PROJECT: Enabling Integrated Climate Risk Assessment for CCD planning in Central Asia

Climate Risk Assessment Guide – Central Asia

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Executive Summary

The **Climate Risk Assessment Guide – Central Asia** provides a clear and practical process to assess the impacts and outcomes of climate-related events on lives and livelihoods in Central Asia. The need the **Guide** arises from the region's arid climate and the livelihoods systems based on this climate, significant impacts from climate-related damage, and regional infrastructure not designed to reflect current capacities to address climate risk impacts. Short and long-term climate risks threaten poverty reduction and developmental sustainability. Existing climate impact reports for Central Asia need to be complemented by assessment results that downscale the understanding of climate impacts in ways that support sub-national climate risk management.

The **Guide** is divided into three broad sections:

- Conceptual background to risk assessment,
- Methodological approaches and procedures for the Central Asia assessments process, and
- A step-by-step process for conducting assessments based leading to the development of climate risk assessment profiles or other practical outputs.

The climate risk assessment process includes steps that define:

- The correlation between short and long-term climate-related hazards and temperature or precipitation;
- Impacts of climate events in terms of economic damage;
- Impacts of climate events on livelihoods (using a Delphi-based approach);
- Comparative risks of climate events;
- Future damage, livelihoods and risk outcomes; and
- Perceptions of climate-related hazard events and willingness to address these risks.

The use of the **Guide** requires subject-matter experts (e.g., meteorology, hydrology, geology, economics, social science research, etc.) but the procedures are sufficiently straightforward that extensive teams of experts should not be needed. Community, government, and non-government organization representatives from the areas being assessed are expected to participate in the assessment process.

The procedures set out in the **Guide** provide results that can be compared at the sub-national level across Central Asia. The principal limitation faced by the process set out in the **Guide** is weak data on the impacts of climate risks at the sub-national level. Community-based participatory impact assessment procedures[1] can be used to address this limitation although this reduces the detail of the analytical process.

[1] For instance, Abarquez and Murshed, 2004.

I. Introduction

Understanding and managing the impact of climate on lives, livelihoods and society is critical to ensuring human rights are assured and the process of development is successful. The climate of a location contributes to defining opportunities for a safe and productive life while setting conditions that can create risks that can threaten these same opportunities. Human interaction with the climate of a location is often through seeking to gain maximum advantages from the climatic conditions while at the same time accepting and adjusting to the risks that come with the climate of a place.

Central Asia – Kyrgyzstan, Kazakhstan, Tajikistan, Uzbekistan and Turkmenistan – comprise a geopolitical unit bound by common geographies, history and economic systems. Yet Central Asia is also diverse, from the steppe of northern Kazakhstan to the Great Karakum Desert of Turkmenistan and Uzbekistan, the high mountain ranges found in each country and the arid, but productive, valleys and plains in Tajikistan, Uzbekistan, Kyrgyzstan, Turkmenistan and Kazakhstan. The regional commonalities, but also diversities, make Central Asia an excellent test bed to develop a process to assess the impact of climate on lives, livelihoods and society.

A need to improve the understanding of climate-related risks in Central Asia is based on four practical considerations:

- The region's arid continental climate, and the livelihoods systems based on this climate, will be impacted by changes in average precipitation and temperature over the long term.
- Climate-related hazards are a principal source of disaster damage in the region[2]. Even if the average number of extreme weather events drops over time, changes in land use, particularly increased urbanization and intensification of land use for agriculture and livestock, mean the hazardousness of place due to climate-related events will increase, as will the absolute cost of future disasters.
- Much of the infrastructure (e.g., roads, irrigation systems) in the region were designed with an expectation of significant recurrent investment to maintain usability in the face of climate-related hazards. For most of the countries in Central Asia, this level of investment is no longer possible and replacement or new infrastructure needs to be more sustainable and designed to better take local climate conditions into consideration.
- Post-independence developmental policies and livelihood systems need to be structured to allow for a flexible and sustainable adjustment to a changing climate and associated risks. Links between basic needs such as water, energy, food, health and security, and climate risks need to be understood so that policies and livelihood changes do not increase (but ideally reduce) the risk posed by climate change and variability.

The countries in Central Asia also face the prospect that short and long-term climate risks can adversely affect poverty reduction efforts. The danger is that expected or possible changes to the climate can make current livelihoods unsustainable, leading to deeper poverty and a shift into poverty of those who are currently not poor. As a result, poverty reduction strategies and activities need to be climate risk wise - that is, as unlikely as possible to be affected by changes in the climate and developed and implemented in ways that take into account a changing climate.

Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (**SREX**) (Intergovernmental Panel on Climate Change, 2012,) is a global attempt to understand the links between a changing climate and extreme weather events and disasters. While **SREX** helps clarify what is understood about climate change and extreme events, the results are global in application and need further refinement for local, national or regional application. Further, the level of effort which went into **SREX**

[2] The **Risk Assessment for Central Asia and Caucasus: Desk Study Review** (Central Asia and Caucasus Disaster Risk Management Initiative, no date), indicates that the most deaths from 1988 to 2007 in Central Asia were caused by earthquakes, a result influenced by the 25,000 deaths following the 1988 earthquake in Armenia. While there clearly exists a risk of an Armenia earthquake-like disaster in Central Asia, climate-related risks appear to be the main source of year-to-year losses.

(over 150 contributors) is impractical for even national or regional climate risk assessments in Central Asia.

A related report, **Managing Climate Extremes and Disasters in Asia: Lessons from the SREX Report** (Climate and Development Knowledge Network, 2012), explores the implication of the results of the larger **SREX** report for Asia. The report notes a number of areas where climate risk management efforts need to focus, including reducing greenhouse gas emissions to limit future adaptation needs and integrating disaster risk management, climate change adaptation and sustainable development. Asia-specific examples of how climate risks can be more successfully managed are also provided. However, the report does not move analysis below the regional level, and defines a need to combine scientific and local knowledge to generate maps of climate risks and plans for climate risk management (Climate and Development Knowledge Network, 2012:20),

The **Risk Assessment for Central Asia and Caucasus: Desk Study Review** (Central Asia and Caucasus Disaster Risk Management Initiative, no date) presents disaster risk assessment results covering climate-related disasters for the countries in the region. However, the report uses data sources that are, at best, national in scale and not fully representative of actual disasters at the sub-national level. Climate risk assessment needs to move to the sub-national, and, if at all possible, to the community level, to provide results that can guide decisions and practical actions to address the impacts of a changing climate.

Each country in Central Asia has developed at least two reports on climate change and expected impacts.[3] These national communications provide a summary of expected changes in the climate, expected impacts on specific sectors and recommendations as to policy and projects to address these expected impacts. The challenge with these reports is that they tend to cover a multitude of actions that need to take place, and are expected to have impacts over periods from decades to almost a century.

While broad long-term approaches are important, the day-to-day reality in Central Asia leads to a need to define and confront climate impacts and associated risks in ways that make life safer, and contributes to sustainable development. In the terminology of the climate change assessment community, there is a need to downscale the understanding of climate impacts and risks to a level where practical local action is possible. This process needs also to provide a basis for prioritizing climate risk management actions to ensure that limited funding (from the affected populations, their governments and the international community) is spent to best effect.

In response to the factors summarized above, the **UNDP Central Asia Climate Risk Assessment Program** is developing climate risk profiles, below the national level where possible, to provide the basis for better climate risk management. This **Guide** is intended to support the development of these profiles. The **Guide** is divided into three broad sections covering the:

1. Conceptual background to risk assessment,
2. Methodological approaches and procedures for the assessments process, and
3. Step-by-step process for conducting assessments based on development of a national climate risk assessment profile.

Development of the **Guide** and inputs to climate risk assessment profiles was supported by the **Climate and Development Knowledge Network** (CDKN) through funding to CAMP Alatoo under the **Developing Integrated Climate Risk Assessment for CCD Planning in Central Asia** project. Additional support was provided by the UNDP Central Asia Climate Risk Assessment Program.[4]

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[3] See http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php.
[4] Further information on this effort can be found at http://camp.kg and http://www.ca-crm.info.

II. Objective

The objective of the **Climate Risk Assessment Guide – Central Asia** (**CRA CA**) is to provide a clear and practical process to assess the impacts and outcomes of climate-related events on lives and livelihoods in Central Asia.

The **Guide** responds to the first component of the project Terms of Reference, *to develop climate risk assessment methodology* (see **Annex A**). The assessment process defined in the **Guide** is based on climate change and climate-related disaster assessment approaches developed in Central Asia and globally. The process takes into account the specific information and operational conditions in Central Asia and is designed to provide results with practical use in climate risk management.

III. Development of the CRA Guide

Development of the **Guide** began with the framing of the larger **Developing Integrated Climate Risk Assessment for CCD Planning in Central Asia** project (**0**). After a review of the Terms of Reference, CAMP Alatoo (the lead organization for the development of the **Guide**) and the UNDP project management identified a group of experts from within and outside Central Asia to develop the **Guide**. The CRA CA team met at Issyk Kyl, Kyrgyzstan, in mid-July 2012 together with UNDP and CAMP Alatoo staff to (1) review the availability of risk-related data in Central Asia, (2) review and discuss existing climate change and disaster risk assessment methods used in Central Asia and elsewhere, and (3) discuss options for framing a Central Asia Climate Risk Assessment process. The results of the Issyk Kyl meeting and a review of other assessment tools and relevant literature[5] were used to refine the general concepts underpinning the climate risk assessment process and identify options for testing the procedures. The resulting draft **Guide** was circulated to team members, select staff within UNDP and CAMP Alatoo, and others for comments and improvements. In parallel, two pilot climate risk assessment exercises, in Kyrgyzstan and Kazakhstan, were initiated by the CRA CA team to verify the procedures set out in the draft **Guide**.

The initial results of these pilots and comments on the methodology were reviewed at a CRA CA Team meeting in Bishkek in early September 2012 together with UNDP and CAMP Alatoo staff. This review led to improvements in the risk assessment process and revision of the **Guide** document.

A second review of applications of the risk assessment process took place in Almaty in mid-October 2012, together with a presentation on the assessment to the meeting on the Central Asia Regional Risk Assessment. A third review of the assessment process results together with discussions on the production of the two **Climate Risk Profiles** covering Kazakhstan and Kyrgyzstan took place in Almaty in mid-December 2012.

A further review of the draft **Guide** and **Profile Reports** took place in Bishkek in late February 2013. This meeting was divided between team-level technical discussions on the **Guide** and **Profile** reports and presentations of project results to outside parties for comment. A final team meeting on the **Guide** and **Profile** reports was held in Alamty at the end of March 2013, where a focus was on integrating different analysis into the **Guide** and **Profile** reports, as well as work on formatting and planning dissemination of the project results. The final draft **Guide** and one **Profile** report, for Kyrgyzstan, were completed in July 2013.

[5] A separate internal report **Central Asia Climate Risk Assessment - Relevant Literature and Practice,** is available from CAMP Alatoo.

Key Terms

The following definitions of climate risk related terms are drawn from the S**REX** report (Intergovernmental Panel on Climate Change, 2012). Note that not all these terms are used in the text but are included as general background to the language of climate risk management. A detailed review of the contrasting uses and meanings of similar terms related to climate change can be found in Levina and Tirpa, (2006).

Abrupt climate change
The nonlinearity of the climate system [that] may lead to abrupt climate change, sometimes called rapid climate change, abrupt events, or even surprises. The term abrupt often refers to time scales faster than the typical time scale of the responsible forcing. However, not all abrupt climate changes need be externally forced. Some changes may be truly unexpected, resulting from a strong, rapidly changing forcing of a nonlinear system.

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

Adaptive capacity
The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse outcomes, moderate harm, or exploit beneficial opportunities.

Climate
Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Climate change
A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate extreme (extreme weather or climate event)
The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes.

Climate model
A numerical representation of the climate system that is based on the physical, chemical, and biological properties of its components, their interactions, and feedback processes, and that accounts for all or some of its known properties. The climate system can be represented by models of varying complexity, that is, for any one component or combination of components a spectrum or hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical, or biological processes are explicitly represented, or the level at which empirical parameterizations are involved. Coupled Atmosphere-Ocean Global Climate Models (AOGCMs), also referred to as Atmosphere-Ocean General Circulation Models, provide a representation of the climate system that is near the most comprehensive end of the spectrum currently available. There is an evolution toward more complex models with interactive chemistry and biology. Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal, and inter-annual climate predictions.

Climate variability
Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate at all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural

Exposure
The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

Disaster
Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk
The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk management
Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development.

Downscaling
Downscaling is a method that derives local- to regional-scale (up to 100 km) information from larger-scale models or data analyses.

Drought
A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term … therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought),

Outcomes
Effects on natural and human systems. In this report, the term 'outcomes' is used to refer to the effects on

Flood
The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods.

Glacial lake outburst flood (GLOF)
Flood associated with outburst of glacial lake. Glacial lake outburst floods are typically a result of cumulative developments and occur (i) only once (e.g., full breach failure of moraine-dammed lakes), (ii) for the first time (e.g., new formation and outburst of glacial lakes), and/or (iii) repeatedly (e.g., ice-dammed lakes with drainage cycles, or ice fall).

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

Heat wave (also referred to as extreme heat event)
A period of abnormally hot weather. Heat waves and warm spells have various and in some cases overlapping definitions.

Permafrost
Ground (soil or rock and included ice and organic material) that remains at or below 0°C for at least 2 consecutive years.

Resilience
The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Return period
An estimate of the average time interval between occurrences of an event (e.g., flood or extreme rainfall) of (or below/above) a defined size or intensity.

natural and human systems of physical events, of disasters, and of climate change.

Likelihood
A probabilistic estimate of the occurrence of a single event or of an outcome, for example, a climate parameter, observed trend, or projected change lying in a given range. Likelihood may be based on statistical or modeling analyses, elicitation of expert views, or other quantitative analyses.

Mass movement
Mass movement in the context of mountainous phenomena refers to different types of mass transport processes including landslides, avalanches, rock fall, or debris flows.

M**itigation (of disaster risk and disaster)**
The lessening of the potential adverse outcomes of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.

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

Uncertainty
An expression of the degree to which a value or relationship is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. Uncertainty may originate from many sources, such as quantifiable errors in the data, ambiguously defined concepts or terminology, or uncertain projections of human behavior. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgment of a team of experts.

Urban heat island
The relative warmth of a city compared with surrounding rural areas, associated with changes in runoff, the concrete jungle effects on heat retention, changes in surface albedo, changes in pollution and aerosols, and so on.

Vulnerability
The propensity or predisposition to be adversely affected.

IV. Concepts and Approaches

A. Risk Assessment Concept Overview

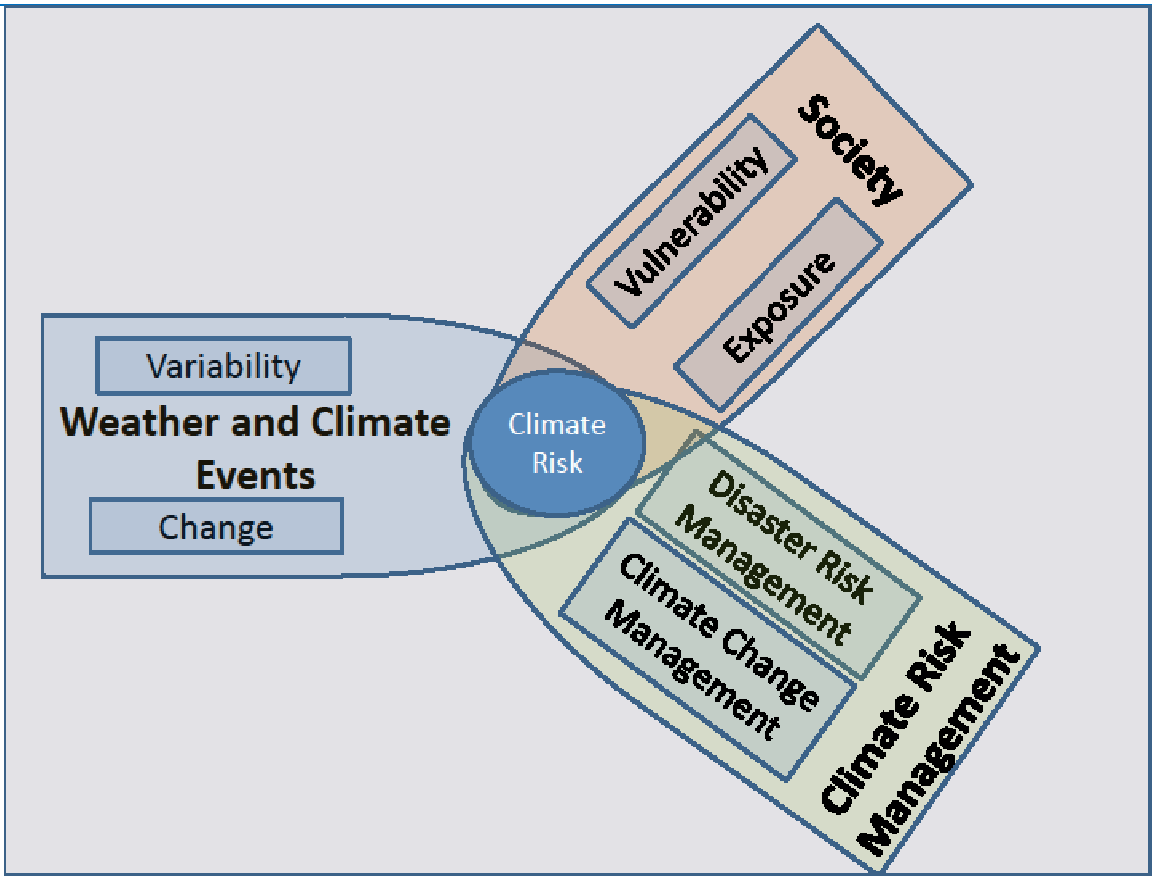
One of the challenges in developing a climate risk assessment is to bridge the concepts and terminologies used for climate change assessment and disaster risk assessment. Climate change assessments reports, and the predictions they provide, tend to focus on longer term outcomes (decades in the future) of a few parameters (e.g., temperature, precipitation). Disaster risk assessments focus on what can be immediately life-threatening events (e.g., disasters) from the immediate to ten year horizon arising from a range of events (e.g., heavy precipitation, drought, hail, flooding, food security, etc.).

Overall, a core reason for assessing climate-related risks is to identify how these risks will affect society. Understanding the threat posed by climate-related risks enables society to act to reduce or avoid the impacts of these threats and make the overall developmental progress sustainable. This section reviews the basis for both approaches and defines a common structure to climate-related risk assessment.

The material in this section is drawn from Coburn, et al (1994), Intergovernmental Panel on Climate Change (2012), Jones et al (no date), Levina and Tirpak (2006), and Twigg (2001), and discussions within the project and with external parties.

B. Conceptualizing Climate-Related Risk

The following diagram, modified from the **SREX** (Intergovernmental Panel on Climate Change, 2012), provides a graphic summary of the linkages between climate, society and climate risk management which are the focus of the assessment process in this **Guide**. Climate risk management is the actions necessary to minimize the negative impacts of climate variability and climate change, including assessments and developing and implanting policies and activities to this end.



For this **Guide**, risk is defined as *the exposure in time and place of one or more humans to an event (a hazard) and the outcome of this event on these humans*.[6] Risks can result in positive or negative outcomes. To limit the scope of the **Guide**, the focus is on the negative outcomes of risks.

Risk is a theoretical condition. When an actual hazard event takes place and affects humans, the result can be dramatic and immediate, as in a flood disaster damaging crop production, leading to food shortages and a loss of assets, and in the extreme, possibly contributing to a famine.

The impact of a hazard can also be of longer term. For instance, a reduction in annual average precipitation over decades can lead to a shift in the predominant food and commercial cereal grown from maize to sorghum. This will change food consumption, what is marketed as the predominant cereal export (and expected as cereal imports in years of poor production), and can change the impact of short-term extreme weather events (e.g., sorghum is more drought-resistant than maize).

The changes to lives, gender roles, the economy and society in general related to a changing climate are deeper, slower and likely more significant than one, or several, severe floods or droughts. At the same time, individual hazard events may provide evidence that climate use systems (e.g., crops grown, industrial water use, etc), may be incompatible with current climate conditions.

As a result, climate risk assessment needs to consider short and long-term social and economic impacts, and not only the change in the nature, magnitude or frequency of the physical aspects of the climate. Put another way, the individual and social impacts of a changing climate are more important over the long term than the actual physical changes to the climate. The impact of these changes, and not the changes themselves, are what affects individuals and society.

The **Guide** makes a distinction between impacts and outcomes. The former refers to the damage done (or which can be done) when a risk materializes, i.e., when a significant change affects humans. This

[6] Adapted from Intergovernmental Panel on Climate Change, (2012), p. 5, and Jones, et al (no date).

change can be immediate, as in the case of a disaster, or over the long term, as in the case of a change in type of livestock raised due to increased arid conditions.

Outcome refers to the combined results of impacts on the unit of analysis, from individuals to society at large. For instance, flooding may lead to the loss of animals (an impact). If the owner has insurance against flood looses, the outcome of the flooding is less severe than if there was no insurance. As hazard events can have multiple impacts, and some of these impacts may be reduced by other factors, it is important to consider impacts and overall outcomes separately to understand more clearly how hazard events affect individuals and society.

Climate-related hazards can be grouped as direct, consequent or contributory, as indicated in the **Climate-Related Hazards** box, below. The key role which climate plays in human life makes it a challenge to incorporate all climate-related events and outcomes into the risk assessment process. To be effective in terms of cost and effort, climate risk assessments best focus on defining the relative significance of possible impacts and outcomes on individuals and society. Assessment results framed in this way focus attention on risks which have more significant societal impacts, for which risk management measures are relatively more important and of greater overall benefit to society.

Climate-related events are defined by a set of parameters which indicate the:

- Type of event (e.g., precipitation),
- The event's frequency (e.g., once every month) and,
- The magnitude of the event (e.g., quantity of mm of precipitation).

More frequent events tend to be of lesser magnitude than less frequent events, although the cumulative outcomes of many smaller events can exceed the outcome of one larger event. At the same time, changes in the climate, for instance an increase in average temperature, are defined by the magnitude of change over very long timeframes relative to normal human activity.

The significance of climate-related events (including the manifestation of changes in climate averages) can be framed by nature of their impacts. These impacts can be:

- Direct or indirect: A drought can affect wheat production (a direct impact) and thus wheat prices and eventually food security (indirect impact).
- Immediate or extended: Hail usually has an immediate impact on crops while an increase in average temperature over 30 years has a longer term impact on water supplies and crop production.

Climate-Related Hazards

The following list of climate-related hazards present in Central Asia is divided into three groups representing the relative physical closeness between a climate event (a characteristic of the climate, such as heavy precipitation) and an impact. This division is useful in defining the range of factors which may contribute to a specific hazard becoming a threat to human vulnerabilities. Of note:

- Hazards are often linked, for instance heavy precipitation contributes to flooding and flooding contributes to reduced food production.
- Some linked hazards occur in different time frames, for instance, heavy snow can contribute to flooding some months after the snowfall.

Direct - A direct link between a climate hazard event and impacts.

- Heavy rainfall
- Heavy snowfall
- High winds
- Extreme heat
- Extreme cold
- Lack of rainfall (drought)
- Increase in average temperature
- Reduction in average temperature
- Change in average humidity
- Lack of snow (drought)
- Extreme humidity
- Extreme aridity
- Lighting
- Hail
- Dust storm
- Increase in average precipitation
- Reduction in average precipitation

Consequent – A hazard which is consequent (the result of) to a climate event.

- Flooding (various types)
- Rock fall (when triggered by temperature or precipitation)
- Reduction in vegetation production (e.g. crop failure)
- Fire (forest, lightning triggered)
- Glacial Lake Outburst
- Mud flow
- Landslide
- Sand/dust storm
- High ground water
- Livestock death (lack of water or natural fodder)

Contributory – A hazard to which direct or consequent climate hazard make a significant, but where other events or conditions are necessary for a negative impact to occur.

- Food shortage
- Disease and illness related to climate extremes
- Water shortage – for direct human, animal and commercial consumption
- Conflict related to resources made scarce due to a changing climate

The **Guide** uses a modification of the **Sustainable Livelihoods Framework**[7] to define the impacts by looking at how short or long-term hazard events can affect specific types of capital. The following capitals are covered in the assessment (quotations from Department for International Development, 1999):

1. Human – "the skills, knowledge, ability to labour and good health".

2. Natural – "the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived".

3. Social – "social resources upon which people draw in pursuit of their livelihood objectives", including "networks and connectedness", "membership of more formalised groups", "rules, norms and sanctions", "relationships of trust, reciprocity and exchanges" and "informal safety nets".

4. Financial - "financial resources that people use to achieve their livelihood objectives".

5. Physical – "the basic infrastructure and producer goods needed to support livelihoods".

6. Political – access to governance systems that influence risk management and impacts.

Political capital, not originally in the **Sustainable Livelihoods Framework**, is included to capture the degree to which governance systems support the management of short and long-term climate risks. In the assessment process, the impact on physical capital is assessed using damage data. Impacts on the other five types of capital are assessed using a consensus-based adaption of the Delphi technique (see below).

The use of the **Sustainable Livelihoods Framework** allows the assessment process to define how severely specific capitals can be impacted following a specific hazard event. As the impact of hazard events normally varies across types of capital, and between different groups (e.g., for females, herders, etc.), understanding different impacts on capitals helps understand the causes of vulnerability and risk, and where risk management interventions could be most effective.

Climate risks are not static and vary with changes in time, for instance between day and night, as well as over longer timeframes, for instance measuring drought risk at a daily, monthly or decade timeframe. Different timeframes may also influence the impact of a hazard event on capitals. For instance, the risk from flooding would be different if it occurs when crops are in development or after they are harvested and removed from the flood area. In a similar way, intra or inter-year changes in capitals (e.g., due to livestock sales in the fall or changes in livelihood systems over the longer term) affect the level of risk and the relative importance of factors defining risk from a specific hazard.

Defining risk should also consider how a hazard outcome will be managed by society to minimize negative outcomes when the hazard event occurs. These management measures can

- Reduce the frequency of a hazard, for instance using retention ponds to reduce the likelihood of flooding following heavy rainfall.

- Reduce the intensity of a hazard, for instance, using crop varieties that are drought tolerant in where drought or a drying climate are hazards.

- Reduce the damage done by the hazard event, for instance building protective structures against mud flows, or relocating at-risk structures from a flood zone (i.e., specifically reducing the threat to physical or natural capital).

[7] See IDS Knowledge Services (2009), and Twigg, (2001).

- Increase the resilience to a hazard event, in particular building the social, financial and political capitals of the at-risk populations so that they are better able to absorb losses caused by hazard events.

All these interventions reduce the risk to human capital from hazard events.

In sum, risk is a theoretical condition defined by the impact of an event on humans, with the scale of the outcome defined by (1) the exposure in time and space, (2) the possible damage from the event and (3) the means available to reduce this exposure and damage. The following sections summarize how this conceptual structure is applied to climate change and climate-linked disaster risk assessments.

C. Climate Change Assessment[8]

The process of climate change assessment can be summarized as:

- Modeling of possible future climate conditions (e.g., temperature, precipitation, etc.) under a variety of conditions and for decades into the future, and
- Assessing the degree to which human systems may be able to manage or be negatively impacted by the projected changes in the climate.

The modeling process uses a variety of models and different parameters to project a range of different future climates. Generally, a range of model results are compared to develop a broad consensus projection of possible future climates. Typical climate change outputs are stated as increases or decreases in average temperature and precipitation from 30 to more than 100 years in the future.

The expected impacts of possible climate changes are referred to as climate change vulnerability. The process of assessing this vulnerability can be summarized as follows:[9]

- Exposure (the "background climate conditions against which a system operates, and any changes in those conditions.") **and** Sensitivity ("the responsiveness of a system to climatic influences, and the degree to which changes in climate might affect it *in its current form*.") **equals** Potential Outcome (of climate change)

- Potential Outcome **and** Adaptive Capacity ("Adaptation reflects the ability of a system to change in a way that makes it better equipped to deal with external influences.") **equals** Vulnerability (to climate change). Note that this use of vulnerability is significantly different from the use in disaster risk assessment. See the table below and Jones, et al, no date for more details.

Climate change assessments generally face three significant challenges. First, the modeling results are based on assumptions about evolving climate conditions. Results change as these assumptions change. And while these changes often are due to improvements in the modeling process, they also contribute to a sense of uncertainty about the accuracy of forecasts of future climates and vulnerabilities.

Second, results are often presented as a range of model outputs over a 30 to 100 year horizon. This horizon is generally beyond the normal period of concern of most people, and public and private policy formulation. As well, presenting a range of outputs suggests a significant degree of uncertainty, which also works against making decisions to address the impacts forecasted.

Finally, the climate change process incorporates adaptive capacity into (not after) the assessment of vulnerability. This raises the question as to whether projections of adaptive capacity reflect actual

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[8] This section draws on CCRC Home > Topics > Climate Change Assessments http://www.fs.fed.us/ccrc/topics/assessments/climate-change-assessments.shtml.

[9] Based on **Climate Change Risk and Vulnerability: Promoting an Efficient Adaptation Response in Australia**, Australian Greenhouse Office (2005), with quoted materials from the pages indicated. Originally developed from **Climate Adaptation: Risk, Uncertainty and Decision Making — UKCIP Technical Report**, UKCIP , Willows, R.I. and Connell, R. K. (eds)) (2003).

actions which will be taken or presumptions about what might happen in the future. This increases the uncertainty of the project climate change impacts over a 30 to 100 year horizon.

Climate Change and Disaster Risk Assessment - Comparing Terminology

Climate change and disaster risk assessments use sometimes overlapping terminology in defining what contributes to risk. The following table summarizes these differences and similarities. (See below for sources of quotations)

Term	As Applies to Climate Change Assessment	As Applies to Disaster Risk Assessment
Exposure	"…background climate conditions against which a system operates, and any changes in those conditions…"	Whether someone or something is in a location which can be affected by a hazard.
Sensitivity	"…the responsiveness of a system to climatic influences, and the degree to which changes in climate might affect it *in its current form...*"	Incorporated as part of vulnerability.
Potential Outcome	Exposure and sensitivity	Incorporated as part of vulnerability.
Adaptive Capacity	"Adaptation reflects the ability of a system to change in a way that makes it better equipped to deal with external influences."	Incorporated as part of vulnerability, but only to potential damage and not to risk reduction.
Vulnerability	Exposure, sensitivity, potential outcome and adaptive capacity, as defined in climate change assessment.	The damage which can be done by a hazard event of a specific magnitude, frequency and timing.
Hazard	The change between the current and future climate (e.g., increase in average temperature).	An event which can lead to negative consequences on humans.
Hazard Event	Incorporated in *Exposure – "*...any changes in those conditions"	A occurrence of a hazard of a specific magnitude, timing and frequency
Frequency	Incorporated in *Exposure – "*...any changes in those conditions"	How often a hazard of a specific magnitude will occur.
Magnitude	Incorporated in *exposure – "*...any changes in those conditions"	The physical scale of a hazard event, measured in a standard metric (e.g., mm of precipitation)
Resilience	Similar *to Adaptive Capacity* but only in relation of a hazard event, not reducing the likelihood of future hazard events.	The means which reduce the initial outcome of a hazard event on six capitals; the means to reduce vulnerability.

perceptions of the at risk population to using national level statistics and remotely sensed data. For the purpose of the **Guide,** disaster risk assessment is defined using the following conceptualization drawn from Coburn, et al (1994):

Disaster risk is the combination of:

- A existence of a hazard, defined by its:

[10] This section draws from Coburn A.W., et al (1994).

- Nature, e.g., flooding,
- Frequency or recurrence,
- Magnitude, e.g., depth of flooding,
- Expected impact, or vulnerability, of human, natural, social, physical, financial and political[11] capitals to damage[12] and,
- Resilience of these capitals to possible damage by the event.

Disaster risk can be measured through three approaches. The first approach is based on the collection and analysis of existing data about specific types of disasters that have occurred in the past based in the hazard involved, and to create a projection of possible future impacts. The historical data-based approach is commonly used in risk assessments due to the low relative cost.

The approach is a relatively straightforward, but can face challenges with:

- Insufficient or incomplete data on disasters, including disasters with return periods long return periods (e.g., large earthquakes or precipitation events which take place on the order of 30 to 50 years), and,
- A presumption that the frequency and impacts of future events will be similar to disasters in the past.

As a result, to use this approach requires a clear understanding of the links between:

- Changes in the climate and changes in the extent and frequency of extreme climate event, and,
- Changes in other factors (e.g., population movement) which can affect risk. These other factors can have a significant, non-climate-based, impact on risk.

Because of uncertainties about changes in future climates and risks, adding a level of confidence indicator to historical data-based risk assessments has be done, as in the case of the **SREX** report (Intergovernmental Panel on Climate Change, 2012).

A second approach is to develop models incorporating the five elements of risk (hazard frequency, timing, magnitude, vulnerability and resilience) for a specific hazard at a specific location and then use these models to build projections of future disaster outcomes based on changes in one or more of the risk elements. This process is usually based on historical data, if available, but can use expert conjecture where data is lacking.

One way to incorporate expert conjecture is to use a modification of the Delphi technique. The original Delhi technique uses a set of questionnaires submitted to experts to collect independent opinions about a subject for which limited data is available. The questionnaires are used to assess and collate the individual expert opinions into a single assessment result. These results can then, over several rounds of review by the experts, refined to a high degree of consensus and provide an agreed assessment of risk involved.

For the level of assessment anticipated in this **Guide**, the Delphi technique is modified for use in a open discussion format, with assessment participants openly discussing their views about a specific aspect of risk, e.g., impact of a hazard in specific types of capital based on clear assessment criteria. While this process does not have the rigour of the formal Delphi technique, it provides a structured process by which expert views can be easily brought into the assessment process and yield defendable results.

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[11] Note that *political* capital is added to the standard five sustainable livelihood capitals to reflect the role that government, and governance, play in climate risk management.

[12] In some formulations, *exposure* to a hazard is included. This formulation presumes that risk only occurs where someone is exposed to a hazard: no hazard exposure, no risk. At the same time, *physical* vulnerability can be define by the extent and nature an object or person is exposed to a hazard and this exposure is usually treated separately from the other capitals listed.

This process can provide better medium to long-term results as the expert conjecture can address uncertainties about future changes in hazard parameters. The process does involve more work than simply using past disaster data to define future impacts. The approach is similar to that used for modeling climate change and may be used to generate results at a decade scale which overlap with this climate change modeling.

Where there is sufficient data, time and funding, the modeling approach can be used to understand very locale-specific aspects of risk, often though mapping of possible disaster outcomes. The past disaster data approach is useful at understanding the broader trends in disaster outcomes and as a tool to define where further investigation (often using disaster risk mapping) should be applied.

The third approach involves collecting location-specific data on hazard impacts: not just statistical data on past disasters, but impact data from actual disasters. This data is used to build an understating of the physical and social impacts of specific types of disasters and in turn create models or scenarios that can be used to project future impacts. The difference from the other procedures is that this approach uses directly collected data of impacts rather than records of past disasters. The approach is particularly useful for events with long return periods (most often earthquakes), for low likelihood/high impact events (e.g., glacial lake outbursts affecting major cities), or where historical data is lacking.

The strength of this approach is that it can generate a more exact understanding of what contributes to risk at a local level. At the same time, this approach can be costly, time consuming and can encounter the same issues with projecting future impacts as noted above, particularly in terms of confidence of future climate scenarios and impacts.

Overall, risks assessments tend to be most commonly based on historical data, whether from records or local knowledge. The cost of risk assessments based on detailed field research is such that it is used most often for rare (long return) events and tends to focus on the physical nature of a hazard rather than the larger range of livelihoods impacts possible. All three approaches eventually rely on developing realistic scenarios of future impacts to develop risk assessments which can be used for climate risk management strategies and actions.

E. Risk Assessment Data

The data needed for a climate risk assessment can be divided into four groups with measurement procedures determined by the nature and specificity of the data available. These groupings, to be integrated into a Geographic Information System (see **Section XI**), can be defined as:

- <u>Baseline data</u>, including elevation, administrative boundaries and place names, hydrologic and physical features (including elevation), population (disaggregated by gender) and roads and other infrastructure.

- <u>Hazard data</u>, including the location, frequency, and magnitude of an event. Measurement is normally in terms of the number of events per period of time, often per year, or per 30 years, or up to 100 years for climate change risk assessments.

- <u>Climate hazard damage data</u>, including aggregate damage in economic terms and in detail (e.g, number of lives loss, quantity of goods lost, number of buildings lost, etc.), as well as assistance provided, with analysis presented as per capita loss per hazard and per period, in monetary terms if possible.

- <u>Socio-economic data</u>, covering available natural, social, financial and physical capitals, in terms of number, type and value. Due to variability in data sources and specificity, only indicator data sets for each type of socio-economic data may be used, for instance, per capital access to potable water (e.g., liters per person per day). In general, poverty data is difficult to use as a general socio-economic indicator as determinates of poverty vary across Central Asia, with some countries not recording poverty data. As a result of inconsistencies in socio-economic data across Central Asia, a Delphi-based approach to assess socio-economic parameters is used, with the results analyzed using simple statistical methods.

See **Section XIV, B, Section XII**, **Section XV** and **Annex D** for more details on the assessment GIS and data sets developed for the for the project.

Two general approaches to data collection and analysis can be used. The first is the *garbage-can approach*, where all available data is collected and analyzed. The second approach is the *six-pack approach*, where only data clearly relevant to the risk assessment process is collected and analyzed. The garbage-can approach can appear to be more accurate based on a presumption that more data means greater clarity as to risk.[13]

However, the six-pack approach is more efficient, defining the data to be collected based on specific understood parameters of risk (e.g., monetary damage caused by flooding) and generally of lower cost and level of effort. The six-pack approach is used in the **Central Asia Climate Risk Assessment**, reflecting the limitations on data availability and specificity and time and resources expected to be available for country-level assessments. In practice, this means that while numerous data sets may be collected for the risk assessment, only those with clear links to risk and of sufficient spatial and temporal detail are used in the assessment process.

V. Evidence, Opinions, Perceptions[14]

One of the most significant challenges facing the assessment of climate-relate risks are the variety of opinions about the origins, outcomes and means to address these risks. This is particularly true for climate change, where there can be confusion between climate variability and changes in climatic averages. A similar challenge exists in disaster risk, where there is a strong focus on the hazard and much less attention to the causes of vulnerability or nature of resilience and the tendency for people to focus on recent events, referred to as the *social attenuation of risk* (see Kasperson, et al, 1998).

The assessment of climate-related risks should be driven by evidence and facts, and present results in ways which clear to the intended audience. Where uncertainty is present in the results, it should be clearly noted, as has been done in the **SREX** report (Intergovernmental Panel on Climate Change, 2012). Where the detail and veracity of data is sufficient, more statistics-based methods can be used to present uncertainty (although a screening of available data indicates such methods are not generally usable for the relevant data sets available for risk assessment in Central Asia).

Assessing the perceptions of climate-related risks may seem out of line with the use of historical data to define these risks. Yet, knowing and understanding perceptions about climate-related risks is important as individuals make decisions and prioritize actions based on the perceptions of the risks they face.

Research on perceptions of hazards indicates that human perceptions often differ considerably from those defined based on objective data. Understanding the extent of any gap between objective and perceptive-based assessments of climate-related hazards, threats and impacts is necessary to assure that efforts to address climate risks correspond to actual concerns about these hazards. Where there is a gap between quantitative assessments and perception of risk, a likelihood exists that quantitative-based risk management efforts will not be supported by the at risk population and these efforts will not correspond to individual or societal concerns. Further information on risk perceptions can be found in

[13] The garbage-can/six-pack definitions are drawn from work by the US AID FewsNet (then FEWS – Famine Early Warning System) in the 1980s and 1990s on assessing risks in conditions with limited data of variable specificity.
[14] Based in part on "Fighting Wildfires with Evidence rather than Opinion", Gibbons, (2012).

Slovic and Weber (2002), Kasperson, et al (1998), Pan American Health Organization (no date b) and Federal Emergency Management Agency (2006).

VI. Cross-Cutting Issues

Probably the four most significant cross cutting issues related to climate risk relate to the difference of outcome of specific risks on:

- In relation to the overall environment,
- In relation to health status,
- In relation to age, and,
- On different genders.

These issues and how they can be integrated into the **Guide** are discussed below.

VII. Environment

The environment is the physical structure within which climate operates: climate defines many aspects of an environment, but is influenced by induced changes to the environment (e.g., urban heat islands). Sustainably living in an environment requires considering climatic conditions, extremes and expected changes, and allowing for these in the way that resources are used and protected. Natural capital generally arises from direct conditions of the environment while the other five capitals are generally defined, or limited, by environmental conditions.

From a climate change perspective, adaptation is the process of (1) changing the environment, (2) changing the way life is lived in an environment, or (3) both. These actions can take place over several decades and should sustainably manage the risk posed by change. From a disaster risk management perspective, climate hazards exist within a larger environmental context where the use of the local environmental can (1) result in disasters (e.g., due to deforestation, settlements in flood plains), or (2) reduce disaster frequency or outcome (e.g., re-establishing natural wetlands to reduce flooding).

In practice, measures to manage climate risk outcomes need to consider three questions to ensure they are environmentally sustainable, a condition which presumes that actualized climate risks will not reduce resource availability below appropriate levels in the future:

1. Will the planned measure have a possible negative impact on the environment?

2. Will this impact be mitigated in a way acceptable to those who could be affected?

3. Will these mitigation measures be sustainable?

These questions can addresses through an environmental impact assessment (EIA) of climate risk management options and approaches.[15] In effect, an EIA provides a risk assessment and leads to a definition of environmental risk management measures that complete the climate risk assessment process. An EIA is the natural follow-on to climate-related risk assessments as a way to provide an answer to the questions above. Environmental reviews mandated by countries in Central Asia should be applied to activities intended to manage climate risk and should include consideration of climate factors in assessing possible impacts.

[15] Information on environmental outcome assessments is available at www.iaia.org.

VIII. Health Status

Weather and climate can have specific and significant impacts on human health (as well as for other living organisms). In terms of human health, the most common outcomes come from (1) extremes in temperature and (2) reduced access to basic needs, most often potable water, food, but also health itself (a basic need) and safe living conditions (often related to climate-related hazards and access to natural resources).

The most direct link between human health status and climate risks relates to heat waves and increases in average temperature. As demonstrated in France in 2003 (Vandentorren, et al, 2006) and Chicago in 1995 (Angel, no date), heat waves can have a dramatic outcome on human health within specific age groups (also see **Age** below).

Less dramatic outcomes can slowly develop from climate-related changes in ground and surface water conditions and quantity, particularly where the water supply (and sewage disposal) systems are not themselves adequate to meet demand. These health-related climate outcomes are often manifest as chronic health problems (e.g., endemic disease), with consequent or contributory links between health outcomes and climate-related hazards.

The World Health Organization (WHO) and national health authorities are developing assessment on climate change and health outcomes for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Information on the WHO work can be accessed at http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/Climate-change, as well as from the WHO Regional Office for Europe [16]. The WHO work should serve as a reference for incorporating health related climate outcomes into the climate-related risk assessment process.

In addition, where data is available, for instance on diseases which have a climate risk link, this data should be used to analyze climate-related trends through the climate risk assessment frameworks and climate risk perception process detailed in this **Guide**.

IX. Age

Climate-related risks often have a significant difference in outcome on different age groups. The general understanding of these outcomes is that young children are more susceptible to hazards as they are physically less able to resist the force of these events, or lack experience needed to safely avoid or survive these events.

For the elderly, a similar understanding exists in terms of physical impacts, exacerbated by decreased mobility and at times reduced mental capacities. Further, as indicated above, climate risks have been shown to have specific age-related outcomes, such as arising during heat or cold waves.[17]

There is need for caution in applying these age-based generalizations. For instance, effective disaster planning can reduce the likelihood of physical outcomes on children (e.g., through good land use planning to reduce the risk of flooding) or the elderly (e.g., well organized evacuation plans). Further, the definition of "elderly" is problematic in societies which experience changes in the average age of mortality over short periods to time.

Between the generalizations and caveats, a climate risk assessment should focus on four points:

1. Data on risk outcomes should be disaggregated by age, including data on deaths and injuries, whenever possible.

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[16] Dr Bettina Menne, Climate Change, Sustainable Development and Green Health Services, WHO Regional Office for Europe, European Centre for Environment and Health Hermann-Ehlers-Str. 10, 53113 Bonn, Germany.

[17] See Vandentorren, et al (2006), and Angel (no date).

2. Perceptions of climate risks should include specific perceptions of different age groups.

3. The collection of information about past climate outcomes (due to climate change and disasters) should include the elderly to ensure information on change cover as long a time period as possible.

4. Youth, particularly young adults, should be included in the collection of information on possible future climate outcomes and management measures. This grouo will experience the outcomes for the longest period of time and will be responsible for any measures to address these outcomes.

Further information on the involvement of children in climate risk can be found in **Children in a Changing Climate** (Save the Children, 2009) and the United Nations Children Fund, (2007). Information on the elderly and climate-related risk issues can be found at http://www.helpage.org/what-we-do/climate-change/ created by HelpAge International and **Witness to Climate Change: Learning from Older People's Experience** (Sylvia, 2009).

X. Gender[18]

As with age, climate risks have different outcomes on different genders and these need to be incorporated into the risk assessment process. The **Guidance Note for CA-CRM Programme: Integrating Gender into the Project Activities** (Kaplina, 2012) provides guidance on defining and managing gender issues related to climate risks.[19]

The basic requirements for considering gender in the risk assessment process are:

1. All data is collected with a gender reference where possible (e.g., the data refers to a man, woman, etc.).

2. All analysis incorporates a disaggregation of data and results by gender.

3. The collection of information on perceptions of climate hazards, climate risk and risk management measures should differentiate between the perceptions of men and boys and women and girls. (This requirement is also linked to the issue of age, noted above.)

In addition to the position paper on gender and climate developed by United Nations Development Program (2010), other sources include the Gender and Disaster Network (http://www.gdnonline.org/), CARE (2010), Oxfam (2010), and Skinner (2011).

XI. Geographic Information Systems

Geographic Information Systems (GIS) provide an efficient tool for managing and presenting climate risk related data. A GIS serves as a convenient repository for the data collected on climate, hazards, vulnerability and other factors. A GIS also provides a tool for graphically presenting data through mapping and provides a powerful graphical interface to visualize data and aid in decision-making process.

A GIS can include data in two formats: raster and vector. Vector data is formed by a graphic (mapping) interface and the tabular interface which contains numerous data in text or numeral format. Those two formats are linked between themselves and in way allow numerous comparisons and

[18] Note that the word gender can include men/boys, women/girls as well as a number of other designations. Given the data expected to be available in Central Asia, only the men/boys-women/girls classifications will be used.

[19] A copy of the document is available from Yegor Volovik, Regional CA-CRM Programme Coordinator, Almaty, yegor.volovik@undp.org.

calculations. As a result, a GIS provides the means to overlay different data “layers” for the same location compare this overlaying between different locations. The result of this comparison can be presented in both tabular and graphic (map) format.

Use of a GIS as the analytical platform for climate risk analysis does require attention to several key issues. First, the accuracy of any analysis is defined by the smallest scale (least detailed) data which is used. This is true for two existing interface of data visualisation geographical and tabular. For the geographical format the analysis is defined by the smallest scale of vectorization (for vector format) or the largest raster collecting resolution (for raster data). In other worlds when comparing data with 10 km resolution with data with 5 km resolution, the obtained result will have a 10 km resolution. For the tabular data, when comparing data collected at the district scale to data collected at the national scale, the result is specific to the national, not the district, level.

Second, the data collections need to come from approximately the same time period and, as far as it possible, for up to the most recent point possible. Indeed, comparing data from 2010 for a country and 2002 for another one will give distorted results.

Third, it is important to clearly identify and understand any conditions which may be associated with the data being used. For instance, data on income from various sources may be collected using different methods and assumptions and may not actually be comparable. If used, these data sets may appear to represent the same indicator but result in inaccurate results since the way the data was collected differed. To understand and know the reliability of indicators, knowledge about how the data was developed is very important.

Fourth, analysis needs to be based on the same unit of measure, for instance, value of crop production and value of irrigation water, or as a ratio of different indicators, for instance, the grain production (tons) to precipitation (millimetres). Using the same unit of measure is preferred, but ratios between indicators are more common due to the challenges of converting different indicators into the same unit of measurement. Note, also, that it is difficult to expand GIS-based analysis beyond comparing the ratio of two indicators if conversion to a common unit of measurement is not possible.

Finally, when presenting analytical results across different locations, the range of units between steps needs to be kept uniform. For instance, the results of comparing the ratio between annual precipitation and wheat production should not be divided into five levels for one location and four levels for another location. This standardization of the interval between data outputs needs attention where there is a wide variability in the data being analysed. For instance, if the ratio of cereal production to precipitation ranges from 2 to 23 in one location and 10 to 31 in another location, the interval between the data used to group the data needs to incorporate both data sets (i.e., include values from 2 to 31) and the intervals between the lowest and highest numbers needs to reflect the spread of data between the lowest and highest units.

To face the issues summarized above, a good knowledge of metadata sources and good and compatible calculation procedures are needed. To standardize how data is organized in a GIS and to ensure that analytical procedures and results are conform to best practice standards, a GIS specialist should manage the GIS used for a climate risk assessment. This specialist can also ensure that industry standards are followed when managing data bases, analysis and presenting results, for instance in creating indicators and formatting output maps.

Annex D contains a summary of the data contained in the GIS used for the Central Asia Climate Risk Assessment at the time this **Guide** was drafted.

XII. Non-Climate Factors

Non-climate factors can have a significant impact on the outcome of climate hazards on society, as well as increasing or diminishing climate-related risks. Because of the wide range of non-climate factors which can affect the outcomes of climate, the process outlined in this **Guide** focuses first on defining the climate-related factors which influence or define specific risks.

Where climate factors do not appear to make a significant contribution to risk impacts then the assessment process should identify which other factors may be determining or making a significant contribution to climate risks. Where possible, these risks should be incorporated into the process of calculating risk. Where these non-climate factors cannot be quantified or incorporated onto the risk quantification process, they should be noted as having a direct, but un-quantified, outcome on climate-related risks.

XIII. Limitations – Data, Models and Resources

The success of the risk assessment process set out in the **Guide** is dependent on sufficient appropriate data for the scale assessment undertaken. A preliminary review indicates that:

- Data on the physical parameters of climate-related hazards (e.g., what caused flooding in a location) are relatively well understood. These understandings of hazard events can be used with a high level of confidence that they represent actual conditions.
- Data on climate parameters (e.g., temperature, precipitation) varies in continuity of collection and spatial coverage across Central Asia. The data has a moderate to high level of confidence and a low to moderate level of spatial coverage depending on the country.
- Data on impacts (e.g., damage, event consequences) of past climate events is available at different scales, has been collected using different methods, and is not available for some locations. This data can be used with a low to moderate level of confidence that accurately represents historical or future damage, but may be considered to be representative rather than a precise statement of national or, particularly, sub-national, outcomes.
- Data on socio-economic factors varies considerably across Central Asia in coverage and time. This set of data has a low to moderate level of confidence that it accurately represents conditions in a specific country or sub-national region. Gaps in the availability of this data necessitate an alternative process for assessing socio-economic factors in a risk assessment.

In a number of cases, data on specific climate risk assessment topics is not available for specific countries or for sub-national regions and alternative methods need to be developed to fill these gaps.

The models used to predict climate change outcomes face challenges when applied to sub-national and local scales, including the considerable local variation in climate found in mountainous areas. Frameworks for defining climate-related hazard outcomes (i.e., analytical frameworks) can include potential inaccuracies when being up-scaled from locale-specific assessments to a sub-national or national level. This weaknesses should be noted when a specific model or framework is used.

The climate risk assessment process defined in the **Guide** presumes sufficient human and financial resources to conduct the necessary data collection and analysis. Where resources are insufficient, this should be indicated in any assessment output and reflected in stated limitations of the assessment results.

Given the limitations which can be faced with data and analytical efforts, the **Guide** adopts the system used for the **SREX** report (Intergovernmental Panel on Climate Change, 2012) in assigning levels of confidence to specific assessment results, and describing the known limitations affecting these results.

XIV. Central Asia Climate Risk Assessment Methodology

A. Overview

The climate-related risk assessment approach identified for Central Asia is based on an input-impact conceptualization of the links between climate and society. The conceptualization is actualized as

- An impact-based assessment of climate events, and
- A perception-based assessment of climate impact consequences and management options.

Both components are based on establishing analytical frameworks for defined combinations of climate-related hazards, impacts and outcomes, with the outcomes allocated across different vulnerabilities, i.e., physical, human, financial, social, natural and political capitals. The spatial focus of the assessment is, where possible, on the Oblast/Province/Region, or on a lower level where data is available.

The outputs of the assessment process provide:

- A level of risk (*vulnerability*[20]) for a specific combination of hazard intensity at a location in monetary value of expected physical damage per capita for an event of a specific frequency (*exposure*), and vulnerability (*sensitivity*), in terms of impact scoring for impacts for which monetary value cannot be assigned. (See **Different Terms**, **Same Process** box, right)
- The hazard impact in six areas of vulnerabilities (capitals), for use in defining risk reduction measures.
- Preferences in terms of risk management options on the part of at risk populations.

Different Terms, Same Process
The following paragraphs define the risk assessment process using the terminology used in climate change and disaster risk assessments. The data used and outcomes are the same for both processes although adaptive capacity is assessed only to the extent it is reflected in actual or expected conditions, not possible future changes in policy or practice.

Climate Change
Exposure and sensitivity equals potential outcome. Potential outcome and adaptive capacity equals vulnerability. Vulnerability to climate outcomes is defined in terms of cost per capita and other outcomes and management actions related to the event

Disaster Risk
The characteristics of a hazard impacting on six types of capital at risk, defined in terms of cost per capita and other outcomes and management actions related to the event.

For the outcome based climate risk assessment, the analytical framework is developed by:

1. Defining the parameters of a climate-related hazard (physical parameters for what triggers an event).
2. Defining the frequency of the event.
3. Defining the link (correlation) between events and climate conditions (e.g., precipitation, temperature, etc.).
4. Defining the link between a climate-related hazard parameter or combination of parameters (direct, consequent, contributory) and specific impacts for the six types of vulnerabilities for a specific return period for a specific population at risk.[21]
5. Quantifying the economic value of these impacts where possible.
6. Describing the impacts where they cannot be assigned an economic value.

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[20] Italicized words refer to climate change terminology.
[21] Cumulative outcomes for shorter return periods may be greater than outcomes from single events with longer return periods. A further review of the data collected for the climate risk assessment can be used to assess whether this occurs in Central Asia.

Quantified risks (e.g., economic value of impact per capita exposed) are then compared to define the relative importance of each risk relative to the overall range of climate-related risks.

The perception-based assessment of climate outcomes is based on the following steps:

1. Defining the outcomes of a climate-related hazard on vulnerabilities (from the analytical framework), for specific return periods and at risk populations.

2. Framing the outcomes on vulnerabilities as specific outcomes on society (individuals, specific groups and society as a whole).

3. Soliciting views of potentially affected populations as to their perceptions as to the importance of these hazards and impacts.

4. Soliciting view from the potentially affected how these outcomes can be managed by individuals, groups (e.g., age, gender) and society as a whole.

5. Using economic value (willingness to pay to manage these risks) to identify the degree to which the potentially affected are willing to take actions to address the risks.

Steps 1 and 2 of this process are accomplished through a Delphi-based expert assessment. Steps 3, 4 and 5 are accomplished through a perception survey of at risk populations.

Due to data limitations, the range of indicators used for specific types of vulnerability (the six capitals) will likely be limited. For physical capital, the relevant indicator is the monetary value of physical damage less any off-setting post disaster assistance provided. Standard indicators for the other types of capitals are suggested below (see **Scaling Capital Impacts for Climate Hazards** table, below). These indicators need to be confirmed before an assessment process begins. The same indicators should be used for all assessment where the results are to be compared.

As noted above, the result of both assessment procedures will incorporate a statement of confidence in the results and note why a specific level of confidence has been identified.

This overall approach also enables a selective approach to (1) sectors (e.g., assessing only agriculture), (2) locations or (3) specific hazards. This selectivity can be useful where specific sectors, locations or hazards are more important than others for reasons of mandate, policy, funding or expected outcome.

Data availability and quality vary considerably across Central Asia. A selective approach to assessing risk may be more enlightening, and more useful to effect policy development and management practice, than attempting a comprehensive assessment effort where there is low confidence in the results.

B. Linking Climate Hazards to Vulnerability to Identify Risk

This section provides a more detailed description of the impact-based assessment of climate-related risks. The first element of the risk assessment is created by defining the parameters of a climate-related hazard for a specific return period. (See the **Climate-Related Hazards** box, above.)

These parameters generally relate to precipitation, air temperature, wind speed and humidity but can also include day length, ground temperature, soil moisture and similar indicators of climatic conditions. These parameters can also be part of consequent hazards and contribute to other hazards, i.e., through a combination of parameters. In developing this element of the assessment it is best to start with one parameter and add parameters which make a significant contribution to the hazard being considered.

Specific attention is needed to assure that return periods for the hazards are clearly defined and realistic. In general, return periods cover once per year, once in five years, once in thirty years and once in one hundred years. Periods beyond 100 years are generally more appropriate for seismic, volcanic or magnetic and space events than for the climate-related events. The exception is continental glaciations, which is not covered in this **Guide**.

The second element of the risk assessment is created by assessing whether climate parameters and climate impacts are closely, loosely, or not, correlated. The assessment of climate risks presumes that the focus of the assessment is on impacts that are influenced by the climate. However, there are other factors which can contribute to impacts on lives and livelihoods even when climate appears to be of obvious importance. The correlation process helps define how well apparent climate-related hazards and climate parameters are related, if at all.

The third element of the risk assessment is created by identifying specific impacts of a hazard event taking place, i.e., of the identified parameters having an outcome on individuals. Often, a number of outcomes occur in relation to a specific hazard parameter. There can also be an overlap or hazard parameters and outcomes. For instance, heavy rainfall can result in damage to leaves, the creation of pools of water, flooding and contribute to an epidemic of disease transmitted by vectors living in wet areas. Where possible, these consequent and contributory hazards and outcomes should be included in the framework under a single initial hazard parameter.

The fourth element of the risk assessment defines impacts in terms of damage, or the vulnerability (the six capitals), of the population at risk. Physical damage should be defined in terms of per capita monetary cost of damage less assistance provided. (Although the impact of a climate hazard on financial capital can also be assessed in monetary terms, it is unlikely sufficient data is available to do this in the current context.)

The monetary quantification of the physical vulnerability impacts provides a direct link between a climate hazard parameter and specific outcomes occurring over a defined period. This result can be presented as a statement that *the risk of event A over the period B equals a cost of x amount per capita per year*. Similar statements can be used to compare risk due different hazards over different periods.

For calculating per capita results beyond one year, the end year population should be used. Where known, damage costs estimated over more than one year should be deflated for the years of the return period, that is deflated for ten years for a return period of ten years.

With some exceptions, other impacts need to be defined in qualitative terms and use standard indicators and standard scaling of the levels of impact. A set of indicators and scaling structure is provided below (see **Scaling Capital Impacts for Climate Hazards** table below)[22]. In most cases, this process uses descriptive criteria and are to be rated by the team doing the assessment.[23] In this rating process attention should be paid to the means available to recover from the hazard event (resilience) with the resulting outcome incorporating resilience factors.

One exception to the qualitative scaling of climate outcomes is health outcomes (part of human capital). Where data exists in terms of outcomes of climate-related risks on health, then this information should be incorporated as a specific per capita outcome (e.g., deaths per capita, increased disease cases per capita) in the framework. (Because of the difficulty of valuing life in Central Asia, deaths and morbidity outcomes should be reported as per capita ratios and not as part of the monetary damage under physical capital.)

The statement of confidence for each risk assessment should be framed in terms of the how well the person or team conducting the assessment thinks the results accurately reflect accrual levels of risk. The confidence statement should refer to low, medium or high level of confidence and be based on the

[22] This approach draws on the Integrated Food Security Phase Classification System. See http://www.ipcinfo.org/.
[23] A description of what is covered under each type of capital can be found at http://www.poverty-wellbeing.net/media/sla/docs/3-3.htm.

(1) data used in the assessment, (2) the perceived accuracy of the assessment process (framework or model) and (3) accuracy of the damage date used to calculate the level of risk.

Finally, a short commentary should be provided indicating whether there are any significant non-climate factors which may affect the climate hazard or outcomes. This commentary should indicate specifically whether the stated outcomes as significantly affected by non-climate factors and the nature of these factors. For example, if movement of people into flood zones is significantly affecting outcomes, then this non-climate factor should be noted.

Scaling Capital Impacts for Climate Hazards[24]					
Type of Capital	Level of Impact on At Risk Populations				
	Insignificant	*Low*	*Medium*	*High*	*Extreme*
Human[25]	No negative outcome on health.	Temporary negative outcome on health; no deaths.	Limited, short term negative outcome on health; few deaths.	Large numbers of persons experiencing negative health impacts, one or more deaths.	Widespread health impacts and deaths above 1:100,000 affected population.
Financial	No loss income or financial assets	Temporary loss of work.	Loss of work extended for several months.	Loss of work extending for more than six months .	Near total loss of income and financial assets.
Social	No need for reliance on social network for support.	Occasional reliance on social network for support.	Heavy reliance on social network for support, but for only 1-3 months.	More than a year reliance on social network for support.	Total reliance on social network for basic needs.
Natural	No damage to natural resources.	Temporary reduced access to natural resources needed to meet basic needs.	Reduced access to natural resources for 3-4 months needed to meet normal needs.	Extended reduced access to natural resources needed to meet normal needs.	No access to natural resources due to damage or change in location or access.
Political	Comprehensive government response.	Minor gaps in government response.	Some government assistance but significant unmet needs.	Very limited government response.	No government response to event.

A final element of the risk assessment process is to define future changes to climate risks. This is accomplished by using the information from the framework as input into scenario-based projections of change over a defined time period, e.g., 20 years. For instance, a scenario can use damage data and a per annum growth rate to project cumulative damage at the end of 20 years presuming no risk management actions, or an increase or decrease in climate-related events. While not precise, or as detailed and complex as climate change modeling, the results can contribute to framing risk management options, strategies and actions.

C. Perception-Based Assessment of Climate Risk Consequences and Management

1. Overview

Understanding the perceptions of individuals, groups and society in general in terms of climate risk is important for three reasons:

[24] This table should be updated by the assessment team but used consistently for all assessments which are to be compared.
[25] Note that if mortality and morbidity are available, then these indicators should be replaced by these indicators.

1. People are unlikely to take or support actions which attempt to address risks which they do not see as important.

2. Where the perception of risks by a population differs from an expert research-based understanding then it is possible that a population will severely affected by a disaster of which they were not aware.

3. There is not an unlimited amount of resources available to address risks. Individuals, groups and society have preferences in terms of what risks they want addressed and what they are willing to pay to reduce a specific risk.

The ways to collect risk perception data fall broadly between the use of a questionnaire administered to one or more persons and discussions with groups of individuals representing society as a whole or specific sub-groups, e.g., women, children, farmers, etc.. In general, a survey using a questionnaire is more costly than group discussions but the results are more amenable to statistical analysis and to track change over time.

At the same time, group discussions can gain a better understanding of local or group-specific concerns and prove to be more useful in creating a narrative about how a risk is perceived and could be managed. One caution with group discussions is that normal memory of weather and climate is relatively short, and often heavily influenced by near term conditions. Under these conditions it can be difficult to collect accurate information on long term climate change when defined as a change in averages over thirty years or more.

Another difference between a questionnaire approach and the discussion group approach is in the data analysis. Questionnaires usually lead to a process of data entry and statistical analysis that, if properly organized in advance, can result in relatively quick results stated numerically.

Discussion group results are usually in the form of notes. These notes need to be transcribed and summarized as results or reviewed on the basis of key word and phrased, this information extracted and analyzed using specific procedures (e.g., frequency and association analysis).

An intermediate approach is to develop a questionnaire and use it as a question guide for group discussions. This allows the same topics to be raised with reach group of respondents but retains the respective advantages of administering a questionnaire or using discussion groups to collect information on perceptions.

2. Sample Size and Survey Criteria

The web site http://www.surveysystem.com/sscalc.htm provides guidance on sample size and other survey criteria where a questionnaire is used. Selecting discussion groups is usually done based on specific intent (e.g., to survey farmers) and calculating a sample size is generally not an issue. However, with both approaches it is necessary to ensure that the number of people selected is representative of the larger population and care is needed to ensure that there are no unintended biases incorporated into the selection of participants in a questionnaire or group discussion survey process.

Normal survey procedures, including disclosing the purpose of the survey, how the information will be used and participant agreement to be part of the survey, should be followed. It is expected that persons experienced in group discussions or questionnaire survey work should be charged to develop and lead any climate risk survey process.

3. Data Disaggregation

All survey data collected should contain information which allows disaggregation by at least gender and, where appropriate, age groups, occupation or other important characteristic. For questionnaires, this is done by including questions related to gender, age and other characteristics in the data collection form. For the discussion group process, the gender, age, occupation and other similar data comes from either counting the number of specific types of participants (e.g., number of men), asking participants (e.g., number of farmers) or defining discussion groups which represent a specific group of interest (e.g., school children).

Results should always indicate gender participation (e.g., number of women/girls of total) as well as age and occupation when these are significant to the purpose of the risk being assessed.

4. Climate Risk Perception Questionnaire Summary

The following section describes the elements of a climate risk perception questionnaire. The section provides (1) actual elements of the questionnaire and (2) descriptions of content where these depend on the actual use of the questionnaire, indicated by a “>” and *italic* text. To allow for flexibility in structuring the action questionnaire, the questions are framed as instructions to the person administering the questionnaire or using it as a question guide.

This questionnaire, and any questions guide based on it, need to be tested before being used for an actual survey. Further, a clear process needs to be established before the survey work for processing data and providing results, include data entry, transcribing notes and what types of statistical analysis to be performed.

Additional questions can be added to the draft questionnaire below. However, the intent is to have a short, focused and quick survey tool to keep the cost and level of effort needed for a survey to a minimum.

1. Date of survey

2. Name of surveyor

3. Location of survey: town or geographic reference (e.g., from a GPS)

>Explanation as to the purpose, content and use of the survey. (This explanation can be provided on a written card and also read to the survey participant.)

4. Signature agreeing to participate in the survey

5. Gender of respondent

6. Age of respondent

7. Occupation of the respondent

8. Number of persons in the family of the respondent

9. Is the respondent the head of the household?

> Short explanation of the meanings of the technical terms to be used for the survey, including climate, hazard, vulnerability, risk and the specific hazards to be covered. (This explanation can be provided on a written card give to the participant, and also read to the participant.)

10. Ask the participant to list the climate-related hazards that affect the location where the survey is taking place.

>This question can have an open ended response (the participant provides the answer without prompting), or the participant can be provided with a list of hazards with summary descriptions (the list of hazards should be drawn from the analytical frameworks developed for the area where they survey is taking place) which is used to select hazards.

The advantage of providing a list is that it is quicker and focused. Using a list allows for the introduction of longer term climate risks (e.g., increased average temperature) which may not be noted independently by the participant. An open ended answer approach can be used to learn the participant's level of awareness of hazards but probably will not include longer term risks.

11. Ask the participant to indicate how often each hazard occurs in terms of each year, each 5 years, each decade and each 30 year period.

> Make the answers on the table completed as part of Question 10.

12. Using the list of hazards which have been identified, ask the participant to rank these hazards from the most important to the least important in terms of their outcome on her alone.

> To facilitate this process, the hazards listed by the participant should be first written down or the list provided for Question 10 be provide for the ranking process.

13. Starting with the highest ranking hazard and covering each of the other hazards, ask the participant to indicate why the ranking was given.

> The answer will be in narrative format and need to be coded by key words when processing the response. The list of hazards developed under Question 10 should be used to guide the answer.

14. Ask the participant if she has experienced any direct or indirect outcomes from the hazard she has identified? If yes, record for each hazard as provided by the respondent.

> This response may cover much of the same information as provided in the previous question, but allows for ensuring an in depth collection of information on outcomes. The list of hazards developed under Question 10 should be used to guide the answer. The answer will be in narrative format and need to be coded by key words when processing the response.

15. Ask the participant of specific hazards have different outcomes on men and women, children, the elderly and other groups?

> Use the previous list of hazards identified and the following matrix to record the results. Add specific groups of interest, e.g., traders, store owners, etc.

Hazard	**Specific Outcomes**				
	Men	Women	Children	Elderly	Other Groups

16. Ask the participant what they would do to reduce the outcomes for the hazards which have been identified.

> The answer will be in narrative format and needs to be coded by key words when processing the response. The list of hazards developed under Question 10 should be used to guide the answer. The following table can be used to record the responses.

Hazard	**Management Actions**				

For each hazard and action ask the participant to prioritize the actions which he or she has identified, with 1 as most important.

> Use the table developed for Question 16 to quickly note the priorities. These priority numbers can be noted directly on the table by the participant or interviewer.

17. Ask the participant how they would spend the local currency equivalent of US$ 5,000 to reduce any of the outcomes of the hazards listed. The respondent can (a) allocate all the funds to one option to reduce an outcome, (b) divide the funds between several measures, (c) decide to not spend any funds or (d) keep the funds for themselves and not spend any on risk reduction.

> Use the table used in Question 17 to note how the funds would be spent as percentage of the total. If no funds are to be used, or if the funds are to be kept by the participant, this should be noted at the bottom of the table.

19. Ask the participant if they had anything to add to the survey or if there was anything that they survey did not cover.

> The answer will be in narrative format and need to be coded by key words when processing the response.

> Close the interview by repeating the purpose of the survey and how the results will be used.

5. Data Analysis Summary

The following analysis should be included in a report on the risk perception survey with reference to the data collected. Data should be reported through tables, charts and in narrative summaries.

Question #	**Topic**	**Analytical Result**
3	Location of survey	Mapping of location to the municipal level.
4	Signature agreeing to participate in the survey	Note of agreement to participate.
5	Gender of respondent	Results disaggregated by gender.
6	Age of respondent	Results disaggregated by age.
7	Occupation of the respondent	Results disaggregated by occupation.
8	Number of persons in the family of the respondent	Results disaggregated by size of family.
9	Is the respondent the head of the household?	Results disaggregated by status as head of household.
10	Ask the participant to list the climate-related hazards which affect the location where the survey is taking place.	List of climate hazards according frequency of mention, disaggregated by gender, age and occupation.
11	Ask the participant to indicate how often each hazard occurs in terms of each year, each 5 years, each decade and each 30 year period.	Climate hazards ranked according to frequency of occurrence (per year, every 5 years, decade, 30 years), disaggregated by gender, age and occupation of respondent.
12	Using the list of hazards which have been identified, ask the participant to rank these hazards from the most important to the least important in terms of their outcome on her and her community.	Ranking of hazards from most to least important, disaggregated by gender, age and occupation of respondent.
13	Starting with the highest ranking hazard and covering each of the other hazards, ask the participant to indicate why the ranking was given.	Narrative summary of responses based on key words/content analysis and noting variations by gender, age and occupation.
14	Ask the participant if she has experienced any direct or indirect outcomes from the hazard she has identified? If yes, record for each hazard.	Frequency of outcomes grouped by hazard and disaggregated by gender, age and occupation of respondent.
15	Ask the participant of specific hazards have different outcomes on men and women, children, the elderly	Frequency of outcomes by each group. Note that outcomes will need to be grouped based on content

	and other groups?	analysis.
16	Ask the participant what they would do to reduce the outcomes for the hazards which have been identified.	Narrative summary of responses based on key words/content analysis and noting variations by gender, age and occupation.
17	For each hazard and action ask the participant to prioritize the actions which he or she has identified, with 1 as most important.	Listing of prioritized actions (based on key words/content analysis) noting variations by gender, age and occupation.
18	Ask the participant how they would spend the local currency equivalent of USD 5,000 to reduce any of the outcomes of the hazards listed. The respondent can (a) allocate all the funds to one option to reduce outcome, (b) divide the funds between several measures, (c) decide to not spend any funds or (d) keep the funds for themselves and not spend any on risk reduction.	Frequency of allocation of funds across outcome management options. These options will need to be grouped through key word/content analysis), noting variations by gender, age and occupation.
19	Ask the participant if they had anything to add to the survey or if there was anything that they survey did not cover.	Narrative summary of comments, noting variations by gender, age and occupation.

6. Contrasting Perception and Expert Results[26]

Local perceptions and expert assessments of climate conditions and impact do not always correspond because of the different perspectives taken in the respective assessment processes. Because risk management strategies and actions are often based on expert assessments of impacts, contrasting the expert to perception results is important to avoid risk management efforts which lack local support.

This comparison is most effectively done by creating a table with assessment topics along the vertical side (e.g., "are temperatures increasing) and indicating expert and perception responses under the respective headings to the right of the table. The results will indicate

- Where there is agreement as to climate impacts,
- Where expert views need to be communicated to the at-risk populations to improve local understanding of climate conditions and impacts, or
- Where experts need to reconsider their data and analysis, as local observations and perceptions may accurately reflect local conditions.

XV. Step-by-Step Climate Risk Assessment Process

The following sub-sections lay out seven practical steps to implement the climate risk assessment process described in more conceptual terms in preceding parts of this **Guide**. These procedures are based on an empirical/historical data process but can be modified for use with the inductive data generation process is used.

The process described below is considerably facilitated though the development of data bases of climate data and impacts. Use of a geographic information structure (GIS) will facilitate the management of the data and the presentation of results.

A. Identify Correlation between Climate-Related Hazards and Climate Parameters

Two procedures can be used to define the degree of correlation between climate-related hazards and climate parameters, as described below. Either process begins with assembling data bases covering

[26] This process was piloted by CAMP Alatoo in the Suusamyr Valley, Kyrgyzstan, with funding from the UNDP Central Asia Climate Risk Management Program.

- Climate related hazard impacts (e.g., flood disaster damage or crop losses due to long term reductions in precipitation) and
- Climate parameters, most often precipitation and temperature, linked to the nature of the hazard being considered.

The preference is for as long as possible data sets (e.g., 30 years) for a better correlation assessment, and to identify whether there have been any changes in climate or event trends over time. At a minimum, ten years of data should be used.

Short Period Data

Where only a short period of data is available (i.e., less than 20 years), a year-by-year comparison of hazard event occurrence and climate parameters can be made. This is done by:

1. Defining expected links between hazard events and climate parameters, e.g., precipitation and flooding.

2. Assembling data sets for these events and parameters.

3. Establishing the average number of events and average climate parameter (e.g., precipitation) for the period for which data is available (e.g., annual average precipitation and floods over 10 years.) These averages can be annual or for a series of months (e.g., January to June) where this period is linked to the hazard being considered (e.g., flooding).

4. Comparing specific hazard or climate data for each period of analysis against the overall averages for the same period. For instance, the total number of flood events (where flooding normally takes place between January and June) as a percentage of the average number of flood events and the precipitation for January to June for one year against the average for 10 years for the same months.

5. Subtracting one period-of-analysis percentage from the other for the same period. The closer the result is to "0", the closer the correlation between the events and the parameter.

The analysis should be done at the lowest spatial level for which reliable event and climate data is available. The results are indicative and not statistically significant and have limited predictive value. Managing the data records and the calculation process can be done using Excel® or similar software.

An example of the results of this process is provided below ("**Table 2**").[27] The gray tone cells indicate a possible correlation. (Negative or positive numbers are not important to the process.)

Note that where there are no or limited indications of correlations, as indicated in the example below, other-than-climate factors may influence event occurrence (and impacts). In this case, these non-climate factors need further assessment before planning risk management strategies and activities.

Table 2

Degree of Correlation Between Precipitation and Disaster Events – Batken Oblast

Annual % of 10 year average disasters subtracted from annual % of 10 year precipitation average.

Disaster and Period of Data Used	2000	2001	2002	2003	2004	2006	2007	2008	2009	2010
Floods and Flash Floods, Jan-June Precipitation Data	0.60	-0.03	-0.47	1.03	-0.55	0.20	-0.06	-1.18	0.16	0.30

[27] From **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

Landslides, Jan-June Precipitation Data	0.74	0.32	-0.95	-0.44	-0.05	-1.05	1.14	-0.26	0.59	-0.04
Avalanches, Oct-March Precipitation Data	-8.72	1.91	2.48	2.29	2.26	1.99	2.77	1.86	2.17	2.75
Heavy Snow, Oct - March Precipitation Data	1.28	-0.59	2.48	2.29	2.26	1.99	2.77	-5.64	2.17	2.75
Storms & Hail, Jan-June Precipitation Data	0.74	-0.59	-0.04	1.38	-1.87	-1.05	1.14	-1.17	0.59	-0.87
Storms & Hail, Annual Precipitation Data	0.90	-0.17	0.19	1.20	-1.57	-1.07	0.92	-1.27	0.45	0.42

Long Period Data

Where more than twenty (and preferably at least thirty) years of event and climate data are available, a more standard correlation analysis can be made. This is done by:

1. Defining expected links between hazard events and climate parameters, e.g., precipitation and flooding).

2. Assembling data sets for these events and parameters.

3. Performing a statistical correlation analysis for the two data sets. The analysis should be done at the lowest spatial level for which reliable event and climate data is available. The calculation process can be done using Excel® or similar software.

An example of comparing crop yields to the standard precipitation index (SPI – a statistical indication of precipitation levels for each period compared to precipitation for the overall period of analysis[28]) is provided below ("**Table 10**").[29] The shaded cells indicate a correlation between yield and SPI. This type of analysis can be used assess whether projections of future SPI can be used to project yield, and eventually crop production.

Table 10

SPI- Agriculture Production Correlation – Chui and Talas Oblasts

Results presented as Correlation Coefficient Squared

Assessment Period – 1991 to 2011

Crop and Period of Analysis	**End-Month of Analysis**									
	March	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
All Cereals – 6 month period of analysis	0.106	0.166	0.18	0.193	0.165	0.150	0.261			
All Cereals - 8 month period of analysis	0.178	0.137	0.157	0.221	0.234	0.239	0.209			
All Cereals - 10 month period of analysis	0.075	0.128	0.212	0.263	0.260	0.332	0.341	0.343	0.290	0.274
Wheat - 7 month period of analysis	0.203	0.222	0.261	0.254	0.255	0.236	0.180			
Barley - 9 month period of analysis	0.074	0.181	0.274	0.316	0.412	0.444	0.446			
Barley - 10 month period of analysis	0.012	0.022	0.122	0.269	0.360	0.460	0.488	0.496	0.428	0.392
Oil Crops – 7 month period of analysis	0.	0.002	0.020	0.021	0.026	0.017	0.022			

[28] For more information on SPI see http://drought.unl.edu/portals/0/docs/spi-program-alternative-method.pdf.
[29] Modified from **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

Potatoes - 7 month period of analysis	0.001	0.005	0.	0.003	0.003	0.	0.003		

B. Define Impacts of Climate Events in Terms Of Reported Damage

The process assesses how significant vulnerabilities have been affected by climate events in monetary terms. The process is relatively simple:

1. For each type of disaster, for each year and for each unit of analysis (e.g., Province, District) establish the value of damage done by climate-related events.

2. Subtract any assistance provided from the damage per unit and period of analysis.

3. Deflate the results if necessary.

4. Convert the results to US Dollars or Euros for comparison between different local currencies.

5. Total the results for each type of event and unit of analysis.

6. Divide the result by the at risk population on an annual basis to create a per capita per year level of damage.

7. Use the results to define the most to least significant types of events.

The period of analysis should be at least ten and preferably more than twenty years.

Three examples of outputs from this analysis are provided below. The first, "**Table 11**"[30], provides the total reported damage per Oblast for five types of climate-related events in Kyrgyzstan. This table indicates which Oblast are more or less affected in terms of total damage.

The second table, "**Table 12**"[31], provides the same results in per year per capita damage. Of note is that the ranking of most-to-least affected Oblasts changes from the first table. This second table is more useful in defining the real level of impact of climate-related events.

Both tables also indicate the significant difference in level of losses between different administrative units and for different types of events. The same analysis can be done for any type of event for which damage can be documented and the results compared across types of events at the level of total damage ("**Table 11**") or per capita damage ("**Table 12**").

Table 11

Total Estimated Damage, Climate Events

US Dollars, Adjusted for Inflation, 2000-2011[32]

Oblast	Landslides	Avalanches	Floods and Flash Floods	Storms and High Wind	Hail	Heavy Snowfall (Blizzard)	Total Estimated Damage
Talas	0	22,164	3,030,756	119,253	0	232,851	3,405,024
Chui	64,045	100,456	4,782,898	194,751	39,190	433,908	5,615,248
Naryn	100,575	124,051	2,778,461	61,484	2,435	1,003,953	4,070,960

[30] From **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).
[31] From **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).
[32] Excluding 2005.

Issyl Kul	27,954	116,858	3,339,283	301,746	22,602	1,016,970	4,825,414
Jalal Abad	439,924	262,656	23,095,707	117,396	17,433	862,231	24,795,347
Batken	75,158	916	3,711,638	64,622	0	334,513	14,186,847
Osh	659,752	150,944	15,591,952	165,496	0	1,033,300	17,601,444

Table 12

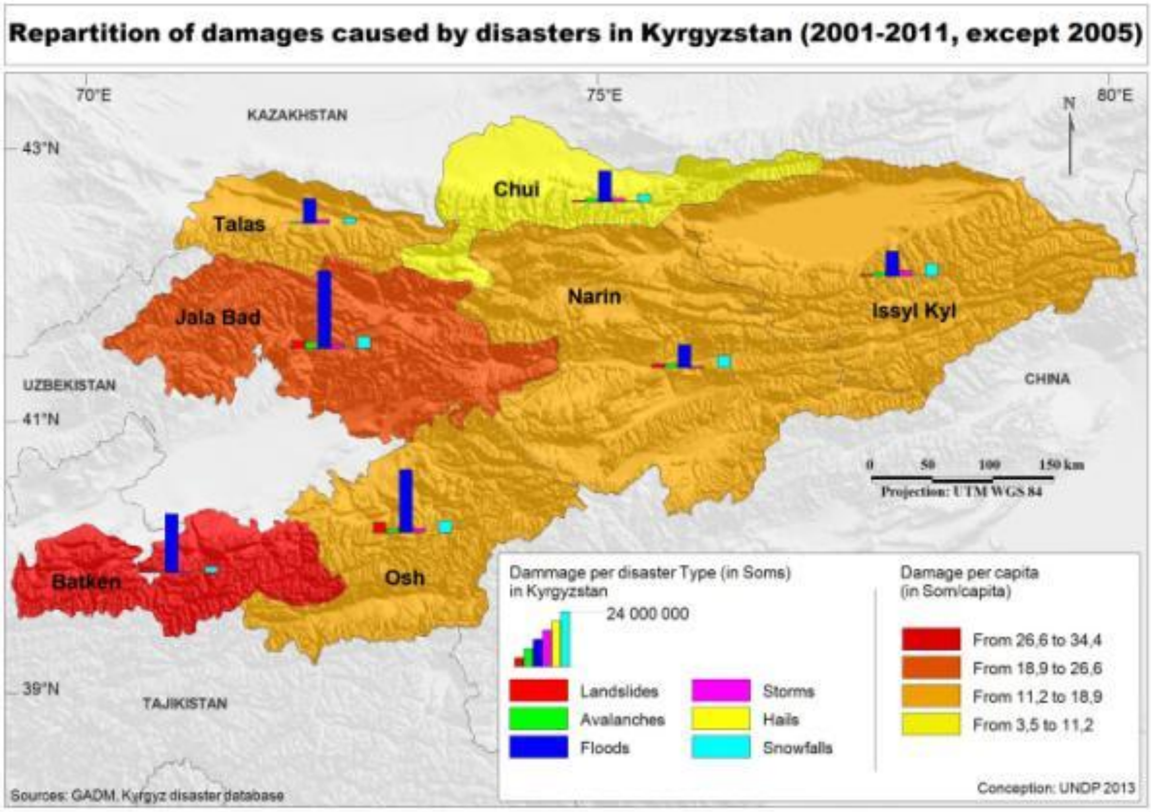
Damage Per Year Per Capita

US Dollars, 2000-2011[33]

Oblast	**Landslides**	**Avalanches**	**Floods and Flash Floods**	**Storms and High Wind**	**Hail**	**Heavy Snowfall (Blizzard)**	**All disasters**
Talas	0.	0.009	1.27	0.050	0.	0.097	1.42
Chui	0.004	0.006	0.27	0.011	0.002	0.025	0.32
Naryn	0.036	0.044	0.99	0.022	0.001	0.356	1.44
Issyl Ky	0.006	0.025	0.71	0.064	0.005	0.215	1.02
Jalal Abad	0.042	0.025	2.19	0.011	0.002	0.082	2.35
Osh	0.046	0.011	1.09	0.012	0.	0.072	1.23
Batken	0.017	0.	3.02	0.014	0.	0.074	3.12

The map below ("**Repartition of damage caused by disasters**…") presents these results by level of per capita impact by type of event and total value.[34] Such graphic presentations can be more effective than tables in communicating results.

[33] Excluding 2005, for which no data was available.
[34] Draft from **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013). This is a preliminary product and final presentation would be in US Dollars.



C. Define the Impacts of Climate Events on Livelihoods

This step involves a Delphi-based process (using the **Scaling Capital Impacts for Climate Hazards** process discussed above) earlier to rank impacts for each livelihoods capital not covered in the monetary value-based impact assessment. In most cases, social, natural, and political livelihoods are assessed in this step. Where no monetary damage data are available for financial and human likelihoods, they are also covered in this assessment process.

The process itself is relatively straightforward and involves:

- Assembling background information on the climate events being assessed (e.g., information on drought), including recorded damage, frequency and areas of impact.
- Assembling a group of individuals (optimally between four and eight) familiar with the climate events, areas and populations being assessed. The group should include a mix of professions (e.g., hydrologist, sociologist) and be gender-representative.
- Reviewing each climate event and its impacts using the **Capital Impacts for Climate Hazards** table and identifying through consensus which of the five levels of impact indicate the historical impact of the climate event on each type of livelihood. This process should be done for, at the minimum, the general population and females, and for old and young if time allows.

The results should be tabulated as a set of scores for each livelihood and each group assessed.

These scores cannot be directly combined as they represent different things. However, the relative value of a livelihood assessment for one type of impacts can be compared to another by:

- Plotting the results for each livelihood assessed on a Spider diagram with a scale of 0 (no impact) to 5 (greatest impact).

- Calculating the area of each triangle in the Spider diagram using the formula: *Area of triangle = ½ Side a * Side b * sin of Angle.*[35]
- Adding the areas of all the triangles in the Spider diagram to create a single score for the set of livelihoods assessed.

The resulting score can be compared with other livelihood assessments as the determining criteria (the descriptions for each cell in the **Capital Impacts for Climate Hazards** table) are the same across all assessments, and it is the resulting area, not the impacts themselves which are being compared.

Note that for this process to work correctly:

- The descriptions used in each cell of the **Capital Impacts** table need to remain the same for all assessment work, and.
- The calculation of triangle area needs to follow the same sequence: Human-Financial, Financial-Social, Social-Natural, Natural-Political, and Political-Human to provide comparable results.

Examples of the livelihood impact scoring ("**Livelihood Impact Scoring**"), a resulting Spider diagram and a table indicating the calculations of area for each triangle in the diagram ("**Calculation of Triangle Area and Addition of Calculations**") are provided below.

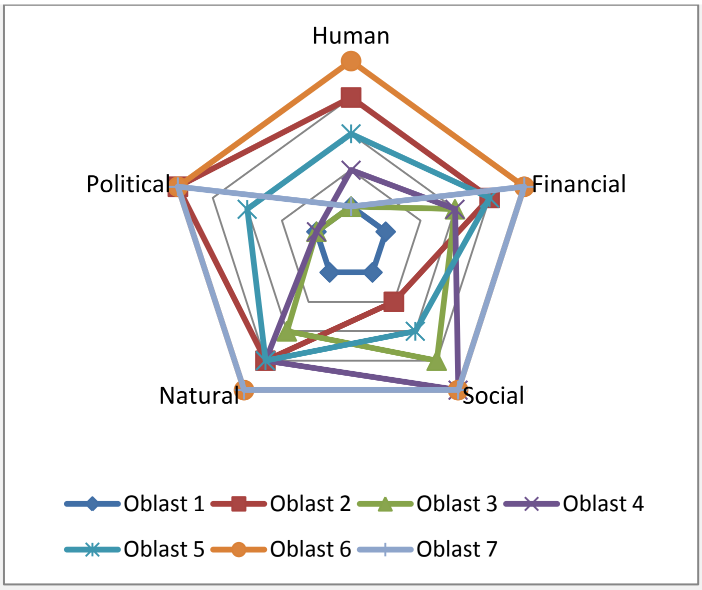
Livelihood Impact Scoring

(Numbers indicate level of Impact)

Capital	**Oblast 1**	**Oblast 2**	**Oblast 3**	**Oblast 4**	**Oblast 5**	**Oblast 6**	**Oblast 7**
Human	1	4	1	2	3	5	1
Financial	1	4	3	3	4	5	5
Social	1	2	4	5	3	5	5
Natural	1	4	3	4	4	5	5
Political	1	5	1	1	3	5	5

The livelihood scoring results can also be presented as maps. The two maps below present livelihoods scoring results for the general population and the difference between the scoring for the the whole population and for females.[36]

[35] An Excel® spread sheet with formulas already installed to calculate the area is available from CAMP Alatoo.
[36] From **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

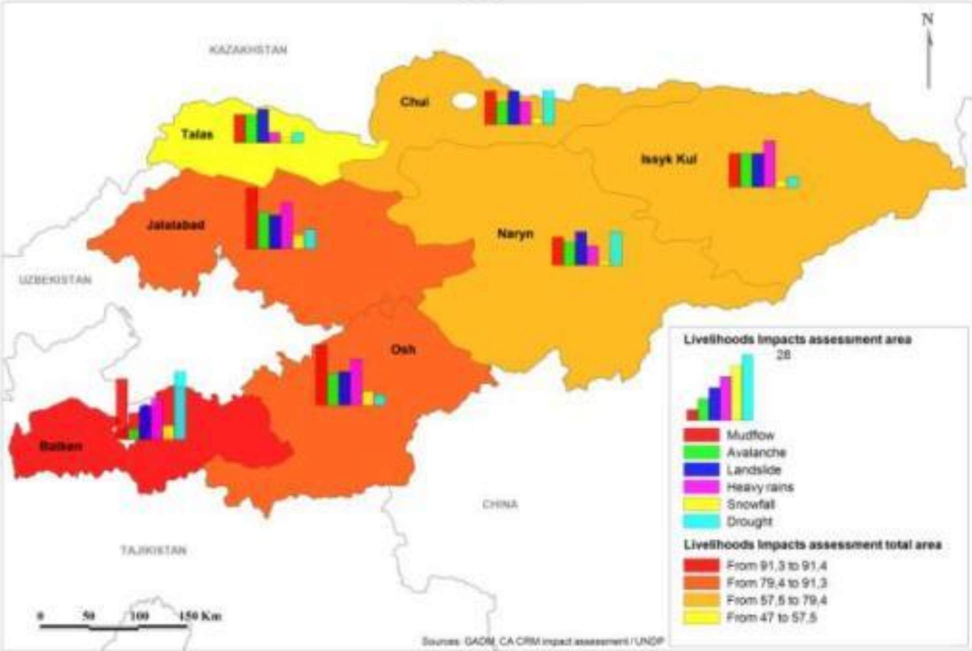


Calculation of Triangle Area and Addition of Calculations

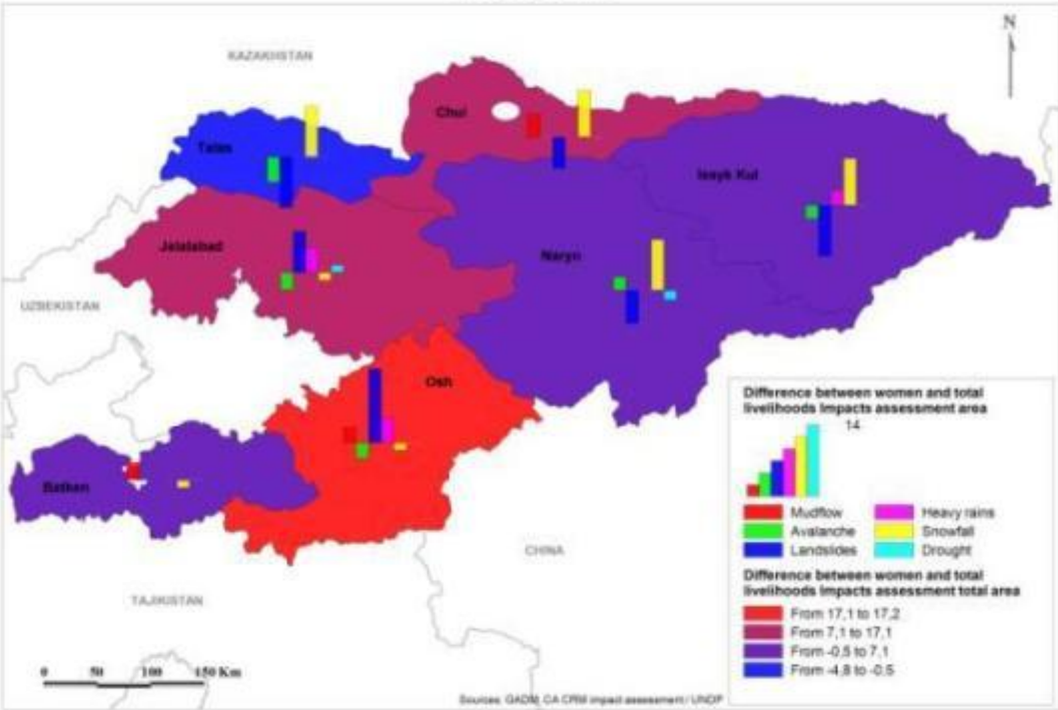
Diagram	Oblast 1	Oblast 2	Oblast 3	Oblast 4	Oblast 5	Oblast 6	Oblast 7
HF	0.48	7.61	1.43	2.85	5.71	11.89	2.38
FS	0.48	3.80	5.71	7.13	5.71	11.89	11.89
SN	0.48	3.80	5.71	9.51	5.71	11.89	11.89
NP	0.48	9.51	1.43	1.90	5.71	11.89	11.89
PH	0.48	9.51	0.48	0.95	4.28	11.89	2.38
Tot. area	2.38	34.24	14.74	22.35	27.11	59.44	40.42
Rank	7	3	6	5	4	1	2

This is the total area shown on the diagram above, highlighted in accordance with the scores.

Livelihoods impacts assessment area (derived from Delphi-based assessment of impacts) in Kyrgyzstan



Livelihoods impacts assessment area (derived from Delphi-based assessment of impacts) in Kyrgyzstan



D. Define the Risk of Impacts from Climate Events

The risk posed by each type of climate event is defined as the combination of the per capita year monetary damage expected from events and the livelihood impacts score, as defined in the previous two steps. As livelihoods impacts cannot be converted into monetary terms, the two results (monetary damage, livelihood impacts) can be presented as tables or as scatter plots using Excel® or similar software.

In the overall scatter plot, the further a climate event damage/livelihood pair is from the "0" point, the greater the assessed risk. For purposes of comparative analysis and presentation, the plot can be divided into four quadrants were the:

1. Upper right indicates high overall risk,

2. Lower left indicates low overall risk,

3. Upper left indicates high livelihoods-based risk, and,

4. Lower right indicates high damage-based risk.

This division can be done based on:

- Equal area by setting the center point for the quadrants based on average scores for all the climate event-based damage-livelihood pairs, or
- Median point of score sets, by establishing the dividing point for the quadrants based on the calculation of the median for all the climate event-based damage-livelihood pairs.

Provided below are examples of risk plots for:

- A specific type of climate event ("**Risk Comparison Floods and Flash Floods**") with the associated damage/livelihood impacts data table ("**Table 16**"), and for
- All damage and livelihood impact scores at the national level ("**Risk Comparison All Climate-Related Events** ") and the associated damage/livelihood table ("**Table 19**").[37]

The damage/livelihood impact pairs can also be presented individually for each climate event and location (e.g., Oblast) for a country as a whole or for several countries to identify the climate events with the greatest or least relative risk.

[37] Both examples from **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

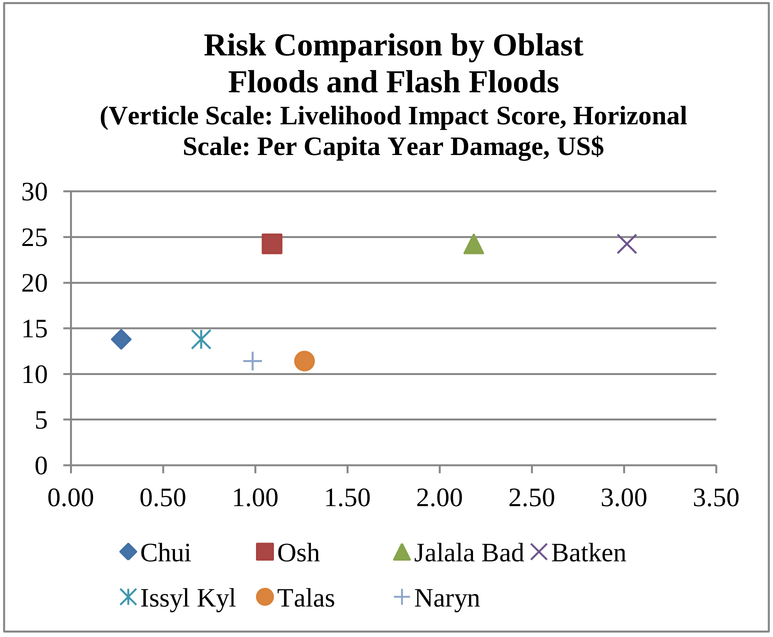


Table 16 Floods and Flash Floods		
Oblast	Damage, per capita year, US$	Livelihood Score
Chui	0.27	13.79
Osh	1.09	24.25
Jalal Abad	2.19	24.25
Batken	3.02	24.25
Issyl Kul	0.71	13.79
Naryn	0.99	11.41
Talas	1.27	11.41

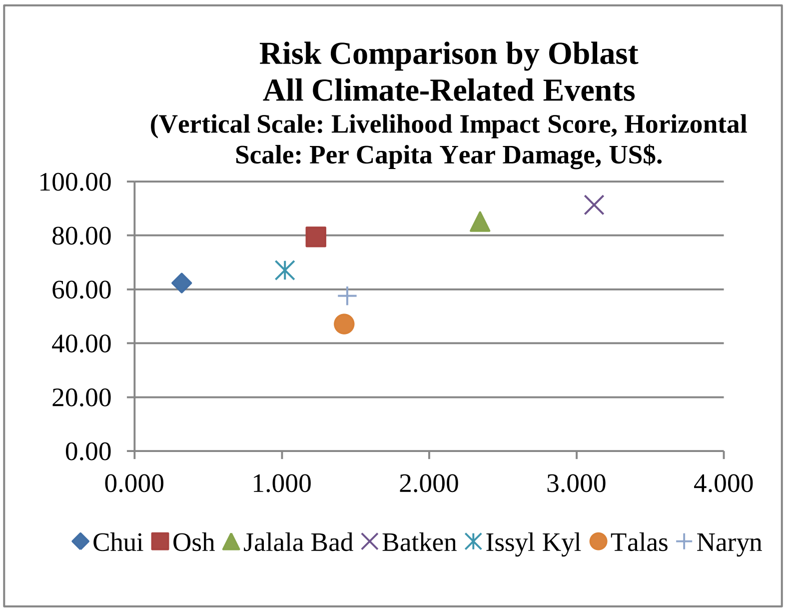


Table 19 All Disasters		
Oblast	Damage, per capita year, US$	Livelihood Score
Chui	0.321	62.29
Osh	1.232	79.41
Jalal Abad	2.346	85.12
Batken	3.121	91.30
Issyl Kul	1.022	67.05
Naryn	1.445	57.54
Talas	1.424	47.08

E. Define Possible Future Risk Outcomes

The preceding steps lead to a definition of current risk from climate-related events and the comparison of different risk across locations and types of events. The next step is to consider the impact of these risks in the future as a basis for defining and prioritizing risk management strategies and actions.

The most straightforward way to present future risk outcomes is to develop simple scenarios using Excel® or a similar spreadsheet software. The scenario is first defined by an annual change in specific conditions over a specific period of years into the future. For instance, it can be assumed that there will be a 1.1% increase in disaster damage per year for 20 years into the future.

The most recent damage data from the **Define Impacts of Climate Events in Terms of Reported Damage** step can be used as a starting point for calculating annual increases in damage per year (multiplying the previous year's damage by 1.1%) and total damage for the 20 years (adding the annual damage totals). The projected annual damage levels can be divided buy the expected population to generate a per capita per year estimate as well.

This baseline scenario can be compared with other scenarios, for instance a 2% per year reduction in damage, to present the cumulative impacts of this level of risk reduction. Once the basic scenario calculation process is developed in Excel or a similar program, it can easily be modified to calculate a variety different scenarios. Setting scenarios can be done using the same Delphi process and team used to assess livelihood impacts.

The same process can be done for livelihoods impacts, either calculating changes to individual livelihoods scores (for instance an increase in the level of impact of climate events on natural capital) or for the livelihoods total score as a whole. Livelihood impacts are likely change slowly over time. The rate of change (which can be positive or negative) is likely to be less than .1% per year. Care is needed to ensure that the rate of livelihood changes are realistic within the bounds of what can be expected in a specific society or a specific group.

The scenario process is most effective when it focuses on selecting livelihoods for which there is a high impact score and considering, through the scenario process, what level of average change per year is needed to lead to a significant improvement in this score and the overall score for all livelihoods.

When making changes to individual livelihood scores, the overall livelihood score will need to be recalculated at the end the period of analysis using the process described in the **Define the Impacts of Climate Events on Livelihoods** step.

The following tables present scenario results for damage resulting from climate events for a country as a whole ("**Table 21**") and at the sub-national level ("**Table 21**").[38] Three scenarios are presented:

1. A 1.1% increase in damage and number of events per year, the same rate as the expected increase in population.

2. A 1.1% increase in damage but not increase in the number of events per year, presenting stable climate conditions but increasing damage per event.

3. A 2.2% reduction in damage but no change in number of events, presenting stable climate conditions with successful efforts at damage reduction.

The results of the three scenarios provide the basis for discussions on damage reduction options and investments. For instance, the possible savings in terms of disaster damage between the first and third scenarios can form the basis discussions about the allocation of funds to damage reduction.

Table 20

Projected Impacts of Three Scenarios Reflecting Climate-Related Disasters in Kyrgyzstan

Impact Parameters	**Scenarios**		
	1.1 % growth in events and damage per event per year	No increase in # disasters year-to-year; 1.1% increase in damage per year	2% annual reduction in average damage per event but no change in # of events per year.
Total Number of Climate-Related Disasters	1,265	1,125	1,265
Total Damage ($US, 21 years)	153 million	135.6 million	109.6 million
Damage Per Capita @ Year 21	1.37	1.101	.735

[38] From **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

Change in Damage per Event Year "0" to Year 20 (USD)	124%	124%	67%
Change in Number of Events per Year, Year "0" to Year 20	124%	0	124%
Change in Average Damage per Year "0" to Year 20	155%	124%	83%
Change in Cost per Person, Year "0" to year 20	124%	0	67%

Table 21

Projected Impacts of Flooding Scenarios in Batken Oblast

Impact Parameters	**Scenarios**		
	1.1 % growth in events and damage per event per year	No increase in # disasters year-to-year; 1.1% increase in damage per year	2% annual reduction in average damage per event but no change in # of events per year.
Total Number of Climate-Related Disasters	290	258	258
Total Damage (USD, 21 years)	31.6 million	28.0 million	20.3 million
Damage Per Capita @ Year 21	3.52	2.83	1.52
Change in Damage per Event Year "0" to Year 20 (USD)	152%	124%	67%
Change in Number of Events per Year, Year "0" to Year 20	123%	0	0
Change in Average Damage per Year "0" to Year 20	123%	124%	68%
Change in Cost per Person, Year "0" to year 20	123%	0	55%

F. Define Perceptions of Those At-Risk and Willingness to Address These Risks[39]

The process of assessing the perceptions of those at risk of climate events and consequent impact is through the use of a short questionnaire, as described earlier in the **Guide**. The use of the questionnaire should follow standard "participatory rapid assessment" procedures, involve individual interviews or focus groups and be integrated into other assessment activities. Where possible, the widest geographical, occupational and social range of respondents possible should be included in the survey process.

A variety of statistical and narrative reporting can be generated through the questionnaire and survey process. Three important outputs are summarized below.

G. Perception of Climate-Related Hazards

The questionnaire collects information on respondent perceptions of climate-related hazards and provides insight into awareness of such hazards and their impacts. The table below ("**Table 22**") provides the results of a question about the impact of climate change and indicate respondent's concerns about cold weather-related hazards. As noted in the survey report,[40] these views may reflect recent events, but also indicate current concerns of at risk populations.

[39] All tables in this section extracted from **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).
[40] See **Kyrgyzstan Climate Risk Profile Report**, CAMP Alatoo (2013).

Another way to consider climate-related perceptions is to consider how respondents see changes in climate-related hazards. The table below ("**Table 23**") provides an extract of responses to the question of whether climate-related hazards had changed over time. The results indicate both current perceived importance and changes in hazards ("occur more often") as well as differences in perceptions of men and women (e.g., for soil erosion, pasture degradation).

Table 22

Reported Indications of Climate Change

Village	**Type of Climate Event**	**Reported Indicators**	**Comments**
Suusamyr, Tunuk	Extreme decrease of air temperature (hard frost)	According to the local inhabitants, the winter became more severe (since 2008). In the winter of 2011, the temperature dropped down to - 60 ^{o}C. In 1970-80s, the temperatures reached 0-55 ^{0}C, and in 1990-2010 to 40-45 ^{0}C. Ice crusts were formed.	It was also mentioned that such phenomena can be linked with the climate change (period of 10-15 years)
	More frequent heavy snowfall	During the last years (since 2007) there were abnormalities in snowfall. At the beginning of November 2011 the height of the snow cover exceeded 1 meter	Before, the snow was falling gradually and reaching maximum height in January-February
	Increase of duration of the snow cover preservation	Since 2008, the period of snow cover had increased by almost for two months (November-April)	Since the late 1990s snow cover has covered the land from December untill March. It is resulted in shortage of the winter fodder.

Table 23

Perception of Changes in Climate-Related Hazards Frequency

Hazards	**Male**			**Female**		
	Yes, occur more often	No, occur less often	I do not know	Yes, occur more often	No, occur less often	I do not know
Avalanche	18%	65%	17%	2%	75%	23%
Heat and Drought	66%	23%	11%	71%	14%	15%
Frost	53%	34%	13%	30%	55%	15%
Strong Wind	19%	78%	3%	9%	79%	12%
Prolonged Winter	97%	2%	1%	90%	5%	5%
Glacier Melting, Outbreak of Glacial Lakes	22%	28%	50%	4%	29%	67%
Soil Erosion	63%	24%	13%	3%	30%	67%
Pasture Degradation	57%	37%	6%	3%	51%	46%
Agricultural Pests	38%	37%	25%	4%	45%	51%
Agricultural Productivity (yield)	26%	57%	17%	10%	54%	36%

H. Contrasting Expert and Perception Results

Perceptions of climate events and climate hazards can differ between experts and respondents because of different frames of reference in considering these hazards and events. The following table ("**Table 24**") compares perception to expert views on specific climate parameters. (If both cells are green for a specific parameter, then the experts and local population agree. Where there is disagreement between experts there is a need to revisit the expert analysis or educate respondents about climate-related hazards, events and change.

Table 24

Comparative Analysis of the Climate Impacts by Experts and the Population

Climate Change Indicator	Summer		Winter	
	Experts	Population	Experts	Population
Temperature, Mean Value	Decrease	Summer is hotter.	Increase	Winter is colder.
Extreme Temperatures	Decrease	Hotter	Warmer	Cold winter (to -60 C).
Frosts (Freezing Weather)			Reduced frequency and impact.	Severe winter. frost. Severe frost in October.
Precipitation, Mean Value	Precipitation decrease, especially in spring-summer.	Less rain, short and dry spring,	Without change or minimum increase.	Often and heavy snowfall.

I. Willingness to Pay

The willingness to pay to address a hazard impact or result of a changing climate is a simple way to assess whether the respondent perceives the impact to be important. Results of a "willingness to pay" survey are provided in the table below ("**Table 25**"). Significantly, a large majority of both male and female respondents indicate that they would spend funds on other than climate risk management activities suggesting that they do not see climate-related risks as important as other challenges they face.

Table 25

Willingness to Pay Survey Results

Replies to the question

"How would you spend the local currency equal to 500 USD (if you would have it), to reduce the above enumerated hazard consequences?"

Reply	**% Responded from Men and Details of Proposed Use.**	**% Responded from Women and Details of Proposed Use.**
Keep money for myself and not spend on risk reduction.	43 % - to increase the number of livestock for later use.	32% - to educate children in Bishkek. 14 %- to buy (children) clothes or buy necessary house wares; buy medicine or start a business 12 % - open a food kiosk
Aallocate all the money to a risk mitigation options.	27% - mainly for insulation of the sheds and vaccination of livestock.	19% - purchase of coal, firewood, foodstuff or fodder.
Not spend the money at all to avoid a headache. Keep money as savings and use it for an "evil" day.	4%	9 %
Share the money among several measures – heat insulation of the sheep sheds, vaccination, fodder conservation, insemination etc.	8 %	0%
Pay off debts.	7%	4%

Invest for interest.	7%	6%
No response.	4%	4%

J. Develop and Circulate a Report of Results.

Assessment results have little value if they are unknown, with being know a prerequisite for being used. The assessment results can be presented in three basic ways, as:

1. A stand-alone reports covering each of the steps set out above.

2. Input into a larger profile of climate issues at the national or regional level.

3. Sector-specific reporting on climate-related risks, for instance, focusing on climate-related disasters or climate impacts on agriculture or animal husbandry.

The second option provides for the greatest use of assessment results by placing them within a larger consideration of climate-related issues and management strategies and actions. The first option has limited value in that it focuses attention on only one part of a necessary overall understanding of climate risks. This option is discussed in more detail in the following section.

The third option permits more targeted attention to specific climate-related issues as input to broader sector-specific discussions. For instance, a climate risk assessment report on livestock would provide useful input into larger discussions about the development of livestock as a sector in a country or region.

The means of dissemination is possibly as important as the content. While web and internet based dissemination are quickly supplanting printed reports, these opportunities for accessing information are not always optimal in rural areas or for individuals with limited means. Thus printed materials, focusing on assessment results and practical impacts and applications, remain and important dissemination tool and should be incorporated into the reporting process.

This process should also recognize the importance of feedback from those affected by climate-related impacts. These individuals are directly affected by these impacts, are largely responsible for managing these impacts and would benefit the most from a better understanding of the challenges they face and options available. This feedback process validates, or necessitates corrections to, the assessment results, a key outcome in determining whether the assessment process is of any value.

XVI. Assessment Input into Climate Profile

As detailed in the preceding sections, the climate risk assessment provides the following inputs into a climate risk profile:

1. An assessment of whether expected climate-related hazards have a close or loose correlation with climate parameters.
2. A summary of the recorded damage done due to climate-linked impacts at the sub-national and national levels.

3. An identification of the level of impact, in gross value[41] and per capita value, at the sub-national level in US Dollars.
4. An identification of the non-monetary and impacts of climate-related events on human, social, natural, financial, and political livelihoods.
5. An identification, at the national and sub-national levels, of relative risk from the climate-linked events assessed.
6. Presentation of scenario-based future impacts of climate risks, in monetary terms and in terms of changes in livelihood impacts.
7. An identification of perceptions of climate-related risks, how these risks have changed over time and what measures should be taken to address these risks.
8. A comparison of expert and respondent views of changes in climate parameters and impacts.

In addition using the inputs as to develop a report narrative, they can be used to build a climate risk profile in the following ways:

1. Assess the documented importance of climate factors as opposed to no-climate factors in framing and defining the challenges faced in the development process (inputs 1 and 2, above).
2. Identify why locations and populations are affected by climate events (inputs 2, 3, and 4, above)
3. Identify the locations and populations most in need of assistance to reduce risk (inputs 5, above).
4. Provide a basis, through the scenario process, of defining strategies, actions and funding limits for climate risk management (inputs 2, 3, 4, 5, and 6, above).
5. Understanding and incorporating perceptions of climate risks into defining strategies and actions to reduce climate risks (inputs 7 and 8).

A climate risk profile should build off the latest national climate change communication for a country and focus on defining impacts of climate change and changing climate variability on the lives, livelihoods and society of those at risk. The risk assessment process set out in the **Guide** enables the development of a profile that focuses on:

1. Impacts over simple descriptions of possible changes to the climate, that is not just stating that there will be less precipitation, but how this will impact lives and livelihoods, and,
2. Preferred options to deal with these impacts.

Further, a **Guide**-based assessment, if sufficient information is available, shifts the focus of climate risk impacts and risk management to the sub-national level. This sub-national focus is necessary to more directly and effectively allocate resources and take action to address the root causes of climate-related risks and damage people's lives and wellbeing.

[41] Information on the value of assistance, needed to define the net value of monetary impacts, appears to be limited in Central Asia.

Annex A. CA CRA Team Member Professional Resume Summaries

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Natural Disaster Expert, Kazakhstan

Yann Garcin

Geographic Information Systems specialist with a background in disaster risk Assessment

Aida Gareeva

Ms Gareeva has over 25 year -experience in natural resource management field. She has been involved to the issues of land use management on local level, conflict management over pasture resources, DRR on local level, climate change adaptation, impact monitoring, soil and water conservation technologies and etc as a Project Coordinator. She has good experience in the elaboration of interactive training modules and simulation games on sustainable resource management (pasture, climate change, water management, energy) and providing ToT on these modules. Mainly, Ms. Gareeva works with elaboration and adaptation of tools, methods and approaches of resource management on the local level. She worked on local, national and regional levels (for CA countries). She has seven publications in the field of natural resources management.

Shamil Iliasov

Ph.D, Associate Professor, Kirghiz Russian Slavic University, Kyrgyzstan,

Charles Kelly

Mr. Kelly has over 30 years of field experience in humanitarian assistance programs dealing with compound disasters, droughts, food insecurity, insect infestation, hurricanes, epidemics, floods, war and other emergencies. Mr. Kelly has been involved in the development of a number of outcome assessment tools, and recently contributed to the development of climate risk assessment procedures in Moldova and Macedonia. Other related work has included development of community-level risk assessment and environmental outcome assessment tools and procedures. Mr. Kelly has worked in over 60 countries and published over 45 articles on disaster management, including on damage, needs, and rights assessment, disasters and mega cities, disaster management systems and disaster-environment linkages. An affiliate of the AON Benfield UCL Hazard Research Centre, Mr. Kelly is a member of the International Research Committee on Disasters, the Society of Risk Analysis, The International Emergency Management Society and ProAct Network.

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PhD, Regional Programme Coordinator, UNDP Central Asia Climate Risk Management Project, Kazakhstan, within his professional career of the last 20 years including over 17 years at the international level in both public and private sectors developed skills, which allowed him to participate in many international multi-disciplinary programmes and projects at various managerial and technical positions. He is familiar with the development processes in the countries with economies in transition, including designing and implementing environmental policy reforms, strengthening management capacity of national and inter-state partners, as well as setting up modern governance systems and favourable enabling environment. He has worked in various geographical regions including Northern and Eastern Europe, the Caribbean, Africa, Central Asia, the Mediterranean and Black Sea basins. His objective is to bring the knowledge and experiences he has come across during professional career to counterparts and colleagues in many regions.

Annex B. Climate Risk Assessment GIS Platform Summary

The methodology used for the implementation of the GIS consists in overlay different layers which contain information about all the different parts of a risk assessment namely hazards, stake (people, assets and system and vulnerability. To these datasets, a component about climate change was added to the different layers. Thereby, the GIS is structured in the same way with those four categories of data and a fifth one for the basics mapping data. Each of those five categories contains different datasets presented in the following.

The first set of this database contains the basic mapping data permitting to have space marks to localize data. Those layers contain:

- Administrative areas for national, provincial (Oblast) and district (Rayon) levels: these represents the administrative boarder lines (source: Global Administrative Data, 2012);
- Water systems (hydrography): these represents the main rivers of central Asia (source: United Nations Environment Program, 2012a);
- Main Cities represent the geographical location of principal cities with the name of the city, and the population data attached in tabular data (sources: National Aeronautic and Space Administration, 2012, Food and Agriculture Organization, 2005);
- DEM (Digital Elevation Model): It is a raster view of the ground elevation. It allows the localization of main mountain range (source: National Aeronautic and Space Administration, 2000).

The second set of data contains disaster information. Those data represent prone hazard areas for different type of disasters. This dataset partially comes from the e-atlas project (WHO, 2011) and is based on different calculations between several dataset like climate or elevation data. Those data provide indexes for different type of hazards with discrimination from very low to very high exposure. This part of the dataset includes:

- Flood hazard index;
- Landslide hazard index;
- Heat wave hazard index for 10 years return period;
- Wind speed hazard index 10 years return period;
- Seismic prone area.

Other layers - added to the GIS were assessing the hazard data concern:

- Peak ground acceleration (PGA): this represent the maximum acceleration of the ground during a seism (m/s^2) for a seism which have 10% probability of exceedance in 50 years which represent a 475 years return period (source: International Lithosphere Program, 1992);
- Aridity index: those data come from complex calculation and take into account potential evapo-transpiration and rain patterns. This index allows highlighting arid areas that are the most vulnerable prone drought areas (source: Consultative Group on International Agricultural Research, 2007).

The third set of data present in this GIS represents the people, assets and systems and their exposure to hazards. This range of data put forward their geographical repartition to compare them with the prone disaster areas repartition to highlight exposed areas. Those data are composed by different datasets which are the following:

- Density of population: this layer regroups density population data projected for 2015 based on 2005 data and basically represent district level resolution (sources: National Aeronautic and Space Administration, 2012, Food and Agriculture Organization 2005);
- Land use: This layer geographically represents the different types of human ground using and classifying 40 categories which go from urban land to virgin forest passing by the different sort of crops, grasslands, forests, water lands and bare areas with emphasis on human use (non use/ extensive use/ intensive use) (source: Food and Agricultural Organization, 2008);
- Protected areas: This layer represents the different environmental protected areas with attached information about the area statue.

The fourth dataset available in this database is around the vulnerability topic. It exists different sorts of vulnerability and different ways to assess them. In this database we will use the sustainable livelihood approach (Twigg, 2001). This method takes into account different types of data which are the following:

- Human capital: this represents skills, knowledge, ability to labor and good health;
- Social capital: this represents social resources upon which people draw in pursuit of livelihood objectives;
- Natural capital: this represents the natural resource stocks from which resource flows and services are derived;
- Physical capital: this represents the basic infrastructure and producer goods needed to support livelihoods. Infrastructure components include affordable transport, secured shelter, adequate water supplies and sanitation and access to information. Producing goods are tools and equipments that people use to productively function ;
- Financial capital: This includes savings and credit, and inflows of money other than earned incomes.

Those data come from the different UN offices (OCHA, UNDP, FAO, Word Bank) and are for the most part available at the district (oblast) level.

The last dataset are about climate change data. The latter represents current and change in climate patterns and are composed by different layers which represent the change in climate trend. This data represents the difference between actual data that represent 1950 - 2000 period (source: Hijmans, et al, 2005) and future data that represent 2080 -2100 period B2 greenhouse gas emission scenario (source: Intergovernmental Panel on Climate Change, 2007). The data presented in this category are as follow:

- Difference in mean temperature;
- Difference between temperature annual range (difference in thermal amplitude);
- Difference between mean precipitation;
- Difference between precipitation of Wettest Quarter;
- Difference between precipitation of Driest Quarter;

All of those data are available in vector format which allows to crossing data between themselves. However it's important to note that the lowest resolution is approximately 10 km for the land use layer which represent the maximum resolution of cross data indicator. It is also important to take into account that the smallest scale is at the province (oblast) level for part of the vulnerability data. In the absence of higher resolution data, this assessment will stay at province level or maximum at district level. Nevertheless, this GIS will allow to highlight the principal hotspots and a local risk assessment will be lead on these areas.

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