Food and Agriculture Organization of the United Nations

FAO WATER REPORTS

44

ISSN 1020-1203

Drought characteristics and management in Central Asia and Turkey

WaterforFood
DAUGHERTY GLOBAL INSTITUTE
at the University of Nebraska

Cover photograph: © H. Null

FAO information products are available on the FAO website
(www.fao.org/publications) and can be purchased through
publications-sales@fao.org

Drought characteristics and management in Central Asia and Turkey

FAO
WATER
REPORTS

44

Land and Water Division,
FAO, Rome

and

FAO Sub-regional Office for Central Asia,
Ankara, Turkey

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2017

ISBN 978-92-5-109604-8

Contents

Foreword

Drought is a normal phenomenon of all climates, with varying characteristics between regions. It materializes in a reduction of precipitation from the long-term average, that extends over a given space scale for a specific period of time and results in impacts. Over the past decades, drought episodes have become more widespread and prolonged in many parts of the world, with increased socio-economic and environmental impacts. More than 80 percent of the damages and losses caused by droughts are to the agriculture sector, affecting livestock and crop production and having severe consequences for food supplies and livelihoods, especially for smallholders and the poorest members of rural societies.

Drought is a slow-onset disaster – consecutive seasons of crop failure or livestock losses caused by extended dry spells and poor rains erode coping capacities and undermine livelihoods. However, the traditional response to droughts is short-term provision of humanitarian assistance in the form of food, livestock feed, cash, health and nutrition support, among others. While humanitarian assistance is critical to ensure lives are saved in the immediate term, a paradigm shift is needed to tackle the root causes of vulnerabilities and reduce disaster risks, focusing on building the resilience of their livelihoods to ensure they can cope with extreme climate events, such as droughts in the long term.

With this concern in mind, the High-level Meeting on National Drought Management Policy (HMNDP), convened by the World Meteorological Organization (WMO), the Food and Agriculture Organization of the United Nations (FAO) and the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), took place in Geneva, in March 2013, gathering over 430 participants from more than 90 countries, including ministers and senior officials, dignitaries, heads of a number of organizations and agencies, scientists and country delegates. The purpose of the meeting was to initiate a dialogue on the need for such a fundamental shift in the way droughts are perceived and managed and to encourage governments to develop and implement national drought management policies consistent with their development objectives. The Meeting issued a declaration that, among other provisions, urged WMO, FAO and UNCCD Secretariat as well as other concerned parties, to assist governments, especially the developing countries, in the development of National Drought Management Policies and their implementation.

The concern about drought impacts is fully embedded into FAO's Strategic Framework which drives the organization's activities. Increasing societal resilience to disasters, especially drought which drastically affects rural livelihoods, is one of the five Strategic Objectives constituting FAO priorities,

Within the framework of its Strategic Objective to increase the resilience of livelihoods from disasters, FAO joined hands with the Robert B. Daugherty Water for Food Institute of the University of Lincoln-Nebraska, for launching a study on drought characterization and management in drought prone regions of the world. Getting a close picture of both drought characteristics and the way it is managed in different regions is essential for steering the shift from emergency response to more pro-active policy and long-term planning.and for assessing gaps and elaborating the right support to countries to achieve

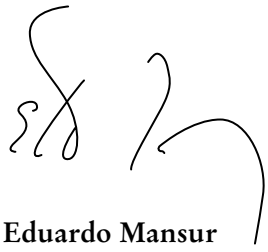
this shift. This reflects the UN's New Way of Working which enables humanitarian and development actors to support affected people through collective outcomes which reduce risk, need and vulnerability, and contribute to sustainable development.

The other goal of the studies is to provide background information, first for designing drought risk management planning guidelines that are tailored for the specific characteristic and needs for each region, and second for the preparation of national and regional projects aimed at implanting pro-active drought management plans.

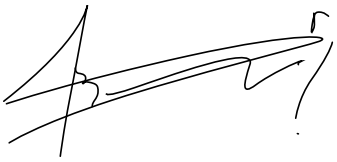
This reports reviews drought issues in the region of Central Asia - in the countries of Kazakhstan, Kyrgyzstan, Tajikistan Turkmenistan, Uzbekistan and Turkey - which is prone to drought with varying intensity and frequency. This situation is exacerbated in the region by political instability, conflicts and structural characteristics of the economy, with a high rural poor population depending on agriculture and livestock for income and employment generation and weak institutional and policy frameworks, contributing to higher vulnerability. The severe drought that hit the region in 2001 proved this vulnerability.

Policy options to tackle drought vary from centralized soviet structures to reformed decentralized frameworks. In most countries there is a system to manage water at basin levels, national drought planning and mitigation strategies and early warning systems; however, all these are improvable. Disaster risk management activities and emergency responses also need to be strengthened in the region according to the report findings. Greater funding, strengthened preparedness planning and coordination among the actors are amongst the factors required to carry out good practices.

The report constitutes a basis to rethink policies and reformulate preparedness and response plans that can strengthen resilience to droughts in Central Asia, taking into account the social, economic and environmental contexts specific to each country. We hope that it will help foster the fundamental shift in the way drought is perceived and managed in the region and we reiterate FAO's continued support to the countries of the region in the development and implementation of drought management policies consistent with their development objectives.



Eduardo Mansur
Director
Land and Water Division
FAO, Rome



Dominique Burgeon
Director
Emergency and Rehabilitation Division
Strategic Programme Leader - Resilience
FAO, Rome

Preface

Concerns have grown about the significant economic, environmental and social impacts of drought in agriculture and related sectors in Central Asia over the 30 years. The economies of Central Asia and Caucasus are still largely based on agriculture which contributes 10 - 38 percent of GDP and 18-65 percent of employment, which makes the economies of these countries vulnerable to shocks from drought by reducing farm production; adversely affecting food prices, trade; and market access and decreasing farm income and unemployment.

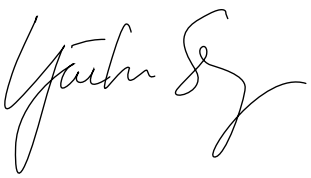
Although institutions engaged in disaster and drought risk management planning and operations in Central Asia has gained significant capacity since the droughts of the early 2000s, they still remain relatively unprepared for droughts. Drought risk management aims to increase the capacity of individuals, organizations and societies, within the context of legislative frameworks, thorough drought preparedness plans and related measures that should be planned proactively and implemented before, during and after droughts.

Under its reviewed Strategic Framework 2010-2019, the Food and Agriculture Organization of the United Nations (FAO), with its technical expertise on risk and crisis management interventions specifically for the agriculture and related sectors, is strengthening its contribution to "Increase the resilience of livelihoods to threats and crises" (Strategic Objective 5) by supporting on-going efforts on drought risk management at local, national and multi-country levels, in close collaboration with stakeholders and partners in regions, to help the world's most vulnerable people achieve food and nutrition security, by applying an inter-disciplinary and programmatic approach that integrates the agriculture, livestock, fisheries/aquaculture, forestry and natural resource management sectors.

The purpose of this publication is to assemble information from various sources to analyse the current situation of drought in Central Asian countries for enhancing drought risk management and increasing efforts to develop drought preparedness plans and implement actions to reduce the impact of droughts.

The report provided useful background information for the preparation of an important project titled "Drought-prone and Salt-affected Agricultural Production Landscapes in Central Asia and Turkey" financed by the Global Environment Facility (GEF) and the beneficiary countries. The project supports these countries to adopt drought risk management planning, among other objectives, and is currently under implementation with FAO's support.

It is hoped that this publication will be useful to the policy developers in their important role of enhancing resilience to drought in Central Asia. This publication is dedicated to those who will find it of use and subsequently utilize the information in drought or as a convenient point of departure for developing strategies or for further research on drought mitigation for all stakeholders.



Yuriko Shoji

Sub-Regional Coordinator for Central Asia

Food and Agriculture Organization of the United Nations

Acknowledgements

This publication would not have been possible without the contribution and valuable support of many persons. The study of drought characterization and management in the Central Asia and Turkey was conceptualized and commissioned jointly by Mohamed Bazza, Senior Water Resources Officer, Land and Water Division, FAO Rome, and Ines Beernaerts, Water Management and Irrigation Officer, FAO Sub-regional Office for Central Asia. The report was first drafted by Eric Patrick, FAO Consultant, based on country reports prepared by national consultants from the study region and reviewed several times by FAO's team. Cody Knutson from the National Drought Mitigation Center, on behalf of the Robert B. Daugherty Water for Food Institute, both at the University of Nebraska-Lincoln, and Mohamed Bazza (FAO) reviewed the draft versions and provided insightful remarks on the essence and the structure of the report. Melvyn Kay, FAO Consultant, provided professional poof-reading and editing. James Morgan, Graphic Designer, FAO, designed the layout and formatted the document, whereas Corinne Spadaro, Staff Assistant, FAO, aligned the document with FAO publication guidelines. Giovanni Munoz, Water Resources and Irrigation Officer, FAO Sub-regional Office for Central Asia, and other staff of the same Office provided ample support and managed the production of the publication. Thanks and appreciation are extended to all.

Thanks, gratitude and appreciation are hereby expressed to all, including those missed or whose names are not mentioned explicitly.

The study is a contribution to FAO Strategic Programme Five which is aimed at increasing the resilience of livelihoods to disasters. It was conducted in partnership with the Robert B. Daugherty Water for Food Institute of the University of Nebraska-Lincoln, USA.

Acronyms and abbreviations

ADB	Asian Development Bank
AGMEMOD	Agricultural Member States Modelling
CACILM	Central Asian Countries Initiative for Land Management
CIHEAM	Centre International de Hautes Etudes Agronomiques Méditerranéennes
CRI	Crop Range Index
DFID	Department for International Development
DMCSEE	Drought Management Centre for South East Europe
DEAWS	Drought Early Warning System
EDI	Employment Diversity Index
DRM	Disaster Risk Management
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
IPCC	International Panel on Climate Change
IWMI	International Water Management Institute
MWAR	Ministry of Agriculture and Water Resources
MFAL	Ministry of Food, Agriculture, and Livestock
MFWW	Ministry of Forestry and Water Works
MGM	Turkish State Meteorological Service
NAPEP	National Action Plan for Environmental Protection
NPF	National Programme Framework
PDSI	Palmer Drought Severity Index
SLM	Sustainable Land Management
TADAP	Turkish Agricultural Drought Action Plan

UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
UNRCCA	United Nations Regional Centre for Preventive Diplomacy for Central Asia
WFP	World Food Programme
WOCAT	World Overview of Conservation Approaches and Technologies
WMO	World Meteorological Organization
WWF	World Wild Fund

Executive summary

Drought is an accepted part of everyday life in Central Asia, but it is exacerbated by climate change and growing anthropogenic pressures, and it is threatening the region's water security. Water is at the heart of the region's development challenges (Perelet, 2008). Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan all share common and limited water resources mainly from the Amu Darya and Syr Darya Rivers which flow from the mountains in Kyrgyzstan, Tajikistan, and Afghanistan and into the Aral Sea basin. Most of the population depends on irrigated agriculture and 90 percent of the region's energy needs are supplied from hydro-power.

Central Asia is an arid region with a population of 65 million people. Steppe and desert cover over 75 percent of the land area. High mountain ranges provide borders to the east, south, and north-east and play an important part in making this region suitable for farming. Rainfall is sparse, unpredictable and varies greatly from year-to-year. From 2000 to 2001 a severe, prolonged drought took hold in Central Asia and the Caucasus. The direct economic cost of lost agricultural production was estimated at US$800 million with the costs being high in all countries; in Tajikistan it was 5 percent of GDP (World Bank 2005). The drought provided impetus for governments and international organizations to improve drought risk preparedness and management in the region.

It is within this context that Central Asia seeks to manage drought as part of a strategy for integrating water resources management as a means of sharing limited water resources among many growing and conflicting demands.

DROUGHT HISTORY

All countries of the region are susceptible to droughts but conditions vary from country to country. Precipitation is highly seasonal but in northern Kazakhstan and parts of Kyrgyzstan there is year-round rainfall and a strong dependency on winter and spring rains and snowmelt.

In Central Asia, the majority of precipitation falls as snow which then melts and flows into the rivers and across the region. Central Asia is exposed to very hot, dry summers and very cold winters. In summer moisture deficits can reach 60 percent. There is some agro-ecological zoning which enables regions to respond in similar ways to drought risk management interventions. But countries have different levels of human, technical, and financial capacity to address these common issues. As land and water management in one country may affect neighbouring countries, there is logic in addressing certain issues at a regional scale but this is still lacking.

Climate change is expected to affect all the countries in similar ways. Changes in precipitation and temperature are expected to reduce glaciers/snow packs and consequently reduce river flows. Evidence suggests that rainfall patterns have shifted in terms of timing, duration, and intensity – all of which pose challenges to land users as well as hydro-power corporations, industry, and urban centres.

Drought occurs almost across the entire territory of **Kazakhstan**, of varying intensity. The problem is further aggravated by the scarcity and uneven distribution of water resources, causing the formation of widespread saline land. In **Tajikistan**, drought is an issue throughout the country, in line with other land problems such as desertification, erosion, and salinization. These land problems are exacerbated by unsustainable land

BOX 1

Policy and Institutional frameworks in countries of Central Asia.

Uzbekistan

The central structure and institutional arrangements inherited from the Soviet period are maintained. The hydrological and meteorological systems, as well as coordination logistics, remain largely intact. Investment programmes are on-going to restore delta ecosystems in the drought-prone north and to improve drinking water supply systems.

Tajikistan

Tajikistan support priorities are moving away from large-scale irrigation and cotton and towards measures which conserve water in both irrigated and rain-fed land, and community-based watershed management measures.

Kazakhstan

Kazakhstan has prepared a national drought plan and mitigation strategy with the participation of a range of stakeholders. It also has an effective emergency intervention system, but more effective monitoring of food reserves including warehouses, especially in the more vulnerable western areas, needs to be considered.

Kyrgyzstan

The main priority is strengthening the Ministry of Ecology and Emergencies to work with other agencies, local government, and communities to develop planning and mitigation measures, and improved pasture management strategies. This includes rebuilding meteorological capacity in order to better forecast available water levels to riparians, but also to improve the capacity to prevent loss of life and regulate electricity generation.

Turkmenistan

In Turkmenistan over 97% of the cropped area is irrigated and so the priority is to improve the management of irrigation and drainage water through policy, rehabilitation, and infrastructure improvement. Turkmenistan also needs to concentrate on maintaining marginal grasslands and preventing further erosion and desertification.

Source: World Bank (2005)

use practices. The Kara-Kum desert occupies more than 80 percent of **Turkmenistan** (>80 percent) which is used year-round as natural pasture.

Most of **Uzbekistan's** territory, except for the foothills and mountains, falls into drought zones, and is susceptible to processes of land degradation, desertification, and drought. Almost 80 percent of the country is desert and semi-desert, including the Kyzylkum desert which is the largest in Central Asia. In **Kyrgyzstan** rainfall is unevenly distributed. Some regions receive up to 1 500mm annually while many regions only receive 150-200 mm. Three of four regional zones are affected by drought; the valley–sub mountain zone, the mid-mountain zone, and the high-mountain zone.

VULNERABILITY

Lessons on the region's vulnerability to drought can be drawn from the episode that hit Central Asia in 2000-2001, resulting in rainfall levels of 60 percent to 40 percent below average and river flows dropping by 35 percent to 40 percent from normal. According to the World Bank (2005), both agricultural and non-agricultural sectors of the economy were impacted in addition to the environment and rural populations. The damage to agriculture was highest in rainfed areas, but irrigated areas were also impacted as water resources became scarce. This situation contributed to increasing poverty rates as rural households lost up to 80 percent of their income, according to estimates, and impacting food security and public health with increased malnutrition and widespread water-related diseases.

Drought impacts were exacerbated by structural factors, such as inefficient water management, agricultural crisis, rural poverty, economic downturn, environmental degradation (World Bank, 2005). In addition, the response to mitigate drought impacts lacked coordination at different scales and levels. The financial capacity of most countries was not robust enough to allocate adequate funds for drought management and mitigation, or large-scale relief operations. As a result, most countries were unable to manage disaster risk and to provide effective disaster recovery.

CAPACITY TO DEAL WITH DROUGHTS

The technical, administrative, and financial capacities have been degraded in some Central Asian countries since the Soviet period. Capacities which do exist respond to drought as an emergency rather than by trying to identify and manage drought risk factors. Prevention can be cheaper than a cure but this logic does not necessarily translate into budget allocations and into changes in the behaviour of institutions. Poor planning can actually exacerbate the impacts of drought and the missed opportunities to attenuate them.

Most countries have institutions that coordinate emergency preparedness (Box 1), as well as response and recovery systems; but they need to be reinforced, with real information exchange and cooperation between agencies at a central level, between local levels, and with much greater community participation and support.

POLICIES AND INSTITUTIONS

Improved information sharing and upgrading hydro-meteorological monitoring systems is a priority throughout the region. Countries, with the support of partner organisations, are helping to strengthen weather forecasting and hydrological monitoring at every level.

According to the aforementioned World Bank report, "countries already have in place a system for managing water in basins under drought conditions, but earlier and systematic information sharing would permit more effective planning and drought mitigation measures". Improvements in legislation regulating water extraction levels, uses, and release, including contamination levels are also needed.

Key policy choices in those countries which have chosen to continue with large-scale, centrally directed and/or managed and/or financed systems relate to water use efficiency through canal lining and maintenance, reduced evaporation in reservoirs, and irrigation water quality.

DROUGHT MITIGATION PRACTICES

The drought episode of 2000-2001 made institutions react and gain experience and capacity to deal with disaster management planning and operations. However, they still have significant constraints notably the lack of preparedness and coordination strategies. The main focus continues to be on emergency response and recovery although there are trends to emphasize mitigation and resilience building. The development and implementation of longer-term programmes to plan for and mitigate the effects of future droughts is still at an early stage in most countries of the region.

Most drought mitigation is embedded in rural, agricultural, and food security development programmes as the most vulnerable sector. They aim to incorporate drought management through disseminating technologies to combat drought, and support policies and incentives to use land and water resources rationally.

Urban areas and industries are often overlooked as droughts may have less direct effect on people and in less dramatic ways but may have higher costs to the economy, given that much of the value addition is typically carried out in urban areas. Improved information sharing and upgrading the hydro-meteorological monitoring systems is a priority throughout the region.

TRADITIONAL PRACTICES

Across the region there have been investments in moisture saving techniques, but not necessarily very good monitoring/reporting of the results nor institutionalisation of successful approaches, leading to wide dissemination.

Traditional drought mitigation strategies are strongest in the pastoral systems from which lessons can be learned. Options include migration, tenure reciprocity, strategic small water infrastructure along routes of transhumance, veterinary services, relationships with relatives or kin in market centres for credit and sales services, and self and mutual insurance practices. In some countries land users are reverting to these systems and this opens up new and demand-driven, participatory approaches. This is already taking place in Tajikistan.

In spite of all this progress, operational disaster management strategies, programmes, and similar planning processes are relatively rare in spite of the manifest importance of drought in the region and the apparent trend of increasing drought vulnerability. But there are examples of good practice. In Tajikistan, the concept of joint forest management was piloted via several projects, and once proven it was mainstreamed into the Forest Code and Law in 2011 and 2012 respectively.

Seed production in Kyrgyzstan and the creation of a national register of approved seeds is being built upon as part of a drought risk management programme to identify and test drought resistant varieties that are potentially suitable to local conditions.

ISSUES

There are still many legacy issues of the Soviet system in the region. Water infrastructure was designed for a specific scale and a highly centralised management style. Kazakhstan has largely retained this approach which has minimized disruption but has limited flexibility for efficient operation. Elsewhere the centralised systems have collapsed or deteriorated and the required technical expertise is no longer available. All this presents a complex picture for drought risk management.

Addressing drought means introducing new technologies and methodologies for sustainable land and water management and building capacity to do this at all levels including changing the behaviour of individuals, institutions, and agencies and the ways in which they interact.

The potential for integrated regional water planning and management, including drought planning, is significant bearing in mind the countries already share a river system for most of their water supplies.

TURKEY

Turkey has many similar drought issues to Central Asia and is a relatively close neighbour. Droughts are increasingly common in many areas, particularly those which are important for the nation's agriculture. The annual average rainfall is 630 mm, with most of it falling in winter and spring. The climate is highly variable and, unlike Central Asia, it is influenced by the major water bodies that surround the country. The west and southern coastal areas are influenced by the Mediterranean Sea, which provides favourable conditions for heavy rainfall in autumn and winter. Similarly the Black sea brings wetter conditions to the north coast with annual rainfall of 2250mm. However, semi-arid environments prevail over much of central, southern, and south-eastern regions. These areas are most at risk from drought and desertification. In parts of Central Anatolia annual rainfall is 300mm and droughts are expected more than once in four years.

Agriculture is the first and most vulnerable sector to drought, particularly under rainfed conditions. Turkey irrigates a total area of 5.5 million hectares which consumes over 72 percent of the nation's water withdrawals. There are concerns over the efficient use of this water as most irrigation is with surface flooding methods. Only 6 percent of the irrigated area is under sprinkler and drip methods. Agriculture employs 27 percent of the country's workforce and generates 9 percent of GNP. In 2007-2008 the damage to the agricultural sector due to droughts was about US$2 million with 435 000 farmers severely affected, with major production losses for cereals and lentils. In the south-eastern Anatolia Region, production losses were estimated at 90 percent for wheat and other grains and 60 percent for red lentil.

The main cities of Ankara, Istanbul, and Izmir are also at risk and are all dependent on fresh water storage in reservoirs.

CAPACITY TO DEAL WITH DROUGHT

Turkey responds to drought mostly as a re-active emergency but is seeking ways to adopt a more pro-active risk management approach. However, the policies for this have yet to be enacted in a comprehensive national approach to managing drought risk.

Overall there is lack of guiding documents, strategies, training programmes, and participation plans, especially targeting women. All of this would improve society's recognition and the understanding of the danger of drought; and the advantages and necessity for a drought early warning system to reduce vulnerability. This currently limits the possibilities for consistent and harmonious integration of management principles and plans of readiness to include drought in national programmes and joint action plans.

DROUGHT MITIGATION PRACTICES

Turkey's economy is well positioned to utilise the abundant natural resources and structure sustainable initiatives to alleviate drought impacts. A good example is the commitment at the national level to develop and implement the Turkish Agricultural Drought Action Plan (TADAP), which outlines priority areas to address preparedness and drought mitigation measures.

A crucial step for success lies in a decentralisation policy whereby decision making on development issues is divested to local levels. The drought management components for local and provincial level development plans are, principally, the basic planning instruments to guide action and budget allocation. The TADAP is encouraging such actions as well, but it will take some time for the Ministry of Food, Agriculture, and Livestock (MFAL) to lead coordinated action with other Ministries and administrative units.

MFAL's goal is to enhance political commitment to address drought management institutions, governance, risk and vulnerability identification, and local stakeholders' capacity (i.e. knowledge and technical skills). Longer-term development plans are being established in the period between droughts to alleviate vulnerability and dependency among target groups.

Turkey has many initiatives designed to manage drought risk. One example is participation in the Drought Management Centre for South East Europe, which is located in Slovenia and co-financed by the European Union through the South East Europe Transnational Cooperation Programme. Such projects enable decision makers to review drought impacts within a regional setting, which can enhance evaluations at country level and pave the way for regional cooperation to structure adaptation/ mitigation measures to reduce drought vulnerability

ISSUES

The political sector has usually advocated for emergency drought relief and rehabilitation initiatives, with minimal commitment on development aimed at reducing the inherent risks and building vulnerable communities' resilience to drought. TADAP needs a budgetary framework and a means of fund disbursement for long-term drought preparedness and development programmes.

Public interest groups are likely to impede progress in the development of plans if they are not included in the process. Therefore, TADAP should also protect the interests of stakeholders who may lack the financial resources to serve as their own advocates.

It is important to structure a system that can evaluate the sectorial and regional issues and model them through an integrated decision-support system. The Ministry of Forestry and Water Works (MFWW) operates across 25 river basins and The MFAL operates across 30 agriculture basins. Therefore, it is important to ensure a strategic integration between the two agencies to ensure the development of a sustainable project and policy initiatives across Turkey.

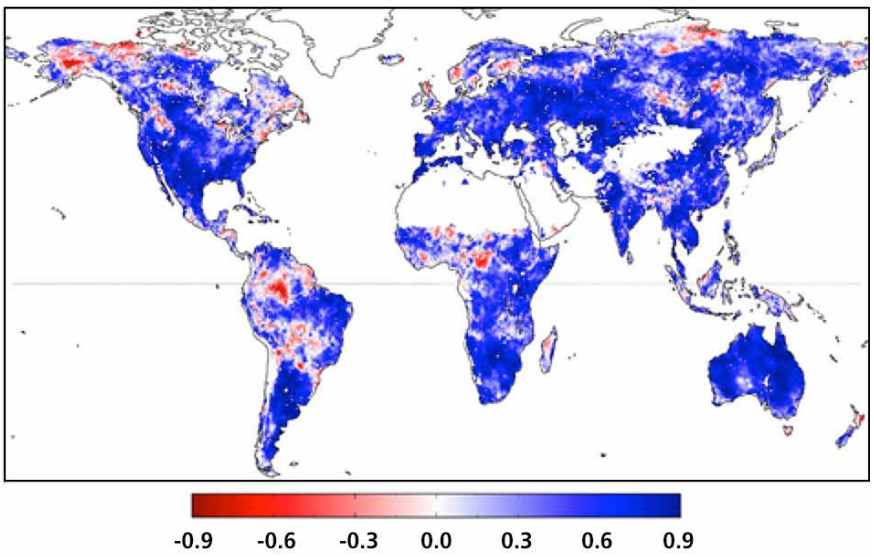
Agricultural data and agricultural drought reports provided by provincial organizations highly depend on some subjective explanations, personal opinions, and evaluations. Moreover, the definition of drought varies from one province to the other. Thus, there is a need for a homogeneous definition of agricultural drought so that in the committee meetings a consensus can be reached. This will increase the quality of information and the methods adopted by the various committees.

1. Introduction

Central Asia is a region where drought is a natural phenomenon and a routine condition of life; however, coupled with climate change and growing anthropogenic pressures, it is becoming a significant threat to the region's water security. Because of population growth, aridity, the importance of irrigation for the cultivation of water-intensive crops, and the shared nature of the region's water resources, water is at the heart of Central Asia's development challenges (Perelet, 2008). Careful water management and mitigation is required in order to prevent costly damage to the economy and the population. Historically, severe precipitation deficits, combined with receding surface and ground water levels, occur at least once, sometimes twice per decade in the region. Variability between years and among sub-regions can reach 200-300 percent (World Bank, 2005). Furthermore, climate change predictions indicate a likely increase in the frequency and intensity of drought (IPCC, 2014). From 2000 to 2001, a severe, prolonged drought took hold in Central Asia and the Caucasus. The direct economic cost of lost agricultural production was estimated at US$800 million with the costs being high in all countries; in Tajikistan it was 5 percent of GDP (World Bank 2005). The drought provided impetus for governments and international organizations to improve drought risk preparedness and management in the region.

Droughts, especially the severest ones, can accelerate the desertification processes (Zolotokrylin, 2003). Increasing albedo reduces the amount of atmospheric precipitation, resulting in climatic desertification (Orlovsky, 1994). In recent years, drought has become common not only to areas with drier climates. Between 1972 and 2002, the Palmer Drought Severity Index (PDSI) (Palmer, 1965) revealed a trend towards effective aridity in many regions of the world. Figure 1 shows the correlation

FIGURE 1
Correlation between annual drought severity index and growing season palmer drought severity index (2000-2011)



Source: Chen et al., 2002

between the annual Drought Severity Index (DSI) and growing season PDSI from 2000-2001. This indicates that drought-like conditions are increasingly common in many areas of crop production, including Central Asia and Turkey. However this has limited usefulness for analysis at national scales, where locally appropriate measures and analyses are necessary. This is discussed in more detail at various points in this report.

1.1 TYPES OF DROUGHT

There are a number of explicit and implicit definitions of drought used by government and other actors in Central Asia and Turkey, and each has different implications in terms of operational and policy approaches that are required to address them. Different ministries may be the logical institutional home to address certain aspects of drought, and in many cases there is lack of coordination between the ministries concerned. As drought is a multi-faceted phenomenon, it is critical that coordination takes place at a high enough level in government, and that finance and convening capacity is attached to this function.

The main aspects or categorisations of drought that are widely used[1] are summarised below:

Meteorological drought is usually an expression of the departure in average precipitation from a long-term statistical average over some period of time. Meteorological measurements are the first indicators of drought.

Agricultural drought occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought. Water user associations and farmers have significant exposure to the impacts of agricultural drought. Agricultural drought links various characteristics of meteorological drought to agricultural impacts such as: precipitation shortages, potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, to name a few. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, the stage of growth, and the physical and biological properties of the soil.

Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between the lack of rain and the reduction of the water in streams, rivers, lakes, and reservoirs, so hydrological measurements do not provide the early indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels. Hydrological drought is a natural phenomenon, but it may be exacerbated by human activities. Changes in land use and land degradation can affect the magnitude and frequency of hydrological droughts.

Socioeconomic drought occurs when physical water shortages start to affect people, individually and collectively. Socioeconomic definitions of drought are associated with the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought. It differs from other types of drought in that its occurrence is influenced by human activities and depends on the processes of supply

[1] http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx

and demand. Socio-economic drought occurs when the demand for an economic good such as water, forage, food grains, fish, and hydroelectric power, exceeds availability as a result of a weather-related shortfall in water supply, causing social and economic impacts.

1.2 DROUGHT AND CLIMATE CHANGE

A more incipient and more serious water crisis will emerge as a result of the long-term trend of average temperature increases in the region, which is already having an effect on the water reserves in the form of ice and snow pack in the mountainous areas of the region. This water is distributed through complex natural and 'man-made' hydrological networks; the latter in the form of extensive irrigation systems which resulted in major spatial re-allocations of water resources to cash cropping schemes. While agricultural policies are changing, there are still countries in the region where centrally determined production targets dominate water allocation, which can lead to an unsustainable use of water, especially where this is combined with various forms of price distortions of input and output markets. Hence, one form of drought risk management is in the area of the economics of water. Another area is in investment in the substantial water infrastructure which is a legacy of the Soviet system, where it is economically and environmentally rational to do so. For example, during the Soviet period a system of artificial artesian wells was created which acted as storage to extend water availability beyond the spring snow melt. The Turkish water management system has generally been more localised, with the exception of a few very large water retention investments.

There is an issue of 'scale trap' in many Central Asian countries, whereby water infrastructure was designed in a centralised way to operate at large scale and to deliver water to certain locations for certain crops. As this system has broken up, new private owners have taken on various parts, without necessarily having the resources to maintain them, nor necessarily having institutionalised relationships with owners of parts of the system up or downstream. This inter-connectedness is also reflected at a trans-national scale as some of the important hydrological networks have to be managed at a regional scale. There are water sharing agreements in place between the water source countries and other riparian states, however these may be subject to tension if and when climate change induced reductions in water availability is manifest through the system.

While climate change impacts would continue due to inertia effects even if greenhouse gas emissions were to suddenly stop globally, the implications for water resources management in Central Asia are considerably subject to human agency at both national and regional scale through pragmatic application of policy tools to promote proven and locally suitable drought risk management techniques. This publication introduces some of the policy options and highlights current policy options that may be sub-optimal with respect to the impacts of drought. It also provides an inventory of some of the drought risk management practices that are either currently being used or have potential in the region, without pretending to be an exhaustive presentation.

1.3 DROUGHT RISK MANAGEMENT

Overall, there is clearly a need for water infrastructure rationalisation in those countries with a legacy of large scale irrigation. As agriculture accounts for at least 70 percent of water use in most countries in the region, the efficiency of water delivery is the single most important drought risk management opportunity in those countries where

irrigation remains critical (for example, in Turkmenistan, 97 percent of crop production is derived from irrigation).

In all countries, crop selection is another critical factor; very large water use efficiency gains can be achieved at lower cost (and with a more widely distributed cost and benefit) in this way than through investments in major water infrastructure. As such investments in agricultural research and in extension systems can be highly cost effective with respect to drought risk management, especially when targeting a range of agro-ecological zones present in a country. As there are similar profiles found across the region there are also possibilities for achieving this efficiently at the regional scale, in particular where there is reduced potential competition between countries (for example for staple crops with moderate export potential). There has been a significant decline in agricultural research and extension systems in the region, more so in the more resource constrained countries. This has had major impacts at farm level, especially when combined with the elimination of various direct and indirect subsidies.

During the Soviet period considerable scientific expertise was accumulated in the region with respect to natural resources and agriculture but was directed through distorted price signals to often unsustainable uses of water. However both economic reforms and an increase in the range of actors in the rural development arena, in particular in the lower income countries, has opened the door to a range of local experimentation, which serves as a resource for drought risk management practices and upon which policy at various levels could be informed. There is still considerable opportunity for the region to benefit from experience across the spectrum of drought risk management dimensions from similar countries elsewhere. However language and other issues have constrained the realisation of this potential. There have been some efforts within the Turkic cultural zone to promote exchange of experience and this should continue to be promoted.

1.4 STRUCTURE OF REPORT

Chapter 2 provides a brief presentation of the physical, environmental, and in particular agro-climatic situation of the countries. A more detailed description of the rainfall patterns in the study countries is presented in Chapter 3, with an emphasis on the frequency and severity of drought exposure, together with an appraisal of the likely impacts of moisture availability trends when taking climate change into account. The vulnerability of these commonly drought prone countries to the potential impacts of drought is addressed in more detail in Chapter 4. This is broken down country-by-country into three dimensions; the vulnerability of various sectors of the economy, the most vulnerable populations (in particular in the rural economy), and the most vulnerable geographical areas. This is preceded by a brief overview of the key common vulnerabilities in the region, which in turn could serve as a basis of a potential collaborative initiative to address these issues, albeit not in substitution for key actions which must take place with the respective countries.

Chapter 5 describes the impacts of drought, with a focus on the recent period and is illustrated by the major region-wide drought in 2000-2001. However the cumulative effect of smaller, less dramatic droughts is often greater and more insidious precisely because the creeping impact on the resources and production assets are often less noticeable. Unfortunately in Central Asia, as with most other regions, the management of drought has typically been reactive, with some evidence of changes in policy and practice in response to the largest drought events. In Chapter 5, a distinction is highlighted between bio-physical and socio-economic impacts and these are presented on a country-by-country basis, with the commonalities summarised in an introductory

overview. Where elements of drought risk management approach is evident, attention is drawn to this fact as a promising basis for future policy directions.

Drought policies and the institutional environment in which they are formulated and through which they are applied is the subject of Chapter 6. These have typically been response oriented, which is an important and necessary dimension. However more attention needs to be put on managing the underlying risk factors. These are typically diffused across sectors and the institutions responsible for them, creating high transaction costs for a coordinated response. However, experience from elsewhere has shown that where drought impacts can sustain the attention of policy setters, together with resources (approaches, technical capacity, financial support) and evidence of their effectiveness can be demonstrated even on a pilot basis, it is possible to achieve a system shift, albeit over time. As economies develop there are more resources to compensate for the losses. However this does not address the underlying problem. In countries like Australia progress was made from a loss compensation approach to one which is focused on water demand management, allocation of water to its highest value use, and water market reform. Similar processes occurred in other water scarce countries, such as Israel, combined with the application of research and technology which has paid for itself through exporting high value crops produced with minimum amounts of water, which is often of poor quality.

There are also general issues of market reform in the region; hence water pricing may not be the most pragmatic starting point in this case. There is some legacy of Soviet investment in science and technology with respect to water use in Central Asia. But there are finance issues over maintaining it and in particular the issues with institutions which were set up to serve the entire region. However the largest opportunities exist at farm level with water use efficiency improvements, targeted incentives for higher value outputs produced in water efficient ways, and grey water recycling, etc. All these technical solutions, however, are dependent on effective supporting institutions. Agricultural extension services are less well-resourced in many countries. From a multi-year budget perspective it would be more rational to allocate resources for drought emergency relief to addressing risk factors. Hence financial and economic (total valuation, including factors which do not have a market, such as land degradation, but the impacts of which can be given an approximate monetary equivalent) assessment of drought impacts needs to be assessed and integrated into policy and the budget-setting processes at the highest levels. However, responsibility for a visible and less obvious dimension of drought is scattered across non-cooperating or even competing institutions, and so leadership is needed at the highest levels. This is most likely to get attention immediately after a major drought event. However analytical, policy management, and operational tools need to be developed and piloted at lower levels (for example in the most drought affected administrative units) in order to work out effective options.

Chapter 7 provides a review of the drought practices by country, distinguishing between those applied by the government or other development institutions and those applied by land users. Where practices of land users are mainstreamed into policies and actions of supporting institutions this is noted and could serve as a model for other countries. Tables of actual and potentially relevant drought management practices and policy measures have also been inventoried, based on a literature review and discussions in with drought management stakeholders by the contributing authors of the respective draft national reports. Finally, Chapter 8, summarises the general challenges facing countries in the region which have implications for better managing drought risk, as well as some promising directions.

2. The region

2.1 KAZAKHSTAN

Kazakhstan is located in the heart of the Eurasian continent, covering an area of around 2.7 million km². It is almost equal in distance from the Atlantic and Pacific Oceans, as well as significantly distant from the Indian Ocean. Such a deep continental location largely determines its natural conditions. Most of Kazakhstan is arid and semi-arid and it is vulnerable to climatic change: 44 percent is desert, 26 percent is steppe, and 14 percent is semi-desert. About 6 percent is forest; the remainder is mountains, sea, lakes, and rivers. The terrain rises from the vast lowlands, located below sea level, to the highest mountain ranges up to 5000 metres. The territory from north to south is divided into natural climatic zones: forest-steppe, steppe, semi-desert, desert, foothills, and mountainous areas.

2.2 KYRGYZSTAN

Being a typical mountainous country, Kyrgyzstan is notable for the considerable complexity of its surface, which is characterised by deep ruggedness, and varied mountainous slopes with different exposure to the sun and air flows. These characteristics create a complex diverse climate. Four climatic zones are distinguished, three of which are important for agriculture and are the most vulnerable in terms of drought.

2.3 TAJIKISTAN

Tajikistan is a small country of 143 100 km² that shares its borders with Afghanistan in the south (1 030km), Uzbekistan in the north and west (910km), Kyrgyzstan in the north (630km), and China in the east (430km) (CIA, 2013). It is a country dominated by mountains; that cover 90 percent of the country. The mountains belong to the highest mountain ecosystem in Central Asia; Tyan-Shan and the Pamirs. Almost half of the country is over 3 000m above sea level. As a result, arable land is scarce, representing only 11 percent of the total land area (IMF, 2012). The lowland areas are generally arid, and therefore dependent on irrigation for agricultural development. Drought is an issue throughout the country, along with other land problems such as desertification, erosion, and salinization occurring widely, that is exacerbated by unsustainable land use practices.

2.4 TURKMENISTAN

Turkmenistan borders the Caspian Sea to the west, Iran and Afghanistan to the south, Uzbekistan to the north-east, and Kazakhstan to the north-west. Turkmenistan has flat-to-rolling sandy deserts with dunes rising to mountains in the south; and low mountains along the border with Iran. The average elevation is 100 to 220 metres above sea level. The highest point is Mount Aýrybaba (3 139m) in the Köýtendag Range of the Pamir-Alaychain in the south-east. The lowest point is the Sarygamysh Lake (close to 100m below sea level). Mount Arlan rises sharply above sea level in the Great Balkhan Range in western Turkmenistan (Balkan Province). Nearly 80 percent of the republic lies within the Turan Depression, which slopes from south to north and from east to west.

Most of Turkmenistan (>80 percent) is occupied by the Kara-Kum desert, which is used as year-round natural pasture. It occupies about 350 000km². Shifting winds create desert mountains that range from 2-20m in height and may be several kilometres long. Chains of such structures are common, as are steep elevations and smooth, concrete-like clay deposits formed by rapid evaporation of flood waters in the same area over several years. Large marshy salt flats, formed by capillary action in the soil, exist in many of the depressions, including the Garaşor, which occupies 1 500 km² in the northwest. The Sandykly Desert west of the Amu Darya river is the southernmost extremity of the Qizilqum Desert, most of which lies in Uzbekistan to the northeast. The productivity of these natural pastures is directly related to the amount of rainfall. The pasture resources lose a significant portion of the plant biomass during the years of severe drought. For instance, Nurberdiev *et al.* (2008) reported that the average biomass yield in the Kara-Kum between 1961 and 1990 was 150 kg/hectare. Whereas during from 1991 to 2008 when droughts were frequent, average productivity of the pastures decreased by 36 kg/hectare. This is 24 percent of the long-term average value.

2.5 UZBEKISTAN

The Republic Uzbekistan is centrally situated within the Aral Sea basin. The landscape of Uzbekistan is extremely diversified. There are plateaus, lowland plains, piedmont inclined plains (70 percent) and mountain spurs and ridges (20 percent). Almost 80 percent of the country is desert and semi-desert, including the Kyzylkum, the largest desert in Central Asia. The total land resources are 44.4 million hectares; 28.5 million hectares (63 percent) are made up of agricultural lands. Of this 23.4 million hectares (52 percent) are low productive pastures and 4.2 million hectares are irrigated (11 percent).

The climatic characteristics (sharp continental climate, aridity, abundance of warmth and sunlight) are conditioned by its southern location inside the vast continent with great distance from the oceans. The period between May and October has the longest hours of sunshine.

According to the UNEP aridity index[2] (Middleton and Thomas, 1992, 1997), most of Uzbekistan's territory, except for the foothills and mountains, falls into drought zones, and is considerably susceptible to the processes of land degradation, desertification, and drought (CACILM, 2009). Average temperatures in January in the south is +30C (Termez) and -80C in the north (Usturt). The highest temperatures in the summer months (July) reach 45-490C and the soil surface can be heated up to 60-700C. The average rainfall in the desert zone is less than 200 mm/year, and in piedmont and the mountainous zones it varies from 400 to 800 mm/year, with a maximum in the highlands of up to 2000 mm/year. In all zones rainfall is subject to significant fluctuations and in some years it may be half the long-term average.

The main water resources come from surface runoff into the transboundary Amu Darya and the Syr Darya River with their tributaries, as well as the Kashkadarya and the Zarafshan rivers. The main flow of the Amu Darya and Syr Darya rivers are formed on the territory of Tajikistan and Kyrgyzstan, respectively. The total surface runoff of these rivers is estimated at 126.9 km^3 for the years with 90 percent probability (UNDP, 2007). The surface flow contributed by Uzbekistan area is 11.5km^3 – 18 percent from the total water demand (Middleton and Thomas, 1992; 1997).

[2] According the UNEP aridity index (correlation of precipitation rate to potential evapotranspiration) arid regions of the world are divided into three regions: arid 0.05-0.20, semi-arid 0.20-0.50, dry sub-humid0.50-0.65.

2.6 TURKEY

FIGURE 2
Map of Turkey

Source: FAO AQUASTAT.

Turkey (Figure 2) is situated in the Mediterranean macroclimatic region of the subtropical zone. It has complex topographic features with proximity to water, and is a transition zone for different pressure systems and air masses originating from polar and tropical zones. Several climatic sub-regions dominate. The amount and distribution of rainfall in the coastal areas is determined by troughs and frontal-type mid-latitude cyclones that are associated with the prevailing upper-level westerly flows. The Mediterranean Sea acts as a primary source for moist air masses that produce high rainfall over the windward slopes of the coastal mountain ranges. Frontal Mediterranean cyclones associated with south-western air flows create favourable conditions for heavy rainfall and thunderstorms in southern and western coastal areas in late autumn and early winter. Annual average rainfall in Turkey is 630 mm, with 67 percent occurring during winter and spring when the eastern Mediterranean basin and the Balkans are influenced by eastward propagating mid-latitude cyclones and Mediterranean depressions (Turkes, 1996).

3. Drought characteristics

3.1 OVERVIEW

While all countries of the region are susceptible to drought as a result of a combination of geographical and structural factors, some characteristics may vary between countries. Droughts episodes also differ with regard to three main characteristics: intensity, duration and spatial coverage. Continental climatic conditions, with highly variable temperature, prevail throughout Central Asia. Exceptions to these conditions include the north of Kazakhstan and parts of Kyrgyzstan where precipitation occurs nearly all year-round and where mountains supply important water flows to the South Asian and Central Asian countries. Central Asia and Turkey are generally characterised by multiple agro-climatic zones, either because of their size and/or continental nature (for example Turkey, Kazakhstan, Uzbekistan) or because of their complex topography (Kyrgyzstan, Tajikistan) or both (in particular Turkey). Turkey is an exception in that it is largely surrounded by major water bodies, and hence has a potentially large water supply, the delivery of which is influenced by complex local weather conditions which make forecasting a challenge.

A distinguishing characteristic of Central Asia is that the majority of precipitation falls as snow. This is then distributed through the hydrological network, including via trans-boundary rivers. As such, Central Asia is relatively well integrated from a hydrological perspective, implying that there should be a regional dimension to national water management, including drought planning. In the north of Kazakhstan and parts of Kyrgyzstan there is a strong dependency on winter and spring rains and snow from mountain ranges such as the TienShen and Pamir, which are the main water sources to watersheds of South Asia and Central Asia (World Bank, 2005). The seasonal patterns of precipitation and mountainous landscapes increase the vulnerability to floods and landslides in addition to droughts.

Central Asian countries are also exposed to extremes of temperature with very hot and dry summers and very cold winters. In summer, moisture deficits can be 60 percent or more, with the number of days of large moisture deficits being correlated with the altitude. In short, there are a range of temperature and rainfall management challenges and opportunities within and across the region, with a variety of 'micro-climates' created by a combination of factors.

Agro-ecological zoning, which has been done in most of the countries, can be translated into a typology of climate-livelihood units reflecting these micro-climates which would respond in similar ways to drought risk management interventions. Furthermore, climate analogues based on units that are currently further along a drought gradient could be identified, which would allow a practical assessment of how a given unit would best be managed under projected climate conditions and, as such, provides the basis for longer-term water management planning. Of course the different countries in the region have different levels of human, technical and financial capacity to address these common issues; however as land and water management in one country may affect the neighbouring countries, there is a logic in addressing certain aspects at a regional scale.

Climate change is expected to affect the countries in similar ways, ranging from a reduction in glaciers/snow pack and a consequent reduction in river flow from which irrigation systems may be derived, to desiccating and erosive winds. There is variable evidence regarding long-term secular declines in average rainfall which might be expected to be associated with climate change; rather there is diverse evidence that patterns of rainfall have shifted: in terms of timing, duration and intensity; all of which pose challenges to land users (as well as hydro-power corporations, industry, urban centres and other water users). Again, these commonalities provide opportunities to identify a limited number of adaptive practices which could be of wide benefit.

There is a common interest in managing diminishing water resources. These reduce effective rainfall even if the actual precipitation remains the same, due to higher evapotranspiration demands. Riparian states in particular have interlinked futures; however this should go beyond water sharing arrangements to sharing water efficient technologies and practices and more general drought risk management approaches.

Other areas of potential collaboration and with the benefit of cost spreading include weather and climate data collection and analysis, as well as translation into effective early warning considered by land users to be useful. Typically, land users complain that early warning is not sufficiently precise in time and space as well as in terms of the way information is made available. There is the legacy of a relatively strong hydro-meteorological network and related scientific capacity in Central Asia. This is generally sufficiently functional to allow countries to continue to monitor the broad trends pertinent to climate change, as well as feeding into zoning for drought management planning and for triggering the declaration of drought emergencies and response resources. However, many of these human and scientific resources are significantly diminished. Therefore there is a need for investment in these systems at country level and/or a shared investment at regional level. Instrumentation of hydrological networks (river gauges) and rainfall gauges need to be improved at national level. Training and some analysis could be carried out more efficiently on a regional basis.

Access to hydro-meteorological information by potential users is another issue; in at least some of the countries there is a difficulty to obtain hydro-meteorological data because of cost and/or institutional issues. There may also be opportunities to use new forms of dissemination (such as the internet) to make hydro-meteorological data available at lower cost to institutional users. This could partly offset the cost of improving information provision.

3.2 RAINFALL TRENDS

The Standardized Precipitation Index (SPI) is increasingly used to characterise precipitation received in an area during a specific time period The outcome of the inter-regional World Meteorological Organization (WMO) Workshop on Drought Indices along with the other workshops in 2009 (Sivakumar *et al*., 2011), encouraged national hydro-meteorological services to use the SPI as one possible index to determine quantitative precipitation deficit at different time scales. An example of the use of the SPI to characterise drought in Central Asia is given in Box 2.

Drought occurs almost across the entire territory of Kazakhstan, with varying intensity. The problem is further aggravated by the scarcity and uneven distribution of water resources, causing the formation of widespread saline land. In Tajikistan, drought is an issue throughout the country, in line with other land problems such as desertification, erosion, and salinization. These land problems are exacerbated by unsustainable land

BOX 2

Characterising drought using the Standardized Precipitation Index in Kazakhstan

The Standardized Precipitation Index (SPI) is increasingly used globally to characterise precipitation deficits and surpluses. In accordance with the Lincoln Declaration on Drought Indices, the national hydro-meteorological services were encouraged to use the SPI as one possible index to determine the quantitative precipitation deficit at different time scales.

For Kazakhstan, the SPI was used to analyse monthly precipitation data of 74 stations in the major grain-producing regions over a 41-year period from 1971 to 2011 (Dolgikh, 2010). The SPI values were calculated for time scales of 1 month, 3 months, 6 months, 9 months and 12 months for each station and the whole region. The dry and rainy periods were determined according to the evaluation results for each station and region. The nature of SPI allows determining the predominance of dryness or above-normal moisture in the area for the selected time scale.

The graphs below (Figure 3) show the frequency of severe and extremely dry periods by months, as well as the frequency of drought periods with any intensity by regions of Northern Kazakhstan. The frequency is estimated by the values of the Standardized Precipitation Index from 1971-2011.

It is revealed that the onset of the atmospheric drought is possible in any month of the growing season, and if drought is considered, regardless of intensity, then the frequency has no obvious seasonality, dry months are 10-22% of 41 analysed cases.

In the Pavlodar region, the number of very dry periods is 2-10% of cases, with a maximum in September. In March, May and August cases with extremely dry conditions were not observed. The maximum frequency of extreme dry periods was observed in January and February and was about 5%.

use practices. The greater part of Turkmenistan (>80 percent) is occupied by the Kara-Kum desert, which is used as a year-round natural pasture. Like most Central Asian countries drought is an issue throughout the country.

Most of Uzbekistan's territory, except for the foothills and mountains, falls into drought zones, and is susceptible to processes of land degradation, desertification, and drought. In Kyrgyzstan precipitation is unevenly distributed. Some regions receive up to 1500mm annually while many regions only receive 150-200 mm. Three of four regional zones are affected by drought; the valley–sub mountain zone, the mid-mountain zone and the high-mountain zone. In Turkey, drought is an issue only in some areas of the country. There is significant variation and ecological factors which change sharply over very short distances.

3.3 DROUGHT CHARACTERISTICS

3.3.1 Kazakhstan

Figure 4 shows a schematic map of the distribution of moisture zones across Kazakhstan, compiled from data for 1971-2011.

In most of Kazakhstan, the moisture conditions are poor both for growing crops and for living. The results of calculations of drought frequency with varying intensity over

FIGURE 3

Frequency of dry periods of varying intensity for four regions of Kazakhstan, calculated for the period 1971-2011

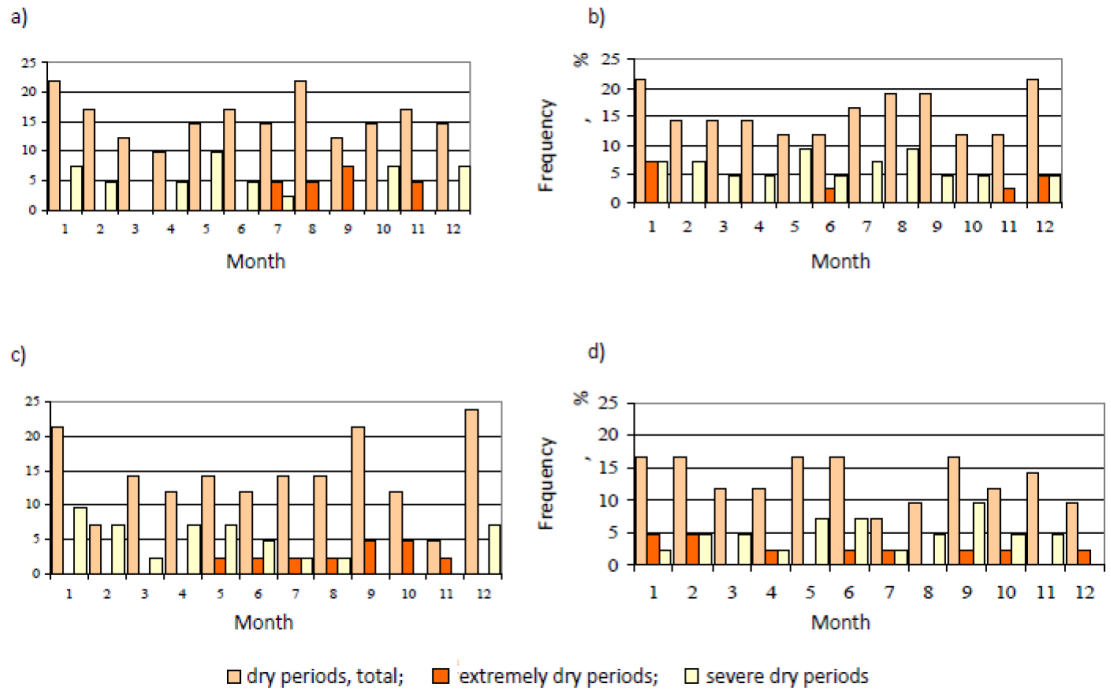
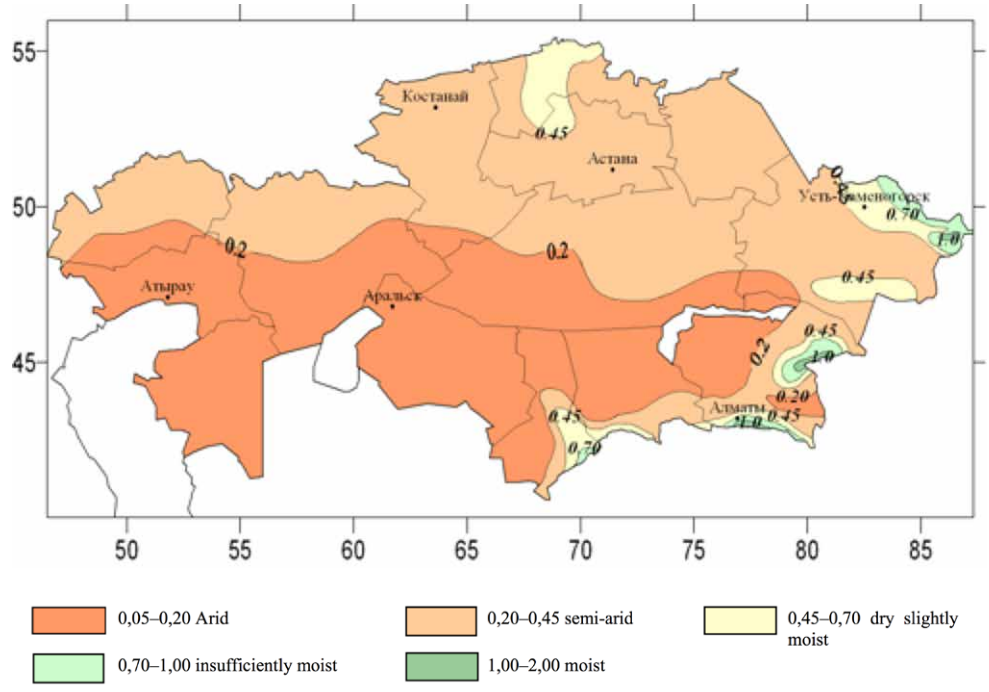


FIGURE 4

Schematic map of distribution of N.N. Ivanov's moisture coefficient on the territory of Kazakhstan, based on data over the 1971-2011 period



Source: Salnikov, 2012.

the period 1971-2011 are shown in Table 1. Severe drought occurs once in 5-7 years, the frequency of severe droughts is between 15 percent (Kostanai, Pavlodar, Almaty provinces) and 22 percent (West Kazakhstan and Akmola provinces).

TABLE 1
Frequency of droughts of varying intensity, calculated from data 1971–2011

Admin area	Frequency of droughts of varying intensity (%)				Incidence of drought (years)			
	No drought	Weak drought	Moderate drought	Severe drought	No drought	Weak drought	Moderate drought	Severe drought
West Kazakh.	43.9	24.4	9.8	22.0	2.3	4.1	10.3	4.6
Aktobe.	51.2	14.6	14.6	19.5	2.0	6.8	6.8	5.1
Karaganda	39.0	26.8	14.6	19.5	2.6	3.7	6.8	5.1
East Kazakh	41.5	26.8	14.6	17.1	2.4	3.7	6.8	5.9
North Kazakh	46.3	22.0	14.6	17.1	2.2	4.6	6.8	5.9
Akmola	48.8	22.0	7.3	22.0	2.1	4.6	13.7	4.6
Kostanai	41.5	22.0	22.0	14.6	2.4	4.6	4.6	6.8
Pavlodar	41.5	24.4	19.5	14.6	2.4	4.1	5.1	6.8
Alma-ata	51.2	14.6	19.5	14.6	2.0	6.8	5.1	6.8
South Kazakh	43.9	34.1	4.9	17.1	2.3	2.9	20.5	5.9
Zhambyl	39.0	31.7	12.2	17.1	2.6	3.2	8.2	5.9

Source: Salnikov, 2012.

3.3.2 Kyrgyzstan

The hottest months in Kyrgyzstan are July and August. The average monthly temperature in these months in different regions varies within the range of 26-280C. Nevertheless, in the south-western part (the Fergana Region) of the country the weather is hotter than in the northern (the Chu Valley). The highest temperatures in these parts of the country are between 43 – 44^{O}C.

The country's entire agricultural area in the vegetation period is characterised by a significant air moisture deficit, which adversely affects the agricultural crop yield and pasture productivity.

The distribution of rainfall is very uneven both in terms of regions and during the year[3]. Annual rainfall varies from 147 mm (the Altay Valley) to 800-1000 mm (the eastern Issyk-Kul region, the nut wood forestland in the Fergana range). However, the total rainfall during the active vegetation period is important in characterising moisture availability for agricultural crops.

3.3.3 Tajikistan

The hottest summer in valleys is characterized by an increase of air temperature up to 40°C and higher. The first ten-year (1990-2000) period was the hottest, with a significant number of days when the air temperature exceeded 40°C in most of the valley area of western Tajikistan, which is linked with the absence of a dense irrigation network.

[3] Information retrieved form Agro-climatic resources of the Osh Province, Kyrgyz SSR. Leningrad, Gidrometeoizdat, 1975.

On average in the foothills of Tajikistan, 15-20 percent of all of precipitation falls as snow. With high altitudes the amount of solid precipitation increases up to 50-70 percent, reaching its maximum on the Pamir (85-90 percent), and Fedchenko Glacier (100 percent). The number of days with precipitation of 0.1 mm and more is about 50-80 days, in foothills it is 80-100 days, and increases up to 125 days in high altitudes. The low rainfall days are in the high altitude desert in Eastern Pamir.

In the major crop growing regions, the intensity of droughts which impact yields by 20 percent or more, are observed:

- Once in 3 years in South and southeast Tajikistan, Danghara, Kulyab, Kurgantubbe, Kabodiyon and Shahrituz regions
- Once in 4 years in Eastern Tajikistan, mostly the GBAO regions
- Once in 5 years - in the North-Tajikistan region.

Severe droughts, reducing average crop yield by 50 percent or more, have a high frequency in southern and western Tajikistan. Dangara, Kulyab, Temurmalik:

- Once in 4-5 years - Southeast Tajikistan, Kurgantube, Kabodiyon, Vakhsh and Shahrituz regions
- Once in 6-8 years in South Tajikistan, Danghara, Kulyab, Temurmalik, Baljuvon, Vose, Kolkhozobod
- Once every 9-11 years in Ghonchi, Nov, Istaravshan regions
- Once in 12-15 years in the KanibadamAsht and Isfara regions

3.3.4 Turkmenistan

There have always been droughts in Turkmenistan, but according to multiple sources they were not persistent and intense. But, by the end of the century, wet years reduced in number and this trend continued into the current century.

Patterns of drought appear to be shifting resulting in more significant impacts due both to combinations of conditions and sequencing of events. For example, as reported by Nurberdiev *et al.* (2008), a recent severe drought persisted on the Kara-Kum area for 6 years during the period from 1999 until 2008, decreasing the average yield of pasture vegetation to 68 kg/ha, so the yield loss dropped to 82 kg/ha and accounted for 55 percent of the average. That drought was unusual, not because of lack of precipitation combined with the high levels of evaporation caused by hot weather during a year, but because of the relentless recurrence of these abnormal conditions over several years (1999-2000-2001, 2005-2006, and 2008). This resulted in extremely low productivity of pastures, a decrease in river flows, and drops in the underground water level in the foothills, which greatly aggravated the situation. Between 2000 and 2002, rainfall in the most provinces of the country was 58-63 percent of the average norm, and the mean annual air temperature ranged from 1.2 to 1.6°C above the long-term average values.

3.3.5 Uzbekistan

Table 2 shows that the probability of drought in deserts and semi-deserts is significantly higher in comparison with the piedmont zone, which is normal. Temperatures equal to and higher than 35°C are observed in the country, mainly, from the end of May till October, though in some years, especially in the south, hot days start in April, and

sometimes even in March. The peak of hot days occurs in July, though in some years they are observed also in August.

TABLE 2
Characteristics of droughts by intensity, duration and spatial coverage

Spatial coverage	Intensity	Duration
Piedmont zone	very strong drought SPI < -50	1-3 times per 100 years
	drought with SPI < -20	3 times per 10 years
Deserts and semi-deserts zone	very strong spring drought SPI < -50	1 time in 10 years
	drought with SPI < -20	3-4 times per 10 years

Source: 2nd National Communication of Republic Uzbekistan to the UNFCCC (2008).

Droughts have become more frequent during the summer and autumn periods, especially downstream of the Amu Darya River and around the Aral Sea. In the 1980s and 1990s droughts were observed on average two years in ten. From 2000–2012 the extreme meteorological drought occurred four times - in 2000, 2001, 2008, and 2011. The drought of 2000-2001 was especially severe according to the scales of its distribution, impacts, and consequences for agriculture, water resources, and other sectors of economy, and environment and rural population.

Temperature data show that the days when the temperature is 40°C and higher is increasing over the whole country. This confirms the trend for long-term changes of meteorological and hydrological drought indices in the Kashkadarya river basin (Varganza gauge) for the period of 1960-2011. According to the measure of global warming, similar tendencies, most probably will become more broadly distributed (CACILM, 2006).

3.3.6 Turkey

The annual average rainfall is approximately 630 mm, with 67 percent of it occurring during the winter and spring (Turkes, 1996). Since Turkey is located in the Mediterranean macroclimate region in the sub-tropical zone, rainfall variations occur from year to year. This causes regional and widespread drought impacts in various intensities. Thus, drought is one of the main natural challenges for Turkey. In most parts of the Central Anatolia Region, which has approximately 600 mm of annual average rainfall, the recurrence period of drought conditions is more than once in 4 years.

The combination of rainfall deficiency and other climatic factors, especially high temperature, creates a serious risk of drought in the central and south eastern parts of the country, where agriculture is the main economic sector (Komuscu *et al*., 1998). According to Saylan (2009), the long-term average (calculated from 1950-2003) precipitation and temperature of Turkey is about 646 mm and 13°C.

According to Sen *et al*. (2010) from the Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM), at the regional scale, the Eastern part of Marmara; the Black Sea Region; and the northern and eastern parts of the East Anatolia Region are characterised by wetter conditions. Most of the agricultural production areas, like central Anatolia (an important wheat production area for Turkey), Mediterranean (mainly corn and citrus products), Southeast Anatolia (cotton and cereals), and the Aegean (fruits trees, cotton, corn) are predicted to suffer from more frequent and intense droughts in the future.

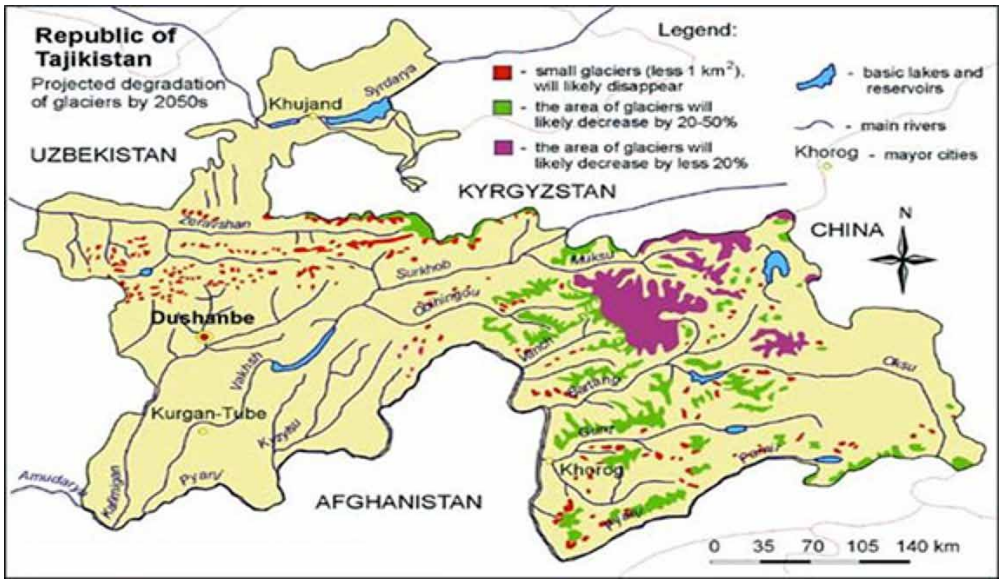
3.4 CLIMATE CHANGE

Rainfall patterns are dynamic in the region and don't follow the same trend. Tajikistan and Kazakhstan are facing a decrease in precipitation whereas in Kyrgyzstan it has increased. Estimates of future rainfall vary widely among countries, whereas temperatures have increased everywhere and are predicted to rise by 2-6 °C. Consequently, it is expected that crop and livestock productivity will likely increase in Kyrgyzstan and northern Kazakhstan while water deficits and desertification will increase in the rest of the region. The most vulnerable regions to suffer the effects of climate change and desertification are the grassy plains of Kazakhstan and the marginal lands of Uzbekistan and Turkmenistan where evapotranspiration is expected to increase (World Bank, 2005)

As described by Perelet (2008), climate change is expected to further exacerbate water scarcity in the region and the problems of the Aral Sea. Rising temperatures are already melting 46 of Central Asia's glaciers. The Pamir-Alai glaciers lost 19 percent percent of their mass during the second half of the 20th century. Glacier coverage in various parts of the Tien Shan, Gissaro-Alai, and Pamir, Dzhungarskiy, and Zailiyskiy Alatau mountains is currently shrinking at the average rate of about 1 percent annually. This melt will ultimately reduce water flow in the Amu Darya and Syr Darya rivers by up to 40 percent and 30 percent, respectively. Increased frequency of droughts and reduced agricultural productivity are also widely predicted. Figure 5 illustrates the projected degradation of glaciers in Tajikistan by 2050 as a result of climate change.

In Kazakhstan, increased aridity in spring can be expected in the northern regions, whereas the lowest aridity increase is expected in the south-eastern and southern regions. In Kyrgyzstan, glaciers and snowfields cover 4.1 percent of the country's territory; these glaciers and snowfields are slowly melting due to climate change and will continue to reduce the runoff of small rivers that feed from them. Tajikistan has seen a seasonal decline in average rainfall levels in most regions especially the west, north,

FIGURE 5
Projected degradation of glaciers by 2050.



Source: Tajikistan (2002) State of the Environment Report.
(http://enrin.grida.no/htmls/tadjik/soe2001/eng/htmls/climate/clim26.htm)

and east. Nevertheless, the central regions are not affected as much. Turkmenistan is expected to see an increase in sand storms, mudflows, landslides, floods, desertification, rise of the sea level, as well as drought. Uzbekistan like Turkmenistan is also expected to see a predicted increase in the annual precipitation. Turkey is expected to have an increase in rainfall during the winter and spring months.

4. Drought vulnerability

4.1 OVERVIEW

According to the International Panel on Climate Change (2007), vulnerability refers to the degree to which a system or a society is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, the magnitude and the rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity. Since the impacts and the adaptive capacity of systems may vary substantially over the next decades and within countries, vulnerabilities can be highly dynamic in space and time. Consequently, there is a strong need to build resilient systems that have a high capacity to adapt to stress and changes and can absorb disturbances.

The drought of 2000-2001 revealed that the countries of Central Asia and Turkey are highly vulnerable to the incurred impacts, with structural factors, such as rural poverty and the unsustainable management of natural resources, being the main causes. The prevailing governance framework was not robust enough to cope with drought, and this exposed the most vulnerable layers of society to significant risk. The economies dependence on one or two main sectors of activity, with agriculture contributing 10-38 percent of their GDP and 18-65 percent of employment, makes them highly vulnerable to drought. Industry which relies on agricultural products for inputs is also hit by the cascading impacts. (World Bank, 2005). Recovery from catastrophes and relief operations at large scale requires important investment that most of these countries are unable to provide. Risk transfer mechanisms such as drought insurance are also non-existent.

One of the consequences of past droughts was the interruption of water supply to large portions of the populations, partly because of uncoordinated actions of sectors at regional and national levels. According to the World Bank (2005), despite the significance of these problems, the main cause of vulnerability to drought was high water consumption, created by a deteriorating infrastructure and poor management, combined with poor discipline by users who treated water as a "free good", as during the Soviet period. After the USSR disintegration, transboundary cooperation in water management has been a challenge. The transboundary water management institution established in Central Asia, the Interstate Water Coordination Commission, faced tough constraints to operate, according to the same source. Figure 6 shows the extent of irrigated land on which there is considerable dependency.

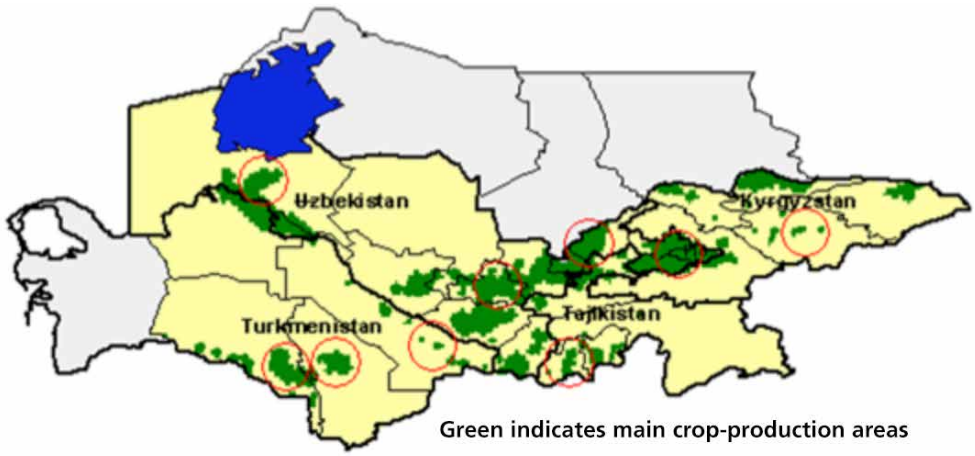
As stated previously, agriculture is a significant contributor to GDP and employment share in Central Asia and Turkey. In the year 2000, crop and livestock production accounted for 50-60 percent and 40-50 percent of agricultural GDP, respectively. The rural population, which depends on this sector for most of its livelihood, accounts for 33-73 percent of the total population (World Bank, 2005). During the Soviet regime large investments were made to convert dry agriculture into more productive irrigated land, through the installation of massive irrigation schemes in semi-arid zones. In addition to unfavourable external factors such as agro-ecological conditions, several agricultural practices introduced by this transformation in the 1990s increased the vulnerabilities. Figure shows the crop production areas in Central Asia.

FIGURE 6
Irrigated land in Central Asia

Source: FAO Aquastat, nd.

Central Asia has become more prone to socioeconomic drought since the 1990s owing to the growing poverty. An illustration of the effects of drought on the economies of the region, is given by a survey carried out around 2005-06 in Turkmenistan. The survey showed that six out of eleven ministries and departments confirmed that drought has a negative effect on their industrial activity, and seven responded that hot dry winds have negative effects. The country's agricultural sector, which is totally based on irrigated agriculture, is especially exposed. The water shortage resulting from drought is mitigated in the irrigated areas, but hot dry winds reduce crop yields in these areas by up to 30 percent. The productivity of pasture vegetation depends on the amount of rainfall and temperature.

FIGURE 7
Irrigated land in Central Asia



Source: FAO Aquastat, nd.

4.1.1 Kazakhstan

VULNERABLE SECTORS

Drought is prevalent among other natural disasters in Kazakhstan in terms of area coverage and the scale of negative impact on the population. The most vulnerable sector of the economy is agriculture. Considering the scale and the increasing severity of droughts, as well as the damage, droughts pose a real threat to food security.

The most important problem is the scarcity of water resources. Climate change may lead to an imbalance of the climate - water - agricultural production system, which will inevitably affect the food security of the population.

The conditions for growing crops and yields will change under conditions of degradation of glaciers, changes in precipitation and temperature, and river flow resources. In addition, the climate in many agricultural regions of Kazakhstan will become more arid[4] which would significantly deteriorate the water supply situation. Most rivers in Kazakhstan have a transboundary nature and so the water dependence on other countries is significant.

According to UN data (World Bank, 2012), out of 272.5 million ha of Kazakhstan's territory, 179.9 million ha is affected by desertification, or 66 percent of the total area. The damage caused by the degradation of pastures was US$963 million; the lost income due to erosion of arable land is US$779 million, due to secondary salinization - US$375 million. Total damage from the loss of humus in Kazakhstan estimated by international specialists is US$2.5 billion.

Climate change may also contribute to forest degradation. The total area of forest reserves in 2010 was 28.4 million ha; of which the land covered with forests was about 12.3 million ha. Forest cover with the saxaul forests and shrubs is 4.5 percent, without them it is 2.3 percent (5.75 million ha)[5]. Basically, forests do not have an economic role; rather they are for soil and water conservation.

As a result of these processes, the agricultural production on rain fed lands and irrigated land due to decreases in water supply and quality and crop yields may be at risk. Livestock, fisheries, and hydropower can also be included in the risk groups. Ecosystem degradation, biodiversity loss, migration and extinction of species, changes in the landscape, wind erosion, increasing risk of forest fires, and consequences for fisheries are threatened. The transportation sector is also vulnerable due to the reduced carriage and navigation on rivers and lakes, tourism due to the loss of recreational areas, lower tourism revenues and reduced tax revenue.

VULNERABLE GROUPS

Increased frequency of droughts in some regions may lead to land degradation; damage crops or reduce yields; reduce the number of livestock due to death and increase the risk of wildfires. Such conditions would represent an increased risk to the population engaged in subsistence agriculture, because of the shortage of food and water, therefore increasing the risks of malnutrition and poor health associated with lack of food and water. All this can cause migration, and impact of the social life of both rural and urban communities.

[4] Information retrieved from http://kapital.kz/economic/621/soyuz-fermerov-prosit-vvesti-rezhim-chs.html.

[5] Information retrieved from http://kapital.kz/economic/621/soyuz-fermerov-prosit-vvesti-rezhim-chs.html.

VULNERABLE AREAS

Kazakhstan has eight major water basins. An assessment of the vulnerability to climate change indicated that the most vulnerable were Almaty, South Kazakhstan, North Kazakhstan and Zhambyl regions.[6]

4.1.2 Kyrgyzstan

VULNERABLE SECTORS

No specific studies were conducted in Kyrgyzstan to assess drought vulnerability. Nevertheless, the evidence that is available suggests that the most vulnerable sector of the economy is agriculture. It produces food products and raw materials for the processing industry. Agriculture holds one of the leading positions in the country's GDP. Table 3 denotes the share of agriculture in Kazakhstan's GDP.

TABLE 3
Share of the agriculture in the GDP of Kyrgyzstan

Country's GDP (million soms)	2007	2008	2009	2010	2011	2012*
Country's GDP	141897,7	187991,9	201222,9	220369,3	273107,8	203837,8
Agricultural GDP	38140,6	41145,7	37743,9	38564,6	49159,4	41582,9
Agriculture's share in GDP (%)	26,9	23,5	18,8	17,5	18,0	20,4

The gross agricultural output in 2009 decreased. This may be due to the 2007 and 2008 droughts with their unfavourable climatic conditions and the deterioration of the general economic situation.

The country does not have a developed information system on drought. The political and economic leadership of the country is therefore poorly informed on the impact of drought and its consequences. Therefore, a limited number of drought control measures are being implemented at country level, as well as at local level. However, the measures taken do not provide adequate technological and economic benefits.

VULNERABLE GROUPS

Drought naturally affects the economic situation of small and medium farmers. Small farmers with land holdings of up to 1 ha are particularly vulnerable. They account for 84 percent of the total number of farmers. These farmers are able to produce a limited range of products, and they often are affected not only by the adverse climatic conditions, but also by market conditions. Farmers with an average of 5-30 hectares may implement crop rotation, and can grow a bigger range of products than the smaller farms, they are less dependent on climatic effects, and less dependent on market fluctuations by growing a wide range of products. During the severe drought of 2012 some farms in the Chu province in Kyrgyzstan saw their yield decrease by 30-40 percent and the income of farms growing winter wheat decrease by an average of 30 percent.

VULNERABLE AREAS

Because of the high temperatures during the summer's growing season, the rainfall is insufficient for normal growth and development of the crops. Southern regions are

[6] Information retrieved from http://kapital.kz/economic/621/soyuz-fermerov-prosit-vvesti-rezhim-chs.html.

particularly vulnerable to drought including the Osh, Jalal-Abad, and Batken oblasts, where the average annual rainfall ranges from 180 to 450mm. The north is divided into two sectors. The most arid zones are the western and central part of Chui valley and the western part of the Issyk-Kul region where annual rainfall varies from 150-180mm to 450-550 mm. Summers are typically dry, especially the months of July and August.

At present, the country's water resources are in the process of changing to a basin managed approach. The main territorial basin authorities are listed in Table 4.

TABLE 4
The territorial basin management in Kyrgyzstan

Territorial administrative	Regions basin management	major sources of irrigation
Chui	Chui territorial basin management	Chu, Issyk-Ata, Sokuluk, Ak-Suu
Issyk-Kul region	Issyk-Kul territorial mountain river basin management	surrounding mountain ranges
Talas	Talas river basin management territorial	Talas River mountain ranges
Naryn	Naryn river basin management territorial.	Naryn River. At-Bashy, etc.
Osh region	not formed	Ak-Buura river, Kara-Darya
Jalal-Abad region	not formed	Kyzy lUnkur Sai
Batken	not formed	Isfara river
Piedmont zone	drought with SPI < -20	3-4 times per 10 years

4.1.3 Tajikistan

VULNERABLE SECTORS

According to official statistics[7], almost one-fifth of the irrigated land regularly experiences a water deficit of 35-40 percent and, hence, the severe impact is brought not just to crop production but also to other sectors of agriculture. For the period 1998-2008, the area of irrigated land declined by one fifth and the area of rainfed lands declined by one third due to poor management. The most prone areas to floods and mudslides remain the mountain slopes of Gissar, Dangara, Kulyab, Karategin, Vakhsh, Darvaz, Yazgulem, and the eastern part of the country. Drought and slope degradation prone areas include the Asht District (Sughd Province) and the Gissar-Zerafshan zones.

Drought and desertification directly and indirectly affected wildlife diversity, and the most protected areas became almost depleted of wildlife due to repeated droughts.

The dry periods of 2001, 2003, 2008 and 2011 made the water in the reservoirs and dams drop sharply and a severe regime of water restriction was introduced all over the country, especially during the winter period of 2008 when the country was put into an emergency situation and the electricity blackout was announced in Dushanbe city.

In 2000, 2003, 2008, and 2011, the wheat harvest was down from 20-35 percent in Khatlon Region. In 2011, cereal crops failed on 139 600 ha. The low quality of seed reproduction and the availability of precipitation also contributed to the low production. Trees, mountain orchards, and vineyards were also damaged during the 2011 drought and the price of fruit was higher than in previous years. Pasture grasses were also destroyed over 135 000 ha.

[7] Information retrieved from http://kapital.kz/economic/621/soyuz-fermerov-prosit-vvesti-rezhim-chs.html.

In 2001 the Government estimated US$41.4 million damage to cereal crops and in 2011 the damage to pastures was estimated to US$18.5 million. The estimate of total damage to the agriculture sector is around US$63 million. Most of the damage to the agricultural sector was in in Khatlon, where the agricultural sector has not yet fully recovered to date. The 2011 drought impacted some 2 million people.

Irrigated agriculture was seriously affected by the drought. The water levels in the Nurek water reservoir were very low and a lack of rainfall resulted in at least a 75 percent fall in the production of wheat, barley, and rice, compared to previous years. The breadbasket for Tajikistan, the northern and southern parts of the country that provide up to 70 percent of the country grain yield, only received about 40 percent of normal rainfall. Thirty-eight percent of irrigated lands are supplied by pumps, which are increasingly expensive and technically infeasible, given the low incomes, the relatively low value of the crops, and the deterioration of the infrastructure. Most pump-supplied agricultural lands are located in Sughd Province.

VULNERABLE GROUPS

The question of vulnerable groups can be explored by examining results from a survey carried out at the District level. Several wellbeing indicators/securities (income, food, safe drinking water, housing and safety of property, and health and personal safety) account for more than 70 percent of all responses within the Tursunzade District. There are some significant differences in how males and females view the impact of the different vulnerability contexts on specific well-being indicators/securities:

- Female groups rated the impact of drought on income higher than men
- The reverse is true in terms of felt impact of price fluctuation on housing and on health
- 42 females rated impact of land use pattern on income as significant, vs. 30 males
- Regarding annual crop farming, male groups considered its impact on income to be more important than did women.

Generally, drought affected all the livelihood securities but had greatest effect on their income and food securities (Table 5).

TABLE 5
Major impacts of the drought (% households) by sectors

Districts	Wheat, barley and other cereals	Cotton, potato. Tomato, cucumber	pastures and livestock	lack of drinking water	lack of irrigation water	Orchard, gardens	No. of HH Reporting
Gissar	42%	51%	63%	37%	43%	31%	41
Dangara	52%	56%	43%	44%	36%	24%	35
Tursunzade	51%	29%	60%	41%	31%	29%	44
Shahrinav	33%	33%	49%	23%	14%	39%	45
Vahdat	36%	63%	54%	28%	42%	54%	42
Shaartuz	28%	24%	57%	55%	71%	38%	35
Total	40.3%	42.6%	54.3%	38%	39.5%	35.8%	
Number of HH	102	70	114	125	85	91	242

Source: Jamoat Resource Centres in Rabot, Vahdat, Shahrinav, Gissar, Kulyab and Shaartuz (Data obtained in January 2013).

VULNERABLE AREAS

About half of Tajikistan is classified as arid or semi-arid. In Khatlon Province desertification is increasing by 2500 ha annually. The factors that contribute to this include deforestation, pasture degradation, erosion, landslides, mining, and road construction.

The increasing extent of desertification leaves both the environment and the population more vulnerable to drought; erstwhile the soil stabilisation efforts and the measures to combat land desertification have largely been curtailed both by the local farming communities and state designated forestry agencies.

4.1.4 Turkmenistan

VULNERABLE SECTORS

Livestock farming is most vulnerable to drought, yet the welfare of the inhabitants in the desert settlements depends on it. The moisture levels for herbage in different years vary widely depending on pasture locations (Nurberdiev *et al*., 2009). The productivity of pasturelands in different years ranges from 20 to 480 kg/ha (Spivak *et al*., 2006). Such variance of productivity creates great difficulties. In the most productive year (480 kg/ha), 2 ha of pasture are required per sheep, but in extremely dry years (20-30 kg/ha) about 30 ha of pasture area is required. In order to feed in extremely dry years, a flock has to travel long distances and expend energy in doing so. When a flock goes far away from wells, it becomes difficult to provide animals with water. All these factors result in trampling pastures, increasing their degradation and creating additional anthropogenic effects to climatic desertification in dry years.

VULNERABLE GROUPS

Drought reduced river flow and water scarcity; are possible risks, which will lead to a decline in the living standard of the population working in agriculture and are the main consumers of water. The largest part of the total population of Turkmenistan lives in the Mari Province (22.7 percent). This is followed by the Dashoguz (20.9 percent) and Lebap (20.4 percent) Provinces. The share of the rural population is largest in the Mari (over 72 percent) and Dashoguz (67 percent) Provinces. By sectors, the largest proportion of employment is in agriculture (49 percent), followed by industry (14.3 percent), construction (5.6 percent), other sectors (31.2 percent). Private sector employees accounted for 38.5 percent out of the total employed population.

A survey of living standards conducted by the Asian Development Bank (Turkmenmillikhasabat, nd) has shown that 74 percent of households in the settlements are engaged in agricultural production.

Ensuring food security has been set as a goal after Turkmenistan obtained its independence, and the goal has been successfully achieved. The previously established specialisation and focus on cotton growing remains. The livestock sector is developing; by early 2004, non-public sector accounted for 94 percent of cattle population, 99 percent of poultry, 81 percent of sheep and goats, 73 percent of camels, and 67 percent of horses.

The development of a market economy has led to an active involvement not only of rural, but also of urban residents in agricultural activities (NFP, 2005). The agricultural production in personal subsidiary farms (PSF) and suburban gardens provides households with additional monetary income. From a gender perspective, the employment of women dominates in the national action plan.

VULNERABLE AREAS

The shortage of water resources is widely observed in almost all the regions except for the narrow strips of irrigated land along the middle reaches of the Amu Darya (the Lebap Province), where almost all of the areas suitable for irrigation are utilised. The Dashoguz (the Aral Sea area) and the Balkan (the Caspian Sea region) Provinces are in the greatest need of water. The deficit of surface and underground fresh water suitable for drinking and domestic purposes is caused by the uneven distribution of water resources across the country and poor water quality. Surface run-off is limited and concentrated in the southern and eastern parts of Turkmenistan. Over the rest of the area, which makes up a large part of the country, river flows are virtually non-existent. The need of water in the southern part of the country has been met to some extent through the construction of the Kara-Kum River.

Table 6 shows the percentage of people in Turkmenistan with access to quality drinking water. The availability of good quality drinking water for urban populations is good, while in most rural areas water quality is poor. The Balkan Province with enormous reserves of oil, salt, mineral wax, iodine, bromine, sodium sulphate, potassium, and magnesium, does not have sufficient water resources for a full-scale utilization of these natural resources, as well as for developing industry, agriculture, and for an adequate water supply to the population for drinking and domestic needs. Therefore, the economic development of the western region of Turkmenistan is being planned to provide additional water resources. Due to the lack of sufficient surface and groundwater sources, desalination of the Caspian Sea water remains a chief option for supplying water to remote villages.

TABLE 6
Availability of quality drinking water in Turkmenistan in 1999 (%)*

Regions	Population	
	Urban	Rural
Turkmenistan – Total	85.4	42.1
Ashgabat	98.8	-
Provinces (Velayats)		
Akhal	87.3	82.5
Balkan	81.6	30.1
Dashoguz	74.6	18.9
Lebap	79.5	36.3
Mari	78.8	44.7

Source: NAPEP, 2002 (Turkmenistan).

4.1.5 Uzbekistan

VULNERABLE SECTORS

According to various assessments (Agaltceva and Rakhmatova 2012; World Bank, 2005; Chub, 2000; Chub and Merkushkin, 2012), agriculture is the most vulnerable sector of the economy. Agriculture contributes about 17.6 percent of gross national product (GNP), around 27 percent of employment and up to 22 percent of export income. Irrigated land is 4.1 million ha, dryland farming covers 0.75 million ha and 21.6 million ha (85 percent of agricultural land area) is low productive pastures, concentrated in desert and semi-desert zones and is rather sensitive to water shortage.

Crop production almost completely depends on irrigation (cereals, barley, wheat, rice, maize, cotton, potato, vegetables). Cotton and cereals are the most important agricultural crops; but there are also significant amounts of fruits, vegetables, milk, and silk production plus household livestock. Agriculture also generates up to 70 percent of internal trade. It satisfies 90 percent of the internal demand for agricultural produce (UNDP, 2011; World Bank, 2009). Growth in agricultural production has brought along some improvement in subsistence support.

Being the main water consumer in the Aral Sea basin, Uzbekistan suffers from water shortage since approximately 80 percent of the flow of the Amu Darya and the Syr Darya rivers (and also local waterways) that supply the country's irrigation sector, take effluent in neighbouring countries, which gives birth to multiple conflicts of interest. Currently, more than 90 percent of yields are grown on irrigated lands of the country, irrigated farming already consumes more than 92 percent of total intake, and the demand for water will be increasing to promote food safety for fast growing population.

VULNERABLE GROUPS

Social assessments carried out by the World Bank (2002) and ADB (2007) note high demand from local communities for potable water quality improvement and for water for cooking and sanitary needs. All of them are forced to spend a significant share of their incomes to purchase and store potable water. In addition to monetary costs, the population bears significant social costs that are expressed in serious risks for health. Women in cities and villages are the most vulnerable inhabitants.

4.1.6 Turkey

VULNERABLE SECTORS

Agriculture is the largest water using sector (72 percent of all withdrawals) in Turkey. The main problem is the efficiency of irrigation methods. The water efficient sprinkling and drip irrigation technologies are used on only 6 percent of the total irrigation area. Potentially inefficient surface irrigation is used in the majority of fields (94 percent).

In 2008, the damage to the agricultural sector due to droughts was about US$2 million with 435 000 farmers being severely affected (MFWW, 2010). Major production losses occurred in cereals and lentil production. In the south-eastern Anatolia Region, production losses were estimated to be 90 percent for wheat and grain, and 60 percent for red lentil (MFWW, 2010).

VULNERABLE GROUPS

The main water user groups exposed to the adverse impacts of hydrological droughts include farmers, hydropower operators, urban water service providers, and industrial users.

VULNERABLE AREAS

Central Anatolia and the Aegean Region especially suffer from drought and over exploitation of water (illegal abstraction). In Turkey's Konya Basin, a combination of drought and excessive abstraction of water for agriculture has led to the drying up of a number of lakes and wetlands. Lake Tuz for example, was formerly the country's second largest body of water and visited by thousands of flamingos each summer, but has severely been reduced in size.

Konya Closed Basin (KCB) is Turkey's fourth largest river basin and is at risk from drought. The basin includes 8 cities and 39 districts. Nearly 3 million people live there and 45 percent of them are in rural areas. In 2008, 92 000 wells were identified in the Konya Basin of which 66 000 are illegal. Over 33 years, the groundwater level has fallen by 14.3 metres with 80 percent of this fall during the last 10 years. The main cities of Ankara, Istanbul, and Izmir are all dependent of fresh water storage in reservoirs.

Lake Tuz has an area of 1500 km^2, it is very shallow, and it is a terminal lake. It is the second most saline lake in the world (32.9 percent salt), after the Dead Sea. Due to

decreasing rainfall and the over use of water resources, almost half of the famous salt lake has dried out due to drought and continuous water withdrawal for irrigation. The same conditions affect Eregli Marshes and Bafa Lake. Beysehir Lake, the largest freshwater lake in Turkey, was 24m deep 25 years ago and is now less than 9m deep.

5. Drought impacts

5.1 OVERVIEW

According to World Bank (2005), when drought spread across Central Asia in 2000-2001, the impacts were severe in the agricultural and non-agricultural sectors of the economy, the environment, and among the rural population. Precipitation levels reached only 40 percent to 60 percent of normal. River flows dropped to between 35 percent and 40 percent below average levels. Irrigation water scarcity became progressively worse. Drought damaged agricultural output mostly in rainfed areas but also tail ends in irrigated areas were affected. Residents of the drought-stricken rural areas lost as much as 80 percent of their income, while poverty rates rose significantly, and malnutrition and water-related diseases became more widespread.

Region-wide droughts have also been recorded historically. They are a part of life in this area of the world and as such must be taken into account as part of the normal development planning processes, rather than treated as exceptional events. Droughts have a knock-on and cumulative effect; for example, estimates of the economically quantifiable costs of the 2000-2002 drought in Tajikistan range as high as 5 percent of GDP. Drought impacts can include conflict, migration, fires, diseases (human – such as respiratory problems and heat stroke; animal, pest infestations), drinking water quality deterioration, reduced nutrition through both absolute reduction of calorific intake and inadequate variety of minerals and vitamins, undermining ecosystems, including salinization of fields due to insufficient water to leach salts. Soils act as an important buffer and filter for both natural and anthropogenic pollutants. But once soils become excessively saline, it can become economically unviable to reverse this process. Soil health translates into agro biodiversity, and at a larger scale has regulating functions for hydrological and nutrient cycles. During droughts low vegetation cover translates into soil crusting, which in turn increases runoff, and soil erosion and reduces soil moisture.

Droughts in Central Asia have widespread impacts at the household level, as well as at the level of national and sub-national economies. Direct impacts at the household level tend to be primarily in terms of crop and livestock production and the socio-economic knock-on effects are worse where there are few alternative sources of income, which is precisely the case in the most drought exposed areas. Drought can lead to the sale of productive assets, such as reproductive animals, sale of land, of pumps; or to undermining natural capital (loss of soil fertility through wind erosion). This all increases the vulnerability of households in terms of the likely impact of future drought events, as well a general reduction in household income and welfare until assets can be rebuilt. In situations where another drought strikes before this asset base can be rebuilt, then families are set on a downward spiral of impoverishment.

In such cases, populations can turn to common resources such as state owned rangeland or forests for subsistence, which can undermine the regulating functions of the ecosystems of which the farms are part.

5.2 Drought impacts and institutions

Drought impacts may also reveal a pattern of under investment in services which would otherwise mitigate the impacts of droughts, or failures of institutions which regulate

access to resources; for example where rangelands become a 'tragedy of the commons'. Lack of knowledge about efficient water use may reflect a failure of the extension system. Both policies and institutions, as much as financial compensatory mechanisms which exist in some countries such as Kazakhstan, can help insure a productive asset base. However, these tend to be biased towards the marketable output and overlook the natural capital base and various inputs.

The technical, administrative and financial capacities have been degraded in some Central Asian countries since the Soviet period, which is a challenging environment in which to make progress; however given that drought clearly has widespread and multi-faceted impact in the region, it should be a priority issue. Unfortunately to date this has mostly been response oriented rather than by trying to identify and manage drought risk factors. Various forms of early warning, land use planning, scenario building, training, targeted extension services, market development, incentives, targeted water infrastructure rehabilitation, etc., can yield significant returns in terms of reduced drought impacts, and as such, they can pay for themselves. Where food relief is provided by either the affected country or others, which may be necessary from a humanitarian perspective, it can nevertheless distort incentives at both local and national scales.

Some of the investments have longer-term returns in terms of both financial rewards as well as drought impact, such as agricultural research for drought resistant varieties, but may nevertheless be highly cost effective. Drought risk management can benefit from local interventions such as storage facilities for inputs (including water) and outputs, as well as from general reform such as improving market access and lowering transaction costs (information, transport, competition, tenure clarity, bureaucratic obstacles, random policy changes, cost of capital and/or insurance, etc.), as with any business.

Hence prevention is cheaper than cure. This logic, however, does not necessarily translate into budget allocations in budget constrained environments or into changes in the behaviour of institutions in the context of vested interests.

Unfortunately natural hazards in the context of poor planning can actually exacerbate the impacts of drought and the missed opportunities to attenuate them. For example, poor water management and planning before a drought, concentration of investments in a value chain of highly water dependent production systems, promotion of narrow livelihood options, forms of ownership which create perverse incentives, failure of coordination across sectors, lack of public awareness, etc., are all within the realm of human control but have a significant effect in terms of the vulnerability of natural and human systems. As such, they have the potential to mediate (accentuate or attenuate) the impacts from a given exposure to a drought event.

5.3 MITIGATING DROUGHT IMPACTS

There is so much scope for the attenuation of drought impacts even in poorer Central Asia countries or areas of Turkey through changes in approach, modes of organization, incentives, awareness, and intermediation of collective self-insurance without necessarily requiring major financial resources. Linking applied research capacity to land user demand, for example, represents an institutional innovation which can help policy makers better understand the drivers of drought impacts on land users, as well as collaboratively identify options to resolve them. However this would require a shift in a culture of planning from a top-down approach using centrally maintained official information as a basis for - together with decentralizing of – decision making and budget allocation, which will be a gradual process in some countries due to the political economy.

As an intermediary or parallel step, land users can be made more risk aware with respect to the variables over which they have direct control; for example through FAO's Climate Field School, which has been piloted in several countries. The rural populations in Central Asia and elsewhere tend to have higher social capital in terms of being able to generate collective actions, which is a resource which could be mobilized where there is a minimum economic scale (for example, to rehabilitate water infrastructure). However the history of a perceived, imposed, collective organization in the region can create resistance to this idea.

The impacts in urban areas and on industries are often overlooked; they may less directly affect people and in less dramatic ways but may have higher costs to the economy, given that much of the value addition is typically carried out in urban areas (e.g., aggregation, processing, distribution, marketing, packaging, exporting). The total economic valuation would thus be a useful tool to inform rational budget allocation with respect to minimizing both the humanitarian (usually better recognized) and economic vulnerabilities in the country.

According to the World Bank (2005), the development and implementation of longer-term programs to plan for and mitigate the effects of future droughts is still at an early stage in most countries. Disaster management training and the development of natural disaster management plans have progressed, and early warning systems in Central Asia function better than before. However, systematic drought management plans still need developing; very few initiatives are directed specifically at managing and mitigating drought.

Some of the ad hoc measures implemented to mitigate drought impacts have included:

- Closing of water basins to groundwater exploitation
- Modernization of irrigation systems
- Installation of water flow metres in critical basins
- Construction of surface water storing structures
- Pricing of groundwater used in agriculture
- Raising public awareness for saving water.

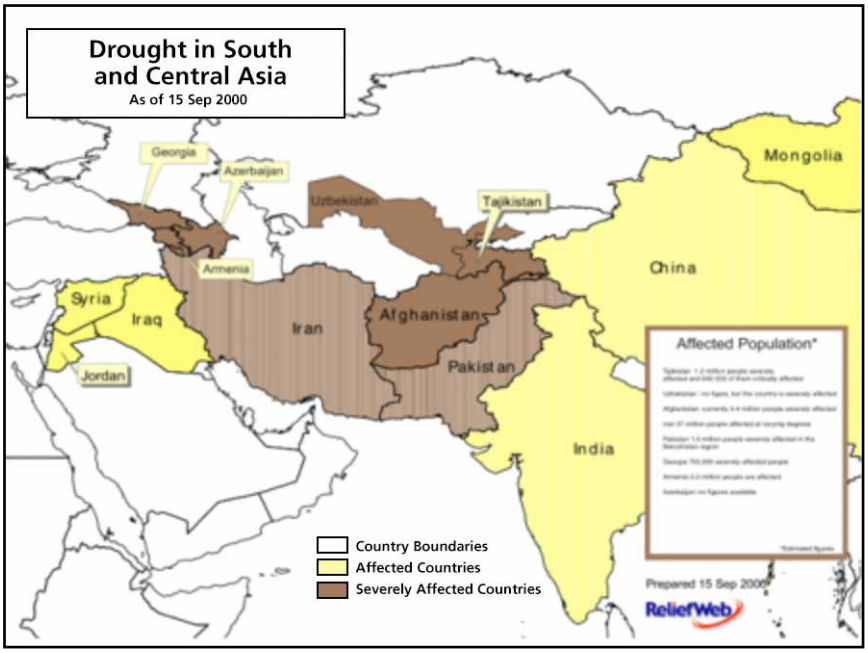
5.4 INFORMATION AND COORDINATION

The Swiss government and a number of stakeholder programs are contributing to strengthening weather forecasting and hydrological monitoring, through both national programs, and through improved coordination of information at both local and regional level. Most Central Asian countries are aiming to incorporate drought management into agricultural, rural and food security strategies, through dissemination of technologies to combat drought, and support to policy and incentive measures to use land and water resources rationally.

Most countries in the region have institutions that coordinate emergency preparedness, as well as response and recovery systems; but they need to be reinforced, with real information exchange and cooperation between agencies at central level, between local level, and with much greater community participation and support (World Bank, 2005). Figure 8 shows the countries in South and Central Asia that were affected or severely affected by the 2000-2001 droughts.

However, there is still a lack of effective and sustained implementation of the rules and administrative procedures, as well as transboundary cooperation and the implementation of international agreements on disaster risk management, in particular of drought.

FIGURE 8
Drought in south and central Asia



Source: Relief Web (2000) http://reliefweb.int/map/afghanistan/drought-south-and-central-asia-15-sep-2000.

5.4.1 Making drought visible to policy-makers

There is a need to raise awareness for capacity building for sustainable management of risks associated with droughts in order to reduce vulnerability. One approach for computing vulnerability associated with socioeconomic factors is documented by the International Water Management Institute (IWMI, 2009). The Socioeconomic Drought Vulnerability Index (SDI), measures the vulnerability of individual countries to socioeconomic drought. It is based on the crop diversity of individual countries and their dependence on agriculture for income and employment generation. It is formulated on the consideration that higher GDP contributions from non-agricultural sectors, lower percentage employment in the agricultural sector, and higher crops diversity will collectively lower a country's chances of developing socioeconomic drought when meteorological drought occurs. Three sub-indices, namely, the Income Diversity Index (IDI), the Employment Diversity Index (EDI) and the Crop Range Index (CDI), make up the composite SDI index.

5.5 COUNTRY DETAILS

In Kazakhstan, drought impacts mostly occur in the agricultural sector, making farmers with small farms the most vulnerable. Currently Kazakhstan is using early warning systems to manage risk and particularly raise awareness and inform stakeholder farmers. In Kyrgyzstan, in the years of drought, there were poor yields which resulted in high prices thus making the food insecure households the most vulnerable. To manage risk,

water management is a critical component for Kyrgyzstan in the light of both climate and socio-economic pressures. In Tajikistan, as with Kazakhstan and Kyrgyzstan, there is a loss in agricultural production from drought impacting the GDP significantly. Risk management and awareness is mainly implemented through the use of an early warning system, the hydro-met system. Similarly the agricultural sector is mostly affected during drought in Turkey, Turkmenistan and Uzbekistan. Turkey and Kyrgyzstan use water management as a critical component to manage risk. Turkmenistan. Kazakhstan, and Uzbekistan mostly use monitoring/early warning systems to manage risk.

5.5.1 Kazakhstan

BIO-PHYSICAL IMPACTS

Droughts produce a devastating effect not only on cropping but they also create problems with feed for livestock. For instance, in 2012 in the Aktobe region, of 580 000 hectares of grain crops, only 301 000 hectares were harvested. A similar situation was observed in the West Kazakhstan region. According to the estimates of the Farmers' Union of Kazakhstan, the Akmola, Kostanai and Karaganda regions lost grain crops and oil crops due to drought on over 1 million hectares.[8]

Significant risks also arise due to inadequate pasture management, making many herders vulnerable to drought. According to the Land Management Agency in Kazakhstan, about 26.6 million hectares of the country's 188.9 million hectares of pastures have severely degraded (in the steppe zones of the country, 5.6 million hectares of 34.8 million hectares, respectively) (World Bank, 2006). Due to limited mobility, neglect (lack of maintenance) of cattle watering sites and small size of herds, rangelands (distant pastures) are inaccessible whereas pastures and wells located near the settlements are overloaded. Loss of protective trees and shrubs, in particular of saxaul, led to wind erosion and degradation of pastures in the KyzylKum, MoyunKum, Sareysk and Atyrau (CACILM, 2009b). Saiga almost disappeared. The less adapted plants or weeds invaded pastures, while fodder plants are rare.

SOCIO-ECONOMIC IMPACTS

A prolonged meteorological drought, characterised by high precipitation deficit and abnormal temperatures, transforms into a hydrological (water shortage) drought, and then into agro meteorological (agricultural) drought. In aggregate, they turn into socio-economic drought and associated distress in agriculture. In Kazakhstan, according to the data of stations with multi-year time series, several such periods occurred. A good example is the 1974-1977 droughts which affected most of Kazakhstan. It was very extensive, especially harmful in the desert regions of the south, the south-west, and west. It lasted for 3 years and was accompanied by significant positive temperature anomalies in conjunction with a large deficit in rainfall which was significantly below the norm (45 percent of annual average).[9]

Drought impacts mostly occur in the agricultural sector, which has been suffering losses due to drought for 11 years of the recent 20 years (five of which were consecutive: 1994-98.). During the worst years, some farmers collected only seeds or even decided not to harvest and suffered a total loss. The drought of 1998, which destroyed almost half of the crop in most of the grain producing areas, led to deterioration in the financial status

[8] Information retrieved from http://kapital.kz/economic/621/soyuz-fermerov-prosit-vvesti-rezhim-chs.html.

[9] Information retrieved from http://kazakh-zerno.kz/index.php?option=com_content&task=view&id=21254.

of farms that have recovered slightly in 1997. Farmers with small farms were the most vulnerable. Introduction of agro-technical measures in 2001 improved the mitigation measures that reduced the impact of the drought in 2004.

At least 43 percent of the population living in the rural areas are directly or indirectly dependent on agriculture, livestock or horticulture.[10] Although the farmers are more vulnerable to drought, they are not fully prepared for the drought. Small farmers do not have enough resources for investment or adequate land parcels for the introduction of crop rotation. Loans are not accessible or available to many farmers, because loans are often disbursed late or are not disbursed at all. Insurance does not cover even catastrophic losses. Although recently many farmers have invested in improving the delivery of inputs, such as fertilisers, etc. and agricultural practices to mitigate the effects of drought, there is still significant potential for the spread of such measures (snow storages, fertilizers, land preparation, planting of elite cultivars, establishment of seed reserves, improvement of crop rotation, time optimization of crops and irrigation schedule, etc.).

A RISK MANAGEMENT APPROACH TO DROUGHT

There is potential to minimise the damage from droughts through various measures, including the use of early warning systems to inform stakeholder farmers about the risk of droughts. There is also on-going work to create a system of sustainable land management, including land use planning. Other measures include improving the supervision of irrigation and drainage systems, the protection of infrastructure from climatic impacts and the improvement of education and awareness level of the population.

Progressive ways of crop cultivation with the application of injection methods of irrigation and non-pressure drip irrigation, crop irrigation using municipal wastewater, and the use of polyethylene, which gives a significant effect of water-saving are being tested at the Kazakh National Agrarian University (KazNAU). The government is also involved in supporting the import of foreign advanced water-saving technologies (e.g., Israeli drip irrigation and other water-saving technologies in the line of the Ministry of Agriculture).

5.5.2 Kyrgyzstan

BIO-PHYSICAL IMPACTS

According to the data from various sources, including the Department of Water Resources and Land Reclamation[11], more than 3500 rivers flow within the borders of the Kyrgyz Republic. These rivers belong to the main basins of the major rivers, such as the Syr Darya, the Amu Darya, Chu, Talas, Ili, Tarim, and Lake Issyk-Kul. The country's water resources are of trans-boundary importance and play an important ecological and economic role in Central Asia.

The total annual runoff of Kyrgyzstan is about 47-50 km^3. The Kyrgyzstan Republic is using 20-25 percent of the available water resources. The rest of the flow goes to neighbouring countries: China, Kazakhstan, Tajikistan, Uzbekistan, and is subject to international water allocation. Kyrgyzstan has the right to use 24 percent of the water flow, and the country's total limit amounts to 11.9 km^3. Some 93 percent of withdrawn

[10] Information retrieved from http://kazakh-zerno.kz/index.php?option=com_content&task=view&id=21254.

[11] Information retrieved from www.water.kg Section: Irrigated agriculture; Water resources.

fresh water in 2011 was used for irrigation and agricultural water supply, 4.6 percent for domestic and drinking purposes, and only 2 percent for industrial purposes.[12]

The water sector of the Kyrgyz Republic provides 1018.7 thousand hectares of irrigated land with water, of which 106 800 hectares[13] are in an unsatisfactory condition. The total length of all the inter-farm canals is 6 500 km, of which 43 percent are lined. There are 34 reservoirs in the country. There are significant problems in the development of hydro-ameliorative facilities, such as enlarging irrigation systems, and improving irrigated land.

SOCIO-ECONOMIC IMPACTS

A strong spring and a subsequent summer drought caused great damage to agriculture in 2007, 2008, 2010, and 2011. Wheat yields significantly declined and national average at national level was to 2.03MT/ha in 2007 and 1.94MT/ha in 2008[14], as it can be seen in Table 7.

TABLE 7
Data on wheat production in Kyrgyzstan

Years	2007	2008	2009	2010	2011	2012	
						planned	actual
Cultivated area under wheat, (000 ha)	357.4	392.3	402.6	376.7	377.4	-	-
Wheat yield, MT/ha	2.03	1.94	2.63	2.17	2.14	-	-
Gross wheat output, (000 MT)	708.9	746.2	1056.7	813.3	799.8	850.0	566.2[a]
Average grain prices (000 soms/MT)	11 352	16 942	13 676	11 807	17 904	-	17 500
Wheat imports (000 MT)	358. 8	304.0	341.0	348.2	289.9	300.0	20.0**

[a] Information retrieved from the information bulletin of Kyrgyz Republic on food security and poverty Third quarter, 2012. Annual publication of National Statistical Committee, KR, 2012 Bishkek, 29August, Kyr TAG.

*data differ in various sources **as of December 2012.

A RISK MANAGEMENT APPROACH TO DROUGHT

A UNDP Project on climate risk management is being executed within the framework of the Environmental Programme for Sustainable Development. Water management is a critical component that needs to be adapted in the light of both climate and socio-economic pressures. Changes in water use will be required related to water availability, increased/decreased demand for irrigation water, as well as other competing sectors. Reducing water losses and increasing the productivity of water are important issues for meeting the competing needs of people and the environment. A projected reduction of water resources creates a need to revise the methods of irrigation water use and to enhance performance of irrigation systems through modernisation. A project on reducing water losses is being implemented in the Jalal-Abad region in southern Kyrgyzstan with the support of the Swiss Agency for International Cooperation Helvetas. Within the project, farmers are trained to implement micro-terrace building techniques, methods of collecting water to take advantage of the landscape, drip irrigation, and other methods of water-saving irrigation.

[12] Information retrieved from National Statistical Committee of the Kyrgyz Republic: Protection and sustainable use of water resources.

[13] Information retrieved from Ameliorative/ hydro-geological expedition of the Water Resources and Land Reclamation Department.

[14] Information retrieved from www.stat.kg. Section: Agriculture.

5.5.3 Tajikistan

SOCIO-ECONOMIC IMPACTS

The biggest problem facing agriculture is drought. Most of the valleys of Tajikistan are dry but there are problems of drought throughout the whole country. Table 8 illustrates the number of communities affected in Rabot Jamoat of Tursunzoda district as a result of drought.

TABLE 8
Livelihood affected by sectors in Tursunzoda district, Tajikistan

Livelihood affected	No of communities affected
Decrease in crop lands	85
Reduced Rainfall	46
Increased cereal yields and prices	7
Lack of water	63
Inadequate irrigation water	8
Inadequate pastures	36
Animal losses	4
Crop diseases	1
Irrigated crop losses	13
High Temperature	1
Inadequate drinking water	1
Seasonal employment opportunities	4

Source: Jamoat Resource Centre "Rabot", Tursunzoda district.

During the severe, prolonged drought between 2000 and 2002 the direct economic cost of the drought in terms of lost agricultural production was estimated at USUS$ 26 million (World Bank, 2005); but the actual unbound economic expenses were higher and was estimated as 5 percent of GDP (Safarov *et al*., 2006).

A Risk management approach to droughtOver the past 20 years, farmers and entrepreneurs have not received any regular warnings about pending droughts. Most farmers report that information on drought and low rainfall only comes when it is already too late. Local institution services are poor. In order to improve drought risk management, it is necessary to create services which would reliably forecast droughts. Tajik hydromet fruitfully cooperates with a number of international organizations and projects such as the UNDP Pilot Programme on Climate Resilience and Climate Risk Management. This is providing new equipment and tools; as well as updating networks to improve the forecasting and delivery systems. Tajik hydro-meteorological unit is interested in improving their capabilities to conduct seasonal forecasts and conduct analysis of longer-term impacts of drought but more support is needed to significantly improve their services.

5.5.4 Turkmenistan

BIO-PHYSICAL IMPACTS

In the national report on the implementation of the United Nations Convention on Biodiversity (2009), climatic changes (specifically autumn-winter droughts) are capable of leading to significant disproportional changes in the temperature and rainfall. The probability of extinction of species will increase (riparian trees and shrubs). The process will shift the natural animal habitat boundaries northwards. Reducing the number of water sources will reduce the population of many mammal species. Forest resources are an essential component of maintaining the environmental balance, and they have a protective function, especially in times of drought.

SOCIO-ECONOMIC IMPACTS

Shepherds and farmers have tried to adapt to drought but most livestock breeders were unprepared and they were not informed about the coming disaster in advance. As a result, the drought caused severe damage to livestock production in 2000-2001, 2005-2006, and 2008. Shepherds tried to transport their cattle to pastures for grazing in 2006, but most of them could not do so due to transportation problems. Some shepherds had to sell about 20-40 percent of sheep, 17-34 percent of goats, and 10-13 percent of camels. Thus, the livestock population was drastically reduced in dry years.

A RISK MANAGEMENT APPROACH TO DROUGHT

Turkmenistan has accumulated a significant amount of data and the necessary capacity for environmental monitoring; however there is no well-established and properly functioning system to carry out the monitoring. Information sources for drought monitoring are fragmented among various ministries and departments, and they are also lacking modern technologies. A mechanism for data sharing has yet to be developed.

5.5.5 Uzbekistan

BIO-PHYSICAL IMPACTS

Uzbekistan is highly susceptible to environmental degradation, in particular, in relation to damage to arid and semi-arid ecosystems (Box 3). Drying of the Aral Sea and the Amu Darya delta has led to the most significant ecosystems damage and the largest man-made disaster in the country. The increasing number of droughts only adds to the problems.

The yield losses of cereals during the drought from 2000-2001 were 14-17 percent; other crops averaged between 45 percent and 75 percent (Amu Darya lower reaches) (World Bank, 2005; CACILM, 2009; UNDP, 2003). Gardens and vineyards are particularly susceptible to yield decreases induced by water scarcity. Lack of water has a cascading impact on livestock productivity from the effect of lower nutritional fodder to lower weight gains in general (World Bank, 2005; CACILM, 2009; UNDP, 2003).

BOX 3

The impact of drought

Drought reduces the ability of soil to work as a buffer and filter pollutants, their role in hydrological and nitric cycles, and their ability to ensure habitat and sustain biodiversity. Loss of vegetation leads to severe soil erosion, compaction of soil structure, and loss of soil health. Drought increases salt mobilisation and accumulation in topsoil layers thus increasing land degradation. Drought reduces the availability of pasture for domestic animals and wildlife due to biomass losses that arise from a lack of water. The prolonged drought also affects the land cover thus undermining the organic matter breakdown of vegetation cover and growth of other species and biodiversity.

SOCIO-ECONOMIC IMPACTS

The analysis of drought consequences of 2000-2001 carried out by UNDP (2003) in the Karakalpakstan and Khorezm regions show that the most dramatic reductions in agricultural production took place due to insufficient planning, forecasting, and water resource control at regional, national and local levels. These measures led to a reduction of water supply for 20-30 percent regionally and 35-80 percent nationally in comparison to the approved water limit. As a consequence, about 200 000 farms (about 1 000 000 people) suffered yield reductions. According to the assessments done by the Ministry of Economy, the agricultural damage on Karakalpakstan and Khorezm was US$50 million in 2000 and US$80 million in 2001 (UNDP, 2003).

According to a regional review by Chub (2012), the losses caused by agricultural drought in 2000-2001 in Uzbekistan were US$130 million or 2.4 percent of agricultural GDP. According to other sources, the value of the damage was US$38-40 million

(World Bank, 2001). Significant losses were observed in the livestock sector. In addition to the economic damage, the drought has significant socio-economic impacts. Food stuff, portable water, assistance in agricultural inputs delivery was required for more than 600 000 people at a cost of US$19 million. Migration beyond Uzbekistan also increased (mainly from Karakalpakstan to Kazakhstan) in the search of better living conditions.

A RISK MANAGEMENT APPROACH TO DROUGHT

Several studies and assessments highlight the need and importance of improving the public awareness and knowledge of targeted groups, particularly end-users, to enhance reliable drought management and risk reduction activities (UNDP, 2003; WMO, 2011). But drought early warning systems (DEWS) and drought risk reduction programmes have not yet been developed. However, various investment projects and technical assistance programs are being implemented to improve the integrated management of water and land resources, land use planning and management based on best practices, and mitigation measures to improve livelihoods and rural development.

The approaches and experiences of the FAO "Field Farmers School" (2002-2005) in training and raising community awareness were demonstrated in the framework of the FAO project in Uzbekistan (Syr Darya and Kashkadarya) and deserve attention (UNCCD, 2011; FAO, 2002-2005). In 2005-2009, the World Bank project "Reconstruction of Irrigation and Drainage Infrastructure and Restoration of Wetlands," adapted the FAO Farmers Field School approach in South Karakalpakstan (lower reaches of Amu Darya River) for training local farmers and members of WUAs in Beruni and Turtkul Districts. Two extension/information services, the Farm Information Bureau and the Farm Information and Advisory Service, were created within the project area in South Karakalpakstan. These two services later became independent private enterprises.

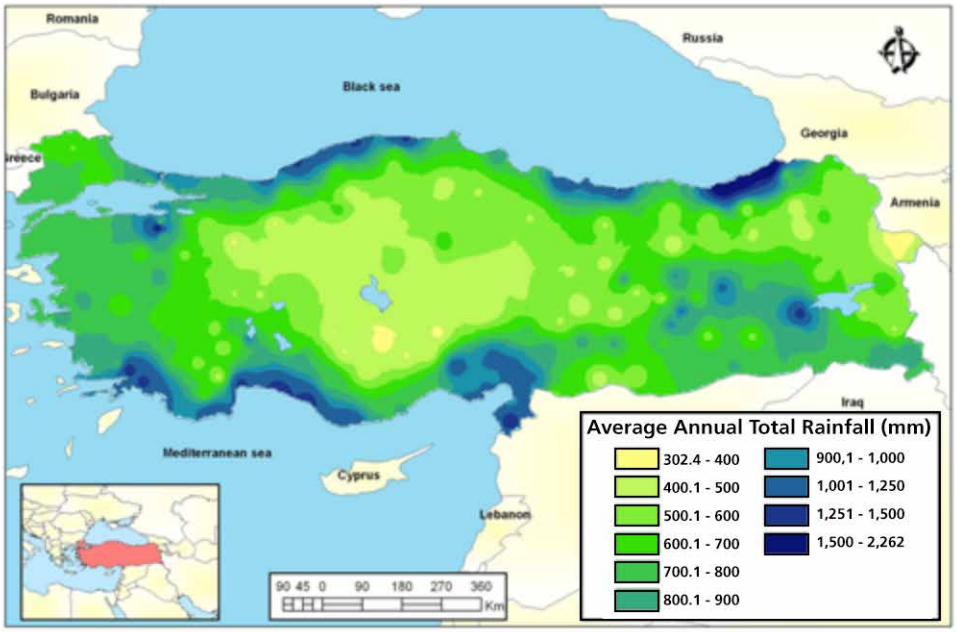
The multi-country capacity building for the sustainable land management (SLM) of Central Asian Countries Initiative for Land Management project (CACILM), 2010-2012, in collaboration with national scientists and specialists documented and selected the best practices and technologies of SLM and provided integration into the global World Overview of Conservation Approaches and Technologies (WOCAT) network (UNCCD, 2011; FAO, 2002-2005). CACILM is a comprehensive 10-year programme of projects and activities on strengthening and advancing approaches and practices of sustainable land management (SLM) and adaptation to drought. This National Programme Framework (NPF) on SLM, prepared a national country report on achievements, experience and lessons learned (NAP CCD, 2000). This was an important contribution to improving awareness and access to SLM approaches and best practices for planning and management with participation of all groups of stakeholders. Numerous assessments, conducted in various regions of the country, show that rural inhabitants (including women) have a much higher social capital than city dwellers both in terms of their relationships with one another and their attitude and willingness to cooperate. They already cooperate with management bodies at national and local levels in order to overcome the shortage of water and engage in joint activities to combat drought.

5.5.6 Turkey

BIO-PHYSICAL IMPACTS

There is a significant variation in annual rainfall across the country (figure 9) from 300mm in the Central Anatolia Region to 2250 mm along the Black Sea region.

FIGURE 9
Average annual rainfall in Turkey

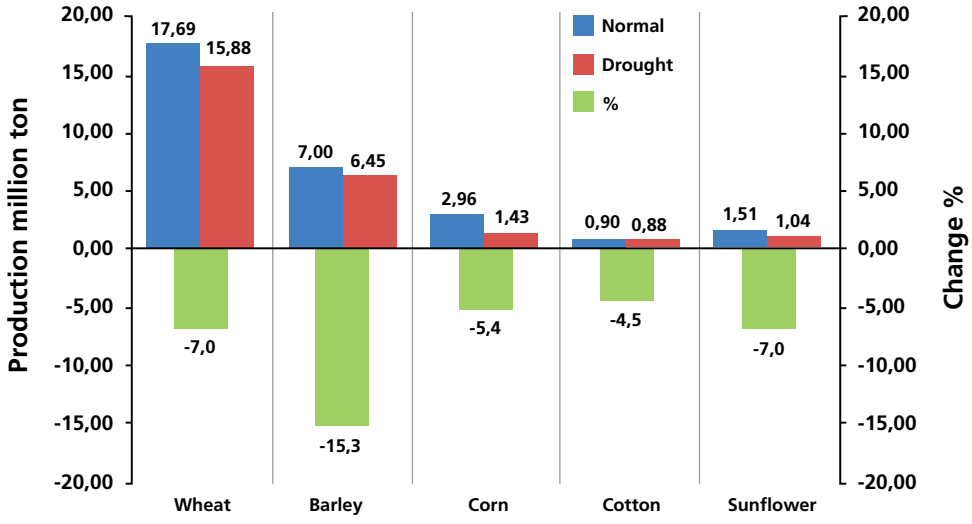


Source: Adapted from MGM bulletins, 2010.

SOCIO-ECONOMIC IMPACTS

In 2007, the production level of all crops decreased from 4.5 percent to 15.3 percent as a result of drought (figure 10).

FIGURE 10
Production changes in Turkey due to the 2007 drought



Source: Adapted from MGM bulletins, 2010.

6. Drought policies and institutions

6.1 OVERVIEW

In Central Asia, improved information sharing and an upgrading of the hydro-meteorological monitoring systems is a priority throughout the region. According to the World Bank (2005), it will be necessary to improve legislation frameworks regulating water extraction levels, water use and pollution. There is a system to manage water at basin levels under drought conditions in most central Asian countries. However, earlier and systematic information sharing would allow more effective planning and the establishment of drought mitigation measures.

6.2 TYPOLOGY OF MACRO POLICY WATER MANAGEMENT CHOICES

The drought risk policy suitable to countries in the region essentially depends on the macro policy choices made in terms of how to manage the legacy infrastructure and systems of water management and food production from the Soviet era. In those countries which have chosen to continue with a large scale centrally directed and/or managed and/or financed systems, the key policy choices relate to the efficiency of water supply through canal lining and maintenance, reduced evaporation in reservoirs, irrigation water quality etc. In addition, policies need to manage water demand as well as promote water use efficiency via pricing or other rational means of water allocation. For those countries where the centralised water management systems are no longer functional, the most pertinent policy options relate to decentralisation, and local administration (including ensuring adequate technical and financial capacity at sub national levels).

In both categories of countries policy options should be considered regarding sustainable extension services which can deliver services to promote climate smart production, with hybrid financing in the case of some countries. The question of how to identify existing drought risk management practices which could be mainstreamed, as discussed in this report for many of the countries, should also be a priority and examples of successful processes for doing so should be considered from elsewhere.

6.2.1 Sustainability as a policy factor

Ecosystem based management (as well as ecological restoration of irrigated, pasture and forest land) is an approach which is relatively new to the region and consideration should be given as to how to shift the policy approaches to more sustainable land management which takes into account a broader perspective when making decisions. There is still a legacy of centrally determined production targets of certain crops without taking into account the local factors. Demonstration projects can prove alternative, multi-benefit approaches.

There is evidence that households are increasingly dependent on government support during drought events, which indicates a decreasing resilience. However, unless a vulnerability driver model is applied to decision making, this will continue to be seen as unfortunate but unavoidable circumstances that require national and/or international

humanitarian responses. Some countries have responded by partially addressing water demand; for example with temporary measures such as prohibiting cultivation of the most water intense crops (rice; Uzbekistan). However regulatory reform is required which has a flexible but predictable provision in order to avoid disincentives and disruptions.

At a more fundamental level, the policies need to reflect an understanding that support is required along the entire value chain, including that of input and output actors; however not just for production support, but towards reducing the water dependence of added value. This would require a new way of thinking, which in turn would require new analytical tools and modes of measurement. The metrics would no longer be focused solely on rainfall and water supply (input) and crop yield (output). There have been attempts to shift decision making using economic tools, such as total economic valuation, and the potential in the context of Central Asia and Turkey should be examined. At the very least they are useful for a dialogue with policy makers by revealing variables, relationships, and unexpected monetary equivalents which can create space for new approaches.

6.2.2 Tools for policy and behavioural change

Realistically, changes in behaviour would need to be incentivised, in particular where there is no market for certain benefits, for example ecosystem health (or where there are slow and/or diffuse causal chains between actions of land users and provisioning services of the environment and/or where benefits cannot be captured by the user who changes their behaviour). There is a policy toolbox for payment for environmental services, which is versatile and has been tested under a variety of circumstances and could be much more widely used in the region at various scales and for different and/or mutually reinforcing objectives. Exchanges with policy makers who started to employ these tools to good effect would be an excellent opportunity. Other financial instruments (some of which are applied to various degrees in Central Asia and Turkey) include soft loans, loan guarantees, forgiveness of interest, reimbursement of premiums for insurance, subsidized insurance and other financial risk transfer mechanisms.

These require a certain level of financial market sophistication and penetration; however in places such as Africa technological innovations, such as banking by mobile phone, have shown that barriers are potentially low. The key factor is the proper regulation, the apolitical allocation of capital, and the financial sustainability of the larger system.

Such tools, however, cannot ultimately compensate for poor core policy decisions which may drive land users towards drought vulnerable production systems. Other policy options include trade-based solutions, which could for example allow specialisation according to comparative advantage – including water endowment – on an intra-regional and/or extra- regional basis; either through preferential trade agreements or other means of trade promotion. The concept of ‘virtual water’ posits that the cereal trade also really represents a market for water transfer, however in this case of the water ‘embedded’ in the crop. In other words the buyer has also substituted for the water which would have been required to grow that same quantity of food in their own country. Viewed from this perspective, rational water decision-making could result in a shift from certain types of production promotion to strategic trade policy.

Water should be allocated to its highest value (a combination of financial and non-financial considerations, which could vary between countries). There have been various attempts to use policy (regulatory, financial and other) tools to reorient water

use in many countries and a review of this experience as applicable to the institutional contexts in the region would be a good starting point. Ultimately this entails trade-offs between groups, sectors, outputs, populations and as such is inherently a political decision. To the degree that more perspectives inform policy the more likely a widely accepted outcome will result.

6.2.3 Trade options to rationalise spatial water endowments

There is some evidence that trade has influenced policy in the most water scarce countries in the Near East. However, due to the politics of food security, many policy makers feel obligated or responsible to ensure food security through domestic production. In the case of Central Asia, however, the fact that countries are already physically inter-dependent through transboundary natural hydrological networks and the asymmetrical distribution between water sources, population, arable land and capital, present an opportunity to rationalise regional resources and trade virtual water through policy. Indeed this is already reflected in water sharing treaties.

6.2.4 Supporting services

Irrespective of macro policy choices, there are a number of supporting services which are necessary to inform policy-making with respect to minimising drought vulnerability. These include targeted research, monitoring systems, well-coordinated relationships between parts of government and/or other actors who play a role in water management and/or drought response. Many of these systems are underfinanced, reorganized in the post-Soviet system, including some research centres which previously serviced the entire region. These need to generate not just weather and climate forecasts but vulnerability profiles by sector/population/geography which are useful for decision making at different scales. They also need to produce an actionable analysis which distinguishes between drought impacts and the drivers of those impacts. This is another area where regional and/or international cooperation could prove fruitful. In all cases, the approaches and tools must be adapted to local realities; in particular institutional modalities. Where decentralisation is occurring, decision support capacity should also be strengthened at those levels.

6.2.5 Overview of country policies relevant to DRM

The following are representative drought policies/approaches to drought risk management (DRM) in selected Central Asian countries.

6.3 COUNTRY DETAILS

6.3.1 Kazakhstan

Kazakhstan counts with a national drought planning and mitigation strategy elaborated with the participation of different stakeholders. It provides as well an effective emergency intervention response. However, according to World Bank (2005), a more effective monitoring of food reserves including warehouses, especially in the most vulnerable western areas, is needed to mitigate risks.

There have been improvements and investments in natural resources management. These include addressing desertification and pasture and forest restoration, together with improved water management. The challenge is now to involve local communities

as main stakeholders in the planning and implementation of programmes (World Bank, 2005).

The potential for minimising the damage from droughts in Kazakhstan includes an early warning system about the probability of droughts to inform stakeholder farmers about the risk of droughts. There is also on-going work to create a system of sustainable land management, including land use planning. Other measures include: improving the supervision of the state of the irrigation and drainage systems; protection of the infrastructure from climatic impacts; and improvement of education and awareness amongst the population. Progressive ways of crop cultivation include the application of injection methods of irrigation and non-pressure drip irrigation, the use of municipal wastewater, and the use of polyethylene, which gives a significant effect of water-saving are proposed and tested at the Kazakh National Agrarian University (KazNAU). There are also examples of government support measures on imports of foreign advanced water-saving technologies.

6.3.2 Kyrgyzstan

Despite not being a water scarce country, it has to conserve water in the upstream part of the region river basins. The modernisation of irrigation systems is important, as well as the development of sustainable water user associations that can manage water in an efficient way. The Ministry of Ecology and Emergencies needs to be strengthen to work with other agencies, local government and communities in the development of plans and mitigation measures. This includes rebuilding meteorological capacity in order to better forecast available water levels, but also to improve pasture management strategies and regulate electricity generation.

Since the country's independence in 1991 the government has undertaken a several measures in order to combat drought and limit its impact on food security. A legal framework was created to regulate the relations among all those involved in the use of natural resources as well as to ensure their rational use and protection. Governmental Decrees are of great importance, however these are not completely implemented. According to World Bank (2005), the Governmental Decree dated December 14, 2007; N 593 states that US$29 million shall be provided for the construction of hydraulic structures. However, in 2008-2010, only US$12.2 million (41 percent) were allocated. Other presidential and governmental decrees and resolutions have also been issued to support farmers by providing seeds, fertilisers, fuel and lubricants, soft loans, to help for timely spring sowing, harvesting, autumn sowing and other works, as well as to contribute to the drought control and mitigation. Some US$20.5 million loan was planned for farmers according to the Program on Accessible Loans to Farmers approved by the Governmental Decree of January 19, 2011, N 12. Only 50 percent of these funds were released, due to bureaucratic obstacles during the application process for credit.

In 2007 they adopted a programme on the construction of water facilities and the development of new irrigated land. Given the importance of providing agriculture with irrigated water, a new programme was developed and approved in 2011, with a view to completing the started water facilities, and introducing new irrigated agriculture.

Practitioner farmers use a variety of different methods and means to mitigate drought. Some of them have a scientific basis developed over a long period by research institutions. But some methods were inherited from their ancestors or were invented by farmers, and after proving their practicality they became part of local knowledge. They also

have a fairly wide distribution. The government through the Ministry of Agriculture, Scientific and Educational Institutions spread them through the publication of teaching materials, by organizing workshops, training, and consultations. Major work in this area is being carried out by governmental and non-governmental services for training, extension and information. Some of them are also promoted through the private sector.

The government has supported farmers during the droughts by providing seeds, fertilisers, fuel, in-kind credits, and soft loans with low interest rate. However, there was no distribution of free-of-charge foodstuff and other relief aid. The losses of farmers due to the drought were not compensated.

The State provides social assistance to those on the unemployed register in social protection institutions in line with legal regulations. However, farmers, rural residents, and members of their families, who have received irrigated agricultural land larger than 0.05 hectares and participate in the production of agricultural products, cannot be registered as unemployed in accordance with the Law On Employment Facilitation dated July 2,1998, N 113. In accordance with Art. 3 of the Law, they are considered as employed.

In mid-2008, the UN agencies concerned about the effects of the 2007-2008 harsh winter and the subsequent 2008 summer drought appealed to the World Food Programme (WFP) to conduct an assessment of food security in the country. The WFP conducted two assessments of the food security situation in October and November 2008. The survey revealed that 35 percent of households in Kyrgyzstan suffered from a low level of food security and 20 percent of them suffered from a very low level of food security. The WFP has developed a project based on these outcomes. This project is aimed at providing food to vulnerable households in the poorest regions of the country in order to meet their minimum food needs in winter and early spring and to prevent them from selling their production assets to buy foodstuff.

6.3.3 Tajikistan

Tajikistan priority actions include, besides improving early warning systems, rebalance public expenditure support and redirect policy from large-scale irrigation and cotton towards measures which conserve water in both irrigated and rain-fed land while promoting community-based watershed management measures which support these programmes (World Bank, 2005). Regarding institutional planning and response systems, the World Bank recommends that the Ministry of Emergency Situations needs to develop the capacity to work more closely with other agencies and with local governments, NGOs, and communities.

The Republic of Tajikistan does not have a national strategy on preparation for drought, but it has a National Plan for Drought Mitigation which has not yet been adopted by the government. The existing national plan on drought mitigation considers drought as dangerous along with other meteorological phenomena, such as long periods of rainfall, intense rainfall, snowfalls, squalls, dust storms, fogs, and sharp falls or rise of temperature. Overall, the national plan for drought mitigation does not propose any tangible actions or mitigation activities though it describes some responsibilities over the relevant state structures during the emergency. It does not specify the exact emergency situations and what concrete actions need to be taken in different types of emergency. When drought occurs, the Ministry of Agriculture sets up an ad-hoc Drought Management Committee which comprises various representatives of the following institutions:

- Deputy Vice Minister (Chairman)
- Ministry of Agriculture
- Ministry of Water Resources
- Tajik Agrarian Academy of Science
- Tajik Hydro-meteorological service
- Local authorities representatives (from areas affected by drought)
- Representatives of district water supply agencies (from areas affected by drought)
- Ministry of Public Health: corresponding depts.
- Representatives from Tajik Agrarian University
- Tajik Institute of Geology
- Representatives from nature protection non-government organizations
- Representatives of mass media

The experts, as part of the ad-hoc working group, evaluate the extent of the impact of drought and on this basis they make recommendations to the Deputy Prime Minister for approval of a Short Term Drought Management and Mitigation Plan. The Government may also seek help from international organizations for humanitarian aid. The proposed plan is presented to the Prime Minister and after approval within the state budget, the implementation of the envisaged short-term tasks and allocation of budgetary funds to corresponding state agencies takes place.

UNDP, the World Bank, DFID and others supporting the government are espousing a number of disaster risk management activities which are being considered as an integral part of the development process in Tajikistan. This view goes beyond implementing projects that focus on disaster warning, planning, and response capacity building and calls for an integration of disaster risk reduction (DRR) into the breath of the development process. The community is greatly benefiting from the initiated bottom-up approaches of the local planning system and addressing the issue of drought as a key element that needs to be timely monitored and recorded.

Presently, Article 3 of the law "on emergency situations of civil evacuations" from 05.06.1997 expresses the main principles of protection of population, environment, and economies under the emergence of natural and man-caused disasters. International cooperation in Tajikistan in the field of emergencies of natural character is implemented based on international (interstate, inter-government, interagency) multilateral and bilateral agreements. International organizations based on their mandates and available possibilities provide different ranges of humanitarian aid to people suffering from drought or other emergencies. So far the response to the drought was only visible on the activities implemented by the international organizations.

With the support of international projects, the State is putting its efforts into mobilising communities and identifying and implementing risk mitigation activities. The State is also promoting participatory rural appraisals and using vulnerability assessments to identify and map the risk zones.

A new system of management planning for the protection of the natural environment is being introduced. A new planning system is also being introduced in State sub-district units to improve planning based on identified priorities, such as drought, which helps to mobilise the local community. A micro-financing system is also being introduced

for agriculture and eco-agriculture, such as forestry, community forestry and other activities, which provides stimulus to the local community to apply and implement mitigation, adaptation, and development initiatives.

6.3.4 Turkmenistan

Turkmenistan has over 97 percent of its cropped area on irrigation; the priority is improved management of irrigation and drainage water through policy, rehabilitation and infrastructure improvement measures. According to the World Bank (2005), Turkmenistan also needs to concentrate some of its efforts in maintaining its marginal grasslands and preventing further erosion and desertification. More adapted crops and cropping patterns should also be introduced to improve productivity of the irrigated areas. For effective and implementable policy initiatives regarding drought management, it is important to strengthen technical capacity at various levels (i.e., local, national and regional) and within various institutions, as well as developing a well-defined national budget. The capacity building should aim at enabling institutions to develop and implement customized technical, administrative and financial tools to combat the adverse impacts of droughts and prioritize the use of human and financial resources accordingly. Box 5 shows how Turkmenistan manages the risk by sharing transboundary water resources.

BOX 5

Shared water management as a risk management tool; the case of Turkmenistan

There are international institutional mechanisms for water resources management, and these play an important potential risk management role in the greater water economy context. They include the Interstate Commission for Water Coordination in Central Asia (ICWC), the International Fund for the Aral Sea (IFAS), the Interstate Commission for Sustainable Development (ICSD), and the United Nations Regional Centre for Preventive Diplomacy for Central Asia (UNRCCA). Detailed information about them can be found in the Analytical Review of the Water Sector in Turkmenistan (UNDP, 2010).

The activities of international organizations are not diminishing. An example confirming this is the meeting held by UNRCCA on November 19, 2011, in which FAO and IFAS representatives also took part. The participants discussed "The mutually acceptable mechanism for integrated use of water resources in Central Asia through a scenario approach". After the collapse of the USSR, significant efforts were made by the ICWC to reach an agreement between Turkmenistan and Uzbekistan on the basic principles for water resource sharing. These principles were applied and thoroughly tested for many years in the joint management of the Amu Darya River water resources. Besides, a permanent agreement between Turkmenistan and Uzbekistan was signed in 1996 on equal allocation of water resources on fifty-fifty basis (Aganov, 2010). On August 07, 2012, Turkmenistan gave consent to the Convention to Protect and Use Transboundary Watercourses, which is very relevant for the country where 95% of the surface water is formed outside its borders. (Neutral Turkmenistan, http://www.turkmenistan.ru/ru/articles/37661.html). The Amu Darya River accounts for nearly 90% of the total water flow into Turkmenistan. A shortage of water in the river will immediately affect all sectors of the economy

A new Regulation regarding the State Commission for Emergency Situations (ESs) and Civil Defence (CD) under the Cabinet of Ministers (CM) of Turkmenistan was adopted on July 22, 2011. The commission operates on the basis of the Law for ESs prevention and response (1998). Also, a list of ES information categories and types was approved to be submitted by the ministries, sectoral departments, and local authorities.[15] In accordance with the document, the baseline for the determination of the extent of a damage caused by a disaster is set at US$35 000. The document also provides for setting up the Commissions for Emergency Situations in ministries, sectoral departments, local authorities and institutions under the chairmanship of a Deputy Head. In accordance with the Law of Turkmenistan on Nature Protection, adopted in 1991[16], parts of the territory, water and air space are declared as areas of emergency environmental situation.

Based on the Law on Civil Defence, adopted in 2003[17], the government, specifically the Central Authority for Civil Defence and Rescue Operations under the Ministry of Defence, takes relevant measures to protect the population, and the economically important areas and facilities from natural and man-made emergency situations (ES). The Authority also carries out activities for the prevention and response to such situations, for the arrangement and execution of all necessary measures to promptly organize assistance in case of natural disasters. The Civil Defence is organized based on the territorial-cum-production principle all over the territory of Turkmenistan. Its functions include monitoring changes in the water level of rivers and large reservoirs, the state of the environment, and warning the population about an upcoming disaster. Understandably, the problem of drought as a natural disaster, along with earthquakes or other environmental emergencies, is legally included in the activities of the ES and CD services.

Turkmenistan is a member of the Interstate Council, set up in accordance with the Agreement on Cooperation for the Prevention and Management of Natural and Man-made ESs, adopted by the Council of Heads of the Commonwealth of Independent States (CIS) Governments (Minsk, 1993). The Civil Defence (CD) Authority of Turkmenistan is open to international cooperation. For example, in 2009, the North Atlantic Treaty Organization (NATO) held a workshop on emergency civil planning, which was a contribution to the implementation of Turkmenistan's intention to create a Ministry for ESs. The International Organization of Migration in Turkmenistan, within the framework of a Project on the Enhancement of Local Capacity and Population Preparedness to Potential Disasters, organized and conducted training sessions in 2012. The objective was to strengthen the capacity of CD, to enhance planning preparedness to disasters, and to improve management capabilities in case of ES. The CD closely cooperates with the population and NGOs such as the Red Crescent Society of Turkmenistan.

Components for monitoring the state of the environment, including droughts, are included in the activities carried out by some Ministries and Departments. Table 9 shows the monitoring information sources and the institutions that provide the information.

A Law on Food Security was adopted in Turkmenistan in 2000. It identifies the main areas for the implementation of state policy to ensure food security in the country. The Law also defines the legal framework for the implementation of a citizens' right to

15 Neutral Turkmenistan, http://www.turkmenistan.ru/ru/articles/36269.html.

16 faolex.fao.org/docs/texts/tuk54028.doc.

17 Available at: faolex.fao.org/docs/texts/tuk54113.doc.

TABLE 9
Monitoring information sources in Turkmenistan

Ministries and Institutions	Monitoring information sources
National Hydro-meteorology Committee under the Cabinet of Ministers of Turkmenistan	Monitoring of the weather conditions, the hydrological regime of surface water, and agro-meteorological parametres
Research and Production Centre for Environmental Monitoring affiliated to the Ministry of Nature Protection of Turkmenistan	Monitoring of large water bodies' quality, the soil and air pollution
Land Resources Department, Ministry of Agriculture of Turkmenistan	Land monitoring
Hydro-geological Office of the "Turkmengeologiya" State-owned Corporation	Monitoring of groundwater regime and quality
"Turkmensuvylymtaslama" Institute, Ministry of Water Resources of Turkmenistan	Monitoring of hydrological and hydro-chemical groundwater regime, irrigation canals and collector-cum-drainage systems
Kaspiekokontrol Department, Ministry of Nature Protection of Turkmenistan	Monitoring of water pollution in the coastal zone of the Caspian Sea
Ministry of Nature Protection of Turkmenistan	Monitoring of the biodiversity status
"Turkmenmillihasabat" National Institute of Statistics and Information	The socio-economic situation in Turkmenistan

Source – National Framework Programme (NFP), 2005.

healthy and good nutrition. The Law on Drinking Water, adopted in 2010[18], stipulates that the water consumed by the population within limits, as approved by a Decree of the President of Turkmenistan, is supplied to the population free of charge. Drainage of sewage is also done at no direct cost to households. The relevant authorised governmental agencies, as well as local executive authorities and local self-government agencies arrange drinking water supply to the population in case of emergency situations (accidents, calamities, natural disasters and others).

The cost of potable drinking water supply to the population in case of emergency situation is covered by the State budget, local budgets, and other sources specified by the legislation.

6.3.5 Uzbekistan

Uzbekistan has largely maintained the central structure and institutional arrangements inherited from the Soviet period. In this way its hydrological and meteorological systems as well as coordination logistics remain almost intact. In the most drought prone regions such as the north there are investments programs to restore delta ecosystems and to improve drinking water supply. To have more impacting policies and institutions it is necessary first to make a policy reform, and second to perform management improvements; rehabilitating drainage and irrigation systems, community engagement in drought planning and mitigation strategies. An added focus on conservation, especially in the steppe areas and marginal lands, would also contain desertification (World Bank, 2005).

[18] Available at: faolex.fao.org/docs/texts/tuk105947.doc.

In order to mitigate the consequences of the severe drought of 2000-2001, the State undertook a number of extraordinary measures in the drought-stricken areas and allocated significant incentive and financial resources for implementation of technical interventions. In addition, the State appealed for support and help from international organizations (World Bank, 2005). The Special Committee on problems of drought in the Amu Darya river basin was created and chaired by the First Deputy of Prime Minister. The Ministry of Macroeconomics coordinated the implementation of initiatives proposed by the Committee. These included:

- Reducing water limits during vegetative season for Kashkadarya, Bukhara and Khorezm regions
- Observing instructions on irrigation methods in the conditions of water shortage by linear collaborators and irrigators of the MAWR
- Observing water use discipline
- Prohibiting rice cultivation as the most water consuming crop in some districts in 2001
- Using drainage collectors water for irrigation
- Providing farms with manual pumps for potable water and irrigation
- Carrying out repair and equip wells, rehabilitate installations for water desalinisation
- Providing delivery of potable water to remote villages.

Coordination at local level was delegated to the regional and district authorities. Local management were executing the works properly, but some of the measures were only partially executed due to a lack of inter-agency coordination, water use control, and failure in water supply.

UNDP Uzbekistan coordinated international activities aimed at mitigating the desertification and drought consequences of 2000-2001. The total operation costs for the promotion of assistance and rehabilitation of drought consequences, allocated by the donors was US$23 million (or 12.2 percent of total donor contribution for Central Asia and Caucasus) (World Bank, 2005).

Analysis shows that the most serious drought consequences were in agricultural and water management sectors and that correspondingly represents a threat for food security. However, the measures taken were not fully effective. After the drought events, farmers and dekhkans continued to use unsuitable land and water management practices which increased the vulnerability of society to drought. This, in turn, impacted incomes and increased their dependency on State support.

Since 2006, the programme of assistance to Central Asian countries has been implemented in the execution of UNCCD CACILM. In the framework of CACILM Phase 1 in Uzbekistan, national and multi-country projects were executed and they are being implemented under support of GEF, ADB, UNDP, the global mechanism (GM), and GIZ – members of the Strategic Partnership Agreement, CACILM. FAO LADA approaches and tools for assessment of land degradation and GIS mapping were introduced by the GIF/ADB/FAO SLM-IS project (CACILM, 2012; UNCCD/FAO/WMO, 2013).

Drought Early Warning Systems (DEWS), with measures for reducing the drought consequences and a strategy for fast reaction, are still at a design and development stage. This is being developed with the Ministry of Extraordinary Situations, Uzhydromet, MAWR, and other institutions. The appropriate scientific basis exists for developing

DEWS (a set of mathematical models that describes the flow formation process; a model of information database that covers a great volume of information flows on environment conditions). Box 6 below describes the main components of DEWS.

Uzhydromet has a broad observation network; methods and tools for forecasting; as well as exchange and access to information (Uzhydromet, 2008). There are databases on meteorology, hydrology, aerology, glaciers, snow covers, air pollution, and hydrochemistry. Hydro meteorological information is being stored in both electronic and hard copy forms (tables, books and magazines). The data are forwarded on a regular basis to authorities' representatives and managers of large agricultural enterprises in the form of 10-days bulletins, seasonal agro-meteorological studies, and also various forecasts of agricultural crops yields. Uzbekistan is now responsible for creating a sub-regional drought early warning system for Central Asia (CACILM, 2009).

6.3.6 Turkey

Turkey's Drought Management System (DMS) has taken drought management just as a response mechanism until recently. In-line with the climatic changes and associated impacts on natural resources, the government institutions have taken into consideration the risk reduction, mitigation and preparedness as important as the response itself.

Turkey has only recently introduced risk management policies and practices and a Drought Management System (DMS). Turkey's policy and practice agenda are presented in an integrated manner by highlighting some of the new policies and practices, which are considered to be risk management oriented. It is important to note that all of these policy initiatives have yet to be to be enacted in a comprehensive national policy setting to provide a coordinated and integrated approach to managing the implications of drought, in the context of a risk management setting. These policy initiatives are expected to address some of the following critical issues:

BOX 6

Drought Early Warning System (DEWS) Components

DEWS is the tool for the assessment, monitoring, prevention, notification and decision making supported by a necessary information platform. The task of DEWS is to provide in advance all interested layers of population with information on the probability of drought. DEWS compose 4 main components:

(i) Data monitoring and analysis – this component is aimed at the assessment of completeness of existing systems for hydrometeorological monitoring, IT development and warning about drought.

(ii) Risk assessment – includes the characteristics of threat, its probability, intensity, and territorial distribution, and assessment of social, economic and ecological consequences.

(iii) Distribution of information and communication – the objective of the component is in preparation and operative submission of the information on potential impacts to all interested parties.

(iv) Potential of reaction – assistance to elaboration and testing of programs on promotion of population readiness and implementation of possible options of measures aimed at reduction of damage.

Source: UNDP CRM Project (2012).

- Emphasise Preparedness – The policy must move the country away from the costly, ad-hoc, and response-oriented approach to drought, and toward a more pro-active approach focused on preparation and planning.
- Improve Delivery of Drought Programmes – The policy should designate a lead federal agency for drought, and it should delineate the roles and responsibilities for coordinating and integrating federal drought assistance programs to ensure the improved and timely delivery of such programmes.
- Facilitate Drought Preparedness Planning – The policy should encourage drought preparedness planning at all levels, including watersheds, and as droughts emerge focus federal funding on the implementation of the preparedness plans in order to proactively mitigate the drought's impacts.
- Improve Forecasting and Monitoring - The policy should coordinate and integrate a variety of observations, analysis techniques and forecasting methods in a system that would support drought assessment and decision-making at the lowest geopolitical level possible. The improved characterization of current drought conditions and forecasting of future droughts should provide a better basis to "trigger" the implementation of preparedness plans and associated drought assistance at the local level.

What is important is that contrary to obtaining short term benefits or to get rid of threats, the risks of climate change must be taken into account from the start in the framework of policy programs through a "proactive/anticipatory adaptation" approach as part of a risk management approach. These are issues which will be structured in the mid- to long-term horizon in Turkey.

Table 10 shows the legislative arrangements in Turkey for combating effects of climate change.

BENEFICIARIES AND IMPACTS

The main beneficiaries are local stakeholders which are coordinated through administrations serving as public organizations to manage and maintain respective local resources in coordination with the national institutions. The local administrations in Turkey are Governorates, Municipalities, Metropolitan Municipalities, Special Provincial Administration, District (town) Administration and Village Administration. The members of the Provincial Municipal Councils and Councils of Elders, mayors and village headmen, are elected by local representatives.

The local Administrations have important responsibilities for supporting the local beneficiaries who benefit from the outcomes of government policy initiatives by delivering public services to the public, cooperating with central state administrative bodies in order to improve and increase public welfare in all cases, as well as the sustainable use of lands and other resources.

The Special Provincial Administration has the authority to evaluate and enhance different regulations on areas such as soil protection, prevention of erosion, education, health, agriculture, industry and trade, etc. The local impacts are also supported by most of the Civil Society Organizations, which are driven by its volunteer members. However, there are some foundations with different statuses. One of them is the 'cooperatives'. In particular, cooperatives and unions, organized in the areas of agriculture and forestry, participate actively in the implementation and the monitoring of policy initiatives set by the government institutions.

TABLE 10
Legislative setting

Category	Legal arrangements on adaptation
Natural Disaster Risk Management	Law on the Organization and Responsibilities of the Disaster and Emergency Management Department; Law No. 5902
	Law on Measures to be Employed and Aid to be Provided In Case of Disasters Affecting General
	Living Conditions Law No. 7269;
	Coast Law; Law No. 3621
Protection of Biodiversity	Environment Law; Law No. 2872
	Forest Law; Law No. 6831. Regulation on the Execution of the Forest Cadastre Activities on the Basis of the Forest Law No. 6831 (15.07.2004) and Law to Promote Tourism; Law No. 2634
	Law on Hunting on Land; Law No. (4915);
	Forest Management Regulation (05.02.2008)
	National Parks Law; Law No. (2873);
	Law on Measures to be Employed and Aid to be Provided In Case of Disasters Affecting General Living Conditions Law No. 7269;
	Agriculture Law; Law No. (5488)
	Pasture Law; Law No. (4342);
	Law on Seeds; Law No. (5553)
Water Safety and Security	Environment Law; Law No. (2872);
	Environmental Impact Analysis (EIA) Regulation
	Regulation on the Protection of Wetlands (17.05.2005);
	Water Pollution Control Regulation (31.12.2004)
	Development Law; Law No. (3194);
	Law on the Use of Renewable Resources for Electricity Generation; Law No. (5346)
Food Safety and Security	Law on the Amendment and the Ratification of the Amended Decree Law on Food Production, Consumption and Inspection; Law No. (5179);
	Bio security Law; Law No. (5977)
	Agriculture Law; Law No. (5488) and Agricultural Catchments Regulation (07.09.2010)

Source: Turkey's National Climate Change Action Plan (Source: MEU, 2011).

Overall there is lack of guiding documents, strategies, training programmes, and participation plans, especially targeting women. All of this would improve society's recognition and the understanding of the danger of drought; and advantages and necessity for DEWS to reduce vulnerability. This currently limits the possibilities for the consistent and harmonious integration of management principles and plans of readiness to drought into national programs and joint action plans for all regions, population groups and sectors of economy.

7. Drought practices

7.1 OVERVIEW

Institutions of the region are not properly prepared for disasters such as droughts, despite having learnt and gained significant capacity from the severe drought in 2001. However, mitigation and recovery is gaining more importance than relief, but the lack of funding, preparedness and coordination are limiting factors. Furthermore, regional cooperation in information exchange, forecasting, early warning, and capacity building are required. In the past and current natural disaster plans not enough attention is paid to disasters such as droughts, without vulnerability and capacity assessment, strategy, planning, and capacity building directed specifically at strengthening drought management and mitigation. Across the region there have been investments in soil and water conservation techniques, but not necessarily very good monitoring/reporting of the results nor replication and dissemination of successful approaches (WMO, 2005).

Extension support is also needed at the farm level. After the Soviet system collapse the basic extension support system was not available anymore or scarce. It is known that sustainable agricultural practices can also reduce drought risk, hence there are possible synergies. At political level, there is a need to discuss budget allocation priorities. Since a high percentage of the population and the GDP are directly or indirectly related to agriculture, this should be a priority.

7.1.1 Institutionalising good practices

In parallel, the practices being tested and or considered need to be systematised within a land use planning framework which goes beyond the current suitability for crops; which takes into account climate and market scenarios, and which is considered together with possible investments in market access or other dimensions of rural development. Land use planning is also useful to scientifically demarcate between the areas suitable for agriculture, pastoralism, forestry etc., or for mixed use, and upon which rational regulatory regimes can be established. The land tenure issues are a consideration in the region, in particular access to state land (often considered common property and/or with usufruct rights by local populations). This can have considerable incentive or disincentive effects on sustainable land management practices, which in turn forms the basis of addressing drought vulnerability in rural areas.

Where possible, traditional DRM strategies should be built upon; as these are likely to have been most strongly retained in the pastoral systems. Traditional DRM options include migration, tenure reciprocity, strategic small water infrastructure along routes of transhumance, veterinary services, relationships with relatives or kin in market centres for credit and sales services, self and mutual insurance practices, etc. In some States, land users are reverting to these systems; but they may be trapped between a partly functioning tradition and partly functional state sponsored systems. While a challenge, this also opens up space for new and demand-driven, participatory approaches. This is already taking place in countries like Tajikistan, where there is a more diverse set of development actors.

Among better resourced countries, there are programs of water infrastructure rehabilitation and/or construction; for example Kazakhstan plans over the period 2013

– 2020 to drill 22 000 wells in rangelands. Experience from rangelands elsewhere shows that if permanent water infrastructure is put in place in rangelands outside of a process which promotes mobility, then there tends to be significant overgrazing around these points. Hence water management is also part of the bigger picture of sustainable livelihoods, based on both an understanding of ecosystems and income needs.

There is a common experience in the region of partial implementation of government decrees in the area of rural development, which is more important during the drought years in terms of impacts on land/water users. One solution would be to simplify the processes and experiences from the public service reforms from elsewhere. Although seemingly distant from the issue of on-the-ground practices, the dynamics in the region mean that the bureaucratic processes and inter-institutional dynamics can critically mediate whether the good practices get mainstreamed and hence, are really effective at a national scale.

7.1.2 Linking DRM practices, planning, and policy

An example of a project which has the potential for national benefits is one on seed production in Kyrgyzstan which was linked to the creation of a national register of approved seeds. This activity could also be built upon as part of a drought risk management programme by identifying and testing drought resistant varieties that are potentially suitable to local conditions. Similarly, shelterbelts to shield fields from desiccating winds are being planted in various countries. They would have a greater effect if incorporated into drought master plans that are based on systematic land use planning in order to know which practices represent the best investment of scarce funds in given areas.

There has been a shift in the approach taking place in some countries in the region. For example, in Tajikistan, the concept of joint forest management was piloted via several projects, and once proven it was mainstreamed into the Forest Code and Law in 2011 and 2012 respectively. In spite of all this progress, operational DRM type strategies, programmes, and similar planning processes are relatively rare in spite of the manifest importance of drought in the region and the apparent trend of increasing drought vulnerability. However, Turkey's TADAP is an exception in being relatively well developed and which is explained in more detail elsewhere in this report. Peer learning should be facilitated to assess the applicability of this sort of experience to other countries in the Turkic speaking world. One challenge is that the natural units such as watersheds, which are the basis for analysis with the TADAP, do not necessarily correspond to administrative units through which resources are allocated and decisions made, especially where decentralization is taking place. It is also important when thinking about DRM planning units not to overlook urban and industrial water users, who may represent a disproportionate amount of value-addition to a unit input of water. Water use efficiency is being promoted in these spheres in particular in Turkmenistan, with more details provided in the country section below.

7.2 COUNTRY DETAILS

7.2.1 Kazakhstan

The development of an efficient system of managing drought risks is extremely important. Analysis of the major trends and events in this area reveals that it requires a systematic approach and appropriate support of the State. The study of long-term

institutional arrangements shows that sustainable free information is essential to ensure timely hydro-meteorological information for the purpose of studying the patterns of drought and the development of methods for early, mid-and long-term prevention. Kazhydromet is the only institution with access to such information. To improve the efficiency of research in this area, it would be best to bring these scientific topics into a competitive environment, with free access to primary hydro-meteorological information.

Areas requiring urgent attention are improving the education and the training of specialists and interested target groups (farmers, businessmen, etc.). Important also is the resolution of the legal and institutional framework to ensure free access to primary hydro-meteorological information. The tools and methodologies for early warning and decision support for drought preparedness planning and policy development are also needed. All this should be integrated into a National Program to Combat Drought.

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

The construction and operation of water storage reservoirs are an effective drought mitigation measure. Currently most reservoirs are in private ownership and the effectiveness of their operation is significantly reduced. In Soviet times, the Bortagayskiy reservoir and the Big Almaty channel were built to address water supply issues in the foothill areas of Zailiysky Alatau. However, these measures have not yet led to a significant increase in crop yields because of poor water management practices.

In some areas groundwater is used to mitigate drought. A network of artesian wells was created in the Soviet period, but large areas are now in private ownership. Consequently, the effectiveness of this very valuable water for agricultural irrigation in the drought period has decreased significantly.

MEASURES AND PRACTICES APPLIED BY LAND USERS

The main occupation of the indigenous population in Kazakhstan was livestock breeding. Nomadic cattle production served as a countermeasure to the summer heat and drought and shepherds moved herds to mountain and foothill areas, and to rangelands, i.e. nomadic migration was used.

Traditional methods of conservation and the subsequent distribution of fodder were used by nomadic herders. The areas naturally protected from strong winds were used as winter grazing pastures, while in summer areas with abundant vegetation and a good water supply were used. Nomadic livestock systems largely based on use of rangelands also included the observance of pasture rotation, which dates back over three thousand years and has never led to the degradation of rangelands, even with the greatest number of livestock – cattle, sheep, goats, horses and camels.[19] Kazakhs were bringing cattle to water sites during migrations; depending on the location these were rivers, lakes, swamps, dug wells, or wells dug by people, and hollows and ravines that collected spring water.

Traditional rainfed crop production knowledge has also helped to mitigate the drought in some regions. Especially in the mountains and foothills, crops were sown prior to or during the rainy seasons, i.e. without irrigation. In this case they were using primitive methods of cultivation and producing mainly grain crops and legumes or forage crops, which were resilient to drought similar to wild plants. Preference was given mainly to

[19] Second National Communication of the Republic of Kazakhstan of the Conference of Parties to the Framework UN Convention on Climate Change. - Astana, 2009. – p. 192.

the slopes facing to the north and west, because the soils on such slopes stay moist for a longer period. Also altitude above sea level was taken into account. The higher the planting the more moisture was available and so the yields were greater.

MAINSTREAMING INTO SUPPORTING INSTITUTIONS

By order of the President of Kazakhstan, in the period from 2013 to 2020, irrigation will be provided to 8 000 000 hectares. The State has allocated about US$14.3 million to undertake this work. Also 22 000 wells will be drilled in the pastures/rangelands by 2020.[20]

To provide assistance to farms, which suffered losses due to the drought in 2012, the government allocated US$11.7 million. Additionally, the government plans to allocate additional subsidies to commodities producers for breeding (pedigree stock) so that farmers can buy forage and avoid loss of their breeding stock. Another form of support to farmers is deferral of debt repayment for agricultural commodities producers who suffered from the effects of drought. They will also be reimbursed part of their insurance premiums paid.

7.2.2 Kyrgyzstan

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

The governmental decrees are of great importance, but in some cases the objectives set in these documents are only partially implemented. For example, the Governmental Decree dated December 14, 2007; N 593 states that US$30 million shall be provided for the construction of hydraulic structures. However, between 2008 and 2010 only US$12.4 million (42 percent) was allocated. Plans were made to lend US$20.6 million to the Program on Accessible Loans to farmers approved by the Governmental Decree of January 19, 2011, N 12., but only 50 percent of the funds were released.

The Ministry of Agriculture publishes a "Register of crop varieties and hybrids" approved for use. High-yield varieties and hybrid grain and forage crops most adapted to arid conditions have traditionally been included in the register. A project to support seed production, the objective of which was the development of a seed industry, was implemented in 1998 to 2008 with the support of the Swedish International Cooperation Agency (SIDA). Financial and material assistance was provided within the framework of the Project such as the training of specialists, the installation of equipment for the department of cereals breeding and seed production in the Institute of Agriculture. The State Seed Inspectorate imported cereal seeds for variety trials with subsequent release for use in the country.

Despite some positive outcomes, the project did not fully achieve its main goal, i.e. the creation of a primary seed production industry. The project activities were limited to the import of higher reproductions of seeds with the aim of further propagation. These varieties were included in the Register; but the mass reproduction of seeds was not enough to meet the needs of farmers.

A number of international organizations and NGOs carried out activities on climate change and its impact on households and agriculture. A UNDP Project on Climate Risk Management in Kyrgyzstan is being executed within the framework of the Environmental Programme for Sustainable Development in Kyrgyzstan.

[20] Summary of Statement the Minister of Agriculture, A. Mamytbekov to the presentation of a new development program for agriculture in the years 2013-2020 The official Internet resource Ministrerstva of Agriculture RK.

The Civil Society Fund SAMR Ala-Too is actively working to provide training, development, dissemination, and the implementation of soil and water conservation technologies (SWC technologies) in order to improve the living standards of people in the mountainous areas. About 80 SWC technologies (Bishkek, 2007) were described with the active collaboration of the Kyrgyz Agrarian University, the Geography Institute of Kazakhstan, and the Soil Science Institute of Tajikistan. Most of these technologies were invented by farmers, some are inherited from their ancestors (local knowledge), or gathered from literature, local extension officials or neighbours.

A project on the efficient use of water is being implemented in the Jalal-Abad region in southern Kyrgyzstan with the support of the Swiss Agency for International Cooperation Helvetas. Farmers are trained to implement micro-terrace building, collect water by taking advantage of the landscape, drip irrigation, and other methods of water-saving irrigation. The project published electronic teaching materials on irrigation (Jooshev et. al, 2012) in the Kyrgyz language and irrigation guidelines (Pluss, 2012b).

MEASURES AND PRACTICES APPLIED BY LAND USERS

Practitioner farmers use a variety of methods and means to mitigate the effects of drought. The government through the Ministry of Agriculture, Scientific and Educational Institutions spread them through the publication of teaching materials, by organizing workshops, training, and consultations. Work in this area is being carried out by governmental and non-governmental services for training, extension and information. Some of them are promoted through the private sector. A list of such measures and methods is provided in Table 11.

TABLE 11
The territorial basin management in Kyrgyzstan

Measures and methods	Supporting agencies	Support method	Knowledge
Lending	Governmental	Issuance of affordable loans	-
Construction of hydraulic structures	Governmental	Governmental funding	-
Delivery of irrigation water	Governmental	Supply through state irrigation network	-
Terracing of slopes	Non-governmental, private	Publication, training, extension	Traditional scientific
Strip farming on slopes	Non-governmental, private	Publication, training, extension	Traditional scientific
Fallow cultivation	Governmental, non-governmental, private	Publication, training, extension	Traditional scientific
Minimum and zero tillage	Non-governmental, private	Training, extension, provision of equipment and services	Traditional scientific
Early spring harrowing of fallow	Non-governmental, private	Training, extension	Traditional scientific
Innovative irrigation methods* (32 innovative methods are described)	Non-governmental	Training, extension, provision of equipment and services	Traditional scientific
Overhead and drip irrigation	Non-governmental, private	Training, extension, provision of equipment and services	Traditional scientific
Mixing manure with irrigation water	Non-governmental, private	Training, extension	Traditional local
Organic fertilizers application	Governmental, non-governmental, private	Training, extension	Traditional scientific
Mulching	Governmental, non-governmental, private	Training, extension	Traditional scientific

It should be noted that except for the State programmes, the government does not fund any other activity specified in Table 11. They rarely provide equipment, such as drip irrigation systems. Private companies, such as "Eurasia Group", provide paid services on minimum and zero tillage.

7.2.3 Tajikistan

Tajikistan's national drought management plan has very few scattered organizational roles and responsibilities for natural disasters. Since 2003, the Ministry of Land Reclamation and Water Resources is developing a National Plan of Integrated Water Resources Management and Water Saving. The latest edition was published in 2011. In spite of this, Tajikistan remains vulnerable to droughts. Its implementation partly depends on the capacity of integrating drought management with natural disaster management. This, in its turn means significant work to coordinate donor agencies working in Tajikistan as well as resource mobilisation.

A Strategy on drought management must be based on four principles:

- Integration of drought management mitigation measures into a State development programme including an agrarian reform programme
- Strengthening hydro-meteorological monitoring, forecasting, and systems of early notification
- Development systems to respond in a coordinated manner to reconstruction under emergency cases
- Development of long-term forecasting and strategies for mitigating the effects of climate change.

Taking into consideration ineffective management and irrational water resources use in Tajikistan, the structural vulnerability of water management system to drought might be reduced, by introducing demand management. Measures available to reduce water demand include:

- Integrating water using sectors, including land management, agriculture, hydro-power engineering, and fish farming into a basin management system
- Creating Basin Councils in the five water-management main basins
- Introducing incentive systems which encourage effective water consumption
- Cancelling subsidies and reducing the support programmes for cultivating water intensive crops
- Promoting the use of methods and technologies of sustainable water conservation
- Transferring the management of former inter-farm irrigation and drainage systems to communities supported by Water User Association development and grants for equipment and modernisation
- Creating integrated contingency plans for water shortages, focusing upon areas most vulnerable to hydrological, agricultural, and socioeconomic drought, especially drought-prone districts within the Khatlon and Sughd Provinces
- Realigning water allocation and distribution priorities among crops (notably cotton) and various types of farm production systems (notably production cooperatives)
- Rehabilitating infrastructure in a manner that is in line with the budgetary

constraints, appropriate for evolving conditions in agriculture, and effective in mitigating drought

- Increasing attention given to conjunctive use of surface and ground water.

Several measures can be part of the actions in the national drought management and mitigation plan:

- Place adequate emphasis on crop and water management on highly vulnerable rainfed cropland
- Spread the experience of establishing shelterbelts in areas affected by hot summer winds (Gharm, Shahrituz, Faizabad and almost whole regions of Sugd province)
- Support the establishment of a national agricultural extension services.
- Improve crop varieties including a strain of wheat that is suitable for both winter and spring seasons.

For timely and efficient response, a better coordination is required between the Ministry of Emergencies, Ministry of Agriculture, Committee for Environmental Protection and TajHydromet, local governments, and NGOs. A coordination and communication action plan should be developed and be part of the national drought management and mitigation plan.

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

As the result of several years of severe drought, the government has started to pay more attention to the environment and has mainstreamed agrarian reform. It allocates more financing to the sustainable development of agriculture which will withstand drought. Presently, the state structure focuses on managing disasters and does not address drought mitigation and resilience. Local institutions lack sufficient capacities and knowledge to keep end land users aware of natural disasters. Most drought mitigation activities are undertaken by international organizations that are shifting from emergency to transitional recovery programmes and delivery activities, such as food for work programmes which introduce self-assurance.

The Parliament of Tajikistan in cooperation with several different international organizations has prepared a new law on pastures to support the effective management of pasture land resources. This was enacted by Parliament on 26 of December 2012. It provides a new legislative framework for the transition from the unplanned and unregulated use of pasture resources to the implementation of systems that ensure their sustainable use by pasture users associations and other legal entities.

Box 7 provides a few examples on how institutions in Tajikistan successfully managed drought risk by taking appropriate measures.

MEASURES AND PRACTICES APPLIED BY LAND USERS

To decrease drought impact, many farms are using crop varieties adapted to the local conditions (local varieties); introducing crop rotations optimal for the region water-saving technologies; leaving crop residues and stubble on the soil surface; using minimum mechanical soil cultivation; substituting mechanical cultivation for chemicals; sowing the crop to take full advantage of rainfall; controlling weeds; and applying mineral fertilisers.

Linking national and local institutions is necessary to successfully address drought risks; this could be done by education as illustrated in Box 8.

BOX 7

Institutional innovations in drought risk management

In order to improve the enabling environment at institutional levels and to mainstream drought mitigation and management policies at the local sub district administrative levels, the local Non-governmental institutions (i.e., Centre for Climate Change and Disaster Preventions) supported the provision of on-the-job trainings for local state officials on the integration of drought management principles into regulatory development and operational planning. This has helped to organize working meetings with the certain Jamoats at the Gissar, Shahrinav and Tursunzade Districts on the incorporation of drought mitigation and management best practices into planning processes, which has been well supported by the sub district units and the topic was well lobbied at the Central District Governmental level for funding.

The success of such an example was ensured due to preparedness of the community to justify their choice and grounded evidences that they were able to present to the attention of the institutions both at the state and nongovernmental organizations for further consideration and response to be mainstreamed into an institutional action plan. Such examples are now being replicated in other neighbouring state sub district units of Tajikistan (UNDP, 2012).

Another example is that, in close cooperation with the UNDP Tajikistan, Multi-Country Capacity Building under the Central Asian Countries Initiative for Land Management project, an inter-ministerial task force was established to review the legislation, develop normative and regulatory acts related to sustainable forest and pasture, and prepare a list of bylaws and rules to support the implementation of the new forestry code. Such a multilateral working group has never been practiced before.

BOX 8

Education as a link between national and local institutional scales for drought risk management

One of the capacity development approaches of the international development projects was through involvement of the educational institutions of Tajikistan, like the Tajik Agrarian University, in pursuing successful knowledge management and dissemination. Drawing upon the extensive national profiles, the experience and knowledge gained through a different development project resulted in the establishment of the field farmers' school and integrating the sustainable land management practices that are able to respond to different climatic conditions, such as drought or rain fed farming, into a university curriculum. Providing an arena of those and other universities with farmer groups and community based organizations on a regular basis, (e.g., through targeted vocational trainings for farmers and farmer field schools, herders, and livestock breeders) and ensuring a better integration in development and policy networks via establishment of cross cutting feedback system, they were able to provide useful services to key national stakeholders at the local levels, while keeping the educational system up to date with emerging environmental issues such as drought and different climatic trends. This enabled the establishment of an effective hub for knowledge that keeps alive the policymaking and the resolution of emerging environmental problems in the long-run.

In order to achieve the successful outcomes, consultations have been structured in order that different layers of the community can have their say in group discussions. The approach employed within the bilateral approaches of the GIZ an UNDP projects proved successful and can be used to inform other community consultation processes in the region. In addition to the formal processes, a social network of partners has facilitated work with the local environmental NGOs from different levels.

Local government capacities have been strengthened to drive and enable the implementation process. The local planning strategies were integrated in four state sub districts, Gissar, Shanhrinav, Tursunzade, and Vahdat. The GIZ forest and pasture sector reform programmes, in cooperation with UNDP projects in Tajikistan, helped strengthen the capacities of local government officials to facilitate and enable management to respond to participatory land use planning, agricultural innovation, development of alternative livelihoods, and resource mobilisation.

It was well known that local planning is a process that requires facilitation, in addition to formal technical support. Community-based organizations were engaged in pilot-testing this new approach. International projects supported operationalising and up-scaling this integrated approach through targeted training for local community leaders and government officials.

EFFECTIVENESS OF MEASURES AND PRACTICES

Some of the best practices have improved the livelihood of more than 3 200 communities in the forestry sector and more than 4 000 households in the pasture sector.[21] Due to effectiveness of these activities they are now consolidated in different state programmes and legislations. For example, the principles of joint forest management, which allows the community to sign a trilateral agreement with the local forestry agency, the local State sub-district units, and the community based council at the neighbourhood level, can regulate the sustainable use of the forest lands. Here the role of the State sub district unit is to secure the land tenure and the forestry agency's role is to support the community to implement the management plan and provide technical assistance for the sustainable management of the forest lands.

Joint forest users are using practical nursery development activities such as mulching to ensure the sustainability of the forestry sector.

MAINSTREAMING INTO SUPPORTING INSTITUTIONS

The connection between farmers and the research community is still not very well established and the connection between farmers between the regions is not well organized. This needs to be improved to exchange experiences of different practices and methods of drought mitigation.

7.2.4 Turkmenistan

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

The industry comprises power plants, oil and gas production, oil refining, chemical and petrochemical sectors, mechanical engineering and metal-working sectors, facilities producing construction materials, and light and food industries. The natural and climatic conditions are favourable for the use of alternative energy sources such as solar, wind, geothermal, and biomass energy; and the production of bio-fuels.

[21] Data obtained from the interview from the representative of GIZ and Ministry of Agriculture of Tajikistan.

The economic upsurge taking place currently in Turkmenistan gives an opportunity for the significant renovation of the housing and public utilities in the country. A large number of woodland parks and fountains on the streets reduce the thermal stress during the summer heat, while the gardening activities of the villagers facilitate shading of their homes and plots from the scorching heat and create a favourable microclimate.

In Turkmenistan, the sectors most vulnerable to drought are human health, agriculture and water resources, as well as natural ecosystems (flora, fauna, forests, and soil and land resources). The health services in Turkmenistan are regarded as a top priority among national objectives. A large-scale integrated governmental programme on health has been developed and successfully implemented. Archman, Mollakara and other health resorts (sanatoria) were fully renovated and re-equipped. Drought is accompanied by an increase in the number of days with an abnormally high temperature, and in connection with this the major measures taken by public health system are:

- The scientific evaluation of the effect of high temperature on the public health in different regions of the country; the practical recommendations in various aspects for the adaptation of the population to the extreme changes in weather conditions
- The development of prophylactic programmes in order to prevent the risks of heat stroke, dehydration, sunburns, etc.
- The preparation of a National Report on the assessment of climate change impact on public health; the promotion of a healthy lifestyle by medical institutions.

All possible efforts are being made for saving water and improving its quality, as well as the development of the legal framework on the use and protection of water resources. A decrease in the volume of water resources makes it necessary to review the methods of water use in irrigation, and to improve the performance of irrigation systems through modernisation. Practical steps for the adaptation of water management to drought are:

- Constructing the Turkmen Lake of the Golden Age in the Kara-Kum Desert. After commissioning the first stage water will be drained into the Garashor cavity located in the north-west. This will improve the conditions for the amelioration of adjacent irrigated lands.
- Drafting a Concept on the Development of Water Resources up to 2030
- Improving water resources management, which includes the introduction of advanced methods of irrigation, desalination, the construction of reservoirs and the reconstruction of hydraulic structures
- Promoting sustainable water use, and developing methods for drinking water supply, including water bottling
- Strengthening international cooperation to conserve and use trans-boundary water bodies and a transition to integrated management of water resources.

MEASURES AND PRACTICES APPLIED BY LAND USERS

Major changes have taken place in the agricultural sector in recent years. The stages and the pace of agricultural development programmes are identified by the Presidential "National Programme of Social and Economic Development for 2011-2030", "10 years of stability", "Grains", "New Village", and the "National Programme of the President of Turkmenistan on Reforming the Social and Living Conditions in Villages, Towns, Cities, Districts and District Centres for the Period up to 2020". To ensure rapid development of industry, a number of legislative and regulatory acts have been

adopted. Due to the climatic conditions, the territory of the country has been classed as a risk zone for agriculture. The decrease of water resources due to drought will have a direct impact on the amelioration of irrigated lands and crop yields. The adaptation measures include:

- Optimizing the placement and specialisation of agricultural production
- Breeding and cultivation of drought-resistant and salt-tolerant crops
- Introducing methods and practices for multiple cropping per year
- Developing an insurance system against weather and climate risks
- Developing and implementing livestock grazing together with phyto-ameliorative measures
- Introducing strict compliance with rotational use of pastures and establishing pasture protective belts of fodder, trees, and shrubs.

The atmospheric moisture runoff from so-called, takyr catchments provide the water needed to maintain livestock and small oasis plant production. Local people have accumulated vast experience in the use and storage of takyr water with traditional hydraulic engineering. This experience could help to reduce the impact of drought on the sheep farms in the Kara-Kum Desert.

Turkmenistan is rich in biological resources. The fauna and flora host more than 20 000 species, including a large number of rare and endemic ones. Forestry is a valuable source of food, raw materials for medicine and dye production, ornamental plants, seeds of various plant species, and as a major carbon sink for greenhouse gases. In order to improve the resilience of ecosystems and forestry to drought, the following are planned:

- Introduce the principles for increasing the stability of ecosystems, biodiversity, rational use of land and water resources in economic activities, so that the production processes could support the functions of natural ecosystems
- Raise the economic potential of specially protected areas by reforming the system of specially protected areas, expanding their total area, creating national parks and introducing alternative sustainable financing mechanisms
- Develop and adopt regulations under the Forest Code of Turkmenistan, including the improvement of the forest inventory system
- Adopt economic, organizational, and technical measures aimed at increasing the forest area.

DEGREE OF MAINSTREAMING INTO SUPPORTING INSTITUTIONS

The National Strategy on Climate Change adopted on June 17, 2012, was announced at the UN Global Environmental Forum in Brazil (Rio+20) by the President of Turkmenistan. The strategy is aimed at ensuring sustainable development under the conditions of possible climate change effects by increasing the economic, food, water, and environmental security in the country. The Strategy defines drought as an extreme hydro-meteorological event, which presents the greatest social and economic threat along with the intense heat, dust storms, frost, heavy rains and mudslides.

The Government carries out high-cost practical activities for drought mitigation in the framework of measures for the adaptation of the national economy.

7.2.5 Uzbekistan

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

A consistent set of measures on the strengthening of regulatory and institutional frames for creating an environment for integrated drought control and efficient use of water and land resources in the country is strategically important for ensuring the country is prepared for drought. These measures were grouped in accordance with the following directions: (i) improvement of water availability and the sustainability of water supply; (ii) water consumption control and improvement and access to safe drinking water, and (iii) water demand control and soils productivity improvement.

IMPROVEMENT OF WATER AVAILABILITY AND SUSTAINABILITY OF WATER SUPPLY

In spite of high water demand, Uzbekistan data on water resources are limited because of the transboundary nature of the rivers on which the country depends. Fifty-five water reservoirs with 19.8 BCM total capacity and more than 4 100 vertical drainage wells were constructed for a sustainable and dependable water supply. Water delivering to fields is by irrigation canals with total length of 183 000 km and 1 588 pumping stations (UNDP, 2007; World Bank, 2009).

To improve water supply for water scarce irrigation systems, technical interventions on inter-basin stream flow allocation are being implemented. For example, in the Kashkadarya river basin, water is delivered by canals from the Zerafshan River; and lands situated in the lower reaches of the Zerafshan River are irrigated by water delivered from Amu Darya River via Amu-Bukhara Irrigation System (World Bank, 2009).

WATER CONSUMPTION CONTROL AND IMPROVED ACCESS TO SAFE DRINKING WATER

The largest user of water resources is irrigated agriculture withdrawing 84 percent of the total volume. The limited water use for consumers is established in accordance with the principle of equal water supply. Priorities in water delivery amongst the sectors of economy are as follows:

- Drinking and municipal water supply
- Industry
- Agricultural and rural water supply
- Water users approved by the special decision of the government
- Sanitary and environmental releases to irrigation systems and small rivers.

The drinking and municipal water supply has the highest priority. However, without a centralised water supply, the domestic needs of the population remain insecure. Seventy-five percent of urban and 65 percent of peri-urban population have improved access to potable water. The regions without centralised water supply are the most vulnerable to drought. In the future, the problem reduces to providing the whole population with pathogen-free drinking water.

WATER DEMAND CONTROL AND SOILS PRODUCTIVITY IMPROVEMENT

Integrated water resources management is seen as the best way of improving water saving and efficient use to provide society and nature with a sustainable water supply. However, there are high water losses in agriculture and irrigation. Loss reduction is achieved by reconstruction and rehabilitation of existing irrigation infrastructure. Approximately 300km of irrigation canals, 75 hydraulic structures, and 41 wells for irrigation were reconstructed from 2006–2010. More than 20 large-scale investment

projects costing US$1 billion (Mamutov, n.d.) were implemented to modernise water infrastructure.

Reconstruction of irrigation and the drainage infrastructure has improved irrigated lands and increased crop yields by up to 8 percent according to the Main Water Resource Department (MAWR). Development of drip irrigation methods, funded also by the Meliorative Fund, has contributed to reducing the irrigation water demand. In accordance with government order, cotton areas were reduced to 20 percent (relatively to 1990) in favour of less water-demanding winter wheat and other grains.

Due to the various measures, water abstraction was reduced from 64.5 km^3/year in 1980 down to 52.0 km^3/year in 2006, and further 19 percent reduction by 2009. The national average water demand for irrigation per hectare was reduced by 46 percent (from 22 400m^3/ha to 12 200m^3/ha), according to MAWR.

MEASURES AND PRACTICES APPLIED BY LAND USERS

The majority of traditional water storage methods disappeared owing to the construction of large-scale reclamation and irrigation works and changes in systems and lifestyles. However, some of these storage methods could be usefully maintained for drought mitigation. For example, autumn impounding of kuyguns (limans) was used for irrigation in the Khorezm oasis and in Karakalpakstan. Some specialists proposed impounding kuyguns to improve pasture quality by over-sowing feed crops.[22]

In the Bukhara oasis a primitive "green barrier" was used to protect against sands coming from the north and west. The forest belts were implemented in accordance with the State plan during the USSR period when there was a large-scale reclamation and irrigation developments. However, these are now degraded because of age-related factors and lack of support to maintain desert ecosystem integrity.

Agricultural methods focused on water saving and improvement of its productivity were used until end of the 1980s. For example, periodical sub-soiling improved hydro-physical properties of soils and provided favourable conditions for development of plants root system and more efficient moisture fixation, and levelling increased watering uniformity and reduced water demands. These measures are not used extensively because of shortages of special farming machinery and insufficient knowledge.

In addition, when day temperatures were very high, irrigation was started only at sunset. In the mountains, irrigation was started early in the morning up to 11.00 hrs then from 17.00 hrs in order to reduce evaporation and salinization of the soil. It is likely that this method continues to be used.

Fallowing fields was used in irrigated areas where there was a water shortage. Winter wheat was sown on fertilised fields, then cotton or Guinea corn, then barley and green gram, and panic grass or spring wheat in spring of the next year. After the ploughing of Lucerne flax, sesame, melons, and water melons, sometimes Guinea were sown. Domination of cotton as monoculture ruined the crop rotation system but this has now diminished owing to the planting of winter wheat. However, the traditional crop rotations have not been restored.

[22] the communities in Central Asia: Introduction of the sustainable land management at the community level and capacity building of local population" under support of the Regional UNDP Center in Bratislava and Global Mechanism UNCCD. Dushanbe 2006.

Pasture rotation and flock rotation are traditional methods of nomadic animal husbandry and provide optimal consumption of forage resources of desert pastures, preservation of plants, and prevention of desertification. At present sedentary life, uncontrolled livestock numbers and the destruction of existing infrastructure of stock water development (watering wells) has led to the excessive loading of pastures, overgrazing, and progressive degradation.

MAINSTREAMING INTO SUPPORTING INSTITUTIONS

The need to take radical action to solve water problems and to mitigate water shortages is already widely recognised. The process of rethinking outmoded principles and outdated stereotypes in natural resources management has begun. It is noteworthy that recent water scarcity, along with insufficient state financing, has provoked a return to the traditions of an earlier time. When people have a very acute sense of the value of water, they are forced to think what they can do about it themselves without outside support. There are some other positive trends in the revival of public participation, especially at the level of local communities (UNDP, 2007).

One of the main tasks of the Water Users Associations (WUA) is the equitable distribution of water between all the members. However, issues on the regulation of water distribution at the local level still remain under the control of the oblast and rayon administrations.[23] Certainly, this is associated with a system of centralised management and a lack of decentralised authorities for decision making, as well as the difficulties of changing people's mind who grew up before the period of transition to the market reforms.

The experience of previous centuries of water use may give one of the key lessons that is a very simple idea for the region's dwellers understanding: "It does not matter to whom water formally belongs, whether it is ample or insufficient in any year, whether its supply to fields is paid fully by agricultural operators or by the state, one can rationally use water without any conflicts only by taking collective decisions at the level of ordinary users as it was done on this land from time immemorial"(UNDP, 2007).

7.2.6 Turkey

The development of appropriate resilience strategies to address drought is typically based on the results of projections of future climate conditions, including those associated with extreme events. An important step in the planning process is to create a detailed set of procedures to ensure adequate plan evaluation. Periodic testing, evaluation, and updating of the drought plan are essential to keep the plan responsive to local, regional, or national needs and settings. To maximise the effectiveness of the system, two modes of evaluation are encouraged as part of the TADAP (Turkish Agricultural Drought Action Plan).

The best solution to overcome the problems in water resources and drought management faced during implementation and integration of the technical and policy solutions is well-designed and integrated basin management models. The following issues are evaluated as part of TADAP:

- Development of procedures to harmonise the activities of the institutions who are responsible for the management of water and land resources

[23] Mamutov R. Improvement water management system and development water saving in Uzbekistan. Main Water Resource Department, MAWR.

- Designation of coordination authorities at the basins
- Evaluation of current and future utilization of water for domestic, industrial, agricultural and energy production purposes in the basin
- Determination of the existing surface and groundwater resources potential
- Establishment of the existing forestry classification
- Identification of the lands that require irrigation and also those that are economically irrigable
- Identification of existing flood problems

Some specific issues considered by various government institutions, universities and NGOs in development of drought reduction programmes, policy initiatives and projects include: weather and climate-oriented programmes as implemented by the Ministry of Forestry and Water Works (MFWW) and the Ministry of European Union affairs (MEU) and include:

- Water harvesting technologies as implemented by various regional directorates
- Effective monitoring of the weather in the country as implemented by the Turkish State Meteorological Service, MGM, which is exchanged at the local scale
- Stakeholder consultations and awareness raising activities about the impending risk through a joint effort between various Ministries and associated local/regional units.

Crop and agriculture programmes as implemented by the respective institutions of MFAL include providing information on drought tolerant, quick maturing and drought avoidance crops through local/regional units and linked research centres. One good example is the work of Bahri Dagdas International Research Institute established in Konya, which focuses on various drought-tolerant crop species. Agro-processing is one of the most dynamic branches of Turkish industry, supplying both the domestic and export markets. The main products include sugar, flour, processed meat and milk, and fruits and vegetables. Livestock production programmes implemented by MFAL and by private livestock farm owners include:

- Critical dry season feeding in terms of both quantity and quality especially for productive ruminants such as dairy cattle
- Strategic stocking
- Vaccinations
- Processing livestock products
- Strategic rangeland development and utilisation.

Forestry programmes implemented by MFWW include:

- Alternative sources of fuel or wood lots
- Afforestation and re-forestation

Agro-forestry applications in Turkey are classified in Table 12.

The crucial issue is the ability of central and local government agencies to structure a coherent and integrated implementation plan, which can be implemented by local stakeholders in a sustainable and effective manner. A good example is the meteorological forecasting and early warning systems implemented by MGM. One of

TABLE 12
Agroforestry systems and practices

Agroforestry systems	Agroforestry practices
Combination of crops and trees	alley cropping; multilayer tree gardens; multipurpose trees and shrubs on farmlands; home gardens; trees in soil conservation and reclamation; shelterbelts and windbreaks
Combination of pastures and/or animals and trees	trees on rangeland or pastures; protein banks; plantation crops with pastures and animals
Combination of crops, pastures and/or animals and trees	home gardens involving animals; multipurpose woody hedgerows; apiculture with trees; aqua forestry; multipurpose woodlots.

Source: Classifications of Traditional Agroforestry Practices in Turkey, Tolunay et al., 2010.

the key factors to the success of MGM is the ability of their key experts to understand the input-output driven processes at the local and regional levels, structure solid technical solutions around these processes, and convey them to the local stakeholders in the form of alerts and early warning systems, and channels including broadcasting and media.

MEASURES AND PRACTICES APPLIED BY INSTITUTIONS

Turkey's economy is well structured to utilise the abundant natural resources and structure sustainable initiatives to alleviate drought impacts. A good example is the commitment at the country level through the development and implementation of TADAP that outlines priority areas to address basic principles of preparedness and mitigation for the effects of drought.

A crucial step of success lies in a decentralisation policy whereby decision making on development issues is divested to local levels. The drought management components for the local and provincial level development plans are, principally, the basic planning instruments to guide action and budget allocation for the components' activities. The TADAP is encouraging such actions as well, but it will take some time for MFAL to lead coordinated action to coordinate with other Ministries and administrative units.

MFAL's goal is to enhance political commitment on addressing the issues of drought management institutions, governance, risk and vulnerability identification, and local stakeholders' capacity (i.e., knowledge and technical skills). There is an increasing level of longer-term development plans established in the period between droughts to alleviate the vulnerability and dependency among target groups.

Turkey is participating in regional study groups and project initiatives. One example is the Drought Management Centre for South East Europe (DMCSEE) which is co-financed by the European Union through the South East Europe Transnational Cooperation Programme. These types of projects enable decision makers to review drought impacts within a regional setting, which can enhance evaluations at country level and pave the way for regional cooperation to structure adaptation/mitigation measures for drought-driven vulnerability.

Another regional initiative with policy relevance is AGMEMOD (Agricultural Member States Modelling) used by member states of the European Union to enable quantitative assessment of the potential impacts on the agricultural commodity markets. AGMEMOD is an econometric, dynamic, partial equilibrium, multi-country, multi-market model. A study was undertaken by the EC Joint Research Centre (2011) to develop a detailed dataset and modelling structure for the main agricultural

commodities in Turkey and integrating this Turkish AGMEMOD sub-model into the overall AGMEMOD modelling framework. As part of this study, a detailed set of Turkish agricultural policy instruments such as direct payments, support prices and import tariffs were developed. These can be used to gain quantitative insights into the impacts on agricultural markets of a future Turkish accession to the EU.

Turkey has many initiatives designed to manage drought risk. One of the more prevalent DRM activities involves water management. Box 9 illustrates some of Turkey's water management projects.

BOX 9

Water management projects in Turkey for drought mitigation

As one of the main regulatory agencies investing in infrastructure measures in the water sector, projects implemented by DSI have direct and indirect impacts on the severity of droughts experienced in the local and regional settings. Sample projects are summarised as follows:

- In order to increase water holding capacity and allocate the required amount for drinking and use, industry and irrigation, reservoirs and lakes are constructed. A total of 677 reservoirs and lakes have been constructed up-to-date and investments are ongoing. One of the most important points is the ability of DSI to evaluate these projects at the basin level, in addition to the regional framework in place. This evaluation structure will enable the integration of social, economic, ecological, biological and environmental infrastructure and evaluate, plan and execute sustainable project templates. This integrated approach should be further supported through the use of specific measures such as fish passages across reservoir systems.
- The 1000 Lakes in 1000 Days (Lake-Water Project) will enable initiation of irrigated agriculture practices in rural areas. The most important aspect of irrigated agriculture is the ability of all stakeholder groups (DSI Regional Directorate, Irrigation Unions, and Provincial Agriculture Directorate) to convene around a joint implementation plan and enable the basis for the most efficient use of water and soil resources
- The irrigation facilities are rehabilitated and/or converted to modern systems to avoid excessive water consumption and to provide sustainability and effectiveness to operation and maintenance activities. DSI has also increased the pressurized irrigation systems from 6% in 2003 to the present level of 11%. As per the irrigation systems under construction, 57% is being constructed as a pressure system. Among those irrigation projects in the planning stage, approximately 88% will be tendered as pressure systems until 2014. One of the most important points is enabling the farmers to use these systems in a sustainable manner by providing technical, administrative and financial basis towards increased efficiency.
- In order to meet the urgent drinking water needs of cities, "Provision of Drinking, Use and Industry Water at 82 City Centres – 2008-2012" was initiated. One of the most important points is to minimize water losses and the ratio of illegal uses along the water distribution system. In order to support this objective, it will be important to support users to utilize water resources in a more efficient and concerned manner and acquire this behaviour for the long-term.

The concept of drought risk management (DRM) is gradually being integrated into the government policy initiatives as part of TADAP. Some of the strategic concepts are laid out and the level of interactions between public, private agencies and local stakeholders are identified. The ultimate goal is to structure a well-defined plan with an increased awareness on some of the key elements as defined in TADAP. The social, economic, and environmental values often clash as the competition for scarce water resources intensifies. Therefore, an important focus of governmental institutions is to identify all citizen groups that have a stake in drought planning and understand their interests.

The goal is to involve these groups early and continuously for fair representation and effective drought management and planning. Government institutions and other sectoral stakeholders recognise that discussing concerns early in the process gives participants a chance to develop an understanding of one another's various viewpoints and generate collaborative solutions. Although the levels of involvement of these groups vary notably based on sectoral and regional initiatives, the power of public interest groups in policy-making is considerable. A good example is the structured coordination and communication between SYGM and WWF-Turkey office. WWF-Turkey is sharing some of the key findings and project outcomes with SYGM, in relation to drought planning and management and integrated basin planning and management in the context of climate change, to support some of the upcoming projects and policy initiatives.

In order to enhance the effectiveness of the measures and ensure sustainability of the practices, government institutions are using some critical tools including training and capacity building and data mining and numerical modelling. The training needs of committees functioning as part of TADAP are evaluated at varying levels: (i) awareness raising at managerial and technical level, (ii) technical training, and (iii) on-the-job-training. These activities are performed at local, regional and national levels. An important aspect is to coordinate these activities between the various government agencies to establish a consistent and sustainable Drought Planning, Management and Response mechanism. A good example is the UNFAO led capacity building activities in Turkey in 2010-2011, structured as part of the United Nations Joint Programme - MDG-F 1680 Enhancing the Capacity of Turkey to Adapt to Climate Change. This was implemented in close coordination with the key stakeholders including government agencies, universities, NGOs and international institutions such as WMO and National Drought Mitigation Center of the University of Nebraska-Lincoln (FAO, 2008). The training activities were typically built around the following themes:

- Understanding of the fundamentals of Risk Assessment, Planning and Management and use of various technical and non-technical approaches to develop the basic concepts and develop a detailed plan accordingly
- The effective use of monitoring, early warning and forecasting tools, which are commonly used in various aspects of drought management including meteorological, hydrological and agricultural.

MEASURES AND PRACTICES APPLIED BY LAND USERS

An important issue for land users includes the variability in agricultural land. This is specifically important in dryland areas, where typical agricultural land includes cropland, irrigated land, and rangeland. The main challenges for the land users include:

- Expansion of cultivated fields and diminishing of natural vegetation cover
- Insufficient amounts of organic material and nutrients

- Burning of organic material (harvest residue, brush fires)
- Soil erosion (wind and water)

Irrigation often causes depletion and contamination of surface and groundwater, leading to water conflicts. Irrigated land is often severely affected by salinization and waterlogging. The main causes of salinization are inadequate drainage and excessive water application.

The rangeland in arid areas includes tree, bush and grass savannah, steppes in temperate zones, and high pastures in arid areas. Nomadic pastoralists graze pastures extensively over large areas, whereas sedentary smallholder farmers use pastureland intensively over smaller areas, which then result in challenges such as:

- Overgrazing, burning and increase in undesirable plants
- Insufficient soil organic carbon
- Soil degradation: erosion, compaction, crusting
- Free grazing, no clear land use rights

The communities prone to drought hazards have valuable information and experiences to share, and they also have a right to participate in key decisions that will affect their lives. Their participation, typically encouraged by the NGOs in drought management (primarily TEMA: Turkish Foundation for Combating Soil Erosion, for Reforestation and Construction of Natural Habitats), has implications on the sustainability of drought risk reduction-related initiatives. The local-based approach on awareness regarding drought effects (e.g., through the establishment of district and sub-district disaster management committees), and action planning based on identified priority issues at the grassroots level have proved to be effective in enabling community participation and in enhancing the sustainability for the developed initiatives.

In combating desertification and conserving the natural resources of the country and helping local communities evaluate the impacts more effectively, practices implemented by universities and NGOs, as defined below, are quite critical. There are various universities, directly or indirectly involved in various aspects of the planning and management of the impacts of drought on water and land resources. There are also limited numbers of NGO's who are involved in various levels of activities including: capacity building, research, planning and management. The primary sources and associated research interests are summarised in Table 13.

A good example was implemented by WWF-Turkey. The keys to success of this project also included various strategic technical, financial and administrative elements:

- Technical: The WWF office collaborated with various local experts, who are well qualified in their respective domains and who are familiar with site conditions and local needs.
- Financial: The WWF was able to associate them with a major cooperation to ensure availability of funding and the sustainable implementation of project outcomes.
- Administrative: The WWF managers were able to communicate well to local people and regional stakeholders. However, the main challenge was the ability to avoid misunderstanding and recognition of project outcomes as a threat to daily operations, which typically remain valid for large institutions that work closely with farmers.

TABLE 13
Drought related projects implemented by NGOs

NGOs	Projects implemented
TEMA Foundation	Climate change and specifically floods, water scarcity and drought
WWF	Relationship of climate changes on agriculture and water resources
Nature Association	Global Warming and impacts on flora and fauna
REC Turkey	Capacity Building and Training on Climate Change and Drought
The Research Association of Rural Environment and Forestry	Impacts of Climate Change on Environment and Forestry
Soil Science Society of Turkey	Impacts of land degradation and land-use patterns on ecology
Global Balance Society	Global warming and Droughts
Protection of Water Basins and Forestry Society	Evaluation of the use of resources and development of rich ecosystems at basin level
Bugday Ecological Living Society	Development and Evaluation of realistic systems to protect livelihood of crops
Friends of Ecology and Environment Society	Develop capacity and provide training to communities wrt Ecology and Environment
Turkey Environmental and Woodlands Protection Society	Identify planning and management tools to better protect the ecosystem
Turkey Environmental Foundation	Develop a public discussion platform on policy development and implementation in environmental matters
Plant Protection Research Institute	Reducing constraints to wheat production caused by sun pest through the development and application of appropriate, low-cost and environmentally acceptable Integrated Pest Management approaches
Institute of Aegean Agricultural Researches	Agro biodiversity and climatic change
Anatolian Development Foundation	Growing and finishing beef cattle strategies and environmental concerns of Turkish livestock production
Trakya Agricultural Researches Institute	The effects of global warming on seed sector and the necessity for developing new drought resistant varieties
Turkish Chamber of Agricultural Engineers	The economic impact assessment of global climate change on agriculture
Institute of Agricultural Economics	Modern biotechnology for engineering drought tolerance: Prospects and constraints

DEGREE OF MAINSTREAMING INTO SUPPORTING INSTITUTIONS

The key challenge in these project activities is the ability to convey the message to key stakeholders and project participants and ensure the sustainability and effective implementation of the outcomes. The typical setting is such that the project outcomes are implemented in the short-term, but then left aside in the mid- to long-term. There are various reasons for the lack of interest in implementing project outcomes including but not limited financial (lack of funding), technical (shift of skilled labour force to other institutions), and administrative (change of priorities in the organization or change of management structure and implementation structure) settings.

8. Challenges and ways forward

8.1 OVERVIEW

There are technological adaptations to be made in the region to address drought risk factors; but there are also adaptive changes that need to be instituted at different levels which include the fact that the capacity to plan and adapt plans is largely absent (or is in the process of being developed) and is a hangover from the former Soviet Union and the centralised five year demand-led planning system. But it would be far too simplistic to see this withdrawal of the administrative structures, technical know-how, and finance as the sole reason behind the current land degradation in the region, not least because the land was already being managed unsustainably during this period.

Therefore, any activities seeking to address the drought issues would necessarily be facing not just a technical challenge that could be resolved by the introduction of new technologies and methodologies for sustainable land management or financing, but also an adaptive challenge, necessitating considerable effort to build the capacity for land resource management at the system, institutional, and individual levels and, in particular, to change the behaviour of individuals, institutions and agencies and the ways in which they interact. However, it has to be mentioned that the capacity to think locally had been very much destroyed and it is an issue that the type of response should not cover just responding with a technological response but also an adaptive response to a collective challenge using simple and affordable measures.

Nevertheless, there are many legacy issues of the Soviet system in the region which represents a common challenge, with different responses from the countries. The water infrastructure was designed for a specific scale, and may not operate efficiently even from a strict technical perspective at other scales; for example, for small farm units which were the result of breaking up the collective land. Furthermore, master management of the system was assumed; different management of different parts of the system would require new institutional arrangements; either a public, private or a hybrid system. The State has maintained various forms of monopoly or advantage which also makes it difficult for other land users to achieve a sufficient size to achieve economies of scale or take advantage of legacy systems. The technical expertise required for complex water management is no longer available in some countries, or central direct and indirect subsidies.

In some countries, such as Kazakhstan, the Soviet water management and agricultural production systems have largely been retained, which has resulted in less disruption but is also contingent upon sufficient autonomous resources. In other countries, they have largely collapsed. Yet, in others, they are still not functioning effectively. All of this presents a complex and country specific background against which drought risk management would take place.

8.1.1 Kazakhstan

An important factor that prevents the development of an effective warning system for droughts is essentially a restriction on the distribution of hydro-meteorological information. It is difficult for research groups to gain access to the primary operational

information, since it is a commercial property of the Republican State Enterprise "KazHydroMet" of the Ministry of Environmental Protection (MEP). Departmental non-integration is also a constraining factor: monitoring information on the atmosphere and hydrosphere is under the "KazHydroMet" authority, information on crop yields is with the Ministry of Agriculture (MoA). The Water Resources Committee of the Ministry of Agriculture deals with the management and allocation of water resources and water use. This situation often makes it difficult to conduct complex, integrated scientific research.

State and private land ownership is recognised and equally protected. However, it is difficult to deal with the maintenance of the irrigation systems for small peasant/farmers. Government support is required. Public-private partnership should be considered to introduce the most advanced water-saving technologies.

8.1.2 Kyrgyzstan

There are several important drought risk management issues. One is the State budget deficit. The State has difficulty financing the long-term, as well as the short-term projects and programmes approved by the government. Thus, construction of initiated projects cannot be completed, or the construction works do not start at all.

Another is the local budget deficit which hinders the accomplishment of the local drought risk management programmes. Unprofitability of farms, especially in severely dry years, is another major challenge. As a result, farmers do not have sufficient funds to make capital investments in risk management. More than 80 percent of arable land is under private ownership. Therefore, there is no risk for farmers regarding the capital investments to manage drought. The Land and Water Codes, as well as other laws do not prohibit owners of agricultural land from constructing water structures (permanent and temporary irrigation canals) on their parcels, from land levelling and planting field-protective forest belts.

A legal lending framework exists in the country and farmers have access to credit. However, loans are granted only for a short-term (maximum 1 year) due to the unstable economic situation. For this reason, farmers cannot make long-term investments. Regardless of the adopted legal framework, another limiting factor is the provision of issuing loans secured by farmland. Lending institutions have no economic interest to take a pledge of land, as it is difficult to implement in a case of non-fulfilment by the borrower of his/her credit obligations.

Many believe that their ownership rights are not adequately protected. This problem has been reflected in a number of strategic development programmes, which indicate the need for improving the regulatory framework. The judicial system is also weak. This has negative effects on the confidence of farmers whose land holdings are close to major cities, where land grabbing practices have reached a threatening scale. Moreover, the legislation provides for the right of the state to confiscate land for public needs (i.e. for the construction of settlements).

8.1.3 Tajikistan

According to FAO estimates[24], over 13 percent of Tajikistan was degraded between 1981 and 2003 (measured as a loss of net primary productivity adjusted for changes in drought), affecting 6 percent of the regional population. Negative environmental impacts have worsened, including the drying up of the Aral Sea, water and air pollution, salinisation, water and wind erosion of soils, loss of biodiversity, and reduced provision of ecosystem services in desert, mountain, wetland and riparian ecosystems. The principal drought related problems are described in the National Programming Frameworks (NPFs)[25] which evolved from the National Action Plans. The nature of these problems and their causes are numerous and complex, and vary across the country.

The country has identified capacity gaps through the National Capacity Self-Assessment process. These sources identify a common low national capacity, ineffective policy environment, low levels of public investment, and the need to develop decision-making frameworks based on lessons learned from field-level projects and investments needed to develop increased national capacity to deal better with a variety of institutional, policy and other barriers to sustainable land management that limit an effective response to drought. In order to create an efficient drought mitigation and adaptation response, the type of response should initially emerge from the bottom-up. The issue being that drought or any other disaster risk planning systems should take place at different scales – national, provincial and local (and farmer) levels.

Developing this hierarchy of planning is critical to developing resilience. Only through this way can the responses be dynamic and adaptive, in as much as they learn and adapt at different levels.

8.1.4 Turkmenistan

According to the UNDP (2005), the way forward to combating desertification and drought in Turkmenistan is to introduce high-quality drainage systems and land reclamation technologies to prevent degradation of cultivated lands and to restore saline lands. A project which followed this initiative resulted in the restoration of 50 ha of degraded land that can be now used in agriculture. About 35 ha of land were prevented from degradation though preventive levelling. In addition, a new collector-channel was built, and the existing collector was cleaned. The project also assisted in constructing nine water-regulating and two water-gauge installations. Following the lessons of this successful project, regular workshops need to be held for land users on the possible application of various advanced methods of agriculture and the effective use of water resources. Research work also needs to be conducted in the areas of inventory and grazing of pastures, monitoring pastures using satellite imagery, study of methods of fighting pests and stimulation of germination and growth of seedlings of juniper, as well as monitoring the salinity of lands in all three project areas. Last but not least, the community-based activities need to be implemented to strengthen the resilience and the coping mechanisms employed by communities. This could be done by conducting a series of trainings on pasture land management and sustainable agricultural management.[26]

[24] ProDoc of FAO project on "Home Based Nursery Development for Improved Food Security and Environmental Protection in Tajikistan". Project symbol GCP/TAJ/006/TUR, November 2009.

[25] National Programming Frameworks are follow-on frameworks to operationalize the UNCCD-National Action Plans. These are available from the CACILM Knowledge Network, accessible at http://www.adb.org/projects/CACILM/19.

[26] http://www.turkmenistan.ru/?page_id=3&lang_id=en&elem_id=17211&type=event&sort=date_desc.

8.1.5 Uzbekistan

The way forward for Uzbekistan is to improve their water resources management and strengthen the institutional efficiency. The evidence of the available data demonstrates that the water scarcity and its devastating consequences in downstream regions are the result of political decisions. Natural, as well as institutional and technical problems of water management, might have contributed to the scarcity; however the main reason for the water scarcity downstream is political. It is the greed for cash crop revenue. The available water is not shared equally amongst the users, but according to economic reasoning at the centre, which preferred the production of cash crops to food crops. Downstream water users growing food crops bear the consequences of the political decision. Consequently, policies need to be modified and enforced to alleviate the water scarcity and to conserve the environment. Farming communities need access to water in the mid-stream whether or not they engage in cash crop production .

8.1.6 Turkey

Linking the best practices for drought risk reduction (such as community-based, networking experiences, and partnership initiatives) to the relevant government and stakeholder implemented programmes are a key aspect of sustainable drought action plans. Such programmes should also be linked to the country's regional development programmes.

The main lessons delivered by the international drought risk reduction policies and programmes include: drought prevention, preparedness, mitigation, and development. These are complex issues that need an integrated approach to achieve meaningful and durable results. Efficient and effective integration of priority drought issues may be achieved through strong and well-functioning institutional frameworks for coordinating the formulation and implementation of the drought-related policies and programmes.

Drought interventions should be designed through effective involvement of local communities to ensure their sustainability. Information for awareness rising, community education, policy advocacy and planning, and monitoring trends and the impact of interventions on drought management and drought risk reduction are central to the success of efforts in combating drought. Potential use of drought committees at district level is a valuable interface between the government, community leaders, and civil society organizations when responding to drought situations, but only in the short-term.

Drought risk reduction interventions are more likely to succeed when initiatives are owned and driven by communities, and are inclusive. Effective community-based policing complements efforts in by strengthening coordination and harmonisation of drought management initiatives. The various gender roles – particularly acknowledging women as key actors in drought management at household level – are essential for effective implementation.

Timely and effective preparedness and mitigation interventions are essential in reducing communities' vulnerability to drought, and alleviating further escalation of the spread of drought. The following issues have to be considered to ensure the sustainability and effective use of drought programmes, especially for the benefit of those communities who are exposed to the impacts at the highest level.

POLICY INITIATIVES

The political sector has usually advocated for emergency drought relief and rehabilitation initiatives, with minimal commitment for development aimed at reducing the inherent risks and building the vulnerable communities' resilience to drought. Overall, the measures lacking in TADAP are a budgetary framework and the disbursement of funds for long-term drought preparedness and development programmes. This can put the gains of national development at risk.

INSTITUTIONAL INTEGRATION

Public interest groups are likely to impede the progress in the development of plans if they are not included in the process. Therefore, TADAP should also protect the interests of stakeholders who may lack the financial resources to serve as their own advocates.

TRAINING AND CAPACITY BUILDING

Considerable time is needed for the risk culture to be embedded into organizations and personnel. It takes regulations, long hours of drills and training. People usually do not care for investing time into evaluating the possible outcome of uncertain events. When they do, they wish to come up with the only one answer that clears the uncertainty in a best way possible. Risk adjusted thinking requires them to consider all the possible outcomes and their probability of occurrence. In the world of risk there is no such a thing as "point estimation" but "vector estimation". It is important to note that the training should not only be evaluated technically, but should encourage building the basis towards strategic thinking and developing optimised socio-economic measures.

DATA COLLECTION AND DATA MINING

These should be done in a risk adjusted environment. The risk factors should be determined and data on these factors and their related environment should be stored in a way that can be easily accessed for risk analysis. The processes and the control points should be determined to follow up the evaluation of the risk factors and their metric or ordered values.

INTEGRATED BASIN SCALE MODELLING

It is important to structure a system that can evaluate the sectoral and regional issues and model them through an integrated decision-support system. The MFWW operate across 25 river basins and The MFAL operates across 30 agriculture basins. Therefore, it is important to ensure a strategic integration between the two agencies to ensure the development of a sustainable project and policy initiatives across Turkey. As part of this integration, it is also important to partition regions in a structured manner, particularly where the status of land ownership is not clear. In areas lacking land ownership plans, practitioners will be reluctant to make long-term investments and would not be able to implement integrated plans.

POST-DROUGHT EVALUATION

Agricultural data and agricultural drought reports provided by provincial organizations highly depend on some subjective explanations, personal opinions, and evaluations. Moreover, the definition of drought varies from one province to the other. The definition of agricultural drought may also differ for MGM, DSI and all the related agricultural government units as well. Thus, there is a need for a homogeneous definition of agricultural drought so that in the committee meetings a consensus could be reached. In addition, a coherent risk measure can be defined using a scientific and homogeneous definition of drought. Therefore, sound reporting to both the internal units and the public is also very important in terms of the credibility of the committees.

It will conduct a natural internal and public auditing procedure on committees' operations. This will increase the quality and the solidity of the information thus the methods used by the committees. It also brings public attention and awareness resulting in a quality and amount increase in the social action plans that are conducted by individuals, other government units, universities and NGOs.

9. Recommendations

The way forward for Central Asia and Turkey could be summarised into three broad measures:

- Provide regular, timely hydro-meteorological data to provide early warning
- Reconcile legal and institutional frameworks
- Implement and optimise water saving techniques and technologies.

All three of these measures require linkages and should work in a complementary manner.

All the countries require an early warning system that can track seasonal weather and climate risks, particularly drought, as well as make reliable projections on crop yields, rainfall, and vulnerability.

The legal and institutional frameworks in all Central Asian countries and Turkey need to be harmonised and strengthened. The water laws and guidelines on possible actions in specific circumstances during drought years need to be developed. The contingency plans should be designed, made operational and enforced by governments, by law, and State programmes. A sustainable drought policy would lead to early intervention and mitigation and less costly damage incurred by drought.

All the countries would benefit from investments in water-saving technologies and techniques as they all suffer to some extent from water scarcity. Stimulation of water conservation and water-saving technologies, such as plastic bottles attached to the tree seedlings; drip irrigation; sprinklers; improvement of canals and aqueducts; and water recycling would not only conserve water but may solve many problems of water shortages.

9.1 KAZAKHSTAN

Kazakhstan needs to improve its data collection, analysis, and dissemination of systematic surveys; its forecasting systems, modelling, and early warning information about emergency hydro-meteorological phenomena. According to the National Adaptation Plan of Action (NAPA) it is a priority for the country to promote timely decision making, correct adaptive steps, and disseminate results among end users (Bizikova *et al.*, 2011). In the short-term, strengthening the sustainable provision of timely hydro-meteorological data would be a first step. By harmonising the drought monitoring and forecasting; developing solid early warning methodologies, and studying patterns of drought, information could be quickly produced and disseminated. Effective dissemination however, would require the development of effective procedures for notification about the possibility of drought occurrence. Initially vulnerability assessments with recommendations to water users done periodically and during emergency situations and made available in a periodic manner would be useful while more effective procedures are being devised.

The creation of a risk management system of drought occurrence would also be useful to manage risks that have already occurred. To minimize the impact of drought,

insurance could be introduced to support those vulnerable to loss from drought. Replacing drought resistant crops on irrigated lands is another option (Bizikova *et al*., 2011). As both of these are long-term measures, starting with the implementation of water-saving tillage technologies would serve in the short-term to mitigate drought.

The above recommendations should all be integrated and tied into the reconciliation of the legal and institutional framework. Contingency plans and water laws and guidelines on the possible actions in specific circumstances during drought years should be developed in order for quick action and relief. In order for these plans to be linked to the early warning systems, the development of triggers and drought thresholds will be critical. Contingency plans and possible actions also need feasibility studies such as the forecasting of future water use for distribution by zones so that interventions are made according to needs.

9.2 KYRGYZSTAN

Kyrgyzstan needs to conduct vulnerability assessments with recommendations to water users. This would be useful in providing early warning information to those affected by drought and also give the affected population ways to cope. According to Bizikova *et al*. (2011), development and the implementation of modern early warning systems is a priority. Water users could benefit from the provision of daily and seasonal weather forecasts. Nevertheless, water scarcity seems to be a recurring issue and so emphasis should also be placed on water conservation. In the short-term, the use of water should be regulated to conserve water as much as possible.

Kyrgyzstan could also increase water availability by desalinisation of brackish and saline waters. As this is a long-term goal and requires allocation of time and resources; short-term and more immediate measures such as the mixing of clean and low-quality water should be taken. With improved water availability more lands could be irrigated while identification and introduction of new irrigated land continues. The problem of water scarcity is not easy to solve in Kyrgyzstan and calls for joint use of the trans-boundary water resources. Therefore initiatives and the making and signing of international agreements need to be made.

Providing incentives for investments in water-saving technologies should also be done. In the short-term, the monitoring and projection of water reservoir stocks could also provide insight on into water availability so that courses of action could be taken in a timely fashion in event of low stocks.

The vulnerable population also needs protection. According to Bizikova *et al*. (2011), crop insurance, and investment in agricultural equities; the diversification of farmer income sources to reduce the risk of income loss caused by climate change are a priority.

9.3 TAJIKISTAN

Tajikistan needs a system of long-term weather, climate risks, and crop yield projections. The early warning system on drought and other climate related disaster risks needs to be strengthened in order to ensure the availability and accessibility of seasonal weather data/information. This information includes crop planting and yield projections, as this would help to stabilise the food security and long-term contracts at interstate level.

To manage drought, strengthening the work done by the Disaster Risk Reduction Centre will be crucial. This Centre should have an updated database with good

information management to facilitate better functioning of the early warning system. The Centre should engage in awareness creation and capacity building to increase the local resilience to drought.

A drought resilience plan should be developed at both national and district levels through the mainstreaming of adaptation measures. This should start by improving stakeholder's awareness at a national and local level. Furthermore, the plan should include a capacity building strategy to build capacity in terms of skills and knowledge on drought resilience in the agricultural sector. The capacity building strategy should use coordination and communication action plans to improve the exchange experience.

Tajikistan also needs to incorporate methods to mitigate drought once it has started. The main recommendation is improved seed quality and reproduction including heat resistant seeds. The seed genetic resources should be strengthened as well as the dialogue between farmers and researchers. According to the Bizikova *et al.* (2011), some of the main priorities in drought risk management for the country are the breeding of crops resistant to drought and salinity and the introduction of efficient irrigation systems such as drip irrigation.

9.4 TURKMENISTAN

Monitoring and forecasting precipitation, education, and raising awareness are critical for Turkmenistan. The monitoring and forecasting of precipitation would provide the early warning information needed to facilitate early decision making while education and raising awareness would prepare those vulnerable to drought to implement coping strategies. In order to set up these systems, harmonisation of the legal and institutional frameworks is needed.

Turkmenistan should consider the development of a risk insurance system for its vulnerable population.

Livestock keeping is a main source of livelihood and so it is important to cater to livestock needs. Given the absence of good grazing land, areas with degraded pastures should be restored; in the meantime grazing land should be provided for rent.

Water availability is a major problem. According to the Bizikova *et al.* (2011), Turkmenistan needs to develop ways to improve the water efficiency ratio of irrigation systems as well as increase water supply, such as by using groundwater, building reservoirs, improving or stabilising watershed management, and installing desalination facilities.

Turkmenistan can increase the amount of water availability by mixing fresh and saline water. Eventually, desalination of brackish and saline water from wells should be mainstreamed.

9.5 UZBEKISTAN

Uzbekistan needs sustainable provision of timely hydro-meteorological data to study drought patterns and provide drought early and long-term warning systems. The immediate course of action is to begin monitoring and forecasting drought regularly. The early warning system will thereby support the decision-making process and ensure planning of drought preparedness and drought policy plans.

In order to effectively disseminate this information, Uzbekistan needs to make legislative amendments guaranteeing free access of targeted groups to primary hydro-meteorological information.

In the long-run, internal and international resources and innovation mechanisms need to be mobilised to support the strategic goals and achieve the expected outputs. Monitoring and evaluation could increase accountability. Furthermore, Uzbekistan should develop an integrated financing strategy, for programmes and local plans.

The Water Users Associations could be useful in water conservation. Strengthening their authority, functions and role in irrigation, monitoring and impact assessment services would be beneficial in the use of water. In order to do so there needs to be an arrangement of a strict order of priorities for irrigation, monitoring, and water balance inventory involving farmers and local communities. According to the Bizikova *et al.* (2011), some main priorities in water management include improvement of the water resources the monitoring system and the introduction of economical irrigation methods (i.e., short furrows, through furrows, night-time irrigation, field levelling, etc.).

Obtaining new crops strains to increase their drought tolerance would also work complementarily with improving water resources. As water scarcity remains an issue in Uzbekistan, it should take a challenging course of action in the application of water saving methods (e.g., water harvesting, soil conservation, zero tillage, surface mulching, and drip irrigation).

9.6 TURKEY

Turkey needs to set up an early warning system for drought. According to the country's national strategy on climate change, Turkey needs an integrated information management system in order to increase the flow and exchange of knowledge in national climate change efforts (Ministry of Environment and Forestry, 2010). The early warning system should therefore work in alignment and complement national climate change efforts. The challenge of setting up an early warning system in a geographically diverse country like Turkey is to balance trade-offs between locally-specific indicators and comparison and objectivity across the different regions.

Drought contingency plans should be consolidated and actioned. In the short-term, emphasis should be placed on involving communities in planning and the design of these drought contingency plans. The early warning systems should feed into these drought contingency plans, thus triggering actions based on alerts.

In drought mitigation, Turkey needs to increase the availability of water. Desalination of brackish and saline waters and increasing water harvesting and storage opportunities are two long-term examples. Water could be made available more immediately by methods such as exploiting high-cost waters and mixing fresh and low quality waters. Turkey is geographically very diverse, therefore its vulnerability needs to be assessed. Vulnerability studies can thereafter be used to advise water users on how to cope with water shortages. As with many Central Asian countries, Turkey could also benefit from using drought resistant crops. According to the countries national strategy on climate change, one of Turkey's priorities it to accelerate research on the development of plant and animal species that are tolerant to heat, drought, diseases and pests (Ministry of Environment and Forestry, 2010).

10. References

Agaltceva, N.A. and Rakhmatova, N. 2012. Drought in Uzbekistan: problems, early warming and consequence mitigations. *Ecological Bulletin Tashkent*, pp. 23-28.

Aganov, S. 2010. *Adaptation of Turkmenistan's water sector to climate change.* UNDP report.

Agency on hydrometeorology of the Republic of Tajikistan. 2007. *Programme of the hydro meteorological stations and posts' reconstruction for 2007-2016.*

Akhmadieva, J.K. 2009. Towards estimation of the sensitivity of some agro climatic moisture indices applicable to atmospheric droughts in Kazakhstan. *Hydrometeorology and Environment*, pp. 51-57.

Asian Development Bank. 2009a. Addressing Climate Change in the Asia and Pacific Region - Building Climate Resilience in the Agriculture Sector- IFPRI Report. Manila.

Asian Development Bank. 2009b. Uzbekistan Grain Productivity Improvement Project. Subcomponent on Improvement of the farmer farms management, Agricultural Restructuring Agency.

Baysholanov, S.S. 2010. About the frequency of droughts in grain-producing regions of Kazakhstan. *Hydrometeorology and Environment*, 3: 27-37.

Bekiýewa, G. 2010. Garagumçölüniňguraklygy we olaryňörimeýdanösümliklerineedý änzyýanlytäsiriniazaltmagyňusullary. *Ylym we tehnika.* No. 3.

Bishkek. 2007. *Land- and water-saving technologies in Central Asia.* Samr ALATOO.

Bizikova, L., Hove, H., Parry, J. and International Institute for Sustainable Development. 2011. *Review of current and planned adaptation action: Central Asia.* Adaptation Partnership. (available at http://www.cakex.org/virtual-library/review-current-and-planned-adaptation-action-central-asia.)

Bova, N.V. 1952. *The climatic study of drought in the south-east of the USSR.* Proceedings of the MGO, 29: 32-46.

Bozkurt, D. and Sen, O.L. 2013. Climate change impacts in the Euphrates – Tigris Basin based on different model and scenario simulations, *Journal of Hydrology,* 480: 149-161.

CACILM. 2012. *Capacity Building for SLM*, Multi-country GEF/UNDP/GM/GIZ project CACILM, Tashkent.

CACILM. 2009a. *An Update National Programming Framework of the Republic of Uzbekistan*, Tashkent, 148 pp.

CACILM. 2009b. *Achieving ecosystem stability in degraded lands in Karakalpakstan and Kyzylkum desert.* GEF/UNDP project.

CACILM (Central Asian Countries Initiative for Land Management). 2006. *National Programming Framework of the Republic Uzbekistan*, Tashkent, 148 pp.

Ceylan, A. 2006. *Regional Drought Management.* Meteorology General Directorate. Turkey.

Chen, M., Xie, P., Janowiak, J.E. and Arkin, P.A. 2002. Global land precipitation: A 50-yr monthly analysis based on gauge observations. *Journal of Hydrometeorology*, 3: 249–266.

Chirkov, Y.I. 1979. Gidrometeoizdat [Agrometeorology]. 320 pp.

Chub, V.E. 2007. Climate change and its impact on the hydro-meteorological processes, agricultural and water resources of the Republic of Uzbekistan. Tashkent: Uzhydromet, NIGMI. 132 pp.

Chub, V.E. 2000. *Climate Change and its influence on natural resources potential of the Republic of Uzbekistan*. Tashkent: SANIGMI. 252 pp.

Chub, V.E. and Merkushkin, A. S. 2012. The Role of the climatic services in mitigating of drought consequences. *Journal Ecological Bulletin*. Tashkent. pp. 6-9

CIA (Central Intelligence Agency). 2013. *World Fact Book 2013-2014: Tajikistan.* Washington, DC: Central Intelligence Agency. (available at https://www.cia.gov/library/publications/the-world-factbook/geos/ti.html.)

Cotton breeding perspectives in Uzbekistan. nd. (available at http://www.ia-centr.ru/expert//).

Cullen, H.M. and deMenocal, P.B. 1999. *North Atlantic influence on Tigris–Euphrates streamflow.* Lamont Doherty Tajikistan Earth Observatory of Columbia University, New York.

Decree of The Kyrgyz Republic's Government, 6 May 2009, No. 274. The Second National Communication of the Kyrgyz Republic on United Nations Framework Convention on Climate Change, Government of Kyrgyzstan.

Decree of the President of Turkmenistan on the Horticulture Development and Greenery Planting in Turkmenistan, 1992. (available at faolex.fao.org/docs/texts/tuk80588.doc.)

Demir, I., Kılıc, G. and Coskun, M. 2008. *Climate projections over Turkey using the PRECIS*. Proceedings of the 4th Atmospheric Science Symposium. Istanbul (Turkey). pp. 365-373.

Dolgikh, S.A. 2010. *Research and forecasting of droughts in Kazakhstan*. Research Report, KazHydroMet. Astana. 284 pp.

Eagles, P. 2008. Governance models for parks, recreation, and tourism. In Hanna, K. S., Clark, D. A. & Slocombe, D. S. eds, *Transforming parks and protected area: policy and governance in a changing world.* Routledge-Taylor & Francis Group, New York and London.

EC Joint Research Centre. 2011. *Potential impacts on agricultural commodity markets of an EU enlargement to Turkey. Extension of the AGMEMOD model towards Turkey and accession scenario*, JRC Scientific and Technical report, European Commission Joint Research Centre, Institute for Prospective Technological Studies, Seville, Spain.

FAO. 2008. *A Review of drought occurrence, monitoring, and planning activities in the Near East region.* FAO Regional Office for the Near East, Cairo, Egypt and National Drought Mitigation Centre University of Nebraska-Lincoln, Nebraska, USA.

FAO. 2005. *Integrated management for sustainable use of salt affected, gypsiferous soils and field farmer school component.* Uzgipromeliovodkhoz Institute, MAWR, Uzbekistan.

Gordeev, A.V. and Kleshchenko, A.D. 2006. *Bioclimatic potential of Russia: theory and practice*. KMK Sci Press and Inst Technol Res Publishers. Moscow. 512 pp.

Government of the Republic of Kazakhstan. 2010. *Sectoral Programme "Zhasyldamu" for 2010-2014*. 551 pp.

Government of Tajikistan. 2009. *National Programming framework of the Republic of Tajikistan*. 2009. Dushanbe.

Government of Tajikistan, 2008. *Second national communication on Biodiversity Conservation and Action Plan of the Republic of Tajikistan*. 2008. Dushanbe

Govenrnent of Tajikistan. 2002. *Second National communication of UNCCD Convention of the Republic of Tajikistan*. Dushanbe.

Government of the Republic of Kazakhstan. 2009. *Second National Communication of the Republic of Kazakhstan of the Conference of Parties to the Framework UN Convention on Climate Change*, 2009. Astana.

Government of the Republic of Kazakhstan. 2005. *Program on desertification control in the Republic of Kazakhstan for 2005-2015 period*. Program No. 49.

Government of Turkmenistan. 2003. *National Program "Strategy of Economic, Political and Cultural Development of Turkmenistan until 2020"*. State Council of elders of Turkmenistan, Hulk Maslakhata and National movement Galkynysh. (available at www.stat.gov.tm/ru/content/activity/development-program/)

Government of Turkmenistan. 2002. *National Action Plan of the President of Turkmenistan on the environment.* 2002. Saparmurat Turkmenbashi. Ashgabat.

Government of Uzbekistan. 2008. *Second National Communication of Republic Uzbekistan on the UNFCCC.*

Government of Uzbekistan. 1999. *The first National Communication of Republic Uzbekistan on UN Framework Convention on Climate Change.* Tashkent.

Gringof, I.G. and Paseciniuc, A.D. 2005. *Agrometeorology and agro-meteorological observations*. Gidrometeoizdat. 551 pp.

Gringof, I.G., Popovm, V.V. and Strashniy, V.I. 1987. *Agrometeorology.* Gidrometeoizdat. 310 pp.

Hurrell, J.W. 1995. Decadal trends in the North Atlantic Oscillation: Regional temperatures and precipitation. *Science*. 269: 676–679.

Hurrell, J.W. and Van Loon, H. 1997. Decadal variations in climate associated with North Atlantic Oscillation. *Climate Change*. 36(3-4): 301–326.

IPCC (Intergovernmental Panel on Climate Change). 2014. *Climate Change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea & L.L. White, eds. Cambridge University Press, Cambridge, United Kingdom and New York, USA. 1132 pp.

IWMI-Central Asia. 2012. Water Productivity Improvement at Plot Level. Project IWM/SIC.

IWMI. 2009. *Mapping drought patterns and impacts: a global perspective.* Research Report No. 133. Sri Lanka.

Ivanovo, Y. N. 2007. Condition and perspectives of the climate observation system. *Bulletin on climate scenarios, climate change impact assessment.* N. 6, Uzhydromet, SHMI, pp. 5-14.

Jansa, A. 1992. Severe weather and cyclogenesis, a Western Mediterranean look. *Proceedings of ICS/ICTP/WMO International Workshop on Mediterranean Cyclones Studies*. 18-22 May 1992, Trieste (Italy), pp. 51–56.

Joint Research Center EU, JRC. 2012. European Drought Observatory. (available at http://edo.jrc.ec.europa.eu).

Jooshev, L., Plyuss, P., E. Tekbayev, and Bishkek. 2012. *Basics of agricultural crop irrigation in Kyrgyzstan. Irrigation guidelines for extension officers and farmers.* Swiss Agency for International Cooperation Helvetas.

Kahya, E. and Kalayci, S. 2004.Trend analysis of stream flow in Turkey. *Journal of Hydrology*, (289): 128–144.

Kazhydromet. 2011. *Annual Bulletin of climate change monitoring in Kazakhstan:* 2010. Astana.

Kogan, F.N. 1990. Remote sensing of weather impacts on vegetation in non-homogeneous areas. *International. Journal of Remote Sensing*, (11): 1405–1419.

Komuscu, A.U. 2001. *An analysis of recent drought conditions in Turkey in relation to circulation patterns.* Drought Network Newspaper No. 22. (available at http://digitalcommons.unl.edu/droughtnetnews/22)

Komuscu, A.U., Erkan, A. and Oz, S. 1998. Possible impacts of climate change on soil moisture variability in the Southeast Anatolian Development Project (GAP) Region: An analysis from agricultural drought perspective. *Climatic Change* 40: 519–545.

Lerman, C. 2003. Water resources and the mechanism of water during the land/water reform. (available at http://departments.agri.huji.ac.il/economics/lerman-turk-water.pdf)

Mamutov R. (n.d.) *Improvement of water management system and development water saving in Uzbekistan.* Main Water Resource Department, MAWR.

McKee, T.B., Doesken, N.J. and Kleist J. 1993. The relationship of drought frequency and duration to time scales. *Preprints, 8th Conference on Applied Climatology, 17-22 January,* pp 179–184. American Meteorological Society, Anaheim, Canada.

Mannava, S.V.K., Motha, R.P, Wilhite, D.A. and Wood, D.A. 2011. Agricultural Drought Indices. *Proceedings of the World Meteorological Organization/UNISDR Expert Group Meeting on Agricultural Drought Indices, 2-4 June 2010, Murcia, Spain.*

Meshcherskaya, A.V. 1988. Drought index and yield of grain crops. *Meteorology and Hydrology*, (2): 91-98.

Middleton, N. and D. Thomas, D., eds. 1997. *World Atlas of Desertification*. 2nd Edition. London. Arnold.

Ministry of Environment and Forestry. 2010. *National climate change strategy (2010-2020). Republic of Turkey.* General Directorate of Environmental Management, Climate Change department. Ankara. (available at http://www.preventionweb.net/files/22115_13335nationalstrategy1.pdf

Ministry of Forestry and Water Works. 2010. *Turkey: national basin management strategy.* Sector Note. Ankara.

Ministry of Forestry and Water Works. 2006. *Turkey's national action program on combating desertification.* Publication No. 250. Ankara.

Mukhmadaliyev, B. 2006. The *hydro meteorological service in Tajikistan: History and Reality*. Agency on Hydrometeorology.

Namias, J. 1985. Factors responsible for the droughts. *In* Beran, M. and Rodier, J.A., *Hydrological aspects of drought: a contribution to the International Hydrological Programme*. Paris, UNESCO–World Meteorological Organization.

NAP CCD. 2000. *National Action Plan to Combat Desertification in the Republic of Uzbekistan*. 2000. Tashkent.

NASA. 2013. NASA's *Gravity Recovery and Climate Experiment (GRACE) satellites.* (available at http://www.nasa.gov/mission_pages/Grace/news/grace20130212.html).

National Report on the implementation of the UN Convention on Biodiversity. 2009. (available at www.cbd.int/doc/world/tm/tm-nr-04-ru.doc).

NFP. 2005. *National Framework Program of Turkmenistan*. Convention to Combat Desertification (CCD) Working group.

Neronov, V.V. 1997. Landscape features of centuries-long changes of humidity in south-eastern Turkmenistan. *Arid Ecosystems,* (3): 6-7.

NeWater. 2007. *The EU Integrated New Approaches to Adaptive Water Management under Uncertainty. Amudarya Case Study*. WP 2.3 Stakeholder Report, Tashkent.

Nurberdiev, M., Bekieva, G.S., Mamedov, B.K. and Orlovskaya, L.G. 2008. Drought and pastures productivity on plains of Turkmenistan. *Journal of Arid Ecosystems*, 15 (1): 37.

Obukhov, V.M. 1949. *Yield and meteorological factors.* Gosplanizdat. Moscow.

Onol, B. 2007. *Downscaling climate change scenarios using regional climate model over Eastern Mediterranean.* Institute of Basic and Applied Sciences. Istanbul.

Onol, B. and Semazzi, F.H.M. 2009. Regionalization of climate change simulations over the Eastern Mediterranean. *J. Climate* 22: 1944–1961.

Orlovskaya, L.G., Kogan, F., Mamedov, B.K., and Spivak, L. 2008. *Estimation of seasonal dynamics of desert pastures productivity in Turkmenistan using NOAA/AVHRR data.* Final report. USAID.

Orlovsky. 1994. Droughts and desertification: possibility of predicting. *Problems of desert development*, 4-5.

Palmer, W.C. 1994. *Meteorological drought*. Research Paper, N.45. Department of Commerce Weather Bureau. Washington.

Ped, D.A. 1975. *Index of drought and excess moisture.* Proceedings of the USSR Hydrometeorological, 156: 19-38.

Perelet, R. 2008. *Central Asia: Background Paper on Climate Chang*e. Human Development Report Office, UNDP.

Pluss, P., Jooshev, E., Tekbaev and Bishkek. 2012. *Sugatsunusaram-jalduupaydala nuujanatopuraktynkyrtyshynsaktooboyunchainnovatsiyalyar.* Catalogue.

Presidential Decree of the Republic of Kazakhstan No. 1241. 2003. *The Ecological Security Framework of the Republic of Kazakhstan for 2004-2015 period*. (repealed in accordance with the Presidential Decree of April 13, 2011 No. 47).

Presidential Decree Republic of Kazakhstan of 14 November 2006. *Concept of Transition of Kazakhstan to Sustainable Development for 2007 - 2024*.

Program of the President of Turkmenistan (nd). The National Program on the Socio-economic Development of Turkmenistan in 2011-2030.

Program of the President of Turkmenistan (nd). 10 years of Stability.

Program of the President of Turkmenistan (nd). Grain.

Program of the President of Turkmenistan (nd). New Village.

Program of the President of Turkmenistan (nd). National Program of the President of Turkmenistan on the Social and Living Conditions in Villages, Towns, Cities, Districts and District Centres until 2020. (available at http://turkmenistan.gov.tm/).

Republic of Uzbekistan. 2007. *Welfare Improvement Strategy of Population of Republic Uzbekistan for 2004-2006.* Presidium of the Cabinet of Ministers of the Republic of Uzbekistan. Tashkent.

Rouse, J.W., Haas, R.H., Schell, J.A. and Deering, D. W. 1973. *Monitoring vegetation systems in the great plains with ERTS*. Third ERTS Symposium. NASA, 1: 309–317.

Safarov, M.T., Kayumov A. K. and Khomidov, A.Sh. 2006. *National Drought Management and Mitigation Plan for Tajikistan.* State Hydrometeorology Agency, State Nature and Forestry Protection Committee, Dushanbe.

Salnikov, V.G. 2005. Cyclicity of temperature and precipitation anomalies in Kazakhstan and the possibility of its account in the forecast models. *Bulletin of the KNU.* Geographical Series, 1 (20): 33-39.

Salnikov, V.G. and Koylyubaeva, A.S. 2005. Climatic features of atmospheric aridity in northern Kazakhstan. *Hydrometeorology and Ecology,* 1: 50-60.

Salnikov, V.G., *et al.* 2012. *Development of methods, models and geo-information technologies of control, analysis and forecasting of dynamics of desertification in the Republic of Kazakhstan*. Report on the research, Almaty, KazNU, RK.

Saylan, L. 2009. *Potential impacts of climate change on agriculture in Turkey*. Istanbul Technical University, Faculty of Aeronautics and Astronautics, Department of Meteorology, (available at http://www.cost734.eu/reports-and-presentations/7th-management-commitee-meeting/potential-impacts-of-climate-change-on-agriculture-in-turkey)

Selek, B., Tuncok, I. K., Dalfes, N. and Sen, O. L. 2010. *Identification of Surface Water Resources Potential and Flood Risks within the perspective of developing Water Resources Management Policies in Seyhan Basin within the framework of Adaptation to Climate Change.* Final Report, UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change, Adana, Turkey.

Sen, B., Topcu, S. and Turkes, M. 2010. Observed and projected changes in drought conditions of Turkey. *In*: López-Francos, A. *Economics of drought and drought preparedness in a climate change context.* Zaragoza. CIHEAM / FAO / ICARD A / GD AR / CEIGRAM /MARM. Options Méditerranéennes : Série A. Séminaires Méditerranéens; No. 95. 2nd. International Conference on Drought Management, 2010/03/04-06, Istanbul.

Simsek, O., Mermer,A., Yildiz,H., Ozaydin A. and Cakmak, B. 2007. Estimation of Wheat Yield for Turkey Using AgroMetShell Model, *Journal of Agriculture Sciences*, 13(3): 299-307.

Spivak, L., Vitkovskaya, I., Batyrbayeva, M. and Terekhov, A. 2010. *Detection of Desertification Zones Using Multi-Year Remote Sensing Data.* North Atlantic Treaty Organization (NATO) Science for Peace and Security Series: Environmental Security Use of Satellite and In-Situ Data to Improve Sustainability, Springer.

Spivak, L.F., Batirbaeva, M.J., Vitikovskaya, I.S., Mamedov, B.K., Nurberdiev, M. and Orlovskaya, L.G. 2006. Inter-seasonal analysis of vegetation dynamics on the territory of Turkmenistan. Problems of desert development No. 4.

Stanchin, I., Lerman, C. and Sedik, D. 2011. *The growth potential of the rural population's income in Turkmenistan on the basis of alternative agricultural crops.* FAO report.

Statistical Agency of Tajikistan. 2010. *Food security and poverty*, Report No. 2.

Statistical Agency of Tajikistan. 2010. *Statistical yearbook of the Republic of Tajikistan.*

Statistical Agency of Tajikistan. 2009. *Environmental protection in the Republic of Tajikistan.* Statistical yearbook.

Statistical Agency under the president of the republic of Tajikistan (TAJSTAT). 2012. Accessed in December 2012. URL: http://www.stat.tj/english/home.htm.

Svoboda, M. D. 2011. *Drought Monitoring: Indices and Indicators.* White Paper. National Drought Mitigation Centre, University of Nebraska-Lincoln/School of Natural Resources.

Swain, M. 2010. *Drought Vulnerability and Livelihoods: Impacts and adaptation strategies in western Odissa, India.* Saarbrucken, Germany, VDM verlag.

Tezcan, L., Ekmekci, M., Atilla, O. and Gurkan, D. 2007. *Assessment of climate change impacts on water resources of Seyhan River Basin*. Final Report of ICCAP. Impact of Climate Changes on Agricultural Production System in the Arid Areas, Kyoto, Japan.

Tolunay, A., Korkmaz, M. and Alkan, H. 2010. Definition and Classification of Traditional Agroforestry Practices in the West Mediterranean Region of Turkey, *International Journal of Agricultural Research*, 5 (12): 1145.

Tonkaz, T. 2008. *Trend analysis of reference evapotranspirations in the GAP Region.* Conference on Irrigation and Salinity, Sanliurfa, Turkey.

Tonkobaeva, A.R. 2012. *Sustainable land management in a changing climate: traditional knowledge and best practices.* Astana, Turkey.

Topaloglu, F. 2006. Trend detection of stream flow variables in Turkey. *Fresenius Environmental Bulletin*, 15: 644–653.

Topcu, S. 2011. *Water for agriculture: a great but inefficient consumer*. Berlin. Springer-Verlag.

Topcu, S., Sen, B., Giorgi, F., Bi, X., Kanit, E. G. and Dalkilic, T. 2008. Impact of climate change on agricultural water use in the Mediterranean Region. *In 13th World Water Congress. International Water Resources Association. Montpellier, France.*

Tuncok, I. K. 2012. *Technical Specifications for the Ministry of Environment and Urbanization, Evaluation of Regional and Sectoral Vulnerability of Turkey in the context of Adaptation to Climate Change.* Ministry of Environment and Urbanization. Turkey.

Tuncok, I. K. 2011. *Impacts, Vulnerability and Adaptation on Water Resources.* Enabling Activities for the Preparation of Turkey's Second National Communication to the UNFCCC. UNDP. Turkey.

Tuncok, I. K., Kirmizatas, H. and Gulcubuk, B. 2009. *Evaluation of the impacts of Climate Change on Konya Closed Basin and Eastern Mediterranean Basins*. Final Report of Turkey's Future Agenda Project, Konya.

Turkes, M. 1999. Vulnerability of Turkey to desertification with respect to precipitation and aridity conditions. *Turkish Journal of Engineering and Environmental Sciences,* 23: 363–380.

Turkes, M. 1996. Spatial and temporal analysis of annual rainfall variations in Turkey. *International Journal of Climatology*, 16: 1057–1076.

Turkes¸ M. 2003. *Spatial and temporal variations in precipitation and aridity index series of Turkey*. Mediterranean climate variability and trends. Regional Climate Studies. Springer Verlag, Heidelberg,

Turkes¸ M. and Erlat, E. 2005. Climatological responses of winter precipitation in Turkey to variability of the North Atlantic Oscillation during the period 1930–2001. *Theoretical and Applied Climatology,* 81: 45–69.

Turkes¸ M. and Sumer, U.M. 2004. Spatial and temporal patterns of trends and variability in diurnal temperature ranges of Turkey. *Theoretical and Applied Climatology*, 77: 195–227.

Turkes¸ M. and Tatli, H. 2009. Use of the standardized precipitation index (SPI) and modified SPI for shaping the drought probabilities over Turkey. *International Journal of Climatology*, 29: 2270–2282.

Turkmenistan's Law on drinking water. 2010. (available at http://www.saglyk.info/makalalar/siz-oz-hak-hukuklarynyzy-bilyanizmi/30-umumy/397-laws.html)

Turkmenistan's Law on Food Security. 2000. (available at http://www.saglyk.info/makalalar/siz-oz-hak-hukuklarynyzy-bilyanizmi/30-umumy/397-laws.html)

Turkmenistan's Law on Nature Protection. 1991. (available at faolex.fao.org/docs/texts/tuk54028.doc)

Turkmenmillikhasabat (nd). *Social statistics and the living standard level.* National Institute of Statistics and Information. (available at http://www.stat.gov.tm/ru/content/methodology/methodrecomendations/social-statisticss/)

Ulanova, E.S. and Strashnaya, A.I. 2000. Droughts in Russia and their impact on crop productivity. *Proceedings ARRIAM.* No. 33. 64-83.

UNCCD. 2011. *Combating Desertification and land Degradation. Proven Practices from Asia and the Pacific.* Changwon, Republic of Korea: Korea Forest Service.

UNCCD. 2007. *Report for the first technical workshop on preparation of Terms of Reference for the Regional Centre of Droughts in Central Asia in the context of UNCCD*, Tashkent. (available at http://www.unccd.int/Lists/SiteDocumentLibrary/Regions/Asia/meetings/regional/Tashkent2007/report-rus.pdf)

UNCCD. 1994. *Elaboration of an international convention to combat desertification in countries experiencing serious drought and/or desertification, particularly in Africa.* United Nations General Assembly, Intergovernmental negotiating committee, Paris.

UNCCD. 2003. *Sub-regional Action Program of Central Asia countries for Combating Desertification in the CCD context.* Havana, Cuba.

UNCCD/FAO/WMO. 2013. *Policy Document: National Drought Management.* Policy High Level Meeting on National Drought Policy (HMNDP). Geneva, Switzerland.

UNDP. 2011. Mainstreaming Drought Risk Management: A Primer. Nairobi, Kenya.

UNDP. 2010. Food Security in Uzbekistan, Tashkent.

UNDP. 2008. Climate Change in Central Asia. (available at http://europeandcis.undp.org/news/show/6EEEA7CD-F203-1EE9-B8E09D9A56670836).

UNDP. 2007. *Water critical resource for Uzbekistan's future*. Tashkent.

UNDP. 2006. *Traditional knowledge in the field of land and water use.* Mobilization of the communities in Central Asia: Introduction of the sustainable land management at the community level and capacity building of local population, Regional UNDP Centre in Bratislava and Global Mechanism UNCCD. Dushanbe.

UNDP. 2003. *Assessment of the 2000-2001 drought impact in Karakalpakstan and Khorezm.*

UNECE. 2012. *First Environmental Performance Review of Turkmenistan.* Environmental Performance Reviews Series No. 35. United Nations Economic Commission for Europe. (available at http://www.unece.org/index.php?id=31866)

University of Nebraska Lincoln, UNL. 2012. *The US drought impact reporter.* National Drought. University of Nebraska Lincoln.

Uzbekistan State Cadaster of Zones with High Natural Danger: (n.d). Zones of High Danger of Hydrometeorological Phenomena.Tashkent.

Uzbekistan State Statistical Bulletin on agriculture and economy. 2011. Tashkent.

Uzhydromet. 2008. *Measures to mitigate climate change.* Bulletin No. 8. NIGMI, Tashkent.

Valikhanova, A. 2005. *Thematic Review: Desertification/land degradation.* The UNDP / GEF project "National Capacity Assessment for Global Environmental Conventions", Astana.

Volovik, E. 2010. *Analytical survey of water sector of Turkmenistan.* UNDP report.

Water Code of Turkmenistan. 2004. (available at faolex.fao.org/docs/texts/tuk54109.doc)

World Bank. 2012. *Activating DROUGHT. Management assessment and mitigation for Central Asia and the Caucasus.* The World Bank Europe and Central Asia, Office of sustainable environmental and social development.

World Bank. 2009. Review of planning investments in water sector.

World Bank. 2006. *Drought. Assessment of mitigation and management for Central Asia and the Caucasus.* Washington DC.

World Bank. 2006. *Drought Management and mitigation in Central Asia and the Caucasus. Regional and country profiles and strategies.* The World Bank, (available at (http://siteresources.worldbank.org/INTECAREGTOPRURDEV/Resources/CentralAsiaCaucasusDroughtProfiles&Strategies-Eng.pdf).

World Bank. 2005. *Drought Management and Mitigation Assessment for Central Asia and Caucuses*. World Bank, Report No: 31998-ECA. (available at https://openknowledge.worldbank.org/handle/10986/8724)

World Bank. 2004. *Tajikistan Public Expenditure Review. Republic of Tajikistan Poverty Assessment Update.* World Bank Report No. 30853-TJ.

World Meteorological Organization, WMO. 2012. *Standardized Precipitation Index User Guide*. Geneva.

World Overview of Conservation Approaches and Technologies (WOCAT) reports and approaches database. URL: http://cdewocat.unibe.ch/wocatQT/qt_report.php; and http://cdewocat.unibe.ch/wocatQA/SearchApproach.php.

WMO. 2011. Agricultural Drought Indices. *Proceedings of an Expert Meeting,* 2-4 June, 2010, Murcia, Spain.

WMO. 1992. *International Hydrology Dictionary.* Geneva.

You, L.L. and Wei, W. 2007. *Drought in Asia and Pacific*. Regional Implementation Meeting for Asia and the Pacific for the 16th session of the UN Commission on Sustainable Development (CSD-16), Jakarta, Indonesia, 2007.

Zolotokrylin, A.N. 2013. Climatic desertification.

FAO TECHNICAL PAPERS

FAO WATER REPORTS

1 Prevention of water pollution by agriculture and related activities, 1993 (E/S)
2 Irrigation water delivery models, 1994 (E)
3 Water harvesting for improved agricultural production, 1994 (E)
4 Use of remote sensing techniques in irrigation and drainage, 1995 (E)
5 Irrigation management transfer, 1995 (E)
6 Methodology for water policy review and reform, 1995 (E)
7 Irrigation in Africa in figures/L'irrigation en Afrique en chiffres, 1995 (E/F)
8 Irrigation scheduling: from theory to practice,1996 (E)
9 Irrigation in the Near East Region in figures, 1997 (E)
10 Quality control of wastewater for irrigated crop production, 1997 (E)
11 Seawater intrusion in coastal aquifers – Guide lines for study, monitoring and control, 1997 (E)
12 Modernization of irrigation schemes: past experiences and future options, 1997 (E)
13 Management of agricultural drainage water quality, 1997 (E)
14 Irrigation technology transfer in support of food security, 1997 (E)
15 Irrigation in the countries of the former Soviet Union in figures, 1997 (E) (also published as RAP Publication 1997/22)
16 Télédétection et ressources en eau/Remote sensing and water resources, 1997 (F/E)
17 Institutional and technical options in the development and management of small-scale irrigation, 1998 (E)
18 Irrigation in Asia in figures, 1999 (E)
19 Modern water control and management practices in irrigation – Impact on performance, 1999 (E)
20 El riego en América Latina y el Caribe en cifras/Irrigation in Latin America and the Caribbean in figures, 2000 (S/E)
21 Water quality management and control of water pollution, 2000 (E)
22 Deficit irrigation practices, 2002 (E)
23 Review of world water resources by country, 2003 (E)
24 Rethinking the approach to groundwater and food security, 2003 (E)
25 Groundwater management: the search for practical approaches, 2003 (E)
26 Capacity development in irrigation and drainage. Issues, challenges and the way ahead, 2004 (E)
27 Economic valuation of water resources: from the sectoral to a functional perspective of natural resources management, 2004 (E)
28 Water charging in irrigated agriculture – An analysis of international experience, 2004 (E) efforts and results, 2007 (E)
29 Irrigation in Africa in figures – AQUASTAT survey – 2005, 2005 (E/F)
30 Stakeholder-oriented valuation to support water resources management processes – Confronting concepts with local practice, 2006 (E)
31 Demand for products of irrigated agriculture in sub-Saharan Africa, 2006 (E)
32 Irrigation management transfer – Worldwide, 2008 (E/S)
33 Scoping agriculture–wetland interactions – Towards a sustainable multiple-response strategy, 2008 (E)
34 Irrigation in the Middle East region in figures – AQUASTAT Survey – 2008, 2009 (Ar/E)
35 The Wealth of Waste: The economics of wastewater use in agriculture, 2010 (E)
36 Climate change, water and food security (E)
37 Irrigation in Southern and Eastern Asia in figures – AQUASTAT Survey – 2011 (E)
38 Coping with water scarcity - An action framework for agriculture and food security (E/F)
39 Irrigation in Central Asia in figures (E)
40 Guidelines to control water pollution from agriculture in China Decoupling water pollution from agricultural production (E)
41 Yield gap analysis of field crops: Methods and case studies (E)
42 Drought characteristics and management in the Caribbean (E)
43 Water accounting and auditing: A sourcebook (E)
44 Drought characteristics and management in Central Asia and Turkey (E)

Availability: September 2014

Ar – Arabic
C – Chinese
E – English
F – French
P – Portuguese
S – Spanish

Multil – Multilingual
* Out of print
** In preparation

The FAO Technical Papers are available through the authorized FAO Sales Agents or directly from Sales and Marketing Group, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

Drought characteristics and management in Central Asia and Turkey

Drought is a normal phenomenon of Central Asia and Turkey's climates. It results in impacts which can be drastic for societies and national economies. The prospects are high that climate change will gradually make future drought episodes more frequent, more intense, of longer duration and having larger spatial extents. However, the much needed change to build greater societal resilience to drought - as the most appropriate way to address these impacts - through the adoption of proactive drought management policies, is still in infancy in the region.

This report reviews drought and the way it is managed in Central Asia and Turkey. We hope that it will trigger the much needed shift in the way drought is perceived and managed, with the uptake of proactive drought management approach. FAO and partners have provided capacity development on this approach for the region. They have also made available appropriate guidelines describing the approach and explaining the process for its adoption; and they further remain disposed to support countries in developing and implementing such plans.

ISBN 978-92-5-109604-8 ISSN 1020-1203
9 789251 096048
I6738EN/1/01.17