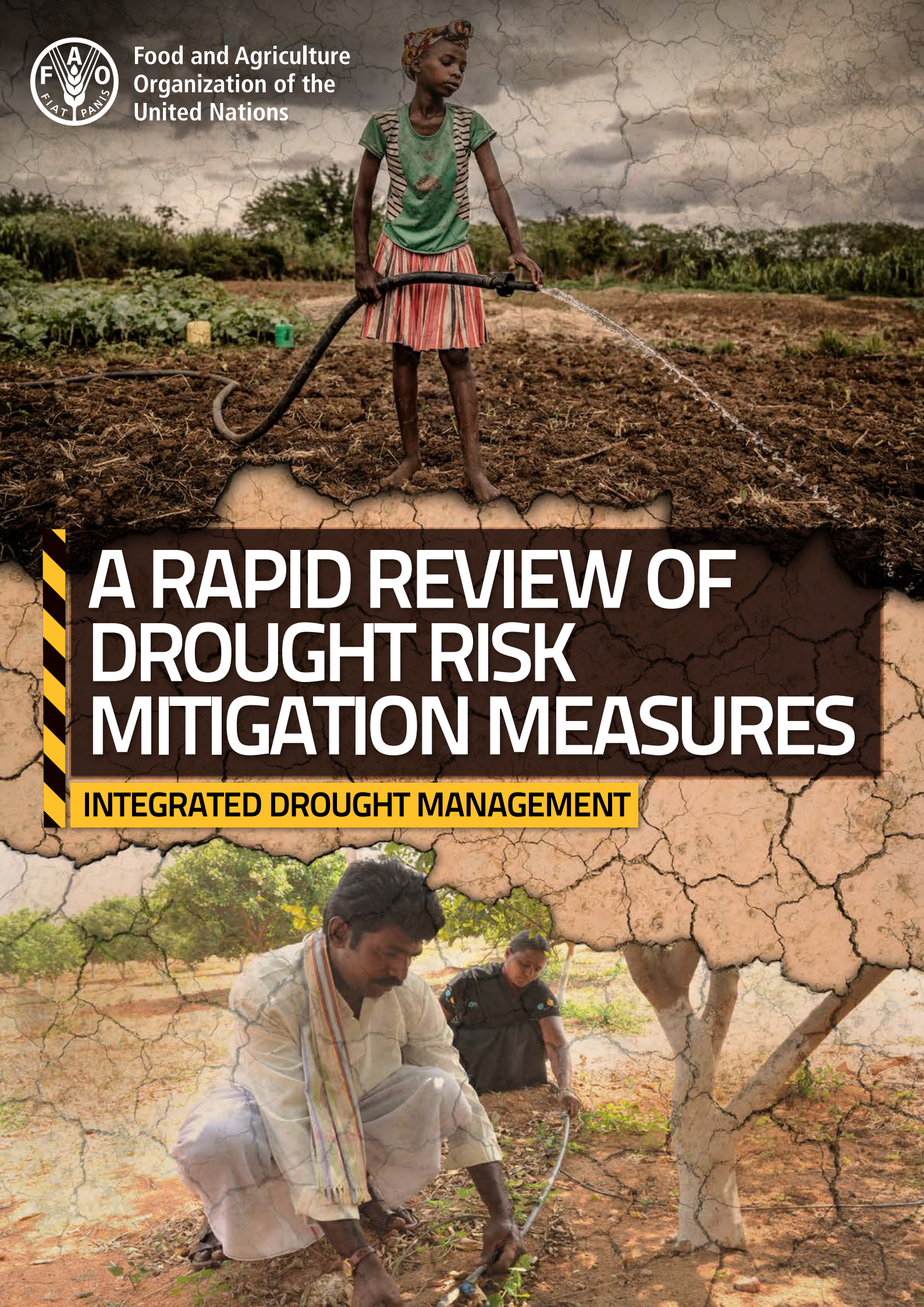

Food and Agriculture Organization of the United Nations

A RAPID REVIEW OF DROUGHT RISK MITIGATION MEASURES

INTEGRATED DROUGHT MANAGEMENT

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INTEGRATED DROUGHT MANAGEMENT

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Overall direction and coordination were provided by Maher Salman, FAO and Daniel Tsegai, UNCCD.

Abbreviations and acronyms

ACT	African Conservation Tillage Network
ADPC	Asian Disaster Preparedness Center
CACILM	Central Asian Initiative for Land Management
CCF	Community Contingency Funds
CoP	Conference of the Parties (to a Convention)
CST	Committee on Science and Technology
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CRED	Centre for Research on the Epidemiology of Disasters
DRR	Disaster Risk Reduction (DRR) (see also UN DRR and GFDRR)
EDgE	End to End Demonstrator for improved Decision-making in the water sector in Europe
EM-DAT	Emergency Events Database at the Centre for Research on the Epidemiology of Disasters (CRED)
ECMWF	European Centre for Medium-range Weather Forecasts
EC	European Commission
FAO	Food and Agriculture Organization of the UN
FBF	Forecast-based financing
GEF	Global Environment Facility
GEF STAP	GEF Scientific and Technical Advisory Panel
GF DRR	Global Facility for Disaster Risk Response
GMES	Global Monitoring for Environment and Security
GRADE	Global Rapid Post-Disaster Damage Estimation
GCF	Green Climate Fund (see also IEU GCF)
GWP	Global Water Partnership
HSNP	Hunger Safetynets programme
ICPAC	Climate Prediction and Applications Centre of IGAD
ICT	Information and Communications Technologies
IEG	Independent Evaluation Group of the World Bank
IGAD	Intergovernmental Authority on Development
IGAD IDRISI	IGAD Drought Disaster Resilience and Sustainability Initiative
IDMP	Integrated Drought Management Programme
IDM	Integrated Drought Management

IEU GCF	Independent Evaluation Unit (for the Green Climate Fund
IFAD	International Fund for Agricultural Development
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
IWG	Intergovernmental Working Group on Drought
LDFA	Land Degradation Focal Area
LDC	Least Developed Countries
LDCF	Least Developed Countries Fund of GEF
NDMA	National Drought Management Authority
NDMC	National Drought Management Centre (e.g. in the US or Iran)
OSS	The Sahara and Sahel Observatory
PES	Payments for Ecosystem Services
PDNA	Post Disaster Needs Assessment
PSNP	Productive Safetynets Programme
PAs	Protected Areas
RAPTA	Resilience, Adaptation Pathways and Transformation Assessment
RCMRD	Regional Centre for Mapping of Resources for Development
RESET II	European Resilience Building and Creation of Economic Opportunities in Ethiopia (RESET II)
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SFERA	Special Fund for Emergency and Rehabilitation Activities
SFM	Sustainable Forest Management
SHARP	Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists tool
SLM	Sustainable Land Management
SPI	Science Policy Interface (UNCCD)
UNCCD	United Nations Convention to Combat Desertification
UN DRR	United Nations Disaster Risk Reduction
UN FAO	United Nations Food and Agriculture Organization
UNFCCC	The United Nations Framework Convention on Climate Change
UNW-DPC	United Nations -Water Decade Programme on Capacity Development
WMO	World Meteorological Organization
WOTR	Watershed Organization Trust

Executive summary

Droughts need not always cause humanitarian and economic disasters. Their effects on vulnerable communities and ecosystems can be mitigated by human institutions and actions. Preparedness for drought risks and mitigation of them can involve a range of different sectors and strategic entry-points from water conservation and natural resource management to multi-hazard approaches, public education and conflict resolution.

In light of the wealth of mitigation measures available, this knowledge product offers an overview of current and best practices. It has been developed in partnership with the Integrated Drought Management Programme (IDMP) and in consultation with its many partners. Mitigation of drought risk and impacts is an essential element of Integrated Drought Management (IDM).

This knowledge product is conceived as the second in a three-part series reflecting the established three pillars of IDM: (I) effective drought monitoring and early warning systems; (II) vulnerability and impact assessment; and (III) drought preparedness, mitigation and response. It builds on a previous IDMP publication that reviewed practices and policy recommendations for drought impact and vulnerability assessment. The following three types of measures for managing drought risks are explored:

- prevention, mitigation and preparedness;
- response and recovery; and
- transformation.

Methods used to generate insights draw on practitioners' experiences and documentation from planning, implementation and evaluation of these measures, including evaluation and knowledge materials generated by the Global Environment Facility (GEF), Green Climate Fund (GCF) and their respective independent offices of evaluation. A series of case studies focusing on different drought-affected parts of the world ensures regionally balanced insights. An expert review panel has guided the preparation of the review.

The body of knowledge presented confirms the availability of a wide range of available options to mitigate, prepare and respond to drought risks. Different options have been tested and are under implementation in different contexts. In each case, there is a need for decision-makers to experiment and adapt until they find the solutions that work best with stakeholders' needs and context. Societies' abilities to transform drought risks and move beyond mitigation strategies depend on how they are able to learn from adaptation experiences.

Qualitative lessons have been learned due to improved forward planning and growing attention to institution-building as well as economic and social aspects of drought risk over the recent decades. Quantitative evidence of the effects of risk mitigation actions in terms of changes in resource conditions on the ground is still weak. In the regions most vulnerable to drought, the hydrological imbalances that adversely affect land resource production systems, livelihoods and economies are still not fully monitored and assessed. As a result, it is still difficult to evaluate fully the extent to which national drought risk mitigation programmes have worked (or not), how well, and how this affects economies and human decision-making at different scales.

Recommendations focus on engaging capacities at local, national, regional and global levels. Significant improvements in cross-scale information flows, as well as sharing of knowledge across sectors and between the global funds, convention processes and stakeholders addressing drought risks at different levels could be achieved. To fill current gaps, much better use could now be made of the available tools, technologies, databases and local knowledge so that these could inform global knowledge and actions.

1.Introduction

Drought emergencies are declared when hydrological imbalances threaten the survival of communities and ecosystems. They can have multiple dimensions, causes, interactions, effects and feedbacks (meteorological, hydrological, agricultural, environmental, social and economic) (Figure 1). These exacerbate a complex range of other hazards and effects. The crisis level is reached when the society and state cannot cope and function as normal. In developed and developing countries, droughts and heatwaves can interact with social conflicts, demonstrations or riots, as well as wildfires, disease-and health-risks of various kinds and other effects on ecosystems and economies (UNCCD 2020b, FAO 2019b). The associated feedbacks are not always predictable. However, in the least developed and most drought-prone regions, concurrent threats such as water stress, disease, floods, fires and climate change cause droughts to result in humanitarian disasters – even when these are relatively predictable and preventable. As the world is increasingly interconnected, threats hatching in the areas and sections of society that are most vulnerable can mutate and spread quickly.

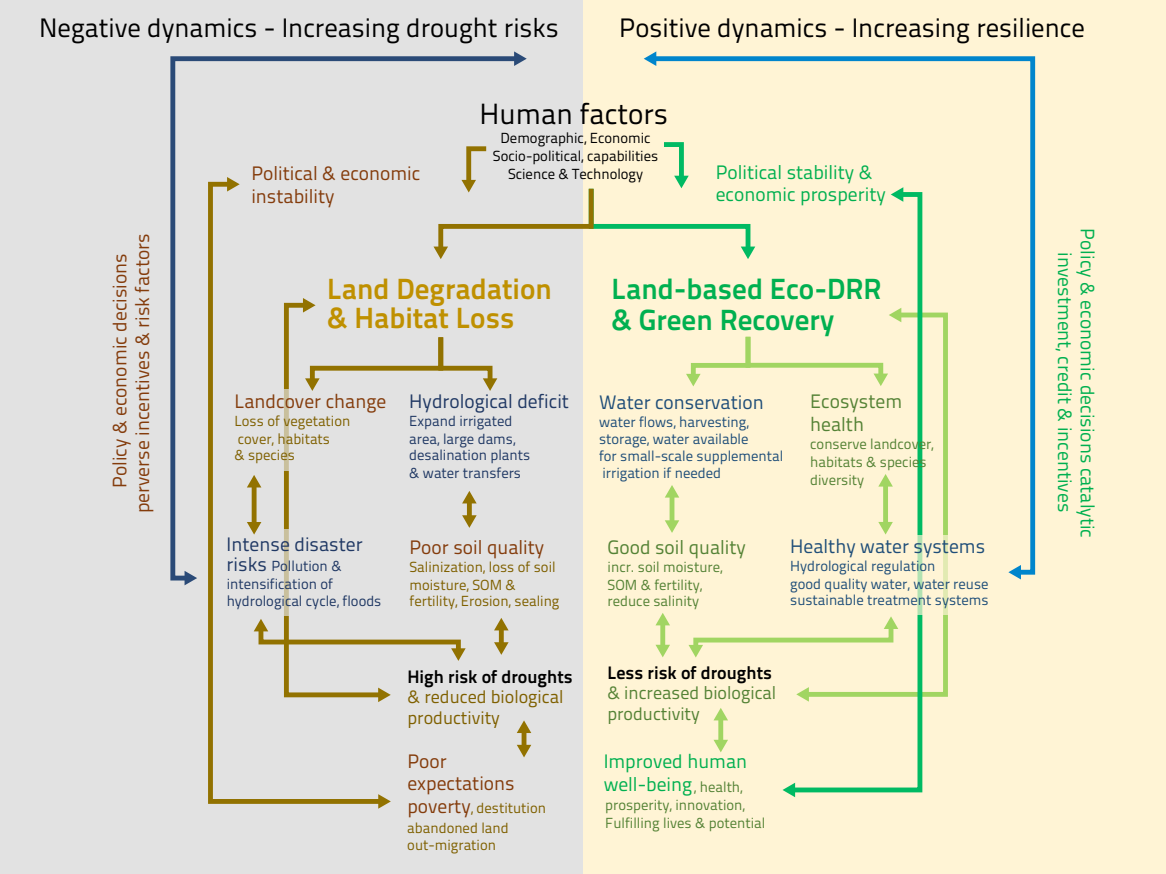
As yet, preventable drought effects in some of the least developed and most drought-prone regions of the world are still not routinely prevented. Rather more often, they are compounded by and permitted to ferment with other societal problems such as civil unrest, terrorism, insecurity and public health crises – all of which can feed vicious cycles of rural poverty and global insecurity (GEF/IEO, 2018, p. xi). Understanding of the negative effects of these on people and economies in other parts of the world is still only partial. However, droughts are recognized to account for a major share of risks to the global economy identified in the 2020 and 2021 global risks maps (natural disasters, human-environmental disasters, and extreme weather) (WEF 2020, 2021). In the worst-affected areas, children not miscarried during extreme droughts may suffer stunted growth, compromised health and immune systems, and reduced overall life-expectancies (Cervigni and Morris, 2016; Damania *et al.*, 2017). Globally, society is aware of this and the range of other risks and effects of droughts.

This knowledge product includes consideration of the drought challenge as an essential aspect of global drought risk mitigation, preparedness and response. It is intended as a contribution to the global discussion of the drought mitigation challenge that is ongoing amongst policymakers and practitioners working across a range of levels, including the global level. Droughts' effects on

vulnerable communities and ecosystems can be mitigated through human institutions and actions. Mitigation of drought impacts are essential elements of Integrated Drought Management (IDM) to assist countries in developing national drought management policies. IDM approaches drought mitigation, preparedness and response as the third of three carefully aligned pillars (WMO and GWP, 2021 – forthcoming; Pischke and Stefanski, 2018; Tsegai, Liebe and Ardakanian, 2015).[1] The two parallel pillars consist of: (I) Monitoring and early warning systems; and (II) Vulnerability and impact assessment.

Drought risk and impact mitigation measures can involve many different sectors that are affected by drought (e.g. agricultural, municipal, water, health, food security, energy, transportation, tourism/recreation, industry, forest/rangeland, fires, education, environment, ecosystem services/ biodiversity), and strategic entry-points from water conservation to public education and conflict resolution. Despite the wealth of mitigation measures available, there is currently no fully comprehensive overview of current and best practices. The purpose of this knowledge product is to rapidly provide this review, including insight and perspectives from the work of a range of different agencies and parts of the world. It is not to advocate any single solution to fit all contexts.

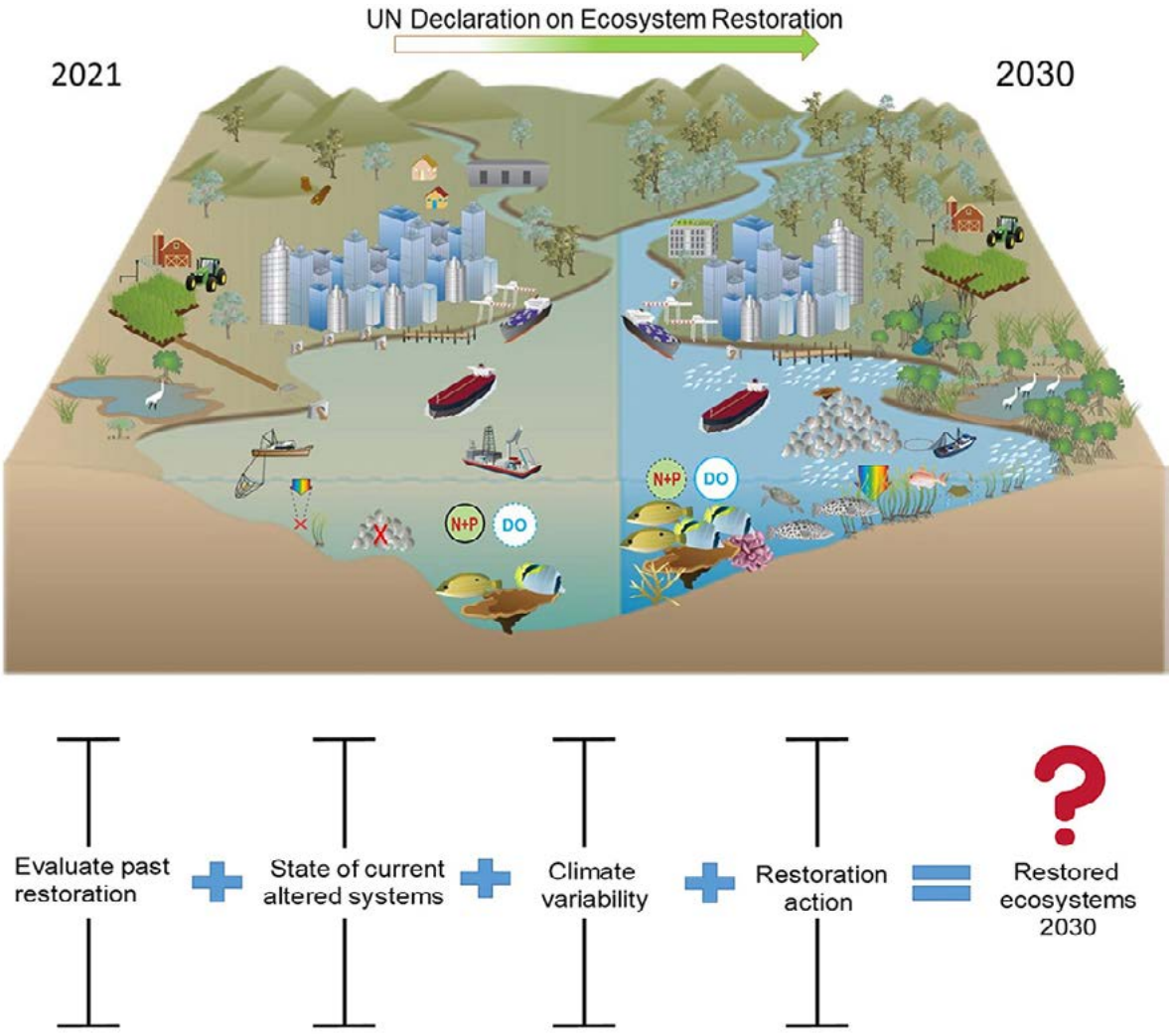
Figure 1: Schematic view of drought risk vs drought risk mitigation



Source: Updated from Adeel et al. 2005, Van Loon et al., 2016.

[1] These three pillars were established by the IDMP High-Level Meeting on National Drought Policy (HMNDP) held in Geneva in March 2013.

Figure 2: Current state of impacted coastal ecosystems and expected state after restoration



Source: Waltham, N. J. et al., 2020.

The remainder of this introductory section provides a brief conceptual orientation, some context on integrated drought management, and a description of the approach taken to develop this knowledge product, including its three-part structure. Building on the IDMP approach and definitions of drought mitigation, and the findings of previous work on strategic approaches to drought risk management (e.g. WWF-GIWP-UNESCO, 2016; FAO 2019b), the following three types of measures (including their planning, implementation and evaluation) are described in Sections 2 to 4:

- drought impact prevention, mitigation and preparedness (adaptation measures);
- response and recovery; and
- transformation.

A brief explanation of the relevance of these three dimensions is provided in the following Section (1.1). A discussion in Section 5 briefly reviews what we currently know and don't know about whether or not drought risk and impact mitigation actions are working. This highlights the continuing agenda and capacities for evaluation, monitoring and knowledge systems.

Conclusions and recommendations reflect forward to next steps for international cooperation to strengthen all three of the IDM pillars so that the success and the lessons to be learned from drought risk mitigation can be better monitored, assessed and outcomes improved.

1.1 What do we mean by drought impact and risk mitigation, preparedness and response?

Droughts affect natural and human systems (IPCC, 2014), both negatively (e.g., economic losses) and positively (e.g. economic gains) (UNISDR, 2017). Negative effects (see examples in case studies 1 and 2) can destroy lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure. These create needs for action to secure economies (at both macro and micro scales) and human development including medium and long term effects on the quality of human life (EU/WB/UN, 2014). The UN Disaster Risk Reduction (DRR) community is continuing to widen their view and understanding of the complexity of risks of disasters in general (UNDRR 2019a), and of droughts in particular. These give special recognition to drought as a phenomenon that interacts with a complex range of other hazards.

Drought risks affecting human populations and the ecosystems where they live can be exacerbated by changing climatic or anthropogenic stresses (Figure 1). A proactive approach to drought involves managing all of these risks so that the worst impacts can be avoided. It is notable that the climate change community reserves the use of the term "mitigation" to refer to the reduction of greenhouse gas emissions. These cause climate change, which can exacerbate the meteorological aspects of drought. The disaster management community continues to advocate mitigation of drought and other disaster risks through a broader range of measures (UN, 2016). In both cases, the term "mitigation" is used in recognition of the fact that some adverse impacts may not be fully preventable, even though the scale and severity of losses and damage can be lessened.

Mitigation can be understood as a more positive alternative than threatened litigation to punish negligent parties for inaction to prevent loss and damage due to climate change. But it still has rather hollow-sounding legal overtones, and still advocates only incremental change to alleviate rather than systematically reverse or remove the problem. This does not take into consideration the possibility that society could overcome or transform drought risks. On the other hand, amongst the climate change community (Diemen *et al*., 2019; GCA, 2019), a transition through drought risk mitigation to adaptation and transformation is considered possible. This is anticipated to emerge from deep social learning processes. It offers an alternative to the point of view expressed by some commentators that many of the programmes for adapting to climate change so far have been too incremental to make any real difference (Kates, Travis and Wilbanks, 2012).

It is challenging but essential for the international community to initiate transformative learning processes. This involves evaluating the extent to which the necessary transformation of drought risks is happening or not. The intention is then to be able to help better toward achieving the intended transformation (see further discussion in Sections 4 and 5).

Case Study 1: Mitigating drought risks in the Sahel
(see more detail in case studies section)

It is difficult to evaluate fully and objectively the extent to which national drought risk mitigation programmes across the Sahel are working (or not), what additional volume and duration of rainfall deficit communities and ecosystems are able to withstand as a result of their cooperative actions, how the benefits feed into the regional economies, and to what extent this could be expected to accelerate the achievement of regional and global peace, security and development objectives. Quantitative evidence of the effects of risk mitigation actions in terms of changes in resource conditions on the ground is still difficult to compile and analyze.

Some effects from land-users' investments in soil and water conservation and soil protection are visible to them and to the wider community in terms of increased greening and crop production (CILSS, 2016). The additional positive effects that these have on the critical stream-flows and hydrological balances in the system that can buffer drought risks for society as a whole are still not fully monitored, assessed[1] and regulated. Nonetheless, they determine the health, income and well-being of vulnerable individuals, households' communities, ecosystems and the regional economy. The challenge involves aspects that are as much political and institutional as technical and technological.

Different drought mitigation options have been tested and are under implementation across the Sahel. Achievements in mitigating drought risks through co-developing landscape management, including through the collective transboundary management of transhumant grazing systems, conservation of rangelands and forests, and community-level soil and water conservation actions, agroforestry and irrigation improvements are still under-recognized, obscured and held back by ongoing conflicts and security risks. Public expenditures and initiatives to engage communities, including private individuals, in these forms of peaceful cooperation, co-development and collective drought risk reduction are still dwarfed by military expenditures to contain ongoing security threats.

Rather than further escalating militarization in the Sahel, a stronger case could be made for increased investment in building peaceful productive systems and economies with the resources and capabilities to resolve their own conflicts and build their own cooperation to mitigate the effects of ongoing risks such as drought (see selected national policies in Table 8 and the Great Green Wall across the Sahara in Case Study 11). Having made the case for investment, monitoring systems provided by AGHRHYMET, as a specialized regional institution of the Permanent Interstates Committee for Drought Control in the Sahel (CILSS), play an important role in tracking progress in implementation and providing evidence of success on the ground in terms of positive effects achieved in communities and ecosystems.

Insight provided by: Issa Garba, CILSS

[1] http://agrhymet.cilss.int/index.php/bulletins/

1.2 Drought impact and risk mitigation measures as a pillar in the Integrated Drought Management framework

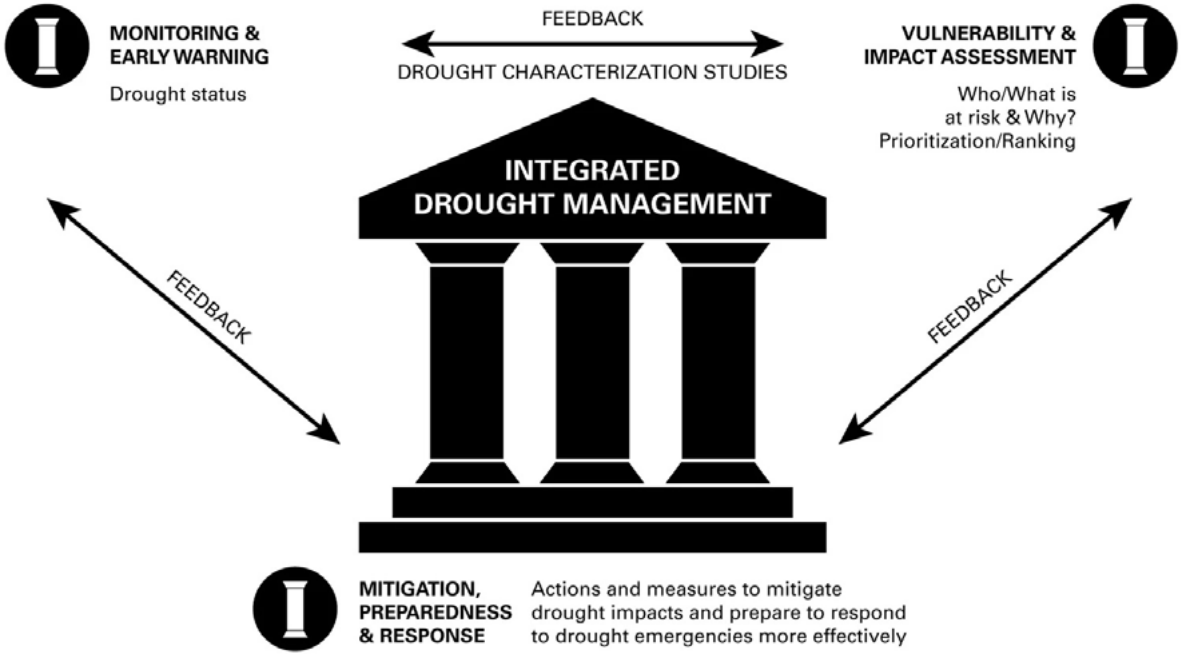
Mitigation, preparedness and response is approached as one of three pillars[2] (WMO and GWP, 2021 – forthcoming; Pischke and Stefanski, 2018; Tsegai *et al.*, 2015) within the overall IDM framework (Figure 3). The two parallel supporting pillars consist of: (I) Monitoring and early warning systems; and (II) Vulnerability and impact assessment.[3] This reflects the idea that drought risk mitigation should ideally be informed by assessments of the nature and extent of drought

[2] These three pillars were developed by the Integrated Drought Management Programme (IDMP), which was established as a result of the High-Level Meeting on National Drought Policy (HMNDP) held in Geneva in March 2013 (WMO, 2013).

[3] For more information see: www.droughtmanagement.info/pillars/

impacts and vulnerability so that the mitigation measures can be effectively targeted to reduce them. Also, drought risk mitigation should be integrated with systems for monitoring drought hazards, exposure and vulnerability so that decision-makers and communities can effectively contextualize and track the achievements of the mitigation measures that are implemented. ome initial mapping of global drought risks has been attempted (Figure 4).

Figure 3: The three pillars of integrated drought management

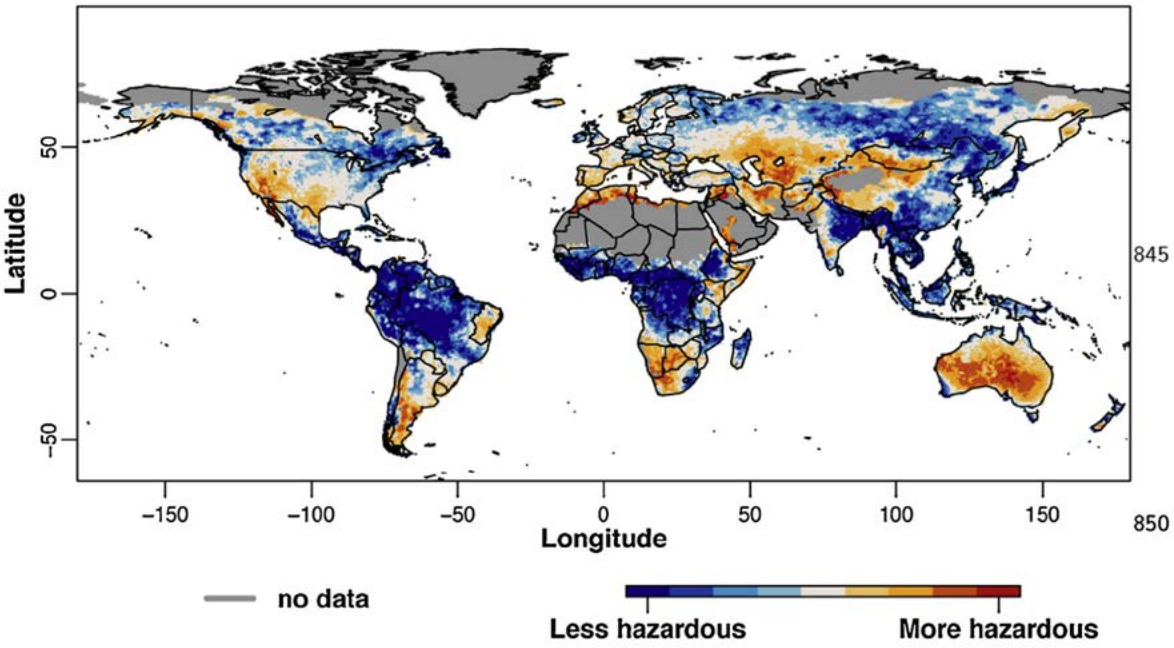


Source: Pischke and Stefanski 2018.

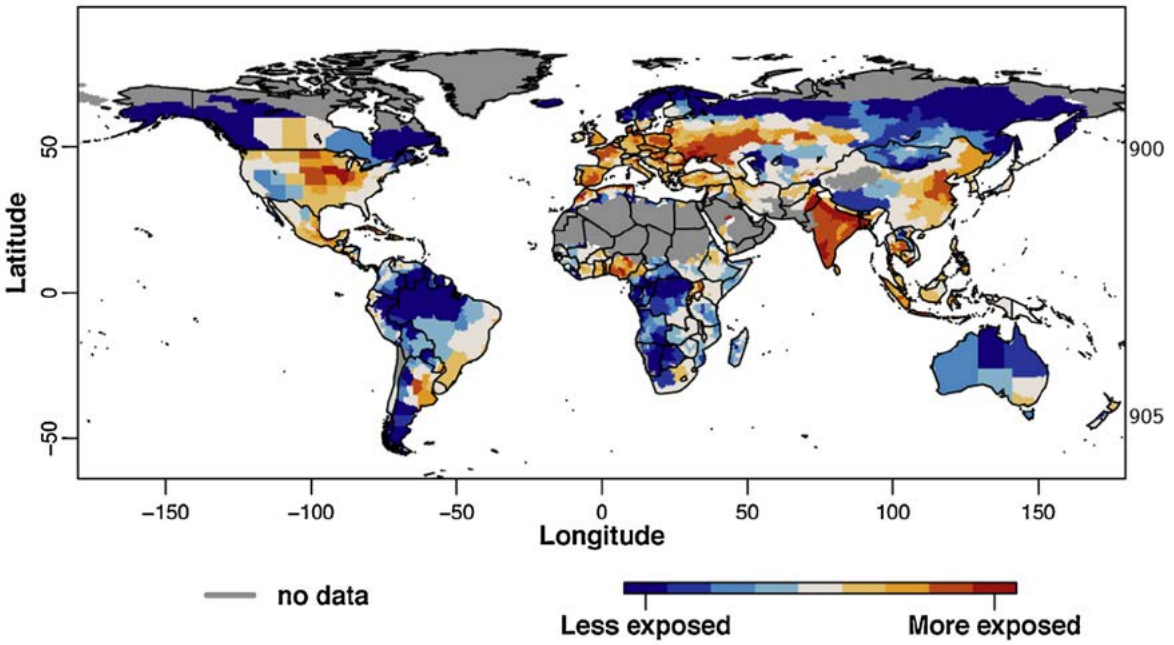
The three key pillars of IDM follow the principles of the Sendai Disaster Risk Reduction framework (UNISDR, 2015). They have been popularized through a series of regional drought management policy capacity-building workshops that took place in Eastern Europe, Latin America and the Caribbean, Asia-Pacific and Africa during the UN-Water Decade Programme on Capacity Development (UNW-DPC) from 2013–2015 (UNCCD, 2019). The three pillars provide a common framework for capacity building to support the development of national drought policy and management plans.[4]

[4] For more information see: https://knowledge.unccd.int/drought-toolbox

Figure 4: Global maps of meteorological drought hazard and exposure to drought risk



Notes: Based on the weighted anomaly of standardized precipitation (WASP) index.
Source: Carrão, Naumann and Barbosa 2016.



Notes: Based non-parametric and non-compensatory Data Envelopment Analysis (DEA) combining agricultural land uses, gridded human and livestock populations and baseline water stress.

Case Study 2: Systemic institutionalized hydrological management challenge (see more detail in case studies section)

According to a recent global mapping of drought risk (Carrão *et al.* 2016), India is one of the countries most consistently at risk. This is due to the high levels of exposure of the population and ecosystems, which is mapped in terms of human and livestock population density, agricultural lands and baseline water stress (Figure 4).

Weaknesses in the institutional capacity for drought and flood management in state water resources departments were identified by the Indian National Hydrology Project (phase III). Some states (e.g. in southern India and in Himachal Pradesh and Punjab) had capabilities for river basin planning and management, but these were not evenly distributed amongst all states and there was generally little human resource capability for integrated management approaches.[1] Many States were also facing significant groundwater management challenges that were anticipated to increase further with growing water demand and climate change. The knowledge base and drought management capability was not adequate to provide early warnings on drought or to plan for appropriate management responses (WB, 2017). In the short term, these issues were manifesting as frequent and poorly informed drought alerts.

A Drought Management Plan (DMP) (GoI, 2017) helps in delineating roles and responsibilities of different Ministries/ Departments of the Government of India involved in drought management for mitigation, preparedness and for relief measures. The key focus is to ensure better preparation and timely communication among stakeholders, to help reduce the time taken in mobilizing resources for an effective response and enable a harmonious relationship among stakeholders, these are critical in managing a drought.

Institutional Arrangements

The Department for Agriculture, Cooperation and Farmers Welfare (DACFW) is responsible for monitoring and coordinating the central government response to drought. A Crisis Management Group functions under the Chairmanship of the Central Drought Relief Commissioner with representatives of associated ministries and organizations. The Crisis Management Group meets from time to time to review the drought situation in the country and progress of relief measures.

At the state level, the Department of Disaster Management and Relief, headed by a Secretary or Relief Commissioner is responsible for directing drought operations in the State. At the district level, Collector implements all decisions related to drought management through a number of line departments and field agencies. At the subdistrict level, Panchayati Raj institutions (PRIs) are involved in the implementation of drought management programmes. A National Agricultural Drought Assessment and Monitoring System (NADAMS), provides near realtime information on prevalence, severity level and persistence of agricultural drought at state/district/sub-district level. It covers 14 states of India, which are predominantly agriculture based and prone to drought.

Insight provided by: Rajendra Prasad Pandey, National Institute for Hydrology (NIH), India.

[1] For a review of disaster management plans available in six Indian states as of 2016 see: https://www.preventionweb.net/publications/view/49489 and Gujurat State level plan including drought vulnerability assessment at http://www.gsdma.org/Content/state-level-disaster-management-plan-4160

1.3 Approach to the development of this knowledge product

This knowledge product is based on a combination of document review and practitioners' insight. The intention is that it should shed light on drought mitigation experiences particularly in the parts of the world where drought risks are most persistent and devastating. In light of this, a concerted effort has been made to draw on experiences and perspectives from programmes and practitioners in those areas, presenting these to the intended wider global readership. A regionally balanced series of case studies is introduced and referenced.

The intention is to produce a light practical reflection -rather than an academic read. This approach is similar to the one pursued for a previous knowledge product on Vulnerability and Impact Assessment (King-Okumu, 2019a). A number of case studies that were explored during the preparation of that publication are pursued further in this one. Conversations with practitioners interviewed previously have been revisited. In addition, the pool of case studies has been expanded and additional practitioners requested to provide advice. Two side events organized in New Delhi on the sidelines of the fourteenth Conference of the Parties (CoP 14) for the United Nations Convention to Combat Desertification (UNCCD) with support from IDMP, UK Centre for Ecology and Hydrology (UKCEH), International Water Management Institute (IWMI), Asian Disaster Preparedness Center (ADPC) and other partners provided additional insights from relevant practitioners and policymakers from a range of countries.

In addition to the national practitioner group, a panel of twelve global experts was requested to send feedback on conceptual aspects and issues. Two virtual meetings were convened for the group by IDMP in November 2020 to guide the preparation of the case studies and in December 2020 to review the draft report. Experts also provided additional inputs via email, phone and Zoom calls.

The growing wealth of available documented experience in drought risk mitigation includes in particular:

- The IDMP online drought management library.[5]
- The UNCCD online Drought Toolbox, which includes information on the status of national drought plans and available tools to address the three pillars of IDM.[6]
- The FAO Drought Portal. FAO has created an online drought portal, through which it shares information concerning its work with countries on drought risk mitigation (Annex 8).[7]
- Alongside national drought plans, a range of other plans and policies in use in different countries address drought risk mitigation. These include nationally determined contributions for addressing climate change,[8] land degradation and desertification and biodiversity, as well as the voluntary national reviews of progress toward the relevant Sustainable Development Goals (SDGs).[9]

5 https://www.droughtmanagement.info/find/library/

6 https://knowledge.unccd.int/drought-toolbox

7 http://www.fao.org/land-water/water/drought/drought-portal/en/

8 https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx

9 https://sustainabledevelopment.un.org/vnrs/

- The reports of the Intergovernmental Panel on Climate Change (IPCC) provide useful conceptual background information and definitions, as well as thinking about the evolving nature of drought hazards, exposure, vulnerability and available options for mitigation and transformation of the climate change-related aspects of drought.[10]
- The United Nations Framework Convention on Climate Change (UNFCCC) provides an online portal presenting information about climate change adaptation planning, including a page[11] where developing countries are invited to share their plans and a summary report has been published.
- Information on the mobilization and use of climate finance to support developing countries in the implementation of adaptation and mitigation projects and other activities under the UNFCCC is available on their website.[12] This includes adaptation projects funded by the GCF and Adaptation Fund to address drought and other climate risks, but is not fully updated (see the funds own websites – listed below).[13]
- The Warsaw International Mechanism (WIM) on Loss and Damage has produced a Technical Paper addressing loss and damage associated with climate extremes and slow onset events.[14] WIM has also created a Technical Expert Group on Comprehensive Risk Management and published a general Compendium of approaches to Climate Risk Management (including a number that relate to drought risk).
- Numerous Global Funds, including international climate funds and also the Global Environment Facility (GEF), together with their independent offices of evaluation, provide information on programmes that they support to address drought risks (GEF, 2019; GEF, 2020) (Annex 3).
- The Independent Evaluation Unit (IEU) for the Green Climate Fund (GCF) has conducted a number of evidence reviews examining adaptation to climate change (including the increasing frequency and intensity of droughts) and transformational change more broadly[15] (Annex 4).
- The Adaptation Fund provides a listing of its projects on its website (Annex 5).
- The World Bank has a searchable database in which 592 projects include drought as amongst their relevant keywords. 281 of these refer to "drought risk". Of these, as of August 2020, 158 also referred to mitigation (Annex 6 and 7).
- A global knowledge platform on Disaster Risk Responses (including drought and other disasters) is maintained by the World Bank's Global Facility for Disaster Risk Response (GFDRR).[16]

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10 Available at: https://www.ipcc.ch/

11 Available at: https://www4.unfccc.int/sites/napc/Pages/Home.aspx

12 Available at: https://unfccc.int/climatefinance?home

13 Available at: Additional climate-finance focused analyses is available at: https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2019/

14 Available at: https://unfccc.int/documents/196468

15 Available at: See https://ieu.greenclimate.fund/

16 Available at: https://www.gfdrr.org/en/knowledge-hub

- In addition to this, periodic reports on Disaster Risk Responses, including drought response are compiled by the UNDRR GAR.[17]
- The International Fund for Agricultural Development (IFAD) displays information about its relevant projects on its website. This database is not searchable using keywords such as drought risk mitigation. However, a range of materials describing its work on broader climate change issues are available.[18]
- UNEP periodically compiles an Adaptation Gap Report (UNEP, 2021).
- A survey of the availability of disaster risk reduction plans in Africa was conducted by the African Union (AU).[19]
- GIZ has published a review of its international cooperation on drought risk management (Augenstein, no date).

It is important to note that not all funding agencies offer search engines through which it is possible to isolate all of the relevant work that they do on the mitigation of drought risks[20], nor do they routinely make Terminal Evaluations available from their websites. In the case of the World Bank, which does so, it is still not easy to identify from the website how all of the projects that are associated with "drought risk" and mitigation as keywords are mitigating drought risks. This task might be most effectively undertaken through a systematic process with the involvement of relevant agency staff and staff of national governments working with them to assist with guidance and background information.

Relevant programming approaches can be broadly classified into those that directly focus on mitigating drought risks as a primary objective, and those in which the mitigation of drought risks are rather a cross-cutting issue that is either explicitly or implicitly integrated into the programme design.

In addition to the documented practical experiences that have been gained in drought risk mitigation, a considerable body of peer-reviewed published literature has been devoted to the question of drought impacts and risk mitigation, preparedness and response measures. For the purpose of this knowledge product, a search of the SCOPUS bibliographic database was made on 15 August 2020, using the search terms "drought risk" and "mitigation". This yielded a set of 167 records published between 2000 and 2020. The largest number of scientific publications on drought risks and mitigation focused on the situation in parts of Asia (46 percent), followed by Europe (15 percent) and North America (10 percent). Only 8 percent were dedicated to understanding drought risks and mitigation in Africa, 4 percent for Australia and just 2 percent focused on Latin America and the Caribbean. Of the remaining publications, 6 percent were explicitly global in focus, and for 9 percent no particular geographical scope was identifiable.

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17 See https://gar.undrr.org/ and https://sendaimonitor.undrr.org/

18 See e.g. https://www.ifad.org/en/climate-and-environment

19 Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/38982-doc-1st_africas_biennial_report_on_disaster_risk_reduction_full_report_english.pdf

20 As of August 2020, a search of the project database of the GEF at https://www.thegef.org/projects using the search term "drought" revealed only 15 projects, whereas a greater number of projects than these have generated relevant experiences. From the projects identified, 7 have been completed, and 7 more approved (Annex 3). In the case of the climate funds, similarly searchable databases are not yet available

Through the case studies, engagement with practitioners and consultation of institutional reports, a broader range of insights were brought into the review than resulted from the keyword searches of academic literature. The review of project databases and knowledge platforms also yielded a greater diversity of material and sectoral approaches than the initial literature review. Nonetheless, all 167 of the identified scientific publications were systematically reviewed to explore the nature of recommendations being put forward for drought risk mitigation, preparedness and response. In addition, a range of other publications of various kinds are also referred to throughout this knowledge product. These include previous reviews of academic literature (GCF/IEU, 2020) as well as agency reports and project databases.

The World Bank database includes classifiers distinguishing projects according to themes within and across the various sectors. This tells us that 12 projects out of the total 158 addressing drought risk mitigation are classed with natural disaster management themes, whereas 12 are focused on rural services and infrastructure and 11 focus on water resource management and 7 are "other environment" and "natural resources management", 1 deals with biodiversity, 2 are "pollution management and environmental health" and 2 are "other rural development" and rural non-farm income generation (2). Only 8 are classified as climate-change themed projects.

A rather less broad range of sectoral practices is explored in the scientific literature on drought risk mitigation, as compared to the projects databases. The literature also encompasses water resource management practices, land management and agricultural practices. It is also frequently concerned with emissions reduction (for climate change mitigation). Numerous publications have also focused on advocating more proactive and improved approaches to policy and planning across sectors – e.g. including more strategic attention and greater investment in devolved and/or community led approaches. The majority of scientific publications that were identified through the search of scientific literature advocate the use of a particular approach to drought risk assessment – and many claim that their methods and findings in relation to these are relevant to the mitigation of drought risks through improved planning and management actions.

None of the materials consulted can be considered entirely free from bias. Although an objective approach has been sought for this knowledge product, it is inevitably colored by the previous experiences of the experts and individuals involved. This is why the review process included in the knowledge product development is particularly important.

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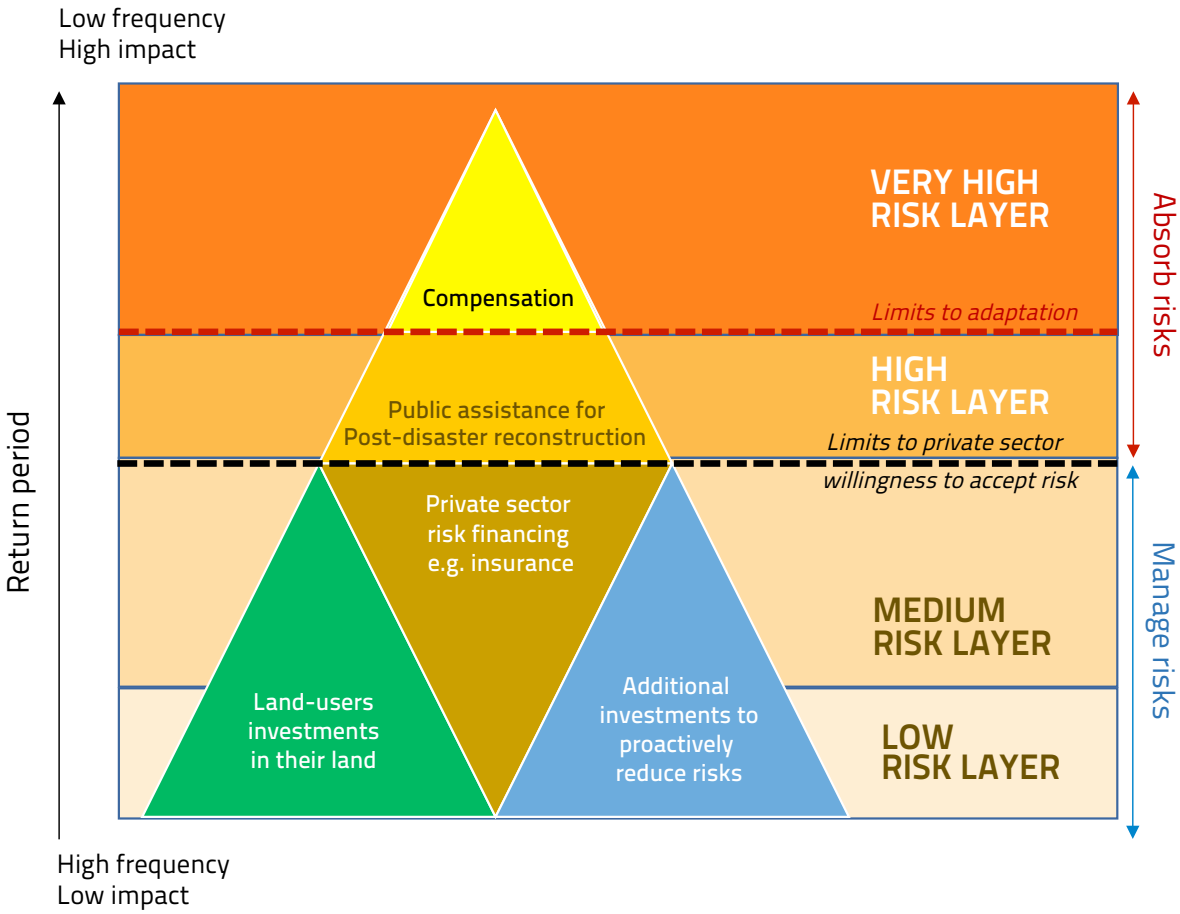
2.Shifting from drought response to a more proactive approach

Droughts have often resulted in reactive crisis management approaches consisting in ad hoc emergency measures. This can cause ineffective, poorly coordinated, and untimely outcomes that do little to reduce the vulnerabilities underlying the worst impacts of droughts. Increasingly, the international community has come to recognize that although emergency relief measures do provide immediate benefits, they can also cause increased dependencies – and so increase long-term vulnerability (Venton *et al*., 2012). Following this realization, over the last two decades, increasing attention has been paid to the need for improved drought preparedness planning (Crossman, 2018) as well as recovery. A continuously strengthening economic and financial case has been presented for the benefits of proactive resilience-building interventions (shown in blue and green in Figure 5), to avoid the needs for emergency assistance and compensation to be provided either by public authorities or private insurers (Venton *et al*., 2019; GCA, 2019) (see additional discussion of disaster risk financing in Section 3).

Figure 5: Layered disaster risk management, including financing from different sources



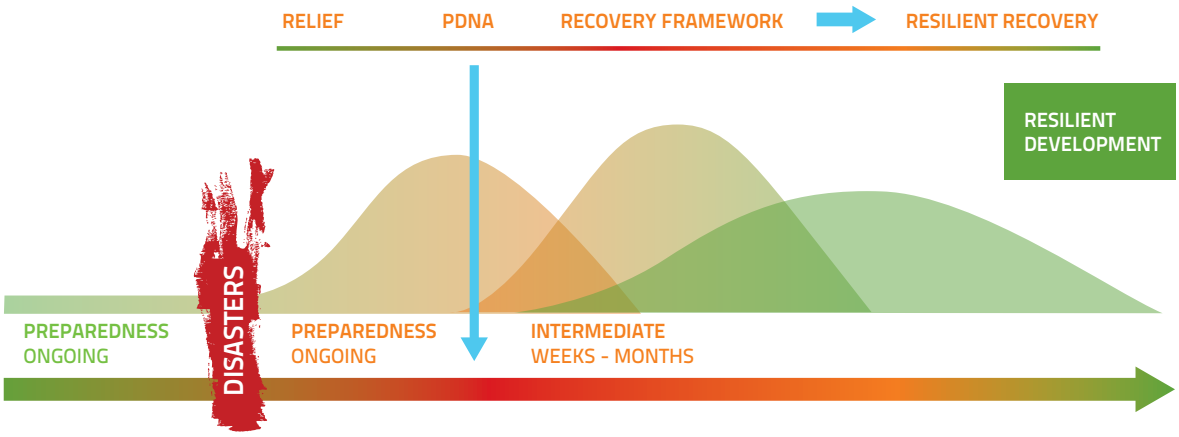
Source: Modified from Mechler et al. 2014.

Drought preparedness planning involves proactive measures that can be implemented before droughts occur as well as during and after (Table 1). The emphasis on the proactive approach, including iterative cycles of learning and adaptation, is in line with the broader thinking about the management of change, including both climatic change and disasters. Proponents of adaptation estimate that overall rate of return on successful proactive adaptation can achieve benefit-cost ratios ranging from 2:1 to 10:1, and in some cases even higher. This means that every USD 1 invested in adaptation could result in USD 2 to 10 in net economic benefits (GCA, 2019; Venton, 2018; IFRC, 2019b; IFRC, 2019a).[21] GCF project proposals include ex-ante projections of the economic benefits and rates of returns that they anticipate to generate. It is too early for most of these to be evaluated. However, some assessments of the rates of returns on drought risk mitigation have been attempted in bilaterally funded projects (Siedenburg, 2016; King-Okumu *et al.*, 2017b; Venton, 2018).

[21] GCA figures were based on a technical paper by World Resources Institute. 2019. "Estimating the Economic Benefits of Climate Adaptation Investments." – not available at this time. See also: Brahmbhatt, M., *et al.*, Estimating the Economic Benefits of Climate Adaptation Investments: Background paper for the Global Commission on Adaptation. Draft manuscript cited in: https://www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.C.59.STAP_.Inf_.06.Rev_.01_Natured_Based_Solution_GEF.pdf

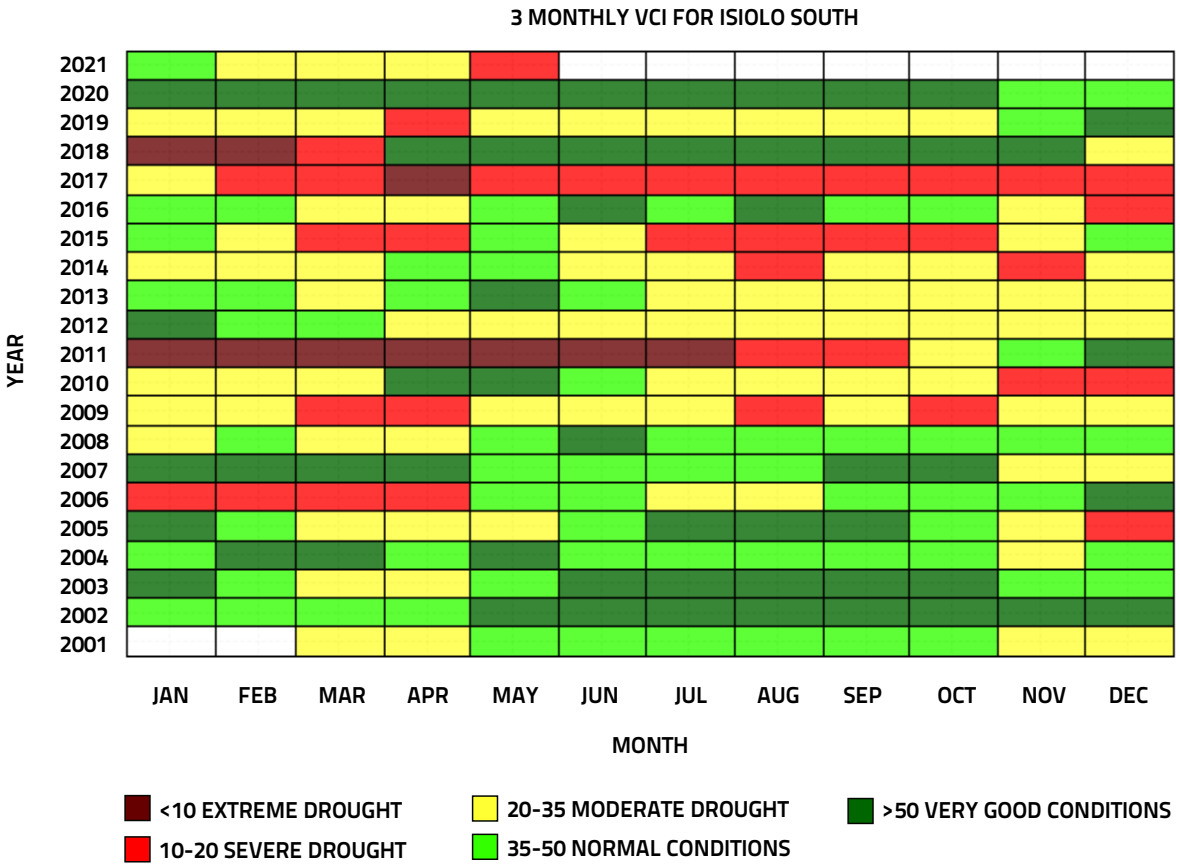
Proactive drought risk mitigation measures begin before the onset of droughts (Table 1 and Figure 6). Advance preparedness can help to enable ecosystems and communities to withstand the effects of drought. Preparedness can involve information gathering, policy-making, planning and actions (Figure 6). Where lessons are learned with hindsight from experience of droughts, these can be used to increase and improve the level of preparedness measures. It is very important to understand that in many drought-affected areas, managing the drought cycle involves not only understanding and managing the different phases of preparedness, response and recovery, but also coping with the continuing residual effects of past droughts and dealing with an accelerating cycle of recurrent droughts with ever-deepening effects (Figure 7). This is especially the case in the worst affected regions.

Figure 6: Established conceptual model of a drought cycle (assuming single event)



Source: GFDRR, 2020; FEMA, 2011; FEMA, 2016.

Figure 7: Varying cycles of preparation, response and recovery from recurrent drought



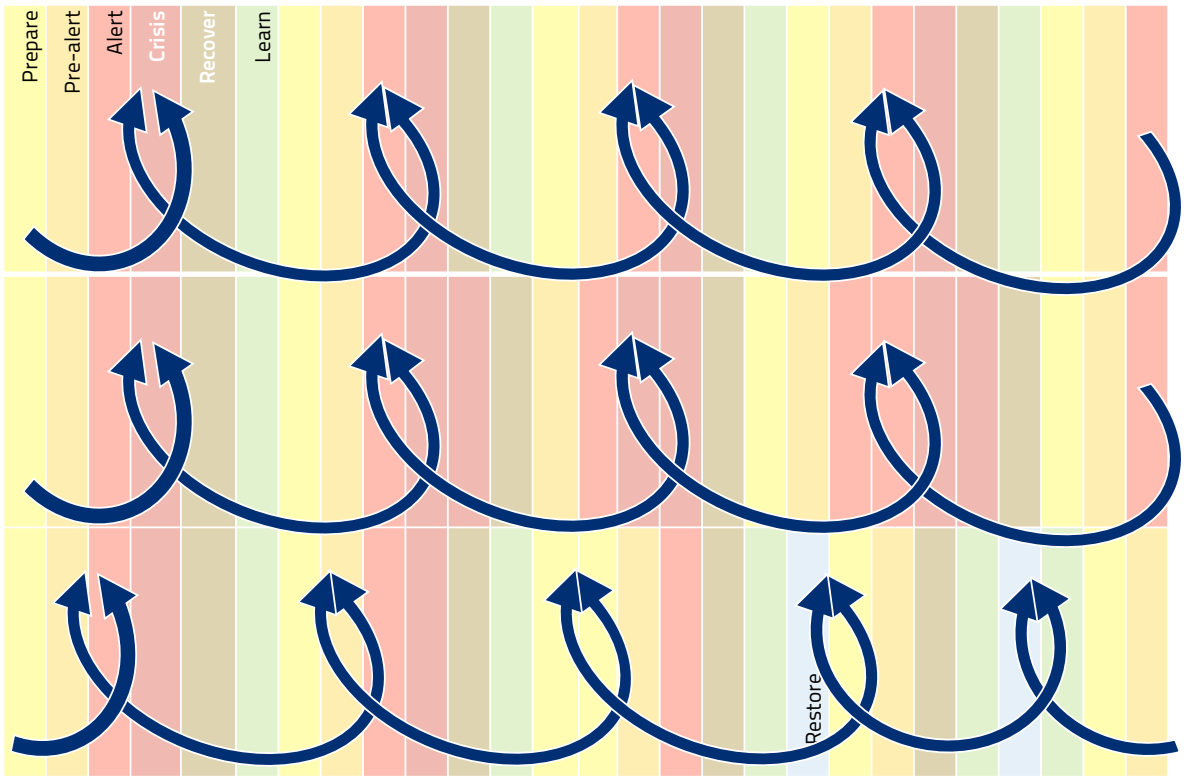


Table 1: Drought risk mitigation measures at different points in an idealized drought cycle

Mitigate risks		Prepare	Response & recovery				Learn
Assess	**Prevent**	**Prepare**	**Pre-alert**	**Alert**	**Emergency**	**Recovery**	**Adapt**
i. **High level review** of policy & decision-making systems, and future risks	i. Boost current decision-making systems and adjust future plans	i. Put in place monitoring and EWS	i. Promote low-cost voluntary actions by water users	i. Restrict non-essential water uses	i. High-cost direct demand restriction including urban users	i. Monitor resource and learn lessons	i. Plan zonation of future developments
ii. **Sectoral reviews** of infrastructure, including power supplies, maintenance and other risks	ii. Maintain infrastructure, ensure power supplies, – fix leaks, etc	ii. Identify and develop additional reserve capacity (including transfers, groundwater, desalinization	ii. Ensure and prepare infrastructure to prioritize essential water needs	ii. Revise tariff on non-essential water use	ii. Infrastructure responses including water transfers, trucking	ii. Declare end of Drought – Norms reinstated	ii. Develop risk acceptance and awareness
iii. **Sectoral reviews** of drought risks in production systems	iii. Reinforce drought-smart production systems	iii. Reform abstractions of water and align agricultural use	iii. Increase communication and awareness	iii Review readiness for emergency	iii. Emergency supplies or losses of crops and needs to compensate	iii. Temporary restrictions, restore and restock water reservoirs and soils	iii. Embed a process of ongoing learning and adaptation of production systems
iv. **Sectoral reviews** of water management including, recharge patterns, risks & options	iv. Restore recharge patterns, and catchment management practices	iv. Plan water allocation and sharing at catchment levels	iv. Ensure normal water sharing rules in effect, encourage voluntary water trading	iv. Water sharing rules change, water value / prices and trading increase	iv. Temporary unsustainable extractions to meet emergency needs	iv. Rehabilitate & refill reservoirs	iv. Re-evaluate capacity needs for watershed mgt incl. flood management
v. **Sectoral reviews** of risks to habitats supporting hydro-logical processes	v. Maintain and restore habitats & hydrological processes	v. Community engage in assessing risk & resilience of systems	v. Protect key habitats including species at risk by legislation or other	v. Ensure minimum environmental flows	v. Save certain species e.g. translocate	v. Monitor habitats recovery and promote habitat restoration	v. Model & report effects on water bodies & habitats under stress
vi. **Implementation reviews** of local risk awareness and responsible institutions	vi. Reinforce local awareness and responsible institutions	vi. Communicate priorities and risk awareness	vi. Intensify local monitoring of scenarios	vi. Communicate alert to govern-ment & all other stakeholders	vi. Ensure response reaches all vulnerable	vi. Ensure response reached all vulnerable & assess recovery needs	vi. Promote local understanding of co-dependence on ecosystems
vii. **Review finance** mechanisms (local, national & global)	vii. Adjust and replenish funds and mechanisms	vii. Prepare results monitoring of financing in place	vii. Refresh training for all staff and inform public	vii. Ready disbursement and results monitoring	vii. Disbursement and monitoring	vii. Conclude disbursement. Fund recovery needs	vii. Assess results from monitoring systems

In some areas and regions, drought managers have time and resources to invest in recovery, learning, restoration and transformation phases (WWF-GIWP-UNESCO, 2016). However, in the more drought-affected regions this luxury has often not been possible (King-Okumu *et al*., 2017a; Jillo *et al*., 2016). This has been due to the pace and severity of the cycles of recurring hazards as well as to a lack of resources and established norms, processes and expectations that decision-makers should provide support for institutionalized learning to take place at different levels. In such cases, the recovery phase is ever-present -even while it may never receive the level of resourcing and attention needed to complete it.

The following topics are explored further in the remainder of this section:

- anticipating, reducing risks;
- preparing for drought risks across sectors; and
- identifying entry-points to mitigate drought risk at different scales.

2.1 Anticipating and reducing drought risks

Where drought managers are able to draw lessons from past drought impacts and management failures to invest in planning and preparing better for future drought risk management, this can enable them to build resilience and slow down the escalation of subsequent drought emergencies (Table 1 and Figure 6). Making the connections back from recovery and learning to explore new and improved proactive approaches to preparation and planning is critical (Box 1). This can make the difference between a drought-sensitive situation and a more drought-resilient one (see further discussion in Sections 4 and 5). Examples of different national strategies for mitigation of drought risks currently under implementation can be seen in the national drought plans from 40+ countries that are available from the UNCCD Drought Toolbox (see common Drought Resilience Adaptation and Management Policy framework in Box 1). All of these are informed by the succession of past droughts and drought impacts (a number of which had disastrous repercussions that are recognized as still not fully resolved and ongoing).

Further examples of drought risk and preparedness planning can also be found in plans for climate change mitigation and adaptation and disaster risk reduction more broadly (Table 8). However, strategies for adaptation to climate change are primarily oriented to anticipating and mitigating future climate change as a source of increasing and intensifying future drought risks and adapting to these changes. They do not necessarily prioritize actions needed to address the present realities of droughts as a lasting systemic feature involving non-meteorological aspects and causes (ecological, hydrological, agricultural and socio-economic). This is because in climate-focused actions, the meteorological component tends to receive comparatively greater emphasis and investment.

National Climate Change Adaptation planning is useful because it helps to generate simplified long-term planning scenarios that are based on the science of meteorological patterns that can be predicted. To include accurate predictions of other phenomena affecting vulnerable peoples' access to resources and productive activities, integration with data and scenarios capturing effects on land and water is essential. In many drought-prone areas, systems for modelling these are weaker than the available meteorological systems and require significantly more investment.

Box *1*: Drought Resilience Adaptation and Management Policy (DRAMP) framework

Generic guidance and methods to identify the nature and extent of the exposure of ecosystems and communities to drought risks, and the factors affecting their vulnerability are available from the IDMP website and the UNCCD Drought Toolbox, amongst others.

According to the UNCCD's Drought Resilience Adaptation and Management Policy (DRAMP) framework (ICCD/COP (13)/19), assessing drought vulnerability and risk entails:

i. identifying drought impacts on vulnerable economic sectors including cropping and livestock, biodiversity and ecosystems, energy, tourism and health.
ii. assessing the physical, social, economic and environmental pressures on communities before, during and shortly after drought in order to identify who and what is at risk and why.
iii. assessing conditions or situations that increase the resistance or susceptibility to drought and the coping capacity of communities affected by drought.
iv. assessing the extent of potential damage or loss in the event of drought.

Other relevant cross-sectoral national planning frameworks include national strategies for achieving the SDG on Land Degradation Neutrality (LDN) and National plans for disaster risk reduction. These address a wider range of hazards than only drought. However, this can be useful where it enables improved management of both drought and floods and strengthens the sectoral frameworks for water management. National plans for LDN overlap with adaptation objectives. These take into consideration the existing relationships between land and climate and the interacting processes that have linked them in the past and present, as well as for the future.

Sectoral plans for Integrated Water Resource Management (IWRM) often include some consideration of drought risks and mitigation measures. However, most often, these plans are focused on management of the large infrastructure and water flows that can be directed by the central government. They are often also based on assumptions for annual water resource availability that do not fully consider the ways in which different users' access to water will be affected during droughts. Although water sector plans can recognize the role that individual land and water users' decisions make to water availability, particularly for groundwater management, they often do not have the institutional arrangements in place to change these. To do so, there is a need for water resource planners to work closely with the agricultural sector, local governments and municipalities

Across all of these planning frameworks, drought risk is usually conceptualized as a function of the drought hazard, combined with the exposure and vulnerability of ecosystems and communities (Figure 8). Significant efforts are already underway across the international community to mitigate the extent to which climate change is causing the intensification of meteorological drought hazards (Shukla *et al.*, 2019) In addition to this, there are also other entry-points through which it is possible to more immediately mitigate drought risks (Figure 8). These include actions to reduce other aspects and causes of the drought hazard (hydrological, ecological, agricultural or socio-economic/anthropogenic). They can also involve directly reducing the exposure of ecosystems and communities to these hazards. It is also possible to reduce drought vulnerability factors. These are a function of the sensitivity of the exposed ecosystems and populations and their capabilities to cope with their exposure to the drought hazards (Carrão *et al.*, 2016).

Table 2: National policy frameworks addressing drought in selected countries of the Sahel

	National Adaptation Plan[1]	Land Degradation Neutrality Targets[2]	National Drought Plans[2]	DRR Plan[3]
Senegal	(not yet available) https://climateanalytics.org/projects/pas-pna-science-based-national-adaptation-planning-in-sub-saharan-africa/senegal/	**2018** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/senegal		
Mali	**2011** Stratégie Nationale Changements Climatiques Plan d'Action National Climat (2011)	**2020** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/mali	**2020** https://knowledge.unccd.int/sites/default/files/country_profile_documents/PLAN%20SECHERESSE%20DU%20MALI%20VERSION%20FINALE.pdf	2019 Stratégie Nationale de Réduction des Risques de Catastrophes au Mali et Plan d'action pour la mise en œuvre 2015-2019
Burkina Faso	**2015** https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/BURKINA%20FASO%29%20National%20Climate%20Change%20Adaptation%20Plan%20%28NAP%29.pdf	**2018** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/burkina-faso		(see Report on SDG 1.5: https://sustainable development.un.org/content/documents/23390 Burkina_Faso_VNR_FINAL.pdf)
Niger		**2018** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/niger		**2019** Stratégie Nationale de Réduction des Risques de Catastrophe (SNRRC) et Plan d'Action de mise en œuvre (2019-2023).
Nigeria	**2011** National Adaptation Strategy And Plan Of Action On Climate Change For Nigeria (Naspa-Ccn) (2011)	**2018** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/nigeria	**2018** https://knowledge.unccd.int/sites/default/files/country_profile_documents/1%2520FINAL_NDP_Nigeria.pdf	**2019** National DRM Policy (2019)

	National Adaptation Plan[1]	Land Degradation Neutrality Targets[2]	National Drought Plans[2]	DRR Plan[3]
Chad	**2017** Strategie nationale de lutte contre les changements climatiques (2017)	**2015** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/chad		(see: https://sustainabledevelopment.un.org/content/documents/23405RAPPORT_NATIONAL_VOLONTAIRE_FINAL_TCHAD.pdf)
Sudan	**2016** https://www4.unfccc.int/sites/NAPC/Documents%20NAP/National%20Reports/Sudan%20NAP.pdf	**2018** https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/sudan	**2018** https://knowledge.unccd.int/sites/default/files/country_profile_documents/1%2520FINAL_NDP_Sudan.pdf 2019 CPP https://resilience.igad.int/wp-content/uploads/2020/02/CPP-SUDAN.pdf	(see report on Sdg 1.5: https://sustainabledevelopment.un.org/content/documents/21741VNR_Sudan.pdf
Ethiopia	**2019** https://www4.unfccc.int/sites/NAPC/Documents/Parties/Final%20Ethiopia-national-adaptation-plan%20%281%29.pdf	**2016** https://knowledge.unccd.int/sites/default/files/inline-files/ethiopia-ldn-country-report-final.pdf	**2017** FAO http://www.fao.org/3/a-i7693e.pdf 2019 IDDRSI CPP https://resilience.igad.int/wp-content/uploads/2020/02/CPP-ETHIOPIA.pdf	(see: https://sustainabledevelopment.un.org/content/documents/16437Ethiopia.pdf)
Eritrea		**2018** https://knowledge.unccd.int/sites/default/files/ldn_targets/Eritrea%20LDN%20TSP%20Country%20Report.pdf		

National Adaptation Plan[1]	Land Degradation Neutrality Targets[2]	National Drought Plans[2]	DRR Plan[3]
Somalia	2020 https://knowledge.unccd.int/home/country-information/countries-having-set-voluntary-ldn-targets/somalia	2020 (see also 2018 pdna plan) https://knowledge.unccd.int/sites/default/files/country_profile_documents/FINAL%20NATIONAL%20DROUGHT%20PLAN%20FOR%20SOMALIA%28final%29%2016%20Dec%202020%28%20PDF%20version%29.pdf	

1) See https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx and https://unfccc.int/topics/adaptation-and-resilience/workstreams/national-adaptation-plans

2) See https://knowledge.unccd.int/home/country-information/overview-countries-unccd-annex and https://resilience.igad.int/resources/

Ongoing analysis by Stephen Adaawen, UNCCD at:

https://www.preventionweb.net/english/professional/policies/index.php?typid=0&stypid=0&cid=79&x=14&y=9

and https://reliefweb.int/sites/reliefweb.int/files/resources/38982-doc-1st_africas_biennial_report_on_disaster_risk_reduction_full_report_english.pdf

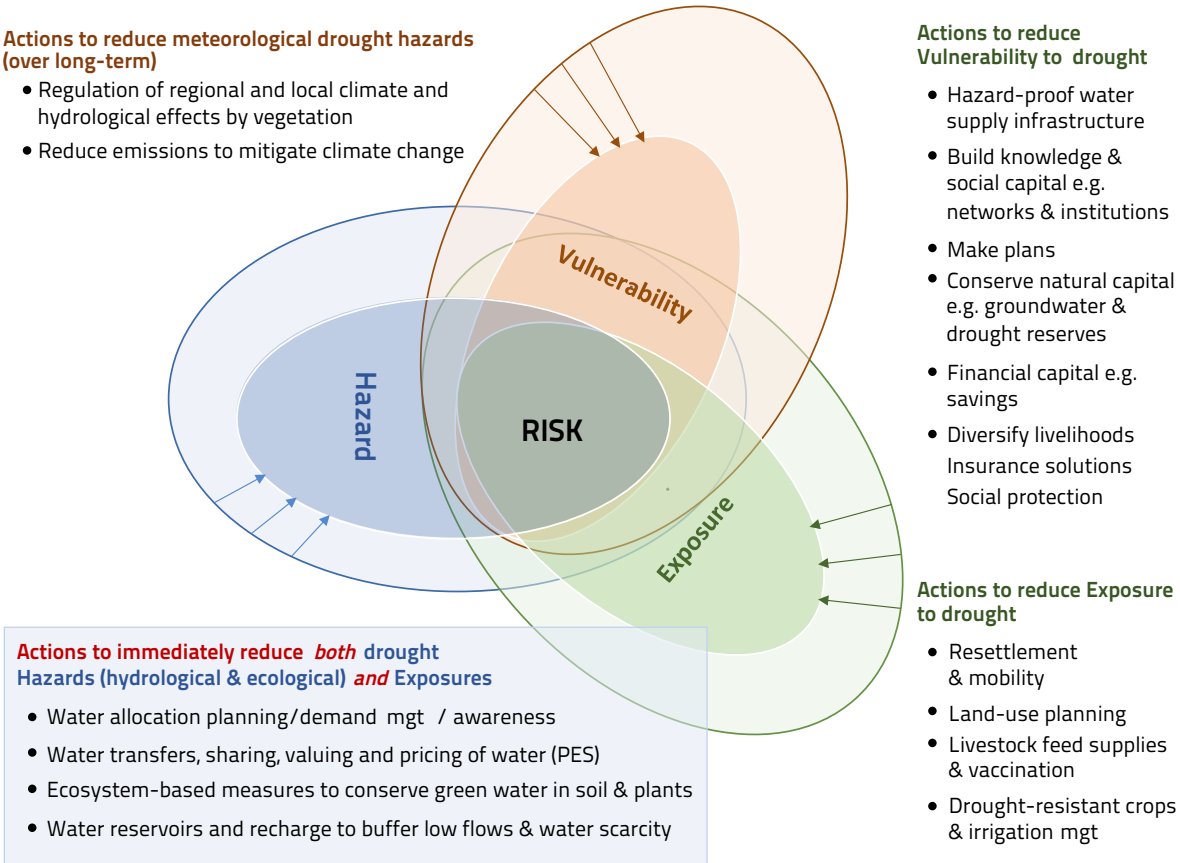
and https://sendaimonitor.undrr.org/ and https://sustainabledevelopment.un.org/vnrs/

Notes: Based on ongoing analysis for UNCCD by Stephen Adaawen.

To assess the nature and extent of the exposure of ecosystems and communities to drought, and investigate which drought risk mitigation measures could be suitable in those areas, maps of the locations and extent of ecosystems and their dependent populations can be combined with drought hazard maps (Carrão *et al.*, 2016; UNCCD, 2019) (Figure 4). These can help national decision-makers to identify areas of their countries and entry-points where actions could be taken to investigate further with the affected communities which mitigation measures could immediately reduce and buffer their exposure to drought hazards and reduce their vulnerability. These maps often reveal significant variations in drought risks within countries. Preventive actions that can be taken in the areas most at risk to reduce the exposure of ecosystems and communities to drought can then be explored and planned at sub-national scales in the more affected areas.

At the national and global levels, generalized indicators of vulnerability to a range of hazards (not necessarily only drought) are sometimes mapped (see e.g. Carrão *et al.*, 2016). These generic inequality and risk maps can be used to guide stakeholders in discussions of measures and options to reduce vulnerability. Furthermore, positive factors and capabilities that can increase the resilience of the ecosystems and populations by enhancing their capability to withstand and recover from drought risks (such as available resources, skills and knowledge) can also often be identified and increased.[22] This also is most meaningfully approached through context-specific qualitative exploration of interrelated factors and processes.

Figure 8: IPCC risk framework showing options for drought risk reduction



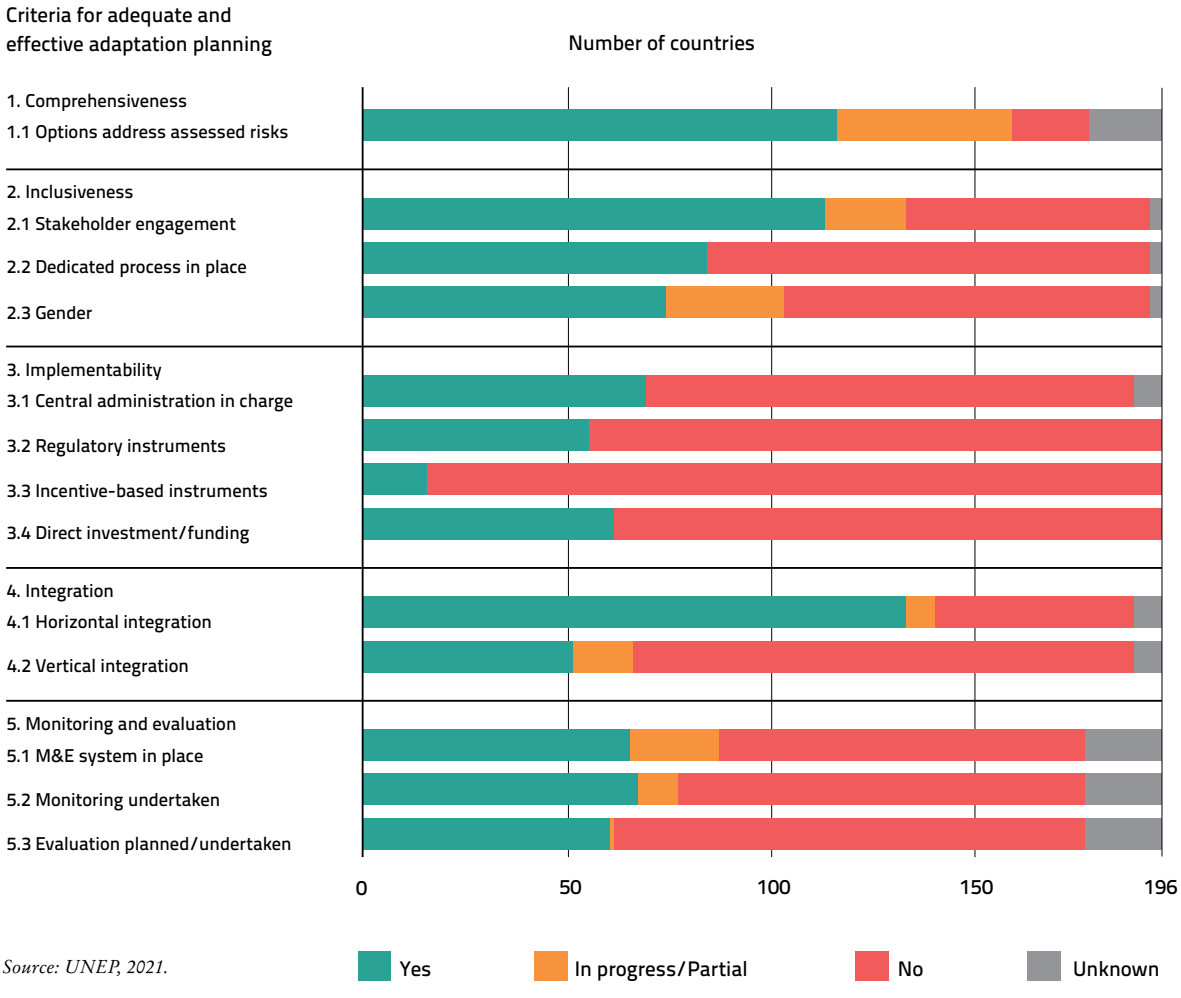
Source: Modified from IPCC 2019.

[22] Practical approaches and methods for assessing vulnerability and resilience to drought are discussed in a previous knowledge product available from: https://www.unccd.int/publications/drought-impact-and-vulnerability-assessment-rapid-review-practices-and-policy

A recent review of climate change adaptation policies and programming for the Adaptation Gap Report (AGR) (UNEP, 2021) has highlighted the challenges of assessing which policies work best. This is helpful because many of the current funded drought risk mitigation programmes are funded as adaptations to climate change. These make up a significant proportion of the overall adaptation portfolio, especially in the more drought-affected developing countries. The most striking findings from the AGR underline gaps in the implementability, monitoring and evaluation of the current adaptation plans and programmes (Figure 9). Often, there is a significant distance between the central government planning authority and the drought-affected communities that need to implement, monitor and benefit from drought risk mitigating measures.

At the more local scales, the measures that communities can take to proactively reduce drought risk include sustainable land and water management practices. Proactive land and water management measures (as identified in Table 1 and Figure 7 and 9) protect the available capacities of ecosystems and communities to buffer against deepening drought risks (described in Vickers, 2018). These systemic measures can be determined, prioritized and triggered as part of a proactive drought-preparedness approach (see Box 1 and examples in Case Study 3, 6 and 10). These can mitigate drought risk by reducing water stress and replenishing the water balances during non-drought (FAO 2018a; EU, 2008, Venton *et al.*, 2019; FAO, 2018b). This is in line with the European Commission (EC) recommended disaster risk assessment framework (EC, 2010) which focuses on exposure as the entry-point to risk reduction.

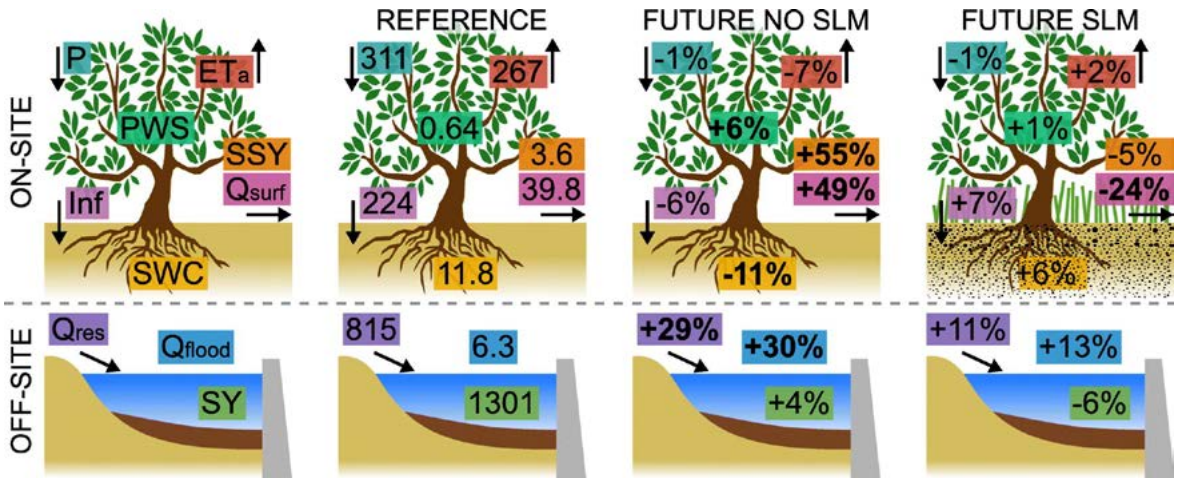
Figure 9: Assessing the adequacy and effectiveness of adaptation planning worldwide



Source: UNEP, 2021.

In addition to reducing exposure to drought effects, land and water management interventions that are planned and implemented at the local level with communities of land and water users can also reduce the incidence and severity of hydrological drought hazards including life-threatening hydrological imbalances (Case Study 3). They do this by increasing water storage in the soil, subsurface and vegetation (Figure 10). Where land and water management contribute to economic or social development objectives, they can also immediately reduce vulnerability to drought and help to build the resilience of the community. These measures frequently feature in national strategies for drought management, water management, land management, and adaptation to climate change. However, their impacts in terms of reducing drought risk and increasing the reserves of water available to buffer droughts are rarely monitored and reported in quantitative ways. This requires the use of water balance models at different scales (Figure 9 and Case Study 4).

Figure 10: How can land management conserve water for drought in dry environments



Source: Eekhout and de Vente, 2019.

Case Study 3: Connecting drought response to sustainable development for Northeast Brazil (see more detail in case studies section)

National drought responses in Brazil have mostly included distribution of water, food and cash. In the past, these programmes often were linked with work programmes for job creation and distribution of food or small payments. For example, Brazil employed about three million rural workers during the 1983 drought in such programmes. In contrast to this, today, Brazil has a system of social protection that provides monthly cash transfers to low -income people. The government also distributes animal feeds at below market prices to help cattle-raising communities in drought-affected areas of North-east to maintain their productive assets and livelihoods during droughts. Water trucks distribute water to both rural and urban populations.

Proactive response actions require preparedness plans at national, state or provincial, and local levels, as well as territorial (water basins), urban, and sectoral levels. This involves three levels of government, including municipalities, states and the federal government. Such planning requires attention to a range of questions: How can we ensure a continuous water supply for a specific community in times of severe drought? How do we manage water supply from a dam that is prone to low water levels? How do we coordinate state actions to meet the needs of local people? How do we link response actions to mitigation actions and to regional and national sustainable development? Brazil has succeeded to put in place a National Water Policy. This has helped planners to identify needs for new aqueducts and wells to be built, desalination tools to be used, and new sources of water to be sought.

The last major drought emergency in Brazil occurred in 2017. This demonstrated that the national social protection system had largely replaced the work programmes and was sufficient to prevent the drought emergency from escalating to become a national calamity involving loss of life. However, the available infrastructure was not enough to prevent the needs for water trucking to urban and rural areas. The national water policy was not fully integrated with a cross-sectoral approach including sustainable land and water management. This is necessary to ensure that sufficient water could be stored in the ground and in the reservoir systems to enable the public water supplies to continue to function and provide water during droughts.

Rainwater harvest and storage, if accompanied by the current agricultural model, may be temporarily palliative – subject to severe water loss due to high evapotranspiration from heat and wind – but productivity would remain limited. In fact, water investments in the semiarid zone must be complemented by soil recovery practices to allow infiltration of rainwater, increase soil biomass rate, create shade and wind shelters to reduce evapotranspiration (which can exceed 2 000 mm/year). The specific flora and fauna in the semiarid zone have developed a high capacity to access and store water (in roots, trunks, stems and leaves), resulting in a biota capable of supplying more water than needed for growth and reproduction, adding surplus water to the system.

Recently, the GCF Approved a project implemented by IFAD on Planting Climate Resilience in Rural Communities (PCRP) of the Northeast Brazil (GCF, 2020). The project focuses on building resilience to drought and water scarcity. It builds on a Policy Coordination and Dialogue for Reducing Poverty and Inequalities in Semi-Arid North-east Brazil (PDHC)[1] and also a previous activity by IFAD in the Northeast that was financed by the GEF.[2] The GCF project connects water storage, land management and knowledge management components that complement and reinforce one another to promote climate resilience as well as reduce greenhouse gas (GHG) emissions.

Insight provided by: Antonio Magalhaes, Center for Strategic Studies and Management (CGEE), Brazil.

[1] https://www.ifad.org/en/web/operations/project/id/1100001620
[2] https://www.thegef.org/project/sustainable-land-management-semi-arid-sertao

Case Study 4: Water harvesting and sustainable land management to buffer drought in Southern Tunisia (see more detail in case studies section)

In Wadi Oum Zessar, Southern Tunisia, droughts cause interruption of drinking water supplies for the human needs, as well as loss of agricultural production. Traditionally, a wide range of water harvesting practices are used to collect and conserve water on the hillslopes and wadi beds of the catchment. These include Jessour, Tabias and cisterns known as Fesguia and Majel. Land users and researchers are continuing to adapt these practices, and to innovate new systems to accelerate the capture, recharge and purification of runoff water to recharge the aquifer using Managed Aquifer Recharge (MAR) techniques. These include check dams, retention ponds and recharge wells.

The percentage of the annual rainfall that is captured and used each year in the catchment is not known, and the quantitative difference made by nature-based solutions, such as water harvesting is not fully assessed in terms of its effects on water productivity and recharge to storage. As a result, decision-makers do not have complete information about the volume of risks that can be mitigated when they are assessing these options. Instead, they usually resort to drilling wells as a means to prepare for drought, if they can afford to do so. Unfortunately, as the aquifer is already over-stressed, this option is becoming less and less feasible. Seawater desalination plants offer an expensive alternative, increasing the national debt. One is already in operation to serve the urban population near the coast, and a second one is under construction.

Increasing investments in sustainable drought risk reduction solutions, such as water harvesting and managed aquifer recharge, could avoid some of the costs of constructing more desalination plants. To improve decision-makers' understanding of the scope of these measures, research and extension agencies have explored various methods to evaluate their effects on groundwater recharge processes and agricultural production under different drought and non-drought conditions. These evaluations require modelling tools and approaches to be combined with systems for field data collection, management and analysis. International scientific and technical cooperation through the Wadismar project[1] has put in place a piezometer that is generating data to enable improved modeling of groundwater recharge processes under drought and non-drought conditions, and to evaluate the effects of different practices, such as water harvesting and managed aquifer recharge (Carletti *et al.*, 2019; Carletti, 2017).

Insight provided by: Mohamed Ouessar and Mongi Benzaied, Institute of the Arid Regions (IRA), Tunisia; Georgio Ghiglieri and Alberto Carletti, Università degli Studi di Cagliari, Italy.

[1] See http://www.wadismar.eu/About%20WADIS-MAR.htm

2.2 A typology of drought risk mitigation measures across sectors

Many economic sectors are exposed and vulnerable to drought. In light of this, there are a wide range of available entry-points for human decision-making to reduce drought risks and build resilience. A helpful typology of potential drought impacts from a sectoral perspective has been provided by the Post Disaster Needs Assessment (PDNA) Manuals (GFDRR, 2013) which describe disaster impact assessments across 18 Sectors.[23] Furthermore, the World Bank classifies projects addressing

[23] Additional information is available at: https://www.undp.org/content/undp/en/home/librarypage/crisis-prevention-and-recovery/pdna.html

drought risks and mitigation according to 53 overlapping sectoral classifications. Based on these, the sectoral relevance of drought risk mitigation could be generalized to a short-list of around 10 sectoral definitions (Table 3), related to a longer list of sectoral classifiers used by the World Bank, intersecting with 30 different associated themes (Annex 6).

Sector policies can play an important role in drought risk mitigation – even if they are not aimed explicitly and exclusively at addressing drought risks. Sustainable production and consumption (Figure 8) can involve many different sectors of governance and economic activity. This means that it is useful to check the alignment of planning across the full range of different sectors to see whether or not they will work with or against policies that are dedicated to directly addressing drought. This can help to maximize co-benefits and reduce duplication of efforts.

In terms of sectoral focus, the largest numbers of World Bank projects addressing drought risks and mitigation focus on the water, sanitation and waste management sectors (72 out of 158 projects), followed by projects in the agricultural and forestry sectors (52 out of 158). All of the projects in the FAO Drought portal also come under this agriculture sectoral category. Transportation (including road, rail and air) is another important sector for World Bank-funded projects including drought risk and mitigation aspects (30 out of 158). Projects in the energy sector (including both extractives and renewable energy generation and distribution) also refer to drought risks and mitigation (16 out of 158). Other relevant sectors for World Bank projects referring to drought risks and mitigation include trade and industry, finance, Information and Communications Technologies (ICT), education, health and housing.

In the energy sector, droughts can have particularly profound effects, but strategies for mitigating these can also transform national economies (Box 2 and Section 4). For example, rainfall deficits in Uganda in 2010–2011 reduced the availability of sugar cane to enable electricity generation from bagasse – resulting in a 40 percent reduced supply. At the same time, hydropower generation was also decreased by nearly 4 percent. As a result, higher fuel imports were required, resulting in greater overall dependence on thermal power plants and increasing emissions (FAO, 2019b). As part of their Nationally Determined Contributions (NDC) to mitigate future anticipated climatic changes, many countries have introduced reforms to reduce greenhouse gas emissions across all sectors – including power generation. In some enlightened cases, such as Costa Rica, the government has been able to use the proceeds from a carbon tax to immediately address current drought impacts and challenges by establishing a Water Fund.

Nature-based solutions for adaptation to drought risk often involve integrated watershed and landscape management, as well as reforestation and climate-smart agricultural practices such as agroforestry and agroecology (UNEP, 2021) (Box 3, Figure 9 and Case Study 5 in the High Andes). This builds on global understanding of the role of watersheds, water towers (Viviroli and Weingartner, 2004; Viviroli *et al.*, 2007) and watershed management in hydrological regulation. Human societies traditionally inhabiting dry environments have observed cloud and fog water capture/interception by rocks and vegetation and have built technologies to harvest this water. More contemporary reinventions of fog-water collectors seek new ways to harvest water from these natural processes.

Table 3: Sectors at risk from drought and entry-points to mitigate drought risks: master-list based on project portfolios & published literature

	Sector	Drought risks, exposure & vulnerability	Drought risk mitigation measures
1	Water, sanitation & waste	Inadequate water storage and supply systems cause shortages and increased costs during droughts and heatwaves. Furthermore, lack of waste treatment and removal together with reduced dilution causes increased threats to human and ecosystem health from pollution during drought.	Store water and regulate flow levels in water bodies to maintain safety for humans, species and ecosystems, reduce water demand
2	Urban and rural development & land registration, community infrastructure, municipal services, housing & construction	Settlements are often constructed with poor systems for water supply, sanitation ventilation, cooling and energy supply, which make them unsuitable and unhealthy places to live during droughts and heatwaves. Furthermore, when construction of informal housing causes loss of fertile agricultural land, this further reduces food security and increases vulnerability to drought.	Improve strategic planning and of sustainable construction programmes, technical know-how and financing for affordable housing. Improve use of landscaping and NbS
3	Agriculture, Livestock, Fisheries & Forestry	Lack of rainfall and/or water supplies for drinking and irrigation reduces the productivity of livestock and crop-producers. It can also threaten water quality for fisheries, reduce the survival of trees, and increase deforestation due to cutting of trees for emergency feed, fuel and income-generation. Market effects on prices, trade and value chains, consumer credit, purchasing, etc.	Store and conserve water and feed supplies, cultivate drought resistant crop and livestock varieties, protect forest and grazing reserve areas, manage transhumance, reduce discharge of waste into waterbodies. Improve use of ICT for Early Warnings
4	Commerce, Trade, Industry, Manufacturing & tax collection, Banking, capital & financial, Employment, Livelihood & Social Protection	Droughts can distort markets and prices – due to spikes and crashes in demand and supply of agricultural and other products. Loss of agricultural harvests, livestock and livelihoods can cause default on loans and/or late payments and needs for insurance payouts, additional credit, etc. Droughts affect livelihoods and employment in the agricultural sector and all supporting service sectors. Loss of assets such as livestock, productive land and expected harvests and inability to borrow from neighbors.	Diversify income-generating activities Improve availability of credit and insurance for businesses and individuals. Improve storage and transportation facilities. Provide incentives for sustainable businesses Cash transfers and other social protection.
5	Environment, nature conservation & national parks Tourism, customs & migration	Droughts can destroy wildlife, habitats and tourist attractions. Also reduce supplies of water, power, food and labor to the hotel sector. Increase risks of forest and brushfires. People can move into nature reserve areas.	Sustainable land and water management. Create reserves for wildlife and ensure availability of supplementary drinking water, food supplies, rangers.
6	Transportation, roads, railways & aviation, ports & waterways	Low flows can affect the use of waterways for transportation. Droughts can also cause dust and congestion on roads and railways, lack of water for cleaning and cooling of engines and passenger facilities, as well as overheating of vehicles and outbreak of fires.	Maintain minimum flow levels in waterways. Maintain water storage facilities and fire hydrants. Plant drought-tolerant shade trees along transportation routes.

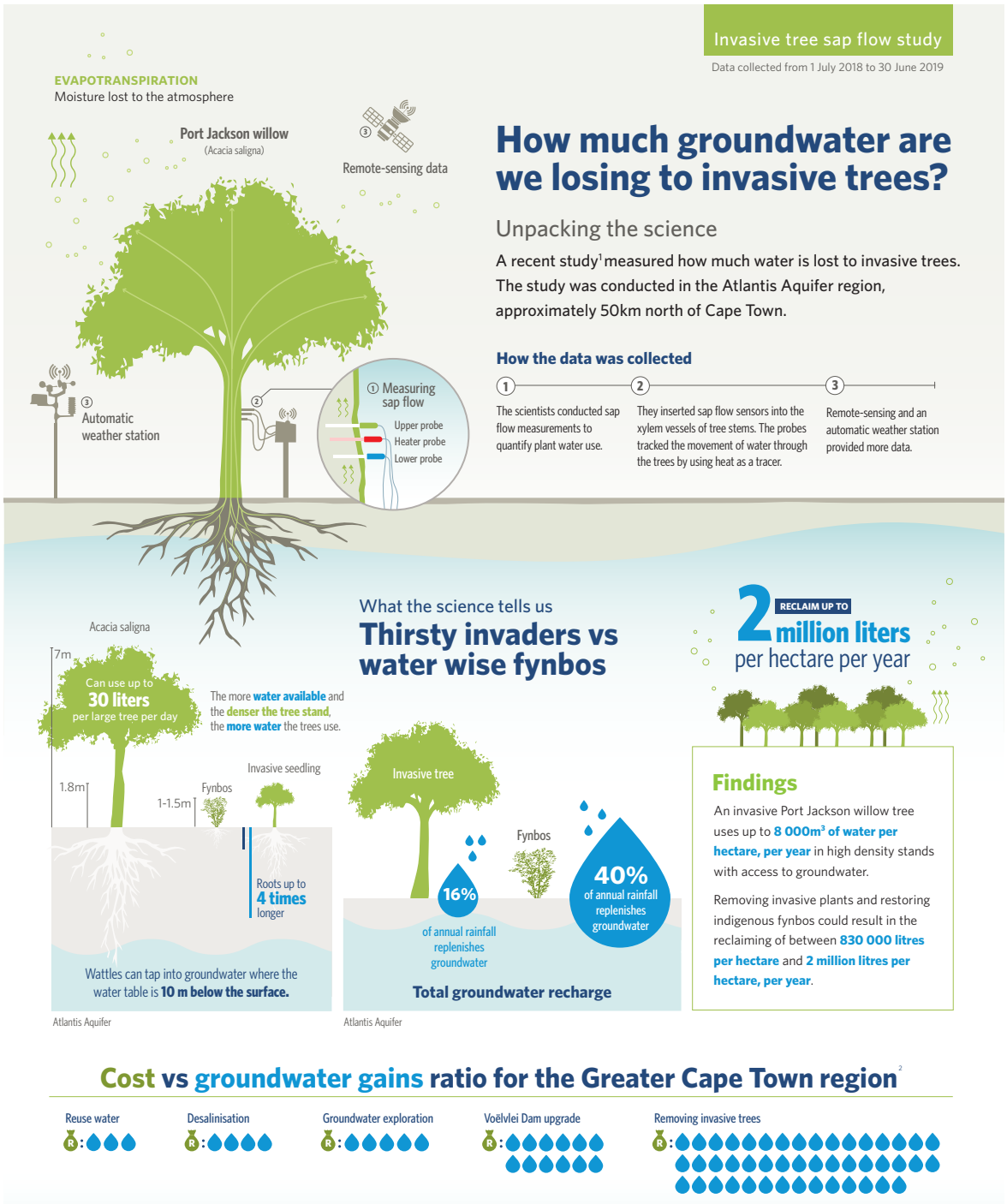
	Sector	Drought risks, exposure & vulnerability	Drought risk mitigation measures
7	Energy (extractives, power generation & distribution)	Droughts can cause increased energy demands to pump water and power cooling systems. At the same time, they can reduce the availability of water for hydropower and wood for fuel. Reliance on biofuels can increase competition with food production needs for land and water.	Shift away from fossil fuels and hydropower to cleaner renewable power sources such as solar energy.
8	Public information & awareness, culture & Sports, Education & gender issues	Droughts can cause reduced school attendance and health issues due to reduced water supplies, excessive heat, dust and reduced nutrition and health of students and teachers, and effects on households reducing their ability to pay school fees and/or remain in the areas where the schools are located. Some water- and health-related effects reduce school attendance by girls in particular. Drought effects on household economies can increase stress and domestic violence.	Ensure safe water and food supplies to schools, construct adequate schools in all areas, including provision of mobile schools, boarding facilities and transportation to schools from remote areas. Increase free or affordable access to schools.
9	Health, physical, environmental, mental, reproductive, child development, nutrition	Reduced water supplies can affect hygiene and prevalence of waterborne diseases, communicable diseases, and stress related diseases. Also excessive heat, dust and reduced nutrition affect health. Diseases can transfer from wildlife and livestock to humans. Dairy products and other perishable foods can go off faster and become contaminated more easily. Poor diets can cause stunting and other long term health problems. Dusts can cause respiratory diseases and eye problems.	Ensure adequate water supplies for all members of the population, including seasonal migrants. Ensure access to adequate health facilities and shady, peaceful outdoor environments.
10	Governance, political / electoral, law and order, security	Movements of people & animals can be accompanied by security concerns and threats due to the temporary presence of disenfranchised strangers. Scarcity of water and land resources, food and grazing areas can cause conflicts, unrest and disturbances.	Conflict resolution, community planning and decision-making, awareness-raising, collective resource management and conservation.

In addition to measures that focus on individual sectors, many programmes where there is a need for consideration of drought risk mitigation focus on building and strengthening institutions and government across all sectors (40 out of 158). Environmental policies and institutional themes appear in the World Banks list of current projects (4 projects), along with rural policies and institutions (2), infrastructure services for private sector development (4), municipal governance and institution-building (3), other public sector governance (1), decentralization (2), participation and civic engagement (1) public expenditure, financial management and procurement (2), administrative and civil service reform (1), land administration and management (1), municipal finance (1) urban services and housing for the poor (3) and other urban development (2). Also, one project with a thematic focus on debt management and fiscal sustainability is identifiable, another on micro, small and medium enterprise support, and one on regional integration.

These themes reflect a growing emphasis on "soft" or "non-structural" measures (e.g. policies and awareness raising) (Toulmin *et al.*, 2015) alongside structural (e.g. engineered and constructed infrastructure, technologies), such as digging wells and increasing reservoir water storage and irrigation delivery infrastructure to agriculture more traditionally undertaken to limit the adverse impact of natural hazards. The integrated approach (UNCCD, 2019) has been championed by the disaster risk reduction community and also by the broader communities of practice advocating

integrated water resource management for drought risk management and adaptation to climate change. Institutional and policy-focused measures are considered further in Section 4 of this knowledge product.

Figure 11: Infographic – Capetown waterfund



Source: https://panorama.solutions/sites/default/files/infographic_groundwater_losses_sapflow.pdf.

Box 2: Mitigating drought effects in the Brazilian power sector

For many of the world's major economies – including California and Brazil, hydropower has been the primary source of clean and renewable energy. During prolonged droughts, countries and regions have replaced hydropower with natural gas and coal-fuelled power plants (Lawrence, 2014). The decline of hydropower has had a more severe impact on Brazil's grid, but in both places, this development is expected to drive further dependence on gas-fired power generation and renewables. Due to the current cost of renewables, the consequences of this shift may be a rise in greenhouse gas emissions in each country's electric power sector. However, thermal plants are also often affected by droughts (Harto and Yan, 2012; Van Vliet *et al.*, 2016).

The leading producers of hydropower in the world in 2014 were China, followed by Brazil, which sourced three-fourths of its national energy supplies from hydropower. That year in Brazil, droughts resulted in blackouts across the country so in the run-up to the 2014 World Cup, the Brazilian government provided more than USD 5 billion to subsidize electric utilities*, replacing lost hydroelectric generation with fossil fuel-fired generation, including large amounts of liquefied natural gas. While this helped stabilize the grid during the event, it nearly doubled greenhouse gas emissions from the power sector.

Brazil's experience provides a harsh lesson for drought-stricken areas with a high dependence on hydropower. While natural gas is a low-carbon alternative relative to coal-based generation, it may stall or reverse carbon mitigation efforts when used in place of hydropower. Renewables can help make up the difference, but by 2014 it was clear that state-led actions would be needed to reform energy subsidies because even with sharp declines in the market prices of solar PV and wind, they remained far more expensive than hydropower or natural gas.

* https://www.eia.gov/todayinenergy/detail.php?id=16731

Source: FAO, 2019a.

Box 3: Nature -ecosystem- or land-based solutions for drought risk reduction

The concepts and practice of Nature-based Solutions (NbS), ecosystem-based adaptation (EbA) ecosystem-based disaster risk reduction (Eco-DRR), Land Degradation Neutrality (LDN) and Drought-Smart Sustainable Land Management (D-SLM) have been developed and refined in recent years as integrative approaches to reduce the risk of drought and other climate-related hazards. These approaches emphasize the role of ecological processes in reducing risk and take into consideration practices through which individuals and societies can benefit from maintaining and managing these through environmental conservation and restoration.

Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. EbA aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change (UNDRR, 2020).

Ecosystem-based disaster risk reduction (Eco-DRR) is sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development (CBD, 2018; CBD, 2019).

Nature-based Solutions (NbS) work with and enhance nature to help address societal challenges. But they exclude approaches related to biomimicry, that is, the creation of interventions inspired by, but not based on nature (GEFSTAP, 2020).

Sustainable land management (SLM). The stewardship and use of land resources, including soils, water, animals and plants to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and maintenance of their environmental functions.

All of these overlapping approaches promote the sustainable management, conservation and restoration of ecosystems and biodiversity to adapt to change. Eco-DRR, EbA, NbS, and SLM are conceptually similar, sharing common underlying principles of sustainable management, conservation and restoration of ecosystems to increase the resilience of social-ecological systems, and all tend to emphasize participatory approaches. Nature-based solutions emphasize working with nature, whereas sustainable land management, EbA and Eco-DRR span a spectrum of naturalness, from natural to semi-natural or hybrid, covering a wide range of natural to artificial ecosystems. This can include intelligent green building features and urban design.

Examples of EbA and Eco-DRR include restoration of floodplains for water storage; greening of cities to counter the heat island effect; crop diversification with indigenous varieties that are resistant to drought; the creation of protected areas to enhance ecosystem resilience and provisioning of essential ecosystem services such as sustainable management of grasslands and rangelands to enhance pastoral livelihoods and increase resilience to climate-induced drought; or green spaces, green roofs and walls in cities to reduce the risk of heat shocks, or rainwater storage to alleviate water shortages can be considered hybrid or semi-natural options. Ecosystem-based approaches can be flexible and cost-effective as an alternative to investments in humanitarian assistance or large infrastructure.

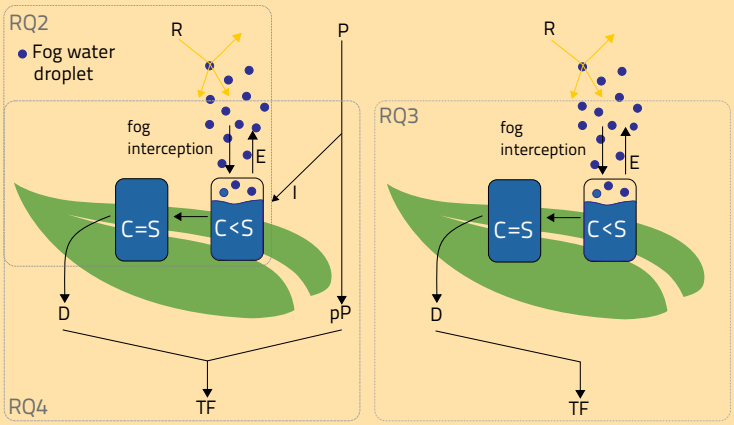
An online database provides 101 examples of NbS solutions to drought risk, including e.g. the Greater Capetown Waterfund to restore the water catchment. Whereas, increasing vegetative cover can often help to conserve water in dry environments (as in Box 3 and Figure 10), this depends on the species and context. Watershed restoration measures identified by the greater Capetown waterfund include removing thirsty invasive species that were reducing the availability of water stored in the subsurface (info-graphic).

*Source: CBD, 2018; CBD 2019*es.

Case Study 5: Nature buffers for drought management in the Andean highlands (see more detail in case studies section and Box 5)

Water supplies to the dry areas of most of South America originate in the headwaters of the high Andes mountains. These are the largest tributaries to the Amazon basin, supplying hydropower plants and domestic, agricultural and industrial consumption needs across a vast region of arid and semi-arid lowlands in the inter-Andean valleys and out along the coasts. For example, the city of Bogotá relies on the páramo in the Chingaza National Park for around 80 percent of its water supplies. The mountain ecosystems play a critical role in regulating drought risks across the South American continent. They act as a sponge that filters and slowly releases a regulated water flow to aquifers, springs and rivers.

Water from rain, fog and thawing snow and ice is collected and stored in the natural vegetation and soils of neotropical alpine grasslands that cover the upper region of the Northern Andes, known as the páramos. These areas cover 35 700 km^2 in the high mountain areas of Colombia, Venezuela, Ecuador and Peru (Rodríguez-Morales *et al.*, 2019; Buytaert and Beven, 2011; Lazo *et al.*, 2019; Buytaert *et al.*, 2006). Below the páramos, tropical montane cloud forests across the region are recognized to collect water and exercise a notable influence on catchment hydrology (Ramírez *et al.*, 2017; Molina *et al.*, 2015; Ramírez, 2018; Ramírez *et al.*, 2018).



Conceptualization of processes related to canopy interception and the research questions addressed in this study (RQ2 to RQ4). The conceptualization represents canopy interception (I) of rainfall (P), the proportion of rainfall that passes through the canopy gaps (pP) and the effects of fog in partially reflecting and scattering radiation (R) and reducing evaporation (E; RQ2), filling the canopy water storage (water stored -C in relation to the canopy water storage -S) and draining (D) during fog only events (RQ3), and enhancing through-fall (TF) during events with both fog and rainfall (P; RQ4).

Source: Ramírez *et al.*, 2018.

In the páramos, the qualities of the volcanic ash-soils favor high water retention and rapid recovery from drought (Iñiguez *et al.*, 2016). Furthermore, the natural vegetation also plays an important role in transferring water to the soil and in controlling the soil water content. This includes a range of functions for capturing mist and fog-water, as well as rain, snow and ice. For example, the stemflow processes of the natural vegetation at the high altitudes are more efficient in transferring water to the soil than other vegetation types found at lower altitudes, such as potato and maize crops (Janeau, Grellier and Podwojewski, 2015). Notably, under lower rainfall intensities, the native species transfer a higher volume of water into the soil through their stemflows than they do under wetter conditions. This means that the natural vegetation has a built-in mechanism enabling them to further help to buffer drought conditions.

Continuing scientific investigation and monitoring the health of the mountain ecosystems is important to maximize their contributions to buffering drought risks (Correa *et al.*, 2020). A recent national drought plan for Colombia gives consideration to the effects of environmental degradation in exacerbating drought risks. Across the region, increasing use is being made of innovative schemes involving payments for ecosystem services. Therefore, it is essential to generate clear models and information that decision-makers can use to continue to improve drought risk prevention and mitigation (Liniger *et al.*, 2020)

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2.3 Selecting an entry-point to mitigate drought risk (even while still recovering)

Working across different scales of decision-making is essential to the mitigation of effects that occur at the level of ecosystems and communities (see example from Mexico in Case study 6; and also Cook *et al.*, 2017; and King-Okumu *et al.*, 2017a). Drought risk mitigation measures can range in scale from the local community, household and individual scale (Table 4) up to the scales of national and regional programmes and policies, or sometimes to policies and processes that are transcontinental or global in scale. At each level, different groups of stakeholders may become involved in decision-making or implementation in differing capacities (Table 5, 6 and 7 and Box 4).

Table 4: Drought-smart land management measures

Scale	Land Use Type	Land/ecosystem management measures
Field level	Water bodies	Managing extraction to maintain minimum flows to vulnerable communities and ecosystems
		Regulation of polluted discharges/water quality management
		Use or non-use of wells, artesian or with pumping systems
	Built environment	Access to services (food distribution, water supply, health centers)
		Construction siting and practices for cooling, ventilation, access to clean water, waste management and removal
		Water and food storage, cycling, treatment
		Vegetation management for shade and air conditioning
	Rangelands	Regulating access to water & energy sources
		Seasonal/rotational grazing & mobility
		Reseeding/vegetation management
	Tree-based systems	Forest Reserves (including PAs w/ sustainable forest/natural resources)
		Afforestation & Reforestation
		Agroforestry
	Cropped lands	Improved vegetation management
		Improved water management/irrigation
		Control soil erosion
		Integrated soil & fertility management

Scale	Land Use Type	Land/ecosystem management measures
Watershed/ catchment	Mix of types listed above	Integrated watershed management
		Afforestation/conservation of forest cover
		Water harvesting & recharge
		Maintain ecological water requirements
Regional/ landscape	Mix of types listed above	Ecosystem management & classification
		Power lines and grid management
		Paved roads & transportation systems
		Transhumance corridors (people & livestock)
		Wildlife conservation, protected areas (PAs)
		Transfers/markets for water & food
		Telecommunications, radio & internet access
National	Mix of types listed above	Agricultural subsidies & incentives/PES, credit & extension/ agricultural advisory programmes
		Emergency preparedness and response, social security, insurance
		Integrated land-use planning, sustainable & inclusive access to land, responsible land governance & tenure security, & taxation
Multi-nation/ regional	Mix of types listed above	Transboundary cooperation/border management
		Surveillance, security & peacekeeping
		Access/movement of people, goods, customs
Multi-lateral / global	Mix of types listed above	Global Climate Finance
		Global Green Finance & Risk Insurance
		Environmentally Sustainable Trade Policies
		Negotiated global compensation mechanism for worsening loss and damage to land due to droughts and other climate extremes
		Other possible legal measures based on Polluter Pays principle

Source: King-Okumu and Reichhuber et al., 2019 p. 62.

Inclusive approaches that focus on including minorities and individuals and respecting diversity are important to ensure that everyone can be part of the drought risk mitigation solution. This can help to avoid situations where actions taken by some individuals or groups may contribute to exacerbating the problems faced by others. It is also very important to make sure that the most vulnerable groups are part of the discussion of drought risks and mitigation options (e.g. as in Case Study 6, or see additional example from Kenya in King-Okumu *et al.*, 2020). For further guidance including gender sensitive approaches, see the UNCCD Drought Toolbox and Case Study 9 from Central Asia. While the very local level is important for mitigating drought risks, the full range of different stakeholders will need to be involved in enabling solutions. This requires stakeholders and actors working at different scales to be informed of and receptive to the needs at the local level (Tables 5, 6 and 7).

Leadership is required from all levels to fully mitigate drought risks (Box 4 and Case Study 2). Since the local actors are the first responders and they are the most experienced and knowledgeable

Box 4: Drought risk reduction in the water sector, from small to larger scales

Many Integrated Water Resource Management (IWRM) options are available to enhance supply and reduce demand on water resources to limit exposure to drought risks. Some of the options are long-term measures that are implemented in preparation for future drought, while others are short-term and can be implemented during drought to reduce exposure. Water supply enhancements are mostly long-term options, such as new or expanded storages, aqueducts and canals, desalinization, wastewater treatment and reuse, groundwater recharge and installation of wells, water treatment and transfer infrastructure. Many of these are centrally managed, but some, such as rainwater harvesting can be implemented by water users, where there are effective incentives, policies and institutions in place (Mwenge Kahinda, Taigbenu and Boroto, 2010; Lebel *et al.*, 2015).

In-situ water harvesting practices include ridging in fields to slow runoff, mulching to reduce evaporation of soil moisture and reduced or no tilling. It also include sustainable land management and climate change resilience, as implemented by Saidi Mkomwa, African Conservation Tillage Network (ACT), and watershed organization trust (WOTR) in Kumbharwadi, Maharashtra, India (Srinidhi and D'Souza, 2018). *Ex-situ* options include small water harvesting dams and agroforestry measures that stabilize soils and improve microclimates to reduce evaporation. These can have positive effects on yields, biodiversity, water quality, land restoration and soil erosion reduction under drought and non-drought conditions (Mekdaschi-Studer and Liniger, 2013; Dile *et al.*., 2016a; Dile *et al.*., 2013; Dile, Rockström and Karlberg, 2016b; Worku *et al.*., 2020; Worqlul *et al.*., 2018) (see also Case Study 4).

Farmers taking part in a project to reverse environmental degradation and rural poverty through adaptation to climate change in drought Stricken Areas in Southern India via a hydrological unit pilot project approach in Andhra Pradesh recorded reduced input costs and sustained yields during drought due to adaptations organized by Climate Change Adaptation Committees including water harvesting/storage, water conservation, intercropping and border cropping, mulching, integrated pest management/non-chemical pest management, and fodder cultivation (GEF/IEO, 2015; GEF/IEO, 2018).

Water demand reduction options can be substantially more cost effective than supply enhancements and can sometimes be implemented rapidly (UNCCD 2019). This makes them suitable for implementation either before or during drought in response to specific triggers of severity. Demand measures include water saving education programmes, regulation of water allocation and use, water monitoring, metering and forecasting systems, water markets and pricing, and water efficient technologies. The implementation of supply augmentation and demand management options must be fair, equitable and targeted at reducing vulnerability (see also Stevens, Turner and Sarkar, 2019; WWF-GIWP-UNESCO, 2016; Vogt and Somma, 2000; Groves *et al.*., 2019). Normally, these are part of national water resource management planning and/or planning at the catchment scale.

In some cases, IWRM requires larger scale approaches that may be transboundary amongst neighboring riparian countries along a shared watercourse or basin. In others, they may even be transcontinental – where international trade and economic development policies have been found to drive unsustainable water extractions to supply irrigation for commodities that are grown for export. International and global drivers can also cause other threats to water resource availability during droughts – e.g. via demand for polluting industries, densely populated settlements with

inadequate sanitation and waste removal facilities or land-use changes that cause deforestation and loss of hydrological regulation. Mitigation measures to address these globally driven effects on exposure to drought risks in the water sector can require awareness-raising amongst distant communities as well as those who are on the receiving end of the drought risks and impacts.

Source: based on UNCCD, 2019; FAO, 2017; FAO, 2020.

in understanding the drought risks that affect them. Because of this, the identification of solutions often can and should be led from the very local level. On the other hand, the mobilization of resources and capabilities needs to be enabled from the national level. Sometimes this has implications for leadership or regulation also from the other levels as well. There are also important scales for decision-making at the intermediate scales of water catchments, landscapes and basins. In many cases, these can be transboundary either within or between countries and regions. This raises challenges and needs for institutional coordination.

The devolution of responsibilities for drought risk management and adaptation is a common feature of many national frameworks, including the Senegalese national planning framework for climate change adaptation, the Malian national planning framework, the Kenyan framework and many others. This is intended to ensure that the plan will not only be community based, but also that it can be effectively coordinated and endorsed across all levels of government. Tunisia's voluntary national review of the achievement of SDG 6 describes the preparation of a new water code which will put in place a decentralized participatory governance process (RoT, 2019, p. 100). This will recognize water as a "collective heritage" to be managed through the decentralized institutions, including those that operate in the southern part of the country (Case Study 4). The draft code stipulates the creation of regional water councils and organizes collective rights to water and sanitation.

Where national ministries and agencies for water resource management tend to experience difficulties in reaching the drier regions of certain countries, such institutions struggle to lead drought risk mitigation. In these situations, regional and local institutions that are able to work across sectors and engage local stakeholders have a very important role (Box 4). This has been demonstrated successfully in the case of Tunisia (Case Study 4) where local agricultural development associations have consistently played a key role in managing water at the local level. In Mexico and Brazil, critical roles are played by watershed councils and municipalities (Case Study 6 from Mexico and Case Study 3 from Brazil). In some countries, such as the United Kingdom of Great Britain and Northern Ireland and Australia, drought preparedness planning is not only devolved to the regions, but specific responsibilities are also entrusted to privatized water utility companies that are regulated by the State through a national regulatory agency (Cook *et al.*, 2017; WWF-GIWP-UNESCO, 2016).

Within countries, national drought planning is often the responsibility of a particular Ministry or Agency – sometimes a Ministry of Agriculture, or a Ministry of Water. In some countries, there is an expectation that drought risk preparedness and response will be mainstreamed across sectoral agencies and departments, whereas in others this is not the case. Often, national adaptation planning for climate-related hazards including drought is led by a Ministry of Environment, in coordination with other sectoral ministries. In the extreme event of a drought emergency, often

the Head of State may have to take charge of response planning to ensure strategic coordination. A temporary parastatal emergency coordination structure may then be established. In Lebanon, a parastatal agency has coordinated all emergency assistance and reconstruction actions since the civil war – including assistance to the regional water establishments to cope with drought, refugees and other challenges (Verner *et al.*, 2018)

Case Study 6: Watershed councils and municipalities lead the national strategy to mitigate drought risk – Programa Nacional contra la Sequia, Mexico (see more details in the case studies section)

In 2013, Drought Prevention and Mitigation Measures Programmes (PMPMS) were created in 26 Watershed Councils across Mexico (as well as 13 cities). In order to do this, selected universities were engaged by the Instituto Mexicano de Tecnología del Agua (IMTA) to provide local technical support to each of the watershed councils (Meza-González and Ibáñez-Hernández, 2016).

The programme consists of two components:

1. Developing programmes of measures to prevent and reduce drought risks at basin or basin groups.

2. Implementation of actions to mitigate the effects of existing droughts.

For each of the 26 Basin Councils, a specific programme of measures to prevent and mitigate drought is elaborated following a vulnerability assessment. In general, these strategies focus on (WWF-GIWP-UNESCO, 2016):

- improving permanent monitoring of rainfall and climatic conditions and at a national scale the development of a strong cooperation with Canada and the United States of America to monitor drought occurrence and evolution in the three countries;
- reducing the assigned volumes of water, mainly for farming activities and hydroelectric power generation;
- implementing federal programmes that provide economic resources to states, municipalities, irrigation districts and irrigation units to improve the use of clean water and the reuse of treated wastewater, so volumes required by different users are diminished;
- accessing additional federal support from a specific emergency fund to carry out emergency measures, such as: clean water supply through portable treatment plants, implementation of health monitoring and protection measures, emergency well drilling and operation, and rehabilitation and renovation of hydraulic infrastructure.

WMO/GWP (2014), IBRD (2017) describe how CONAGUA staff and researchers from 12 national institutions were trained to standardize the activities and contents of these programmes, which were implemented in the second and third years of PRONACOSE (2014–2015). After evaluation of the implemented programmes in 2016–2017, the programmes were to be improved, updated, and implemented again from the sixth year (2018). A continued gradual implementation beyond the sixth year is expected through ownership of the programmes by the basin councils.

Insight provided by: Rene Lobato Sanchez, National Water Commission of Mexico (CONAGUA/Mexican Institute of Water Technology (IMTA)), Mexico.

In Kenya, where drought risks have been recognized as a long-term structural challenge to national development, a permanent National Drought Management Authority (NDMA) was established under the Ministry of Devolution and Planning. This replaced a series of short-term project-based structures that had previously relied on external donor support. Within Kenya, the NDMA plays an important national coordination role, not only amongst the national sectoral agencies and different levels of government within the country and affected communities. It also provides an essential focal point for coordination across the international donor community. In its turn, the UNDRR plays an important coordination role from the international level. At the local level, county governments are expected to coordinate. The NDMA therefore provides capacity building and backstopping support to enable them to do so.

Table 5: Examples of local level stakeholders and their potential contributions to the proactive approach

Stakeholders	Roles in identification and delivery of mitigation measures
Individuals & households (including different economic status, age, gender, nationalities, etc.)	Provide knowledge on well-being issues and input to plans and related processes.
	Identify and publicize priorities related to evidence and knowledge needs.
	Seek, claim and make use of access to data and information.
	Encourage integration across sectors, policies and plans at all levels.
	Engage in and advocate capacity building around drought issues.
	Participate in the development of Drought Risk Management strategies.
	Inform international cooperation and national polices, plans and programmes where these will affect or seek to benefit individual or household interests and concerns.
Local businesses	Provide knowledge on business issues and input to plans and related processes.
	Identify and publicize priorities related to evidence and knowledge needs to be drought-resilient and prepared.
	Seek, disclose and enable use of access to data and information about the business activities, resource use and sustainability.
	Advocate sector policies and plans according to business needs.
	Engage in and advocate capacity building around drought issues.
	Participate in the development of Drought Risk Management strategies.
	Maintain good public image and corporate social responsibility.
Local community groups and customary associations	Share knowledge on community issues and input to plans and related processes.
	Identify and publicize priorities related to evidence and knowledge needs.
	Seek, advocate and enable use of access to data and information.
	Advocate sectors, policies and plans according to community needs.
	Engage in and advocate capacity building around drought issues.
	Participate in the development of Drought Risk Management strategies.
	Inform international cooperation and national polices, plans and programmes where these will affect or seek to benefit community interests and concerns.

Stakeholders	Roles in identification and delivery of mitigation measures
Non-governmental Organizations (NGOs)	Share knowledge on organizational agendas and input to plans and related processes. Identify and publicize priorities related to evidence and knowledge needs. Seek, advocate, disclose and enable use of access to data and information. Advocate sectors, policies and plans according to community needs. Engage in and advocate capacity building around drought issues. Participate in the development of Drought Risk Management strategies. Inform international cooperation and national polices, plans and programmes where these will affect or seek to promote interests and concerns of the organization.
City or village governments	Share knowledge on plans and related processes. Facilitate participation and capacity-building of local community and other stakeholders Translate on the ground concerns to influence national strategic planning process Translate the national strategic planning process back into on the ground actions Identify and publicize priorities related to evidence and knowledge needs. Seek, advocate, disclose and enable use of access to data and information. Coordinate, align and deliver sectors, policies and plans according to local needs. Engage in, deliver and advocate capacity building around drought issues. Participate in the development of Drought Risk Management Strategies. Inform international cooperation and national polices, plans and programmes where these will affect or seek to benefit local people and their governance processes.

Source: Modified from WWF-GIWP-UNESCO, 2016 and King-Okumu et al., 2017a.

Table 6: Examples of sub-national/regional level stakeholders and their potential contributions to the proactive approach

Stakeholder	Roles in identification and delivery of mitigation measures
Farmers associations and agricultural sector	Share knowledge on agricultural development plans and related processes. Facilitate participation and capacity-building of local community and other stakeholders. Translate on the ground concerns to influence national strategic planning process. Translate the national strategic planning process back into on the ground actions. Use drought-smart conservation practices to increase soil moisture, reduce evaporation, reduce runoff and encourage infiltration, consider the best management of water for livestock and irrigation systems, select drought-adapted varieties, maintain and establish riparian buffers, filter strips, grassed waterways, and other types of conservation buffers near streams and other sources of water. Identify and publicize priorities related to evidence and knowledge needs, install and maintain monitoring systems (e.g. devices for monitoring water resource conditions, use and trends in quality parameters). Seek, advocate, disclose and enable use of access to data and information. Coordinate, align and deliver sectors, policies and plans according to local needs. Engage in, deliver and advocate capacity building around drought issues. Participate in the development of Drought Risk Management strategies. Inform international cooperation and national polices, plans and programmes where these will affect or seek to benefit local people and their governance processes.

Stakeholder	Roles in identification and delivery of mitigation measures
Local credit agencies, banks and insurance providers	Provide credit and insurance to individuals and businesses on responsible terms. Encourage participation and capacity-building of local community and other stakeholders, as needed. Encourage responsible access to and use of data and information. Favor the development of Drought Risk Management strategies and sustainable development.
Utility service providers (water, energy, transport)	Continue to promote water efficiency messages among customers and volunteer water saving during droughts. Reduce water footprints and support their customers in reducing water use (through, for example, efficient appliances). Reduce dependence on water consumptive activities.
Academic institutions	Contribute evidence on the drought hazards, exposure and vulnerability. Provide data and information on drought risks (present and future). Help build capacity across drought issues.
Media, public information and communications providers	Raise awareness of evidence on the drought hazards, exposure and vulnerability. Provide data and information on drought risks (present and future). Help build capacity across drought issues.
Regional (within-country) government and development agencies	Facilitate integration across and within a region. Provide knowledge and advice on sector policies, plans and related processes. Identify and publicize priorities related to evidence and knowledge needs. Facilitate access to data and information at local and national levels. Encourage integration across sectors, policies and plans at all levels by creating and strengthening linkages as needed. Facilitate capacity building around drought issues. Participate in the development of Drought Risk Management strategies. Act on evidence to inform national polices, plans and related programmes.
Catchment and watershed institutions (multi-jurisdiction, multi-stakeholder)	Facilitate integration and cooperation across and within a catchment. Provide knowledge and advice on sector policies, plans and related processes. Identify and publicize priorities related to evidence and knowledge needs. Facilitate access to data and information at local and national levels. Encourage integration across administrative boundaries, sectors, policies and plans at all levels by creating and strengthening linkages as needed. Facilitate capacity building around drought issues. Participate in the development of Drought Risk Management strategies. Act on evidence to inform national polices, plans and related programmes.

Source: Modified from WWF-GIWP-UNESCO, 2016.

Table 7: Examples of national and international stakeholders and their potential contributions to the proactive approach

Stakeholder	Roles in identification and delivery of mitigation measures
Sectoral agencies of national government	Provide knowledge and advice on sector policies, plans and related processes. Identify and publicize priorities related to evidence and knowledge needs. Facilitate access to data and information. Encourage integration across sectors, policies and plans at all levels. Facilitate capacity building around drought issues. Participate in the development of Drought Risk Management strategies. Act on evidence to inform international cooperation and national polices, plans and other water and development related programmes.
Interdepartmental structures of national government	Provide knowledge and advice on cross-sectoral policies, plans and related processes. Identify and publicize priorities related to evidence and knowledge needs. Facilitate access to high level decision-making, as needed Encourage integration across sectors, policies and plans at all levels. Facilitate capacity building around drought issues. Drive the development of Drought Risk Management strategies. Act on evidence to inform international cooperation and national polices, plans and other water and development related programmes.
Donor coordination groups and development partners to national governments	Align priorities, programmes and resources to country needs and priorities. Acknowledge and enhance capacity building around drought issues. Facilitate the development of stakeholder owned Drought Risk Management strategies. Act on evidence to inform international cooperation and national polices, plans and other water and development related programmes.
Regional (transnational) economic communities	Align priorities, programmes and resources to country needs and priorities. Assess and enhance capacity building around drought issues. Facilitate the development of stakeholder owned Drought Risk Management Strategies. Act on evidence to advocate and improve international cooperation and national polices, plans and other water and development related programmes.
Transboundary resource management programmes	Align priorities, programmes and resources to country needs and priorities. Facilitate and deliver capacity building around drought issues. Facilitate the development of stakeholder owned Drought Risk Management strategies. Act on evidence to advocate and improve international cooperation and national polices, plans and other water and development related programmes.
International agencies (technical or financial assistance)	Align priorities, programmes and resources to country needs and priorities. Facilitate and deliver capacity building around drought issues. Facilitate the development of stakeholder owned Drought Risk Management strategies. Act on evidence to advocate and improve international cooperation and national polices, plans and other water and development related programmes.

Stakeholder	Roles in identification and delivery of mitigation measures
International policy processes	Align priorities, programmes and resources to country needs and priorities.
	Facilitate and deliver capacity building around drought issues.
	Facilitate the development of stakeholder owned Drought Risk Management strategies.
	Act on evidence to advocate and improve international cooperation and national polices, plans and other water and development related programmes.
Global business and finance community	Provide knowledge on business issues and input to plans and related processes.
	Identify and publicize priorities related to evidence and knowledge needs to be drought-resilient and prepared.
	Seek, disclose and enable use of access to data and information about the business activities, resource use and sustainability.
	Advocate sector policies and plans according to business needs.
	Engage in and advocate capacity building around drought issues.
	Participate in the development of Drought Risk Management strategies.
	Maintain good public image and corporate social responsibility.

Source: Modified from WWF-GIWP-UNESCO, 2016.

A recent strategic guide prepared by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (UNESCAP, 2020) emphasizes the role that regional coordination amongst groupings of neighbor countries can play in mainstreaming adaptation to drought. Regional level coordination and transboundary cooperation has also been important across the Arab Region – both for drought risk assessment and preparedness planning (AWC, 2019), and also for emergency response and relief work. A number of case studies in this knowledge product draw on other experiences from the regional level – including in the High Andes (Case Study 5), the Dry Corridor (Case Study 7), East Africa (Case Study 8), Central Asia (Case Study 9), and West Africa (Case Study 11).

UNESCAP identifies a range of different entry-points at which it can be possible to design drought risk mitigation actions that will successfully cut across sectoral boundaries. This includes actions at the very local level – e.g. through district-level planning. The feasibility of these entry-points will depend on the availability of institutional structures, capacities and finance. Coordination amongst multiple stakeholders is time consuming, and therefore relies upon the availability of resources in terms of agency staff time, communications and meetings.

Following the establishment of a comprehensive and clear problem scope and definition or map (as described in the previous sections), simple devices such as decision trees can help decision-makers at each scale to analyze causal factors, processes and intervention opportunities to mitigate drought risks. These can reveal entry-points that do not necessarily need a change in the global scale climate system to immediately mitigate drought risks. Rather, they often focus more simply and directly on changing human resource management, behavior or decision-making to reduce exposure and vulnerability to drought risk. Observing, understanding and learning from the experiences of past drought hazards can help stakeholders to identify the most tractable aspects of risk at different levels within the ecosystem and community and the measures that are available to reduce or fundamentally reverse them.

3. Sustainably reducing residual drought risks and emergencies

Since droughts will always occur, dealing with emergencies remains a necessary part of proactive IDM. This requires effective responses to be ready and prepared in advance. In these cases, an important question is: How can continuing response systems and actions contribute to rather than weaken longer-term drought resilience? This section includes knowledge gained by putting in place more systematic early responses that are better integrated to learning and evaluation and enable effective feedbacks to prevention and recovery.

Declaration of emergency and extraordinary measures can help in occasional extreme cases. But recurrent emergencies generally do not improve responsible social decision-making. When this happens, people will tend to adapt and assimilate dysfunctionality as a systemic feature of the new normal. Usually there are limitations on the extent to which response-oriented emergency programming to achieve humanitarian objectives can allocate necessary resources also to feed into longer term recovery and sustainable development planning. However, there is also a growing realization that sustainable development gains cannot be secured without first addressing the disasters such as drought that continuously threaten and obliterate development progress (Case Study 1 from the Sahel and Case Study 2 from India). This is reflected in the growing emphasis on risk-informed sustainable development to achieve the sustainable development goals (UNDRR, 2019b; GEF/IEO, 2018).

Since the 1970s, the international community has accumulated five decades of experience in responding to droughts and other disasters (UNDRR, 2019b). Rapid and well-targeted responses can help to avoid the escalation of losses by enabling early actions at the onset of droughts. Responding effectively to drought requires institutional structures to be in place to rapidly assess needs and sufficient resources to deliver relief as required, when and where it is needed. Assessments of drought risk, vulnerability and impact (Pillar II of IDM) are explored in more detail in a parallel

knowledge product devoted to them[24] as well as via the broader consideration of vulnerability, risks and adaptation to climate change by the UNDRR series of Global Assessment Reports on disaster risks and response(UNDRR, 2019b)[25], and the literature of climate change adaptation needs(UNEP, 2021). Better targeted and resourced responses building on such assessments require significant in-country coordination.

The following topics are explored in this section:

- Achieving more timely responses to prevent harm to the most vulnerable;
- Resourcing and coordinating responses and recovery; and
- Connecting better from emergency response to sustainable development.

3.1 Achieving more timely responses to prevent harm to the most vulnerable

Once a drought emergency is declared, this signals a departure from "normal" operating conditions. This can mean that extraordinary measures will be taken, established plans will be changed, basic services may not be assured to citizens and procedures for budgeting and resource allocation can also be adjusted or overridden due to the ensuing disaster and incapacity of available institutions to cope. Often, the process of drought declaration has been a response to a "crisis" situation – where a state – e.g. via its civil protection agency (or other) uses its powers to "declare" emergency. It may then later "deactivate", the drought declaration. For example, in Brazil, the federal government recognizes two special states, that can be declared, whether it is for a drought event or any other disaster (Gutiérrez *et al.*, 2014):

- A Declaration of Emergency (less severe): an abnormal situation provoked by disasters that cause damages and losses, which are grave enough for the local government to be partially unable to respond. In these cases, the State may request support from the Federal Government for the delivery of cash transfers and/or trucking for water distribution to prevent escalation from emergency to calamity.
- A State of Public Calamity (more severe): is an abnormal situation provoked by disasters that cause damages and losses which are grave enough for the local government to be substantially unable to respond. This can involve loss of life.

Guidelines note that the declaration of either situation or state should last for as short a time as possible (to re-establish normality) and also only include the areas affected by the drought declaration (Gutiérrez *et al.*, 2014; WWF-GIWP-UNESCO, 2016). In many countries, past declarations of drought have been criticized for including limited understanding of the risks and limited engagement of the relevant stakeholders to determine what is the situation, what response will be needed, and by whom (Case Study 2 from India). This leaves them open to criticism and accusations of corruption, bias and economic or political motivations. There can be concerns that

[24] See: https://www.unccd.int/sites/default/files/relevant-links/2019-09/190829%20UNCCD%20A%20Rapid%20Review%20Web.pdf

[25] See: https://gar.undrr.org/

declarations may favor a particular group of influential stakeholders, typically from farming or industry. There may be little incentive for such groups to prepare responsibly for drought if they can instead expect to take advantage of emergency powers.

Wider groups of stakeholders, especially those representing marginalized groups or environmental interests, can find themselves excluded both from the drought declaration process, and from the identification of measures to be taken. To make things worse, during crises, points of view on the way forward can become polarized, and collective decision-making can become more difficult than usual. Recently, improved systems to avert the escalation of a drought crisis have been put in place in the city of Capetown, for example, following some difficulties that were faced there (Rodina, 2019; Muller, 2018).

To avoid and reduce problems concerning the declaration of droughts and increase the systematization of response measures, many countries have established ways to classify different levels of drought status using expert judgement and/or objective indicators and measurements. Often, these are systematized via early warning systems (see pillar I of IDM). They reduce the level of discretion required from decision-makers and help to make the path to action less contentious and more objective, as well as to speed the delivery, reducing uncertainties and errors. They can also provide reassurance to external partners and funding agencies that they have a factual assessment of the relative severity of the drought situation, and a clear basis for action that will be free from accusations of corruption.

In many parts of the world including in India, Kenya, and many others a drought management plan supports the process of "declaration" and sets out in detail what action will be taken in case of a drought, who will be responsible for the drought declaration, who should be consulted, what evidence should be used, etc. It is important to understand that drought management and response plans are used in both developing and developed countries such as England, Australia and some parts of the US, such as California (WWF-GIWP-UNESCO, 2016). However, the nature of responses will vary according to different contexts and conditions. Over 30 validated national drought plans from different developing countries are available online in the UNCCD drought toolbox in order to showcase best practices and promote learning among countries.[26]

Approximately one third of all support provided by the GEF through its Least Developed Countries Fund (LDCF) to a cohort of 29 completed projects reviewed in a 2020 annual review (GEF, 2020) had been devoted to the development of early warning systems for drought and other hazards. This was more frequent than any other common thematic focus that the Independent Evaluation Unit could identify amongst the LDCF portfolio. The first pillar of IDM is devoted to the development of drought alerts through early warning systems (FAO, 2018c; WMO, 2006). Relevant topics are also covered by the IDMP Handbook of Drought Indicators and Indices (Svoboda and Fuchs, 2016). Alternative approaches to drought monitoring including more direct ground-level focus on water levels in water bodies and reservoirs are also in use in some countries (WWF-GIWP-UNESCO, 2016). The quality of responses using any or all of these tools rely on the uses that individual human decision-makers, institutions and societies identify the need to make of them.

[26] Available at: https://knowledge.unccd.int/drought-toolbox/page/drought-planning

Drought responses are often phased – according to different levels of severity of the drought conditions. These can refer to characteristics of drought effects, and types of preparedness and responses to them that are required across a range of different environmental compartments and economic sectors – including industry, energy, water, environmental protection, municipal and agricultural sectors, as well as social protection and financing sectors (see discussion of the cross-sectoral nature of the drought challenge in previous section). Examples of drought classification systems can be found in the Indian Manual for drought (Case Study 2), as well as the drought monitor in the United Kingdom of Great Britain and Northern Ireland[27] and many of the available national drought plans in the UNCCD online toolbox.

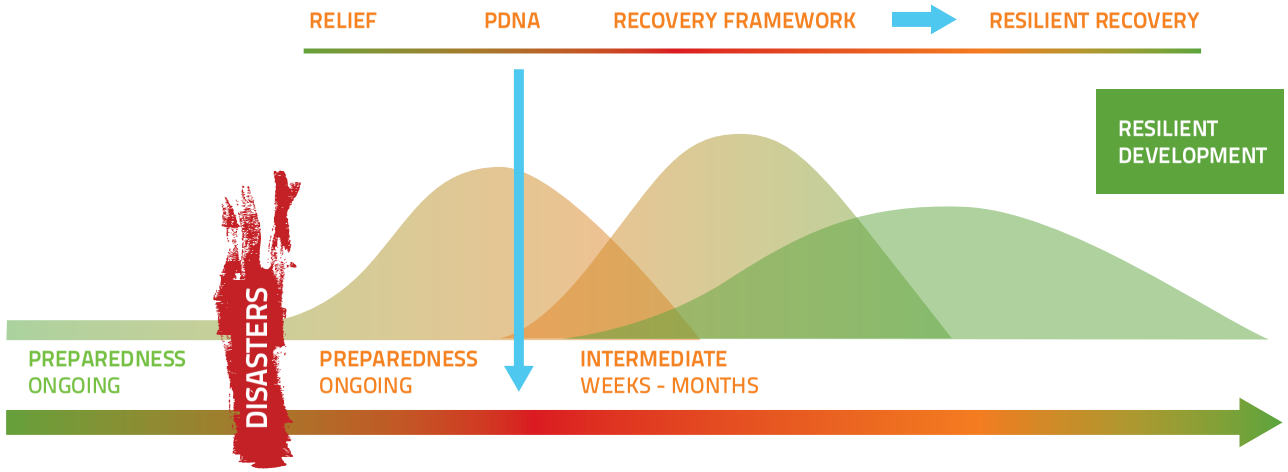
A broad range of drought response and preparedness measures can be triggered by drought declarations. Drawing on available developed country frameworks (WWF-GIWP-UNESCO, 2016) and developing country developing country experiences, an illustrative typology of selected disaster response and preparedness measures can be presented (Figure 11). Most of the response options require preparatory activities and resourcing to enable timely and effective delivery when droughts hit. In many cases, drought-affected communities can be able to prepare themselves for oncoming droughts, assuming some basic conditions and assumptions.

It is widely observed that the reality of a drought is invariably different to whatever scenario may have been planned for (WWF-GIWP-UNESCO, 2016). Planning for a greater range of drought scenarios and embedding an adaptive, but open and transparent, process of adjustment as the drought extends can help with this somewhat. Acknowledging and managing flexibility, responsibility and any constraints limiting human capacity is important. These factors should be kept in view and maintained in a careful balance. Flexibility is as important as following plans and procedures because if decision-makers claim that they are entirely unable to make or change their decisions, as needed, this is an abdication of their responsibility. Where such situations occur, they can be indicative of deepening risk factors that may need to be faced by the society.

For many countries, drought effects and their dynamics can be occurring on scales that exceed the boundaries of their territory and jurisdiction. These require transboundary responses, preparedness and coordination. Alongside the growing range of national, sub-national and municipal response systems are regional platforms and action systems have been established and are operating in different ways across various parts of the world – e.g. in Africa an important role is played by the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) in West Africa; Intergovernmental Authority on Development (IGAD), Climate Prediction and Applications Centre (ICPAC), and Regional Centre for Mapping of Resources for Development (RCMRD) in the East; Southern African Development Community (SADC) in the South; and the Sahara and Sahel Observatory (OSS) in the North.

[27] Available at: https://eip.ceh.ac.uk/droughts

Figure 12: Phases of human decision-making preparing for drought response and recovery: ideal view and basic inherent assumptions



Assumptions	Preparedness	Relief and assessment	Needs assessed recovery	Resilient recovery
Local authorities can budget for vehicles	Prepare fuel supplies, water trucks and staff	Emergency water supplies	Re-inject resources to restore water supplies	Re-establish local resource management
Authorities or NGOs funded & operational	Stock foods and prepare distribution system	Food relief distribution and fire-fighting	Restore productive assets and activities of households	Restore good nutrition practices and replenish food-stores
Local land users needs not threatened /resolve conflicts	Areas for tents with access to water supplies and safety	Shelter displaced people and serve basic needs	Interim housing and assess needs for services	Permanent housing and/ or re-established seasonal use
Management financially stable and experienced	Establish back-up generators, fuel stores and mgt structures	Emergency pumping systems operational, w power supply	Map water sources, storage and needs: prioritise upgrade	Restructure and adapt water management infrastructure
Availability of financial resources & political will	Prepare emergency funds and economic planning	Emergency cash transfers and assess households coping	Re-establish businesses	Economic revitalization
Resource users budget for vaccines and non-wood fuels	Vaccinate livestock, store feeds, assess grazing reserves	Emergency salvage of assets (livestock, trees, crops, etc)	Supplemental livestock feeds and conservation of trees	Recognize and invest more in drought-smartest systems
Local authority services or NGOs funded & operational	Prepare water purification aids, first aid supplies, points for distribution, awareness	Emergency medical attention for waterborne diseases, dusts, heat stress, etc	Restore basic health care services. Assess needs of settled & transient people.	Enhance basic healthcare services, environmental health,
Functioning social systems and absence of other conflicts	Social support systems and networks	Trauma counselling for individuals	Community mobilization	Return children to school
Sufficient resources and will for database management	Information systems and databases	Assess and understand vulnerability	Strategize risk mitigation options & take opportunities	Implement strategic risk mitigation actions as agreed

The regional bodies connect to regional forecasts within the WMO Global Framework for Climate Services,[28] and also work in various ways to build the accuracy of forecasting capabilities. Seasonal forecasts are shared through regional Climate Outlook Forums.[29] In some cases, the regional decision-support platforms also set out to reinforce capabilities within the national and sub-national agencies. However, such initiatives cannot necessarily extend to resourcing the local and national agencies that are expected to make use of them to improve their responses to droughts.

Increasingly, the private sector is involved in the delivery of services to populations where drought sensitivity and response are essential (see example from a private water utility company in Figure 13). In addition to the provision of water supplies, these also include other services such as energy from hydropower, and also insurance and credit for investments in agriculture. Companies involved in the production of major export commodities, such as tea, coffee and sugar from East Africa also do invest in their own systems based on early warning information to respond to climate risks.

3.2 Resourcing and coordinating responses and recovery

Coordination structures and institutions are important to ensure effective drought response and recovery. Resource constraints are often seen as a major limiting factor for coordination – since it is difficult for agencies and individuals to act without these. Where resources are confirmed, the focus and mode of operation required from coordination institutions and individuals can be clearer and more straightforward. This clarity and coordination make it easier for external partners to contribute assistance effectively during times of need.

There is a need for stakeholders and partners to work together to assess the needs for actions once disasters such as drought have hit – or ideally sooner. Some recognition of what this means in practice has been accumulated, documented and made available through the Global Facility for Disaster Reduction and Recovery (GFDRR) (Jeggle and Boggero, 2018). Just conducting post disaster needs assessments – even before taking rapid actions to deliver effective responses when and where they are needed – requires significant resources to be available to support both delivery and coordination activities. Where institutional structures, databases and procedures are already in place to rapidly assess the needs for action in drought-prone regions, this can help to save time.[30]

Post-disaster needs assessments themselves depend on their own resourcing and coordination requirements. Ensuring that sufficient contingency plans and resources are in place beforehand to cope with the emergencies as they arise is critical. This can enable actions to be taken in a less haphazard and more coordinated way. It can also enable greater consideration, time and scrutiny to be devoted to the preparation and design of emergency funds, contingency funds and insurance programmes at a range of different levels. Post-crisis evaluations are also important processes for learning.

The World Bank has worked extensively on risk financing, risk layering and risk transferring to maintain current livelihoods (GFDRR, 2020) (Figure 4). Where risks cannot be reduced through

[28] See: https://gfcs.wmo.int/ and https://gfcs.wmo.int/gfcs_implementation

[29] See: https://public.wmo.int/en/our-mandate/climate/regional-climate-outlook-products

[30] See: https://www.unccd.int/sites/default/files/relevant-links/2019-09/190829%20UNCCD%20A%20Rapid%20Review%20Web.pdf

proactive investments (as described in the previous section), the remaining risks can either be retained or transferred (Table 8). By definition, risk financing is aiming to preserve the status quo. This involves:

- improving macro-fiscal frameworks to support drought preparedness and response;
- ensuring access to capital to respond to drought, for example through contingent financing;
- creating insurance programmes that focus on sharing drought risk between parties and be based on solid analysis of hazards and risks; and
- planning social safety net programmes and financial protection programmes in key sectors vulnerable to drought impacts, e.g., agriculture insurance, financial support programme for tourism industry, etc.

These measures can help by guaranteeing availability of rapid and predictable funds to deliver early action to protect vulnerable areas, communities and households at risk. A taxonomy of disaster risk financing instruments (Meenan, Ward and Muir-Wood, 2019) demonstrates that they can be tailored to different groups (or "risk-holders") with needs for vary timing, purpose, scales and levels of support (Table 8). It can also be possible for measures designed to finance drought response and recovery by retaining or transferring risks (Table 8) to also build in financial incentives for more proactive investments in drought risk reduction (as described in Section 2). These might include, for example, reduced premiums for land-users who invest in sustainable land and water management practices that would make disastrous drought events less likely to occur.

The GFDRR is a multi-donor trust fund that is managed by the World Bank. At the national level, a range of sovereign national drought funds also exist -such as the Australian drought fund and the Kenyan drought contingency fund. At the sub-national level, devolved funds that can be managed by responsible agencies can focus on the level of catchments, local governments (counties or municipalities), or community level (see Case Study 7 on Community Contingency Funds in the Dry Corridor of Central America). Examples of community-level arrangements include emergency revolving funds and others. At the household level, building up reserves of savings and also other productive assets[31] can ensure that they are there to be used in times of need due to drought. This is important because where droughts destroy income and productive assets or raise prices for basic commodities and resource access, households can be forced sell other remaining assets, go into debt or engage in other risky coping strategies.

The FAO Drought Portal contains numerous examples of emergency responses to drought, including 20 for the Horn of Africa region alone, alongside many for other regions as well. For example, the Special Fund for Emergency and Rehabilitation Activities (SFERA)[32] was established in 2004 to enhance FAO's capacity to rapidly respond to emergency situations. Through strategic resource partner funding, SFERA provides FAO with the financial means and flexibility to react promptly to humanitarian crises, reducing the time between funding decision and action on the ground. From its inception in 2004 through 31 December 2019, SFERA received USD 249 million, which enabled response to a range of sudden onset disasters, including El Niño response, pathogenic avian influenza, desert locust outbreaks, fall armyworm, and other protracted crises, as well as droughts.

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31 It is important to understand that savings and credit systems are often different in developing countries from those in developed countries. Traditional societies often regard their productive assets, such as livestock, land and social relations as a form of savings and credit systems. Where cash cannot be kept in the bank, it may also be kept in other ways and forms – e.g. in jewelry and other tradeable goods and commodities alongside land and livestock.

32 Available at: http://www.fao.org/emergencies/about/funding/sfera/en/

Forecast-based financing (FBF) releases humanitarian funding based on forecast information for planned activities which reduce risks, enhance preparedness and response, and make disaster risk management overall more effective. A humanitarian agency and stakeholders like meteorological services and communities at risk can agree and plan on selected actions that will be worth carrying out once a forecast reaches a certain threshold of probability. Then each action is allocated a budget to be activated when the forecast is received. The window between the forecast and extreme weather event is used for implementing actions to scale up preparedness before the potential disaster happens. The German Red Cross and World Food Programme have tested this approach in seven high risk countries, including Bangladesh, Dominican Republic, Haiti, Mozambique, Nepal, Peru, and Philippines.

The International Finance Corporation (IFC) develops tools for index-based insurance (weather, area yield, and livestock index insurance products). They have a dedicated unit, the global index insurance facility.[33]

Increasingly, insurers and reinsurers are experimenting with the use of different parameters or indices to trigger insurance pay-outs (sometimes referred to as "parametric" insurance). Alongside information generated by weather stations, additional observation and modelling tools capture more parameters associated with drought risks. These can more accurately deliver insurance solutions that are intended to be increasingly more efficient, affordable and viable, including for vulnerable communities.[34] Innovations in parametric insurance have included integration of vegetation cover parameters for livestock insurance.[35]

Swiss Re have developed a Soil Moisture Deficit Index Insurance using remotely sensed information on soil moisture to trigger compensation payouts for farmers whose crops are affected by droughts.[36] In contrast to a traditional crop insurance where the insurance pay-out must be based on loss adjustment observed in the field, the remotely sensed soil moisture information can be combined with block-chain technology to automatically trigger a pay-out at a pre-defined level of soil moisture deficit. This system has been tested in Kazakhstan and parts of Europe.

Social protection systems such as the Hunger SafetyNet Programme (HSNP) in Kenya[37] and the Productive SafetyNet Programme (PSNP) in Ethiopia[38] have experimented with forecast-based approaches that enable them to provide cash transfers to poor households when the onset of a drought appears (see Section 3.3). FAO has also implemented programmes delivering cash-transfers to enable households to cope with droughts[39]. Lately, there has been growing interest in the possibilities for the private sector to play a greater role in providing forecast-based and index-based social insurance systems. An initiative by the African Risk Capacity is exploring these options.

The intention of the social protection systems is to enable households to survive the drought without depleting their productive assets to the extent that they would become destitute or incur unmanageable debts. PSNP provides six months of public works employment for payment in cash

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33 Available at: https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/financial+institutions/priorities/access_essential+financial+services/global+index+insurance+facility

34 See: https://www.mmc.com/insights/publications/2018/dec/parametric-insurance-tool-to-increase-climate-resilience.html.

35 See: https://www.ilri.org/publications/story-index-based-livestock-insurance-ibli.

36 See: https://www.swissre.com/risk-knowledge/mitigating-climate-risk/natcat-2019/drought-is-insurable.html

37 See: https://www.hsnp.or.ke/

38 See: https://projects.worldbank.org/en/projects-operations/document-detail/P163438# and https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/133685/filename/133897.pdf

39 Available at: http://www.fao.org/emergencies/fao-in-action/cash-and-vouchers/en/

Table 8: Measures for financing risk retention or transfer where risks cannot be fully reduced and removed

		Risk Holder				Risk Level			Timeframe			
		Capacity and need of the risk-holder				Level of risk (return period)			to spend funds on what?			
	Instrument	Individual	community	municipality	sovereign	Life & livelihood	Operational	Physical assets	Annual	1-10 year	10-50 year	50+ year
Risk retention	Budget contingency			■	■		■		■	■		
	Reserve funds	■	■	■	■	■	■	■	■	■		
	Contingent loans				■		■			■	■	
Risk transfer	Micro insurance	■	■			■				■	■	■
	Agriculture insurance	■	■			■				■	■	■
	Takaful and mutual insurance	■	■	■	■	■	■	■		■	■	■
	Insurance and reinsurance	■	■	■	■	■	■	■		■	■	■
	Catastrophe bonds			■	■	■	■	■			■	■
	Risk pools			■	■		■	■		■	■	■

Source: based on Meenan et al. 2019, p.30

Case Study 7: Community Contingency Funds in the Dry Corridor of Central America (see more detail in case studies section)

Central America's 'Corredor Seco" or Dry Corridor, which covers a large part of Guatemala, El Salvador, Honduras and Nicaragua as well as demarcated areas of Costa Rica and Panama has been hit particularly hard by recurrent droughts and increasingly irregular rainfall. In three out of five harvest cycles, small farming families suffer significant losses and often their harvest is not enough to feed their families; what is harvested rarely covers the nutritional requirements of a family considering that, on average, the livelihoods of 62 percent of the population depend on the production of staple grains.

Community Contingency Funds (CCFs) are an innovative risk protection and financial transferal mechanism that provides a form of farm insurance for those who do not have access to conventional financial systems. These have been put in place by FAO with support from Belgian cooperation.[1] CCFs are resources managed by a producers' association for the purpose of providing assistance to its members in emergency situations and to fund activities aimed at helping the most vulnerable families following an unexpected event such as drought, hurricanes, floods, earthquakes or other extreme events. CCFs target households that do not have access to formal financing and insurance systems to safeguard their livelihoods. These funds provide supplementary resources for the sustainability of their livelihoods and for the association's Savings and Loan schemes.

CCFs can provide funding for various activities, provided that they have been approved by the association's board of directors. These activities include the purchase of supplies for the new agricultural season in the event of crop losses, to cover household expenses during emergencies, and for productive and commercial activities for the community when income sources have been lost, etc. Members of the association have access to CCFs at a variable rate of interest (established by the association) of between 3 and 5 percent. Non-members of the association can also apply for CCFs under certain circumstances, namely during emergencies, at a higher rate of interest. CCFs are a solidarity fund for those who have been affected and as such are generally provided at a lower rate of interest than regular loans.

Association and rural credit bank members in both countries were asked to make cash contributions for the distribution of FAO and government-run agricultural project inputs (seed money, credits, etc.). These contributions make up the first part of the CCF (40 percent). Another part of the CCF (40 percent) has been donated by the project implemented by FAO. The remaining 20 percent was collected and is constantly capitalized through income-generating activities developed and carried out by each association (e.g. production of handloom fabrics, community grocery stores, gourd seed hulling, mushroom production, poultry production, farm supplies stores and vegetable production).

In Guatemala, association board of directors are responsible for activating CCFs through the Early Warning System known as 'Sitio Centinela" (sentinel site), which consists of four commissions. These commissions assess the availability and access to food, its biological use and the management of risk. The decision to declare the emergency based on this information is made at an assembly meeting. In Honduras, CCFs are activated when an emergency is declared by the national-level Permanent Commission for Contingencies (COPECO), which is the only agency legally authorized to declare an emergency. The process is initiated at a local level, where members of the Local Emergency Committee (CODEL) establish the emergency based on data provided by the Food Crisis Early Warning System (SATCA) and report to the Municipal Emergency Committee (CODEM) on the need to issue an official declaration of the emergency. In both countries, associations have been equipped with a rain gauge and thermometer to register monthly rainfall in millimeters and average temperatures.

Insight provided by: Alberto Bigi and Valentina Georda, FAO.

[1] Available at: http://www.fao.org/fileadmin/user_upload/emergencies/docs/Corredor_Seco_Breve_EN.pdf

or grain alongside Direct Support for a small number of individuals, primarily elderly and disabled persons. The latest fourth phase of PSNP seeks to benefit approximately 8 million Ethiopians, making it one of the largest social protection programmes in sub-Saharan Africa.

The Brazilian Bolsa Familia is another well studied example of a large social protection programme that has made a difference to mitigating drought effects on vulnerable households. The largest numbers of recipients are concentrated in the drought-prone areas in the Northeast of Brazil (Case Study 3). However, this programme continuously provides social assistance to households in the – whether or not they are in drought-affected regions and whether or not there is a drought, whereas the climate-driven social protection programmes in East Africa only provide assistance in extreme years, rather than continuously.

3.3 Connecting better from emergency response to sustainable development

Risk-informed sustainable development is essential to the achievement of the sustainable development goals (UNDRR, 2019b). This is particularly the case in the least developed and most drought-prone regions where droughts can periodically wipe out development progress and prevent recovery in three ways (Tanner *et al.*; 2015a; Tanner *et al.*; 2015b):

- disaster losses and damages;
- holding back investor and confidence and economic growth;
- preventing other development co-benefits, such as institution-building.

It is also important to recognize that drought responses create a major development opportunity for building back better. And they put in place emergency response capacities that can respond also to other threats that may also emerge – such as floods, locusts, conflicts, arrival of refugees, etc. In an ideal situation, there will be sufficient time and resources for the drought response to include provisions for recovery and learning. But in cases where disasters recur rapidly, and programming and resources do not extend effectively through recovery to re-establish a more sustainable development patterns, problems can progressively deepen.

The international humanitarian community often acknowledges the importance of the connections from response and recovery to sustainable development (Table 1). However, practical connections in terms of the results, learning, evidence and necessary monitoring and management systems both for emergency response and for sustainable development remain weak. For example, the Indian drought manual does not describe any connection linking the drought risk monitoring and indices to triggers for measures to replenish reservoirs and groundwater reserves during and after droughts (as in Figure 13). However, recovering fully after droughts is important to ensure that exposure to water stress and human-induced drought risks is not increased.

Early actions that can be taken in response to drought warnings include analysis of groundwater and surface reservoir deficits (where monitoring systems are in place – see Case Study 4), assessing recharge needs and anticipated catchment areas, restoring floodwater control and

harvesting structures, cleaning drains, storage cisterns, identifying and managing pollution sources, improving reservoirs, strengthening associated governance systems, including local resource users, strengthening committees, transfer of information, responsibility and funds between levels of government, etc. Lately, the GCF has supported a proposal to increase groundwater recharge in India's Odisha State.[40]

Since the adoption of the Sustainable Development Goal and target 6.4.2, FAO has begun providing a tool that enables all countries to periodically review their systems for monitoring the hydrological balance, and to request necessary capacity building support.[41] A global status report was published in 2018 (FAO, 2018d). A broader commentary on challenges faced by Least Developed Countries (LDCs), Landlocked Developing Countries (LLDCs), Small Island Developing States (SIDs), countries in conflict or post-conflict situations, African countries, and middle-income countries (UNDESA, 2020) takes a view across all goals. Guidance for 2021 reviews re-emphasizes the needs to anticipate the risks of disasters (including droughts).

Actions at the wider basin or catchment scale can make a significant difference to the water balance (affecting ongoing exposure and vulnerability). This can include actions taken by large numbers of individuals across catchments in dry times before rains. For example, to reduce the hydrological deficits and increase the rate of groundwater recharge, water harvesting programmes, both rural and urban, have been launched in many parts of India (Pathak *et al.*, 2019; GEF/IEO 2015; Anonymous, 2020). This entails a rethink of seasonal early warning and decision-support systems so that they could trigger investments and actions in preparation for the rains that may be coming. The more multi-hazard approach to response systems monitoring the onset of both drought and floods, amongst others, is a consistent recommendation in recent work by the UNDRR and others.

Within some donor-funded projects in Kenya, and under the Ethiopian PSNP, there have been some evaluations of the returns on investments in different types of community scale water management projects during drought – including investments in rehabilitating water pans, and other programmes focusing on water harvesting, etc. Although these programmes often involve community consultations, such investments do not tend to be initiated voluntarily by local decision-makers. On the other hand, local government sectoral plans in drought-prone areas do frequently refer to drought challenges; and do involve investments in water management infrastructure.

There is an assumption that is inherent in much of the drought response programming in Sub-Saharan Africa that if institutional capacities and livelihoods were improved, then communities and individuals could use them to sustainably reduce their exposure and vulnerability to drought hazards. In the future, it may be possible for drought managers to identify achievements in terms of improved levels of access to safe water supplies under different and comparable levels of drought severity and duration. But for the time being, there is no such indicator in the national drought monitoring systems. The available water management indicators in the Kenyan early warning system, instead, focus on water sources and distances trekked to water for livestock in terms of km.[42]

Biannual evaluations since 2006 have shown that the Ethiopian PSNP programme has improved household level food security and helped protect assets, but impacts on nutrition levels are

40 See Case study 2 and https://www.greenclimate.fund/project/fp045

41 For more information see: https://www.sdg6monitoring.org/indicator-642/ and: https://sustainabledevelopment.un.org/vnrs/

42 Early warning bulletins are available at: https://www.ndma.go.ke/index.php/resource-center/early-warning-reports

still subject to debate (Berhane *et al.*, 2020)[43]. Evaluations have also not yet been able to fully demonstrate the intended transitions to resilience and sustainable development (see Section 3.3) (Venton, 2018). Index-based response triggers combine meteorological forecasts with other remotely sensed information to trigger actions. In some humanitarian and food security-focused interventions, this has been combined with household survey information (Enenkel *et al.*, 2020). International humanitarian programming has made innovative use of mobile technologies to increase the availability of survey information. On the whole, the international humanitarian community still appears to have little expectation that national data collection systems could generate and manage the necessary information for themselves (Enenkel *et al.*, 2020).

Making the connection between drought responses and sustainable development has been an important theme in much of FAOs work on drought response. FAO has frequently provided support to rebuilding sustainable livelihoods and institutions. For example, the SFERA funds are used to restore the productive assets of households so that they can continue to grow food and support themselves following disasters such as droughts and others. Institution-building is also an important recurrent theme. FAOs Drought Portal contains around twenty examples of responses it has delivered in the Horn of Africa alone. Many of these have included work to reinforce national drought management policy goals (FAO, 2018c). Alongside SFERA, other examples include: the Ethiopian drought response plan and priorities for 2017, the Somalia 2016/17 rapid results drought response plan and cash for work programmes.

National governments have embraced the institution-building agenda to connect drought response to recovery and sustainable development. It is quite challenging to evaluate the achievements of investments in human and institutional capacities. Early reports suggest that national drought management programmes in Kenya have achieved significant successes in decoupling the effects of extreme long dry spells from the child malnutrition and terms of trade indicators that are routinely monitored by the national drought management authority (Venton *et al.*, 2012). Furthermore, the process of carrying out a systematic mid-term review of the Ending Drought Emergency (EDE) programme has already commenced. Under its Knowledge Management Pillar, Kenya has also begun developing an online knowledge sharing platform or central repository for drought resilience. Through its Drought Disaster Resilience and Sustainability Initiative (IDDRSI), IGAD ICPAC is working with several countries in the Horn of Africa region to assess the impacts of improved drought early warning and response (Case Study 8).

At the regional level, some emergency funds, such as the European-funded programme on Resilience Building and Creation of Economic Opportunities in Ethiopia (RESET II) do not only set out to address national agendas for sustainable development. RESET II is designed to support sustainable development not only in the drought-affected areas and countries, but also in other countries and regions. It is intended to prevent effects on more developed economies by addressing the root causes of displacement and irregular migrations caused by drought. It does so through the creation of economic opportunities and the strengthening of the resilience capacity of the most vulnerable communities. The focus is on livelihoods, employment, and improving access to basic services in the affected regions. Evaluations identifying how the improvement of these

[43] See also: http://documents1.worldbank.org/curated/en/453701556642818045/pdf/Disclosable-Version-of-the-ISR-ET-Productive-Safety-Nets-Project-4-PSNP-4-P146883-Sequence-No-09.pdf; for information about the PSNP4 and also other information on the World Bank support for rural safety nets and urban safety nets in Ethiopia: https://projects.worldbank.org/en/projects-operations/projects-list?lang=en&searchTerm=&countrycode_exact=ET

indicators in one country or region could affect socio-economic conditions also in another country or region could also be methodologically demanding. This would require creative use of emerging sustainable development datasets and evaluation tools.

Across all scales, local-national-regional-global, the effects of drought risk and response actions on sustainable development are complex and difficult to attribute to individual programmes or initiatives. However, it is still desirable and useful to understand what is the direction of travel (King-Okumu, 2017b; King-Okumu, 2017a). After several decades of investment in institutional capacity building for drought management, it is instructive to consider the extent and various different ways in which exposure and vulnerability to drought in the most affected regions is and is not changing. For example, in the Horn of Africa, much has changed since the 1980s famine that rocked the world at Christmas-time. But yet, still less ground-level information is systematically collected at present than was available in the 1970s concerning the effects of drought risk and mitigation strategies on the basic conditions of water resources across most of Somalia and neighboring areas.

Local institution-building alone does not always result in confidence that the wider systems are working well. The material effects on resources and livelihoods that are associated with drought and other concurrent stresses still remain difficult for local authorities to assess. This hinders management action and limits the availability of evidence that it was effective. Much of the information challenge could in theory be overcome thanks to the potential and promise of new apps, drones, satellites, modelling tools, etc. However, considerable cooperative actions would be needed to achieve that in many of the more drought-affected conflict-prone affected areas and harder to reach areas[44] (GEI/IEO, 2020). There would then still be a need and an opportunity for society to make effective use of the improved information.

[44] See countries voluntary national reviews of progress toward the SDGs at https://sustainabledevelopment.un.org/vnrs/ and suggestions to incorporate disaster risk reduction as described above.

Case Study 8: Drought risk mitigation in Eastern Africa – A humanistic approach (see more detail in case studies section)

Drought is a slow onset disaster that affects communities whose livelihood is based on agriculture farming and pastoralism) which requires good rains (in terms of volume, intensity, duration and timing). The onset and intensity of a drought event (meteorological and agricultural) can be detected, and advisories can be issued and disseminated to stakeholders. However, this will have very limited contribution to mitigate the drought impacts unless communities (as the first responders and victims) can respond to prevent the drought hazard from turning into a disaster. Community centered approaches are needed to guide governance structures, investments and the use of technology to mitigate the impacts of droughts on human populations and ecosystems.

Capabilities for responding to drought in the Horn of Africa have been transformed since the 1980s. Following a regional drought in 2008–10, a coherent regional response system has been put in place at the level of the IGAD region (King-Okumu, Orindi and Lekalkuli, 2019b). All IGAD member states committed to ending drought emergencies in the region during a Summit of Heads of State and Government of the Horn and East Africa region held in September 2011 in Nairobi. Following this summit, Country Programme Papers (CPPs) were developed by each country. Periodic progress reports are made available by each of the countries, providing an overview of drought resilience programming.

At the onset of the 2015/16 drought, the regional early warning systems showed an improved level of information available concerning the forecast hazard, vegetation conditions and populations exposed –as compared to the previous major drought event in 2009–11. However, mitigating the impacts of drought also requires looking beyond monitoring of the physical exposure. Important human aspects of vulnerabilities to drought (social, economic, cultural) require attention. The two most important elements of drought risk mitigation in (east) African settings are:

- risk governance structures; and
- coping mechanisms and capacities.

These are crucial because they determine how communities can be able to respond. By putting in place a robust and responsive regional risk governance structure that is based more on scientific knowledge (less on political affiliation and bureaucracy) an important stride has been achieved towards transforming the way countries and regional organizations are dealing with drought risk management in the IGAD region. On the other hand, community centered approaches (that understand the ability of a community to overcome hardship) with well-designed investment (well before a disaster) on strengthening coping mechanisms and building capacities are the practical measures that bring about in-built and self-sustaining solutions that will mitigate drought (and related) risks.

Some of the solutions to achieve the above two include devolving risk governance to the lower administrative levels (King-Okumu *et al.*, 2017a), shifting programming towards community centered mini projects (like the IGAD climate smart agriculture prototype project in Arid part of Kenya), setting standard operating procedures at community level (what to do when including traditional mechanisms) and fostering durable solutions (Jillo *et al.*, 2016; Jarso, Tari and King-Okumu, 2017) (Case Study 10).

Insight provided by: Ahmed Amdihun, IGAD ICPAC.

4. Beyond risk mitigation to transformative change

It is possible to turn global drought threats into opportunities and drought-events from disasters into development success stories. This requires approaches that move beyond preparing to resist or respond to droughts. To do so requires more than simply responding or adapting incrementally to change. Transformative change refers to a fundamental, system-wide change. This must include holistic consideration of technological, economic and social factors, including in terms of paradigms, goals or values (IPBES, 2020). Many agencies and initiatives aspire to achieve transformations that will shift the dynamics shaping our world and how it works (IEG, 2016; GEF, 2017; Puri, 2018; Itad/CIF, 2020; Itad/CIF, 2019; UKICF, 2019; ICAT, 2018) (Figure 13). Transformations can affect both natural and human systems, including via economic, technological and behavioral changes. This can include changes in the ways that energy and infrastructure are used and produced, natural resources are managed, and institutions are set up. It can also involve changes in the pace and direction of technological changes.[45]

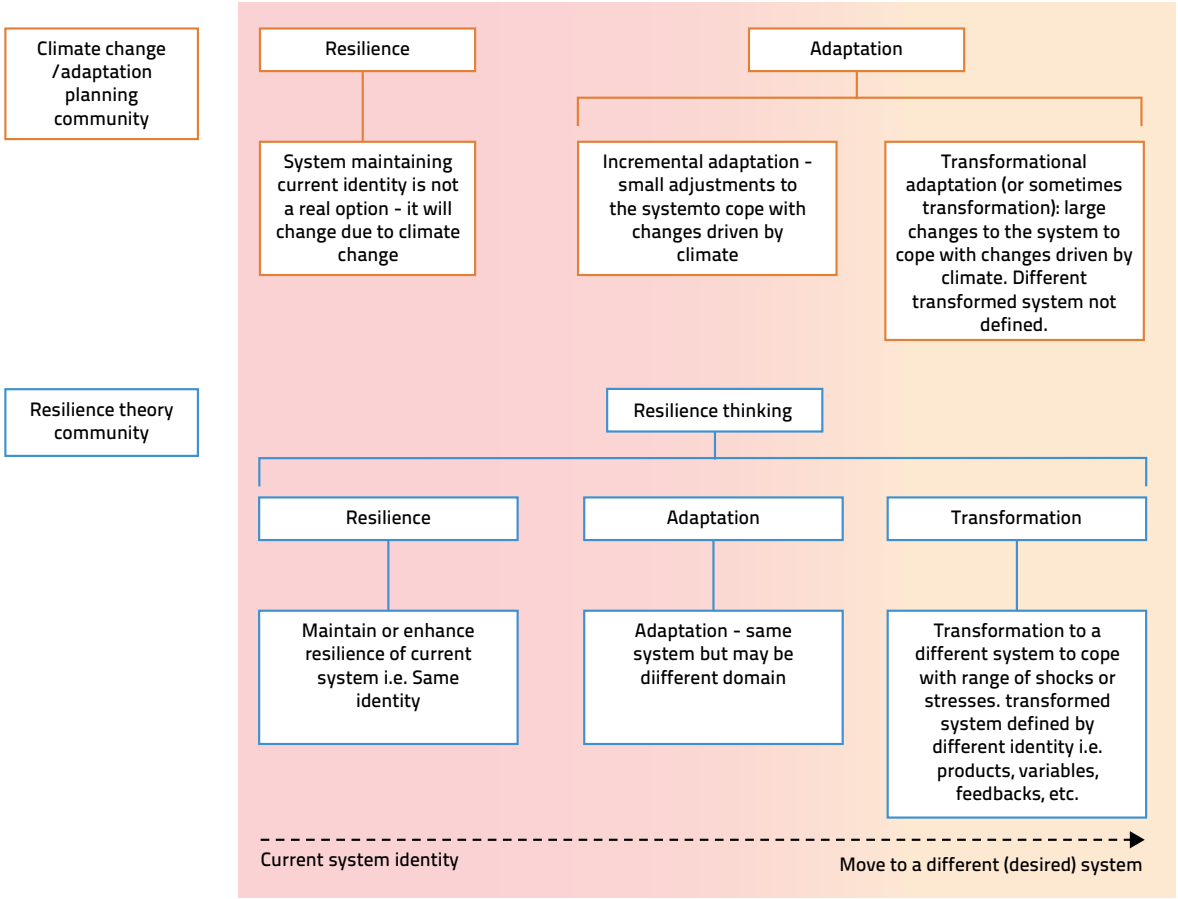
A generic definition of transformational change has been proposed by the Independent Evaluation Group (IEG) of the World Bank for evaluation purposes (IEG, 2016). This refers to deep, systemic, and sustainable change with the potential for large-scale impact in an area of a major development challenge. The GEF Independent Evaluation Office (IEO) refined this definition to focus on areas of global environmental concern (IEO, 2018; GEF/STAP, 2019a). Transformation can involve: (1) removing critical constraints; (2) causing or supporting fundamental change in a system; (3) achieving large-scale impact at the national or global level; and (4) remaining economically, financially, and environmentally sustainable. In light of this, both IEG and IEO observe four criteria that help to differentiate truly transformational interventions from engagements that are "merely" highly successful, complex, or large in size:

[45] See glossary and description of transformation in: https://www.ipcc.ch/site/assets/uploads/2019/01/SYRAR5-Glossary_en.pdf

- relevance to global (environmental and/or development) challenges;
- depth of change (driving a fundamental change in a system or market);
- scale of change ("full-scale" impact at the local, national, or regional level); and
- "sustainability" (the impact endures financially, economically, environmentally, socially and politically, long term after the intervention ends).

Guidance from the GEF Scientific and Technical Advisory Panel (STAP) (O'Connell *et al.*, 2016) illustrates how resilience assessments applied in projects in drought-affected areas of Ethiopia, Kenya, and Uganda have identified issues and processes operating within the affected socio-ecological systems (e.g. within the pastoral production systems). The approach has focused on seeking changes in these systems (Figure 15). The guidance emphasizes the idea that transformative project design should consider dynamics at the scales above and below the target system scale (i.e. including local and regional levels as well as the national policy level) addressing larger governance and policy barriers and supplementing community perceptions with objective evidence.

Figure 13: Resilience, Adaptation and Transformation: Available understanding of the concepts



Source: O'Connell et al. 2016.

Transformative approaches to drought risk can involve any or all of the mitigation preparedness and response measures – similar to or different from those presented in the previous sections. The point is that collective success in the application of these mitigation measures should fundamentally change perceptions of the problem and its pre-determined consequences – turning the drought risks from a threat into an opportunity for collective action and benefit. This can occur particularly in cases where learning has taken place so that innovative new approaches have been tried and insights gained have made a difference – such as via the following (amongst others), as explored in the remainder of this section:

- reshaping institutions for risk management, recovery and resilience-building;
- re-integrating systemic "win-win" solutions to risks and trade-offs for ecosystems and society;
- establishing self-sufficient and sustainable financing models and value chains.

The essential factor is that transformative approaches to drought risk mitigation, preparedness and response must work with social decision-making and other (non-drought) agendas – e.g. social and security-related, engagement of youth, etc. – not only on the technologies or processes/approaches (see observations made by contributors of Case Study 1 in the Sahel and Case Study 8 in the Horn of Africa). Where this happens, overcoming drought challenges collectively (including through any or all of the approaches already described) can be a transformative social process in and of itself – with potential to contribute to changing mindsets and approaches to national cohesion, green economic recovery, international cooperation, faith in systems, hope for the future, and achievement of the SDGs.

4.1 Reshaping institutions for risk management, recovery and resilience-building

It is important to recognize the wider value of the institution-building, collective decision-making, risk-sharing, problem-solving, conflict resolution and other social learning processes that enable successful drought risk reduction. Successes achieved can bring benefits that go well beyond mitigating drought effects – and in fact make a major difference. This shifts the larger objectives of societies into reach so that droughts need not act as an exacerbator of the complex range of multi-hazard threats that characterize the most drought-prone regions, as described in Section 1 and in UNDRR (2019b). Rather, where societies can affirm that they have achieved and experienced collective success in de-risking drought, this should boost the levels of trust, cooperation and belief in shared systems that are needed to de-escalate other interlinked hazards as well.

Previous sections of this document have already discussed the engagement of local actors and institutions in proactive risk mitigation approaches (Section 2) and in more responsive actions (Section 3). In many parts of the world, these institution-building processes are a work in progress. It is difficult to evaluate their successes. But it is easy to observe the failure of drought risk mitigation projects that have set out to provide infrastructure or other technical support intended to mitigate drought risks, and failed due to inadequate attention to the needs to build institutional

support. In many parts of the Sahel, and other drought-affected regions, surmountable drought risks cannot be mitigated due to the presence of conflicts that block coping measures such as seasonal migrations, and access to additional water, grazing reserves, food or other relief (as in Case Study 1). Regional institution-building (as in Case Study 1 and Box 5) can help to build capabilities, overcome localized conflicts and focus attention on shared achievements and challenges.

Institution-building enables communities to overcome conflicts surrounding access to resources during periods of scarcity by establishing systems, rules and responsibilities (Case Study 10). They can also establish peaceful ways to seek recourse when these are transgressed or when exceptions are needed. These can protect the rights of the dependent populations, including particularly those who are the most vulnerable. In countries that have been undergoing rapid change and development processes, traditional systems that have been established to govern the management of scarce water resources can break down or require innovation. An example would be the traditional water and land management systems of the Boran people in Ethiopia and Kenya. Innovation in these systems[46] has enabled them to work with the processes of modern government (Case Study 10), to resolve conflicts emerging with other ethnic groups, and to become progressively more willing to engage women and youth in their customary decision-making processes.

As another example, a transformative shift from drought coping to drought risk mitigation was observed in the city of Nebraska (Jedd *et al*., 2018). The city's resilience was attributed its ability to draw upon prior experience with droughts, having a formal municipal plan, and strong human and social capital to coordinate individual knowledge and expertise across agencies. In this way, droughts may have served a catalytic function, prompting the community to transform land-use practices, water conservation planning, and built infrastructure in lasting ways. For this reason (as well as others – see Section 2), available good practice guidance (UNCCD, 2019) often emphasizes putting local communities at the center of drought decision-making processes, policy design and planning. International recognition and celebration of the success, and sharing with others across the region, also helps the community to feel glad to be part of it.

Policies that promote institution-building can build in social objectives that will help the institutions to function better. For example, transformative effects on social objectives for gender-inclusive institution-building approaches were explored through a recent knowledge management review of an international programme on building resilience to climate extremes and disasters such as drought (Wilkinson and King-Okumu, 2019). The growing body of learning and knowledge on these topics can be progressively reintroduced to improve ongoing programme design (see example of CACILM II design incorporating gender inclusive approach in Case study 9).

[46] See: https://qcat.wocat.net/af/wocat/technologies/view/permalink/3709/

Case Study 9: Integrated natural resources management including gender-sensitive project design in drought-prone and salt-affected agricultural production landscapes in Central Asia and Turkey ("CACILM2") (see more detail in case studies section)

The CACILM- 2 is phase 2 of a regional project in Central Asia and Turkey financed under the Global Environment Facility (GEF) that demonstrates effective agricultural technologies, measures the impact of drought and degradation of agricultural land per GDP, and contributes to food security, welfare and agricultural productivity. The phase 2 project includes a gender equality and social inclusion strategy based on the needs and previous experience of the management and project staff on gender issues. Long term, process-orientated competence development focuses on staff attitudes, values and knowledge of gender equality, gender roles and responsibilities of women and men.

The project targets resource-dependent farmers in drought-prone areas of Central Asia including women through women's cooperatives, NGOs that work with rural women, women's self-help groups, and Farmer Field Schools (FFS) that provide access to improved market information on value-chains.

Prior to the launch of the project, rapid gender analysis conducted at project design stage prioritized the following dimensions (amongst others):

- Special actions should be taken to ensure the inclusion of women who face particular disadvantages (such as women in female-headed households) among project beneficiaries.
- Selection of agricultural production landscapes/land use systems include home gardens to ensure potential impacts of the project on household food security/nutrition and increase women's access to knowledge.
- Gender to be mainstreamed in the management arrangements of the project (for example, by introducing gender competency requirement into the TORs of the project personnel, inviting qualified female candidates, recruiting specialized staff with gender expertise, providing initial sensitization and awareness training at the project orientation stage, etc.) to advance women's equal voice and representation in relevant institutions engaged with project preparation and ensure gender sensitivity and responsiveness.
- Multi-country collaborative work will include partnerships with regional, national and local organizations that are engaged in work to support rural women, through policy-making or direct support.
- Efforts will be made to bridge the gap between existing national gender equality policy and strategy and policy, legal and institutional frameworks on INRM through an approach to resilience that takes gender differences into consideration (Component 2).
- During the process of up-scaling climate-smart agricultural practices, attention will be given to ensuring women's equal participation in local planning processes, the selection of innovative approaches that are accessible to women as well as men, and measures to remove any impediments that female farmers may face in accessing advisory and extension services (Component 3).
- Gender sensitive indicators have been chosen for each project outcome/outputs and fully incorporated into the monitoring and evaluation system (Component 4).

Insight provided by Akmaral Sman, Ekrem Yacizi and Makhmud Shaumarov, FAO.

Case Study 10: Reshaping institutions for drought risk management and recovery at the grassroots in Kenya (see more detail in case studies section)

Governance reforms introduced since the promulgation of the new constitution in Kenya (GoK, 2010) have included the devolution of some key functions from the national government, based in Nairobi, to county governments across 47 counties. This is intended to give more autonomy and agency to the people through local-level development planning, management and provision of basic services, including water, health, and local roads. Because populations do not necessarily stay in one county during droughts, emergency support from the NGOs and the National Drought Management Authority (NDMA) under the Ministry of Devolution and Planning is still essential in enabling the local government to cope during the dry seasons and droughts and to achieve the objectives of the national strategy to end drought emergencies (GoK 2015). Community institutions together with NDMA had developed County and Ward level contingency plans to proactively prepare and respond to cyclic droughts and persistent resource-based conflicts.

Community groups include a range of different associations, including groups that are united by gender, religion, tribal affiliations, occupational activities, or others. These can help the local government to mobilize community participation in planning and decision-making processes to prepare for or respond to droughts. Since 2003, in Isiolo County, Kenya, the Merti Integrated Development Programme (MIDP) has worked with communities to resolve conflicts, train the youth and build capacities that prevent droughts from becoming disasters. It has provided support to the county government and customary institutions as they have risen to the challenge to deliver on its new mandate for devolved strategic planning.

As Executive Director of MIDP, Mr Abdullahi Shandey convened and coordinated the county level development partners and local CSOs and established a CSO umbrella organization (Isiolo County CSOs Network (ICCN)) with the County Government of Isiolo. He organized the ICCN members into Technical Sector Working Groups to bring the other organizations closer to the devolved government planning processes. He brought governments and CSOs together and made a big difference to the plans that shaped the future of Isiolo County and larger northern Kenya region. In 2020, Shandey passed away due to Covid-19. He is missed by all of the youngsters he has trained to step up and carry on his legacy. They are recovering and continuing to prepare the County Disaster Risk Management Bill.

Insight provided by: Ibrahim Jarso and Molu Tepo, Merti Integrated Development Programme (MidP).

Box 5: Building a regional hydro-meteorological community of practice in the Andes

The GEF funded Proyecto Páramo Andino, which ran from 2006 to 2012. This stood out because of its role in building a research community. In 2010, the project initiated the iMHEA regional network (Célleri *et al.*, 2009; Célleri and Feyen, 2009; Ochoa-Tocachi, Buytaert and De Bièvre, 2016a). Such initiatives created a strong connection between the scientific and operational communities. For example, many recent studies on the spatial-temporal variability of precipitation processes in the Andes are joint efforts between national and international meteorological offices and scientists (e.g., Manz *et al.*, 2017; Nerini *et al.*, 2015). This has led to an accelerated uptake of the use of satellite-based precipitation products in operational practice, and an optimization of the monitoring efforts between different research groups. Political decisions to make hydrometeorological datasets available for scientific use have further accelerated this evolution.

The iMHEA started originally as a community of practice of scientists, government institutes, decision-makers and civil society representatives. All these actors aimed at understanding the high Andean water resources and address the critical data scarcity in the region (Célleri *et al.*; 2009; Célleri and Feyen; 2009). The network grew until today and manages 27 flow gauging stations and 67 rain gauges in headwater catchments of the Andes of Ecuador, Peru, and Bolivia. The network is designed to complement institutional hydrometeorological monitoring, and to generate evidence on land management practices through a pairwise catchment design (Ochoa-Tocachi *et al.*, 2018). In addition to the scientific productivity, the network is creating an institutional legacy as well. In Peru, the iMHEA methodology has been adopted by the National Drinking Water and Sanitation Regulation Agency (SUNASS) to evaluate the implementation of recent laws on ecosystem services. The mentioned methodology promotes the use of natural infrastructure for water security.

The exceptional experience of linking evidence generation with *in-situ* water management have raised similar convergence between scientific and policy priorities in other disciplines. The growing awareness of the potentially dramatic impact of climate change on high mountain regions has triggered several concerted efforts to improve the predictive capacity of GCMs. This has promoted the development of more appropriate downscaling methods, the evaluation of the multiple impacts of climate change, and the development of better and more flexible adaptation strategies in the tropical Andes. Socially relevant research has been generated to understand how people manage their landscapes, use their land and water, and produce and incorporate community and citizen science in their decision making (Buytaert *et al.*, 2014). New theories for water governance have emerged from the polycentric nature of this ecosystem and the need to incorporate data from multiple actors and consider power balances between them (Zogheib *et al.*, 2018).

Source: Correa et al., 2020.

4.2 "Win-win" approaches to risks and trade-offs for ecosystems and society

Where systemic increases in drought risks are driven by growing human pressures on ecosystems, it is possible for these processes to be recognized and reversed (Figures 1 and 2). Creative rethinking of interlinked risks and trade-offs can involve improving social decision-making for the conservation of natural drought buffers (see discussion of NbS in Section 3 and Box 7 on mobilizing multilateral support). For example, Payment schemes for Ecosystem Services (PES) can offer economic incentives to reduce anthropogenic pressures on the environment (Case Study 5). Payments for water transfers that were first introduced during droughts in California shaped the development of a state economy that now dwarfs those of many other countries.

GEF has supported numerous projects on PES including water (Ishii, 2015), e.g. via a global project on ecosystem services in Chile, Lesotho, South Africa, Trinidad and Tobago, and Vietnam as well as national level implementation of the Environmental Services Payment Programme in Costa Rica and the Hydrological Environmental Services Programme in Mexico (involving fuel and forestry taxes). Also, the GEF's Earth Fund helped establish five water funds in Latin America and the Caribbean to pay for the conservation of watersheds that provide water and support globally important biodiversity. In the Fynbos and grasslands of South Africa, GEF has supported agreements between buyers and sellers of important ecosystem services, including water, fiber, and medicines.

Box 6: Payment for Ecosystem Services (PES) from the high Páramo (Case Study 5)

Increasing vulnerability to drought in downstream areas and recognition of the needs to conserve the upstream water catchment areas has driven the creation of protected areas, public re-education, punishments for violators of environmental legislation, and PES across the region of the high páramo (Farley and Bremer, 2017). Several PES programmes have promoted either afforestation or alteration of traditional burning regimes under the assumption that these land management strategies would maximize ecosystem services, particularly carbon storage. However, recently scientific investigations have confirmed local land users' views that when both above-ground biomass and soil carbon are considered, locally managed grasslands can provide a more diverse and valuable range of ecosystem services than afforestation (Bremer *et al.*, 2016; Bremer *et al.*, 2019; Bremer *et al.*, 2014).

PES systems offer a financially sustainable way for society to reward communities in the high páramo for the ecological restoration and conservation services that help to secure the continuation of water supplies against drought risks. However, the use of PES to incentivize systemic resilience-building relies on the organization and governance systems available within communities –not only to distribute benefits (Hayes and Murtinho, 2018) – but also –more fundamentally – to ensure effective design by involving local communities and their knowledge of the ecosystem services and functions (Llambí *et al.*, 2019; Llambí, Puentes Aguilar and García-Núñez, 2013; Llambí and Rada, 2019; Llambí *et al.*, 2005). Commentaries on the success of PES focus on community management plans with time and institutional funding, and implementation of agroecological models, as well as biocultural rescue memory and changes in agrarian structure (Avellaneda-Torres, Rojas and Sicard, 2015).

Replacing the páramos natural vegetation by afforestation with pine plantation has been estimated to reduce water yields by about 50 percent (Buytaert, Iñiguez and Bièvre, 2007). Local farmers' practices of potato cropping and grazing do not necessarily have such an extreme effect on water yields, but they can still reduce the natural hydrological regulation services generated by the ecosystem (Ochoa-Tocachi *et al.*, 2016b) and affect soil carbon, nitrogen, and water retention capacity (Farley *et al.*, 2013; Farley, 2007; Farley *et al.*, 2011; Farley and Bremer, 2017). These are important insights for the design of future water conservation and drought preparedness initiatives.

Analyses of the trade-offs that societies can achieve between competing priorities for food production, energy use, and conservation of water and ecosystems challenge systems thinking can lead to the identification of transformative solutions (IPBES, 2020; IPBES, 2018). These can involve, for example, increasing the availability of solar powered technologies to enable new economic activities that will reduce dependence on the availability of water. In this way, vulnerable communities could be able to access a viable alternative to meet their needs for food, energy and income without exacerbating land degradation and drought through the removal of water-and shade conserving vegetative cover.

In situations where societies are heavily dependent on irrigated agricultural production (as in the dry regions of India, the rest of Asia, North Africa, Europe and the United States of America – see Shah, 2009), transformative solutions such as solar-power generation may arrive first to supply the established market for powering irrigation systems. The new available energy supplies and technologies can then be adapted in different ways – for example, for powering other electronic equipment to be used by households and businesses. Applications can include appliances for

refrigeration, entertainment systems, IT, communications, and others, depending on the nature of local demands and priorities. In some cases, the solar energy itself can be sold back into a power grid.

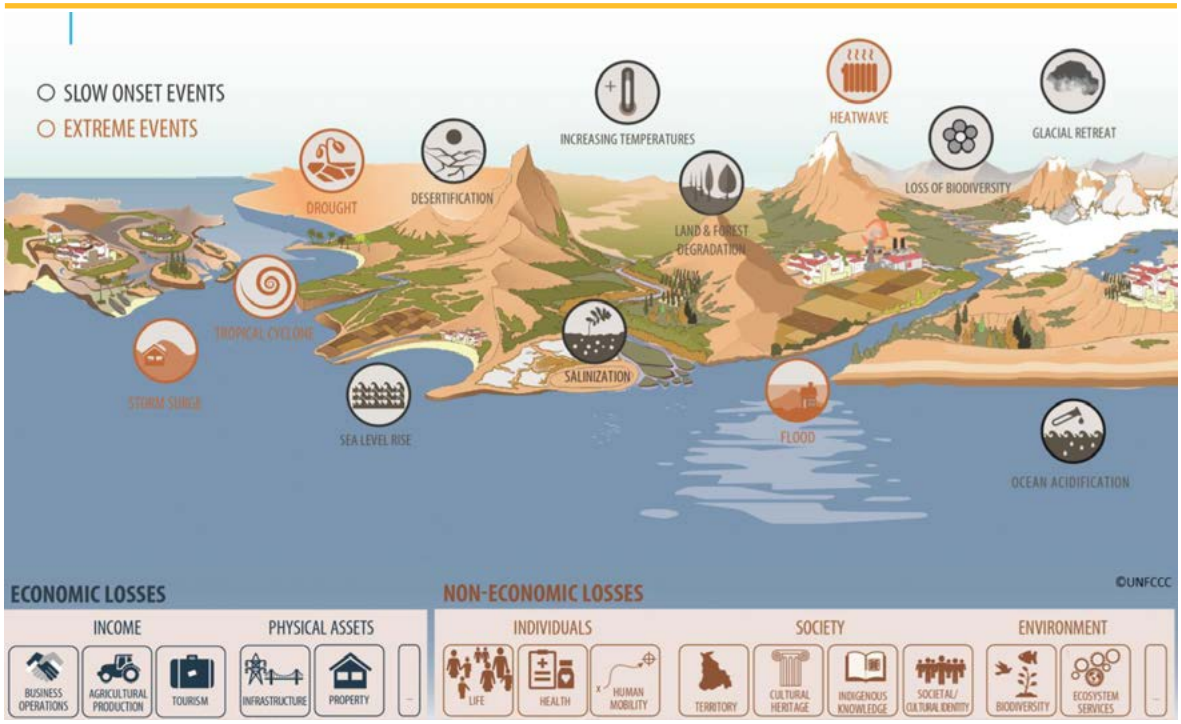
It is important to acknowledge that in many drought-prone regions, energy transitions and the emergence of the fossil fuel economy have already created major transformative effects. In a number of cases, state subsidies (e.g. for fuels or irrigation equipment) have been blamed for driving groundwater pumping races that have deepened vulnerability to drought, especially amongst smaller farmers to encourage water conservation. Following a public debate about this, in Egypt fossil fuel subsidies have been largely removed (GoE, 2018; King-Okumu *et al*., 2019a; Shouman, El Shenawy and Badr, 2016; IFAD, 2016). In Tunisia, a perverse subsidy previously favoring over-use of irrigation to cultivate olive trees in areas that are increasingly vulnerable to drought has been eliminated (Daly-Hassen, Annabi and King-Okumu, 2019), and research and extension have instead transferred their attention to alternative adaptation options more suited to drier conditions.

Working with the nature and specific characteristics of drought-prone ecosystems instead of against them is often seen as an essential aspect of a systemic approach to transformation (see Box 3 on Nature- Ecosystem or Land-based Solutions for drought risk reduction). For example, rather than installing air-conditioned facilities to maintain heat-sensitive dairy cattle or irrigation systems in drought-prone environments, investing and innovating to enhance the value of products from better-adapted extensive small ruminant and camel-production can be smarter options (IOE/IFAD, 2016a). In areas with strong traditions of pastoralism, innovations in these systems can build on available local knowledge and skills.

Win-win transformative approaches to drought risk can involve more positively embracing the drought "hazard" and learning to work with it. People who are used to living with risks and extremes, including marginal pastoral societies and others, tend to adjust to them as a matter of course (IOE/IFAD, 2016b). The extended pause before the arrival of anticipated rain, and the suspension of "normal" economic and social activities as occurs during drought can make more time available than anticipated for other unscheduled activities. These can involve, for example, reinforcing social ties, spontaneously reaching out to neighbors in new ways. It can also provide conditions that are well-suited for additional preparing, drying, delivering and sharing of foods and feeds as well as managing and sharing pasture reserves. Gradually, external partners in national or international institutions can learn to recognize these tried and tested local adaptations and can then provide assistance to widen and boost their positive effects for society as a whole (IOE/IFAD, 2016b).

As wildlife will need to migrate toward water sources, droughts can create a particular opportunity (as well as an imperative) for reorganizing and using wildlife routes and observation posts. These are not only essential for the survival of the wildlife – but also offer the society a spectacular opportunity either for well managed in situ public observation, or for sensitive filming of them. There is often a need to reinforce fire-prevention codes and practices during droughts – and therefore a stronger case than at other times for increased public investment in rangeland and forest services and surveillance systems as well as in wildlife conservation.

Figure 14: Taking a whole systems view of drought risks



Source: UNFCCC, 2020.

New jobs and economic opportunities are systematically created during droughts, for example for transporting food and water supplies to where they are needed, or for transporting livestock and people if they need to move quickly. Where traders are ready and equipped to take advantage of droughts, they can offer major bonus opportunities exceptionally extending some economic, social activities, including trading, moneylending, cultural events, concerts, and other spontaneous open-air gatherings, etc. Understanding how local economies, labor markets and environments will change temporarily during a predictable meteorological drought can help economic decision-makers to make the most of these opportunities and benefits that they can create for society. In this way, rather than expecting economies to collapse during meteorological drought, more experienced investors are able to recognize how they create opportunities.

For investors who are able to see opportunities and make effective injections of credit, droughts accelerate opportunities in trade, transportation and service sectors, including for energy as well as water. In some cases, there is an urgent need for advanced planning to ensure effective regulation of these opportunities by local government, for example in areas of booming enterprise such as water vending. There are also a range of other ways in which governments and other actors can boost the opportunities for positive engagement by the private sector in support of ecologically sustainable drought mitigation strategies. Some of these are discussed in the following section.

Box 7: Mobilizing multilateral support for drought risk mitigation measures

The GCF has developed a Simplified Approval Process (SAP) for integrated drought management projects. This emphasizes multi-stakeholder collaborative approaches. A mix of a hard infrastructure (such as water supply augmentations) and soft solutions (such as capacity building, green infrastructure and nature-based solutions) is usually recommended for absorbing and recovering from the effects of drought (Coates and Smith, 2012; UNCCD, 2019). GCF "SAP-able" types of projects include land use regulation (e.g. protection of aquifer recharge zones), on-farm water harvesting and household level grey-water recycling. Non-SAP-able drought projects consist in those that involve the construction of large infrastructure likely to pose potentially adverse environmental and/or social risks.

GEF Scientific and Technical Advisory Panel (STAP) has lately released a guidance document on climate risk screening that presents a common standard for the screening of all GEF projects for potential climate risks, including drought (GEF/STAP, 2020b; GEF/STAP, 2019b). This builds on the recommendations of an evaluation of the Land Degradation Focal Area (LDFA), conducted in 2017, which recommended to give due consideration to complex contextual factors including drought, food insecurity, and migration during project and programme design (GEF/IEO, 2018). In response to these recommendations, the current GEF-7 LDFA strategy incorporates drought prone and/or fragile areas to address drivers of fragility and land and water insecurity, to reverse resource pressures, enhance or restore governance and rebuild natural resource-based livelihoods and jobs.

Additional projects addressing drought have been added to the portfolios of the GEF Special Climate Change Fund (SCCF) and GEF-LDCF and more are anticipated, since drought is one of the highest priority climate threats in many Least Developed Countries (LDCs). Furthermore, the Climate Funds, including the Adaptation Fund, Green Climate Fund and others, are scaling up their work in these areas (Annex 4 and 5), building on the continuing body of insights emerging from the land- and nature-based initiatives of the GEF (Annex 3).

4.3 Self-sufficient and sustainable financing models and value chains

Sustaining drought risk reduction requires solutions that are financially viable, and most ideally self-supporting (rather than remaining reliant on public funds or social assistance). Mobilization of the private sector through income-generating activities and trade systems (including local, regional and global) is an essential aspect of the transformation of drought-stricken economies. Often, the more disastrously drought-prone economies have been characterized by large reliance on informal employment (e.g. in the livestock and agricultural sectors, as well as various associated un-licensed trading, transportation and hospitality-based occupations). These have been challenging for governments and external actors to understand and develop. They are also not easy for social or private insurance providers to assess and insure.

Over recent years, knowledge has grown concerning the hidden value chains in the informal sectors of the least-developed and more drought-prone economies. A fascinating array of commodities and services have been provided by these least-developed economies and sectors. Some of them – such as khat from Yemen and the Horn of Africa (Keenan and Kabale, 2019) or opium from Afghanistan (Hagen, 2018; UNODC/IRA, 2019) are illegal narcotic crops, often requiring irrigation, that accelerate drought risks by causing the depletion and export of water away from deprived areas.

Producing them generates income for criminal elements and imposes a very high cost on the rest of society. Such trades can entrap vulnerable people and feed into other illicit activities such as the trafficking of people and weapons, contributing to armed conflicts and insecurity.

On the other hand, there are sustainable drought-smart value chains that can generate income and secure environmental benefit in marginal and drought affected areas. Sustainable forest and rangeland products from drought-prone regions can involve gums and resins, oils, perfumes, medicines, herbs, tree fruits, honey, livestock products and fuel (Box 8 and Case Study 11). Associated trades involve processing, transportation, providing security, hospitality, credit and others (IFAD, 2019). Legalizing and regulating informal trades in sustainable products from drought-prone regions brings the triple benefit not only of making them more traceable for consumers and taxable for social benefit; it also dissociates vulnerable people who work in these trades from insecurity, risks of extortion by criminal elements and association with them.

Box 8: FAO Sustainable Forest Management (SFM) Toolbox

SFM is a comprehensive online technical package of tools and examples to facilitate and guide the implementation of sustainable forest management in various contexts. The Toolbox aims to make the wide body of collective knowledge and experience about sustainable forest management more accessible to forest managers and other stakeholders, thereby supporting SFM dissemination and implementation on the ground. SFM can be viewed as the sustainable use and conservation of forests with the aim of maintaining and enhancing multiple forest values through human interventions. A dedicated module highlights the importance and vulnerability of dryland forests and agro-silvopastoral systems and provides guidance on their sustainable management, protection and restoration.

Source: FAO (http://www.fao.org/sustainable-forest-management/toolbox/modules/dryland-forests-agrosilvopastoral-systems/tools/en/).

Enabling value addition and market access for drought-smart legal commodities can transform petty trades and increase profits. As they grow, producers can achieve further gains through economies of scale and leverage more advantages through the creation of larger and more organized producer associations, attract more external investment, better terms of trade and contractual arrangements, etc. On the whole, new thinking about how to green marginal, drought-prone and informal economies and financial systems still lags behind the greening of better-established economic activities from more water-rich areas (King-Okumu, 2015). However, it could be possible to change this through prioritizing investments in climate- and drought-smart products and their value chains from the more marginal and drought-prone areas.

Several GEF projects and programmes are beginning to more explicitly take into consideration the challenges of private sector engagement to address inter-related drought, land degradation and desertification issues, for example, to guide future investment in Sustainable Land Management (SLM) in the Great Green Wall countries (Burkina Faso, Ethiopia, Niger, Senegal – GEF ID #9825); and work with private sector stakeholders on the introduction of drought resistant species in the Sudan Sustainable Natural Resources Management Project (GEF ID #9575) and aquifer replenishment for Sustainable Management of Water Resources, Rangelands, and Agro-Pastoral Perimeters in the Cheikhetti Wadi Watershed of Djibouti (GEF ID #9599).

Case Study 11: Sustainable value chains for drought-smart non-timber forest products from West Africa (see more detail in case studies section)

Under hot, dry and wind-prone conditions, as found across the Sahara and the Sahel, vegetative cover can play a positive role. Regional weather and cloud convection patterns respond to the conditions of the earth surface (e.g. soil moisture, vegetation roughness, etc.). Societies living in this region have a strongly held belief that trees actively encourage good rainfall levels (establishing a balanced reciprocal relationship of mutual benefit with them). Observation, experience and facts are continuing to validate this view. Scientists have found significant evidence confirming that reduced vegetative cover and drier soils accelerate the intensity of storm-cloud formation, escalating patterns of hydro-climatic extremes (floods and droughts) (Klein and Taylor, 2020). On the other hand, vegetative cover can regulate and reduce localized heat and windspeed effects – instead raising evapotranspiration, conserving soil moisture and achieving a cooler micro-climate beneath canopy shade and protection. This is known as the "oasis effect".

At more local scales, the retention of soil moisture under tree canopy allows soil formation and nutrient retention. This improves the growing conditions for food crops in the Sahel, such as sorghum and cowpeas, as well as grass and other food and fodder (grazing) for livestock. Soil improvements increase productivity in both drought- and non-drought years. The presence of trees also provides cooler, less windswept, less dusty and healthier living environments for human and livestock populations under non-drought and drought conditions. These management practices that are implemented locally and in the field to conserve plant cover and soil moisture are particularly essential for drought risk reduction as they enable trees, crops, livestock and human populations to withstand dry conditions for longer periods of time (as necessary to survive during droughts). These measures can contribute to reducing the vulnerability of ecosystems and populations.

Widespread recognition that sustainable forest management practices could help mitigate drought risks across the Sahara and Sahel and globally has led to substantial investments in reforestation programmes and recently, notably the establishment of a "Great Green Wall across the Sahara" making it possible to maintain and strengthen forestry potential and socio-ecological balances. This initiative faces major challenges in terms of sustainable management (sustainability) as the survival rate of trees depends on accompanying measures (the availability of sufficient economic conditions) and appropriate incentives for local communities to survive and thrive alongside them while ensuring effective conservation management.

The government of Senegal has invested in research and extension to create climate-smart livelihood opportunities for communities that practice tree conservation (Sanogo et al., 2019; Raile et al., 2019). These focus on actions to regreen village land with the consequence of improving value chains and market access conditions for high value-added non-timber forest products which are suitable for sustainable production under drought-prone conditions. A climate smart village in Daga-Birame highlights the potential of marketable export products, such as baobab powder, jujube and others (Sanogo et al., 2017). The promotion of these underused exotic products to passing tourists, both in the demonstration village and in the airport duty free shops, has generated additional consumer demand for these products and increased producers' access to high value markets. It also strengthens local and regional markets, value chains and management systems (CSE, 2018).

To scale up the success of the climate-smart learning village of Daga-Birame in Senegal and to support the sustainable management of forests across the Sahel, more work is needed. Eventual re-regulation of transcontinental trading systems may still be necessary, as well as continued engagement, organization and certification of producer organizations in the Sahel and Sahara regions. The first

steps of these processes involving the establishment and local governance systems and the marketing of economically viable tree plantations were established building on the foundation provided by the previous success of the private sector in the sustainable tree production of trees. For example, with non-wood forest products such as honey, gums and resins, mango and others.

Increasingly, the capacities available in most parts of the world for remote sensing can be integrated with locally managed ground verification systems to model drought and climate intelligence of supported forest plantations in the Sahel (Sarr et al., 2021). These inform future scenarios with and without the effects of the retention of vegetation and soil moisture on the regional climate and the extent and severity of drought episodes predicted in the Sahara.

Remotely sensed and locally validated observation of forest conditions can further be combined with available techniques for analysis of plant genetic material to triangulate and improve systems for certification, traceability, etc. of produce for export consumption to ensure green financial sustainability. Remaining needs concern the re-education of economic decision-makers at the level of the international trade systems and associated investments needed for the application of necessary and available scientific tools and technologies.

Insight provided by: Diami Sanogo, National Forestry Research Center, Senegalese Institute for Agricultural Research (ISRA CNRF), Senegal.

Furthermore, the GEF 7 Impact Programme on Dryland Sustainable Landscapes (GEF ID #10206) focuses on the potential of underutilized, indigenous and drought tolerant crop value chains to address desertification and drought as part of its integrated approach (e.g. through dryland restoration and rehabilitation activities to address desertification). The programme focuses specifically on the Miombo and Mopane ecosystems of southern Africa (with participating countries Angola, Botswana, Kenya, Malawi, Mozambique, Namibia, Tanzania, and Zimbabwe), the savannas of West Africa (Burkina Faso) and the temperate grasslands, riparian forests, and shrublands of Central Asia (Kazakhstan and Mongolia).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5. Discussion: How are we learning and what could we do better?

Much experience has been gained over the past decades of drought risk mitigation, preparedness and response. The body of insights collected together in this knowledge product underlines the possibility that societies can move beyond mitigation of risks to overcome and transform them. The aim of this section is to briefly review what we currently know and don't know about whether or not all of the various types of drought risk and impact mitigation actions presented so far are working. This discussion highlights a continuing agenda for learning, reviewing, reinforcing and refreshing the available institutional capacities, including technical capacities as well as financial, administrative and oversight capacities for the implementation and evaluation of mitigation actions. This reflects the idea that the transition through drought risk mitigation to adaptation and transformation that is described in this knowledge product is considered to emerge from deep social learning processes.

The following sections explore: (1) What did we learn, (2) How are we learning, and (3) What recommendations for capacity building can be drawn.

It is well-recognized that there is no single policy prescription or magic formula for catalyzing transformational change. In fact, IEG (2016) observed that it is difficult, even impossible, to identify and design transformation ex-ante. This is because economic and social development is not a mechanistic, linear process. It involves complex and multidimensional socioeconomic and political processes and interventions in systems that require contextualized and tailored solutions, adaptation, and active management of change processes. The ways to achieve transformational effects on drought impacts and risks will likely continue to change over time. Each institution has its own evolving framework of objectives against which it will measure progress to enable learning. The important thing is that they must be open to learn and share lessons as they are learned so that mistakes should not be repeated.

5.1 What did we learn?

This section revisits six major lessons or summary observations emerging from the body of collected knowledge presented in this knowledge product:

1. A wide range of options to mitigate, prepare and respond to drought risks available

This knowledge product presents an array of options at different points in the drought cycle and for application across different sectors scales. Options also range from hard to soft, and from short term to long-term options. However, this is still not an exhaustive catalogue of options – and many more are available. What is clear from the range of options presented is that to do nothing to address drought risks is not an option. There are many more promising options for decision-makers to choose from. Decision-makers must select the most practical options according to their current knowledge and ensure continuous learning.

2. Different options have been adapted to work in different contexts

This knowledge product illustrates options at work in different regions and contexts, including many in LDCs. Interestingly, there is increasing understanding that while adapting and refining options that have worked elsewhere, the established social systems and institutions in the affected communities have a critical and central role to play in innovating and creating their own solutions from the ground-up (IOE/IFAD, 2016a; Wilkinson and King-Okumu, 2019). This means, for example, that transformation need not necessarily require pastoral communities to abandon their drought-adapted pastoral production systems – despite recommendations that have sometimes been made to this effect in the past by different groups of political actors or experts (Cervigni and Morris, 2016; O'Connell *et al.*, 2016). Rather, it requires governments and external partners to better understand the ways in which societies can accommodate and share risks, risk-taking and returns in order to enhance resilience-building in these contexts.

3. Observing failures can contribute to learning and improve risk mitigation over time

The need for greater attention to drought risk and variability in development programming has been the important lesson learned from the repeated observation that development gains are frequently wiped out by droughts (GEF/STAP, 2020b; GEF/IEO, 2018). Other reasons for failure of mitigation measures (other than insufficient consideration of drought risks) can be human (e.g. conflicts), technical (e.g. poor design or workmanship in systems to convey or store water), or socio-economic (e.g. solutions not complementary to social habits or economically unsustainable). This knowledge product did not present examples of failed risk mitigation measures, but it drew positive examples from critical evaluations where some of these have been documented. For example, learning about the need to make interventions financially affordable and sustainable was described in the GEF 2017 review following observations of this lesson from SLEM CPP, India (GEF/IEO, 2018) (Box 2).

4. There have been improvements over time due to proactive approach

The shift from emergency response to the more proactive approach for preparedness in and of itself has been well-established as the major lesson learned by the international disaster risk reduction

community. Considerable progress has been made on forward-planning of drought management. National responses in the Horn of Africa have accelerated and become more coordinated – including more attention to human decision-making institutions and processes. In contrast to the time of the droughts in the Sahel that emerged in the 1970s, and the Horn of Africa in the 1980s, international support for responses to drought emergencies has also accelerated and become more coordinated over recent decades (UNDRR, 2019b). But lack of monitoring systems and methods still make this hard to translate into quantitative progress measures – such as USD saved (Venton, 2018).

5. Attention to institution-building and to economic and social issues has increased

Case studies identified in the sections of this report on transformative approaches demonstrate that there have been a range of practical common-sense lessons learned about project design – for example about how to include women in institution-building (as in Case study 9), how to include local institutions in the design of PES (as in a case study 5 from Colombia). They have also begun to demonstrate ways to ensure that drought-resilient livelihoods can be financially sustainable (as in Case Study 11 from West Africa).

6. We still could learn more what has worked (or not) and how well

There is still limited time and support for retrospective evaluation and learning. The part of the drought cycle for recovery, learning and adapting is the critical counterbalance to the planning part of the proactive approach (Figures 2 to 6). But this usually receives relatively little time and resource investment. On the whole, learning is still difficult due to very short-term horizons of emergency funding and support, lack of information concerning baseline conditions, and lack of resources to follow up after the humanitarian response has been completed. However, there are some exceptional cases (such as the HSNP and PRSP – where significant investments have been made in monitoring some aspects of programme impact).

5.2 How are we learning?

Many of the mitigation approaches or case studies described in previous sections are already connected into systems for monitoring and learning, either at the level of individual resource users, or at the level of time-bound projects (including participatory evaluations). It is very important to consider the needs for learning to take place at all levels, including the global level as well as on the ground.

Within the most drought affected communities, learning processes are an inevitable part of life – most often done through hard-won experience and local collective memory. However, at the international level, learning processes about what works in drought risk mitigation do not necessarily occur in the same ways. It is difficult for the international community to observe and evaluate what is a requisite level of success in drought risk mitigation, and collective memories are often relatively short. In light of this, there is a danger that ineffective or underperforming approaches may be repeated.

Finally, the observation and learning process learns reflectively about itself. This is important because it transfers lessons from resource users and practitioners to decision-makers at other scales. Across the message of "adaptive" programming community of practice, and particularly within the drought, water and land management communities, there has been a growing focus on who is learning. This emphasizes needs to communicate about lessons and to engage different stakeholder groups in the learning processes. The ways of learning are recognized to involve not only higher-level academic learning but also on the job-learning, including learning that can take place late in life as well as early on. There are also different paces for learning, and some learners may need more time than others.

Learning on the ground

It can take time and effort for national and global economic development planners to appreciate the value of local knowledge systems enabling pastoral communities to survive in contexts even where they are vulnerable. Support for ground-based monitoring – particularly by, with, and for people who are living and working in fragile drought-prone contexts has been inadequate (GEF, 2020). Interestingly, remote sensing and geospatial tools are enabling increasingly objective understanding of changes affecting ecosystems such as those in the Sahel and other drought affected areas under varying climatic conditions (Jarso, 2020). These systems have under-utilized potential for use in evaluation not only of drought effects, but also of both hard and soft human programming measures designed to mitigate these (GEF/IEO, 2020; Dean, 2020; GEF/STAP, 2020a).

Summary of gaps remaining:

- Learning that takes place at the local level should be better connected to inform decision-making at other scales.
- At the local level, the effectiveness of local, national and regional monitoring systems can be reviewed and validated through periodic local drought risk management planning, action and evaluation.
- There is a need to make use of new options for low-cost geographic information systems for monitoring and modeling drought risk while integrating these with other sources of local and national information.

Learning at the national level

A considerable number of projects focusing on establishing national drought risk monitoring and early warning systems (IDM Pillar I) are underway, including in many LDCs. However, it is still difficult to identify cases where the effectiveness of drought risk mitigation actions that they trigger are subsequently monitored or evaluated using these information systems. In some of the cases explored in this knowledge product (e.g. Colombia and Mexico) and some developed country cases also, national hydrological services and information do inform drought risk mitigation in some ways, whereas in many developing countries, this is still not possible due to remaining institutional disconnects – especially in the drier areas. Observation of remotely sensed effects on Normalized Difference Vegetation Index (NDVI) following mitigation programming is sometimes used (e.g. in Venton, 2018). But this is complicated and problematic due to poor integration with ground-level observation systems.

Mitigation interventions are generally not systematically evaluated via national policy processes for assessment of drought impacts, vulnerability and risk (IDM Pillar II). However, sometimes funded projects do incorporate these as a part of their preparatory project design activities. Usually, this does not do much to enable learning because it tends to be only a once-off process rather than a systematic quantitative and iterative measurement process. A helpful set of available tools for climate proofing of GEF investments has been presented by GEF/STAP (2019b). Few of these appear to be systematically used in national planning processes as yet.

Summary of gaps remaining:

- There is a need for national policies to include specific provisions for drought risk mitigation and response to be connected to monitoring and evaluation systems.
- Information systems available in an increasing number of countries have been designed for early warning purposes to trigger actions. These information systems should also be more routinely used for monitoring and evaluation of the impacts of mitigation actions.
- National policies should also reinforce the use of decision support systems for sustainable land and water resource management and retrospective economic impact monitoring and national accounting systems to improve monitoring, evaluation and the design of more effective actions to more sustainably mitigate and transform risks over both the long- and short-term.

Box 9: Evaluating national programmes in Kenya and Ethiopia: Hunger Safety Net Programme (HNSP) and Poverty Reduction Strategy Paper (PRSP)

Ex-post evaluation systems built into some national drought response programmes such as the PRSP and the HSNP have generated information about how many people in how many communities such programmes are reaching, including what is their gender and socioeconomic status (e.g. Venton, 2018). These are exceptional programmes demonstrating that it is possible to design learning systems to capture lessons from drought response. Few other such programme monitoring systems exist in drought risk mitigation programming.

The HSNP and PRSP demonstrate that it is possible to connect drought response monitoring systems to national data collection and for them to be managed by national agencies. They also reveal that this is a major undertaking requiring building of capacities and institutions. Neither of these programs could yet begin to demonstrate nor interrogate what has changed in the occurrence of hydrological imbalances which are the most fundamental characteristic of drought. Systems are still not in place at the catchment and national levels to monitor and evaluate these effects as they are achieved through water harvesting or other interventions. Neither programme has sought to change this. However, Environment and Natural Resource Management is Pillar 1 of IGADs regional resilience-building programme IDDRSI, which is also preparing evaluations.

Learning at the regional level

Although regional drought risk monitoring has been mostly focused on using remotely sensed indicators, and generally can observe only meteorological aspects of drought risk, they could be reoriented to focus more on the wider hazard definitions, exposure and impacts on ecosystems, productivity and economic indicators and to connect better to data sources on the ground. Such systems could then shed more light on drought mitigation success, failure and scope for

improvements. Regional exchanges of knowledge about the field level practices for drought risk mitigation have been identified via this review – for example, through the Central Asian Initiative for Land Management (CACILM) (Case Study 9). Regional institutions, such as IGAD, Aghrymet/CILSS, and OSS have not yet enabled member states to conduct systematic analyses connecting their mitigation actions to the regional hydrometeorological monitoring systems supported by the *Global Monitoring for Environment and Security* (*GMES*) programme and others. However, a new initiative now underway in Central Asia that may address this could offer additional insight for a future knowledge product.

In theory, it should be feasible for regional institutions to connect mitigation initiatives to regional drought risk monitoring systems in the near future. This could be more practical than to expect to see monitoring and evaluation of mitigation actions at the global level initially. In some regions, drought risk monitoring systems do already incorporate ground-based monitoring of drought risks and impacts (Vogt and Somma, 2000). For example, the European Centre for Medium-range Weather Forecasts (ECMWF) Copernicus Climate Change Service has created a system called End to End Demonstrator for improved decision-making in the water sector in Europe (EDgE) that provides seasonal forecasts of drought effects on the hydrological balance. To scale up a global approach putting in place such systems would require other regional institutions to create their own such systems in the most drought-affected ecosystems and communities. A model for interregional transfer of knowledge on drought risk monitoring has been established by the World Bank to share knowledge from Mexico and the USA with practitioners in Brazil (De Nys, Engle and Magalhães, 2017).

Summary of gaps remaining:

- Regional economic communities have an important role to play in bringing together effective systems to understand and address impacts on the regional economies (as in the IGAD region).
- In many regions, information systems available at the regional level already play an important technical role in building capability for downscaling from global climate forecasts for early warning purposes to trigger actions. These information systems could be more routinely used for estimating the economic impacts of droughts to build the case for more cooperative regional and transboundary actions, where needed.
- Regional and transboundary cooperation can reinforce the use of decision support systems for sustainable land and water resource management in transboundary basins where win-win solutions can be identified for all stakeholders to benefit from shared initiatives to overcome drought risks.

Learning in global programming

At the global level, learning processes tend to be particularly slow, uneven, and prone to forgetting. It is also counter-intuitive to learners at this level to consider that they may be the ones whose systems are poorly adapted and most need to change (rather than requiring always to change the local coping systems). Some of the climate funds are still in the process of establishing evaluation systems and have not been in operation long enough for these to be fully accessible and informative for people who are external to the project agencies. However, projects and programmes are systematically evaluated through the longer-established independent evaluation programmes (such

as those of the GEF, World Bank and other agencies). This currently enables global learning, comparison, and knowledge-sharing as well as identification of areas where challenges still remain to operationalize integrated drought risk management. This knowledge-sharing and learning function and agenda of the GEF could be expanded in coordination with the other funds and Convention processes e.g. IWG and WIM (UNFCCC, 2019).

Tools currently in use to inform project design and drought risk monitoring systems include the GEFs RAPTA tool (O'Connell *et al*., 2016) (Box 10) and the Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP) tool which focuses on climate resilience. To date, GEF IEO reports have been very focused on learning about the qualitative aspects of drought risk management – for example, focusing on lessons regarding governance and gender issues (GEF, 2020). Alongside growing realization that better biophysical global drought risk mitigation monitoring systems can be possible (INWEH, 2011; King, 2011; Dean, 2020), scientific contributions are already objectively informing the design of economic and policy measures such as PES to mitigate drought risks in some particular contexts where they have been applied (see, for example, Case Study 5 from Colombia).

At the global level, the global climate change community will continue to review climate change adaptation policies and programming through the Adaptation Gap Report (AGR) (UNEP, 2021) and other efforts to track the effectiveness of climate change adaptation outcomes over time, e.g. through the Global Commission on Adaptation. This works with a series of different initiatives that endeavor to track the outcomes of adaptation:

- GAMI – Global Adaptation Mapping Initiative;
- IPAM – International Platform on Adaptation Metrics;
- CPI – Climate Policy Initiative;
- UNEP – in particular Adaptation Gap Report of the United Nations Environment Programme;
- NDCP – Nationally Determined Contributions (NDC) Partnership; and
- MDBs – Multilateral Development Banks

The UNCCD, particularly through its Committee on Science and Technology (CST) and Science Policy Interface (SPI), is working with countries to develop common global guidelines and approaches for evidence-based global assessment of its Strategic Objective to mitigate the effects of drought on communities and ecosystems (UNCCD, 2019; UNCCD, 2017). In this way, it should be possible over the coming years to record measurable physical changes in resource conditions, drought risks and the resilience of terrestrial ecosystems (including the communities that depend on them) following the implementation of improved policies and institutional arrangements. Over the next biennium, the Parties to the UNCCD will prepare their first (baseline) reports for global assessment and monitoring of vulnerability and resilience to drought of ecosystems and communities in their countries. With the global baseline to be put in place in the near future, going forward all countries could be able to measure changes achieved through effective drought risk mitigation measures. These systems may be rudimentary at first but through use and review they will improve over time.

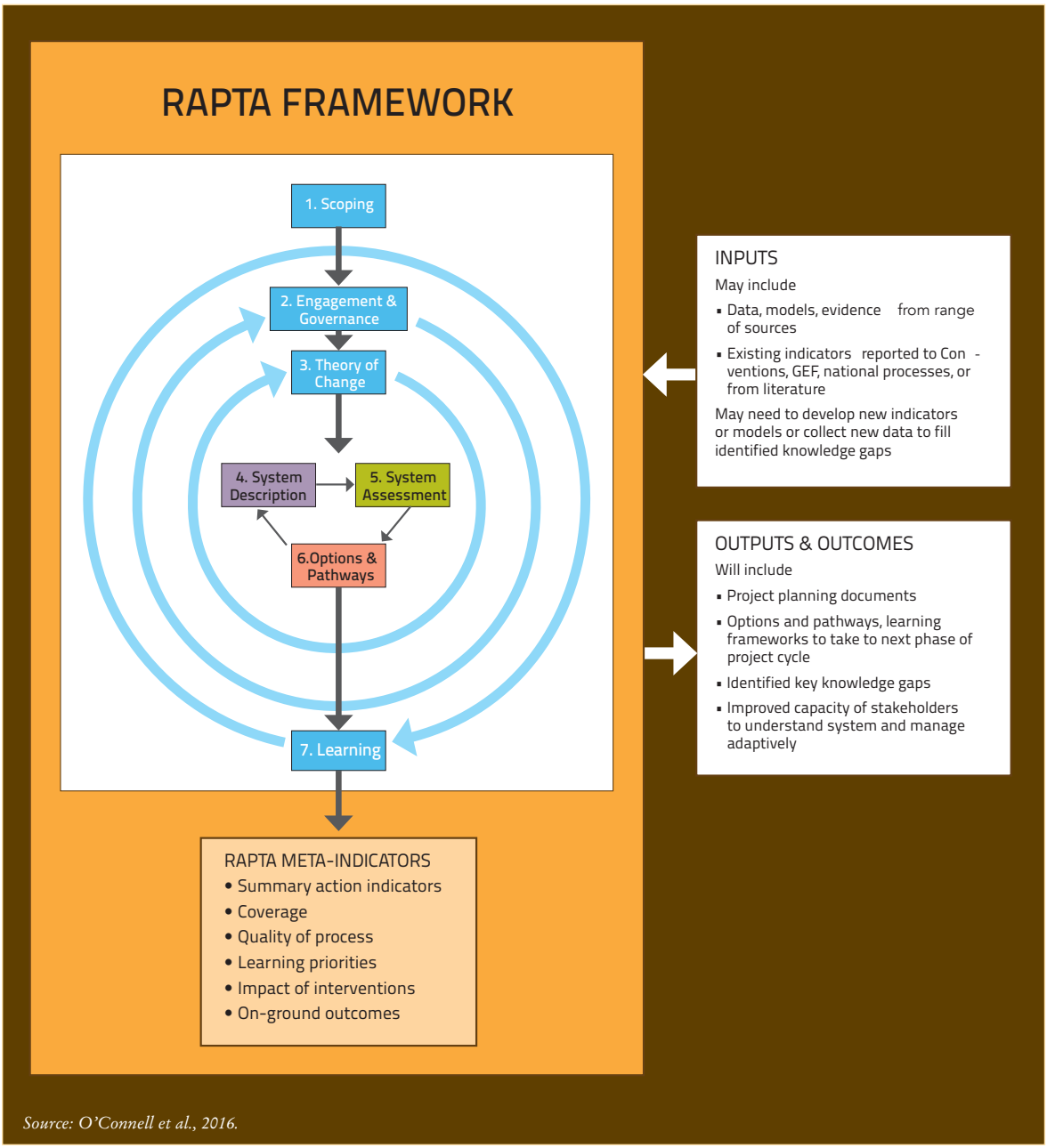
Already, there are tools and databases available that provide information about aspects of drought impacts in different parts of the world (Carrão *et al*., 2016; Barker *et al*., 2019; Smith *et al*., 2019; Hannaford *et al*., 2019; Tijdeman *et al*., 2018; Bachmair *et al*., 2016; Barker *et al*., 2016; Stahl *et al*., 2016; King-Okumu *et al*., 2020). There are more systems and databases available in developed countries than in developing countries(CRED 2019). Globally available databases include the SDG databases, WAPOR and Aqueduct water risk atlas alongside others that are listed in the UNCCD Drought Toolbox. At the moment, there is some disconnect between systems for monitoring drought hazards (meteorologically), and systems for monitoring drought and other disaster impacts – like the Emergency Events Database (EM-DAT) at the Centre for Research on the Epidemiology of Disasters (CRED) and, PDNAs and Global Rapid Post-Disaster Damage Estimation (GRADE) (Enenkel *et al*., 2020).

These disconnects have been noted in a previous IDMP knowledge product (King-Okumu, 2019b), and by an Intergovernmental Working Group under the UNCCD that has begun to compile information on the wide range of different systems that are currently used for monitoring drought risks at the regional, national and sub-national levels (UNCCD, 2020a). Continuous coordinated review should be maintained in coordination with the GEF, as well as the other international climate funds and Convention processes, engaging capacity building support from the regional level wherever possible.

Box 10: Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) Framework

The core features of RAPTA are a systems' view, focus on key drivers, risks and thresholds, adaptive management, and stakeholder participation in planning and implementation of intervention options. RAPTA is underpinned by the system description that identifies the main resources and products of the system, key controlling variables, threshold effects, cross-scale interactions and feedback loops. Detailed resilience assessment includes identifying risks or points-of-no-return, opportunities for adaptation and/or transformation, and the costs and benefits of these options. RAPTA does this iteratively, as understanding and competence grow. It builds in learning at every stage and uses the increasing understanding to refine the project plans and develop the capacity of stakeholders to manage them to successful implementation, no matter what else arises.

The RAPTA guidelines are particularly relevant for projects addressing resilience of agricultural systems, such as those on African dryland agriculture, and draw on the Global Environment Facility's (GEF) 'Fostering Sustainability and Resilience for Food Security in sub-Saharan Africa" (Food Security IAP) programme. However, RAPTA also applies to a much broader range of programmes and sectors related to the UN's Sustainable Development Goals. With further elaboration and guidance, RAPTA can also be applied to support project implementation, monitoring and assessment, and project evaluation.



Source: O'Connell et al., 2016.

Summary of gaps remaining:

- Global knowledge-sharing and learning on drought risk mitigation should be expanded through a coordinated process across the relevant global funds and Convention processes.
- A global approach should enable all countries to begin to monitor drought risks to their national economies, and to progressively improve both the monitoring system and its use to support decision-making through a continuous global review process.
- The global approach should not only galvanize nested actions from the regional level, national and local levels, but also should better facilitate and accelerate inter-regional cooperation and exchanges.

5.3 What recommendations for capacity building?

The assessment of the lessons learned and the state of the existing systems for learning reveals capacity needs at all levels – from the global level to the level of individual resource users and managers. A listing of gaps has been included in the previous section. It is important to recognize that the transformation of drought risks may best be anticipated to work synergistically with other emerging agendas for global environmental transformations, including the transformative change options for achieving the 2050 agenda as a whole, and the vision for ecosystems and biodiversity.[47]

There are major capacity needs to strengthen the emergency response systems and to better connect them into sustainable development planning. The particular targets and monitoring systems for SDGs and other globally agreed goals that relate to drought – such as the various relevant SDGs as well as the UNFCCC and CCD targets all have particular contributions to make, and all raise capability issues. These are most acute in the drought-affected regions. The same is true for the emerging frameworks for economic accounting for disaster losses, including natural capital.[48] Without effective systems for monitoring the results from drought risk mitigation, it is very difficult to identify the extent to which mitigation, response and preparedness measures are working well or not. This makes it difficult to improve or to assess improvements.

Global level recommendations

As observed in this knowledge product, the results systems of the longer-established agencies working on drought, such as the FAO, World Bank, GEF and others are well-established, whereas the international climate funds are only just beginning to develop systems for learning and evaluation (UNEP, 2021). National systems for monitoring sustainable development objectives are all at different stages of development. Coordination amongst agencies is considered important. A common system for knowledge management and learning could be helpful.

Common ground amongst all actors and agencies involved in the mitigation of drought risks has been articulated in the form of a strategic objective for mitigating the effects of drought under UNCCD as agreed by all Country Parties and observer Agencies. The UNCCD provides a global process for strengthening national capabilities for land and water management. There is also already a global framework in place to build more hydromet capacities in developing countries (Salman , Dixon *et al*., 2020) and a global System of Environmental-Economic Accounting – Experimental Ecosystem Accounting (SEEA EEA) under revision for agreement in March 2021. There will be growing needs for these to work together more effectively. There are also opportunities to further strengthen the monitoring systems that are established via global projects and portfolios at the climate funds and the GEF.

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47 See: https://ipbes.net/transformative-change

48 The Global Assessment of Environmental-Economic Accounting is available at: https://seea.un.org/content/global-consultation-complete-draft https://seea.un.org/content/global-assessment-environmental-economic-accounting#:~:text=The%20Global%20Assessment%20of%20Environmental,Environmental%20Economic%20Accounting%20(UNCEEA).&text=The%20review%20also%20helps%20assess,countries%20for%20implementing%20the%20SEEA

Table 9: Global level recommendations

GAPS IDENTIFIED AT GLOBAL LEVEL	CAPACITY BUILDING ACTIONS RECOMMENDED
Global knowledge-sharing and learning on drought risk mitigation should be expanded through a coordinated process across the relevant global funds and convention processes.	Improve both the UNCCD Drought Toolbox with linkages to relevant drought portals (such as Drought Portal of FAO[1]), and the UNFCCC Climate Finance portal[2] adaptation section and build on the independent evaluation systems of the GEF and ICFs to create a common system for drought risk mitigation knowledge management including a compendium of case studies similar to WOCAT or the Warsaw Mechanism (WIM) Compendium on Comprehensive Risk Management Approaches[3] but with more specific focus on impacts on drought risk. Include a linked repository for compiled monitoring and evaluation materials.
A global approach should enable all countries to begin to monitor drought risks to their national economies, and to progressively improve both the monitoring system and its use to support decision-making through a continuous global review process.	Work with the VNR and Post 2020- processes to review national progress on the relevant SDG Targets (1.5, 6.4 &15.3), and more explicitly map and articulate susceptibility to drought risk within countries, ecosystems and communities, highlight capacity needs, list priority areas where capacity support is needed, etc.
The global approach should not only galvanize nested actions from the regional level, national and local levels, but also should better facilitate and accelerate inter-regional cooperation and exchanges.	The World Economic Forum and G20 have established forums for mapping global risks, including inter-regional risks and transfer of risks. Engagement with the Forum is recommended. A high-level event addressing this issue could be planned to take place on the sidelines of the forthcoming UNFCCC CoP. This should be preceded by a training for schoolteachers in the drought-affected regions on the use of social media to flag the concerns of their students and communities.

[1] Available at: http://www.fao.org/land-water/world-water-day-2021/drought/drought-portal/en/

[2] Available at: https://unfccc.int/climatefinance?home

[3] Available at: https://unfccc.int/sites/default/files/resource/FINAL_AA3_Compendium_September_2019%28revised%29.pdf

Regional level recommendations

At the regional level, there are different capabilities and capacity challenges in each region. Regional economic communities engage in different ways. These require more attention because they offer a practical way to build national, transboundary and global level capabilities. Regional land and water management exchanges on measures for drought risk mitigation tend to be project- based rather than institutionalized – therefore these need strengthening and integration with regional economic communities and development planning. They also should be better connected to regional capabilities and global capabilities for drought hazard monitoring – including a more complete range of drought hazards (hydrological, ecological, agro-ecological, urban concentration-related, and socio-economic).

Table 10: Regional level recommendations

GAPS IDENTIFIED AT REGIONAL LEVEL	CAPACITY BUILDING ACTIONS RECOMMENDED
Regional economic communities have an important role to play in bringing together effective systems to understand and address impacts on the regional economies (as in the IGAD region).	Regional risk assessments and capacity assessments to be generated by regional economic communities and validated by countries. Regional Economic Commissions could play a key role in this.
In many regions, information systems available at the regional level already play an important technical role in building capability for downscaling from global climate forecasts for early warning purposes to trigger actions. These information systems could be more routinely used for estimating the economic impacts of droughts to build the case for more cooperative regional and transboundary actions, where needed.	Regional forecasting of drought impacts to be verified, monitored and validated by countries.
Regional and transboundary cooperation can reinforce the use of decision support systems for sustainable land and water resource management in transboundary basins where win-win solutions can be identified for all stakeholders to benefit from shared initiatives to overcome drought risks.	Transboundary structures need to identify win-win cases for cooperation to mitigate drought risk.

National level

At the national level, capacity needs are assessed through the national drought planning processes in some countries. The ideal would be not only for mitigation measures to be monitored and assessed through the national drought monitoring systems. But also, connection of these to longer term national environmental monitoring systems and economic development planning frameworks as well. Alongside the information management capabilities, other important associated capacity needs to better enable mitigation measures concern capacities for financial management and budgeting, as well as project planning, implementation and evaluation. All of these require effective use, recording and sharing of information. Therefore, strengthening information management skills and systems can be an entry point for improving other management capabilities, including financial management, project and programme management.

Table 11: National level recommendations

GAPS IDENTIFIED AT NATIONAL LEVEL	CAPACITY BUILDING ACTIONS RECOMMENDED
There is a need for national policies to include specific provisions for drought risk mitigation and response to be connected to monitoring and evaluation systems.	Specific training for national governments to be able to report long term improvements and learning achieved and ongoing in their VNRs for drought relevant indicators.
Information systems available in an increasing number of countries have been designed for early warning purposes to trigger actions. These information systems should also be more routinely used for monitoring and evaluation of the impacts of mitigation actions.	Technical support and peer to peer exchange to be facilitated by FAO or others to enable national governments to prepare short inspirational public awareness-raising videos of cross-sectoral coordination – especially for integration of water and climate service information and monitoring systems (using available databases at FAO or WRI, e.g. WAPOR or Aquaduct).

GAPS IDENTIFIED AT NATIONAL LEVEL	CAPACITY BUILDING ACTIONS RECOMMENDED
National policies should also reinforce the use of decision support systems for sustainable land and water resource management and retrospective economic impact monitoring and national accounting systems to improve monitoring, evaluation and the design of more effective actions to more sustainably mitigate and transform risks over both the long- and short-term.	Preparation of a 'how-to' guide for reviewing the drought-risk proofing of national economic projections including case study examples demonstrating the use of any available hydrological models and/or water accounting systems.

Sub-national and local levels

In many countries, there are particular needs to strengthen capabilities in sub-national regions and areas that are more drought-affected and marginalized. There are also individuals and groups that can play a particularly important role, e.g. including women and the youth. Many of these capacity challenges are "chicken-and-egg" problems, i.e. if individuals or communities have not ever had access to budgets to spend on drought risk reduction, they will not have been able to learn skills in public financial management. Conversely, where communities have not ever previously been involved in public financial management, governments and donors tend to resist calls to entrust budgetary and other responsibilities to them. Equally, at the global level, because decision-makers do not have capacity to recognize and observe results from investment in drought risk reduction, they consider the results inadequate, so they do not invest adequately in them.

Rather than focusing on capacities that people in drought affected regions do not have, it can often be useful to consider the range of different ways in which people in drought-affected regions inevitably do have significant resource management knowledge. At the present time, the global and regional level capabilities for learning and risk management are even weaker than those at the national and local levels due to disconnects between these levels. Ultimately, the best approach to building capability is learning by doing. This point has been made well by the case study provided by the Mexican PRONACOSE programme (Case Study 6). This could be scaled up by further increasing the proportion of the global drought risk mitigation and response programming budgets that are allocated to information systems, learning and integration with long-term national economic development planning frameworks, and working more effectively with local and national knowledge and decision systems rather than focusing only on short-term project-based approaches.

Table 12: Sub-national and local level recommendations

GAPS IDENTIFIED AT SUB-NATIONAL LEVEL	CAPACITY BUILDING ACTIONS RECOMMENDED
Learning that takes place at the local level should be better connected to inform decision-making at other scales.	Global reporting and assessment processes (IPCC, IPBES, UNDRR and Rio Conventions) to make space for specific reports from local governments, including those in vulnerable regions.
There is a need to make use of new options for low-cost geographic information systems for monitoring and modeling drought risk while integrating these with other sources of local and national information.	Global programmes to ensure practical, accessible training materials for local government technicians available online free of charge (e.g. as in UNESCAP 2020).
At the local level, the effectiveness of local, national and regional monitoring systems can be reviewed and validated through periodic local drought risk management planning, action and evaluation.	Global programmes to invite sharing of local plans and experiences via permanently accessible public online platforms.

6. Conclusions

This knowledge product has affirmed that there are many options available to ensure that droughts need not always cause humanitarian and economic disasters. Risk mitigating and transformative actions can be taken across a range of sectors and scales to ensure that drought effects on vulnerable communities and ecosystems can be mitigated through human institutions and actions. They can include proactive and preventive measures to be implemented before droughts arise, alongside preparatory measures to accelerate and enhance responses and recovery. Furthermore, societies can learn and adapt so that some drought risks can be transformed into economic opportunities.

Different options have been tested and are under implementation in different contexts. In each case, there is a need for decision-makers to experiment and adapt until they find the solutions that work best with stakeholders' needs and context. Societies abilities to transform drought risks and move beyond mitigation strategies depend on how they are able to learn from adaptation experiences.

Over the recent decades, numerous insights and lessons have been gained at the global level through the monitoring and evaluation of drought risk mitigation programming by the GEF and its Agencies as well as at some of the emerging global climate funds. Alongside this, many countries and regions have established information and early warning systems to help them to mitigate drought risks. Important lessons have been learned about the governance of drought risk, and the needs for attention to aspects such as gender, land tenure, and the economic incentives that affect risk management strategies employed by local resource users and the private sector.

Despite considerable investments in improving monitoring, evaluation information and early warning systems, there are still gaps in the integration of these with information required to assess longer term ecological and economic impacts from drought in many countries. As a result, it is still often difficult to assess the effects of risk mitigation in terms of changes in resource conditions on the ground and economic opportunities for vulnerable people. This means that it is still difficult to evaluate the extent to which national drought risk mitigation programmes have worked (or not), how well, and how this affects economies and human decision-making at different scales.

To fill the remaining gaps in knowledge and learning on drought risk mitigation, much better use could now be made of the available tools, technologies, databases and local knowledge to monitor impacts on resource conditions on the ground and to model and assess their implications for economies at different scales. Recommendations focus on engaging capacities to achieve this at local, national, regional and global levels. At the present, learning systems are weakest at the global level, and there is a need to improve cross-scale information flows, as well as sharing of information between the global funds, convention processes and stakeholders addressing drought risks across different levels.

Box 11: Options for recommended next steps

Global level actions:

- Improve both the UNCCD Drought Toolbox and the IDMP HelpDesk Website (www.droughtmanagement.info), with linkages to relevant drought portals (such as Drought Portal of FAO), and the UNFCCC Climate Finance portal adaptation section and build on the independent evaluation systems of the GEF and ICFs to create a common system for drought risk mitigation knowledge management including a compendium of case studies similar to WOCAT or WIM CRM but with more specific focus on impacts on drought risk. Include a linked repository for compiled monitoring and evaluation materials.
- Work with the VNR and Post 2020 processes to review national progress on the relevant SDG Targets, and more explicitly map and articulate susceptibility to drought risk within countries, ecosystems and communities, highlight capacity needs, list priority areas where capacity support is needed, etc.
- The World Economic Forum and UNCTAD have established forums for mapping global risks, including inter-regional risks and transfer of risks. A high-level event addressing this issue could be planned to take place on the Sidelines of the forthcoming UNFCCC CoP. This should be preceded by a training for schoolteachers in the drought-affected regions on the use of social media to flag the concerns of their students and communities.

Regional level actions:

- Regional risk assessments and capacity assessments to be generated by regional economic communities and validated by countries. Regional Economic Commissions could play a key role in this.
- Regional forecasting of drought impacts to be verified, monitored and validated by countries.
- Transboundary structures to identify win-win cases for cooperation to mitigate drought risk.

National level actions:

- Specific training for national governments to be able to report long term improvements and learning achieved and ongoing in their VNRs for drought relevant indicators.
- Technical support and peer to peer exchange to be facilitated by FAO to enable national governments to prepare short inspirational public awareness-raising videos of cross-sectoral coordination – especially for integration of water and climate service information and monitoring systems (using available databases at FAO or WRI, e.g. WAPOR or Aquaduct).
- Preparation of a how-to guide for reviewing the drought-risk proofing of national economic projections including case study examples demonstrating the use of any available hydrological models and/or water accounting systems.

Local level actions:

- Global reporting and assessment processes (IPCC, IPBES, UNDRR and Rio Conventions) to make space for specific reports from local governments, including those in vulnerable regions.
- Global programmes to ensure practical, accessible training materials for local government technicians available online free of charge.
- Global programmes to invite sharing of local plans and experiences via permanently accessible public online platforms.

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Glossary

Drought

According to common usage and popular experience, droughts are disruptions to normal availability of water. Under the extenuating circumstances associated with droughts, agreed services for water supply may not be available as normal, unusual restrictions on certain uses of water and land may be imposed, and/or the costs to access water may increase. The French word for drought is secheresse, Spanish is sequía and Arabic is jafaaf.

According to the most recent IPCC report (Shukla *et al*., 2019), the latest definition of drought is "a period of abnormally dry weather long enough to cause a serious hydrological imbalance". Drought is a relative term, therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation. A period with an abnormal precipitation deficit is defined as a meteorological drought.

Megadrought: A very lengthy and pervasive drought, lasting much longer than normal, usually decade or more.

According to meteorologists, including WMO (1992), drought is more narrowly defined as a 1. "prolonged absence or marked deficiency of precipitation" and 2. "period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance".

Human-induced hydrological imbalances have been observed by some scientists (e.g. Van Loon *et al*., 2016) to increase population exposure and vulnerability to droughts. This anthropogenic water stress also is predicted by IPCC to accelerate faster than growing human demands for water due to ongoing climate changes (Shukla *et al*., 2019). For example, the IPCC Special Report on Global Warming of 1.5°C highlighted the attribution of an increase in droughts in the Mediterranean to man-made climate change with medium confidence (IPCC, 2018).

The UNCCD provided the following consensus definition of drought: "drought" means the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.

Hydrological imbalance

All accepted definitions of drought refer to hydrological imbalance as the central characteristic (which can be attributed to various causes). None of them defines what is hydrological imbalance.

The following definitions are provided in the IPCC Special Report on Climate Change and Land (SRCCL) (Shukla *et al*., 2019).

Hydrological cycle: The cycle in which water evaporates from the oceans and the land surface, is carried over the Earth in atmospheric circulation as water vapour, condenses to form clouds, precipitates as rain or snow, which on land can be intercepted by trees and vegetation, potentially accumulating as snow or ice, provides runoff on the land surface, infiltrates into soils, recharges groundwater, discharges into streams, and ultimately, flows out into the oceans as rivers, polar glaciers and ice sheets, from which it will eventually evaporate again. The various systems involved in the hydrological cycle are usually referred to as hydrological systems.

Hydrological systems: the various systems involved in the hydrological cycle. Human organizations and institutions play a major role.

Human system: any system in which human organizations and institutions play a major role. Often, but not always, the term is synonymous with society or social system. Systems such as agricultural systems, urban systems, political systems, technological systems, and economic systems are all human systems in the sense applied in this report.

Freshwater withdrawal as a proportion of available freshwater resources is referred to as the Sustainable Development Goals Indicator 6.4.2 "Level of water stress":[49]

"The level of water stress: freshwater withdrawal as a proportion of available freshwater resources is the ratio between total freshwater withdrawn by major economic sectors and total renewable freshwater resources, after taking into account environmental water requirements. This indicator is also known as water withdrawal intensity and will measure progress towards SDG Target 6.4."

A previous definition of water stress (still also relevant) is as follows (FAO, 2012):

Water stress: the symptoms of water scarcity or shortage, e.g. widespread, frequent and serious restrictions on use, growing conflict between users and competition for water, declining standards of reliability and service, harvest failures and food insecurity.

Impacts[50]

Disaster impact is the total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being.

[49] Available at: http://www.fao.org/sustainable-development-goals/indicators/642/en/

[50] Including those caused by droughts (see UNISDR: https://www.undrr.org/terminology/disaster).

Impacts associated with climate change (including but also not limited to droughts and other disasters) according to the IPCC (2014):[51]

Impacts (Consequences, Outcomes): effects on natural and human systems. In this report, the term "impacts" is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes.

The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.

Recent guidance available at the international level (EU/WB/UN, 2014) focuses on two main aspects of the impacts of disasters such as droughts:

- Economic impact at macro and micro levels: the estimation of the disaster's likely effects on economic performance and the temporary macro-economic imbalances that may arise from it, as well as its varied impacts on personal/household income and employment in all sectors.
- Human development impact: the impacts of the disaster on the quality of human life in the medium and long term.

Risk

The IPCC Special Report (Shukla *et al*., 2019) defined risk as follows: the potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. In the context of the assessment of climate impacts, the term risk is often used to refer to the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation responses to such a hazard, on lives, livelihoods, health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.

Risk is the product of Hazard x Exposure x Vulnerability

Hazard: the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.

Exposure: the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure or economic, social, or cultural assets in places and settings that could be adversely affected.

[51] Notes: an IDMP Glossary is also available at: http://www.droughtmanagement.info/find/glossary/.

Vulnerability: the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Mitigation

The IDMP glossary[52] follows the IPCC 2012 definitions of mitigation (IPCC, 2012):

Mitigation (of disaster risk and disaster): the lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.

Mitigation (of climate change): a human intervention to reduce the sources or enhance the sinks of greenhouse gases.

The Disaster Management community defines mitigation (UN, 2016):

Mitigation: the lessening or minimizing of the adverse impacts of a hazardous event.

Annotation: The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. It should be noted that, in climate change policy, "mitigation" is defined differently, and is the term used for the reduction of greenhouse gas emissions that are the source of climate change.'

Mitigation of climate change (Diemen *et al*., 2019):

Mitigation measures: in climate policy, mitigation measures are technologies, processes or practices that contribute to mitigation (of climate change), for example renewable energy technologies, waste minimization processes, public transport commuting practices.

IPCC has defined and clarified a continuum of approaches to preparing for climate change that contrast mitigation (alleviating ongoing effects while accepting that such effects would continue and might never be completely redressed) to transformation (a more profound systemic change) as a more beneficial adaptation to climate extremes such as drought.

Transformation

Adaptation: in human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

Incremental adaptation: adaptation that maintains the essence and integrity of a system or process at a given scale (Park *et al*., 2012).

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[52] Available at: https://www.droughtmanagement.info/find/glossary/

Transformational adaptation: adaptation that changes the fundamental attributes of a social-ecological system in anticipation of climate change and its impacts.

Transformation pathways: trajectories describing consistent sets of possible futures of greenhouse gas (GHG) emissions, atmospheric concentrations, or global mean surface temperatures implied from mitigation and adaptation actions associated with a set of broad and irreversible economic, technological, societal, and behavioral changes. This can encompass changes in the way energy and infrastructure are used and produced, natural resources are managed and institutions are set up and in the pace and direction of technological change (TC).

Transformation: a change in the fundamental attributes of natural and human systems.[53]

Societal (social) transformation: A profound and often deliberate shift initiated by communities toward sustainability, facilitated by changes in individual and collective values and behaviours, and a fairer balance of political, cultural, and institutional power in society.

Transformative change: A system wide change that alters the fundamental attributes of the system.

Transformative change (or transformational change; the terms are used interchangeably): it refers to a fundamental, system-wide change that includes consideration of technological, economic and social factors, including in terms of paradigms, goals or values.

[53] IPBES have proposed a slightly different definition of transformation: https://ipbes.net/sites/default/files/Initial_scoping_transformative_change_assessment_EN.pdf

Annex 1: Case Studies

Case study 1: Mitigating drought risks in the Sahel

Contributor: Issa Garba, Comité permanent inter-État de lutte contre la sécheresse au Sahel (CILSS)

Droughts need not always cause humanitarian and economic disasters. Their effects on vulnerable individuals, communities and ecosystems can be mitigated by human actions and institutions. These include actions to reinforce and share scientific and technical capabilities across boundaries that exist within the region and beyond. Mitigation, preparedness and response measures for drought risks can involve a range of different sectors and strategic entry-points from soil and water conservation, soil protection, restoration and natural resource management to multi-hazard approaches, public education and conflict resolution.

Different mitigation options have been tested and are under implementation in different contexts across the Sahel (see the national strategies and targets for Land Degradation Neutrality and disaster risk reduction in Table 2). In each case, there is a need for decision-makers to experiment and adapt until they find the solutions that work best with stakeholders' needs and context. Societies' abilities to transform drought risks and move beyond mitigation strategies depend on how they are able to learn from adaptation experiences. Qualitative lessons have been learned over the recent decades concerning the needs and opportunities for increased attention to conflict-resolution and institution-building as well as economic and social costs of continuing drought risk. Unfortunately, military expenditures to contain ongoing security threats in the Sahel still far exceed expenditures on peaceful cooperation, co-development and drought risk reduction.

To change the dynamics of this self-perpetuating cycle would require a different approach, and a strong case to be made for increased investment. Quantitative evidence of the effects of risk mitigation actions in terms of changes in resource conditions on the ground is still weak. Some effects from land-users' investments in soil and water conservation and soil protection are visible in terms of increased greening and crop production (CILSS, 2016). But the additional positive effects that they have on the critical stream-flows and hydrological balances in the system that can buffer drought risks are still not fully monitored and assessed. As a result, it is still difficult to evaluate fully the extent to which national drought risk mitigation programmes are working (or not), what additional volume and duration of rainfall deficit communities and ecosystems are able to withstand as a result of these actions, how the benefits feed into the regional economies, and to what extent this could be expected to accelerate the achievement of regional and global peace and security objectives.

Following the severe droughts that destabilized the Sahel region in the early 1970s, the AGRHYMET Regional Center was created in 1974 as a specialized institution of the Permanent Interstates Committee for Drought Control in the Sahel (CILSS). Its mission is to work with multidisciplinary practitioner groups across the region to monitor the meteorological, hydrological, and vegetation conditions that enable the population to remain resilient throughout the dry seasons and to withstand periodic droughts when they occur. In this way, the political structures for decision-making are equipped with the technical support and warning systems that they need to work together to achieve their shared objectives according to the AU 2063 strategy for the Africa We Want. According to this strategy, the actions of a multitude of actors, including producers' associations and NGOs, must be engaged to implement technological innovations and adaptation in the shared endeavor to mitigate drought risk across the region. The regional monitoring and evaluation systems play an essential coordinating role.

Source: Partially based on http://agrhymet.cilss.int/index.php/bulletins/

Case study 2: Hydrological Drought in India –
An institutionalized systemic hydrological management challenge

Contributor: Rajendra Prasad Pandey, National Institute for Hydrology, India

The national hydrology project (phase III) observed weaknesses in the institutional capacity for IWRM, including flood and drought management, particularly in the state water resources departments. During HP-II and through other projects, some states (e.g. in southern India and in Himachal Pradesh and Punjab) had been equipped with the tools for river basin planning and management, but there was generally little human resource capability for integrated management approaches. There was an acute shortage of hydrologists, water resources planners, water managers, and other skills. The knowledge base and drought management capability was not adequate to provide early warnings on drought or to plan for appropriate responses (WB, 2017).

In the short term, this was recognized to be the root cause of poor drought alert capability. For longer term, the weaknesses in the hydrological capabilities were then also translating into inadequate planning and investment in the large-scale watershed management programmes and poor strategic development of water resources for irrigation that were demanded to minimize the impacts of drought on agricultural production and the dependent populations and economies. Groundwater management problems were accelerating drought effects in states such as Gujurat and Odhisha.[13]

Many river basins in (particularly south) India are regulated by reservoirs that serve as a cushion for flood and drought. Although states are responsible for the operation of their reservoirs, they seek the help of the Central Water Commission (CWC) for streamflow forecasting. Reservoir operations are still based on original operating rules and are not geared to the flexible release of water to better manage flood risk and optimize storage. In the northern transboundary river basins (Ganga and Brahmaputra), the reservoirs and barrages were not considered sufficient to regulate effectively while alert and response systems were also not adequate to prepare for the floods. Out of India's total annual surface water resources, the Ganga and Brahmaputra basins account for 60 percent of streamflow and 70 percent of the population of the country.

The National Hydrology Project (NHP) set out to extend the reach of national Water Resource Information System (WRIS) to support integrated river basin planning and management over the entire country - removing disparities between the states that had benefitted from HP-I and HP-II and those that had not. It highlighted the need to update the national water resources assessment. It observed that global experience of water sector institutional reforms indicates that these require time. As, for example, it took more than 20 years for the European Union to have all the member countries onboard for an integrated platform.

Groundwater is under severe pressure in many parts of India, with more than half of the resource developed for use and over extraction prevalent in many intensively farmed areas. Demand for water is projected to nearly double (1.6 times) by 2050 (to reach 1 069 billion m3 as compared to the current 659 billion m3). Demand will continue to rise in all sectors, particularly in the industrial and domestic sectors, placing pressure on agriculture, which currently accounts for 90 percent of water use. National programmes such as the Prime Minister's Irrigation Scheme (Pradhan Mantri Krishi Sinchaiyee Yojana, PMKSY), which aims to ensure irrigation water supply to every field in India, already face water constraints due to overexploitation of groundwater, limited water availability in surface storage, and growing demand for reallocation of agricultural water to other priority sectors.

The quality of surface water and groundwater is a rising concern, decreasing effective water availability further. According to the Central Groundwater Board (CGWB), groundwater in 276 of India's 660 districts have high levels of fluoride; in 387 districts, it has nitrates exceeding safe levels; and in 86 districts, it has arsenic. According to the Central Pollution Control Board (CPCB), about 650 major towns and cities in India are on the banks of rivers contaminated with pesticides from farms and effluents from industries.

Initiatives for Objective Assessment and Mitigation of Drought in India

There is an extensive history of occurrence of documented famines and droughts in India which had caused notable human sufferings and economic loss repeatedly. The response actions at national and state level had been more often too inadequate, too late and hence ineffectual. The Government of India introduced a primary law as Disaster Management Act – 2005 at the national level that provisions for management of disasters in the country. It mandates that there shall be a National Disaster Management Plan (NDMP) for the whole of India which will pertain to the disaster management including drought for the entire country (GoI, 2010). The government of India has notified the Department of Agriculture, Cooperation & Farmers' Welfare (DACFW) as the nodal agency to formulate policies, plans and institutional mechanisms related to drought management in the country. DACFW has actively been engaged in devising guidelines and practices that are followed by the state and district level authorities to mitigate drought conditions in their area.

The revised Drought Management Manual has been published in December 2016, which is a guide for governments and agencies engaged in the monitoring, mitigation and management of drought (GoI, 2016). It defines various set of indicators and indices provides objectivity to the process of determination of drought in an area for early drought alerts and declaration of drought. The "drought declaration" signifies the beginning of Government response measures to be initiated to minimize acute water stress for agriculture and drinking need and damage to life and regional economic activities. This also ensures quick assessment of ground scenarios to reduce any time lag in occurrence, assessment and response mechanism for management of drought.

To provide necessary guidance to the implementation authorities, Crisis Management Plan (CMP) and District Agriculture Contingency Plans (DACPs) have been formulated by DACFW in collaboration with ICAR Central Research Institute for Dryland Agriculture (ICAR-CRIDA). CMP, a strategic guiding document for Central Ministries and State Governments, is prepared before the commencement of each Kharif season and provides critical steps that need to be taken in different times of the year with respect to drought preparedness. CMP is pressed into action in the event of a drought and delineates the roles and responsibilities of various stakeholders, including central and state government and their agencies in managing the drought effectively. The CMP focuses on management interventions required during the crisis.

DACPs recommend contingency measures in terms of alternate crops/crop varieties/agronomic practices/other management options appropriate for district specific drought scenarios. Specificity of DACPs is extremely exhaustive and provides for measures to cope with drought in rainfed and irrigated farming situations, on account of delayed onset of monsoon (2/4/6/8 weeks delay), for field and horticulture crops and for early/ midseason/terminal drought scenarios. DACP also talks about establishment of seed bank, fodder bank as well as nutrient centers, at strategically advantageous locations for providing relief to farmers during distress period.

Further, the DACFW has also prepared a Drought Management Plan (DMP) in November 2017 (GoI, 2017) which helps in delineating roles and responsibilities of different Ministries/ Departments of the Government of India involved in drought management for mitigation, preparedness and for relief measures in managing the drought. Key focus of DMP is to ensure better preparation and timely communication among stakeholders, to help reduce the time taken in mobilizing resources for an effective response and enable a harmonious relationship among stakeholders, which is critical in managing a drought.

Institutional Arrangements

DACFW is responsible for monitoring and coordinating the central government response to drought. A Crisis Management Group functions under the Chairmanship of the Central Drought Relief Commissioner with representatives of associated ministries and organizations. The Crisis Management Group meets from time to time to review the drought situation in the country and progress of relief measures.

At the state level, Department of Disaster Management and Relief, headed by a Secretary or Relief Commissioner is responsible for directing drought operations in the State. The Relief Commissioner/ Secretary monitor the drought situation and regulate the release of all financial assistance to the district administration.

At the district level, Collector implements all decisions related to drought management through a number of line departments and field agencies. District collector heads a district drought/disaster management committee consisting of public representatives and line departments.

At the subdistrict level, Panchayati Raj institutions (PRIs) – Zilla Parishads, Panchayat Samitis, and Village Panchayats – are involved in the implementation of drought management programmes. National Agricultural Drought Assessment and Monitoring System (NADAMS), provides near real-time information on prevalence, severity level and persistence of agricultural drought at state/ district/ sub-district level. It covers 14 states of India, which are predominantly agriculture based and prone to drought.

Also, there are large scale national programmes/missions on water conservation, watershed development and management and rejuvenation of water rivers, springs, tanks, lakes and other bodies, including people's participation in rainwater harvesting and conversation. The implemented of such nation-wide schemes, (namely, 1. Drought Prone Area Development Programme (DPAP), 2. National watershed development Programme (NWDP), 3. Prime Minister Krishi Sinchai Yojana (PMKY), 4. National Water Mission (NWM) etc.,) are effectively continuing from years as proactive drought mitigation strategies.

Connecting better from timely and consistent drought declarations and response to inform more proactive and preventive upstream actions

Drought declaration and response management in India have always been complex tasks requiring coordination between various States' government levels. In 2016, the Supreme Court of India heard accusations of inconsistent application of subjective criterion in the drought declarations by different States. The Court directed the Union government to revise its 2009 Drought Management Manual and to put in place a more objective scientific approach to drought monitoring and declarations. A new manual published in 2016 placed complete responsibility on the State governments to monitor, assess and declare drought using the approach prescribed in it. The States may then seek financial assistance from the Federal Government for drought-affected regions only in cases that meet with the objective criteria.

The communication of the drought indicators is facilitated by a new online data interface (Parry, Chitson and Pandey, 2020). Even with the drought manual and improving information systems, still many controversies and concerns continue to arise over drought declarations and growing needs for action to ensure more proactive management of water demands. As yet, the drought manual does not trigger proactive management interventions that could help to more directly address and mitigate the aspects of drought risk that are due to water-use and demand patterns (Pandey *et al*., 2010; Rickards *et al*., 2020).

However, seasonal early warning and decision-support systems could trigger preparation for the rains before they arrive. Early actions to be taken include monitoring groundwater and surface reservoir deficits, assessing recharge needs and anticipated catchment areas, restoring floodwater control and harvesting structures, cleaning drains, storage cisterns, identifying and managing pollution sources, improving reservoirs, strengthening associated governance systems, including local resource users, strengthening committees, transfer of information, responsibility and funds between levels of government, etc. These would be context-dependent and difficult to prescribe through a one-size fits all national level manual.

Individual State-level drought management plans could take into consideration the hydrogeological conditions of the main water sources, and detail measures to be followed in each context. All states in the country are already required to produce State Disaster Management Plans (SDMPs), which outline the preparations, risk-reduction actions and responses needed to reduce and cope with the threats specific to their region.

Source: Partially based on http://documents1.worldbank.org/curated/en/954111490207555730/pdf/India-National-Hydrology-PAD-02242017.pdf and see: https://www.preventionweb.net/publications/view/49489.

Notes: In 2019 the Government of India published a new vulnerability atlas for a range of disasters: https://bmtpc.org/DataFiles/CMS/file/VAI2019/Index.html.

In 2017, the GCF approved a project to support groundwater recharge to adapt to drought and floods in Odisha:
https://www.greenclimate.fund/sites/default/files/document/funding-proposal-fp045-nabard-india.pdf
https://www.greenclimate.fund/countries/india
https://sustainabledevelopment.un.org/content/documents/26279VNR_2020_India_Report.pdf
https://www.preventionweb.net/publications/view/49489

Disaster management planning and vulnerability assessment in Gujurat State:
http://www.gsdma.org/Content/state-level-disaster-management-plan-4160
For more information on disaster management in India see: https://ndma.gov.in/Governance/Guidelines and Gupta et al.*, (2014)*


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Case study 3: Connecting drought response to sustainable development for Northeast Brazil

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Response actions can involve three levels of government, including municipalities, States and the Federal Government. Response actions – by definition – tend to be reactive. Often this has meant that they would not be defined until a drought strikes. However, the UNISDR framework on disaster risk reduction, especially the Hyogo Framework and the Sendai Framework, and efforts by national civil defence systems have provided support for developing countries to work with international and civil society organizations to take a more proactive planned approach and prepare for relief assistance to be available during droughts. However, in countries such as Brazil, there remains a need for drought planning to be better integrated with sustainable development planning to prevent rather than prepare for drought emergencies.

Drought responses in Brazil mostly include distribution of water, food and cash. In the past, these programmes often were linked with work programmes for job creation and distribution of food or small payments. For example, Brazil employed about three million rural workers during the 1983 drought in such programmes. In contrast to this, today, Brazil has a system of social protection that provides monthly cash transfers to low-income people. The government also distributes animal feeds at below market prices to help cattle-raising communities in drought-affected areas of North-east to maintain their productive assets and livelihoods during droughts. Water trucks distribute water to both rural and urban populations.

Proactive response actions require preparedness plans at national, state or provincial, and local levels, as well as territorial (water basins), urban, and sectoral levels. Such planning requires attention to a range of questions: how can we ensure a continuous water supply for a specific community in times of severe drought? How do we manage water supply from a dam that is prone to low water levels? How do we coordinate state actions to meet the needs of local people? How do we link response actions to mitigation actions and to regional and national sustainable development? Brazil has succeeded to put in place a National Water Policy. This has helped planners to identify needs for new aqueducts and wells to be built, desalination tools to be used, and new sources of water to be sought.

The last major drought emergency in Brazil occurred in 2017. This demonstrated that the social protection system had largely replaced the work programmes and was sufficient to prevent the drought emergency from escalating to become a national calamity involving loss of life. However, the available infrastructure was not enough to prevent the needs for water trucking to urban and rural areas. The national water policy was not fully integrated with a cross-sectoral approach including sustainable land and water management. This is necessary to ensure that sufficient water could be stored in the ground and in the reservoir systems to enable the public water supplies to continue to function and provide water during droughts.

As a result of continuing poor integration between the water policy and the various levels and sectors of government that are affected by drought, in 2017 the government had to truck emergency water supplies. These were necessary as storage cisterns were depleted in the rural areas and the water supply intakes for the urban areas had too little water to distribute through their piped networks.

The Brazilian Drought Monitor is coordinated by the National Water Agency (ANA) with the active participation of other climate and research institutions in Brazil, particularly state water and meteorological services, such as the Foundation on Meteorology and Water Resources of Ceará (Funceme), the Pernambuco Agency for Water and Climate (APAC), and the Bahia Institute of Environment and Water Resources (INEMA). The Brazilian Drought Monitor issues a map and a report every month, which is prepared by climate and water research institutions and validated by local experts . The Monitor uses SPI – standard precipitation index – and SPEI – standard precipitation and evapotranspiration index – data, as well as information on the state of the reservoirs.

Recently, the Green Climate Fund Approved a project implemented by IFAD on Planting Climate Resilience in Rural Communities (PCRP) of the Northeast Brazil (GCF, 2020). The project focuses on building resilience to drought and water scarcity. It builds on a Policy Coordination and Dialogue for Reducing Poverty and Inequalities in Semi-Arid North-east Brazil (PDHC) and also a previous activity by IFAD in the Northeast that was financed by the GEF. The GCF project consists of three components that complement and reinforce one another to promote climate resiliency as well as reduce greenhouse gas (GHG) emissions. As such it is considered an "integrated" project achieving mitigation and adaptation objectives:

- Component 1 will introduce climate resilient productive systems (CRPS), which should increase the resilience of family farmers and traditional communities to the impacts of climate change, as well as mitigating GHG emissions. This component contributes to the total emission reduction commitment of the project by strengthening carbon sinks on 84 124 ha comprising family farms, backyard gardens and collective areas, and by converting these territories to sustainable management. This component also includes installing 540 eco-efficient stoves, building 540 biodigesters for family farmers, and implementing 540 income-generating activities in collective areas (mainly forests and pastures), supported by investment in 70 micro enterprises to supply small-scale equipment for CRPS.

- Component 2 will reduce the impact of severe droughts by focusing on improving access to water for family farmers and traditional communities, and by investing in small-scale technologies for harvesting, reuse, treatment and storage of rainwater. The technical assistance provided to the beneficiaries will focus on addressing issues such as efficient water management, good irrigation practices, techniques for limiting evapotranspiration and precautions to prevent soil salinization. All pumping systems will use renewable energy (photovoltaic or wind power). The anticipated results of this component are 20 000 cisterns with walkways (cement patios with underground tank), 500 trench barriers, 500 small underground dams, 10 000 greywater reuse systems, 5 000 blackwater treatment systems (green septic tanks); and

- Component 3 is dedicated to knowledge management and scaling up CRPS. This component is considered by the project to be fundamental for future sustainability. The water access solutions proposed in Component 2, such as rainwater harvest and storage, if accompanied by the current agricultural model, may be temporarily palliative – subject to severe water loss due to high evapotranspiration from heat and wind – but productivity would remain limited. In fact, water investments in the semiarid zone must be complemented by soil recovery practices promoted in Component 1, to allow infiltration of rainwater, increase soil biomass rate, create shade and wind shelters to reduce evapotranspiration (which can exceed 2 000 mm/year). The specific flora and fauna in the semiarid have developed a high capacity to access and store water (in roots, trunks, stems and leaves), resulting in a biota capable of supplying more water than needed for growth and reproduction, adding surplus water to the system.

The project will deliver and monitored results. For example, GHG emissions will be reduced by more than 11 million tons of carbon dioxide equivalent (MtCO2eq) over 20 years; at least 1 080 smallholder households will save 80 to 104 Brazilian real per month as a result of a reduction in firewood consumption owing to implementation of efficient stoves and biodigesters; 67 000 family farms participating in CRPS are estimated to reach an increase in biomass production of at least 50 000 kg/ha after a 10-year period; agricultural losses during drought periods will be reduced by 10 percent compared with the 2010–2020 baseline; and soil moisture during the dry season will be increased by 15 percent compared with the baseline. Approximately 1 million people in 250 000 family farms (40 percent women and 50 percent youth) directly benefit from the project.

Notes: For additional examples of sustainable land management in the semi-arid zone, see Caatinga in (IRP, 2019 p. 108): https://knowledge.unccd.int/knowledge-products-and-pillars/unccd-science-policy-weblog/brazil-sets-novel-model-reverse and https://www.indepthnews.net/index.php/the-world/latin-america-the-caribbean/2157-brazil-sets-up-an-innovative-model-to-reverse-land-degradation

Case study 4: Water harvesting and sustainable land management to buffer drought in Southern Tunisia

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In Wadi Oum Zessar, droughts cause interruption of drinking water supplies for the human needs, as well as loss of agricultural production. Traditionally, a wide range of water harvesting practices are used to collect and conserve water on the hillslopes and wadi beds of the catchment. These include Jessour, Tabias and cisterns known as Fesguia and Majel). Land users and researchers are continuing to adapt these practices, and to innovate new systems to accelerate the capture, recharge and purification of runoff water to recharge the aquifer using Managed Aquifer Recharge (MAR) techniques. These include check dams, retention ponds and recharge wells.

The percentage of the annual rainfall that is captured and used each year in the catchment is not known, and the quantitative difference made by nature-based solutions, such as water harvesting is not fully assessed in terms of its effects on water productivity and recharge to storage. As a result, decision-makers do not have complete information about the volume of risks that can be mitigated when they are assessing these options. Instead, they usually resort to drilling wells as a means to prepare for drought, if they can afford to do so. Unfortunately, as the aquifer is already over-stressed, this option is becoming less and less feasible. Seawater desalination plants offer an expensive alternative, increasing the national debt. One is already in operation to serve the urban population near the coast, and a second one is under construction.

Increasing investments in sustainable drought risk reduction solutions such as water harvesting and managed aquifer recharge could avoid some of the costs of constructing more desalination plants. To improve decision-makers' understanding of the scope of these measures, research and extension agencies have explored various methods to evaluate their effects on groundwater recharge processes and agricultural production under different drought and non-drought conditions. These evaluations require modelling tools and approaches to be combined with systems for field data collection, management and analysis. But monitoring systems require the drilling of observation wells (which do not produce water supplies), whereas decision-makers prefer to invest in wells that can provide water to the public. These are more likely to be popular decisions – even if the productive wells may then fail sooner or later.

International scientific and technical cooperation through the Wadismar project[19] has put in place a piezometer that is generating data to enable improved modeling of groundwater recharge processes under drought and non-drought conditions (Carletti, 2017; Carletti *et al*., 2019), and to evaluate the effects of different practices, such as water harvesting and managed aquifer recharge. Two and a half years of data is enabling researchers to improve previous estimates of the effects of rainfall patterns on groundwater levels in an area where water-harvesting structures are in use. With the addition of a control site (monitored or hypothetical), this could translate into estimates of desalination cost savings and also into income generation due to improved production of fruit trees in the upstream water harvesting areas. Importantly for decision-makers, adding a second data point could generate lasting evidence of the extent to which rehabilitating water harvesting structures routinely results in reduced drought risks on an annual basis.

Previous commentaries have suggested that further use of field data and analyses could justify payments for ecosystem services to reward local herding and farming communities maintaining and improving the water harvesting structures and monitoring systems (see further discussion of PES systems in use elsewhere in Section 4). While continually increasing national debts to pay for additional desalination plants, downstream urban populations might also succeed to pay their own upstream communities for conserving and recharging naturally purified groundwater supplies to reach them.

Intended beneficiaries: Farming households, smallholder irrigation farmers, herdsmen, user of wells in the project locations.

Case study 5: Natural buffers for drought management in the Andean highlands

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Water supplies to the dry areas of much of South America originate in the headwaters of the high Andes mountains. These are the largest tributaries to the Amazon basin, the inter-Andean Magdalena river basin, and the Orinoco river basin supplying hydropower plants and domestic, agricultural and industrial consumption needs across a vast region of arid and semi-arid lowlands. For example, the city of Bogotá relies on the páramo in the Chingaza National Park for around 80 percent of its water supplies. The mountain ecosystems play a critical role in regulating drought risks across the South American continent. Water from rain, fog and thawing snow and ice is collected and stored in the natural vegetation and soils of neotropical alpine grasslands that cover the upper region of the Northern Andes, known as the páramos. These areas cover 35 700km2 in the high mountain areas of Colombia, Venezuela, Ecuador and Peru (Rodríguez-Morales *et al*., 2019; Buytaert and Beven, 2011; Lazo *et al*., 2019; Buytaert *et al*., 2006). A recent national drought plan for Colombia[20] considers the effects of environmental degradation in exacerbating drought risks.

The qualities of the volcanic ash-soils in the páramos favour high water retention and rapid recovery from drought (Iñiguez *et al*., 2016). Furthermore, the natural vegetation also plays an important role in transferring water to the soil and in controlling the soil water content by a low evapotranspiration and high fog water interception. This includes a range of functions for capturing mist and fogwater, as well as rain, snow and ice. The soil that receives this infiltrated water will act as a sponge that slowly releases a regulated flow of water to aquifers, springs and rivers (Ramírez, 2018; Liniger *et al*., 2020). The stemflow processes of the natural vegetation at the high altitudes are more efficient in transferring water to the soil than other vegetation types such as potato and maize crops (Janeau *et al*., 2015). Due to this built-in mechanism the natural vegetation helps to buffer drought conditions.

FAO has provided support to municipalities in the high Andes to strengthen their local planning and budgeting systems through preparedness planning for the full range of climatic effects that they face, including cold waves and sudden hailstorms. Together, FAO, IDMP, and other partners are continuing to work with the government of Colombia to support the combination of locally managed land degradation monitoring systems and datasets with objectively verifiable remotely sensed information (now under preparation via the GEF-funded project on Tools for Land Degradation).

Payments for ecosystem services from the high páramo

Increasing vulnerability to drought in downstream areas and recognition of the needs to conserve the upstream water catchment areas has driven the creation of protected areas, public re-education, punishments for violators of environmental legislation, and Payments for Ecosystem Services (PES) across the region (Farley and Bremer, 2017). Several PES programmes have promoted either afforestation or alteration of traditional burning regimes in the high páramo under the assumption that these land management strategies would maximize ecosystem services, particularly carbon storage. However, recently scientific investigations have confirmed local land users' views that when both above-ground biomass and soil carbon are considered, locally managed grasslands can provide a more diverse and valuable range of ecosystem services than afforestation (Bremer *et al*., 2016; Bremer *et al*., 2019; Bremer *et al*., 2014).

PES systems offer a financially sustainable way for society to reward communities in the high páramo for the ecological restoration and conservation services that help to secure the continuation of water supplies against drought risks. However, the use of PES to incentivize systemic resilience-building relies on the organization and governance systems available within communities, not only to distribute benefits (Hayes and Murtinho, 2018), but also – more fundamentally – to ensure effective design by involving local communities and their knowledge of the ecosystem services and functions (Llambí *et al*., 2019; Llambí et al., 2013; Llambí and Rada, 2019; Llambí *et al*., 2005). Commentaries on the success of PES focus on community management plans with time and institutional funding, and implementation of agroecological models, as well as biocultural rescue memory and changes in agrarian structure (Avellaneda-Torres *et al*., 2015).

Replacing the páramos natural vegetation by afforestation with pine plantation has been estimated to reduce water yields by about 50 percent (Buytaert *et al*., 2007). Local farmers' practices of potato cropping and grazing do not necessarily have such an extreme effect on water yields, but they can still reduce the natural hydrological regulation services generated by the ecosystem (Ochoa-Tocachi *et al*., 2016b) and affect soil carbon, nitrogen, and water retention capacity (Farley *et al*., 2013; Farley, 2007; Farley *et al*., 2011; Farley and Bremer, 2017). These are important insights for the design of future water conservation and drought preparedness initiatives.

Significant opportunities still remain for better connecting local ecological knowledge and planning systems in the páramos to national and regional systems informing decision-making for drought risk reduction. The Colombian national Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) is collaborating with a range of local and scientific partners to better understand how the natural systems of the páramo can be conserved and managed. Partners include the research group Biología para la conservación of the Universidad Pedagógica Tecnológica de Colombia (UPTC), the Instituto de Investigation de Recursos Biologicos – Alexander von Humboldt (IAvH), The Universidad Nacional de Colombia (UN) as well as other University partners in the United Kingdom of Great Britain and Northern Ireland, the Royal Botanical Gardens, Kew, and the UK Centre for Ecology & Hydrology (Gerard, 2019).

Case study 6: Watershed councils and municipalities lead the national strategy to mitigate drought risk – Programa Nacional contra la Sequia, Mexico

Contributor: Rene Lobato Sanchez, National Water Commission of Mexico (CONAGUA/Mexican Institute of Water Technology – IMTA)

In 2013, Drought Prevention and Mitigation Measures Programmes (PMPMS) were created in 26 Watershed Councils across the country (as well as 13 cities). In order to do this, selected universities were engaged by the Instituto Mexicano de Tecnología del Agua (IMTA) to provide local technical support to each of the watershed councils (Meza-González and Ibáñez-Hernández, 2016).

The programme consists of two components:

1. Develop programmes of measures to prevent and reduce drought risks at basin or basin groups.
2. Implementation of actions to mitigate the effects of existing droughts.

For each of the 26 Basin Councils, a specific programme of measures to prevent and mitigate drought is elaborated following a vulnerability assessment. In general, these strategies focus on (WWF-GIWP-UNESCO, 2016):

- Improving permanent monitoring of rainfall and climatic conditions and at a national scale the development of a strong cooperation with Canada and the United States of America to monitor drought occurrence and evolution in the three countries;
- Reducing the assigned volumes of water, mainly for farming activities and hydroelectric power generation;
- Implementing federal programmes that provide economic resources to states, municipalities, irrigation districts and irrigation units to improve the use of clean water and the reuse of treated wastewater, so volumes required by different users are diminished; and
- Accessing additional federal support from a specific emergency fund to carry out emergency measures, such as: clean water supply through portable treatment plants, implementation of health monitoring and protection measures, emergency well drilling and operation, and rehabilitation and renovation of hydraulic infrastructure.

WMO/GWP (2014), IBRD (2017) describe how CONAGUA staff and researchers from 12 national institutions were trained to standardize the activities and contents of these programmes, which were implemented in the second and third years of PRONACOSE (2014–2015). After evaluation of the implemented programmes in 2016–2017, the programmes are to be improved, updated, and implemented again from the sixth year (2018). A continued gradual implementation beyond the sixth year is expected through ownership of the programmes by the basin councils.

The councils require periodic training and updating to enable them to respond collectively according to the PMPMS recommendations. The success of PRONACOSE and PMPMS relies on the watershed councils' ability to appropriate the vulnerability assessment, collectively assimilate the problems, and build the necessary consensus amongst their stakeholders to implement solutions.

This inclusive consensus-based devolved approach is a social process that takes time. But it is the best way forward because in drought, nobody wants to act alone.

Source: Based on https://www.unccd.int/publications/drought-impact-and-vulnerability-assessment-rapid-review-practices-and-policy.

Case study 7: Community Contingency Funds in the Dry Corridor of Central America

Contributors: Alberto Bigi and Valentina Giorda (FAO)

Central America's Corredor Seco (dry corridor), which covers a large part of Guatemala, El Salvador, Honduras and Nicaragua as well as demarcated areas of Costa Rica and Panama has been hit particularly hard by recurrent droughts and increasingly irregular rainfall. In three out of five harvest cycles small farming families suffer significant losses and often their harvest is not enough to feed their families; what is harvested rarely covers the nutritional requirements of a family considering that, on average, the livelihoods of 62 percent of the population depend on the production of staple grains.

Community Contingency Funds (CCFs) are an innovative risk protection and financial transferal mechanism that provides a form of farm insurance for those who do not have access to conventional financial systems. These have been put in place by FAO with support from Belgian cooperation via project OSRO/RLA/304/BEL "Integrated community disaster preparedness for the development of resilient farmers associations in highly at-risk areas of Honduras and Guatemala".

CCFs are resources managed by a producers' association for the purpose of providing assistance to its members in emergency situations and to fund activities aimed at helping the most vulnerable families following an unexpected event such as drought, hurricanes, floods, earthquakes or other extreme events. CCFs target households that do not have access to formal financing and insurance systems to safeguard their livelihoods. These funds provide supplementary resources for the sustainability of their livelihoods and for the association's Savings and Loan schemes.

CCFs can provide funding for various activities, provided that they have been approved by the association's board of directors. These activities include the purchase of supplies for the new agricultural season in the event of crop losses, to cover household expenses during emergencies, and for productive and commercial activities for the community when income sources have been lost, etc. Members of the association have access to CCFs at a variable rate of interest (established by the association) of between 3 and 5 percent. Non-members of the association can also apply for CCFs under certain circumstances, namely during emergencies, at a higher rate of interest. CCFs are a solidarity fund for those who have been affected and as such are generally provided at a lower rate of interest than regular loans.

Association and rural credit bank members in both countries were asked to make cash contributions for the distribution of FAO and government-run agricultural project inputs (seed money, credits, etc.). These contributions make up the first part of the CCF (40 percent). Another part of the CCF (40 percent) has been donated by the project implemented by FAO. The remaining 20 percent was collected and is constantly capitalized through income-generating activities developed and carried out by each association: e.g. production of handloom fabrics, community grocery stores, gourd seed hulling, mushroom production, poultry production, farm supplies stores and vegetable production.

In Guatemala, association board of directors are responsible for activating CCFs through the Early Warning System known as Sitio Centinela (sentinel site), which consists of four commissions. These commissions assess the availability and access to food, its biological use and the management of risk. The decision to declare the emergency based on this information is made at an assembly meeting. In Honduras, CCFs are activated when an emergency is declared by the national-level Permanent Commission for Contingencies (COPECO), which is the only agency legally authorized to declare an emergency. The process is initiated at a local level, where members of the Local Emergency Committee (CODEL) establish the emergency based on data provided by the Food Crisis Early Warning System (SATCA) and report to the Municipal Emergency Committee (CODEM) on the need to issue an official declaration of the emergency. In both countries, associations have been equipped with a rain gauge and thermometer to register monthly rainfall in millimeters and average temperatures.

Notes: Specific project information supporting the contributors based on: http://www.fao.org/fileadmin/user_upload/emergencies/docs/Corredor_Seco_Breve_EN.pdf.

Case study 8: Drought Risk Mitigation in Eastern Africa – A humanistic approach

Contributor: Ahmed Amedihun, IGAD

Drought is a slow onset disaster that affects communities whose livelihood is based on agriculture farming and pastoralism) which requires good rains (in terms of volume, intensity, duration and timing). The onset and intensity of a drought event (meteorological and agricultural) can be detected, and advisories can be issued and disseminated to stakeholders. However, this will have very limited contribution to mitigate the drought impacts unless communities (as the first responders and victims) can respond to prevent the drought hazard from turning into a disaster. Community centered approaches are needed to guide governance structures, investments and the use of technology to mitigate the impacts of droughts on human populations and ecosystems.

Capabilities for responding to drought in the Horn of Africa have been transformed since the 1980s. Following a regional drought in 2008-10, a coherent regional response system has been put in place at the level of the IGAD region (King-Okumu *et al*., 2019b). All IGAD member states committed to ending drought emergencies in the region during a Summit of Heads of State and Government of the Horn and East Africa region held in September 2011 in Nairobi. Following this summit, Country Programme Papers (CPPs) were developed by each country. Periodic progress reports are made available by each of the countries, providing an overview of drought resilience programming.

At the onset of the 2015/16 drought the regional early warning systems showed an improved level of information available concerning the forecast hazard, vegetation conditions and populations exposed –as compared to the previous major drought event in 2009–11. However, mitigating the impacts of drought also requires looking beyond monitoring of the physical exposure. Important human aspects of vulnerabilities to drought (social, economic, cultural) require attention. The two most important elements of drought risk mitigation in (east) African settings are:

1. risk governance structures; and:
2. coping mechanisms and capacities.

These are crucial because they determine how communities can be able to respond.

By putting in place a robust and responsive regional risk governance structure that is based more on scientific knowledge (less on political affiliation and bureaucracy) an important stride has been achieved towards transforming the way countries and regional are dealing with drought risk management in the IGAD region. On the other hand, community centered approaches (that understand the ability of a community to overcome hardship) with well-designed investment (well before a disaster) on strengthening coping mechanisms and building capacities are the practical measures that bring about in-built and self-sustaining solutions that will mitigate drought (and related) risks.

Some of the solutions to achieve the above two include devolving risk governance to the lower administrative levels (King-Okumu *et al*., 2017a), shifting programming towards community centered mini projects (like the IGAD climate smart agriculture prototype project in Arid part of Kenya), setting standard operating procedures at community level (what to do when including traditional mechanisms) and fostering durable solutions (Jillo *et al*., 2016; Jarso *et al*., 2017).

Notes: Background information supporting the contributor can be found at: https://resilience.igad.int/resources/.

Case study 9: Integrated natural resources management including gender-sensitive project design in drought-prone and salt-affected agricultural production landscapes in Central Asia and Turkey ('CACILM2')

Contributors: Ekrem Yacizi, Makhmud Shaumarov and Akmaral Sman, FAO

Climate-smart agricultural practices in drought prone and/or salt affected production landscapes) can be upscaled by civil society organizations and the private sector.[21] At the local level, this depends on the capacity of communities (including women) who are dependent on natural resources to access new knowledge and implement best management practices. In part due to high levels of male labour migration from Central Asia, a large number of women who remain behind have become de facto household heads and farm managers, and yet they generally lack the legal status of farm owners (farms, livestock and agricultural equipment are typically registered to male family members). While women undertake much of the day-to-day farm work, they are generally still not recognized as the key decision-makers and often have very limited access to information and knowledge concerning farming practices that could help them to be prepared against droughts.

The CACILM- 2 is a regional project in Central Asia and Turkey financed under the Global Environment Facility (GEF) that demonstrates effective agricultural technologies, measures the impact of drought and degradation of agricultural land per GDP, and contributes to food security, welfare and agricultural productivity.

The project developed its gender equality and social inclusion strategy that increases staff know-how, which ranges from traditional information exchange or short training activities to a more intensive process. The awareness raising, training, counselling or coaching component is being provided to all staff based on the needs and previous experience of the management and project staff on gender issues. Long term, process-orientated competence development process of sensitizing staff aims to affect their attitudes, values and knowledge of gender equality, gender roles and responsibilities of women and men and addressing any misconceptions they might have about the relevance of gender issues to the CACILM2 project. Also, gender-responsive communications training is conducted to all project staff to learn gender-specific objectives and use learned skills in public speeches, production of visibility materials, interactions with stakeholders and beneficiaries, media statements etc.

The project targets beneficiaries such as resource-dependent women farmers in drought-prone areas of Central Asia through women's cooperatives, NGOs that work with rural women, women's self-help groups, and Farmer Field Schools (FFS) that provide access to improved market information on value-chains. Prior the launch of the project, preliminary and rapid gender analysis were conducted at project design stage to prioritize following dimensions:

- Special actions should be taken to ensure the inclusion of women who face particular disadvantages (such as women in female-headed households) among project beneficiaries.
- Selection of agricultural production landscapes/land use systems include home gardens to ensure potential impacts of the project on household food security/nutrition and increase women's access to knowledge.
- Gender will be mainstreamed in the management arrangements of the project (for example, by introducing gender competency requirement into the TORs of the project personnel; inviting qualified female candidates; recruiting specialized staff with gender expertise; providing initial sensitization and awareness training at the project orientation stage, etc.) to advance women's equal voice and representation in relevant institutions engaged with project preparation and ensure gender sensitivity and responsiveness.
- Multi-country collaborative work will include partnerships with regional, national and local organizations that are engaged in work to support rural women, through policy-making or direct support.
- Efforts will be made to bridge the gap between existing national gender equality policy and strategy and policy, legal and institutional frameworks on INRM through an approach to resilience that takes gender differences into consideration (Component 2).

- During the process of up-scaling climate-smart agricultural practices, attention will be given to ensuring women's equal participation in local planning processes, the selection of innovative approaches that are accessible to women as well as men, and measures to remove any impediments that female farmers may face in accessing advisory and extension services (Component 3).
- Gender sensitive indicators have been chosen for each project outcome/outputs and fully incorporated into the M&E system (Component 4).

Various activities were organized at national and regional level to empower rural women. For example, in Tajikistan, there were first training sessions for 206 members arranged (8 farmers groups) on the topic of drought-resistant and salt-resistant crops cultivation, over 30 percent of the audience were women. The project included home gardens on the selection of agricultural production landscapes/land use systems to ensure potential impacts of the project on household food security/nutrition and increase women's access to knowledge. Training modules were gender mainstreamed and awareness raising on Gender Equality, empowerment of vulnerable people was included in the Farmer Field School agenda in Tajikistan.

Notes: FAO, Drought characterization and management in Central Asia Region and Turkey, http://www.fao.org/documents/card/en/c/d2da11f3-4d0c-4f30-ab8d-fe6a0cd348ab/.

Case study 10: Reshaping institutions for drought risk management and recovery at the grassroots in Kenya

Contributors: Molu Tepo and Ibrahim Jarso, Merti Integrated Development Programme (MidP)

Governance reforms introduced since the promulgation of the new constitution in Kenya (GoK, 2010) have included the devolution of some key functions from the national government, based in Nairobi, to county governments across 47 counties. This is intended to give more autonomy and agency to the people through local-level planning, management and provision of basic services, including water, health, and local roads. Because populations do not necessarily stay in one county during droughts, emergency support from the NGOs and the centralized National Drought Management Authority (NDMA) under the Ministry of Devolution and Planning is still essential in enabling the local government to cope during the dry seasons and droughts (GoK, 2015).

Community groups include a range of different associations, including groups that are united by gender, religion, tribal affiliations, occupational activities, or others. These can help the local government to mobilize community participation in planning and decision-making processes to prepare for or respond to droughts. Since 2003, in Isiolo County, Kenya, the Merti Integrated Development Programme (MIDP) has worked with communities to resolve conflicts, train the youth and build capacities that prevent droughts from becoming disasters. It has provided support to the county government as it rises to the challenge to deliver on its new mandate for devolved strategic planning.[22]

As CEO of MIDP, Mr Abdullai Shandey established a CSO umbrella organization working with the County Government to bring the other organizations communities into the devolved planning process. With good humor and kindness, he bought everyone together and made a big difference to the plans that shape the future. In 2020, Shandey passed away due to Covid-19. He is missed by all of the youngsters he has trained to step up and carry on his legacy. They are recovering and continuing to prepare the County Disaster Risk Management Bill.[23]

Source: Government of Kenya, 2010. The constitution of Kenya. Nairobi, Kenya. Retrieved from (https://www.kenyaembassy.com/pdfs/the%20constitution%20of%20kenya.pdf), and Government of Kenya, 2015. Ending drought emergencies common programme framework, November 2015. Nairobi, Kenya. Retrieved from (https://www.ndma.go.ke/index.php/resource-centre/send/6-ending-drought-emergencies/67-common-programme-framework).

Case study 11: Sustainable value chains for drought-smart non-timber forest products from West Africa

Contributor: Diami Sanogo, National Forestry Research Center, Senegalese Institute for Agricultural Research (ISRA CNRF), Senegal

Under hot, dry and wind-prone conditions, as found across the Sahara and the Sahel, vegetative cover can play a positive role. Regional weather and cloud convection patterns respond to the conditions of the earth surface (e.g. soil moisture, vegetation roughness, etc.). Societies living in this region have a strongly held belief that trees actively encourage good rainfall levels (establishing a balanced reciprocal relationship of mutual benefit with them). Observation, experience and facts are continuing to validate this view. Scientists have found significant evidence confirming that reduced vegetative cover and drier soils accelerate the intensity of storm-cloud formation, escalating patterns of hydro-climatic extremes (floods and droughts) (Klein and Taylor, 2020). On the other hand, vegetative cover can regulate and reduce localized heat and windspeed effects – instead raising evapotranspiration, conserving soil moisture and achieving a cooler micro-climate beneath canopy shade and protection. This is known as the "oasis effect".

At more local scales, the retention of soil moisture under tree canopy allows soil formation and nutrient retention. This improves the growing conditions for food crops in the Sahel, such as sorghum and cowpeas, as well as grass and other food and fodder (grazing) for livestock. Soil improvements increase productivity in both drought- and non-drought years. The presence of trees also provides cooler, less windswept, less dusty and healthier living environments for human and livestock populations under non-drought and drought conditions. These management practices that are implemented locally and in the field to conserve plant cover and soil moisture are particularly essential for drought risk reduction as they enable trees, crops, livestock and human populations to withstand dry conditions for longer periods of time (as necessary to survive during droughts). These measures can contribute to reducing the vulnerability of ecosystems and populations.

Widespread recognition that sustainable forest management practices could help mitigate drought risks across the Sahara and Sahel and globally has led to substantial investments in reforestation programmes and recently, notably the establishment of a "Great Green Wall across the Sahara" making it possible to maintain and strengthen forestry potential and socio-ecological balances. This initiative faces major challenges in terms of sustainable management (sustainability) as the survival rate of trees depends on accompanying measures (the availability of sufficient economic conditions) and appropriate incentives for local communities to survive and thrive alongside them while ensuring effective conservation management.

The government of Senegal has invested in research and extension to create climate-smart livelihood opportunities for communities that practice tree conservation (Sanogo *et al*., 2019; Raile *et al*., 2019). These focus on actions to regreen village land with the consequence of improving value chains and market access conditions for high value-added non-timber forest products which are suitable for sustainable production under drought-prone conditions. A climate smart village in Daga-Birame highlights the potential of marketable export products, such as baobab powder, jujube and others (Sanogo *et al*., 2017). The promotion of these underused exotic products to passing tourists, both in the demonstration village and in the airport duty free shops, has generated additional consumer demand for these products and increased producers' access to high value markets. It also strengthens local and regional markets, value chains and management systems (CSE, 2018).

To scale up the success of the climate-smart learning village of Daga-Birame in Senegal and to support the sustainable management of forests across the Sahel, more work is needed. Eventual re-regulation of transcontinental trading systems may still be necessary, as well as continued engagement, organization and certification of producer organizations in the Sahel and Sahara regions. The first steps of these processes involving the establishment and local governance systems and the marketing of economically viable tree plantations were established building on the foundation provided by the previous success of the private sector in the sustainable tree production of trees. For example, with non-wood forest products such as honey, gums and resins, mango and others.

Increasingly, the capacities available in most parts of the world for remote sensing can be integrated with locally managed ground verification systems to model drought and climate intelligence of supported forest plantations in the Sahel (Sarr *et al.*, 2021). These inform future scenarios with and without the effects of the retention of vegetation and soil moisture on the regional climate and the extent and severity of drought episodes predicted in the Sahara.

Remotely sensed and locally validated observation of forest conditions can further be combined with available techniques for analysis of plant genetic material to triangulate and improve systems for certification, traceability, etc. of produce for export consumption to ensure green financial sustainability. Remaining needs concern the re-education of economic decision-makers at the level of the international trade systems and associated investments needed for the application of necessary and available scientific tools and technologies.

Annex 2: Projects identified from the Global Environment Facility (GEF) database addressing 'drought'

Title	Focal Areas	Grant and Co-financing (USD)	Implementing Agencies	Countries	Fund Source
Integrated Natural Resources Management in Drought-prone and Salt-affected Agricultural Production Landscapes in Central Asia and Turkey (CACILM2)	Climate Change, Land Degradation	10 874 659 64 885 046	FAO	Regional, Kyrgyz Republic, Kazakhstan, Tajikistan, Turkmenistan, Turkey, Uzbekistan	TF
Supporting Implementation of the Cuban National Programme to Combat Desertification and Drought (NPCDD)	Land Degradation	2 444 500 24 544 380	UNEP	Cuba	TF
Supporting Climate Resilient Livelihoods in Agricultural Communities in Drought-prone Areas	Climate Change	3 046 347 20 830 000	UNDP	Turkmenistan	SCCF
Implementation of SLM Practices to Address Land Degradation and Mitigate Effects of Drought	Land Degradation	870 900 5 803 54	UNDP	Philippines	TF
Ecosystem-based Approaches to Adaptation (EbA) in the Drought-prone Barind Tract and Haor "Wetland" Area	Climate Change	5 200 000 55 032 617	UNEP	Bangladesh	LDCF
Disposal of Obsolete Pesticides including POPs and Strengthening Pesticide Management in the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) Member States	Persistent Organic Pollutants	7 450 000 25 337 684	FAO	Regional, Burkina Faso, Cabo Verde, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, Chad	TF

Title	Focal Areas	Grant and Co-financing (USD)	Implementing Agencies	Countries	Fund Source
Development of Tools to Incorporate Impacts of Climatic Variability and Change in Particular Floods and Droughts into Basin Planning Processes	International Waters	4 090 000 22 464 842	UNEP	Global	TF
SLEM/CPP: Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach (under India: SLEM)	Climate Change	909 091 2 878 563	FAO	Global, India	TF
Adaptation to the effects of drought and climate change in Agro-ecological Zone 1 and 2 in Zambia	Climate Change	3 795 000 9 804 000	UNDP	Zambia	LDCF
Coping with Drought and Climate Change	Climate Change	983000 0	UNDP	Zimbabwe	SCCF
Coping with Drought and Climate Change	Climate Change	960 000 0	UNDP	Mozambique	SCCF
Coping with Drought and Climate Change	Climate Change	995 000 0	UNDP	Ethiopia	SCCF
Sustainable Land Management in Drought Prone Areas of Nicaragua	Land Degradation	3 000 000 17 494 639	UNDP	Nicaragua	TF
CPP Cuba: Supporting Implementation of the Cuban National Programme to Combat Desertification and Drought (NPCDD)	Land Degradation	1 483 000 79 437 499	UNDP	Cuba	TF
Groundwater and Drought Management in SADC	International Waters	7 000 000 6 120 000	WB	Regional, Botswana, Mozambique, South Africa, Zimbabwe	TF

Source: TF = GEF Trust Fund; SCCF = Special Climate Change Fund; LDCF = Least Developed Countries Fund.

Projects identified from the GEF database at https://www.thegef.org/projects on 16/08/2020 using search term "drought".

Annex 3: Selected Adaptation Projects funded by the Green Climate Fund (GCF) in West and East Africa

Country	GCF Country page	GCF Adaptation	Amount (USD millions)	Agency
Benin	https://www.greenclimate.fund/countries/benin	SAP005 Enhanced climate resilience of rural communities in central and north Benin through the implementation of ecosystem-based adaptation (EbA) in forest and agricultural landscapes https://www.greenclimate.fund/project/sap005	10	UNEP
Burkina Faso	https://www.greenclimate.fund/countries/burkina-faso	FP074 Africa Hydromet Programme – Strengthening Climate Resilience in Sub-Saharan Africa: Burkina Faso Country Project https://www.greenclimate.fund/project/fp074	25	IBRD
Cape Verde	https://www.greenclimate.fund/countries/cabo-verde	(NDA nomination)		
Chad	https://www.greenclimate.fund/countries/chad	(multi country: FP092 Programme for integrated development and adaptation to climate change in the Niger Basin (PIDACC/NB) https://www.greenclimate.fund/project/fp092	209	AfDB
Gambia	https://www.greenclimate.fund/countries/gambia	FP011 Large-scale Ecosystem-based Adaptation in The Gambia: developing a climate-resilient, natural resource-based economy https://www.greenclimate.fund/project/fp011	25.5	UNEP
Guinea	https://www.greenclimate.fund/countries/guinea	(multi country: FP092 Programme for integrated development and adaptation to climate change in the Niger Basin (PIDACC/NB) https://www.greenclimate.fund/project/fp092	209	AfDB
Guinea Bissau	https://www.greenclimate.fund/countries/guinea-bissau	(2018 concept note: Enhancing livestock resilience to drought in Guinea Bissau) https://www.greenclimate.fund/document/enhancing-livestock-resilience-drought-guinea-bissau		West African Devt Bank

Country	GCF Country page	GCF Adaptation	Amount (USD millions)	Agency
Ivory Coast	https://www.greenclimate.fund/countries/cote-d-ivoire	(multi country: FP092 Programme for integrated development and adaptation to climate change in the Niger Basin (PIDACC/NB) https://www.greenclimate.fund/project/fp092	209	AfDB
Mali	https://www.greenclimate.fund/countries/mali	FP012 Africa Hydromet Programme – Strengthening Climate Resilience in Sub-Saharan Africa: Mali Country Project https://www.greenclimate.fund/project/fp074	25	IBRD
Mauritania	https://www.greenclimate.fund/countries/mauritania			
Niger	https://www.greenclimate.fund/countries/niger	SAP012 Inclusive Green Financing for Climate Resilient and Low Emission Smallholder Agriculture https://www.greenclimate.fund/project/sap012 (multi country: FP092 Programme for integrated development and adaptation to climate change in the Niger Basin (PIDACC/NB) https://www.greenclimate.fund/project/fp092	14.1	IFAD
Senegal	https://www.greenclimate.fund/countries/senegal	FP003 Increasing the resilience of ecosystems and communities through the restoration of the productive bases of salinized lands https://www.greenclimate.fund/project/fp003	8.2	CSE

Country	GCF	Project	Amount (USD millions)	Agency
Burundi	https://www.greenclimate.fund/countries/burundi	SAP017 Climate proofing food production investments in Imbo and Moso basins in the Republic of Burundi	31.7	IFAD
Djibouti	https://www.greenclimate.fund/countries/djibouti	(Regional concept note: Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation) https://www.greenclimate.fund/document/strengthening-climate-information-systems-climate-change-adaptation-greater-horn-africa		

Country	GCF	Project	Amount (USD millions)	Agency
Eritrea	https://www.greenclimate.fund/countries/eritrea	(Regional concept note: Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation) & approved readiness proposal https://www.greenclimate.fund/document/strengthening-climate-information-systems-climate-change-adaptation-greater-horn-africa		UNEP
Ethiopia	https://www.greenclimate.fund/countries/ethiopia	FP058 Responding to the increasing risk of drought: building gender-responsive resilience of the most vulnerable communities	50	
Kenya	https://www.greenclimate.fund/countries/kenya	FP113 TWENDE: Towards Ending Drought Emergencies: Ecosystem Based Adaptation in Kenya's Arid and Semi-Arid Rangelands	34.5	IUCN
Rwanda	https://www.greenclimate.fund/countries/rwanda	FP073 (x-cutting) Strengthening Climate Resilience of Rural Communities in Northern Rwanda	33.2	Min of Environment Rwanda
Somalia	https://www.greenclimate.fund/countries/somalia	(Regional concept note: Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation) & approved readiness proposal https://www.greenclimate.fund/document/strengthening-climate-information-systems-climate-change-adaptation-greater-horn-africa		UNDP
South Sudan	https://www.greenclimate.fund/countries/south-sudan	(Regional concept note: Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation) & approved readiness proposal https://www.greenclimate.fund/document/strengthening-climate-information-systems-climate-change-adaptation-greater-horn-africa		UNEP

Country	GCF	Project	Amount (USD millions)	Agency
Sudan	https://www.greenclimate.fund/countries/sudan	FP139 Building resilience in the face of climate change within traditional rain fed agricultural and pastoral systems in Sudan https://www.greenclimate.fund/project/fp139 (abstract mentions drought)	41.2	UNDP
		SAP019 (x-cutting) Gums for Adaptation and Mitigation in Sudan (GAMS): Enhancing adaptive capacity of local communities and restoring carbon sink potential of the Gum Arabic belt, expanding Africa's Great Green Wall https://www.greenclimate.fund/project/sap019	10	FAO
Tanzania	https://www.greenclimate.fund/countries/tanzania	FP041 Simiyu Climate Resilient Project https://www.greenclimate.fund/project/fp041	209.8	Kreditanstalt für Wiederaufbau
Uganda	https://www.greenclimate.fund/countries/uganda	FP034 Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda https://www.greenclimate.fund/project/fp034 abstract mentions drought	44.3	UNDP

Annex 4: Full list of Projects funded by Adaptation Fund

Project title	Implementing Entity	Country	Sector
Technical Assistance Grant for ESP and Gender	Interprofessional Fund for Agricultural Research and Advice (FIRCA)	Cote d'Ivoire	
Technical Assistance Grant for ESP and Gender	Mexican Institute Of Water Technology (IMTA)	Mexico	
Technical Assistance Grant for Gender	National Fund for Environment and Climate (FNEC)	Benin	
Project Scale-Up Grant: Reducing Vulnerability to Climate Change in North West Rwanda through Community Based Adaptation (RV3CBA)	Ministry of Environment (MoE) - Rwanda	Rwanda	
South-South Cooperation Grant (SSC)	National Environment Management Authority (NEMA) - Kenya	Mozambique	
South-South Cooperation Grant (SSC)	National Environment Management Authority (NEMA) - Kenya	Botswana	
Technical Assistance Grant for ESP and Gender	National Environment Management Council (NEMC)	Tanzania, United Republic of	
Technical Assistance Grant for ESP and Gender	Ministry of Water and Environment (MoWe)	Uganda	
Technical Assistance Grant for ESP and Gender	Environmental Management Agency (EMA)	Zimbabwe	
Adapting to Climate Change Through Integrated Risk Management Strategies and Enhanced Market Opportunities for Resilient Food Security and Livelihoods	UN World Food Programme	Malawi	Food Security
Djibouti, Kenya, Sudan and Uganda – Strengthening Drought Resilience for Small Holder Farmers and Pastoralists in the IGAD Region	Sahara and Sahel Observatory	Regional	Disaster Risk Reduction
Readiness Package	Centre de Suivi Ecologique (CSE)	Burundi	
Readiness Package	Centre de Suivi Ecologique (CSE)	Mali	

Project title	Implementing Entity	Country	Sector
South-South Cooperation Grant (SSC)	National Bank for Agriculture and Rural Development (NABARD) - India	Afghanistan	
Technical Assistance Grant for ESP and Gender	Environmental Project Implementation Unit (EPIU)	Armenia	
Technical Assistance Grant for ESP and Gender	Bhutan Trust Fund for Environment Conservation (BTFEC)	Bhutan	
Technical Assistance Grant for ESP and Gender	Dominican Institute of Integral Development (IDDI)	Dominican Republic	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Mauritius	
Community Adaptation for Forest-Food Based Management in Saddang Watershed Ecosystem	Partnership for Governance Reform (Kemitraan) of Indonesia	Indonesia	Food Security
Improving adaptive capacity of vulnerable and food-insecure populations in Lesotho	UN World Food Programme	Lesotho	Food Security
Building climate and disaster resilience capacities of vulnerable small towns in Lao PDR	UN-Habitat	Lao People's Democratic Republic	Disaster Risk Reduction
Building urban climate resilience in south-eastern Africa (Madagascar, Malawi, Mozambique and Union of Comoros)	UN-Habitat	Regional	Disaster Risk Reduction
Integrated climate-resilient transboundary flood risk management in the Drin River basin in the Western Balkans (Albania, the Former Yugoslav Republic of Macedonia, Montenegro)	UN Development Programme	Regional	Disaster Risk Reduction
Integration of climate change adaptation measures in the concerted management of the WAP transboundary complex: ADAPT-WAP (Benin, Burkina Faso, Niger)	Sahara and Sahel Observatory	Regional	Disaster Risk Reduction
Enhancing Climate Resilience in San CristÃ³bal province, Dominican Republic Integrated Water Resources Management and Rural Development Programme	Dominican Institute of Integral Development of Dominican Republic	Dominican Republic	Water Management
Strengthening land based adaptation capacity in communities adjacent to protected areas in Armenia	Environmental Project Implementation Unit	Armenia	Forestry
Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin	World Meteorological Organization	Regional	Disaster Risk Reduction
Artik city closed stonepit wastes and flood management pilot project	Environmental Project Implementation Unit	Armenia	Urban development

Project title	Implementing Entity	Country	Sector
Reducing climate vulnerability and flood risk in coastal urban and semi urban areas in cities in Latin America (Chile, Ecuador)	Development Bank of Latin America	Regional	Disaster Risk Reduction
Flood Resilience in Ulaanbaatar Ger Areas – Climate Change Adaptation through community-driven small-scale protective and basic-services interventions	UN-Habitat	Mongolia	Disaster Risk Reduction
Building Resilience of the Agriculture Sector to Climate Change in Iraq	International Fund Agricultural Dev	Iraq	Agriculture
Practical Solutions for Reducing Community Vulnerability to Climate Change in the Federated States of Micronesia	Micronesia Conservation Trust	Micronesia, Federated States of	Multisector Projects
â€œAkamatutuâ€™anga kia Tukatau te Oraâ€™anga ite Pa Enuaâ€Pa Enua Action for Resilient Livelihoods (PEARL)	Ministry of Finance and Economic Management	Cook Islands	Multisector Projects
Technical Assistance Grant for ESP and Gender	Agence pour le DÃ©veloppement Agricole (ADA)	Morocco	
South-South Cooperation Grant (SSC)	Department of Environment (DoE) - Antigua and Barbuda	Dominica	
South-South Cooperation Grant (SSC)	Department of Environment (DoE) - Antigua and Barbuda	Maldives	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Côte d'Ivoire	
Scaling up climate-smart agriculture in East Guinea Bissau	Banque Ouest Africaine de Developpement	Guinea-Bissau	Agriculture
Increasing the resilience of informal urban settlements in Fiji that are highly vulnerable to climate change and disaster risks	UN-Habitat	Fiji	Urban development
Enhancing urban resilience to climate change impacts and natural disasters: Honiara	UN-Habitat	Solomon Islands	Urban development
Pilot rural desalination plants using renewable power and membrane technology	Desert Research Foundation of Namibia	Namibia	Water Management
Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar and Fadial)	Centre de Suivi Ecologique	Senegal	Coastal Management
Adapting to Climate Change in Lake Victoria Basin	UN Environment Programme	Regional	Water Management

Project title	Implementing Entity	Country	Sector
Building adaptive capacity through food and nutrition security and peacebuilding actions in vulnerable Afro and indigenous communities in the Colombia-Ecuador border area	UN World Food Programme	Regional	Food Security
AYNINACUY: Strengthening the livelihoods of vulnerable highland communities in the provinces of Arequipa, Caylloma, Condesuyos, Castilla and La Union in the Region of Arequipa, Peru	Development Bank of Latin America	Peru	Rural Development
Ecosystem Based Approaches for Reducing the Vulnerability of Food Security to the Impacts of Climate Change in the Chaco region of Paraguay	UN Environment Programme	Paraguay	Ecosystem-based Adaptation
Agricultural Climate Resilience Enhancement Initiative (ACREI) (Ethiopia, Kenya, Uganda)	World Meteorological Organization	Regional	Food Security
Ecosystem-Based Adaptation at Communities of the Central Forest Corridor in Tegucigalpa	UN Development Programme	Honduras	Ecosystem-based Adaptation
Climate Smart Integrated Rural Development Project	Ministry of Finance and Economic Cooperation of the Federal Democratic Republic of Ethiopia	Ethiopia	Rural Development
Enhancing the Climate Resilience of vulnerable island communities in Federated States of Micronesia	Secretariat of the Pacific Regional Environment Programme	Micronesia, Federated States of	Coastal Management
Adapting to climate change through integrated water management in Panama	Fundacion Natura	Panama	Water Management
An integrated approach to physical adaptation and community resilience in Antigua and Barbuda’s northwest McKinnon’s watershed	Department of Environment Ministry of Health and the Environment (ABED)	Antigua and Barbuda	Multisector Projects
Technical Assistance Grant for ESP and Gender	Department of Environment (DoE)	Antigua and Barbuda	
Technical Assistance Grant for ESP and Gender	National Bank for Agriculture and Rural Development (NABARD)	India	
Technical Assistance Grant for ESP and Gender	National Environment Management Authority (NEMA)	Kenya	
Technical Assistance Grant for ESP and Gender	Desert Research Foundation of Namibia (DRFN)	Namibia	
Technical Assistance Grant for ESP and Gender	PROFONANPE	Peru	
Technical Assistance Grant for ESP and Gender	Ministry of Natural Resources (MINIRENA)	Rwanda	

Project title	Implementing Entity	Country	Sector
Technical Assistance Grant for Gender	FundecooperaciÃ³n	Costa Rica	
Technical Assistance Grant for Gender	Micronesia Conservation Trust (MCT)	Micronesia, Federated States of	
Technical Assistance Grant for Gender	Centre de Suivi Ecologique (CSE)	Senegal	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Burundi	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Togo	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Niger	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Chad	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Cape Verde	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Guinea	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Mali	
South-South Cooperation Grant (SSC)	Centre de Suivi Ecologique (CSE) - Senegal	Sierra Leone	
South-South Cooperation Grant (SSC)	National Environment Management Authority (NEMA) - Kenya	Malawi	
South-South Cooperation Grant (SSC)	National Environment Management Authority (NEMA) - Kenya	Zimbabwe	
Technical Assistance Grant for ESP	South African National Biodiversity Institute (SANBI)	South Africa	
Technical Assistance Grant for ESP	Micronesia Conservation Trust (MCT)	Micronesia, Federated States of	
Technical Assistance Grant for ESP	FundecooperaciÃ³n	Costa Rica	
Technical Assistance Grant for ESP	FundaciÃ³n Natura	Panama	
Technical Assistance Grant for ESP	National Environment Fund (FNEC)	Benin	
Technical Assistance Grant for ESP	Centre de Suivi Ecologique (CSE)	Senegal	
Enhancing the climate and disaster resilience of the most vulnerable rural and emerging urban human settlements in Lao PDR	UN-Habitat	Lao People's Democratic Republic	Disaster Risk Reduction

Project title	Implementing Entity	Country	Sector
Building Adaptive Capacities of Communities, Livelihoods and Ecological Security in the Kanha-Pench Corridor of Madhya Pradesh	National Bank for Agriculture and Rural Development	India	Forestry
Enhancing resilience of communities to climate change through catchment-based integrated management of water and related resources in Uganda	Sahara and Sahel Observatory	Uganda	Water Management
Enhancing Resilience of Agriculture to Climate Change to Support Food Security in Niger, through Modern Irrigation Techniques	Banque Ouest Africaine de Developpement	Niger	Rural Development
Adaptation to the Impacts of Climate Change on Peru’s Coastal Marine Ecosystem and Fisheries	Peruvian Trust Fund for National Parks and Protected Areas	Peru	Coastal Management
Climate changes adaptation project in oasis zones â€“ PACC-ZO	Agence pour le Developpement Agricole	Morocco	Agriculture
Programme Support for Climate Change Adaptation in the vulnerable regions of Mopti and Timbouctou	UN Development Programme	Mali	Multisector Projects
Increasing the resilience of poor and vulnerable communities to climate change	Ministry of Planning and International Cooperation	Jordan	Multisector Projects
Building Adaptive Capacities of Small Inland Fishermen Community for Climate Resilience and Livelihood Security, Madhya Pradesh, India	National Bank for Agriculture and Rural Development	India	Food Security
Increased Resilience to Climate Change in Northern Ghana through the Management of Water Resources and Diversification of Livelihoods	UN Development Programme	Ghana	Water Management
Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities	National Bank for Agriculture and Rural Development	India	Agriculture
Climate Proofing of Watershed Development Projects in the States of Tamil Nadu and Rajasthan	National Bank for Agriculture and Rural Development	India	Water Management
Enhancing resilience to climate change of the small agriculture in the Chilean region of O’ Higgins	Agencia de Cooperacion Internacional de Chile	Chile	Agriculture
Adapting to climate induced threats to food production and food security in the Karnali Region of Nepal	UN World Food Programme	Nepal	Food Security
Taking adaptation to the ground: A small Grants Facility for enabling local-level responses to climate change	South Africa National Biodiversity Institution	South Africa	Multisector Projects
Building Resilience in the greater uMngeni Catchment, South Africa	South Africa National Biodiversity Institution	South Africa	Water Management

Project title	Implementing Entity	Country	Sector
Integrated Programme To Build Resilience To Climate Change & Adaptive Capacity Of Vulnerable Communities In Kenya	National Environment Management Authority	Kenya	Multisector Projects
Reducing the Vulnerability by Focusing on Critical Sectors (Agriculture, Water Resources and Coastlines) in order to Reduce the Negative Impacts of Climate Change and Improve the Resilience of these Sectors.	Fundecooperacin Para el Desarollo Sostenible	Costa Rica	Multisector Projects
Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal	National Bank for Agriculture and Rural Development	India	Agriculture
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	National Bank for Agriculture and Rural Development	India	Coastal Management
Belize Marine Conservation and Climate Adaptation Initiative	International Bank of Reconstruction and Development	Belize	Coastal Management
Reduction of Vulnerability to Coastal Flooding through Ecosystem-based Adaptation in the South of Artemisa and Mayabeque Provinces	UN Development Programme	Cuba	Coastal Management
Addressing Climate Change Risks on Water Resources and Food Security in the Dry Zone of Myanmar	UN Development Programme	Myanmar	Rural Development
Ecosystem Based Adaptation to Climate Change in Seychelles	UN Development Programme	Seychelles	Water Management
Developing climate resilience of farming communities in the drought prone parts of Uzbekistan	UN Development Programme	Uzbekistan	Agriculture
Reducing Vulnerability to Climate Change in North West Rwanda through Community Based Adaptation	Ministry Natural Resources Rwanda	Rwanda	Rural Development
Enhancing the Adaptive Capacity and Increasing Resilience of Small-size Agriculture Producers of the Northeast of Argentina	Unidad Para Cambio Rural Argentina	Argentina	Agriculture
Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka	UN World Food Programme	Sri Lanka	Rural Development
Increasing Climate Resilience and Enhancing Sustainable Land Management in the Southwest of the Buenos Aires Province	International Bank of Reconstruction and Development	Argentina	Rural Development

Project title	Implementing Entity	Country	Sector
Enhancing adaptive capacity of communities to climate change-related floods in the North Coast and Islands Region of Papua New Guinea	UN Development Programme	Papua New Guinea	Disaster Risk Reduction
Enhancing Resilience of Communities to the Adverse Effects of Climate Change on Food Security in Mauritania	UN World Food Programme	Mauritania	Food Security
Climate Smart Agriculture: Enhancing Adaptive Capacity of the Rural Communities in Lebanon (AgriCAL)	International Fund Agricultural Dev	Lebanon	Agriculture
Enhancing the Resilience of the Agricultural Sector and Coastal Areas to Protect Livelihoods and Improve Food Security	Planning Institute of Jamaica	Jamaica	Multisector Projects
Building Resilient Food Security Systems to Benefit the Southern Egypt Region	UN World Food Programme	Egypt	Food Security
Developing Agro-Pastoral Shade Gardens as an Adaptation Strategy for Poor Rural Communities	UN Development Programme	Djibouti	Agriculture
Reducing Risk and Vulnerability to Climate Change in the Region of La Depresion Momposina in Colombia	UN Development Programme	Colombia	Disaster Risk Reduction
Enhancing Climate Resilience of Rural Communities Living in Protected Areas of Cambodia	UN Environment Programme	Cambodia	Ecosystem-based Adaptation
Promoting climate resilience in the rice sector through pilot investments in Alaotra-Mangoro region	UN Environment Programme	Madagascar	Agriculture
Enhancing Resilience of Samoa’s Coastal Communities to Climate Change	UN Development Programme	Samoa	Multisector Projects
Building resilience to climate change and variability in vulnerable smallholders	Agencia Nacl Investigacion Innov UY	Uruguay	Agriculture
Akamatutuâanga i te iti tangata no te tuatau manakokore ia e te tauiâanga reva – Strengthening the Resilience of our Islands and our Communities to Climate Change	UN Development Programme	Cook Islands	Disaster Risk Reduction
Implementation Of Concrete Adaptation Measures To Reduce Vulnerability Of Livelihood and Economy Of Coastal Communities In Tanzania	UN Environment Programme	Tanzania, United Republic of	Coastal Management
Developing Climate Resilient Flood and Flash Flood Management Practices to Protect Vulnerable Communities of Georgia	UN Development Programme	Georgia	Water Management
Climate Change Adaptation Programme in the Coastal Zone of Mauritius	UN Development Programme	Mauritius	Coastal Management

Project title	Implementing Entity	Country	Sector
Climate change resilient production landscapes and socioeconomic networks advanced in Guatemala	UN Development Programme	Guatemala	Rural Development
Addressing climate change risks to farming systems in Turkmenistan at national and community level	UN Development Programme	Turkmenistan	Water Management
Increasing climate resilience through an Integrated Water Resource Management Programme in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo Island	UN Development Programme	Maldives	Water Management
Ecosystem Based Adaptation Approach to Maintaining Water Security in Critical Water Catchments in Mongolia	UN Development Programme	Mongolia	Ecosystem-based Adaptation
Enhancing resilience of communities in Solomon Islands to the adverse effects of climate change in agriculture and food security	UN Development Programme	Solomon Islands	Urban development
Reducing Risks and Vulnerabilities from Glacier Lake Outburst Floods in Northern Pakistan	UN Development Programme	Pakistan	Disaster Risk Reduction
Reduction of Risks and Vulnerability Based on Flooding and Droughts in the Estero Real Watershed	UN Development Programme	Nicaragua	Water Management
Addressing Climate Change Risks on Water Resources in Honduras: Increased Systemic Resilience and Reduced Vulnerability of the Urban Poor	UN Development Programme	Honduras	Water Management
Climate Change Adaptation Programme In Water and Agriculture In Anseba Region, Eritrea	UN Development Programme	Eritrea	Rural Development
Enhancing resilience of communities to the adverse effects of climate change on food security, in Pichincha Province and the Jubones River basin	UN World Food Programme	Ecuador	Food Security
Adaptation to Coastal Erosion in Vulnerable Areas	Centre de Suivi Ecologique	Senegal	Coastal Management

Annex 5: Projects identified from the World Bank database

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Sava and Drina Rivers Corridors Integrated Development Program	Western Balkans	133.99	Active	August 6, 2020
Vinh Long City Urban Development and Enhanced Climate Resilience Project in Vinh Long Province	Vietnam	126.9	Active	June 30, 2020
National Food and Agriculture System Project	Myanmar	200	Active	June 26, 2020
Mozambique Urban Development and Decentralization Project	Mozambique	117	Active	June 26, 2020
Nurek Hydropower Rehabilitation Project Phase 2	Tajikistan	50	Active	June 26, 2020
COVID-19 Crisis Response Emergency Development Policy Financing	Seychelles	15	Active	June 25, 2020
Kandadji Project (WRD-SEM APL2A) Second Additional Financing	Western Africa	150	Active	June 24, 2020
Urban Water Supply Strengthening Project	Honduras	45	Active	June 22, 2020
Malawi Watershed Services Improvement Project	Malawi	157	Active	June 19, 2020
Irrigation for Climate Resilience Project (ICRP)	Uganda	169.2	Active	June 18, 2020
AF Haiti Rural Accessibility & Resilience Project	Haiti	33	Active	June 18, 2020
Cameroon - Chad Power Interconnection Project	Western Africa	385	Active	June 16, 2020
Urban Resilience and Solid Waste Management Project	Cote d'Ivoire	315	Active	June 12, 2020
Water Security in the Dry Corridor of Honduras	Honduras	70	Active	June 12, 2020
ALBIÄ - Chad Local Development and Adaptation Project	Chad	50	Active	June 12, 2020
Tunisia First Resilience And Recovery Emergency Development Policy Financing	Tunisia	175	Active	June 12, 2020

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Wastewater Management Sustainability Project	West Bank and Gaza	10	Active	June 10, 2020
Fostering and Leveraging Opportunities for Water Security Program (Project 1)	Kosovo	27.4	Active	June 9, 2020
Agricultural Competitiveness and Export Diversification Project	Benin	160	Active	June 2, 2020
Caribbean Regional Air Transport Connectivity Project - Haiti	Haiti	84	Active	May 28, 2020
Zambia Education Enhancement Project	Zambia	120	Active	May 21, 2020
Sri Lanka Integrated Watershed and Water Resources Management Project	Sri Lanka	69.53	Active	May 18, 2020
Agriculture and Livestock Competitiveness Program For Results	Senegal	150	Active	May 12, 2020
PNG Agriculture Commercialization and Diversification Project	Papua New Guinea	40	Active	April 22, 2020
Honduras DRM Development Policy Credit with a Catastrophe Deferred Drawdown Option (Cat DDO)	Honduras	119	Active	April 10, 2020
Emergency Multi-Sector Rohingya Crisis Response Project Additional Financing	Bangladesh	100	Active	March 31, 2020
Water and Sanitation Sectoral Project	Mauritania	44	Active	March 30, 2020
Linha de Crédito para Resiliência Urbana no Sul do Brasil	Brazil	98.8	Active	March 24, 2020
Dhaka Sanitation Improvement Project	Bangladesh	170	Active	March 20, 2020
EG Inclusive Housing Finance Program Additional Financing	Egypt, Arab Republic of	500	Active	March 20, 2020
Liberia First Inclusive Growth Development Policy Operation	Liberia	40	Active	March 17, 2020
Kiribati Outer Islands Transport Infrastructure Investment Project	Kiribati	30	Active	March 12, 2020
Nepal Development Policy Financing with CAT DDO	Nepal	50	Active	March 10, 2020
Balochistan Livelihoods and Entrepreneurship Project	Pakistan	35	Active	March 3, 2020
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)	Mexico	120	Active	February 27, 2020
Bolivia Urban Resilience	Bolivia	70	Active	February 19, 2020

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Tuvalu First Resilience Development Policy Operation with a Catastrophe-Deferred Drawdown Option	Tuvalu	13.5	Active	December 13, 2019
West Bengal Major Irrigation and Flood Management Project	India	145	Active	December 10, 2019
Somalia Urban Resilience Project II	Somalia	50	Active	December 9, 2019
Climate Smart Management of Grassland Ecosystems	China	3.77	Active	November 19, 2019
Prosperous Villages	Uzbekistan	100	Active	November 14, 2019
Kingdom of Eswatini: Water Supply and Sanitation Access Project	Eswatini	45	Active	October 10, 2019
Odisha Integrated Irrigation Project for Climate Resilient Agriculture	India	165	Active	September 30, 2019
Ceará Water Security and Governance	Brazil	139.88	Active	August 8, 2019
Bangladesh Municipal Water Supply and Sanitation Project	Bangladesh	100	Active	July 11, 2019
Samoa Agriculture & Fisheries Productivity and Marketing Project (SAFPROM)	Samoa	19.95	Active	July 2, 2019
Guinea-Bissau - Rural Transport Project	Guinea-Bissau	15	Active	July 1, 2019
Somalia - Water for Agro-pastoral Productivity and Resilience	Somalia	42	Active	July 1, 2019
Karachi Water and Sewerage Services Improvement Project (KWSSIP)	Pakistan	40	Active	June 27, 2019
TEGUCIGALPA: WATER SUPPLY STRENGTHENING PROJECT	Honduras	50	Active	June 27, 2019
Urban Water Supply and Sanitation Project	Cote d'Ivoire	150	Active	June 27, 2019
Climate Resilience Multi-Phase Programmatic Approach	Sri Lanka	310	Active	June 25, 2019
Liberia Urban Water Supply Project Additional Financing	Liberia	30	Active	June 14, 2019
Belarus Utility Efficiency and Quality Improvement Project	Belarus	101	Active	June 14, 2019
Integrated and Resilient Urban Mobility Project	Sierra Leone	50	Active	June 13, 2019
One WASH—Consolidated Water Supply, Sanitation, and Hygiene Account Project (One WASH—CWA)	Ethiopia	300	Active	June 13, 2019

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Vietnam - Dynamic Cities Integrated Development Project	Vietnam	194.36	Active	June 11, 2019
Dushanbe Water Supply and Wastewater Project	Tajikistan	30	Active	June 5, 2019
CAR: LONDO "Stand Up" Project	Central African Republic	100	Active	May 30, 2019
Improving Resilience and Emergency Response Project	Romania	57	Active	May 29, 2019
Shaanxi Sustainable Towns Development Project	China	100	Active	May 28, 2019
Indonesia Fiscal Reform DPL 3	Indonesia	1000	Closed	May 23, 2019
Strengthening Climate Resilience in Mali Project	Mali	8.25	Active	May 23, 2019
CAR-Agriculture Recovery and Agribusiness Development Support Project (ARADSP)	Central African Republic	25	Active	May 17, 2019
Lesotho Lowlands Water Development Project - Phase II	Lesotho	78	Active	May 17, 2019
Urban Water Supply and Sanitation Sector Project	Solomon Islands	15	Active	May 16, 2019
Ho Chi Minh City Development Policy Operation 1	Vietnam	125	Closed	May 16, 2019
Development Response to Displacement Impacts Project in the HoA	Uganda	150	Active	April 17, 2019
Water Supply and Sanitation Improvement Project	Cambodia	55	Active	March 28, 2019
Scaling-Up Water Supply, Sanitation and Hygiene Project	Lao People's Democratic Republic	25	Active	March 14, 2019
Local Development Support Project	Sri Lanka	70	Active	March 14, 2019
Emergency Multi-Sector Rohingya Crisis Response Project	Bangladesh	165	Active	March 7, 2019
Climate Smart Irrigated Agriculture Project	Sri Lanka	125	Active	March 7, 2019
Bangladesh Scaling-up Renewable Energy Project	Bangladesh	156	Active	March 1, 2019
Paraiba Improving Water Resources Management and Services Provision	Brazil	126.89	Active	February 28, 2019
Shimla Water Supply and Sewerage Service Delivery Reform Programmatic Development Policy Loan 1	India	40	Active	January 16, 2019

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Maritime Investment in Climate Resilient Operations	Tuvalu	20	Active	December 18, 2018
DR Resilient Agriculture and Integrated Water Resources Management	Dominican Republic	80	Active	December 13, 2018
Djibouti Integrated Slum Upgrading Project	Djibouti	20	Active	November 9, 2018
Kenya Development Response to Displacement Impacts Project Additional Financing	Kenya	8.18	Active	November 6, 2018
Additional Financing Dominica Disaster Vulnerability Reduction Project	Dominica	31	Active	September 28, 2018
Ghana Secondary Cities Support Program	Ghana	100	Active	September 25, 2018
AF to Sustainable Rural Sanitation Services Program	Egypt, Arab Republic of	300	Active	September 21, 2018
Chad - Refugees and Host Communities Support Project	Chad	60	Active	September 12, 2018
Togo - Infrastructure and Urban Development Project	Togo	30	Active	July 17, 2018
Mali Drylands Development Project	Mali	60	Active	July 5, 2018
Dynamic City Integrated Development Project - Thai Nguyen	Vietnam	80	Active	June 22, 2018
Disaster Risk Management Development Policy Credit with a Catastrophe Deferred Drawdown Option (Cat DDO)	Kenya	200	Active	June 21, 2018
Integrated Water Management and Development Project	Uganda	280	Active	June 14, 2018
Hezhou Urban Water Infrastructure and Environment Improvement Project	China	150	Active	June 13, 2018
Angola: Commercial Agriculture Development Project	Angola	130	Active	May 29, 2018
Sindh Barrages Improvement Project AF	Pakistan	140	Active	May 25, 2018
China: Hubei Inland Waterway Improvement Project	China	150	Active	May 18, 2018
GEF Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project	Vietnam	6.09	Active	May 11, 2018
Agriculture Competitiveness Project	Lao People's Democratic Republic	25	Active	April 26, 2018

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Regional and Local Roads Connectivity	Albania	50	Active	April 25, 2018
Emergency Agricultural Livelihoods and Climate Resilience Project	Dominica	25	Active	April 13, 2018
Sustainable Cities Project 2	Turkey	91.54	Active	April 12, 2018
Burundi Landscape Restoration and Resilience Project	Burundi	30	Active	April 11, 2018
Second Agriculture Sector Wide Approach Support Project	Malawi	55	Active	April 7, 2018
Sustainable Enterprise Project	Bangladesh	110	Active	March 29, 2018
Serbia Second Public Expenditure and Public Utilities DPL	Serbia	200	Closed	March 20, 2018
NP Modernization of Rani Jamara Kulariya Irrigation Scheme - Phase 2	Nepal	66	Active	March 20, 2018
Mali - Economic & Environmental Rehabilitation of the Niger River	Mali	27.8	Active	March 16, 2018
Ethiopia Urban Institutional and Infrastructure Development Program	Ethiopia	600	Active	March 14, 2018
Maharashtra Project on Climate Resilient Agriculture	India	420	Active	February 27, 2018
Freetown Emergency Recovery Project	Sierra Leone	10	Active	February 22, 2018
Baghdad Water Supply and Sewerage Improvement Project	Iraq	210	Active	January 31, 2018
Water and Electricity Upgrading Project	Central African Republic	20	Active	January 17, 2018
Punjab Agriculture and Rural Transformation P4R Program	Pakistan	300	Active	December 15, 2017
Enhancing Waterway Connectivity and Water Service Provision in Colombia’s Plan Pazcifico	Colombia	41.9	Active	December 14, 2017
Additional Financing for Punjab Irrigated Agriculture Productivity Program Project	Pakistan	130	Active	November 30, 2017
Lesotho Transport Infrastructure and Connectivity Project (LTIC)	Lesotho	18.3	Active	November 20, 2017
Additional Financing Irrigation System Enhancement Project	Armenia	2	Active	November 14, 2017
Shire Valley Transformation Program - I	Malawi	160	Active	October 18, 2017

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Lesotho Smallholder Agriculture Development Project Additional Financing	Lesotho	10	Active	September 29, 2017
Ethiopia Rural Productive Safety Net Project	Ethiopia	600	Active	September 14, 2017
Assam Agribusiness and Rural Transformation Project	India	200	Active	August 31, 2017
Cameroon: Inclusive and Resilient Cities Development Project	Cameroon	160	Active	August 22, 2017
Additional Financing for the Niger Community Action Phase 3	Niger	20.8	Active	June 29, 2017
Forest Sector Modernization and Coastal Resilience Enhancement Project	Vietnam	150	Active	June 22, 2017
Municipal Development and Urban Resilience Project	Haiti	48.4	Active	June 20, 2017
Myanmar Southeast Asia Disaster Risk Management Project	Myanmar	116	Active	June 15, 2017
Dakar Bus Rapid Transit Pilot Project	Senegal	300	Active	May 25, 2017
OECS Regional Agriculture Competitiveness Project	OECS Countries	8.3	Active	May 25, 2017
Zambia Integrated Forest Landscape Project (GEF)	Zambia	17	Active	May 4, 2017
Nurek Hydropower Rehabilitation Project Phase I	Tajikistan	225.7	Active	May 3, 2017
Integrated Water Resources Management in Ten Basins	Peru	40	Active	April 28, 2017
Development Response to Displacement Impacts Project (DRDIP) in the Horn of Africa	Eastern Africa	103	Active	April 26, 2017
Agricultural Productivity and Diversification Additional Financing	Benin	45	Active	April 14, 2017
Capacity Augmentation of the National Waterway- 1 (JAL MARG VIKAS) Project	India	375	Active	April 12, 2017
GEF Sustainable Landscape Management Project	Madagascar	13.7	Active	March 23, 2017
National Hydrology Project	India	175	Active	March 15, 2017
Preparation of Strategic Program for Climate Resilience	Bhutan	1.5	Active	February 20, 2017
Rwanda Pilot Program for Climate Resilience	Rwanda	1.5	Closed	February 11, 2017

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Additional Financing for the Emergency Resilient Recovery Project	Mozambique	20	Active	January 13, 2017
Agro-Pastoral Productivity and Markets Development - AF	Burundi	25	Active	December 15, 2016
Ningbo Sustainable Urbanization Project	China	150	Active	July 15, 2016
Climate Resilience Improvement Project Additional Financing	Sri Lanka	42	Active	March 21, 2016
MZ - Emergency Resilient Recovery Project	Mozambique	40	Active	September 29, 2015
Climate Resilience Improvement Project (CRIP)	Sri Lanka	110	Active	April 22, 2014
Mekong Integrated Water Resources Management Project- Phase II	Vietnam	25	Closed	November 27, 2013
Water Management and Development Project	Uganda	135	Closed	June 26, 2012
AFCC2/RI Horn of Africa Emergency Health and Nutrition Project	Africa	30	Closed	September 15, 2011
Henan Zhoukou Longhu Wetland Protection and Management Project	China	200	Dropped	
Water Management Capacity and Infrastructure Development Project	Nicaragua	50	Pipeline	
Boosting Inclusive Growth for Zanzibar: Integrated Development Project	Tanzania	150	Pipeline	
Valorization of Investments in the Valley of the Benue	Cameroon	200	Pipeline	
Preparation Project for Agus Pulangi Hydropower Complex for Rehabilitation	Philippines	0.7	Pipeline	
Integrated productive landscapes through land use planning; restoration; and sustainable intensification of rice in Yaque and Yuna	Dominican Republic	4.06	Pipeline	
Turkey Resilient Landscape Integration Project (TULIP)	Turkey	300	Pipeline	
Nile Cooperation for Climate Resilience	Eastern Africa	40	Pipeline	
Financing Locally-Led Climate Action Program	Kenya	300	Pipeline	
Phu Quoc Sustainable Water Management Project	Vietnam	110.7	Pipeline	
Dry Corridor Climate Resilient Agriculture Project	Nicaragua	50	Dropped	

Project Title	Country	Commitment Amount (USD millions)	Status	Approval Date
Amaravati Sustainable Infrastructure and Institutional Development Project	India	300	Dropped	
Building Climate Resilience in the Niger Basin - Project 1	Western Africa	55	Dropped	
Chongqing New Urbanization Pilot and Demonstration Project	China	100	Dropped	

Annex 6: Rapid analysis of World Bank-funded projects

The records of projects addressing drought risk and mitigation in the database includes projects dating back to 2011, but the majority are more recent. Of the total 158 projects listed, 137 are still active and only 7 have been closed. Fifteen are grant-funded, whereas the others are classed as IDA financed, IBRD and "other". The majority of countries have one project per country, but in some cases it is more. Countries with the highest numbers of projects are in Asia. Both India and Vietnam each have eight projects. Of the African countries, Uganda has the largest number of projects (4), whereas the country with the largest number of projects in Latin America and the Caribbean is Honduras (also with 4 projects). However, on a regional basis, Africa (not including North Africa) has 62 of the projects, whereas there are 56 in Asia (not including Middle East). There are 21 projects in Latin America and the Caribbean and 13 in Europe and Central Asia. In terms of sectoral focus, the largest numbers of projects focus on the water, sanitation and waste management sectors.

Thematically, the World Bank database includes classifiers enabling to distinguish projects according to themes. This tells us that 12 projects address natural disaster management, whereas 12 are focused on rural services and infrastructure and 11 focus on water resource management and 7 are "other environment and natural resources management", 1 is for biodiversity, 2 are "pollution management and environmental health" and 2 are "other rural development" and rural non-farm income generation (2). Only 8 are classified as climate-change themed projects.

There are projects on communicable diseases (1), child health (1), nutrition and food security (1).

Interestingly, the Bank classifications identify other themes such as trade facilitation and market access (5 projects), rural markets (3), also environmental policies and institutions (4), rural policies and institutions (2), infrastructure services for private sector development (4), municipal governance and institution-building (3), other public sector governance (1), decentralization (2), participation and civic engagement (1) public expenditure, financial management and procurement (2), administrative and civil service reform (1), land administration and management (1), municipal finance (1) urban services and housing for the poor (3) and other urban development (2). Also one project on debt management and fiscal sustainability and another on micro, small and medium enterprise support. And one on regional integration.

Annex 7: Potential showcase examples already compiled by FAO

Drought: Forging a new path to agricultural resilience through proactive and integrated action

Seminar, 19 June 2017

POTENTIAL SHOWCASES

PROJECT TITLE	INSTITUTION	GOAL	COUNTRY
Theme 1: What to do differently? Integrating and aligning water and soil management strategies to maximize response to drought			
Sustainable Land Management & Climate Change Resilience	African Conservation Tillage Network	Promote adoption of conservation agriculture (CA) based on agro-ecology principles to combat land degradation	Kenya, Tanzania, Mali, Burkina Faso, Zimbabwe, Madagascar Mozambique
Projet de gestion intégrée de la sècheresse en Afrique de l'ouest (PROGIS/AO)	Global Water Institute	Promotion of innovative drought resilience practices through the establishment of a multifunctional agroforestry park	Burkina Faso
Water harvesting and Agricultural techniques in dry lands: an Integrated and Sustainable model in Maghreb Regions (WADIS-MAR)	Sustainable Water Integrated Management (SWIM) –European Union, University of Sassari	Achieve an integrated, sustainable and participated harvesting water and water & agriculture management for adaptation to drought.	Tunisia, Algeria
Integrated water resource management to combat drought –water conservation *	UNISDR, UNESCO, EU, UNEP, UNO, UNDP, FAO, CILSS etc.	Build climate resilience, reduce economic and social losses, and alleviate poverty in drought-affected regions of the world through an integrated approach to drought management	To be decided

PROJECT TITLE	INSTITUTION	GOAL	COUNTRY
Fostering new paradigms in organizational structure	National Drought Management Centre	Raise efficiency of drought planning and implementation of actions	Iran
Theme 2: Connecting farmers to technologies and drought forecasts			
Drought Tolerant Maize for Africa Seed Scaling (DTMASS)	International Maize and Wheat Improvement Center	Improve access to good-quality maize through production and deployment of drought-tolerant maize varieties	Ethiopia, Kenya, Mozambique, Tanzania, Uganda and Zambia
African seed health	Centre for Agriculture and Biosciences International	Train farmers in the regulation involved in seed production, post-harvest handling, processing, packaging and marketing	Kenya
Management of Agricultural Biodiversity – Semiárido seeds	Articulação Semiárido Brasileiro (ASA)	Strengthens the stock culture of native seeds	Brazil
R4 – Rural Resilience Initiative)	WFP	Help farmers build their resilience to climatic shocks	Zambia
Water Efficient Maize for Africa	African Agricultural Technology Foundation *et al.*	Increase water efficiency and productivity to deal with water	Kenya, Mozambique, South Africa, Tanzania, Uganda
Satellite-Assisted Pastoral Resource Management (SAPARM)	Project Concern International (PCI); USAID	Develop customized digital community grazing maps overlaid with vegetation data derived from NASA satellites.	
Theme 3: Moving from reactive to proactive management in drought emergencies			
Food Security Climate Resilience (FoodSECuRE)	World Food Programme (WFP)	Linking climate and hazard forecasting with flexible multi-year financing	Zimbabwe, Guatemala
Forecast-based Financing (FbF)	German Government, International Federation of the Red Cross and Red Crescent Societies (IFRC), the Red Cross Red Crescent Climate Centre (RCCC)	Establish an "anticipatory humanitarian system"	Bangladesh, Haiti, Dominican R., Mozambique, Peru, Nepal, Philippines
Programa Nacional contra la sequia (PRONACOSE)	Government of Mexico	Adopt early warning and early action to anticipate, prevent and act against drought	Mexico

PROJECT TITLE	INSTITUTION	GOAL	COUNTRY
Early Warning – Early Action	FAO, WFP, International Federation of Red Cross and Red Crescent Societies, Save the Children, Oxfam	Implement proactive measures to help reduce the effects of droughts	
Theme 4: Mainstreaming drought management in the context of the 2030 agenda			
Drought resilience in northern Kenya	Institution: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Key institutions for agricultural development, promote drought-resilient agriculture and rural development	Kenya
Drought Adaptation (DROP)	European Union	Enhance the preparedness and resilience of Northwestern European Regions to periods of droughts	Northwestern Europe
GiZ – Territorial approach to climate change adaptation (EKF)	Institution: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Target groups sustainably manage natural resources; synergies with other development actors are created	Kenya
Sowing Diversity = Harvesting Security (SD=HS)	Oxfam Novib	Influence local and global policies and institutions on access to and sustainable use of plant genetic resources for food/agriculture	Zimbabwe

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