation Dep Officer	Environmental Authority
7.	Mohammed Mahmoud Ali	Waste Management Dep Officer	Environmental Authority
8.	Sarah Amer	Planning Dep Officer	Environmental Authority
9.	Dilon Salim Shamoun	Urban Environment Dep Officer	Environmental Authority
10.	Halkwat AbdulRahman Esmail	Director General of Forests, Pastures and Horticulture Directorate	Ministry of Agriculture and Water Resources
11.	Carwan Sabah Hama Salih	Director General of Water Resources Dep	Ministry of Agriculture and Water Resources
12.	Salman Kareem Hamed	Head of Design and studies/ Water Resources Directorate	Ministry of Agriculture and Water Resources

13.	Aram Najat	Pastures Dep/ Forests, Pastures and Horticulture Directorate	Ministry of Agriculture and Water Resources
14.	Lukman Mustafa Ali	Erbil Agricultural Directorate Head	Ministry of Agriculture and Water Resources
15.	Jalil Shamsulldein Hamid	Sulaymaniyah Agricultural Directorate Head	Ministry of Agriculture and Water Resources
16.	Fiker Ahmed Ali	Duhok Water Directorate Head	Ministry of Agriculture and Water Resources
17.	Hegga AbdulWahid	Duhok Irrigation Directorate Head	Ministry of Agriculture and Water Resources
18.	Amjid Obaid Mohammed	Duhok Agricultural Directorate Head	Ministry of Agriculture and Water Resources
19.	Najim Omer	Halbja Agricultural Directorate Head	Ministry of Agriculture and Water Resources
20	Shalaw Rifaat Hamid	Erbil Forests Directorate Head	Ministry of Agriculture and Water Resources
21.	Hawkar Jalal Mulla Ahmed	Sulaymaniyah Forests Directorate Head	Ministry of Agriculture and Water Resources
22	Kawa Sabri Faris	Duhok Forests Directorate Head	Ministry of Agriculture and Water Resources
23	Mohammed Mahmoud	Halbja Forests Directorate Head	Ministry of Agriculture and Water Resources
24	Kawjar Jamal Twofeeq	Doukan Dam Head	Ministry of Agriculture and Water Resources
25	Saman Esmail Mohammed	Duhok Dam Head	Ministry of Agriculture and Water Resources

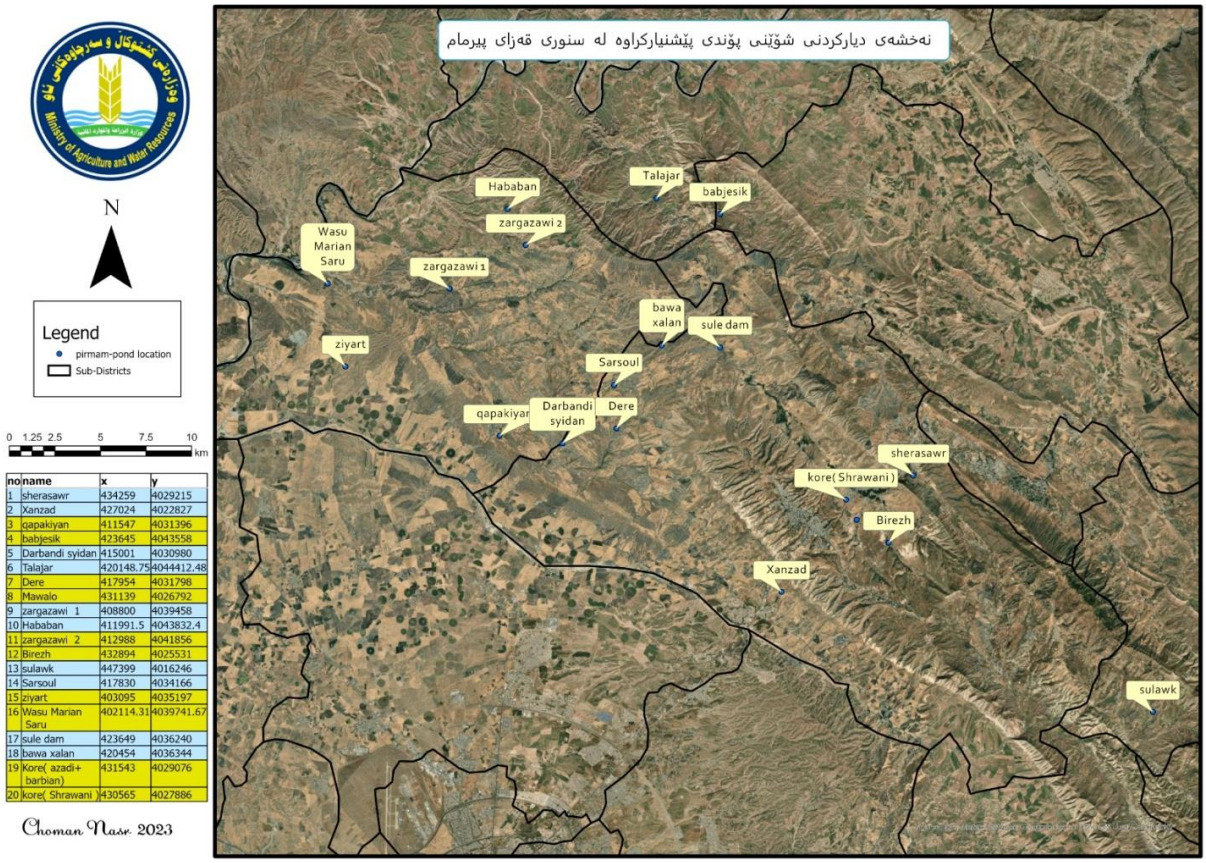
26	Farhad Mohammed Taheer	Darbendikhan Dam Head	Ministry of Agriculture and Water Resources
27	Ahmed Wassman Ahmed	Hydraulic dep Officer	Ministry of Agriculture and Water Resources
28	Rebouir Hassan	Erbil Irrigation Directorate Head	Ministry of Agriculture and Water Resources
29	Ari Faiq Hassan	Sulaymaniyah Irrigation Directorate Head	Ministry of Agriculture and Water Resources
30	Rejean Hussein Mohammed	Duhok Irrigation Directorate Head	Ministry of Agriculture and Water Resources
31.	Ashraf Hassan Wessemourad	Halbja Irrigation Directorate Head	Ministry of Agriculture and Water Resources
32	Ganar Othman Abdullah		KRG Tourism Authority
33	Sahar Hussein	Climate change directorate	Federal Ministry of Environment
34	Najlaa Mohsin	Director General of Technical Department	Federal Ministry of Environment
35	Ammar Abu Drais	International consultant	UNDP expert
36	Korsh Ararat	National consultant	UNDP expert
37	Islam Daoud	International consultant	UNDP expert
38	Hussein Al-Kisswani	International consultant	UNDP expert
39	Omar Al-Sheikhly	National consultant	UNDP expert
40	Mamunur Rashid	Portfolio manager	UNDP staff
41.	Mustafa Abdulmohsin Ali	Project Associate	UNDP staff

42	Yulia Isaeva	Programme specialist	UNDP staff
43	Ines Zegoulli	Programme specialist	UNDP staff
44	Ali Al-Muwali	Project officer	UNDP staff

Appendix 3: Natural Ponds Coordinates and Map

Pond name	Coordinates	
	X	Y
Pishti Kolak	426151	4013954
Kani Gani 2	427757	4006185
Kani Gani3	425810	4006788
Zargatan	423542	3995934
Ponguna	424369	3999506
Omara Sour 1	423545	3986235
Omara Sour 2	423397	3988099
Mortika Gwara	417077	3989919
Sargrid	381510	4013427
Bastami Gawra	380072	4011621
Monoment Shahidan	424667	4007884
Baghamera Shahab2	423602	3996055
Sherasawr	434259	4029215
Xanzad	427024	4022827
Qapakiyan	411547	4031396
Babjesik	423645	4043558
Darbandi Syidan	415001	4030980
Talajar	420148.75	4044412.5
Dere	417954	4031798
Mawalo	431139	4026792
Zargazawi 1	408800	4039458

Hababan	411991.5	4043832.4
Zargazawi 2	412988	4041856
Birezh	432894	4025531
Sulawk	447399	4016246
Sarsoul	417830	4034166
Ziyart	403095	4035197
Wasu Marian Saru	402114.31	4039741.7
Sule Dam	423649	4036240
Bawa Xalan	420454	4036344
Kore(Azadi+ Barbian)	431543	4029076
Kore(Shrawani)	430565	4027886



no	name	x	y
1	sherasawr	434259	4029215
2	Xanzad	427024	4022827
3	qapakiyan	411547	4031396
4	babjesik	423645	4043558
5	Darbandi syidan	415001	4030980
6	Talajar	420148.75	4044412.48
7	Dere	417954	4031798
8	Mawalo	431139	4026792
9	zargazawi 1	408800	4039458
10	Hababan	411991.5	4043832.4
11	zargazawi 2	412988	4041856
12	Birezh	432894	4025531
13	sulawk	447399	4016246
14	Sarsoul	417830	4034166
15	ziyart	403095	4035197
16	Wasu Marian Saru	402114.31	4039741.67
17	sule dam	423649	4036240
18	bawa xalan	420454	4036344
19	Kore(azadi+ barbian)	431543	4029076
20	kore(Shrawani)	430565	4027886