Incorporating Climate Change in Snow Leopard Landscape Management Planning

Advice Document Addendum to the General Guidelines for Climate Smart Snow Leopard Landscape Management Planning

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1. Background

Climate change is already having drastic effects across the high mountains and steppes of snow leopard range. Like the poles, the region often referred to as the "third pole" is facing some of the most dramatic warming and subsequent impacts of any region on earth. Rapidly increasing temperatures are melting glaciers and permafrost and changing local hydrology and vegetation patterns, while increasingly variable precipitation patterns are causing more frequent and intense extremes, from heat waves to high intensity storms and rapid fluctuations in between and resulting in more frequent natural hazards like drought, flooding and landslides. All of these are significantly impacting the unique ecosystems, wildlife, and surrounding communities throughout the region.

While there is evidence that the snow leopard might be resilient to some of these changes in the short term, there is so little information about its ecology that it is impossible to be certain how it will respond to the many changes already affecting its habitat[1]. The species itself may not be highly vulnerable now, but **climate change impacts on people living in and around its habitat throughout the range will nevertheless increase many of the threats it currently faces**, from habitat loss and encroachment to declines in prey base, retaliatory killings and poaching. In landscapes across the region, local communities are highly vulnerable to changes to ecosystem services that directly support their livelihoods, from grasslands for grazing and medicinal plants, to water provided by snow and glacier melt. When these are compromised by climate change, human-wildlife conflict can increase as people seek alternative livelihoods, including poaching.

Photo 1. Snow leopards often travel along ridgelines such as this one in India's Spiti Valley. Photo Credit: Nature Conservation Foundation / Snow Leopard Trust

Additional indirect threats of climate change will come through on-going economic development that, if managed unsustainably, can and will have major damaging effects in the landscape and worsen the

[1] http://assets.worldwildlife.org/publications/732/files/original/Snow_leopard_-_WWF_wildlife_and_climate_change_series.pdf?1435159228

impacts of climate change. Extractive and energy industries and their associated infrastructure, and unmanaged road development, for example, can increase existing erosion that will lead to further landslides as precipitation intensity increases with climate change. It is, thus, imperative for snow leopard management plans to tackle these issues in holistic, integrated ways that build resilience for communities, ecosystems and wildlife, without which threats to snow leopards will only grow in the future.

This document is intended to provide additional guidance in how to address the impacts and risks of climate change, as a supplement to the existing guidance framework developed by the Snow Leopard Trust, "*General Guidelines for Snow Leopard Landscape Management Planning*." As such, the recommended principles and step-by-step process described herein aim to cross-reference the relevant sections of the General Guidelines. For brevity, however, the document is largely limited to Part A: Situation Analyses. Part B: Management will be addressed in additional future supplemental guidance.

2. Key Principles of Climate-Smarting

Below are some basic principles to follow to ensure that the impacts and risks of climate change are properly accounted for in the landscape planning process, loosely based on guidance and principles from conservation organizations, the peer-reviewed literature, and learning from years of climate change adaptation planning for conservation. To be truly climate-smart, plans should:

- **Follow the premise that climate change is an unstoppable and inescapable force** that affects all biodiversity, communities, livelihoods and economic sectors in the landscape, albeit to different degrees, either directly or indirectly; and acknowledges that climate change can drive and change the nature of direct human threats to ecosystems, often synergistically exacerbating their impacts.
- **Use appropriately scaled (geographic and temporal) climate-related information to inform planning:** these include observed climate trends, near- and longer-term climate change projections, community perceptions of change, spatial mapping (GIS), and climate vulnerability assessments, among others.
- **Recognize that people are important parts of landscapes** and ecosystems and that human responses to the changing climate can have profound and negative consequences on biodiversity. Therefore, the landscape plan should be devoted to helping communities living in proximity with nature to adapt in ways that maintain, or at least do not undermine, ecosystems and their services and wildlife.
- **Manage (rather than avoid) uncertainty associated with climate change** and its impacts through the use of scenario planning—based on climate projection data—and other relevant tools, including those listed in more detail in the Key Resources section below.
- **Openly acknowledge information gaps and create plans to address them**, including through continuous monitoring and evaluation of ongoing climatic, biological, geophysical and socio-economic change, all of which have implications for management design and implementation.
- **Focused on the short to medium term (2020 to 2050),** while also planning for the longer term (2080) so that plans are flexible and adaptable as conditions change and new information becomes available.
- **Avoid maladaptation and prioritize "robustness"** so that near-term planned activities do not eliminate conservation and development options for the future that may be needed as the

climate continues to change. Activities do not reduce vulnerability of one interest at the expense of others (biodiversity vs community, community vs community, etc.)

- **Does not contribute to increased carbon-emissions** and better still, actively seek to reduce them.

These principles are not intended to be comprehensive, but if followed, should provide a strong foundation to ensure that the impacts of current and future climate change impacts and risks, both indirect and also direct, are explicitly considered in the planning and ultimate management of the landscape. The following steps guide planners in putting these principles into practice.

3. Steps for Climate-Smarting

While there is no universally accepted, peer-reviewed guidance for incorporating climate change impacts and risks into snow leopard conservation planning, the following steps developed through trial and error engagement with diverse stakeholders and landscapes around the world provide a foundation for creating a climate-smart snow leopard landscape management plan. As with the principles, they are not intended to be comprehensive, but rather a list of the most critical steps to begin to address climate change in landscape plans.

3.1 Assess the current climate

Assess the current climate and the importance of major seasons to different economic sectors, habitats and local communities through engagement with a diverse set of stakeholders, and as part of the collection of baseline information.

There are a number of tools and approaches to facilitate this process (see Key Resources below), but a particularly useful starting point is to **develop a seasonal climate calendar** for the landscape. In this exercise, ideally at a participatory workshop with local community members, or a more focused expert team, a 12 month calendar is placed on a wall, and using sticky notes, participants write important seasons for climate--e.g. snow season, monsoon season, dry season—and place them on the wall above or below the relevant month(s) where the seasons occur (this can also be done electronically in Microsoft Word, Excel or a similar program with a more focused team). This is then repeated with ecosystems and wildlife, culture, and socioeconomics and livelihoods (Figure 1). This process helps establish an important baseline of information that will be important later as the impacts of climate change are assessed for the landscape. At this point, it can be valuable to discuss how the climate might already be changing and what it would mean for each of the above major areas: ecosystems and wildlife, socioeconomics and culture (For more information about each step, see Appendix 1).

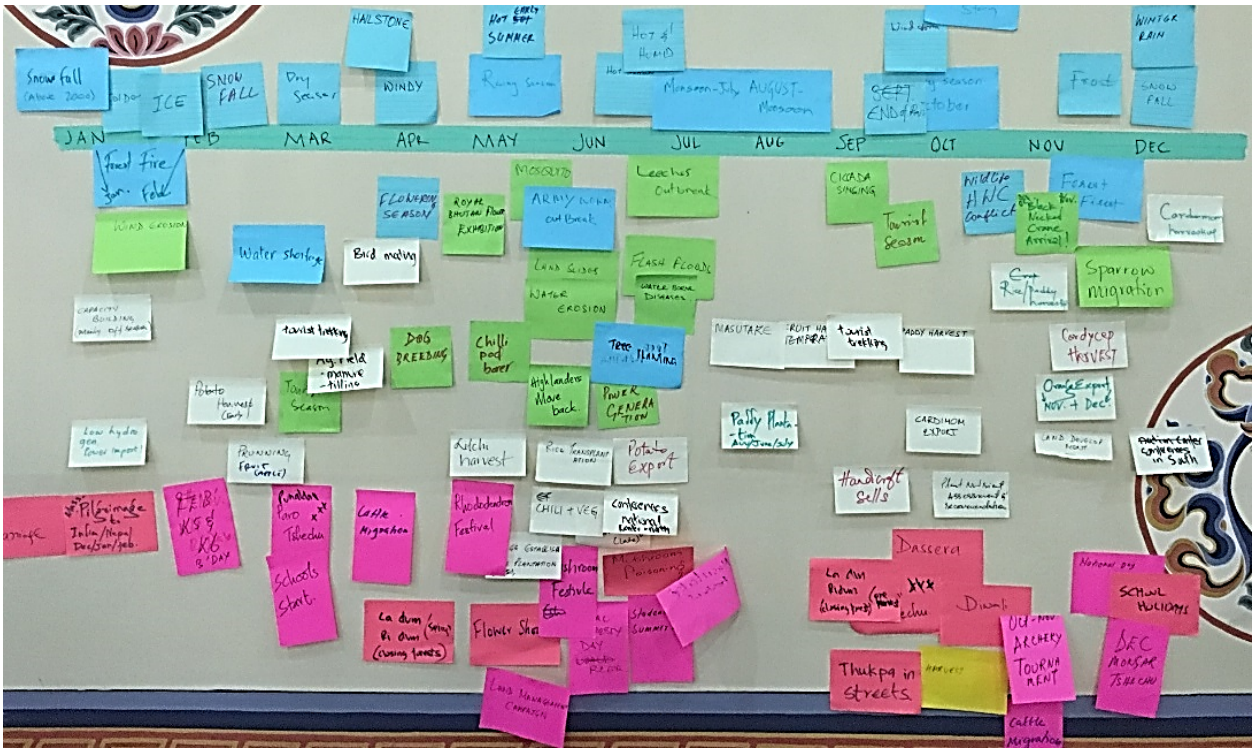


Figure 2. Example Seasonal Calendar. Months are listed across, with different seasons posted in different colors: climate in blue, environment in green, cultural in yellow and socioeconomic in pink.

3.2 Assess recent climate trends and future climate

Assess recent climate trends and future climate using available data and tools, including participatory approaches with local communities and local and global datasets, and accounting for uncertainty, all tailored to specific landscape needs.

With baseline information on current climate patterns established, the next step is to analyze local and global data to determine how the climate is changing. Ideally, this is done by experts who can use the seasonal calendar to guide their analysis, particularly in choosing which seasons to assess historically and model for the future. Local weather station data with preferably 30 years of measurements in temperature and precipitation at a daily time-step should be collected and analyzed for three important reasons: 1) it is real, observed data, so is less biased than analyses generated by downscaled global models; 2) it allows for analysis of how often extreme events—high intensity storms, droughts, high temperatures—occur in the landscape and if they are increasing in frequency and intensity, which is critical information for landscape planning; and 3) because such data is observed, rather than modeled, it can be used to increase the accuracy of the modeled future climate projections.

Projections of the future climate should be tailored to the local climate and seasonal calendar, answering the question of how the climate is likely to change during priority seasons in each landscape; e.g. during the monsoon and dry seasons of the eastern Himalaya. **It is also important that these projections be produced to depict a *range of future scenarios for specific seasons, not a single average annual estimate***. Because the models are inherently uncertain and will depict considerable uncertainty across the entire snow leopard range, and due to complex topography that makes downscaling models

difficult, they should only be used to show a range of future possibilities, not indicate false certainty in one number as the model average would (See Table 1 below). Good practice here is to focus on projections for seasons, rather than annual averages, which provide much less useful information and less clear trends. It is much more important to plan for multiple possible futures using a scenario planning approach, particularly for changes in precipitation that are far more uncertain, than to overly rely on one average number for planning.

	2011-2040	2041-2070
Summer	-3 to +26%	+8 to +40%

Table 1. Example Climate Projections: Future Change in the Summer Monsoon, Eastern Nepal. Defining the ranges: the low estimate represents the 25th percentile and the high estimate the 75th percentile of 42 model runs, with 21 models run for two Representative Concentration Pathways (RCPs), 4.5 and 8.5 to represent low and high estimates of climate change.

The selection of which variables to model and ultimately use for the planning process in the next step is also critical: for higher altitude mountain ranges of the snow leopard range, in many cases, **the daily minimum and maximum temperatures, rather than the average, are often more valuable for assessing the impacts of climate change**, as they reveal more about important aspects of the seasonal calendar like for example spring thaw and snow melt, or high temperatures that might limit crop productivity.

Because such technical assessments often cannot be carried out for a variety of reasons—insufficient local data, lack of resources—and due to their often high degree of uncertainty, it is important to take additional approaches and tools that require less technical expertise, but are also still important information sources. These include stakeholder workshops with local community members to collect local perceptions as to how the climate has changed compared to recent decades, and how people typically respond and how this might affect surrounding wildlife and ecosystems (see Appendix 2). It is, therefore, critical to ensure that questions about climate change and how people and ecosystems in the landscape respond are included in all community interviews and assessments. There is also likely to be at least some publicly available information on changes in the landscape and how they affect livelihoods, ecosystems and wildlife, including in the peer-reviewed literature and national communications to the United Nations Framework Convention on Climate Change (UNFCCC) or National Adaptation Program of Action (NAPA) reports, both of which often contain historical analyses and future projections (see more information in the Key Resources section below). For spatial analyses in the landscape, there are numerous freely-available sets of spatial climate data (see WorldClim in Key Resources below), but this is less optimal than primary analysis of climate change risk information directly tailored to the needs of the landscape planning process.

3.3 Build future climate scenarios

Build future climate scenarios and assess impacts and responses of people, ecosystems and wildlife using all available information sources on trends and projections in temperature and precipitation for the landscape.

Once information on climate trends has been gathered—in all forms, whether community surveys, national reports or technical assessments, including climate and spatial models—the next step is to develop future climate scenarios. This is a particularly important step in landscapes of the snow leopard

range due to very high levels of uncertainty in climate models that struggle to accurately depict the very complex climates of central high Asia because of step topography and lacking historical data. This approach, called scenario planning (see more information in the Participatory Tools section below), helps to address scientific uncertainty about future changes by allowing stakeholders **to plan for a *range of possible future climates***.

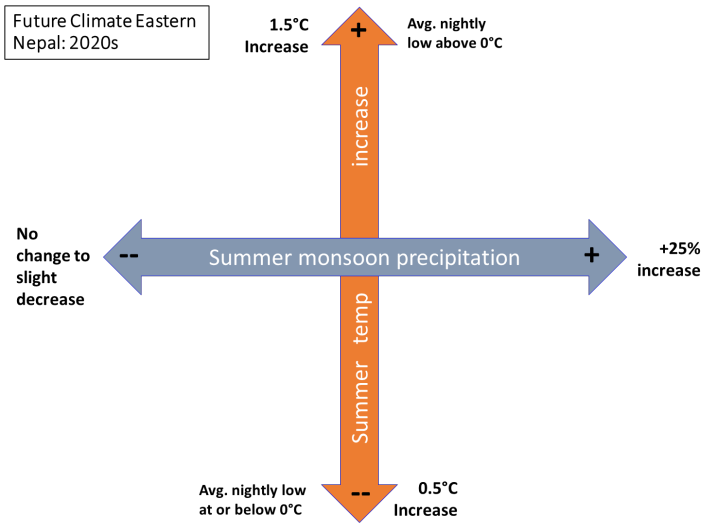


Figure 2. Example Climate Scenarios: Eastern Nepal

Ideally, this step is carried out during a participatory workshop, as it will require considerable expertise from a broad coalition of stakeholders—biologists, climate and spatial mapping experts, local community leaders, among others—to determine exactly how these changes in future climate will affect the landscape, but it can also be done in a small team with the right expertise. Scenarios are typically divided along two basic axes to create at least four scenarios, one for each quadrant (see Figure 2 above). With the climate in each quadrant generally defined—e.g. rapid warming and declining summer precipitation in the upper left, the major changes and resulting impacts on people, ecosystems and wildlife are discussed and outlined: for example, increasing drought extremes will lead to increased poaching of wildlife as agriculture becomes a more difficult livelihood.

These changes, and their potential threats to ecosystems and wildlife in the landscape, are then discussed in detail in the Threat Analysis process (see Addendum 1: Strategic Management Planning in Snow Leopard Landscapes), which helps landscape planners identify key threats to be addressed in the management plan (see Part B: Management in the main text). At this stage, it is also ideal to overlay development scenario axes on top of climate change scenarios as well, to help determine how economic development in the landscape might interact with climate change to produce potentially larger or more damaging impacts on surrounding ecosystems. These interacting effects (also known as indirect effects) on key conservation and development targets are then prioritized in the management plan (see Addendum 1: Strategic Management Planning in Snow Leopard Landscapes).

3.4 Incorporate climate change impact information (threats) and climate scenarios into the landscape plan

The information summarized for each of these scenarios serves as a critical resource for planners as they move forward; it should be used as a resource to regularly guide activity planning throughout the landscape, i.e. in informing Part B: the Management Plan. As the management plan is written, many new activities may be required to address climate change impacts and risks, including:

- additional **vulnerability or adaptive capacity assessments for communities** throughout the landscape (beyond those that may have already been assessed; see Climate Crowd and CVCA in Key Resources below)
- **vulnerability assessments of snow leopard prey species** and their food sources
- **vulnerability assessments at the landscape or river basin scale** to connect community and species vulnerabilities to larger risks and impacts up- and downstream
- gathering **more weather data by installing weather stations** or engaging communities in weather monitoring
- **additional climate projections** as science improves
- **additional research identified in the peer-reviewed** literature on snow leopard climate vulnerability, including improving understanding of genetic diversity among populations, monitoring for new pests and disease outbreaks, and changes in behavioural responses as climate change impacts worsen (see Snow Leopard Climate Vulnerability Assessment in Key Resources below).
- **adaptation interventions identified by communities:** as many of the high altitude communities are subsistence pastoralists or small-scale farmers, many interventions will need to focus on improved grazing practices to address changing vegetation patterns and improved agriculture practices to reduce vulnerability to hydro meteorological variability and hazards like droughts and flooding.
- **monitoring and learning plan with communities** to assess the efficacy of adaptation interventions and identify changes if needed, especially if vulnerability has unintentionally increased and has led to increased unsustainable natural resource exploitation
- **revised species management plans** to account for direct and indirect effects of climate change on snow leopards, their prey base and other important wildlife in the landscape
- **review of external conditions** that promote or hinder the implementation of these new aspects of the plan. Identify and advocate for needed policy changes with governments and donors.

Following the principles above about adaptive management, it is important to recognize that once these steps have been completed, the process is not complete; **plans should be continually revised as new information on climate risks and impacts is reassessed**, perhaps every 5 years, if not more frequently.

4. Key Resources

There are hundreds of tools available that could be useful for the landscape planning process to address the impacts of climate change. Rather than try to include them all here, only a limited few are listed

below that are most relevant to incorporating climate risk into integrated landscape plans across the snow leopard range.

4.1 Participatory Tools

1. Climate Vulnerability and Capacity Analysis (CVCA): This method developed by CARE provides guidance and additional tools to assess how communities are responding to climate change. This tool, while very useful at the community scale, is very focused on community well-being and not necessarily the surrounding environment, so it is important to modify the approach to include questions in community surveys specifically about reliance on surrounding ecosystems and their services (i.e. grazing habitat, medicinal and aromatic plants, freshwater supplies, timber, etc.) and any interaction with snow leopard populations or their prey base. [http://careclimatechange.org/tool-kits/cvca]
2. Climate Crowd: a local survey tool for assessing how local communities respond to climate change impacts and extreme events, and how that response affects local biodiversity (see survey draft in Appendix 2). [www.wwfclimatecrowd.org]
3. Scenario Planning: first outlined by Peterson et al. in 2003, this approach allows for planners to account for uncertainty in future climate trends and projections by planning for multiple future scenarios. [http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.2003.01491.x/full]

4.2 Climate Vulnerability Assessments

1. Documents submitted by national governments to United Nations Framework Convention on Climate Change (UNFCCC), including Intended Nationally Determined Contributions (INDCs), and National Adaptation Plans and Programmes of Action (NAPs, NAPAs). [http://unfccc.int/adaptation/items/4159.php]
2. WWF Snow leopard climate vulnerability assessment: a tool developed by WWF-US species and climate experts, this is a trait-based assessment of factors from the peer reviewed literature that assess the entire species' climate vulnerability. [http://www.worldwildlife.org/pages/snow-leopards-and-climate]
3. Climate Vulnerability in Asia's High Mountains (WWF): A 2013 review of the latest peer-reviewed and grey literature on climate change impacts and vulnerability across central Asia's major mountain ranges. [http://www.worldwildlife.org/publications/climate-vulnerability-in-asia-s-high-mountains-how-climate-change-affects-communities-and-ecosystems-in-asia-s-water-towers]
4. Guardians of the Headwaters (WWF): A 2013 map book analysing climate change across the snow leopard range, including potential impacts to habitat extent based on tree line shift, and additional impacts on water supplies due to increasing aridity. [http://www.worldwildlife.org/publications/guardians-of-the-headwaters-snow-leopards-water-provision-and-climate-vulnerability]
5. Peer-reviewed academic research: Google Scholar is an excellent source for searching for academic research on climate change impacts in each landscape, but paid access is often

required to read full articles, and articles are largely limited to English. [https://scholar.google.com/]

4.3 Other Climate-Smarting and Mainstreaming Guides

1. U.S. Fish and Wildlife Service, "Climate-Smart Conservation: Putting Adaptation Principles into Practice," provides a comprehensive guide for addressing climate change in the entire planning and management cycle. [https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice]

4.4 Climate and Other Relevant Spatial Data

1. Worldclim: freely available spatial climate data already in raster format, downscaled to 1km resolution, including from the most recent IPCC 5th Assessment Report (AR5) CMIP5 models. [http://www.worldclim.org/]
2. WRI Aqueduct: global depiction of risk to water supplies, including seasonal and annual variability. [http://www.wri.org/our-work/project/aqueduct]
3. Third Pole Geolab: an interactive mapping site that summarizes a series of maps and review of the climate literature for Central Asia, highlighting the connections between snow leopard habitat, climate change and water provision. The site is also home to a GIS data repository containing relevant spatial data for the region. [http://www.thirdpolegeolab.org/]

Appendices

Appendix 1. Understanding Your Climate: Creating a Seasonal Calendar

Understanding Your Climate

Developed by Shaun Martin

Objective: We often discuss climate change as if we already thoroughly understand the historic climate its role in local ecology, culture, and economies. It is difficult to understand change if we do not understand where we are starting from. Through this participatory exercise, participants will use their current knowledge to jointly develop a visualization of the historical annual climatic cycle for their region of interest (usually where they live or work). This activity also helps facilitators and trainers to better understand the climate of a region that they may be unfamiliar with. This will be helpful in facilitating subsequent discussions about local climate change.

Background: This is a fast-paced, fun collaborative exercise where all participants work in a single group. This activity should be conducted at the beginning of a workshop, before formal presentations begin. If participants already know one another very well, it can be used instead of an ice-breaker. The visualization of the climate can remain on the wall for the duration of the workshop to refer back to when necessary.

Time required: About 30 minutes.

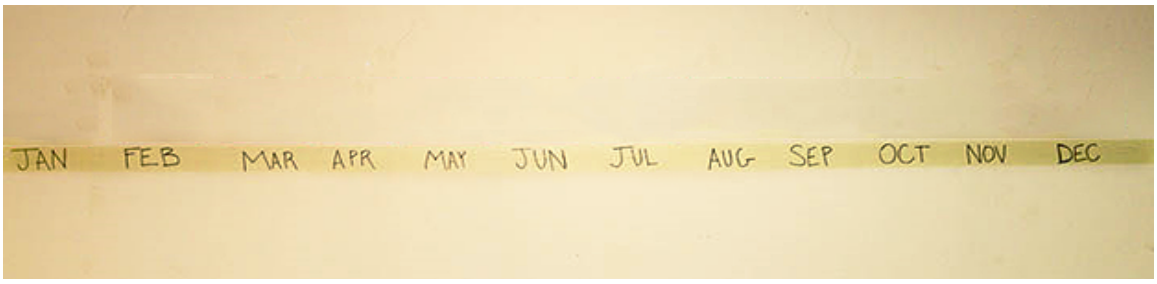
What is needed:

- About 5-6 meters of masking tape about 10 centimetres wide
- Plenty of large coloured sticky notes in at least 2-4 colours
- Plenty of thick-tipped Sharpie pens or magic markers
- A clean wall at least 5-6 meters long

Preparation:
This activity requires set up before participants arrive at the meeting venue. Set up takes about 10-15 minutes. Begin by placing the masking tape horizontally along the wall in a single line about 5-6 meters long. If your masking tape is less than 10cm wide, you can place 2 or 3 strips of masking tape on the wall to form a single strip of sufficient width. The tape should be place at a height where most participants can reach comfortably above it leaving plenty of space below it.

With a black thick-tipped Sharpie or magic marker, write the months of the year evenly spaced across the masking tape, starting with January on the left and ending with December on the left. You may use abbreviations for months like JAN, FEB, DEC, etc.

Your “climate calendar” should look something like this:



Distribute large colored Sticky Notes in all colors you have available and several Sharpies or magic markers at each table.

Explain to the participants the objective of the exercise as described above. Participants will use the colored sticky notes and Sharpies to build a visualization or "climate calendar" based on what they believe their historical (and usually current) climate to be.

Begin selecting a single color Sticky Note and have participants write down seasons and climate-related events using their Sharpies. They may also draw pictures of the seasons and events if they prefer. You can prompt thinking by suggesting a few seasons to start. For example, "When does the rainy season start?" Someone may respond, "In April." Have the participant write or draw a picture of "rainy season" on a Sticky Note and have them place it above "April" on the wall.

Continuing with this example, "When does the rainy season end?" Someone may respond "In June." Have that person write or draw "rainy season" on a Sticky Note and place it above June on the wall. Have another person write or draw "rainy season" and place it above May so that all months of the rainy season are identified as such.

Then ask participants for other seasons of the year. For example, "dry season," "hurricane season," "monsoon" or "cold season." By now participants should be writing the seasons and climate-events on their own. As they place it on the wall, they should verbalize it to the group. If more than one person writes the same season, have them place the second Sticky Note above another month for that season until all months with that season are identified.

Once participants have run out of seasons to identify, review the calendar to make sure all seasons have been identified and everyone agrees on the timing of seasons as represented on the wall. At this point, the climate calendar should look something like this:

In the next step, following the same process above, participants use different colored Sticky Notes to represent various ecological, social and economic processes and events and place them in the appropriate months below the calendar. If you have enough colors of Sticky Notes, choose one color for ecological processes, another for social events and a third for economic activities. If you have only two colors, combine social and economic activities. You may want to start with a single theme or you can do all three simultaneously. You can start the activity by giving various examples of each of the 3 themes.

Ecological

- bird migrations (departures and arrivals)
- fish spawning aggregations
- breeding seasons for various terrestrial species
- flowering and fruiting of important plants

Social

- important festivals and celebrations
- start and conclusion of the academic year
- start of the government fiscal year and budgeting season (particularly for government groups)
- holiday period for workshops

Economic

- planting and harvesting seasons
- tourist season
- logging season
- fishing and hunting seasons

At this point in the activity, one person's ideas lead to many others bringing up new ideas and the calendar can get full very quickly. Let this process happen without interruption. When no one has anything more to add, review the calendar on the wall with the entire group starting with January and moving through the entire year. You might want to make observations as you go along and ask questions to clarify things you might not understand that will be useful in later discussions during the workshop.

As a last step, explain again to your participants what they have created – a calendar that shows links between the climate and ecological, social and economic processes and activities. Our way of life has evolved around the premise of a stationary climate. Explain that climate change means that the climate-related seasons on the wall above the calendar are shifting. Take one Sticky Note, for example, "rainy season" above April, and move it to another month or remove it from the wall altogether. Ask, "What happens to everything below the calendar if the rainy season shifts so that starts earlier or later or is shorter or disappears altogether?" This is what we will explore in this workshop.

If you are able to keep the calendar on the wall for the rest of the workshop, you can use it to show changes in local climate during presentations on freshwater, marine, forests, etc.

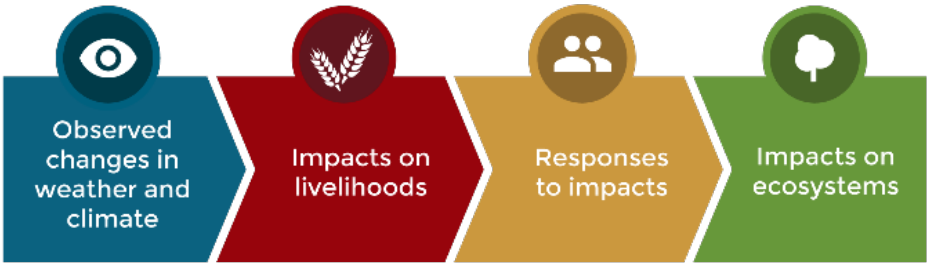
Appendix 2. Survey: Assessing Human Responses to Climate Change and Potential Impacts on Biodiversity

WWF Climate Crowd

www.wwfclimatecrowd.org

Community survey on human responses to climate change
and subsequent impacts on biodiversity

Far removed from decision-making bodies and financial resources, rural communities in developing countries are often left to their own devices to cope and adapt to changes in weather and climate. Because coping strategies and autonomous adaptation responses go largely undocumented, we miss important opportunities to learn from the experiences of these communities and integrate learning into planning efforts.



The aim of this research is to investigate the nature of any changes in weather and climate, how rural communities are responding to these, and the effect of these responses on biodiversity. Key informants – or community leaders with positions of responsibility – should be sampled – but they are being asked to give their answers based on the community as a whole, not just themselves.

There is inequality between men and women in communities. This research is gender-sensitive, meaning it recognizes these differences and makes an effort to hear the voices of men and women. Women and other disadvantaged groups should be proactively sought for participation. In order that women feel able to speak freely, they should be interviewed by female researchers. There is a box to tick whether or not a man is present in interviews with women. Such presence may impede a woman's ability to express herself freely, and cause her to present the views of the powerful, even if she does not agree. It is thus important for valid analysis for us to know whether or not this is the case.

This survey contains a mixture of closed-answer questions (where there is a yes/no answer, or a box to tick) and open-answer questions. In the open answer questions please probe the issue with your respondents so you are satisfied that you have a valid picture of the situation. Some potential examples are provided to form the basis of discussion, but this is by no means exhaustive. New findings – beyond these examples – will particularly add to the research impact. For example, if one response to a decline in crop yield is to gather wild resources, you could ask more about the resource being collected. Is it in a

protected area for example? Such detail will help us to know more about the specific nature of responses, and how they vary from place to place.

The survey comprises 4 sections:

A. Background information
B. Changes in weather and climate
C. Impacts of changes in the weather, climate and responses to these changes
   C1 Crop yield
   C2 Livestock production
   C3 Fish catch
   C4 Human health
   C5 Natural resources, e.g. water, wood
   C6 other responses
D. Impacts of responses on biodiversity

In your introduction, explain that you are interested to see if (s)he has seen any changes in weather and climate and, if so, what the effects of these have been on livelihoods, and how people are responding to them. Explain that the results of the survey will remain anonymous, and that your respondent has the right to refuse to participate or withdraw at any time. Please apply a questionnaire reference in the first box – we suggest your first and last name, and a sequential number e.g. Jane Smith 1; Jane Smith 2; etc. This identifying reference is important during the analysis of data.

Once collected, please submit all data at https://www.wwfclimatecrowd.org/form
Contact Nikhil.advani@wwfus.org for any questions

Questionnaire reference					
Interviewer's name		**Interviewer's sex**	M	F	
Interviewer's organisation		**Country**			
Date		**Village**			
Time started		**Time ended**			
GPS Location					

A. BACKGROUND INFORMATION

A1 Respondent's role *(e.g. farmer, park ranger, village leader, etc.)*							
A2 Main livelihood(s) in village *(e.g. farming, livestock, fishing, trading, etc.)*							
A3 Respondent's sex	M	F	**A4 If the respondent is a woman, is a man present during the survey?**			Y	N
A5 How many years have you lived in this area?	Less than 1 year		1 – 5 years		6 – 10 years	>10 years	
A6 What is your age?	18 – 35		36 – 53		54 – 70	>71	

B. CHANGES in WEATHER and CLIMATE

Try not to lead by simply asking the questions as they appear in the questionnaire. Rather engage the interviewee in conversation about different aspects of the weather and, if you are not certain of their answer/ if it is not obvious from your conversation, then ask them to clarify e.g. After a chat about rainfall, "so, do you think rainfall is staying the same or increasing or decreasing? What about timing?"

(Circle the correct answer, and you may circle more than one.)

B1 Have you noticed changes in temperature?	No / Stayed the same	Hotter	Cooler	More variable	Don't know
B2 Have you noticed changes in the amount of rainfall?	No / Stayed the same	More	Less	More variable	Don't know
B3 Have you observed changes in the timing of the rainy season?	No / Stayed the same	Earlier	Later	More variable	Don't know
B4 Have you observed changes in how often floods occur?	No / Stayed the same	More frequent	Less frequent	More variable	Don't know
B5 Have you observed changes in how often droughts occur?	No / Stayed the same	More frequent	Less frequent	More variable	Don't know
B6 Have you observed changes in wind patterns?	No / Stayed the same	More	Fewer	More variable	Don't know
B7 Have you observed any changes in landslides	No / Stayed the same	More	Fewer	More variable	Don't know
B8 Have you noticed any changes in ice or permafrost melt?	No / Stayed the same	More	Less	More variable	Don't know
B9 Have you noticed any change in sea level?	No / Stayed the same	Higher	Lower	More variable	Don't know

If any of section C1-6 is not relevant, for example in a fishing-dominated village there may be no livestock production, please skip and write not relevant.

C. IMPACT of CHANGES in WEATHER and CLIMATE and RESPONSES

C1 Crop Yields

C1a Has there been a change in crop yields?	Decrease	Stayed the same	Increase

C1b Which of the changes in weather and climate have played a role?	**C1c What have been the specific impacts on crop yields?** e.g. increases in pests and diseases, increased sun exposure burning crops *(Elaborate the nature of the change with as much detail as possible. The examples are merely indicative)*

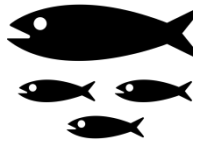
C1d How have people responded to these impacts? e.g. change in farming practices, change in farming location, water management, disease/pest management, diversifying livelihood, use of natural resources, etc.	

C1e Have these responses had impacts on biodiversity?	Yes	No	*(See section D to add more detail)*

C. IMPACT of CHANGES in WEATHER and CLIMATE and RESPONSES
C2 Livestock production

C2a Has there been a change in livestock production?		Decrease	Stayed the same	Increase
C2b Which of the changes in weather and climate have played a role?		**C2c What have been the specific impacts on livestock production?** e.g. greater deaths, loss/gain in production, health, changes in fodder/water availability, increases in pests and diseases *(Elaborate the nature of the change with as much detail as possible. The examples are merely indicative)*		
C2d How have people responded to these changes? e.g. change in livestock practice, water management, disease/pest management, change in location, natural habitat encroachment, use of natural resources, illegal hunting, diversifying livelihood, etc.				
C2e Have these responses had impacts on biodiversity?		Yes	No	*(See section D to add more detail)*

C. IMPACT of CHANGES in WEATHER and CLIMATE and RESPONSES
C3 Fish catch



C3a Has there been a change in fish catch?	Decrease	Stayed the same	Increase

C3b Which of the changes in weather and climate have played a role?		**C3c What have been the specific impacts on catch?** e.g. total catch, size of fish caught, type of fish caught *(Elaborate the nature of the change with as much detail as possible. The examples are merely indicative)*

C3d How have people responded to these changes? e.g. change in fishing practice, catch other species, diversifying livelihood, change in location, natural habitat encroachment, use of natural resources, etc.			
C3e Have these responses had impacts on biodiversity?	Yes	No	*(See section D to add more detail)*

C. IMPACT of CHANGES in WEATHER and CLIMATE and RESPONSES
C4 Human health

C4a Has there been a change in human health?	Worsened	Stayed the same	Improved

C4b Which of the changes in weather and climate have played a role?	**C4c What have been the specific impacts on human health?** e.g. who has been affected, any particular diseases, have new health conditions emerged, are people living longer/dying earlier *(Elaborate the nature of the change with as much detail as possible. The examples are merely indicative)*

C4d How have people responded to these changes? e.g. disease management, working earlier or later in the cooler parts of the day, change in location, diversifying livelihood, etc.	

C4e Have these responses had impacts on biodiversity?	Yes	No	*(See section D to add more detail)*

C. IMPACT of CHANGES in WEATHER and CLIMATE and RESPONSES
C5 Natural resources

C5a Has there been a change in availability of natural resources, e.g. water, wood?	Decrease	Stayed the same	Increase

C5b Which of the changes in weather and climate have played a role?	**C5c What have the impacts been on natural resources, e.g. water and wood?** e.g. traveling further for firewood, traveling further for water, using alternative species for fire (including protected/slow-growing species), reduction in the variety and/or size of wild animals to eat, any animal species no longer seen, reduction in availability of wild fruits *(Elaborate the nature of the change with as much detail as possible. The examples are merely indicative)*

C5d How have people responded to these changes? e.g. natural habitat encroachment, illegal hunting, change in livelihood location, diversifying livelihood, water management, etc.	

C5e Have these responses had impacts on biodiversity?	Yes	No	*(See section D to add more detail)*

C. RESPONSES to the CHANGES in the WEATHER, CLIMATE

C6 Other responses

This question provides an opportunity to investigate if there have been any other general responses to changes in weather and climate that are not specific to the categories above *(Fill in with as much detail as possible)*

C6 Have there been any other ways people have responded to changes in the weather, climate and nature environment? e.g. migration, borrowing, reliance on NGO/government support, selling assets	

D. IMPACT of RESPONSES on BIODIVERSITY

The intention here is to investigate whether any responses to changes in weather in climate are having knock-on effects on biodiversity (local wildlife and ecosystems). In some cases, this will be obvious from the impacts and responses outlined in **section C**, and so you will be able to fill these in yourself. In other cases, the respondent may not explicitly point to the impact of responses on biodiversity – particularly if it is negative. However, with your knowledge you may be aware of the implications for certain responses, and so can further probe these. For example, if it has been mentioned that livestock are now roaming a protected area, you can specifically probe issues such as increased human-wildlife conflict, and change in wildlife populations, as a result *(Circle the Y/N. If Y, fill in the box with as much detail as possible)*

D1a Have any of the responses led to increased human-wildlife conflict?	Y / N	**D1b Which response(s)?** **How?**
D2a Have any of the responses led to increased competition (with other people and with wildlife) for resources such as water, food and land?	Y / N	**D2b Which response(s)?** **How?**
D3a Have any of the responses led to increased wildlife mortality?	Y / N	**D3b Which response(s)?** **How?**
D4a Have any of the responses led to wildlife moving to/	Y / N	**D4b Which response(s)?** **How?**

away from communities?		
D5a Have any of the responses led to increased land degradation?	Y / N	**D5b Which response(s)?** **How?**
D6a Have any of the responses led to changes in water supply?	Y / N	**D6b Which response(s)?** **How?**
D7a Have any of the responses led to other impacts on local environment and ecosystems?	Y / N	**D7b Which response(s)?** **How?**