VULNERABILITY AND ADAPTATION

TECHNICAL ASSESSMENT REPORT

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2020/11/08

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LIST OF ABBREVIATIONS

ACCSAP	Afghanistan Climate Change Strategy and Action Plan
ANDMA	Afghanistan National Disaster Management Authority
ASAP	Adaptation for Smallholder Agriculture Programme
ASDRR	Afghanistan Strategy for Disaster Risk Reduction
CSA	Climate-smart agriculture
DRR	Disaster risk reduction
EbA	Ecosystem-based adaptation
EWS	Early warning systems
GCF	Green Climate Fund
GEF	Global Environment Facility
IFAD	International Fund for Agricultural Development
IKI	International Climate Initiative
IWRM	Integrated water resource management
LDCF	Least Developed Countries Fund
MAIL	Ministry of Agriculture, Irrigation and Livestock
MDBs	Multilateral development banks
MRRD	Ministry of Rural Rehabilitation and Development
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NDC	Nationally Determined Contributions
NEPA	National Environmental Protection Agency
RCP	Representative Concentration Pathway
SCCF	Special Climate Change Fund
TNA	Technology Needs Assessment
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

The high dependence of its population on agricultural livelihoods, fragile environment, poor socio-economic development, high frequency of natural hazards and over four decades of conflict make Afghanistan vulnerable to climate change. Considerable expansion of adaptation action will be required to reduce the impacts of climate change such as loss of lives and livelihoods as well as damage to infrastructure and economic assets. This report sets out to identify:

- The main impacts of climate change on important sectors.
- Potential sources of funding for climate change adaptation.
- Proposed priorities for adaptation action based on national strategies and plans.

Models for optimistic and pessimistic future climate change scenarios project a temperature increase of 2.6–6.3°C by 2100. This is higher than the expected global temperature increase for the same period. There is much regional variation in the expected increase, with greater warming expected at higher altitudes. Precipitation projections for the same period indicate no significant change in total annual rainfall for the country. However, there is high regional variation within the country, while there are also expected to be shifts in the seasonality of the precipitation.

Afghanistan is prone to frequent hazards that cause losses and damages to lives, livelihoods and assets. Climate change is expected to increase the frequency and severity of such hazards. It will also have impacts on key sectors such as water, agriculture, natural resources, the built environment and human health.

While Afghanistan has high per capita water availability, this has been decreasing since the 1960s. Moreover, these water resources are not uniformly distributed across the country and some areas experience water scarcity. Climate change will exacerbate water shortages through: i) increased temperatures and thus water stress; ii) faster melting of glaciers and snowpack; and iii) loss of glacial and snow cover. Rapidly melting snow will also increase flood risk during spring and summer.

With high levels of reliance on agriculture, climate change impacts on agricultural productivity will knock-on effects on food insecurity and poverty. Recurring droughts affect millions of Afghans and are expected to cause agricultural losses of USD 3 billion. Predicted reductions in spring precipitation will impact rain-fed agriculture during critical growth periods. Increased temperatures will cause outbreaks of agricultural pests and diseases, further reducing agricultural productivity, while flooding of croplands will destroy productive assets.

Afghanistan's ecosystems provide goods and services that underpin rural livelihoods. These include fodder and forage, food, fuel, medicinal plants, construction material and nuts. However, most ecosystems in Afghanistan are severely degraded, which will be further exacerbated by climate change. Increased temperatures and variable precipitation will decrease rangeland productivity and permanently change vegetation cover. Degraded ecosystems are also more prone to erosion, flooding, avalanches and landslides. These ecosystem risks endanger the livelihoods of communities that depend on natural resources.

Infrastructure and the built environment have suffered from damages inflicted by the ongoing conflict in Afghanistan. Domestic energy production is low, despite the high potential for hydropower generation. Most of the country's roads are in poor condition which hampers access to services and markets. Rapid urbanisation has created challenges such as poor service delivery, high population density, urban poverty and poor living conditions. Climate change will have negative impacts on all aspects of the built environment. Erratic water availability and frequent flooding will affect hydropower generation. Floods can also damage roads, bridges and other transport infrastructure, further reducing access to services and markets. Urban water supplies will be affected by depleted groundwater, while flooding will damage houses (especially

in informal settlements) and other infrastructure such as industrial and manufacturing facilities. This will further exacerbate unemployment and poverty.

Afghans have poor access to health care services and limited access to improved water sources and sanitation facilities. This results in low life expectancy, chronic malnutrition and disease prevalence. Climate change will impact on health outcomes through higher temperatures and changed precipitation that may increase the spread of infectious diseases such as cholera, typhoid fever, malaria and polio. The impacts of climate change food security are likely to perpetuate chronic malnutrition. In addition, high temperatures will cause heatwaves that pose risks to children, the elderly and the infirm. This will be compounded by water stress from reduced water availability.

To address the impacts of climate change, Afghanistan has developed a number of climate change strategies and plans. These include the National Adaptation Programme of Action, Afghanistan Climate Change Strategy and Action Plan, National Adaptation Plan, Nationally Determined Contributions and Technology Needs Assessment. All of these have identified the main impacts that climate change is expected to have in Afghanistan, as well as priorities for addressing these impacts. A number of adaptation actions proposed are common between all of these plans, including:

- Improved management of watersheds and water resources
- Resilient agricultural techniques such climate-smart agriculture, agroforestry, improved irrigation, rehabilitation of traditional irrigation systems and climate-resilient crops
- Improved management of forests, rangelands and other natural ecosystems
- Disaster risk reduction, preparedness and response
- Climate information and early warning systems
- Improved health care and management of climate-related diseases
- Climate-proofing of rural and urban infrastructure
- Training and capacity development on climate change

The government of Afghanistan spent approximately USD 100 million on climate change between 2013 and 2015, but this is inadequate compared to the annual climate finance needs of USD1,078.5 million. Because public expenditure is largely reliant on donor assistance, Afghanistan well need to obtain this funding shortfall for climate action from multilateral and other funding mechanisms.

The Global Environment Facility administers three funds that can be used to support climate change adaptation. The Least Developed Countries Fund is dedicated to climate change adaptation in Least Developed Countries. The Special Climate Change Fund is also focused on climate change but is open to all developing countries. The GEF Trust Fund finances environmental interventions such as biodiversity conservation, sustainable land management and climate change mitigation and can support projects with adaptation co-benefits. Afghanistan has successfully accessed funding through the Global Environment Facility and should continue to do so for adaptation in the agriculture and natural resources sectors.

The Adaptation Fund also supports adaptation projects in developing countries. Afghanistan has registered a national designated authority with the Adaptation Fund and has so far received one project of 9.4 million USD. Accessing such funding should be seen as a high priority for projects on include climate-resilient agriculture, community-based adaptation and ecosystem-based adaptation.

The Green Climate Fund supports large-scale projects for both adaptation and mitigation. Afghanistan has received approval of a mitigation project but not yet for any adaptation projects. Accessing the Green Climate Fund should be a high priority but will be challenging without sufficient capacity for formulating proposals.

The Adaptation for Smallholder Agriculture Programme provides climate finance to smallholder farmers that is complementary the International Fund for Agricultural Development's ongoing investments into agriculture. The large number of smallholder farmers in Afghanistan makes this fund ideal for upscaling climate change adaptation and should be undertaken through government engagement with the International Fund for Agricultural Development to formulate future projects.

The International Climate Initiative finances projects on various environmental issues including climate change and implementation of national adaptation priorities. Preparation of proposals to the International Climate Initiative IKI should be a high priority for themes such as ecosystem- and community-based adaptation as well as preparation of climate change policies, strategies and plans.

Afghanistan's government spent millions of dollars per year on climate change through thousands of projects across various ministries and institutions. In the near future, this will be the most important source of funding for climate change because larger projects take a long time to be realised. Streamlining of government expenditure on adaptation will also facilitate future access to funding from multilateral sources and will enhance efficiency and provide co-financing for such projects. Consequently, improved programming of government expenditure on adaptation should be prioritised.

Afghanistan is heavily dependent on foreign aid, with various donors providing support through government, UN agencies, NGOs and other entities for climate change adaptation, food security, agriculture, resilience-building and disaster risk reduction. This aid is a significant opportunity for increasing adaptation spending but depends on advocacy and engagement with donors.

Multilateral development banks provide significant amounts of funding, particularly in sectors that are threatened by climate change. These banks can facilitate the development of climate change strategies and support transformational projects based on national priorities that show socio-economic benefits. If the low capacities for accessing climate finance, low levels of co-financing and limited proof-of-concept on the economic benefits of adaptation can be overcome, Afghanistan will be able to access to substantial projects for adaptation from multilateral development banks.

Afghanistan's primary climate change threats are floods and droughts. Climate-resilient integrated water resources management is thus a top priority to reduce threats to lives and livelihoods. This should include both "hard" (infrastructural) and "soft" (policy and institutional) options for water management. Appropriate projects would be large-scale and suitable for funding from the Green Climate Fund and multilateral development banks with additional funding from government expenditure for post-project costs such as operations and maintenance plans. Priorities for improving climate-resilient integrated water resources management include:

- Hydrological studies to determine water balance under future climate conditions
- Institutional mechanisms and planning for climate-resilient integrated water resources management
- Climate-resilient infrastructure for water storage and distribution

Addressing the impacts of hazards in Afghanistan has historically been focused on response and recovery. However, adaptation action should include more proactive disaster risk reduction for climate-induced hazards, particularly in rural communities. Effective disaster risk reduction would again entail both "hard" and "soft" options to reduce vulnerability to climate-induced hazards. Projects may be a mix of large- and small-scale projects suitable for funding from a variety of sources. Larger funds are more suitable for a national agro-hydro-meteorological monitoring network and a national-level early warning system. Funding for community-level measures can be obtained from smaller multi- and bi-lateral funding sources as well as regular government expenditure, while ongoing development and humanitarian actions can also be directed into disaster risk reduction activities. Priorities for disaster risk reduction include:

- Disaster risk assessment and planning
- Climate monitoring and early warning systems
- Hazard prevention and mitigation measures

Because of the reliance of Afghan households on agriculture, climate-resilient agriculture should be a priority for enhancing the resilience of local communities. Climate-resilient agriculture comprises "hard" investments into improved production to increase efficiency and effectiveness of water use as well as "soft" options such as improving agricultural extension services and research into climate-resilient crops. There are a large number of funding opportunities for climate-resilient agriculture. Smaller funds provide support for community-based approaches to resilient agriculture while infrastructural projects are better suited to larger multilateral funds and development banks. Priorities for climate-resilient agriculture include:

- Improved livestock management
- Improved agricultural water use
- Climate-smart agriculture
- Agricultural research, extension and other services

Ecosystem-based adaptation integrates biodiversity conservation and ecosystem management with climate change adaptation. It is cost-effective in reducing the impacts of climate change while providing co-benefits such as biodiversity conservation and climate change mitigation. In contrast to traditional approaches, ecosystem-based adaptation is a "green" approach that is twice as cost-effective as "hard" approaches. It is particularly relevant for Afghanistan given the extent of environmental degradation in the country. Funding has been well supported through multilateral donors in Afghanistan. The cost-effectiveness of ecosystem-based adaptation can be leveraged to integrate it into traditional development projects, especially if approaches are piloted and shown to be successful through smaller projects. Priorities for ecosystem-based adaptation include:

- Development of climate-resilient watershed management plans
- Improving forest and rangeland management coupled with expansion of protected areas
- Adoption of ecosystem-based disaster risk reduction approaches
- Promotion of alternative and diversified livelihoods and alternative energy sources

While there has been little historical focus in Afghanistan on urban adaptation this will become increasingly important in future. The main impacts of climate change in urban areas of Afghanistan will decreased water and frequent hazards. Measures for building resilience in urban areas has been previously funded by most multi-lateral climate finance mechanisms. Bilateral funding for such work may also be readily available in future. Large-scale funding for transport and water infrastructure will benefit from climate-proofing. Addressing urban vulnerability to climate

change will be best achieved through a mix of adaptation projects along with mainstreaming of climate change into projects in the sector. Priorities for urban resilience include:

- Including climate resilience into urban planning frameworks and land-use planning controls
- Implementing measures to increase the availability and efficient use of water
- Enforcing climate-smart building codes
- Climate-proofing existing and new public infrastructure

The health impacts of climate change have historically received little attention in Afghanistan but will become more relevant in future. Climate change will increase the prevalence of diseases and cause heatwaves and water stress. This will require adaptation of current practices to avoid such impacts and strengthening of response measures to address public health concerns. As few projects exist that focus on human health, standalone projects for adaptation in the health sector may not be realised in the near future. Sensitisation of donors will be required and climate change should be mainstreamed into ongoing public health activities. Priorities for resilience in the health sector include:

- Improve understanding of climate change impacts on human health
- Establish early warning systems for climate-sensitive water-, food- and vector-borne diseases
- Improve water management to prevent contamination and control diseases
- Train healthcare practitioners on climate-sensitive diseases
- Undertake vector control and eradication campaigns
- Increase public awareness on climate-sensitive diseases

To address Afghanistan's priorities for climate change adaptation, a number of measures will need to be taken. The difficulties involved in accessing the Green Climate Fund mean that it should not be seen as the sole future source of funding for climate change adaptation. Securing climate finance will be improved if various funding sources are leveraged to support preparatory work and as co-financing for larger projects. Moreover, The preparation of a Green Climate Fund roadmap has identified adaptation projects that could also be developed into proposals for other funding sources to act as bridging funding, to develop demonstration projects for upscaling or to act as complementary or co-financing projects until Afghanistan is able to obtain Green Climate Fund support. Funding from large-scale mechanisms is more suited to infrastructural projects and those that are national in scope with more demonstrable economic benefits. Smaller, local-level and non-infrastructural projects are better suited to smaller funding mechanisms and specialised donors.

Besides the Green Climate Fund roadmap, a national portfolio of adaptation projects should be formulated for leveraging financial support for immediate and future adaptation opportunities. This should be based on country assessments and sector-specific strategies and plans, particularly for implementation of Afghanistan's Nationally Determined Contributions. Having a more coordinated and coherent approach is likely to lead to greater success in securing climate finance. A country programme would also allow for blending of finance from various sources to address climate change.

The requirements for accreditation with multilateral funds are extremely rigorous and most finance from such sources has been through international implementing entities. These processes are often slower than working with national implementing entities. Afghanistan should thus identify and support the accreditation of national implementation entities. Eligible organisations should demonstrate specialised capacity for climate change action. This should

include a record of delivering such projects and compliance with fiduciary, ethical, environmental and social standards. Potential accredited entities should receive support to meet such criteria capacity strengthening under ongoing and new initiatives on climate change.

Strengthening the capacity of national institutions such as line ministries is needed to facilitate future funding applications, whether for direct access or through international entities. Institutional capacity strengthening would streamline engagement and improve the success of applications. Cross-ministerial coordination would mean that line ministries are better informed and able to articulate national priorities, improving engagement with funding mechanisms. Strengthening of technical capacities will also increase the quality of funding proposals and the likelihood of success. Briefings for policy- and decision-makers should highlight the relationships between climate change and other issues of national priority such as sustainable growth and development, conflict and peace-building, and poverty alleviation. This would enable policy-makers to position climate change as an issue of national importance and mainstream climate action into relevant programmes and projects. Similar sensitisation of donors would ensure that they recognise the importance of climate change in the achievement of social and economic development goals and increase the likelihood of funding being provided for climate action.

Training should be provided for technical personnel within government on how to access climate finance, particularly through multilateral funding mechanisms. Government personnel have experience in accessing funding for development and humanitarian action but the formulation of climate change proposals requires specialised language because multilateral funding mechanisms require that climate action is additional to that addressing baseline development issues. Training should thus cover the preparation of funding proposals that would meet donors' criteria and priorities. Besides training, government personnel should also be actively engaged in the formulation of new proposals view to build their capacity so that they are able to lead the preparation of proposals when a national implementing entity is accredited.

1. Introduction

The Islamic Republic of Afghanistan is ranked as being one of the countries most vulnerable to the impacts of climate change[1]. The United Nations Environment Programme (UNEP) and the National Environmental Protection Agency (NEPA) have been working together since 2013 on climate change adaptation and capacity building to reduce vulnerability to climate change in Afghanistan. One of the objectives of this collaboration is to develop a resource mobilisation strategy that identifies interventions to achieve long-term adaptation goals based on vulnerability mapping and assessments. This vulnerability and adaptation assessment report provides an overview of the climate vulnerabilities of various sectors in Afghanistan and identifies priority adaptation interventions to address these vulnerabilities. The report comprises the following sections:

- A Background section describing Afghanistan's environmental and economic context.
- A section detailing Climate Change Projections for Afghanistan.
- An assessment of the Sectoral Impacts of Climate Change.
- A summary of existing Adaptation Plans and Strategies in Afghanistan.
- A compilation of Priority Adaptation Interventions to address sectoral impacts of climate change.
- An overview of Funding Sources that could be used to support the adaptation priorities.
- A Conclusion section.

[1]. Eckstein et al. 2018. Country Rankings. Global Climate Risk Index 2019.

2. Background

2.1. Environmental Profile

Afghanistan is a landlocked country in Central Asia with a total surface area of over 652,000 km^2. Its diverse landscape includes mountainous areas covering a quarter of surface area while the south-west and north of the country comprise extensive plains. Afghanistan has an arid to semi-arid continental climate characterised by cold winters and hot summers, with considerable seasonal and spatial variation. Mean annual precipitation is 300 mm with topographically-induced variation in across the country[2] from 50 mm in the south-west to 1,200 mm in the north-east. As there is little rainfall across most of Afghanistan, there is considerable reliance on water from snowmelt for agricultural production.

This varied topography and climate have contributed to Afghanistan's biological diversity. Over 700 animal species[3] and 4,000 plant species can be found in the four biomes and fifteen eco-regions in the country[4]. These eco-regions range from alpine tundra in the high-lying mountainous regions to low-lying desert areas (see Figure 1). More than 70% of Afghanistan's surface is covered by shrublands, grasslands and savanna, with most of the remainder comprising exposed soil with low vegetation cover and croplands[5]. However, ecosystem degradation – caused by habitat fragmentation, overexploitation of natural resources and climate change – is driving biodiversity loss in the country. For example, an estimated 34,000 km^2 (or 5% of the surface area) may have historically been covered by denser forest ecosystems[6] but this had decreased to 3,600 km^2 by 1980 and by 2003 only approximately 1,800 km^2 (i.e. only 0.25% of the country) of forest ecosystems remained[7,8] .

2.2. Demographic Profile

Afghanistan has an estimated population of 32.9 million people[9]. It is ranked at 170 out of 189 countries on the Human Development Index[10] and 87 out of 107 developing countries on the Multidimensional Poverty Index[11] owing largely to poor health and living standards as well as low levels of education. Poverty is widespread, with 54.5% of the population living below the national poverty line, a trend that is worsening[12] . Despite increasing rates of urbanisation, more than 70% of the population still lives in rural areas[13] . These rural communities are also affected to a greater extent by poverty, with an estimated 58.6% of the rural population living in poverty compared to 41.6% of the urban population[14].

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2. UNEP. 2008. Biodiversity Profile of Afghanistan.
3. Afghanistan. 2014. National Biodiversity Strategy and Action Plan.
4. Olson et al. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience 938–933 :51.
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6. Freitag, H. 1971. Die natürliche Vegetation Afghanistans. Beiträge zur Flora und Vegetation Afghanistans I. Vegetatio. Acta Geobotanica 349–285 :22.
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8. UNEP. 2003. Post-conflict environmental assessment: Afghanistan
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11. UNDP & OPHDI. 2020. Global Multidimensional Poverty Index 2020. Charting pathways out of multidimensional poverty: Achieving the SDGs.
12. CSO. 2018. Afghanistan Living Conditions Survey 17–2016.
13. NSIA. 2020. Afghanistan Statistical Yearbook 2019.
14. CSO. 2018. Afghanistan Living Conditions Survey 17–2016.

2.3. ECONOMIC PROFILE

Afghanistan's economic growth is primarily dependent on development assistance from donors, while the protracted conflict and political instability undermine private sector investment and a range of economic activities[15]. In 2019, the country experienced 4% growth in GDP[16], up from less than 1% in 2015[17]. While the overall GDP grew, Afghanistan's per capita GDP has contracted from USD 755 in 2014/15 down to USD 560 in 2019/20[18,19]. The service sector contributed 57.4% of the total GDP[20], followed by the agricultural sector at 25.5% and the industrial sector at 12.1%. However, the agricultural sector employs a disproportionately large number of people, providing jobs for 44.3% of the overall population and 52.6% of the rural population[21]. Without changes in the ongoing conflict and stabilisation of the country's politics, it is expected that Afghanistan will continue to experience slow economic growth[22]. The country's economy is also expected to suffer from losses and damages caused by the impacts of climate change owing to the vulnerabilities of critical economic sectors such as agriculture.

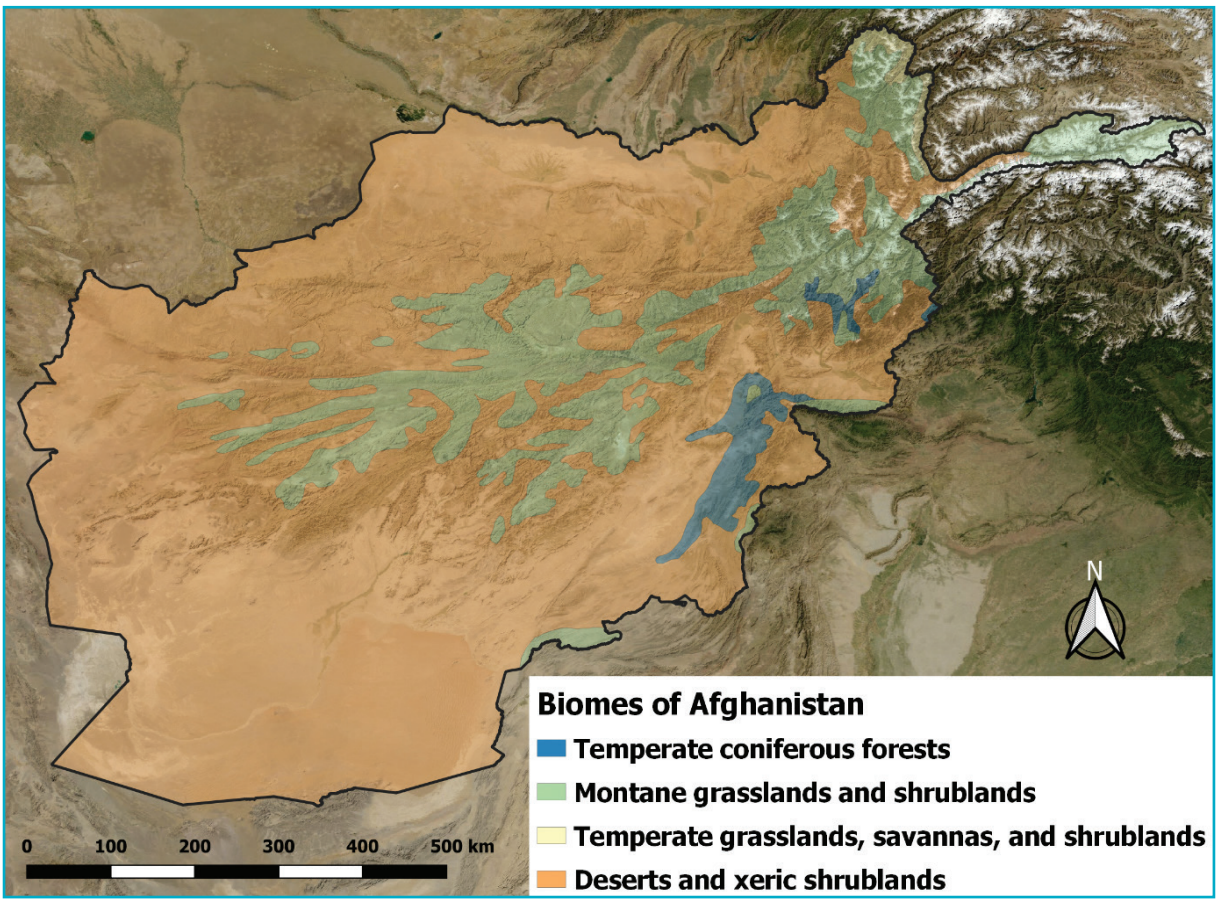

Figure 1. Biomes of Afghanistan[23].

[15]. World Bank. (n.d.). Afghanistan Country Overview.
[16]. NSIA. 2020. Afghanistan Statistical Yearbook 2019.
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[20]. NSIA. 2020. Afghanistan Statistical Yearbook 2019.
[21]. CSO. 2018. Afghanistan Living Conditions Survey 17–2016.
[22].World Bank. (n.d.). Afghanistan Country Overview.
[23]. Data from: Olson et al. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience :51 938–933.

3. CLIMATE CHANGE PROJECTIONS

[All data for this section, unless otherwise specified, are drawn from: *Aich, V. & Khoshbeen, A.J. 2016. Afghanistan: Climate Change Science Perspectives.; and Aich et al. 2017. Climate Change in Afghanistan Deduced from Reanalysis and Coordinated Regional Climate Downscaling Experiment (CORDEX) – South Asia Simulations. Climate 5(38).*]

3.1. RECENT CLIMATE TRENDS

Climate reanalyses from model outputs were combined with observations from weather stations in Afghanistan for air temperature and precipitation. From 1950 to 2010, Afghanistan's mean annual temperature increased significantly by 1.8°C – approximately double the global mean annual temperature increase for the same period[24] – with much higher warming of 2.4°C in the south-west of the country. Over the same period, the overall quantity of mean annual precipitation did not change significantly. However, detailed analysis of the seasonality of precipitation revealed that spring precipitation decreased significantly by –27% across the country as a whole, with decreases of –30% or more in the north, central highlands and east of Afghanistan. This decrease in spring precipitation is particularly relevant for rain-fed agriculture and dependent on sufficient rainfall during this period.

Indeed, the regions most affected by the decrease of spring precipitation are also those that are the major contributors to the country's agricultural production. Neither winter precipitation nor heavy precipitation events showed any significant changes in trend during the period 1950 to 2010. While the unchanged trend in extreme precipitation is at odds with anecdotal reports of recent increases in flooding, landslides and related hazards[25], heavy precipitation is not the sole cause of such hazards. For example, the higher temperatures lead to rapid melting of snow in spring and also cause droughts that harden soils and thereby reduce the permeation of water during heavy precipitation events; both of the phenomena increase the risk of flash flooding.

3.2. FUTURE CLIMATE CHANGE PROJECTIONS

Climate models from the Coordinated Regional Climate Downscaling Experiment for South Asia were used to develop detailed climate change projections for Afghanistan. Two Representative Concentration Pathway (RCP) scenarios were used, an optimistic scenario (RCP 4.5) representing a medium-term reduction of greenhouse gas emissions and a pessimistic scenario (RCP 8.5) that represents "business-as-usual" emissions. The results from this study are confirm projections from earlier studies that relied solely on general circulation models[26].

Projections for Afghanistan indicate an expected increase in mean annual temperature of 1.4°C by 2050 and 2.6°C by 2100 under the optimistic scenario, while the pessimistic scenario shows more extreme warming of 2.0°C by 2050 and 6.3°C by 2100. Under both scenarios, there are considerable sub-regional differences in the projected temperature increases, with greater warming expected at higher altitudes in the northeast and central highlands (>2.5°C under the optimistic scenario and >6.5°C under the pessimistic scenario). All of these projections were statistically significant. Moreover, similar to the analysis of climate trends since 1950 presented above, the projected increases under both scenarios and in all regions of the country are higher than the projected increase in global mean annual temperatures for the same period[27,28].

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[24]. Hartmann et al. 2013. Observations: Atmosphere and Surface. In: Stocker et al. (eds.). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[25]. Such as those presented in Afghanistan's National Adaptation Programme of Action.

[26]. Savage et al. 2009. Socio-economic Impacts of Climate Change in Afghanistan.

[27]. Kirtman et al. 2013. Near-term Climate Change: Projections and Predictability. In: Stocker et al. (eds.). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[28]. Collins et al. 2013. Long-term Climate Change: Projections, Commitments and Irreversibility. In: Stocker et al. (eds.). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Projections up to 2100 for annual precipitation for the country as a whole showed no significant trends under either scenario, similar to the trend since 1950. However, there is sub-regional variation in these projections, with different areas expected to receive either more or less mean annual precipitation, depending on the scenario. When considering spring precipitation, there is projected to be a significant decrease of −20% under the pessimistic scenario. This is most evident in sub-regional projects for the north, central highlands and south-east of the country. This suggests that the trends observed since 1950 are likely to continue in the future, with expected impacts on rain-fed agriculture in these important production areas.

Projections for winter precipitation – which largely falls as snow in Afghanistan – show a slight increase under the optimistic scenario but a slight decrease under the pessimistic scenario. However, there are again considerable sub-regional differences, with only the north-east expected to see increases in winter precipitation, while the central highlands, south-east and south-west are all expected to have decreased winter precipitation.

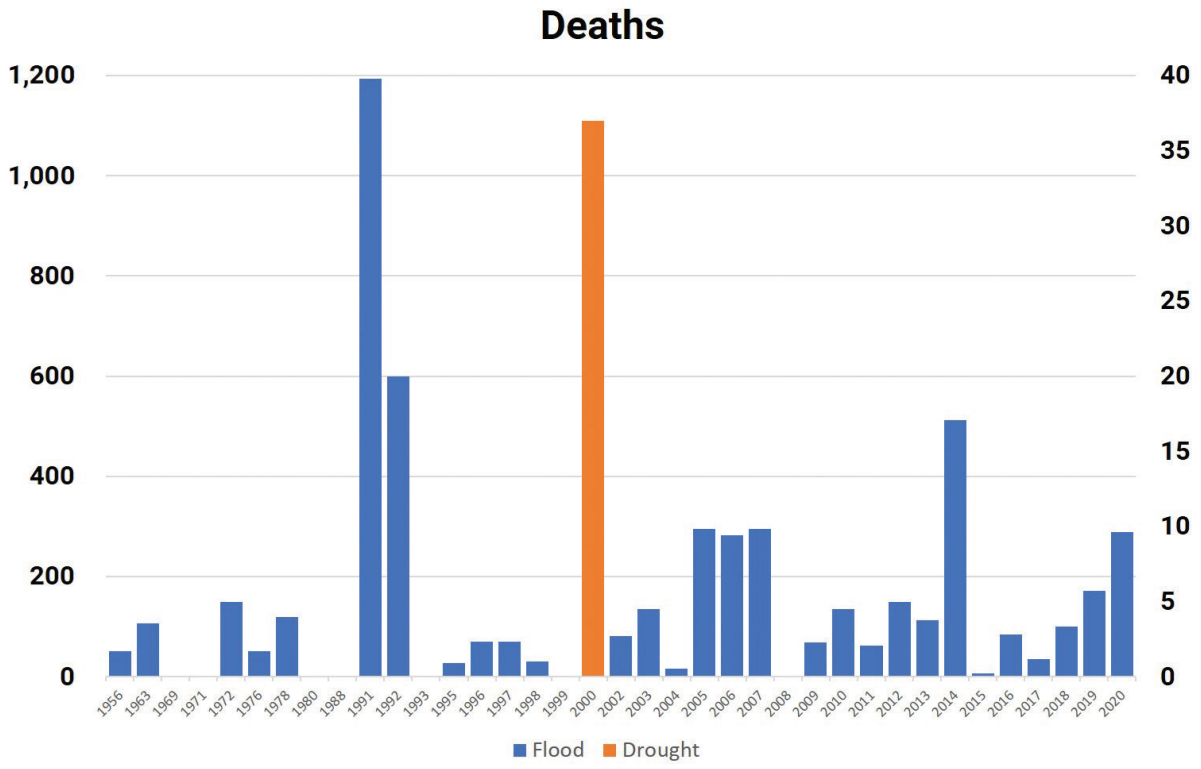
The projections for extreme precipitation events show a similar pattern of a minor increase for the country as a whole, while there are important implications of projections at the sub-regional level. The north-east, south-east and south-west of the country are expected to experience an increase in extreme precipitation events of more than 10%; this is of concern as these areas already see high incidences of flash flooding.

Table 1. Projected climatic changes for Afghanistan for the period 2010–2100 for two representative concentration pathway scenarios. Only statistically significant trends are indicated, non-significant trends are indicated as "N.S.".

Climate Region	Mean Annual Temperature	Mean Annual Precipitation	Winter Precipitation	Spring Precipitation	Heavy Precipitation
Overall			*Optimistic (RCP4.5)*		
	+2.6°C	N.S.	+11.5%	N.S.	+8.9%
			Pessimistic (RCP8.5)		
	+6.3°C	N.S.	−8.6%	−20.1%	N.S.
North			*Optimistic (RCP4.5)*		
	+2.6°C	N.S.	N.S.	N.S.	N.S.
			Pessimistic (RCP8.5)		
	+6.1°C	−13.0%	N.S.	−31.8%	-9.8%
North-east			*Optimistic (RCP4.5)*		
	+2.7°C	+13.6%	+21.6%	N.S.	+13.0%
			Pessimistic (RCP8.5)		
	+6.8°C	N.S.	+7.5%	N.S.	+11.9%
Central highlands			*Optimistic (RCP4.5)*		
	+2.7°C	N.S.	N.S.	−17.6%	N.S.
			Pessimistic (RCP8.5)		
	+6.5°C	N.S.	−23.8%	−25.4%	−12.3%
South-east			*Optimistic (RCP4.5)*		
	+2.3°C	+10.6%	N.S.	−18.1%	+9.4%
			Pessimistic (RCP8.5)		
	+5.7°C	%7.7+	−32.6%	N.S.	N.S.
South-west			*Optimistic (RCP4.5)*		
	+2.4°C	+21.1%	N.S.	N.S.	+11.8%
			Pessimistic (RCP8.5)		
	+5.9°C	N.S.	−25.3%	N.S.	N.S.

3.3. CLIMATE CHANGE-INDUCED HAZARDS

One of the primary impacts of climate change is the potential increase in frequency and/or severity of natural hazards. Afghanistan is highly prone to such hazards that result in considerable losses and damages to inter alia lives, livelihoods and productive assets. During the formulation of Afghanistan's National Adaptation Programme of Action (NAPA)[29], widespread consultation identified the impacts that natural hazards have on lives, human health, food security, livelihoods, water availability and the environment. Through this process, expert participants stated that all hazards are occurring with increasing frequency and that floods, droughts, and rising temperatures are affecting thousands of Afghans and causing millions of dollars of damages. For example, since the 1950s, floods and droughts combined have caused over 5,000 deaths, affected over 21 million people and caused more than USD 540 million in losses and damages (see Figure 2)[30]. A summary of relevant natural hazards and the expected impacts of climate change (based on the projections reported in Section 4.2) is provided in Table 2.



[29]. NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.
[30]. EM-DAT. CRED / UCLouvain.

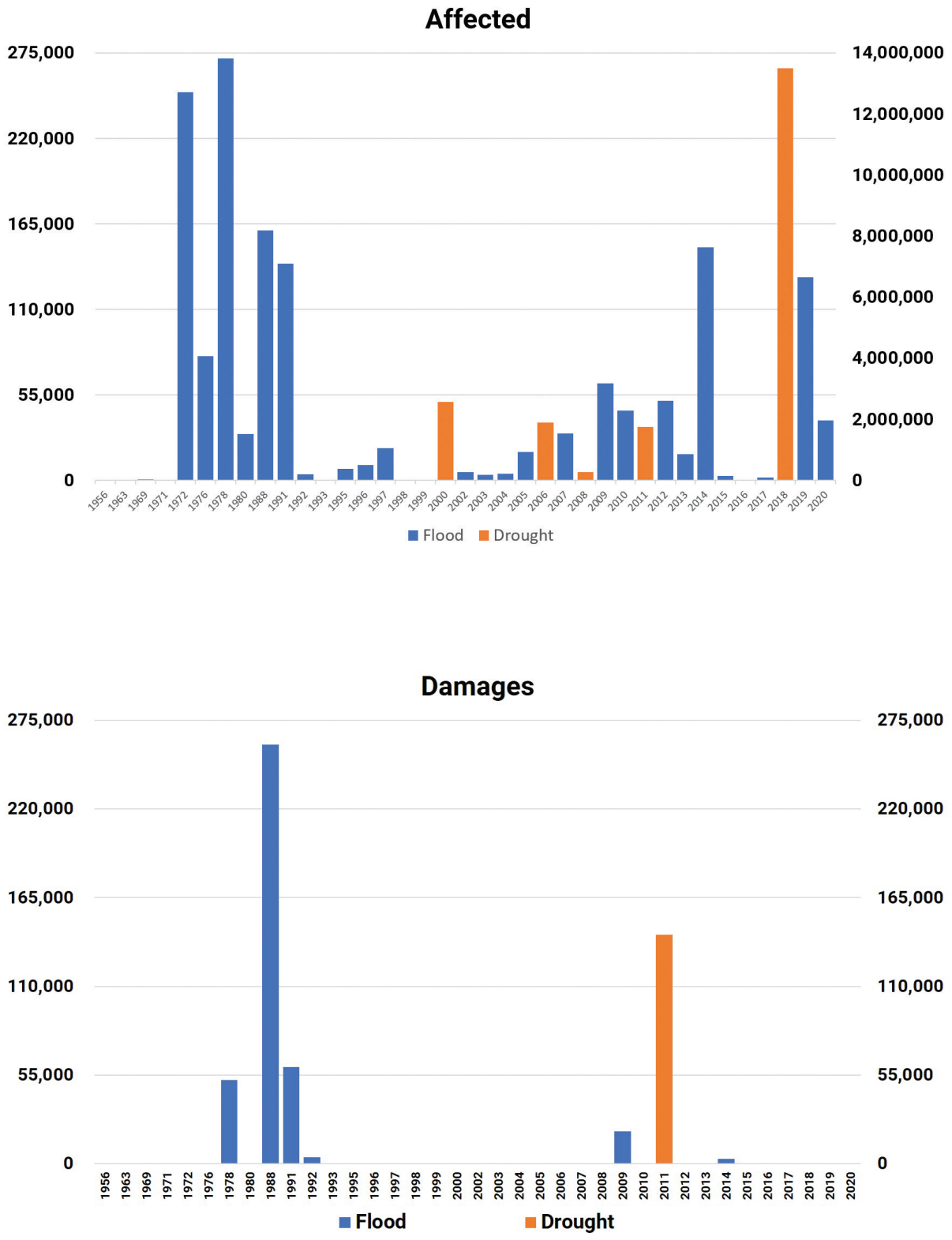


Figure 2. Overview of number of deaths, number of people affected and damages(in USD '000) caused by floods and droughts in Afghanistan since 1956[31].

[31]. Data derived from EM-DAT. CRED / UCLouvain.

TABLE 2. OVERVIEW OF CLIMATE CHANGE IMPACTS ON NATURAL HAZARDS IN AFGHANISTAN[32].

Hazard	Loss of Life	Climate Change Impacts	Human Health and Socio-Economic Impacts	Livelihoods and Food Security	Environment and Natural Resources	Water Quality and Availability
Extremely high temperatures	1,000 direct casualties per year	Overall temperature increase will cause extreme high temperatures to occur more frequently	Increased incidence of diseases such as malaria, leishmaniasis, typhoid and diarrhoea	Increased incidence of livestock and agricultural diseases Decreased agricultural, livestock and horticultural production	Reduced productivity of natural ecosystems Changes in habitat, vegetation cover and grazing availability Displacement of wildlife	Increased evapotranspiration Reduced water levels
Flooding caused by heavy rainfall	750 direct casualties per year	Higher incidence of heavy rainfall events will cause more frequent flooding, especially in the north-east, south-east and south-west	Increased incidence of diseases such as cholera, typhoid, diarrhoea and malaria Destruction of houses and other infrastructure Economic losses	Destruction of agricultural lands and loss of crops and livestock Decreased agricultural production of up to %10 in riparian areas	Degradation of soil resources Loss of forest areas Increased siltation and sedimentation in water bodies Displacement of wildlife	Destruction and sedimentation of irrigation canals Damage to and destruction of infrastructure worth USD 300m
Flooding caused by snowmelt	100 direct casualties per year	Increased winter precipitation and overall temperature increase will cause lead to greater amounts of snow to melt faster, causing to more frequent and extreme flooding	Increased incidence of diseases such as cholera, typhoid, diarrhoea and malaria Destruction of critical infrastructure such as bridges and gabions	Destruction of agricultural lands in riparian areas	Degradation of soil resources through soil erosion and landslides Degradation of riparian and forest ecosystems Increased siltation and sedimentation in water bodies Displacement of wildlife	Degradation of water bodies through rising river levels Damage to and destruction of infrastructure worth USD 400m

[32]. Information on hazard impacts drawn from: NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change. Information on climate change impacts drawn from: Aich, V. & Khoshbeen, A.J. 2016. Afghanistan: Climate Change Science Perspectives.

Hazard	Loss of Life	Climate Change Impacts	Human Health and Socio-Economic Impacts	Livelihoods and Food Security	Environment and Natural Resources	Water Quality and Availability
Periodic drought	10,000 indirect casualties per year of severe drought	Reduced spring precipitation will lead to more frequent and severe agricultural droughts	Increased incidence of diseases such as malaria, leishmaniasis, cholera, typhoid, taeniasis, ascariasis and diarrhoea Malnutrition Displacement and forced migration Decreased exports and economic losses	Decreased rainfed and irrigated agricultural production of up to %85 Loss of livestock Changes in livelihoods	Reduced production of forest products Displacement of wildlife Drying up of waterfowl sanctuaries Degradation of watersheds	Decreased availability of ground water and irrigation water from springs and kareze Decreased water levels in reservoirs and dams
Frost and cold spells		300 indirect casualties per year	Increased incidence of illnesses associated with cold weather Economic losses and increase in poverty	Increased incidence of agricultural diseases Decreased agricultural production of up to %20	Reduced success of afforestation and forest rehabilitation	N/A
Hail, thunder, and lightning	150 direct casualties per year	Higher incidence of heavy rainfall events may be associated with more frequent incidence of hail, thunder and lightning	Increased incidence of illnesses associated with cold weather Loss of life	Decreased agricultural and horticultural production of up to %20 Loss of crops and livestock	N/A	N/A
Monsoon and -120 day winds	10 indirect casualties per year	Increased incidence of droughts will increase the frequency and severity of -120day winds	Increased incidence of ocular and respiratory diseases Air pollution Destruction of assets and infrastructure	Degradation of agricultural lands and rangelands Decreased agricultural production	Desertification Decreased vegetation cover	Temporary and permanent damage to water infrastructure Siltation of water bodies

4. SECTORAL IMPACTS OF CLIMATE CHANGE

Afghanistan's NAPA quantified the vulnerability of seven key sectors (water resources, forestry and rangeland, agriculture, biodiversity, health, energy, and waste) to four climate change impacts (increased temperatures, increased evapotranspiration, changing precipitation patterns and increased drought)[33]. Based on this assessment, climate change is expected to have the greatest impact on the water, agriculture, forestry, rangeland and health sectors. When the individual components of vulnerability to climate change were assessed, it was found that drought is expected to be the greatest driver of vulnerability to climate change for most sectors (see Figure 3).

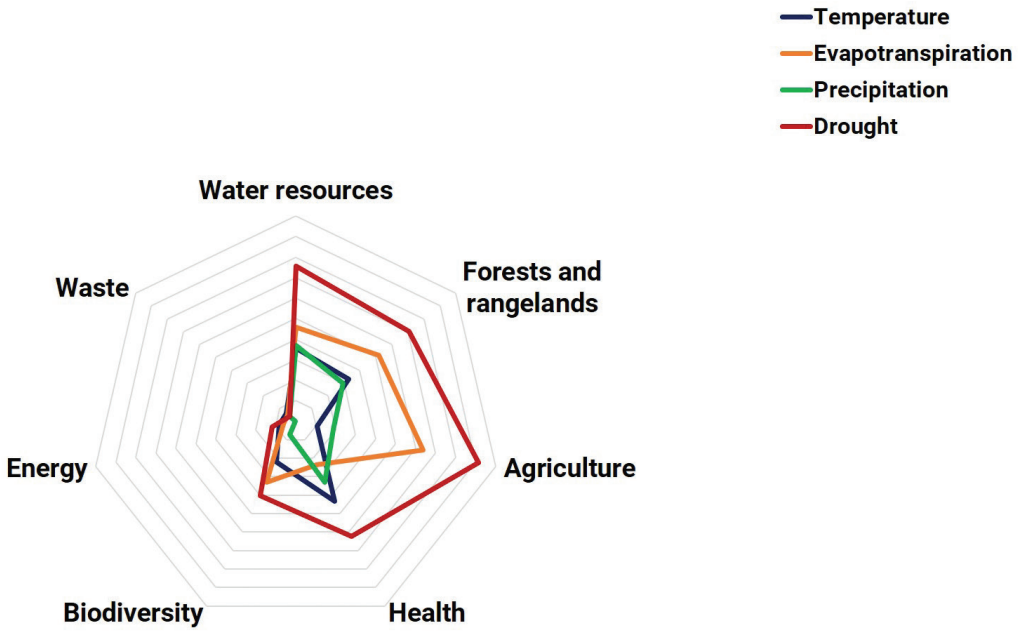


Figure 3. Vulnerability of key sectors to constituent drivers of climate change impacts[34].

In the decade since these assessments were made, it has become apparent that a broader range of sectors, impacts and vulnerabilities should be considered. For example, flood risks are inadequately considered in the NAPA while little consideration is given to the losses and damages that climate change is expected to cause to infrastructure and the built environment. This can probably be attributed to the limited availability of quantitative data on climate change projections available at the time of the NAPA's formulation. This report has therefore adapted the broader range of sectors and impacts provided in Afghanistan's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC)[35].

[33]. NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.
[34]. Adapted from figure 9 in: NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.
[35]. Afghanistan. 2019. Second National Communication under the United Nations Framework Convention on Climate Change.

4.1. WATER

Afghanistan's total renewable water resources are estimated at between 47–55 billion m^3 per annum[36,37]. Based on current population estimates, this corresponds to a per capita water availability of between 1,429–1,672 m^3 per annum, representing a 75% decrease since the 1960s[38]. Moreover, these water resources are not uniformly distributed, with huge variation from more than 7,000 m^3 per capita per year in the north-east down to less than 700 m^3 per capita per year[39]. Of concern, two water basins are water availability is below what is defined as being water stressed and one of which – the agriculturally important north of the country– experiences water scarcity (see Figure 4). Neither are water resources equally accessible throughout the year. Much of the water exists as snowpack that is precipitated during winter and released as snowmelt during the rest of the year[40]. Given the limited capacity for water storage and distribution[41], these water resources are not able to be stored for later distribution to meet demand in times or areas that experience water shortages.

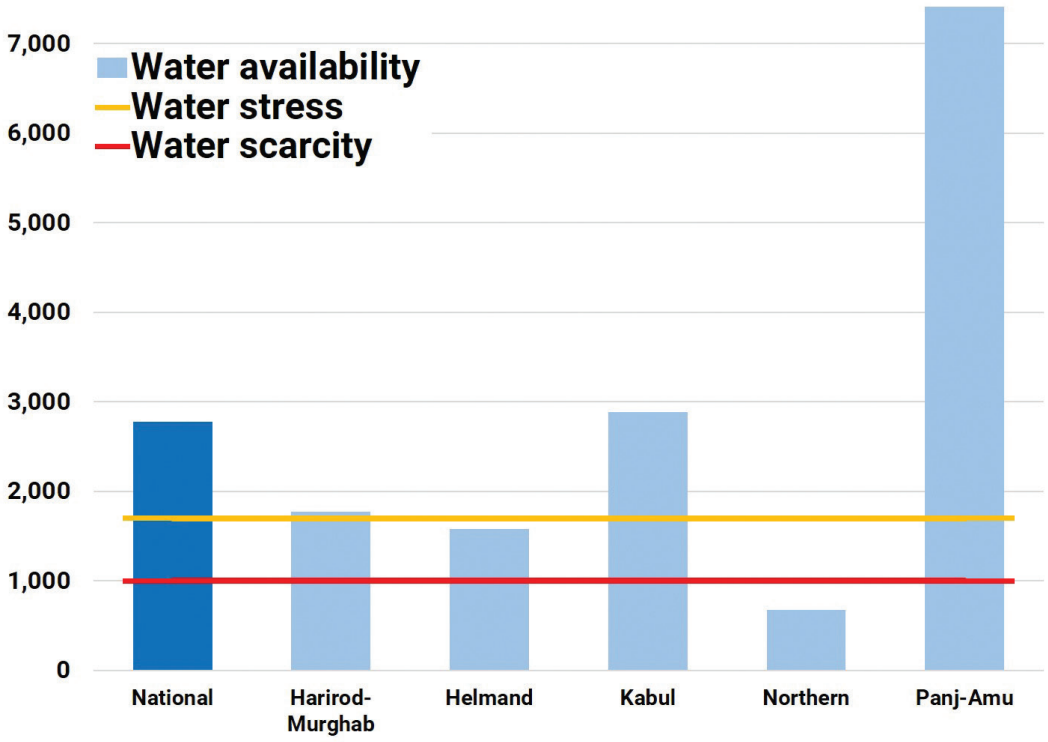


Figure 4. Annual per capita water availability (in m^3 per person per year) at the national level and in the five major river basins of Afghanistan[42].

[36]. FAO. 2012. AQUASTAT Country Profile – Afghanistan.
[37]. CPHD. 2011. Afghanistan National Human Development Report - The Forgotten Front: Water Security and the Crisis in Sanitation.
[38]. FAO. 2016. AQUASTAT Main Database.
[39]. CPHD. 2011. Afghanistan National Human Development Report - The Forgotten Front: Water Security and the Crisis in Sanitation.
[40]. Singh et al. 2011. Climate Change in the Hindu Kush-Himalayas: The State ofCurrent Knowledge.
[41]. UNDP. 2016. Human Development Index 2015: Work for Human Development.
[42]. Data derived from: CPHD. 2011. Afghanistan National Human Development Report - The Forgotten Front: Water Security and the Crisis in Sanitation.

Climate change will exacerbate the water shortages brought about by Afghanistan's growing population and resulting increase in agricultural, domestic and industrial water demand. While overall precipitation is not predicted to change significantly because of climate change, the expected temperature increases will increase rates of evapotranspiration and thus increase water stress. The temperature increase will also cause snowpack and glaciers to melt faster and over a shorter period, reducing the recharge rate of groundwater. Reductions in winter precipitation will reduce the availability of water resources – particularly in centres of agricultural production – as there will be less snow acting as a reservoir during the remainder of the year[43]. Widespread loss of glacial and snow cover is projected to continue in the 21st century, reducing overall water supply and changing the seasonality of river flows[44].

Faster melting of snow will also increase flood risk during the spring and summer. The Afghanistan National Disaster Management Authority (ANDMA) identifies flooding as the most frequent occurring disaster, causing 19% of all casualties ascribed to natural hazards[45]. Floods also cause economic damages estimated at USD 54 million per annum on average up to more than USD 500 million for large flood events[46]. Climate-induced increases in riverine flooding caused by rapidly melting snow as well as flooding caused by intense precipitation events are likely to result in significant increases in losses and damages for the agricultural sector, the built environment and human health[47]. This is expected to be particularly severe in mountainous and deforested areas as well as for communities living adjacent to rivers.

4.2. AGRICULTURE

The growing population is straining Afghanistan's capacity for agricultural production. Less than 5% of the surface area comprises irrigated agriculture, of which around 10% uses modern irrigation techniques with a further 2% used for rain-fed agriculture when precipitation is favourable[48,49]. Given the prominence of agriculture for livelihoods, particularly in rural areas, the impacts of climate change on agricultural productivity would have severe knock-on effects, particularly with the existing elevated levels of food insecurity. While some positive impacts of climate change such as increased CO_2 levels and longer growing seasons may become evident, the changes in temperature and precipitation are more likely to have devastating impacts on the predominantly traditional agricultural practices[50].

In Afghanistan, droughts affect a larger proportion of the population than other hazards. Since 1969, recurring droughts have had huge impacts on Afghan communities, with the droughts of 1997–2008 affecting an estimated 10 million people[51] and four droughts since 2000, affecting 6.5 million people[52]. Such droughts have also caused permanent changes to the country's hydrology; for instance, changing the nature of some river systems from being snow-fed to becoming wholly reliant on rain.

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[43]. Doosti, A.A. & Sherzad, M.H. 2015. Climate Change and Governance in Afghanistan.
[44]. Singh et al. 2011. Climate Change in the Hindu Kush-Himalayas: The State of Current Knowledge.
[45]. ANDMA. 2011. Afghanistan Strategic National Action Plan for Disaster Risk Reduction: Towards Peace and Stable Development.
[46]. World Bank & GFDRR. 2017. Disaster Risk Profile: Afghanistan.
[47]. WFP, UNEP & NEPA. 2016. Climate Change in Afghanistan: What does it mean for Rural Livelihoods and Food Security?
[48]. CSO 2017. Afghanistan Statistical Yearbook 2017–2016. Kabul: Central Statistics Organization.
[49]. Afghanistan. 2012. Initial National Communication under the UNFCCC.
[50]. WFP, UNEP & NEPA. 2016. Climate Change in Afghanistan: What does it mean for Rural Livelihoods and Food Security?
[51]. Afghanistan. 2012. Initial National Communication under the UNFCCC.
[52]. World Bank & GFDRR. 2017. Disaster Risk Profile: Afghanistan.

Extreme droughts are also expected to lead to agricultural losses of up to USD 3 billion[53]. For example, livestock populations in Afghanistan decrease by up to 50% during periods of drought, which is cause for alarm given that an estimated 80% of households derive at least some proportion of their livelihoods from the livestock sector that comprises more than 50% of the agricultural GDP[54]. This is exacerbated by maladaptive practices such as overgrazing and conversion of pastures to rain-fed agriculture. In the latter case, predicted reductions in spring precipitation may prove catastrophic for rain-fed agriculture that is dependent on adequate water during critical growth periods.

Increased temperatures are also expected to change the distribution and frequency of outbreaks of agricultural pests and diseases[55] with concomitant reductions in agricultural productivity. This could increase the need for irrigation, putting even greater stress on dwindling water resources.

The widespread nature of flooding in Afghanistan already has severe impacts on agriculture, as croplands are typically constrained to narrow riverine areas. Rapidly rising rivers as a result of snow melting under higher temperature regimes can easily destroy the economic and productive assets of entire communities, a situation that is likely to become more frequent under climate change conditions. Localised flooding after intense precipitation events has similar results, as observed in the floods of 2019 in the south-west of Afghanistan.

4.3. NATURAL RESOURCES

Afghanistan has a wide range of ecosystems from the high alpine environment of the mountainous north-east to desert ecosystems in the north and south-west. These ecosystems support a diverse range of flora and fauna and provide critical ecosystem goods and services that underpin rural livelihoods. For example, three-quarters of Afghanistan's surface area is used for livestock grazing[56] and 45% of the area is classified as rangelands[57]. Besides fodder for livestock, these rangelands also provide ecosystem goods such as food, fuel and medicinal plants that are vital for rural communities. Forests cover a smaller area of the country but provide important sources of timber and non-timber forest products such as fuelwood, construction material, nuts and medicinal plants.

Rangelands, forests and other ecosystems in Afghanistan are severely degraded because of decades of deforestation and drought[58]. This is attributed to factors such as: i) population increase; ii) poor resource governance; iii) over-exploitation; iv) low incentives for reforestation; v) urban expansion; vi) local conflict; and vii) uncertain land tenure[59,60,61]. Ecosystem degradation in turn changes plant communities, degrades soil resources, reduces water availability and fragments habitats[62,63].

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[53]. World Bank & GFDRR. 2017. Disaster Risk Profile: Afghanistan.
[54]. Bedunah, D.J. 2006. An Analysis of Afghanistan's Rangelands and Management Issues for the Development of Policy and Strategies for Sustainable Management. USAID.
[55]. NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.
[56]. Bedunah, D.J. 2006. An Analysis of Afghanistan's Rangelands and Management Issues for the Development of Policy and Strategies for Sustainable Management.
[57]. Ali, A. & Shaoliang, Y. 2013. Highland Rangelands of Afghanistan: Significance, Management Issues, and Strategies. In: Ning et al. [eds.] High-Altitude Rangelands and their Interfaces in the Hindu Kush Himalayas.
[58]. Adger, N. 2000. Social and Ecological Resilience: Are They Related?
[59]. Shroder, J. 2012. Afghanistan: Rich Resource Base and Existing Environmental Despoliation.
[60]. UNEP. 2003. Post-Conflict Environmental Assessment: Afghanistan.
[61]. NEPA & UNEP. 2008. Afghanistan's Environment.
[62]. Blench, R. & Sommer, F. 1999. Understanding Rangeland Biodiversity. Working Paper 121, Overseas Development Institute.
[63]. Alkemade et al. 2013. Assessing the impacts of livestock production on biodiversity in rangeland ecosystems. PNAS 20905–20900 :110.

Indeed, most of Afghanistan's soils are already degraded[64] and 75% of the country is already affected by desertification[65], while forest cover has reduced by up to 80% from more than 3 million ha in the 1950s to approximately 1 million ha at present[66,67,68].

Ecosystem degradation and desertification will be further exacerbated by climate change. Increased temperatures and erratic precipitation – particularly in spring – will decrease the availability of livestock fodder, reducing rangeland productivity. This was seen during the drought of 1970–1972 when the national herd decreased by 40% as a result of water shortage, increased incidence of diseases and poor nutrition. More frequent droughts will impact on livelihoods, with the resultant displacement of human populations and reductions in human welfare.

Climate change is expected to become the largest global cause of biodiversity loss before the end of the century and is becoming a driver of biodiversity loss in Afghanistan[69]. For example, warmer temperatures will cause shifts in the geographic range of plant species, thereby changing vegetation cover and further increasing risks posed by desertification, erosion, flooding, avalanches and landslides. New diseases and invasive species may be better able to compete under future climate conditions, further impacting on ecosystems and natural resources. These changes put forest and rangeland systems at risk, thereby endangering the livelihoods of rural communities that depend on these natural resources[70].

4.4. BUILT ENVIRONMENT

Afghanistan's built environment has suffered considerably from more than four decades of conflict. Domestic energy production has hardly increased since the 1970s because of degraded generation capacity[71]. As a result, Afghanistan is heavily reliant on electricity imported from neighbouring countries and less than 30% of Afghan households are connected to electricity distribution systems[72].

The abundant water resources provide considerable potential for hydropower generation, which currently comprises 50% of domestic electricity production[73]. The development of hydropower generation capacity has been prioritised to reduce reliance on energy imports for economic growth[74]. However, climate change will put these ambitions at risk. Erratic water availability constrains reliable generation of electricity, while frequent floods cause damage to hydropower generation facilities every year; both of these impacts are only likely to increase under future climate change conditions.

In 2001, only an estimated 10% of the road network was in good condition[75]. Rehabilitation of transport infrastructure is seen as key to socio-economic development by improving access to services and markets, resulting in huge investments made by government and donors in the past two decades. Climate change poses a huge risk that will undermine these investments as well as the development gains that they seek to achieve. In particular, flooding is expected to cause annual damages of almost USD 4 million to road infrastructure[76]. Floods that damage bridges or make them impassable also cut off access to critical services such as medical care for remote communities precisely in times when such support is most needed.

64. Saba, D.S. 2001. Afghanistan: Environmental degradation in a fragile ecological setting. International Journal of Sustainable Development and World Ecology 289–279 :8.
65. Eswaran et al. 2001. Land degradation: an overview. In: Bridges et al. (eds.). Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification.
66. Delattre, E. & Rahmani, H. (n.d.). A Preliminary Assessment of Forest Cover and Change in the Eastern Forest Complex of Afghanistan: Report Submitted to WCS Afghanistan and USAID.
67. Groninger J.W. 2012. Reforestation strategies amid social instability: lessons from Afghanistan. Environmental Management 845–833 :49.
68. Groninger, J.W. 2006. Forestry and forestry education in Afghanistan.
69. CBD. (n.d.). Climate Change and Biodiversity.
70. Doosti, A.A. & Sherzad, M.H. 2015. Climate Change and Governance in Afghanistan.
71. USAID. (n.d.). Afghanistan Energy Sector Overview; South Asian Regional Initiative for Energy Integration.
72. MEW. 2014. Renewable Energy Magazine.
73. DABS. 2013. Energy Sector Overview.
74. Afghanistan. 2008. Energy Sector Strategy.
75. Afghanistan. 2012. Initial National Communication under the UNFCCC.
76. World Bank & GFDRR. 2018. Afghanistan: Multi-hazard risk assessment.

Approximately a quarter of Afghanistan's population lives in urban areas[77]. This is expected to increase up to half of the population living in cities by 2060[78]. Rapid urbanisation has created constraints such as poor service delivery, high population density, urban poverty and poor living conditions[79]. Climate change will put pressure on urban water supplies owing to depleted groundwater and cause frequent flooding, particularly in informal settlements. Natural hazards will also cause damage to economic infrastructure such as industrial and manufacturing facilities, further exacerbating the high levels of unemployment and poverty.

4.5. HEALTH

Afghanistan's population contends with poor access to quality health care services. Only half of the population is within one hour's travel from a health care facility, while health service quality often suffers from low competence and limited supplies[80]. As a result of these and other underlying factors such as the ongoing conflict and chronic malnutrition, life expectancy is 62.6 years compared to the global average of 71 years[81]. Moreover, only 40% of households have access to improved sanitation facilities, and 20% of the population uses unimproved drinking water sources[82,83].

Climate change will increase the strain on health care in Afghanistan. Higher temperatures and changes in precipitation patterns can increase the incidence of bacterial diseases such as cholera[84] and typhoid fever[85] as well as vector-borne diseases such as malaria[86] and leishmaniasis[87]. Of particular concern is the effect of warmer temperatures on the spread of polio, as Afghanistan is one of only three countries where it is still endemic[88]. Climate change will thus increase the prevalence of infectious diseases in an already strained health care system.

Afghanistan already has a high prevalence of malnutrition[89]. The negative impacts of climate change on agricultural production will further constrain food security across much of the country[90], thereby perpetuating chronic malnutrition. This will continue to lead to associated adverse outcomes on cognitive and social development as well as increase susceptibility to other diseases. Higher temperatures are likely to result in more heatwaves, which are particularly dangerous to vulnerable groups such as children, the elderly and the infirm. This will be compounded by increased water stress brought about by the expected reduction in water availability. Climate change is thus expected to directly impact the prevalence of diseases and other negative health outcomes.

77. NSIA. 2020. Afghanistan Statistical Yearbook 2019.
78. UN-Habitat. 2015. The State of Afghan Cities.
79. Afghanistan. 2008. Afghanistan National Development Strategy 2013-2008.
80. WHO. 2017. Joint External Evaluation of IHR Core Capacities of the Islamic Republic of Afghanistan.
81. WHO. 2020. World health statistics 2020: monitoring health for the SDGs, sustainable development goals.
82. UNICEF. 2017. Afghanistan Annual Report 2017.
83. UNICEF. 2020. Country Profile: Afghanistan.
84. Asadgol et al. 2019. The effect of climate change on cholera disease: The road ahead using artificial neural network. PLOS ONE 14: e0224813.
85. Saad et al. 2018. Seasonal dynamics of typhoid and paratyphoid fever. Scientific Reports 8:6870.
86. Martens et al. 1995. Potential impact of global climate change on malaria risk. Environmental Health Perspectives 464–458 :103.
87. Kholoud et al. 2018. Management of Leishmaniases in the Era of Climate Change in Morocco. International Journal of Environmental Research and Public Health 1542 :15.
88. Oberste, M.S & Lipton, H.L. 2014. Global polio perspective. Neurology 1832–1831 :82.
89. Varkey et al. 2015. Afghanistan in transition: call for investment in nutrition. The Lancet 3: E-13E14
90. WFP, UNEP & NEPA. 2016. Climate Change in Afghanistan: What does it mean for Rural Livelihoods and Food Security?

5. ADAPTATION PLANS AND STRATEGIES

Since the formulation of its NAPA[91] in 2009, Afghanistan has developed a number of strategies, plans and other key documents that outline adaptation priorities. Notable amongst these are the Afghanistan Climate Change Strategy and Action Plan[92] (ACCSAP), National Adaptation Plan[93] (NAP), Nationally Determined Contributions[94] (NDC) and Technology Needs Assessment[95] (TNA). While Afghanistan's National Communications to the UNFCCC also contain adaptation priorities, these largely comprise recapitulations of the other adaptation plans and strategies outlined here, and are thus not included in this assessment.

5.1. NATIONAL ADAPTATION PROGRAMME OF ACTION

Afghanistan's NAPA identified adaptation priorities based on a vulnerability assessment of key sectors to the impacts of climatic hazards. Over fifty potential adaptation options were identified, categorised into seven broad themes and then subjected to an adapted multi-criteria analysis to reach consensus on the key adaptation priorities. This resulted in a list of eleven project concepts that were then ranked based on weighting criteria. The results of this ranking are provided in Table 3.

Table 3. Ranking of key adaptation priorities in Afghanistan's NAPA[96].

Rank	Key adaptation priority
1	Improved water management and use efficiency
2	Land and water management at the watershed level
3	Development of horticulture
4	Improved terracing, agroforestry and agro-silvo-pastoral systems
5	Agricultural research
6	Rangeland management
7	Development of disaster management strategy
8	Improved food security
9	Improved livestock production
10	Creation of off-farm employment
11	Climate-related research and early warning systems

[91]. NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.
[92]. NEPA. 2016. Afghanistan Climate Change Strategy and Action Plan.
[93]. NEPA. 2016. National Adaptation Plan for Afghanistan.
[94]. Afghanistan. 2015. Intended Nationally Determined Contribution.
[95]. NEPA. 2020. Technology Needs Assessment for Climate Change Adaptation.
[96]. Adapted from Table 12 in: NEPA & UNEP. 2009. National Capacity Needs Self-assessment for Global Environmental Management and National Adaptation Programme of Action for Climate Change.

5.2. CLIMATE CHANGE STRATEGY AND ACTION PLAN / NATIONAL ADAPTATION PLAN

The ACCSAP and NAP were developed through a joint process based on consultation with a wide range of stakeholders including government, civil society and other partners. This led to the identification of a list of implementation priorities, response strategies and themes with timeframes of between three and five years that is replicated in both documents, summarised in Table 4.

Table 4. Implementation priorities, response strategies and themes identified in the ACCSAP and NAP[97].

Implementation Priority	Response Strategy	Theme
Agriculture and food security	Foodgrains management	Public distribution policy and infrastructure
		Pricing and procurement policy
	Agriculture research promotion	Agriculture research institute
Sustainable irrigation and water resource management	Soil conservation and research	
	Watershed planning and implementation	
	Introducing global best practices	
	Developing traditional systems such as ***kareze***	
	Interlinking of canals and water bodies	
	Water resource management in drylands	
Disaster risk management	Disaster preparedness	IT-enabled Early Warning Systems
		Capacity building at local and provincial levels
	Disaster response and management	Disaster response risk assessment, planning and financing
		Capacity development at provincial level
		Disaster monitoring centre established
Infrastructure and community resilience	Access to infrastructure such as roads	
	Rural energy security projects	
	Rural access to knowledge and awareness generation	
	Role of technology and formation of technology development board	
Climate change impact on human health	Nationwide impact assessment of climate change on human health	
	Programme on vector-borne diseases	
Gender and climate-resilient development	Nationwide assessment of how climate change affects gender	
Training and capacity development	Training needs assessment in key ministries	
	Training on climate change impacts and adaptation	
	Vulnerability assessment capacity development	
	Technical domain knowledge development	

[97]. Adapted from "Afghanistan National Adaptation Plan – Implementation Priorities" in: NEPA. 2016. National Adaptation Plan for Afghanistan.; and "Climate Change Action Plan for Afghanistan" in: NEPA. 2016. Afghanistan Climate Change Strategy and Action Plan.

5.3. NATIONALLY DETERMINED CONTRIBUTIONS

Afghanistan's NDC was developed through a series of consultation workshops with government decision-makers and representatives from non-governmental organisations. Adaptation priorities were identified based on the projected impacts of climate change outlined in Section 4. These priorities and their associated technology and capacity-building needs are summarised in Table 5.

Table 5. Adaptation actions, technology needs and capacity-building needs for Afghanistan[98].

Adaptation Action	Technology Needs	Capacity Building Needs
Development and adoption of the ACCSAP		
Development of a system to monitor and assess vulnerability and adaptation to climate change	Climate science technology	Climate science institutes within universities
Mainstreaming of climate change adaptation technologies into sectoral policies, strategies and plans combined with technology transfer	Climate policy technologies and methods	Training of climate policy experts
Strengthening of hydro-meteorological monitoring networks and services including a national hydro-meteorological database	Hydrological, meteorological and data equipment and integrated systems	Operators and analysts for hydro-meteorological and data-integration systems
Development of water resources through rehabilitation and reconstruction of small-, medium- and large-scale infrastructure	Transfer of catchment management technology and methodologies	Ecological engineering and spatial planning for water resources
Improved watershed management through community-based natural resource management	Transfer of catchment planning technology and models	Practitioners for watershed management
Increasing irrigated agricultural land through restoration and development of irrigation systems	Transfer of eco-agriculture and climate friendly irrigation technologies	Vocational and engineering capacity to construct and maintain irrigation networks
At least 10% of land area under a system of conservation areas	Transfer of conservation ecology methods and tools	Training of ecologists, and ecological economists
Promotion of renewable energy to reduce unsustainable use of natural resources and decrease reliance on fossil fuels	Transfer of renewable energy and sustainable energy technologies	National centre for sustainable energy; public-private partnerships
Regeneration of 40% of currently degraded forests and rangeland areas	Transfer of forestry and rangeland management tools and methods	Training of practitioners at university, government and local levels

[98]. Adapted from "Adaptation Needs and Means of Implementation" in: Afghanistan. 2015. Intended Nationally Determined Contribution.

5.4. TECHNOLOGY NEEDS ASSESSMENT

NEPA facilitated the TNA process to prioritise adaptation technologies for the water and agriculture sectors in Afghanistan. This prioritisation included performance evaluations of potential adaptation technologies followed by multi-criteria analysis using weighting of the selected criteria to identify the top-ranked technologies for each sector. Four priorities for the water sector and six priorities for the agriculture sector were identified and ranked, the results of which are provided in Table 6.

Table 6. Top-ranked adaptation technologies for the water and agriculture sectors in Afghanistan[99].

Rank	Agriculture Sector	Water Sector
1	Crop diversification and new crop varieties	Integrated water resource management
2	Responsive agricultural extension	Small dams and micro-catchments
3	Climate-resilient crop varieties	Surface rainwater harvesting
4	Land use planning	Micro-irrigation for efficient water use
5	Conservation agriculture	
6	Agro-forestry	

[99]. Adapted from "Chapter 3 Technology Prioritization for Water Sector" and "Chapter 4 Technology Prioritization for Agriculture Sector" in: NEPA. 2019. Technology Needs Assessment.

6. FUNDING SOURCES

Afghanistan has historically had limited involvement to international climate finance. For the last two decades, the focus donor support has predominantly been for security, conflict resolution and governance. This means that spending on climate change has not been commensurate with the urgency with which adaptation needs to be supported in the country. An estimated USD 100 million was spent per year on climate change between 2013 and 2015 by the Afghan government[100], but this amount is inadequate when compared to the total climate finance needs of USD 1,078.5 million per year[101]. To address this, Afghanistan needs to take advantage of the range of funding mechanisms available for climate action, particularly from multi-lateral funding sources. A summary of such sources is provided below.

6.1. GLOBAL ENVIRONMENT FACILITY

The Global Environment Facility (GEF) administers three funds that can be used to support climate change adaptation. The Least Developed Countries Fund (LDCF) is dedicated to climate change adaptation and was established specifically for Least Developed Countries to finance their immediate and urgent adaptation needs as outlined in their NAPAs. The Special Climate Change Fund (SCCF) is complementary to the LDCF and is also focussed on climate change but is open to all developing countries and allows for a broader range of activities. The GEF Trust Fund finances environmental interventions such as biodiversity conservation, sustainable land management and climate change mitigation. While the Trust Fund is not adaptation-specific, projects for ecosystem restoration can be designed to provide adaptation co-benefits if they are designed according to ecosystem-based adaptation (EbA) principles.

Given the smaller size of projects, less stringent requirements and shorter process compared to some other funds, the LDCF is best suited to adaptation in the agriculture and natural resources sectors. Examples of suitable projects include climate-resilient agricultural practices for small-scale farmers and community-based natural resources management using EbA approaches. Funding is obtained by the submission of project proposals through a collaboration between the Government of Afghanistan and one of the Implementing Agencies accredited by the GEF.

To date, Afghanistan has obtained a total of USD 26.9 million for climate change adaptation through the LDCF. It has also consistently secured funds through the Trust Fund for a range of environmental projects in the focal areas of biodiversity conservation, land degradation and climate change mitigation. As a Least Developed Country, Afghanistan is eligible to access a total of up to USD 50 million from the LDCF, of which USD 10 million can be accessed during the current GEF-7 period[102]. Given the country's track record with four approved full-sized projects, accessing this additional funding from the LDCF should be seen as a high priority before the end of the GEF-7 cycle. Table 7 provides an overview of all projects in Afghanistan funded by the LDCF and GEF Trust Fund in the areas of climate change adaptation, climate change mitigation, sustainable land management and biodiversity.

[100]. GEF. 2019. Progress Report on the Least Developed Countries Fund and the Special Climate Change Fund. GEF/LDCF.SCCF.03/27
[101]. Afghanistan. 2017. Climate Public Expenditure and Institutional Review.
[102]. Afghanistan. 2015. Intended Nationally Determined Contribution.

Table 7. GEF-funded projects in Afghanistan.

Project title	Project budget	GEF fund	Implementing entity
Adapting Afghan Communities to Climate-Induced Disaster Risks	USD 5.6 million	LDCF	UNDP
Building Resilience of Communities Living Around the Northern Pistachio Belt and Eastern Forest Complex of Afghanistan through an EbA Approach	USD 6.9 million	LDCF	UNEP
Strengthening the Resilience of Rural Livelihood Options for Afghan Communities in Panjshir, Balkh, Uruzgan and Herat Provinces to Manage Climate Change-induced Disaster Risks	USD 9 million	LDCF	UNDP
Building Adaptive Capacity and Resilience to Climate Change in Afghanistan	USD 5.39 million	LDCF	UNEP
Combating land degradation and biodiversity loss by promoting sustainable rangeland management and biodiversity conservation in Afghanistan	USD 5.91 million	Trust Fund	FAO
Strengthening capacity in the agriculture, land-use and other sectors for monitoring and reporting on Afghanistan's mitigation and adaptation targets	USD 1.35 million	Trust Fund	FAO
Investing in energy efficiency to strengthen the cold value chain of small and medium enterprises	USD 1.32 million	Trust Fund	UNIDO
Conservation of Snow Leopards and their Critical Ecosystem in Afghanistan	USD 2.7 million	Trust Fund	UNDP
Community-based Sustainable Land and Forest Management in Afghanistan	USD 10.5 million	Trust Fund	FAO
Reducing GHG Emissions Through Community Forests and Sustainable Biomass Energy in Afghanistan	USD 1.74 million	Trust Fund	FAO
Developing Core Capacity for Decentralized MEA Implementation and Natural Resources Management in Afghanistan	USD 0.91 million	Trust Fund	UNEP
Establishing Integrated Models for Protected Areas and their Co-management	USD 6.44 million	Trust Fund	UNDP
Natural Resources and Poverty Alleviation Project	USD 0.98 million	Trust Fund	ADB

6.2. ADAPTATION FUND

The Adaptation Fund was established under the UNFCCC to support adaptation projects in developing countries that are party to the Kyoto Protocol. It has many similarities to the GEF LDCF in terms of the types of actions funded, the project approval process, the size of typical projects and the accredited Implementing Entities.

The Adaptation Fund Board has instituted an initial cap of USD 10 million on a temporary basis. Afghanistan has only recently registered a national designated authority with the Adaptation Fund and received 9.4 million USD from the cap. An application for Afghanistan would likely be considered favourably in light of the fact that it has yet to obtain any funding from the Adaptation Fund to date. Given its similarity to the GEF LDCF and Afghanistan's experience with the latter, accessing funding from the Adaptation Fund should be seen as a high priority. Appropriate projects for preparing and submitting to the Adaptation Fund would include climate-resilient agriculture, community-based adaptation and EbA.

6.3. GREEN CLIMATE FUND

The Green Climate Fund (GCF) was established as the funding mechanism for the UNFCCC and is widely considered to be the main source of climate finance for developing countries. It supports projects for both adaptation and mitigation to promote low-emission and climate-resilient development. GCF projects are expected to be submitted based on countries' climate change strategies and plans such as NDCs, NAPAs and NAPs.

The large amount of funding available through the GCF (currently USD 8.3 billion[103]) and the large size of GCF projects compared to other funds have resulted in an expectation that countries will receive the majority of their climate finance needs from the GCF. However, the rate of approval of projects and disbursal of funds since the inception of the GCF has been slow. This is because of factors such as the complexity of the project formulation process, the high level of detail required in proposals and the stringency of the review process. Expectations should thus be tempered as projects routinely take more than two years for formulation, review and approval.

Afghanistan has begun to engage with the GCF with the recent approval of a mitigation project. However, there have not yet had any successful submissions of adaptation projects for the country. This is likely to remain a challenge for the foreseeable future because of the nascent state of capacities for accessing climate finance in the country as well as low levels of co-financing, constraints relating to meeting GCF requirements for investment criteria and limited data showing demonstrable economic benefits to adaptation activities, which is a prerequisite for GCF projects.

A pipeline of potential GCF projects has been developed, of which five are in the field of adaptation (see Table 8), but many of these will need considerable refinement to meet GCF requirements. Accessing GCF funds should be considered as a high priority because of the potential for such projects to achieve large-scale change. However, this will prove to be extremely challenging without having the requisite in-country capacity for formulating and assessing GCF proposals. This capacity development should thus be done as a matter of urgency to facilitate future GCF applications.

[103]. GCF. 2020. Status of Pledges and Contributions made to the Green Climate Fund.

Table 8. Preliminary GCF project ideas for Afghanistan.

Project title	Project budget	Status	Accredited entity
Building Resilience through the Strengthening of Climate Services and Impact-based Multi-hazard Early Warning in Afghanistan	USD 30 million	Concept note submitted to GCF	UNEP
Climate-Resilient Community-Based Irrigation Infrastructure	USD 115 million	Concept note under formulation	UNDP
Strengthening Resilience to Drought of Food Insecure Populations in Nuristan and Badghis Provinces in Afghanistan through Integrated Climate-risk Management	USD 8.95 million	Concept note under formulation	WFP
Building Resilience of the Vulnerable Communities in the Face of Droughts and Floods Enhanced by Climate Change in Arghandab-Arghestan Sub–River Basins and Lower Helmand River Basin	USD 91 million	Conceptualisation phase	Not yet identified
Forest Restoration for Enhanced Ecosystem Services Functioning and Climate Resilience in Afghanistan	USD 43 million	Conceptualisation phase	Not yet identified

6.4. ADAPTATION FOR SMALLHOLDER AGRICULTURE PROGRAMME

The Adaptation for Smallholder Agriculture Programme (ASAP) is an initiative supported by the International Fund for Agricultural Development (IFAD) to provide climate finance to smallholder farmers for building their resilience to climate change. It is complementary to IFAD's ongoing investments into agriculture and provides co-financing for smallholders to scale up adaptation action.

The large number of smallholder farmers in Afghanistan makes ASAP an ideal opportunity for upscaling climate change adaptation. IFAD's portfolio of projects in Afghanistan are also well-suited to complementary ASAP financing. Therefore, the inclusion of ASAP funding into IFAD's future programme of work in Afghanistan projects should be considered a high priority. This would be best achieved through government institutions, including NEPA and the Ministry of Agriculture, Irrigation and Livestock (MAIL) engaging with IFAD in the formulation of future projects.

6.5. INTERNATIONAL CLIMATE INITIATIVE

The International Climate Initiative (IKI) was established by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety to support countries to achieve the objectives of the UNFCCC as well as the Convention on Biological Diversity. Projects financed by IKI cover a range of environmental objectives, including climate change adaptation. In particular, IKI funding for climate change helps recipient countries to implement their NDCs with a focus on EbA, disaster risk reduction (DRR) and furthering of their NAP processes.

IKI typically funds projects that are similar in size and nature to the LDCF projects that Afghanistan already has experience in applying for. Applicants can be national implementing agencies, NGOs and other national or international organisations. Given the low levels of capacity for accessing climate finance, it is likely that any project in Afghanistan would require assistance from international organisations to secure funding. Nonetheless, preparation of funding proposals to IKI should be a high priority. Suitable themes for IKI's thematic-oriented selection procedure include EbA, community-based DRR and preparation of policies, strategies and plans for climate change.

6.6. GOVERNMENT EXPENDITURE

Between 2013 and 2015, Afghanistan's government spent approximately USD 100 million per year on climate change through almost 3,000 projects across nine line ministries and government institutions[104]. While there is clearly a need for streamlining of expenditure on climate change, it is nonetheless significant that the government is already making investments into climate change. In the short to intermediate term, this is likely to be the most important source of funding for climate change because larger amounts such as those supported by GCF are likely to take some time to be realised. It is thus clear that the Afghan government will remain an important source of funds for adaptation. Streamlining of government expenditure on adaptation will facilitate future access to funding from sources such as the GCF as this will enhance efficiency and enable the co-financing required by GCF projects.

Centralisation and ring-fencing of government expenditure on climate change would also allow for more investment into adaptation. NEPA is currently considering the establishment of focused climate change trust funds and investment funds[105]. This has been successfully piloted in other countries, and in some cases such funds have become national implementing entities for multilateral funds. Consequently, improved programming of government expenditure on adaptation should be prioritised.

6.7. BILATERAL DONORS

Afghanistan is heavily dependent on foreign aid, with 48% of the national budget for 2020 coming from donors[106]. Besides this, various donors provide additional support through government, UN agencies, NGOs and other entities for climate change adaptation as well as other priorities related to climate change including food security, agriculture, resilience-building and DRR. Such aid is provided on a case-by-case basis based on programming priorities. This constitutes a significant opportunity for increasing the amount of adaptation funding but is dependent on sustained advocacy and engagement. Such engagement should be considered a high priority, to be aligned with government programming on climate change.

6.8. MULTILATERAL DEVELOPMENT BANKS

Multilateral development banks (MDBs) – such as the World Bank and the Asian Development Bank – provide significant amounts of funding for a range of development activities. In Afghanistan, these investments have frequently been for large-scale agricultural and infrastructure projects, both of which sectors are threatened by climate change. In addition, MDBs can facilitate the development of strategies to underpin engagement with multilateral funds and can also act as a conduit for such funds. For example, World Bank is developing a Climate Change Action Plan for the South Asia Region to guide future work in the region, including in Afghanistan. World Bank is also the trustee for the Afghanistan Reconstruction Trust Fund. Engagement with MDBs to ensure that climate change is mainstreamed into all projects and that specific funding is made available for adaptation should thus be a priority.

MDBs generally support transformational projects based on NDCs and other national priorities. Moreover, they have a preference for projects that show measurable economic benefits. In these two regards, MDBs are thus similar to the GCF. However, this raises the same challenges as those constraining access to GCF funding in Afghanistan, namely low capacities for accessing climate finance, low levels of co-financing and limited proof-of-concept data for the economic benefits of adaptation. If these challenges can be overcome, MDBs may be able to provide access to substantial projects for adaptation in the fields of agriculture, climate-resilient infrastructure and DRR.

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[104]. Afghanistan. 2017. Climate Public Expenditure and Institutional Review.
[105]. NEPA. 2020. Environment Sector Vision: Afghanistan.
[106]. Ministry of Finance. 1399 .2020 National Budget (Enacted).

7. Proposed adaptation actions

The list of adaptation options proposed below was developed by cross-referencing the government planning and strategy documents summarised in Section 6 with the sectoral impacts of climate change identified in Section 5. For each of the adaptation options outlined here, some proposed actions are provided as well as potential sources of funding based on the priorities of the funders and the nature of the projects. There are some inter-linkages and overlaps been these options, for example where integrated water resource management has implications for agricultural and urban resilience. These have been highlighted where possible, noting that there should be strong coordination between adaptation projects and interventions during their implementation.

It should also be noted that there is a need for capacity development across all adaptation actions. In some cases, specific capacity development priorities have been identified within the actions proposed here. However, the current capacity gaps in Afghanistan and the rapid progress of which adaptation techniques and technologies will necessitate mainstreaming of capacity development into all new climate change programmes and projects. A particular priority is in capacity development for the formulation of concept notes and proposals for adaptation programmes and projects. Many government officials and other development practitioners have experience in contributing to the formulation of humanitarian and development projects for donor aid in the past decades. However, funding for climate change adaptation requires specialised considerations that are not requirements for other types of development assistance. For example, most climate change funding mechanisms expect identification of specific climate change impacts as well as a very clear demonstration of the adaptation benefits and additionality of the proposed action above and beyond the sustainable development benefits provided by traditional development projects. Capacity development for the formulation of project proposals for climate change adaptation should thus become a priority through targeted training.

7.1. Climate-resilient integrated water resource management

Afghanistan's primary climate change threats are floods and droughts. Improved management of water resources is thus a top priority to reduce threats to lives and livelihoods from both rapid- and slow-onset disasters. This will also have positive benefits for health risks posed by climate change when diseases are impacted by water-borne vectors. Integrated water resource management (IWRM) that takes into account climate change adaptation was thus identified by the NAPA[107], ACCSAP / NAP[108], NDC[109] and TNA[110] as a high priority for adaptation.

Climate-resilient IWRM for adaptation entails ensuring the availability of bulk water supply for users in agriculture, industry and domestic consumption. It comprises both "hard" and "soft" options to control water flows. "Hard" options are infrastructural and engineered solutions to manage water resources. Storage dams and reservoirs can retain water during times of excess and then release the water during periods of shortage. This can prevent damage caused by flooding by reducing maximum flows while also ameliorating the impacts of drought by having reserves during times of low flow. Additional co-benefits include the potential for generation of hydro-electricity – a significant source of power in Afghanistan – as well as maintenance of aquatic ecosystems.

[107]. Priorities: "Improved water management and use efficiency" and "Land and water management at the watershed level".
[108]. Priorities: "Sustainable irrigation and water resource management", "Watershed planning and implementation" and "Interlinking of canals and water bodies".
[109]. Priority: "Development of water resources through rehabilitation and reconstruction of small-, medium- and large-scale infrastructure".
[110]. Priority: "Integrated water resource management".

Other "hard" options for IWRM include intra- and inter-basin transfer schemes that to human demands and link water distribution systems to buffer against the high variability in water availability across Afghanistan. This will allow transfer from areas experiencing abundant water to other areas that have a shortage, thereby enhancing water security. In urban areas, wastewater management and stormwater drainage can contribute to the overall management of water supplies and also address some of the health impacts of climate change, especially for water-borne diseases.

"Soft" options for water resource management comprise institutional mechanisms to address climate-induced variability of water resources. These 'soft' tools allow for improved management of water demand and supply through policies, economic instruments, land-use planning, public awareness and other measures. This will improve allocation, conservation and efficiency of use of water resources. Such "soft" options are generally cheaper and more cost-effective than "hard" options, especially over long periods of time. "Soft" options are also extremely beneficial when implemented to complement "hard" options. IWRM for climate resilience should thus include as much of an emphasis on managing water demand through "soft" measures as on increasing water supply through "hard" measures, particularly in a context such as Afghanistan where overall water availability is expected to decline.

- HYDROLOGICAL STUDIES TO DETERMINE WATER BALANCE UNDER FUTURE CLIMATE CONDITIONS

Having improved information on the water balance across space and time under future climate change conditions is critical for the management of water resources. This is particularly pertinent given the changes in precipitation regimes in terms of both timing and volume of precipitation, as well as the increased rates of evapo-transpiration because of higher temperatures.

A comprehensive study or series of such studies for the five major river basins of Afghanistan would be fundamental and underpin national planning and implementation of climate-resilient IWRM. It would also serve to inform other adaptation priorities outlined in this report by providing information for decision-making on agricultural, industrial and domestic water supply and demand. Such hydrological studies could also be integrated into the National Climate Change Information System that is currently being established by the Government of Afghanistan to collect and monitor data on climate change impacts to inform future adaptation actions. Priority activities for undertaking hydrological studies of water balance under future climate change conditions should include:

- Water balance assessments for the five river basins of Afghanistan – preferably at the sub-basin / watershed level (there are 41 watersheds within the five major river basins) – that quantify precipitation, runoff, evaporation and storage to the greatest level of detail possible.
- Modelling of past trends of water balance based on historical data (both quantitative and qualitative) to identify patterns in and baseline data for water resource availability when compared with historical climate data.
- Modelling of expected future water balance by comparing current water balance assessments, past trends of water balance and different scenarios of expected climate change impacts.
- Targeted studies of rivers that have the potential for construction of large-scale water reservoirs and/or hydropower generation to identify impacts of climate change on such infrastructure as well as any positive and negative environmental, social and economic impacts of the infrastructure.
- Establishment of a system for regular re-assessment of water balance to review each of the three activities outlined above on a regular basis (e.g. every 3–5 years) and when new data becomes available (e.g. new climate models are developed).

- INSTITUTIONAL MECHANISMS AND PLANNING FOR CLIMATE-RESILIENT IWRM

The long-term success of IWRM to adapt to climate change is dependent on effective and coordinated planning and implementation. Investment in management and institutional capacities will enhance the returns received on investments into infrastructure in the face of the increased variability caused by climate change. This will allow custodians of water resources at all levels to improve management, storage and distribution water in times of uncertainty.

Accurate and timely information, coupled with responsive and adaptive management, will significantly enhance water security and availability. Strengthened capacities will also ensure optimal decision-making – and thus greatest returns – on investments into both "hard" and "soft" options based on the complexity of the hydrological, socio-economic, environmental and other factors involved in climate-resilient IWRM.

In Afghanistan, this would require strong collaboration between the various national-level government institutions involved (e.g. NEPA, the National Water Affairs Regulation Authority, MAIL and the Ministry of Rural Rehabilitation and Development [MRRD]), municipalities and provincial government authorities as well as other stakeholders such as local water user associations. These would ensure optimal allocation of water resources between different users, between different geographic areas and during different times of the year depending on relative shortages or excess. Potential priority actions for climate-resilient IWRM planning include:

- Participatory assessments of different user group requirements (e.g. agriculture, industry, domestic consumption) with a particular focus on vulnerable groups of society such as women, children, the elderly, people with disabilities, returnees, refugees, internally displaced people and ethnic minorities.
- Identification of goals and priorities for climate-resilient IWRM based on the water balance assessments, consultations and participatory assessments in the light of the expected impacts of climate change.
- National, provincial, district and community consultations to determine priorities, public perception and level of community buy-in for infrastructural options and to ensure that negative social impacts are minimised and positive social benefits are maximised.
- Analysis of "soft" options – including their financial, environmental and political feasibility to inform the formulation, review and amendment of national water policies, strategies, plans and legislation as needed. Such options include:
    - Water restrictions and prioritisation of different water uses for agricultural, industrial and domestic users during times of drought or water stress.
    - Variable water tariffs and other regulatory measures for agricultural, industrial and domestic consumers to improved water use efficiency.
    - Climate-resilient land-use planning to ensure that different types of land use are located in low-risk areas, that water-intensive processes are located in areas of relative abundance and that impacts of land use on water resources are minimised.
    - Communication and grievance redress mechanisms for early identification and resolution of conflicts and other problems related to water security.
    - Public awareness on the importance of management of water resources and the implications of climate change for other water users, natural ecosystems and the proper functioning of the hydrological cycle.
- Formulation, review and amendment of national water policies, strategies, plans and legislation through working groups with technical, institutional, policy and other experts across ministries and sectors.

- Formulation of sub-national water plans at provincial, district and community levels in line with national-level plans.
- Revision of national budget in relevant government institutions
- Establishment and institutional strengthening of mechanisms for coordination, planning and decision-making on climate-resilient IWRM at all levels, including local water user associations in communities.
- Establishment of mechanisms for regular (e.g. five-yearly) revisions of water policies, strategies, plans and legislation based on changes in socio-economic, climatic and other conditions observed.

- CLIMATE-RESILIENT INFRASTRUCTURE FOR WATER STORAGE AND DISTRIBUTION

When there is comparatively little hydraulic infrastructure – as is the case in Afghanistan – then investment in such infrastructure generally provides relatively high returns. The expected climate change impacts will dictate not only the total volume of water storage that should be constructed, but also the location (where the hydrological conditions are suitable) and the appropriate type and scale of the infrastructure constructed.

While construction generally focuses on large-scale, man-made storage reservoirs, there is a broad range of options that could be considered. These include natural storage such as groundwater, wetlands and lakes as well as smaller-scale infrastructure such as household rainwater harvesting and community reservoirs. Ensuring adequate bulk water supply under climate change conditions will require an appropriate mix of such interventions. Priority actions for climate-resilient water infrastructure in Afghanistan include the following:

- Environmental, social and economic studies of infrastructural options including analyses of cost-benefit ratios, internal rates of return, environmental and social impact assessments and related studies all taking into account current and future climate trends as well as other factors such as siltation rates of reservoirs and current and future supply and demand for various water uses.
- Design of location and type of new water storage infrastructure based on the environmental, social and economic studies as well as the hydrological studies of the past, current and future water balance under climate change conditions for river basins and watersheds outlined in the previous section.
- Design of water distribution networks including inter-basin transfer schemes for large-scale movement of water between basins of relative supply to basins of relative demand and canals and pipelines for more localised distribution of water from sources to end-users.
- Design of measures to enhance natural storage such as improving groundwater and aquifer recharge rates as well as improving hydrological functioning of wetlands, lakes and other water bodies in the face of projected climate change impacts.
- Design of modifications and upgrades of existing water storage infrastructure and distribution systems to improve their resilience to climate change, including reduction of evaporation and related water losses as well as integration with new storage and distribution infrastructure.
- Construction of water storage and distribution infrastructure that takes climate change impacts on the infrastructure itself into account (e.g. to avoid or minimise flood damage in at-risk locations) as well as climate change impacts on end-users to ensure water availability at the time and in place where water insecurity is likely to prove problematic.

- Implementation of measures to enhance natural storage and hydrological functioning of water bodies to complement man-made storage solutions.
- Implementation of modifications and upgrades of existing water storage and distribution systems to improve their climate resilience and integrate them with new infrastructure.
- Establishment and implementation of real-time monitoring of water quantity and quality with early warning systems including river gauges and flow-rate monitors to ensure that water supply is maintained at optimal levels, including directing transfer of water through inter-basin transfer schemes at times of relative excess or shortage (these monitoring systems would also provide data for the regular hydrological assessments and feed into the national environmental and climate change information system described previously).
- Establishment and implementation of operations and maintenance plans to prevent failure of storage and distribution infrastructure caused by damage or destruction from hazards as well as ongoing wear and tear.

Projects for climate-resilient IWRM would, in most cases, be large-scale projects suitable for funding from the GCF as well as MDBs owing to the clear case for measurable socio-economic benefits. An optimal mix of funding would likely be the use of GCF funding to supplement large-scale MDB projects. The MDB would finance infrastructural investments while the GCF would finance the additional costs for ensuring resilient and functional infrastructure under future climate change conditions. Funds from MDBs could thus be used as co-financing to leverage GCF funding for greater, more sustainable and longer-term returns. Such projects already approved by the GCF typically comprise around USD 45 million of GCF funding with additional co-financing of USD 15 million for climate-resilient IWRM in a major river basin. Additional funding allocations from government expenditure should be used in a complementary manner, particularly for post-project costs such as the implementation of operations and maintenance plans.

7.2. DISASTER RISK REDUCTION

Much of the action on addressing the impacts of hazards in Afghanistan has historically been focused on response and recovery with an emphasis on early action. However, there are considerable gains to be made by engaging in proactive DRR action to reduce the impacts and risks associated with climate-induced hazards such as flood and drought, particularly for rural communities. Various aspects of DRR have thus been highlighted as priority actions by the NAPA[111], ACCSAP/ NAP[112] and NDC[113] for building the coping capacities of communities in hazard-prone areas.

Similar to climate-resilient IWRM, effective DRR in Afghanistan would entail a combination of "hard" and "soft" options to reduce vulnerability to climate-induced hazards. "Hard" options include infrastructural measures such as flood prevention barriers to reduce the likelihood and scope of potential impacts of hazards on communities. "Soft" options include planning measures and early warning systems (EWS) to increase the preparedness of communities in the event that hazards occur. Again, "soft" options are extremely cost-effective, especially when combined with "hard" options.

- DISASTER RISK ASSESSMENT AND PLANNING

DRR and disaster response are both predicated on in-depth understanding of the risks posed by climate-induced hazards and preparation of plans to prevent and respond to such hazards. This is also crucial to moving from the current reactive approach of disaster response to a

111. Priority: "Climate-related research and early warning systems".
112. Priorities: "Disaster preparedness" and "Disaster response and management".
113. Priorities: "Strengthening of hydro-meteorological monitoring networks and services including a national hydro-meteorological database" and "Development of a system to monitor and assess vulnerability and adaptation to climate change".

more sustainable, proactive approach of risk reduction. This latter approach is also more cost-effective through greater success in preventing losses and damages caused by hazards when they occur. Risk assessment and planning should take place at multiple scales, from national to community levels. Priority actions for disaster risk assessment and planning in Afghanistan include the following:

- Assessment of vulnerabilities to climate-induced hazards across multiple scales including national vulnerability assessments (of which many have been completed) to localised community-level vulnerability and capacity assessments to specific hazards that communities are expected to face under current and future climate change scenarios.
- Planning for community-based disaster preparedness and action, based on community-level vulnerability and capacity assessments to identify preventative and risk-reduction as well as emergency and response measures that are integrated with national and local EWS, as part of national DRR and disaster management plans.
- Training for local communities on preventative and emergency response measures based on community-based disaster preparedness plans.
- Establishment of disaster management structures at national, provincial, district and local level that are vertically integrated to ensure that information passes from national down to local levels and vice versa for accurate communication of disaster risks and needs.
- Finalisation and implementation of a national DRR and disaster management action plan based on the Afghanistan Strategy for Disaster Risk Reduction (ASDRR), including developing budgets and resource allocations for risk reduction and disaster response measures at national, provincial, district and local levels.
- Capacity building and training of government officials within ANDMA, MRRD and other institutions at national, provincial and district levels on risk reduction and disaster management measures to strengthen institutional responses to hazards.
- Strengthening of national and sub-national disaster monitoring centres including integrating them with national and local EWS.

- CLIMATE MONITORING AND EARLY WARNING SYSTEMS

Effective and timely DRR depends on having accurate and up-to-date information on the likely nature, location and timing of climate-induced hazards. This information informs vulnerability assessments, disaster preparedness planning, implementation of disaster mitigation measures and delivery of emergency response services. In particular, the establishment of EWS is a cost-effective approach to DRR that saves lives and reduces losses and damages caused to livelihoods and productive assets across multiple scales. Priority actions for climate monitoring and EWS in Afghanistan include:

- Strengthening of agro-hydro-meteorological monitoring networks and services including creation of a national agro-hydro-meteorological database and establishment of an integrated national network of automated monitoring stations that collect and transmit data to a national monitoring centre for analysis.
- Undertaking climate-related research such as hazard mapping and climate modelling based on past and current agro-hydro-meteorological data to characterise the likely nature, location and timing of various climate-induced hazards at seasonal and inter-annual scales.
- Establishment of an IT-enabled national EWS that collects and analyses data from the agro-hydro-meteorological network in real-time to provide accurate and timely predictions of the likelihoods of hazards occurring, linked to a dissemination system for transmitting the message via multiple media (e.g. mobile phone, radio, television, social media) to government staff, humanitarian actors, local communities and other stakeholders.

- Establishment of local-/community-level EWS based on river gauges and other small-scale hazard prediction equipment, complemented with communication equipment to allow for early identification and communication of imminent localised threats.
- Training on the use of EWS including how to analyse data, transmit early warnings and respond to hazards based on the warnings received.
- Development of weather services for relevant sectors (e.g. agriculture, aviation) to provide real-time information to inform daily planning and decision-making and ensure that this information is readily available for and useful to end-users.

- HAZARD PREVENTION AND MITIGATION MEASURES

Reducing the impacts of and risks associated with climate-induced hazards such as floods and droughts can be achieved through local-level measures to protect lives and livelihoods. Such measures should be based on hazard vulnerability assessments and disaster preparedness planning to ensure that they are contextualised to local conditions for addressing specific disaster risks. Prevention measures can be either structural (e.g. construction of physical infrastructure) or non-structural (e.g. training and awareness), and are more cost-effective than emergency response measures while also increasing the coping capacity of disaster-affected communities. Priority hazard prevention and mitigation measures for Afghanistan include the following:

- Construction of flood mitigation structures such as check-dams, culverts, floodwalls, gabions, levees, gully plugs and storm-water drains to retain water or divert it away from at-risk areas or assets.
- Altering watercourses in flood-prone areas through reducing roughness, removing blockages, deepening and changing the direction of stream channels to increase the speed at which water is diverted away from critical infrastructure and productive assets.
- Construction of terraces, contour bunds and other slope stabilisation measures to reduce flooding and erosion.
- Climate-proofing of roads, bridges and other transport infrastructure to ensure to the greatest possible extent that they are not impacted by flooding and can thus allow for evacuation and provide critical access for emergency and other services during disaster events.
- Flood-proofing of evacuation centres, emergency shelters, houses, hospitals, schools and other critical community infrastructure.
- Construction of reservoirs, dams and other water-storage infrastructure to store water for household, agricultural and other consumption during dry periods.
- Construction of water-harvesting measures that divert water to reservoirs or increase permeation of water into aquifers to increase the availability of water during dry periods.
- Establishment of insurance against climate shocks such as index-based insurance products to reduce the impact of financial losses caused by hazard events.
- Digging of wells and provision of pumps to facilitate access to groundwater.
- Construction and rehabilitation of canals, kareze and other irrigation infrastructure to increase the provision of water for agricultural use, including climate-proofing of such infrastructure to reduce water loss and increase the efficiency of water use.
- Rehabilitation of rangelands, forests and other ecosystems to improve the delivery of climate-resilient ecosystem goods and services (see Section 8.4).

Projects for DRR are likely to be a mix of large- and small-scale projects suitable for funding from a variety of sources. Given the larger amount of funds that may be obtained from the GCF and MDBs, these are more suitable for supporting the establishment of a national agro-hydro-meteorological monitoring network and development of a national-level EWS as these would require large and coordinated investment into infrastructure, equipment and training, while also providing a clear case for cost-effective and measurable socio-economic benefits.

Funding for community-level measures – including assessments, planning, training and field activities – can be obtained from a variety of sources including smaller multi- and bi-lateral funding sources as well as regular government expenditure. Moreover, ongoing development and humanitarian actions from NGOs and other practitioners can be directed into DRR activities through greater coordination and planning.

7.3. CLIMATE-RESILIENT AGRICULTURE

Because of the reliance of the majority of Afghan households on agriculture (both livestock and crops), a lot of investment has been made into the agricultural sector. While this has improved agricultural production, these gains are threatened by climate change, particularly changing precipitation patterns and increased temperatures.

Climate-resilient agriculture has been identified as a priority by the NAPA[114], ACCSAP/NAP[115], NDC[116] and TNA[117] for enhancing the capacities of local communities to maintain production under changing climate conditions.

Climate-resilient agriculture largely comprises investments into improved production techniques, especially those which serve to increase efficiency and effectiveness of water use. However, some "soft" options also exist, particularly relating to improving agricultural extension services and research into climate-resilient techniques and varieties.

- **IMPROVED LIVESTOCK MANAGEMENT**

Given that the preponderance of households in Afghanistan are partially or fully reliant on livestock for some portion of their income, adaptation for agricultural production is particularly important. The main impact of climate change is likely to be decreased water availability as evidenced by the loss of livestock during recent droughts in the country. This is caused by reduced availability of drinking water as well as decreased production of fodder and forage.

In addition, increased temperatures and the spread of disease vectors is likely to put additional stress onto livestock. These impacts would result in increased food insecurity, rising food prices and reduced income for livestock owners. Priority actions for increasing resilience in the livestock sector in Afghanistan include the following:

- Genetic improvement of livestock through the introduction of new varieties and breeding programmes for more efficient properties (e.g. smaller size, lower water requirements, greater reproductive success, increased feed to meat/milk/fibre conversion, disease resistance) that are specific to the changing climate would result in farmers achieving higher levels of productivity per unit of water and feed, allowing them to maintain production under changing climatic conditions.

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114. Priorities: "Development of horticulture", "Improved terracing, agroforestry and agro-silvo-pastoral systems", "Agricultural research", "Rangeland management", "Improved food security" and "Improved livestock production".
115. Priorities: "Food grains management", "Agriculture research promotion", "Soil conservation and research", "Introducing global best practices" and "Developing traditional systems such as kareze".
116. Priority: "Increasing irrigated agricultural land through restoration and development of irrigation systems".
117. Priorities: "Crop diversification and new crop varieties", "Responsive agricultural extension", "Climate-resilient crop varieties", "Micro-irrigation for efficient water use", "Conservation agriculture" and Agro-forestry"

- Enhanced efficiency of nutrition through improving feeding practices such as modifying and supplementing diets, changing the frequency and timing of feeding, and incorporating a wider variety of feed into the diet can promote feed intake and compensate low consumption, reduce heat stress, decrease feed insecurity in the dry season and reduce levels of animal malnutrition.
- Improved pasture management including planting perennial forage and fodder crops, introduction of agroforestry, modification of stocking rates, shifting of grazing locations (e.g. to higher altitudes or areas with water and grazing resources), changing the timing of annual or seasonal pastoral migration, introduction of drought-resistant fodder types, adoption of environmentally friendly practices and soil and water conservation to increase the productivity of livestock and provide other benefits such as water and nutrient cycling (see the sections on Climate-smart agriculture and Ecosystem-based adaptation for more details).
- Introduction of mixed crop-livestock systems by integrating cultivation of staples along with animal husbandry to improve food security by increasing the efficiency of food production per unit of resources such as land and water.
- Reduction of heat stress through measures such as providing shade in pasture through construction of man-made structures and planting of trees, introduction of cooling systems, improved ventilation in livestock housing (e.g. chicken coops) and providing access to water sources such as rivers for cooling (i.e. besides for drinking purposes).
- Improving water efficiency of livestock production through rehabilitation of water supplies in pastures, irrigating pasture (for appropriate pasture crops) and adopting integrated water management approaches.
- Improving livestock healthcare including ensuring vaccination and other veterinary services are readily available, along with integrated management of diseases and their vectors, pests, parasites and weeds to increase animal health and thus productivity.

- IMPROVED AGRICULTURAL WATER USE

The expected increase in the impacts of droughts under future climate change conditions in Afghanistan is of considerable concern for crop production systems. Improved management of agricultural water use – in particular, enhancing the efficiency and effectiveness of dwindling water resources – is thus critical to promoting climate resilience through ensuring food security, adequate nutrition and protection of livelihoods for Afghan communities in the future. As a result, climate-resilient water management in the agricultural sector was prioritised in the NAPA[118], ACCSAP / NAP[119] , NDC[120] and TNA[121].

There are many overlaps and similarities between actions to be taken under improved management of agricultural water supplies and climate-resilient IWRM (as described elsewhere in this report). In the context of adaptation within the agricultural sector, the latter has a primary focus on ensuring adequate overall availability of water resources, while the main focus of the former is on improving the use of such water.

[118]. Priority: "Improved water management and use efficiency".
[119]. Priorities: "Introducing global best practices", "Developing traditional systems such as kareze", "Water resource management in drylands" and "Sustainable irrigation and water resource management".
[120]. Priority: "Development of water resources through rehabilitation and reconstruction of small-, medium- and large-scale infrastructure" and "Increasing irrigated agricultural land through restoration and development of irrigation systems".
[121]. Priorities: "Integrated water resource management", "Small dams and micro-catchments", "Surface rainwater harvesting" and "Micro-irrigation for efficient water use".

Nonetheless, a number of measures are common between the two, and they should be considered in conjunction in any planning for climate-resilient agriculture. As with IWRM, both "hard" and "soft" options should be implemented in conjunction for improved water use in the agricultural sector. Key priorities include:

- Construction, rehabilitation and climate proofing of surface water storage structures with a focus on increasing water storage capacity in both large- and small-scale water infrastructure to capture excess run-off from precipitation and snowmelt for storage to ensure adequate supply during critical growth periods of crops as well as during dry spells.
- Increasing the efficiency of water conveyance to reduce losses during transport of water, through evaporation (e.g. by covering irrigation canals) and leakages (e.g. by waterproofed lining in canals), thereby ensuring that more water is available for agricultural production.
- Improving the efficiency of the water used for irrigation through measures that apply water more directly to the root zones of crops by substituting less efficient practices such as flood irrigation with more efficient practices such as construction of check basins, furrows and raised beds in agricultural fields as well as the introduction of pressurised, drip and micro-irrigation systems.
- Increasing the use of groundwater sources through digging of wells and installation of pumping equipment (especially linked to the improved irrigation practices described).
- Establishment of inter-basin transfer and local water distribution schemes for movement of water from areas of relative abundance to areas of relative shortage (see the section on climate-resilient IWRM).
- Introduction of improved crop varieties such as drought-resistant and early maturing crop varieties that maintain crop yields during periods of low water availability.
- Enhancing the conservation of soil moisture conservation through increasing soil organic matter by the addition of compost and manure, mulching using natural (e.g. crop residues) and synthetic (e.g. plastic) material, construction of bunds and alley cropping around agricultural fields.
- Establishment and strengthening of local water user associations to improve management of local water resources through more efficient allocation and distribution of water through local irrigation canals water depending on the requirements of different water users, achieving lower overall water use by timely release of water during critical growth periods and ensuring more coordinated use of water from multiple water sources (rain, surface and groundwater); this will also reduce the potential for conflict arising from competing water users during periods of lower water availability.
- Rehabilitation and expansion of Afghanistan's traditional *kareze*[122] irrigation structures to reduce water loss through evaporation.
- Establishment of irrigation system monitoring systems to provide real-time information on the supply and demand of water over different areas, during different seasons and in relation to the crop varieties cultivated.
- Ensuring ongoing maintenance, repairs and replacement of infrastructure and equipment to ensure that efficiency gains are maintained over time, especially after floods and other hazard occurrences that may damage or reduce the effectiveness of interventions.

[122]. Kareze are underground canals traditionally used to transport water from a source such as aquifers or wells to the location where such water is needed for irrigation and drinking, thereby reducing loss of water through evaporation as compared to use of surface canals.

- CLIMATE-SMART AGRICULTURE

Climate-smart agriculture (CSA) is an integrated approach to agricultural production that is intended to simultaneously achieve three objectives, namely to: i) sustainably increase agricultural production; ii) increase resilience to the impacts of climate change; and iii) reducing greenhouse gas emissions from the agricultural sector. Thus, while climate change mitigation is an integral part of CSA, it also provides adaptation benefits through reduced vulnerability to climate change.

CSA includes large-scale measures such as landscape management as well as localised interventions such as adopting new agricultural practices and varieties. There is much overlap between CSA and other adaptation interventions such as those described in the preceding sections. However, it is important to note that true CSA has a broader objective than only adaptation as it should also achieve emissions reductions. Appropriate interventions for CSA in Afghanistan include the following:

- Adoption of agroforestry through the integration of trees (e.g. legumes, shade trees, horticultural varieties, fodder crops, etc.) into crop and livestock production systems will improve land management, increase carbon sequestration, improve soil and water conservation and increase nutrient cycling while also increasing the overall productivity of agricultural systems (both livestock and crops) under climate change conditions.
- Adoption of conservation agriculture, which comprises a range of interventions to improve soil quality, water retention and carbon sequestration based on three principles – viz. zero or minimum tillage to reduce soil disturbance, soil surface cover through the retention of crop residues or planting of cover crops and crop rotation or intercropping – which reduces surface run-off and soil erosion while also promoting water infiltration into the soil.
- Improving soil health by maintaining vegetation cover, modifying ploughing practices (e.g. contour ploughing), construction of micro-catchments, surface mulching, land terracing, contour bunds and re-/afforestation of watersheds to increase nutrient availability and water retention while also reducing erosion and leaching.
- Adoption of mixed crop-livestock production systems – including aquaculture – that increase efficiency of resource use, spread risk from climate change impacts across different commodities, enhance food security, improve soil organic matter and water retention, diversify income streams and reduce erosion and run-off.
- Promote integrated soil fertility management involving combined use of inorganic fertilisers (e.g. industrial and mineral fertilisers) and organic fertilisers (e.g. manure and compost), adjustment of agronomic practices – such as timing and density of planting as well as weed control – and inclusion of legumes into crop rotations to improve efficiency of nutrient uptake, promote disease- and pest-resistance, enhance productivity, reduce greenhouse gas emissions and increase efficiency of water.

- AGRICULTURAL RESEARCH, EXTENSION AND OTHER SERVICES

The accelerating tempo of climatic changes as well as the speed at which new techniques and technologies are becoming available means that current adaptation approaches rapidly become outdated and less effective. Consequently, it is necessary to ensure that innovative agricultural practices are identified and their implementation encouraged. This can be achieved through research and knowledge transfer on resilient agriculture coupled with extension and dissemination services. In addition, policy and other "soft" options can encourage the uptake of resilient practices. Priority actions for this in Afghanistan include:

- Improved agricultural research capacity through training of researchers and strengthening of research institutions in government institutions as well as in academia for assessing current and future trends, generating evidence and demonstrating models for adaptation practices and identifying novel approaches to deal with challenges and opportunities.
- Increasing the availability and quality of data, information and knowledge on challenges and best practices through establishment of monitoring mechanisms (see also the sections on hydrological studies and climate monitoring systems) to better inform decision-making at the national and local levels.
- Create a mechanism for coordinating research between government, academia and other stakeholders to leverage existing expertise and capacities.
- Improve agricultural extension services to improve the availability of knowledge for farmers through the dissemination of knowledge and information from research programmes and monitoring systems as well as enhancing risk perception, understanding, acceptance and adoption of innovative adaptation practices by farmers.
- Create regional and international knowledge-sharing mechanisms to promote dissemination of climate-resilient best practices for agriculture.
- Establish weather-index, crop-index and other insurance mechanisms to provide financial support to farmers impacted by climate change and natural hazards.

There are a number of opportunities for accessing funding for climate-resilient agriculture, depending on the type and scale of the interventions. The GEF, AF and ICI have historically provided support for many community-based approaches to resilient agriculture. Larger infrastructural projects and the establishment of insurance mechanisms are better suited to the GCF, ASAP and MDBs, particularly where these can complement ongoing investments from these and other funding sources into improvement of agricultural production (of which there are many examples in Afghanistan). Technology transfer is one of the specific funding priorities of GEF's SCCF, which provides an opportunity for enabling the transfer of best practices for agricultural production.

7.4. ECOSYSTEM-BASED ADAPTATION FOR CLIMATE-RESILIENT NATURAL RESOURCE MANAGEMENT

EbA comprises a suite of interventions and approaches that integrate biodiversity conservation and ecosystem management with climate change adaptation. It has been demonstrated to provide a cost-effective approach to reducing the impacts of climate change while providing co-benefits such as biodiversity conservation and climate change mitigation.

Examples of EbA approaches that are relevant to Afghanistan include reduction of habitat loss, afforestation to stabilise slopes (which enhances soil and water conservation), promotion of agroforestry, and sustainable management and restoration of watersheds. It has similar objectives to sustainable land and forest management, with a specific focus on ensuring adaptation benefits along with environmental and socio-economic outcomes. An emerging field within EbA and DRR is ecosystem-based DRR, which focuses on the benefits that ecosystem restoration provides for the reduction of risks associated with climate-induced and other natural hazards.

In contrast to traditional approaches to addressing climate change impacts, EbA represents a "green" approach to adaptation that has been demonstrated to be cost-effective when compared to traditional "hard" (engineering and infrastructural) approaches[123]. Economic analysis and

[123]. Jones et al. 2012. Harnessing nature to help people adapt to climate change. Nature Climate Change 509-504 :2.

assessments of the costs and benefits of implementing EbA measures, "hard" measures and a hybrid approach combining both show that EbA is at least twice as cost-effective as "hard" interventions while adopting hybrid approaches reduce losses and damages by up to 25% compared to hard approaches alone[124].

EbA is particularly relevant for Afghanistan given the extent of environmental degradation in the country – which has, in turn, exacerbated the impacts of climate-induced hazards such as droughts and floods – coupled with the great proportion of the population that is reliant on natural resources and ecosystem goods and services. This approach includes restoration of the country's extensive rangelands that are currently severely degraded, re- and afforestation of forest ecosystems that have suffered extensive habitat destruction during the ongoing conflict and the expansion of Afghanistan's currently limited protected areas network. This potential for climate change adaptation through conservation of ecosystems and enhancement of ecosystem services by adopting an EbA approach in Afghanistan is well recognised, as evidenced through the identification of priorities that are examples of or relevant to EbA in the NAPA[125], ACCSAP / NAP[126], NDC[127] and TNA[128]. Priority interventions for the adoption of EbA approaches in Afghanistan include:

- Development of local watershed management plans to address climate vulnerabilities by identifying interventions tailored to communities' livelihoods and the specific hazard risks they face.
- Improving rangeland management by adopting of rotational grazing patterns, maintaining more conservative stocking rates, increasing vegetation cover, re-seeding with climate-resilient, multi-benefit species for increased fodder and forage production and implementing sustainable land management interventions for soil and water conservation such as check-dams, contour bunds, water harvesting, slope stabilisation and shelterbelts.
- Adoption of agro-silvo-pastoral systems and other land management approaches that improve the balance between agricultural production and environmental protection, promote ecosystem restoration and diversify the risks posed by natural hazards to income streams and livelihood practices (see also the section on climate-resilient agriculture).
- Promotion of alternative and diversified community livelihood options and sustainable value chains based on ecosystem goods that reduce pressure on and incentivise the conservation and sustainable management of rangeland ecosystems (e.g. cultivation of medicinal plants and value addition for timber and non-timber forest products).
- Adoption of ecosystem-based DRR approaches to watershed management such as rehabilitating and afforesting upper watershed slopes combined with terracing and construction of small-scale structures to reduce flooding and erosion.
- Establishment of community nurseries and woodlots to reduce pressure on forests by providing alternative sources of firewood and building materials as well as to provide seedlings for rangeland and forest restoration activities.
- Development of local-level forest management plans to support assisted natural regeneration through measures such as reduced collection of seeds and nuts during germination periods, protection of seedlings and saplings, supplementary planting of indigenous species, prevention of forest fires, reduced grazing pressure and reduced firewood collection.

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[124]. Rao et al. 2013. An economic analysis of ecosystem-based adaptation and engineering options for climate
[125]. Priorities: "Land and water management at the watershed level", "Improved terracing, agroforestry and agro-silvo-pastoral systems" and "Rangeland management".
[126]. Priority: "Watershed planning and implementation".
[127]. Priorities: "Improved watershed management through community-based natural resource management", "At least %10 of land area under a system of conservation areas" and "Regeneration of %40 of currently degraded forests and rangeland areas".
[128]. Priority: "Integrated water resource management", "Land use planning" and "Agro-forestry".

- Enhance and expand Afghanistan's protected areas network through the identification and gazetting of additional protected areas as well as the development, implementation, revision and updating of management plans for existing protected areas.
- Promote the uptake of alternative energy sources and efficient technologies such as solar and hydro-power, fuel-efficient cookstoves and biogas and biomass systems to reduce extraction and consumption of fuelwood from forest and rangeland ecosystems.

Funding for EbA has been well supported in the past through the GEF, AF and ICI across the world, with some examples of EbA projects in Afghanistan. In addition to GEF's LDCF and SCCF that are specifically focused on adaptation, the GEF Trust Fund can also be used to improve environmental management through biodiversity conservation and sustainable land and forest management that can provide significant adaptation co-benefits.

In addition, MDBs, IFAD and bilateral donors have previously funded work on watershed management that can be easily modified to include more prominent aspects of EbA. The cost-effectiveness of EbA can also be leveraged to integrate it into traditional development projects by climate-proofing infrastructural, irrigation and other interventions.

As the GCF also includes EbA as one of its adaptation targets, this can too be targeted for accessing climate finance for adaptation. However, it should be noted that the requirements of the GCF approval process and criteria are extremely stringent and it will thus require considerable effort to ensure the success of a GCF proposal that predominantly comprises EbA interventions.

Having said that, other countries have also successfully managed to obtain funding from the GCF to upscale EbA actions piloted through GEF and other projects. This is thus an example of a successful approach that should be followed in Afghanistan, namely to pilot EbA projects through funding from other sources that have strong monitoring and evaluation components so that the country may rigorously demonstrate the significant adaptation as well as socio-economic benefits accrue from EbA, on the back of which future funding may be sought from the GCF to upscale these projects.

7.5. URBAN RESILIENCE AND HUMAN HEALTH

Many adaptation projects have in the past primarily focused on rural communities in light of the large proportion of Afghanistan's population that lives in rural areas and are dependent on agricultural and natural resource-based livelihoods. However, considering the rate of urbanisation and the pressures that urban populations are facing from climate change impacts, it will become increasingly important in future to include a focus on climate-proofing of cities and urban populations.

Similarly, the issue of climate impacts on human health has received comparatively little attention in the past as the emphasis has been on reducing losses and damages to lives and livelihoods through prioritisation of addressing natural hazards and the impact of climate change on the agricultural sector.

However, greater levels of investment into human health will need to be made in the future to decrease vulnerability to diseases and other climate change impacts. This is relevant not only in rural areas where such diseases and health impacts have been historically present, but also increasingly in urban areas where poor living conditions and high population densities mean that diseases are likely to spread more quickly in larger towns and cities. This has been highlighted by the recent challenges posed to the public health system during the COVID-19 pandemic.

While COVID-19 does not have proven links to climate change, it has nonetheless shown how urban Afghan populations are vulnerable to rapidly-spreading diseases, a situation which may become more frequent under future climate change conditions. The expected impacts of climate change on urban resilience and human health are recognised by the ACCSAP / NAP[129].

- CLIMATE-RESILIENT URBAN DEVELOPMENT

The main impacts of climate change in urban areas of Afghanistan are, firstly, the decreasing quantity and quality of water for domestic and other consumption, and secondly, the impacts of floods and other disasters in crowded urban areas.

While these types of impacts are seen across the country, these are likely to become of increasing concern in urban areas. Afghanistan experienced the 3rd highest rate of urbanisation in South Asia from 2000 to 2010, with its urban population growing by approximately 4.5% per annum during this period[130], while the capital city of Kabul has been identified as the 5th fastest growing city in the world[131].

High levels of internal displacement caused by conflict and natural hazards contribute to this growth of urban populations, a situation which is likely to be exacerbated by increased numbers of climate refugees in future. This is compounded by poor living conditions, with more than 80% of the urban population living in slums. Many of these urban populations are reliant on groundwater extraction for meeting household needs, which is resulting in the depletion of the aquifers on which such extraction depends. Reducing the vulnerability of urban populations will thus need to receive increased focus in future. Key priorities for building urban resilience to climate change include the following:Improving the climate-resilience of urban planning frameworks by undertaking city planning based on risk and vulnerability analysis of the expected climate change impacts, with a focus on leveraging opportunities such as the lower household water demand in urban areas compared to rural populations and ensuring compact and efficient urban expansion.

- Implement land-use planning controls to identify at-risk areas (particularly for floods) and prohibit the placement of urban infrastructure in risk-prone areas including along rivers and in the proximity of perennial and seasonal wetlands.
- Increase the availability of surface- and groundwater through rainwater harvesting, managed aquifer recharge, catchment softening, urban EbA, expansion of urban green spaces and construction of water storage infrastructure as well as improving water distribution networks.
- Encourage more efficient use of water through smart water tariffs for households and industry, leak reduction programmes, maintenance of water storage and distribution infrastructure, provision of water-saving devices (e.g. low-flow faucets) and awareness-raising in urban populations and amongst industrial and other consumers.
- Improve wastewater management and stormwater drainage to reduce contamination of drinking water and incentivise the reuse and recycling of wastewater – particularly in the industrial sector – to reduce the extraction of water from existing water sources.
- Update and implement climate-smart building codes that will require new construction and renovations of existing structures to include climate-resilient features such as roof-top water-harvesting, flood protection and water-saving devices as mandatory.
- Upgrade existing public infrastructure (transport, energy, etc.) and ensure that all new such infrastructure is climate-proofed through design modifications that confer resilience to expected climate change impacts.

129. Priorities: "Infrastructure and community resilience" and "Climate change impact on human health".
130. Ellis, P. & Roberts, M. 2016. Leveraging Urbanization in South Asia: Managing Spatial Transformation for Prosperity and Livability. World Bank.
131. City Mayors. 2020. The world's fastest growing cities and urban areas from 2006 to 2020.

- **ADAPTATION FOR THE HEALTH SECTOR**

While the health impacts of climate change have historically received little attention in Afghanistan, this is likely to become more relevant with the growing impacts of climate change. In particular, the effects of temperature increase and changing precipitation patterns is likely to increase the number and prevalence of vector-borne diseases that currently have limited geographic distribution across Afghanistan owing to the low winter temperatures currently experienced across much of the country.

Furthermore, heatwaves and water stress are also likely to take their toll, particularly in the elderly and other vulnerable population groups. Malnutrition is expected to increase as a knock-on effect of food insecurity owing to lower levels of agricultural productivity. While these are existing problems across much of Afghanistan, they are likely to become more prevalent and widespread in future. This will require adaptation of current practices to avoid such impacts as far as possible, as well as strengthening of response measures to address public health concerns. Priority actions for improving human health under future climate change conditions include:

- Improve understanding of the potential impacts of climate change on human health through a nationwide impact assessment that links current and emerging human health concerns with future climate change impacts based on climatological modelling.
- Establish EWS for human health impacts of climate change to predict and monitor outbreaks of water-, food- and vector-borne diseases based on changing temperature and precipitation patterns on an annual and seasonal basis (linked to climate monitoring systems as described in the section on climate monitoring).
- Improve waste- and stormwater management to prevent contamination of drinking water and control water-borne diseases as well as those vector-borne diseases that are reliant on water sources within the life-cycle of the vector or pathogen.
- Provide training to healthcare practitioners on those diseases that are likely to increase in prevalence under future climate change conditions to enable them to undertake early identification and treatment, especially in those areas where such diseases have not previously been present and practitioners are thus less familiar with the relevant symptoms.
- Prepare for and undertake pest control and eradication campaigns targeting mosquitoes and other vectors of diseases, including taking preparatory measures for addressing novel outbreaks in areas where such vectors and diseases have not previously occurred.
- Increase public awareness of the potential for the increased prevalence of diseases in areas where they currently occur as well as sensitisation in areas where it is expected that such diseases may expand under future climate change conditions.
- Update building codes to include measures for the amelioration of heatwaves such as improved cooling systems.
- Train healthcare workers to identify the signs of malnutrition, particularly in children, and increase awareness-raising of prenatal and new mothers on possible signs of malnutrition in children for early identification and treatment under conditions of lower food security.

Building the climate resilience of urban areas has historically been a low priority in Afghanistan. However, many examples of such measures have been previously funded by most multi-lateral climate finance mechanisms including the GEF, AF and GCF. Bilateral funding for such work may also prove more readily available in future, particularly when the need for more integrated and

sustainable urban development is highlighted and the need for climate change adaptation to be mainstreamed into infrastructure projects is emphasised.

MDBs often provide large-scale funding for transport and water infrastructure projects, many of which could benefit from climate-proofing of such investments. Addressing urban vulnerability to climate change is thus likely best to be achieved through a mix of specific adaptation projects for addressing these impacts along with effective mainstreaming of climate change into existing and new projects in the sector.

As adaptation within the health sector is a comparatively novel field in climate change (as compared to the body of work focusing on disasters and agriculture, particularly in Afghanistan), this will necessitate innovative approaches to the development of projects and programmes. Comparatively few projects exist that have a focus on human health, and this may create challenges in accessing funding. It is thus unlikely that standalone projects for adaptation in the health sector will be able to be realised in the near future.

Consequently, sensitisation of donors and other stakeholders will be required with a view to ensuring that climate change is integrated into the design of new and existing projects that focus on human health. While funding for this may become more available from sources such as the GCF in the future, it is likely to be more effective if ongoing efforts for improvement of healthcare were expanded by ensuring the mainstreaming of climate change adaptation into such interventions.

8. WAY FORWARD

To support the planning and implementation of actions to address Afghanistan's priorities for climate change adaptation, a number of measures will need to be taken.

8.1. MATCHING OF FUNDING MECHANISMS TO PRIORITIES

The GCF is widely seen as being the premier funding mechanism for action on climate change in the future. However, the stringent approval process for GCF projects means that it should not be seen as a panacea and the sole source of funding for climate change adaptation moving forward.

Indeed, the likelihood of successfully securing GCF finance will be improved if other funding sources are leveraged to support preparatory work and as sources of tangible co-financing. Moreover, the preparation of GCF proposals typically take long periods of up to two years from project conceptualisation until funding is released. This means that there may be long delays in securing funding from the GCF for urgent action on climate change. Blending GCF with other funding mechanisms presents an opportunity to undertake action sooner.

The preparation of a GCF roadmap for Afghanistan means that a lot of the groundwork has been done in terms of identifying some adaptation programmes and projects. However, these concepts can also be developed into proposals for other funding sources to act as bridging funding until a GCF proposal is approved, to develop pilot and demonstration projects for upscaling from GCF or to act as complementary or co-financing initiatives for a new or proposed GCF project. Therefore, a more balanced view needs to be taken of where funding can be obtained until such time as the country is in a position to easily and readily obtain GCF funds.

In general, large-scale funding such as that obtained through the GCF and MDBs is more suited to infrastructural projects and those that are large in scale and national in scope. This is largely because such projects are more easily demonstrated as having favourable cost-benefit ratios, internal rates of return and other economic benefits that such funding entities view as being central to their criteria for awarding of climate finance. The types of projects that are suitable for this include a national climate change EWS, climate-proofing of infrastructure, large-scale irrigation infrastructure and construction of water storage and distribution networks.

Smaller and local-level actions as well as non-infrastructural measures are better suited to other multilateral funding mechanisms as well as more specialised donors with a particular focus on a sector. For example, EbA measures are more likely to be funded by mechanisms such as GEF, AF and IKI than through the GCF or MDBs. Similarly, more focused funding for some DRR and community-based measures is likely to be obtained through specialised funding mechanisms and from humanitarian actors where local-level benefits can be demonstrated and where information such as cost-benefit analyses are not readily available. Focused funding for agricultural interventions at various scales can also be obtained through IFAD and other institutions specialised in the field of agriculture.

Besides the GCF roadmap, a national portfolio of projects and programmes should be formulated that highlights immediate and future opportunities for leveraging financial support for adaptation. This should be based on country assessments and sector-specific strategies and plans, something in which MDBs such as the World Bank and ADB have particular expertise. This expertise should be called on to lay the groundwork for successful development of funding proposals by formulating a coherent national strategy on climate action, particularly with a view to the implementation of Afghanistan's priorities outlined in its NDC.

Having clear strategies of which priorities to address first and where to obtain support for these priorities will result in a more coordinated and coherent approach to funding mechanisms that is likely to lead to greater success in securing climate finance. A country programme for climate action would also allow for better blending of finance from various sources to address

climate change impacts in a harmonised approach, for example, to secure co-financing and for upscaling projects where funding from one source is insufficient to address the extent of the specific challenge.

8.2. OBTAINING ACCREDITATION FOR NATIONAL IMPLEMENTING ENTITIES

The GCF and other multilateral climate funds require the accreditation of implementing entities for obtaining direct access to climate finance. However, the requirements for such accreditation are usually extremely rigorous. To date, most access to climate finance from multilateral sources has thus been through international implementing entities. While this ensures that considerable support is available for development and implementation of climate change programmes and projects, the processes are often slower than working with national implementing entities. Afghanistan should thus seek to identify and support the accreditation of a national entity for project implementation.

Organisations that are eligible for accreditation can be private, public or non-governmental entities. Regardless of the nature of the organisation, it should be able to demonstrate that it has specialised capacity for engaging in climate change action. This should include having detailed, actionable programmes or projects that can be submitted to funding sources, preferably with a track record of having delivered such programmes or projects in the past. They will also have to meet the relevant mechanisms' financial and fiduciary standards as well as having clear policies on other key issues such as ethics, environmental and social safeguards, and gender equity.

Initial steps have been taken in Afghanistan to identify potential national entities for accreditation with inter alia the GCF. This should be followed up with self-assessments performed by each organisation in line with the requirements of the specific funding mechanisms that are targeted for accreditation. In the cases where such self-assessments indicate that organisations meet the criteria and requirements for accreditation, they may go ahead with the next steps in the respective accreditation processes.

However, in all likelihood, self-assessments performed by potential accredited entities in Afghanistan will identify gaps in terms of capacities and policies that will need to be bridged before accreditation can be achieved. Such organisations should then work closely with the Afghan government and other development partners to strengthen their capacities and put the requisite systems in place for meeting the necessary criteria. This would be best achieved through the inclusion of capacity strengthening within ongoing and new initiatives on climate change. For example, accreditation of a national organisation could be included as an outcome of a smaller project on climate change adaptation, in anticipation of then being able to use this entity for directly applying for future such projects once it has been accredited.

8.3. CAPACITY STRENGTHENING OF NATIONAL INSTITUTIONS

In the long term, strengthening the capacity of national institutions such as line ministries will be needed to facilitate successful funding applications, whether for direct access or access through international implementing entities. Institutional capacity strengthening – particularly within NEPA in its capacity as the focal point for multilateral funding mechanisms – would facilitate improved streamlining of engagement with such mechanisms, improving the likelihood of success of applications submitted.

Improved cross-ministerial coordination would also support greater agreement on the priorities for climate action across relevant sectors in a variety of sectors. This would put the line ministries in the position of being more informed so they that are better able to articulate national priorities when engaging with donors, ultimately improving engagement with funding mechanisms and thereby also the quality of the proposals submitted to such mechanisms.

Work on strengthening of technical capacities will also ultimately increase the quality of funding proposals and thereby the likelihood of successful awards being made. Detailed briefings and sensitisation for high-level policy- and decision-makers on climate change should be provided, in particular highlighting the relationships between climate change and other issues of national priority such as sustainable growth and development, conflict and peace-building, and poverty alleviation. This would enable policy-makers to position climate change as an issue of national importance within policies, strategies and plans, with the goal of successfully mainstreaming climate action into all ongoing and future programmes and projects in relevant sectors.

Similar sensitisation of donors should take place, both in-country for bilateral donors and other sources of official development assistance as well as at the international level. This would ensure that donors recognise the importance of climate change for the achievement of social and economic development goals and increase the likelihood of additional funding being provided for climate action through the large number of donor-supported projects and programmes that are active in Afghanistan.

Targeted training should be provided for technical personnel within government ministries and agencies on how to access climate finance, particularly through multilateral funding mechanisms such as the GEF, AF and GCF. While government personnel currently have experience in accessing various forms of funding for development and humanitarian action, the formulation of proposals for climate action requires specialised language to ensure that challenges and solutions are explicitly framed as climate change challenges and solutions and that they are clearly distinguished from business-as-usual activities. This is because multilateral funding mechanisms in particular require the clear demonstration of action as being additional to that required to address baseline socio-economic and development issues.

Training should thus cover aspects central to the preparation of funding proposals such as business-as-usual and adaptation alternative scenarios, demonstration of additionality, formulation of results frameworks, development of operations and maintenance plans, and meeting of donors' criteria and priorities.

Besides the provision of technical training to government personnel, they should be actively engaged in the formulation of new proposals with the view to building their capacity through a learning-by-doing approach so that they are in future able to lead the preparation of proposals, particularly at such time as a national implementing entity is accredited.

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