

INTEGRATING CLIMATE CHANGE ADAPTATION INTO SECURE LIVELIHOODS

POVERTY

TOOLKIT 2: Developing a climate change analysis



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Abbreviations

AGW	Anthropogenic global warming	PRECIS	Providing Regional Climates for Impacts Studies
CBO	Community-based organisation	PVCA	Participatory vulnerability and capacity assessment
CFS	Climate field school	RCM	Regional climate model
COP	Conference of the Parties	RCOF	Regional climate outlook forum
DRR	Disaster risk reduction	UNDP	United Nations Development Programme
GCM	Global circulation model	UNFCCC	United Nations Framework Convention on Climate Change
GFCS	Global Framework for Climate Services	WMO	World Meteorological Organization
GHG	Greenhouse gas		

Front cover photo: Communities explain their development plans, West Bengal, India

Credit: Christian Aid/Richard Ewbank

1. BASIC APPROACH

A key part of assessing the likely climate risk to a livelihood is to understand the degree of change that will occur due to both longer-term trends and shorter-term variability of climate and the likely exposure to each. The focus of this toolkit is on developing this analysis (steps 1 and 2 of the adaptation overview, see Figure 6, Toolkit 1).

As stated in Toolkit 1, an integrated approach to climate change adaptation emphasises the need to build on:

- Innovative or new techniques to combine climate science with local knowledge of climate/climate change.
- Disaster risk reduction (DRR) tools, such as participatory vulnerability and capacity assessment (PVCA).
- Longer-term sustainable livelihoods approaches, such as participatory technology development and community/land use planning.

Focusing on fast- or medium-onset climate change without understanding the longer term, slow onset factors risks promoting activities that could increase long-term vulnerability or maladaptation. However, it is important to remember that adaptation to climate change is as much about, for example, enabling farmers to maximise yields when conditions are good as it is about increasing resilience to climate shocks when conditions are bad.

Given the multiple external factors (climate and non-climate related) that impact on livelihoods, it is important to demonstrate that adaptation is a response to the observed and predicted effects of climate change. It also may be important to show that adaptation is a response to man-made climate change or anthropogenic global warming (AGW), for example in accessing funding for climate change adaptation. However, there are significant methodological problems in separating parts of a development intervention into those that increase resilience to normal variation and those that increase resilience to AGW.

The debate as to how much climate change we are experiencing already, compared to what we should expect by 2020, 2050, and so on, has been vigorous and controversial, and hinges on what can already be detected in terms of changing climate and whether this can be attributed to AGW. As climate science becomes better at separating normal climate variation from AGW, so it will become clearer as to what is directly related to greenhouse gases and what is not. At a community level, this can appear academic because the community perception of climate change and the priorities to address is often quite clear.

The basic approach to developing a climate change analysis is to obtain information from two sources of climate expertise, combining:

- what **climate science** (both meteorological/weather forecasting and climate modelling data) says about the past, present and future in terms of both weather/seasonal variability and longer-term climate change trends,
- with **community/local knowledge** of those most directly affected by these processes.

This approach takes advantage of both sources of knowledge to increase both the accuracy of the analysis and the community's confidence in it as a basis for making decisions about their livelihoods that will increase resilience and their ability to cope with changing climate risks.

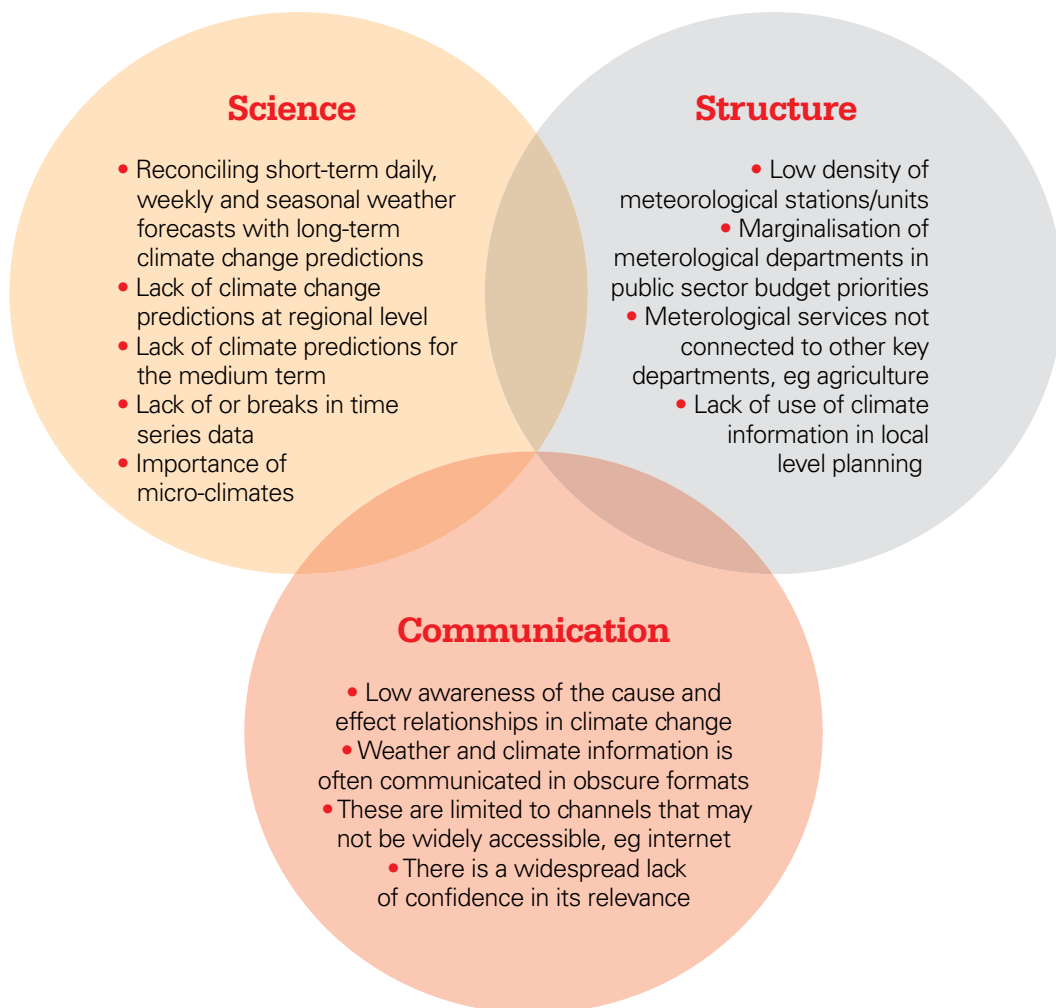
2. CHALLENGES IN USING CLIMATE SCIENCE

In many circumstances, accessing good quality climate science will present considerable challenges. Climate science concepts and data are complicated, often dealing in uncertainties and probabilities rather than concrete predictions. Information must be simplified in order to be easily interpreted and used for decision-making by communities at risk at a local level. There may be existing science-to-community linkages, such as through agricultural

extension systems, that can be used and built upon. Building the capacity of these intermediaries between climate science and the community is an important part of adaptation strategies.

The basic challenges break down into three inter-relating groups: science, structure and communication.

Fig 1. Challenges in accessing climate science



Box 1. PRECIS – Providing Regional Climates for Impacts Studies

PRECIS has been designed for use by local meteorological offices or research institutes developing regional climate models (RCMs) that can give more specific projections at regional and country level. So far institutes in 105 countries have been trained in developing PRECIS RCMs. Regional focal points and data distribution centres have been established in:¹

- **Africa**
African Centre for Meteorological Application to Development (Niger) www.acmad.ne/en/homepage.htm
Climate Systems Analysis Group University of Cape Town (South Africa) www.csag.uct.ac.za
IGAD Climate Prediction and Applications Centre (Kenya) www.icpac.net
- **Asia**
Indian Institute of Tropical Meteorology www.tropmet.res.in
Malaysian Meteorological Department www.met.gov.my/index.php?option=com_content&task=view&id=1315&Itemid=1050
Chinese Academy of Agricultural Sciences www.caas.net.cn/engforcaas/index.htm

- **Caribbean and Central America**
Caribbean Community Climate Change Centre (Belize), www.caribbeanclimate.bz
INSMET Precis Caribe (Cuba), <http://precis.insmet.cu/eng/Precis-Caribe.htm>
- **South America**
Centro de Previsao de Tempo e Estudos Climaticos (Brazil), www.cptec.inpe.br (site in Portuguese)
Comision Interdisciplinaria de Medio Ambiente (Argentina), www.cima.fcen.uba.ar
- **Middle East**
Presidency of Meteorology and Environment (Saudi Arabia), www.pme.gov.sa/en/eindex.asp

PRECIS was developed in order to help generate high-resolution climate change information for as many regions of the world as possible. RCMs work at resolutions of typically 50 x 50 km or less and so have the potential to give more detailed climate predictions at regional/national scale.

See the PRECIS website for more information: <http://precis.metoffice.com/index.html>

2.1 Science

Short-term weather and seasonal forecasting focuses on daily, weekly and seasonal predictions up to a maximum of two years in advance, although seasonal forecasts typically aim at 6-12 months ahead. Climate change modelling is focused on the long-term (40-100 years ahead).

Although seasonal weather forecasting has improved and some models are starting to provide information as much as 20-30 years ahead, this still leaves an uncertainty gap (see Figure 3 below) between one and 20-plus years ahead – exactly the period over which most projects operate, given their management cycles of three to five years per phase.

A fundamental challenge is to integrate the use of short-term weather/seasonal forecasting with longer-term general circulation models (GCMs) to determine future climate change and so better understand the likely impact of fast, medium- and slow-onset climate factors.

Although increasing in horizontal resolution, the definition of GCMs has been too coarse (with a typical refinement of about 270 x 270 km, such as HadCM3) to provide predictive capacity at national or even regional levels. As meteorological science improves, progress will be made and a more seamless system will emerge. For instance, current GCMs (such as HiGEM) are working at 90 x 90 km with increased vertical definition using a larger number of both atmospheric and ocean layers. The latest GCMs (such as the UK Met Office's Nu-Gem²) are using definitions down to 60 x 60 km.

There has been some downscaling of GCMs at regional level (to RCMs) to develop likely scenarios at the 25 x 25 km scale (see Box 1 above). In order to provide reasonably reliable predictions on the future frequency and occurrence of cyclones for example, a resolution below 60 x 60 km is needed, whereas for rainfall an estimated resolution of 14 x 14 km is required, far beyond that of the latest models. As these improve, the use of integrated short, medium and long-term climate predictions will become more feasible.

2.2 Structure

National meteorology institutions often lack adequate resources, are understaffed and may lack facilities to generate timely climate data and support early warning systems. Their ability to develop a grid of weather stations that can provide reliable ongoing data across all geographical and agro-ecological zones is thus often restricted. This can result in a lack of or limited integration of meteorology departments into the planning and operations of other relevant ministries, such as agriculture, transport, environment and local government. While they often have good historical records, these are not always computerised and their availability to development agencies may be limited.

With the rapid increase in concern about climate change, meteorological staff already find themselves in considerable demand, which can then make them difficult to access, particularly by organisations not based in capital cities. Scaling up to meet this demand is likely to take time, because for many meteorology departments, this means sending aspiring scientists overseas for training. Local climate stations can be useful sources of expert advice but have traditionally been established to collect climate information for central processing rather than to act as local training and support resources. Their coverage may also be limited – for instance, Africa has only one-eighth of the minimum World Meteorological Organization recommendation for density of climate stations.

However, despite these constraints, meteorological staff are generally happy to work with NGO partners and provide invaluable technical advice, enthusiasm and support.

2.3 Communication

While the understanding of changing climate over the past 5-10 years at community level may well be detailed, an awareness of the cause and effect relationships in climate change is often limited. Likewise, access to even short-term weather forecasting may be poor and given the structural problems of meteorological services detailed above, it may lack the specific locational relevance or accuracy a community needs to assist local decision-making.

Even when communities can access weather data or more detailed climate information, this data may be in a form that needs considerable interpretation and modification to make it useful and easily understood at community level. Climate scientists often use very specific terminology with a focus on probability and statistics that needs to be carefully explained in order for it to be clearly understood. As a result, there are considerable challenges to integrating this information successfully into livelihood strategies. As well as some individual pilot activities (see Boxes 3 and 4), there are initiatives focusing on improving the meteorological information services chain, such as the Global Framework for Climate Services (see Box 2 below).

Box 2. The Global Framework for Climate Services

The Global Framework for Climate Services (GFCS) was launched at the 3rd World Climate Conference in August 2009. Working under the auspices of the World Meteorological Organization (WMO), the GFCS's overall objective is to:

'...enable better management of the risks of climate variability and change and adaptation to climate change at all levels, through development and incorporation of science-based climate information and prediction into planning, policy and practice.'

Although primarily focused on enhancing the role of national meteorological services and regional/global centres of excellence, the framework requires extensive collaboration with NGOs, civil society, and public and private sectors. A High Level Taskforce has been appointed to make detailed recommendations on the implementation of the GFCS to the WMO in 2011 and has collected

feedback from 140 providers, users and researchers of climate services (including Christian Aid).

Providers have called for increased climate-related data, improved climate-related research capabilities and capacity building in areas such as climate change predictions of impacts for local use.

Users have called for downscaled climate scenarios (around 50 per cent of responses) and for reliable seasonal forecasts and outlooks (around 40 per cent of responses). There was strong interest in being able to obtain climate-related information via the web. The results also showed that there exist barriers to data access and to the availability of expertise in climate services.³

For resources from the conference and information on GFCS developments, visit:

www.wmo.int/pages/gfcs/index_en.html

3. CHALLENGES IN USING COMMUNITY KNOWLEDGE

When discussing climate change at community level, it is important to appreciate the types of bias that may creep into an analysis of past or experienced climate change, and upon which a prediction of future change is made. These may include:

- a) A general feeling that climate used to be better or more reliable – the two main and related biases here are **rosy retrospection** and **hindsight bias**. Rosy retrospection is a tendency to judge past events more positively than they were actually judged at the time, whereas hindsight bias filters the memory of past events through present knowledge so that these past events end up looking more predictable than they actually were. So a statement such as ‘up to 10 years ago, we always had good rains and they always arrived without fail at the beginning of every October’ may well contain both types of bias.
- b) Using extreme or atypical climate events as a starting point – again, two closely related biases can lead to the use of extreme events as a starting point for future climate predictions, with an expectation of extreme events continuing. The **Von Restorff effect** is the tendency of an extreme event that stands out from other lesser events to remain in the memory and the **availability heuristic** leads to communities estimating what is more likely by what is more readily remembered, which tends to be the more vivid, unusual or extreme events. Linked to these two is the **recency effect**, that basically means that people tend to remember more recent events than more distant ones. So when a community that has just experienced a particularly harsh winter confidently predicts a continuation of harsher winters as the most important impact of climate change, it may well be that they are letting all three of these biases affect their conclusion, when a few colder winters may be part of a normal cycle of fluctuating seasonal average temperatures over a 20- or 30-year period.
- c) Ignoring or undervaluing important elements of climate change – three biases can affect responses here. The **focusing effect** refers to the tendency for people to use one aspect of a climate event as a basis for making future predictions; **confirmation bias** is the tendency to search for or interpret information in a way that confirms one’s preconceptions; and the **bandwagon effect** is the tendency to believe things primarily because most other people do. So for example, a community that has heard about the impact of carbon emissions on temperature rise may focus on this climate factor, especially when the majority of community members agree (having heard the same report), when varying rainfall is actually the more important factor.
- d) Overconfidence in assessing climate change – the **overconfidence effect**, or overconfidence in the value of one’s own answers, is a commonly recognised bias. For many questions, answers that respondents rate as ‘99 per cent certain’ are routinely 40 per cent wrong. Linked to this is the **clustering illusion** or a tendency to see patterns where none actually exist. So caution needs to be exercised, for example when a respondent is virtually certain that a particular pattern of extended dry spells is emerging in recent rainy seasons.
- e) The facilitator’s technique – it’s not just the community or respondent that is prone to bias. These can affect the facilitator collecting information also. Two biases deserve particular mention here. **Starting point bias** refers to the way a question is asked leading to a particular answer, so a question ‘Climate change is going to have a big impact on rainfall – what is the most important climate change that has affected you here?’ is likely to lead to answers about rainfall when it may be that sea level rise is the more urgent problem. Likewise **expectation bias** could lead a facilitator to unconsciously disbelieve, discard or downgrade data that appears to conflict with his/her initial expectations about what the community ‘should’ be saying about climate change.

In order to ensure that adaptation and risk reduction interventions address the vulnerability priorities at community level, selecting the right **entry point** and getting the right **sequencing** of climate risks to address is essential. This will ensure that both community motivation and the sustainability of work are enhanced. To begin an adaptation process by talking about what might happen in 2050 is unlikely to be top of the climate risk list at the community level and may well sound rather abstract. Typically the fast-onset climate risk that has the capacity to do the most damage is more urgent and so DRR projects are often the starting point for adaptation work. However, once the urgent disaster risks are addressed, the slower onset more gradual changes become increasingly important.

The assumption is often that the problem is a single-hazard mitigation one. For example, once a community is connected to an early warning system and village committees have been trained so that this is fully operational, and storm shelters have been constructed, then the job is done.

However, evaluations of Christian Aid DRR work in both Central Asia on earthquake preparedness and on cyclone early warning systems in Central America have shown that once these top priority risks have been addressed through establishing the relevant community-based organisations and rapid response capacity and/or early warning systems, the community organisations themselves highlighted the

importance of starting work on slower-onset threats such as droughts, changing seasonality and sea-level rise. They are often quite frustrated that at this point, external support ceases.

Making this transition from single-hazard mitigation to a multi-risk adaptation approach, but using the right entry point and establishing the most appropriate sequence of risks to work on, is a challenge all adaptation initiatives will need to address flexibly and persistently.

It can potentially result in greatly enhanced resilience at community level and so prevent falling back into the recovery trap (see Toolkit 1) or a downward spiral of diminishing livelihood assets. Likewise, there is increasing evidence that it can enhance the ability to bounce back after a severe shock.⁶ Once the climate change analysis is agreed, a capacity and vulnerability assessment can help answer these questions.

See Christian Aid Good Practice Guide: Participatory Vulnerability and Capacity Assessment for more information as well as the resources in Annex 1.

4. DEVELOPING THE ANALYSIS

3.1 Focus of the analysis

Given these challenges, an analysis process combining climate science with community knowledge may well rely as much on the latter as the former. This is not a problem so long as this local knowledge can be verified with climate data or information from other sources, for example, agricultural extension experts verifying that a particular season identified as a drought year by the community was a poor season. The value is in cross-referencing sources of information to obtain as accurate a picture as possible and developing a climate change scenario that has credibility at community level.

To develop a 'most-likely' scenario of where climate trends are emerging and how these might then develop in future, the focus will therefore be on combining:

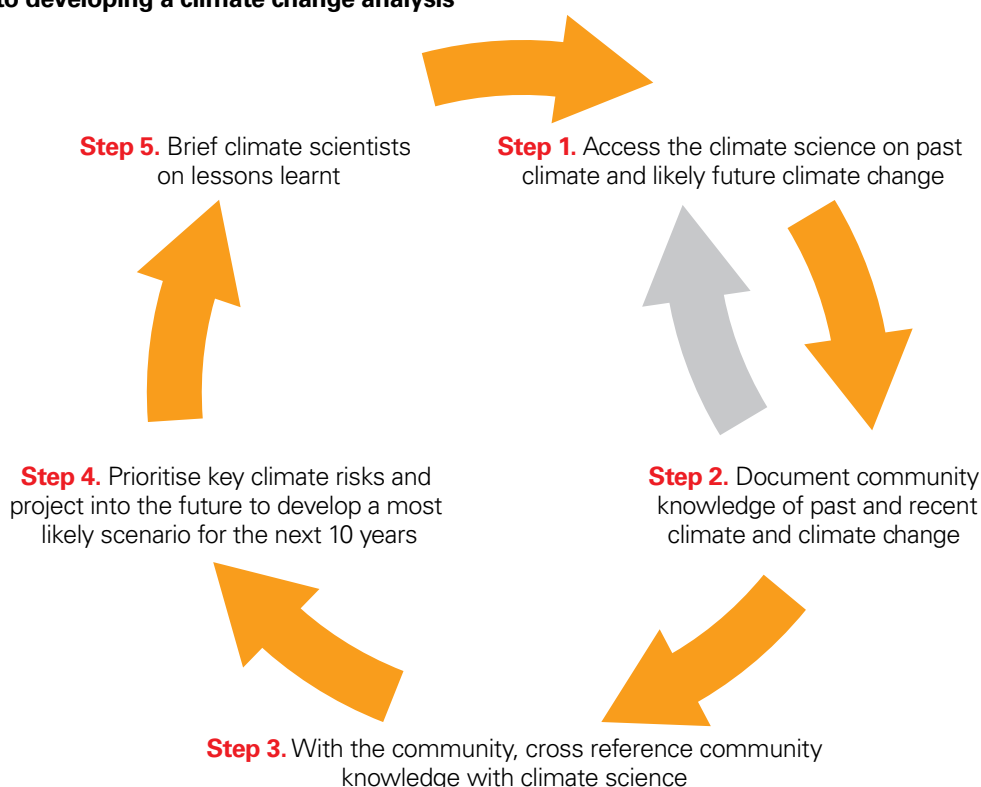
- **Historical data** from meteorological departments, academic departments, weather stations, and so on.
- **Seasonal forecasts** for the next year from meteorological departments and early warning systems.
- **Community knowledge** of past changes.
- **Longer-term climate science** data on future climate change.

3.2 Issues and assumptions

Key issues and assumptions when developing the analysis will include:

- i) **Global temperature rise** – climate change predictions should be tied to those changes that are likely to result from a 2°C global temperature increase by 2050,⁴ given the uncertainty related to:
 - the predictive capacity of climate science,
 - the likely extent of mitigation of GHGs that will be agreed in the post-2012 climate agreement,
 - the impact of that mitigation on ongoing climate change.
- ii) **Community ownership** – without local ownership, and therefore local involvement in its development, any climate change analysis is likely to lack credibility with the user community. Participatory ways of combining science with local knowledge are therefore central to the process.
- iii) **Involvement of climate scientists** – bringing communities into direct contact with climate scientists is not always possible, as scientists are a relatively scarce resource. Even when it is possible, an understanding of what climate science can and cannot provide is needed to avoid unrealistic

Fig 2. Five steps to developing a climate change analysis



expectations. Climate data will often need to be processed and interpreted by a partner into a community-friendly resource, with a particular focus on time-series data to show how rainfall, temperature, and so on has changed over the past 30 years, but particularly over the past 10 years. Long-term climate prediction will only be available on a regional scale (eg east Africa) at best, and so can be used in multiple locations. Historical data and seasonal predictions will be more specific to location or agro-ecological zone.

iv) **Predictions for the next 10 years** – an implicit assumption is that the trend over the last 10 years will be continued over the next 10 years in a linear pattern (ie the direction and speed of change experienced over the last 10 years will continue for the next 10 years), but there is a need to understand any relevant decadal climate cycles so that, for example, a cycle that brings a few cold winters every 30 years is not interpreted as climate change that will permanently shift to cold winters every year.

v) **Updating information** – given the speed at which climate science is progressing, a sustainable link with information sources is important so that the analysis can be updated accordingly.

vi) **Increasing awareness** – ensuring that the community involved has a basic overview of the cause and effect relationship between GHG emissions (where they come from, how they change climate and what that can mean for climate-vulnerable livelihoods) will create an enabling level of understanding from which to move onto developing a local analysis of climate change.

3.3 Five steps to developing a climate change analysis

A major challenge in terms of predicting the medium-term (5-10 years ahead) impact of climate change is the lack of reliable climate science over this timescale.

The gap between seasonal forecasting and climate modelling corresponds to the period over which most development projects are implemented (see Figure 3), so developing a ‘most-likely’ scenario⁵ for the next 10 years is largely aimed at reducing this problem. The process follows five basic steps (see Figure 2).

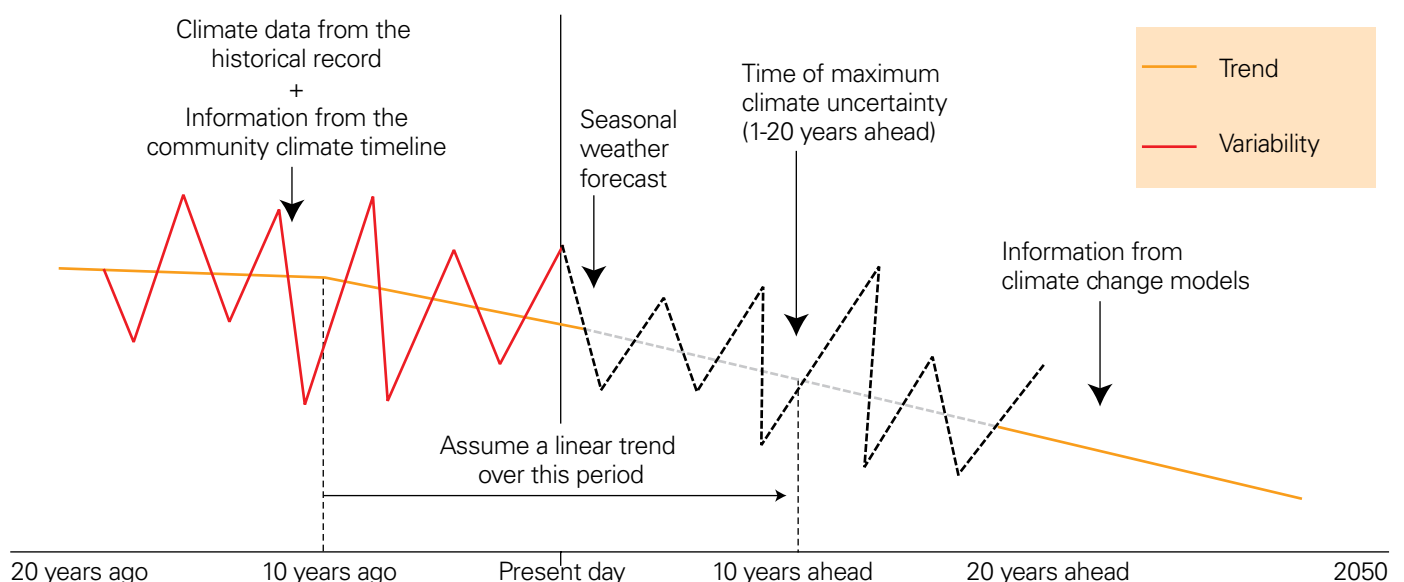
Step 1. Accessing the climate science on past and likely future climate change

The challenges in accessing climate science have been discussed (see Figure 1). The first step in developing a climate change analysis is to access relevant climate science – the quantitative (or numerical) data. A key resource will be time series data or timelines that can give both:

- Changes in **variation** of climate factors from year to year (especially fast/medium onset).
- Changes in the overall **trend** (slow onset factors).

Historical data up to the present day should be collected on the direction of current climate trends and climate variability identified by meteorologists and climate change experts.

Fig 3. Developing a climate change timeline



Box 3. Case study: Integration of seasonal forecasting, Zimbabwe

Farmers in the research area plant a mixture of short-season maize, sorghum and millet as their staple crops. These communities already have access to the seasonal rainfall forecasts developed at the annual Southern African Regional Climate Outlook Forum (SARCOF). The SARCOF forecasts are downscaled, interpreted and disseminated by the Zimbabwe Department of Meteorological Services, with radio being the most common medium for people to learn of them. The forecasts contain rainfall estimates for the early (October-December) and late (January-March) growing seasons, in the form of probabilities for rainfall totals falling in the ranges of below normal (a range defined by the 10 driest of the past 30 seasons), normal, or above normal (a range defined by the 10 wettest of the past 30 seasons).

Beginning in September 2000, a series of annual participatory climate forecast workshops were held, designed to assist a group of 50 farmers in each village to better understand the forecast and to be able to apply it to their farm management decisions.

Local coordinators (extension staff, village chiefs, etc) were asked to invite a random sample of farmers, based on census data, with the constraint of inviting equal numbers of men and women. In subsequent years, the local coordinator randomly invited half of the participants from the previous year's workshop and a new random sample of men and women, again based on census data, to fill the remaining places. The workshops took place in the village primary school, lasted three hours, and were conducted in the local language, with many parts translated from English. Each workshop was videotaped to obtain a transcript of farmers' questions and comments.

The workshops followed a common format, designed to assist farmers in applying the forecast information, yet short enough to be a model for a more widespread communication strategy:

- Farmers were asked to comment on the previous

season's rainfall data, and whether it agreed with their recollection of the forecast.

- Farmers were then asked to comment on the success of their management practices in the past year, given the rainfall that occurred.
- Farmers were asked to offer their insights into the coming year's rainfall, based on their interpretation of local traditional rainfall indicators.
- The forecast for the coming season was explained to farmers, in terms of the probabilities for below-, about-, and above-normal rainfall.
- The forecast was downscaled, using farmers' own historical data for local rainfall quantities, to estimate likelihoods for ranges of actual rainfall.
- The information used to generate the forecast was explained in simple terms and questions were invited, including a discussion of El Niño.
- Finally, a discussion was facilitated between farmers and the local agricultural extension service officer on the appropriate farm management practices for the coming year, taking into account the forecast, local indicators and seed availability.

The use of forecasts was associated with an increase in yield, compared with farmers' typical range of harvests, of 9.4 per cent across the two years and 18.7 per cent in the 2003/2004 season. An interesting feature of the data was that the observed effect of the use of the forecasts was both greater in magnitude and more significant in the second year of the study. This is consistent with prior evidence from Zimbabwe, which suggests that forecast value may be higher in non-El Niño years.

So although it may be in drought years that forecasts are of the greatest value to national-level planners attempting to prepare for food insecurity, it appears that forecasts benefit farmers most when they give them the opportunity to take advantage of good conditions.

Extracted from: A Patt, P Suarez and C Gwata, 'Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe', *Proceedings of the National Academy of Sciences*, 102, pp12623-8, 2005, www.pnas.org/content/102/35/12623.full

Climate variability factors will include, where relevant:

- Increased number of higher intensity rainfall events.
- Increased number of dry spells (>five days) during rainy seasons.
- Increased incidence of storm surges.
- Greater variation in seasonal temperature change (highs and lows).
- Increased incidence of droughts, floods and cyclones.
- Increased intensity of droughts, floods and cyclones.

Climate trends will include:

- Higher average temperatures.
- Shifting and/or increased uncertainty of the timing of seasons.
- Trends towards more/less rain.
- Higher average sea/lake temperatures.
- Rate of sea level rise.

As well as the **speed of onset** (see Toolkit 1, section 4.1), other issues to consider when obtaining information on climatic disturbances include:

- **Magnitude** – such as intensity of past cyclones, floods or droughts and their likely intensity in future.
- **Area affected** – the geographic area covered by the disturbance and any increase in area over the years, for example an increase in the number of districts affected by flooding.
- **Frequency** – whether climate variations are becoming more volatile than they were, such as more frequent droughts.
- **Duration** – the length of each disturbance and how this may be changing.

Data on **future climate change** will include seasonal forecasts and research information on decadal oscillations and climate models, with as much local detail as possible.

A number of key ways to engage meteorological science will improve ongoing access to scientific data and its translation into a useful resource that can be easily understood by communities.

- a) Link with national meteorological offices and other relevant knowledge centres (such as universities, research-focused NGOs, and so on) to discuss what they know about past and expected future impacts of climate change in the country. Local climate stations will have more specific information on rainfall, temperature and other meteorological indicators.
- b) Fill as many knowledge gaps as possible with this climate information, exploring in particular:
 - the historical record for the last 30 years, with a particular focus on the last 10 years
 - seasonal forecasts (weather patterns from three months to a year ahead)
 - longer-term climate change information (up to 2050). This will give a useful long-term indicator of the likely direction of future trends over the next 10-15 years.
 - any information on the impact of climate change on decadal or multi-year climate cycles, such as the El Niño/La Niña-related events.

Examine how this information can become an easily used resource. It can be challenging to get meteorologists to describe complex climate science in a simple and understandable way. Ask for clarification by:

- repeating the question, or asking for the answer to be repeated using simpler or more easily understandable language;
- asking for simple maps and charts that can be easily understood and simplifying data sets into basic tables of figures or time series;

- getting clear explanations of uncertainty and the interpretation of probabilistic forecasts.

A key role of a partner will be the interpretation of scientific data into information and formats readily understood at community level.

- c) Identify specific partner action. This includes bringing the meteorological office into contact with communities so they can better understand the needs and issues of the most vulnerable people, or ensuring communication of longer-term forecasts to local communities through climate field schools or other community-based training opportunities (see Boxes 3 and 4).
- d) If possible, ensure that climate change experts are engaged in the process of developing relevant resources for local communities (including video, radio programmes, information via mobile phones, climate field schools and other communication tools). They can ensure information availability is sustainable, incorporates new climate change knowledge as it becomes available and is correct (within an accepted understanding of variability). This will also help climate experts understand how they can make this information easier to comprehend at the community level.
- e) Develop links that maximise sustainability of access between the sources of climate science and the community. As climate models become better at explaining and predicting the complexity of climate change, so the information that communities can access in planning livelihood adaptation will improve. Where possible, this should integrate the seasonal cycle into the process of access to information. For example, cyclone vulnerable areas need information before each cyclone season, and farmers need information before the rainy season (especially if drought is forecast) to inform their decisions on planting and crop varieties (see also step 5).

Step 2. Documenting community knowledge of past and recent climate and climate change

Local communities, particularly those relying on natural resources for their livelihoods, have developed a high degree of local qualitative (ie descriptive) knowledge, but this is rarely formalised. Capturing this information is important, in order to:

- take advantage of its location-specific value;
- fill knowledge gaps that conventional climate science cannot meet;
- ensure that the climate change analysis is verified, agreed and owned by the community.

Box 4. Climate field schools, Indonesia and the Philippines

Climate field schools (CFSs) were first developed in Indonesia, modelled on the 'farmer field school' approach that was designed to promote integrated pest management. The basic objective was to develop an effective method for communicating climate forecast information to end users (in this case, farmers). More specifically, CFSs were intended to (i) increase farmers' knowledge on climate and their ability to anticipate extreme climate events; (ii) assist farmers in observing climatic parameters and their use in guiding farm activities; and (iii) assist farmers to interpret climate (forecast) information, in particular for planting decisions and cropping strategy.

CFS development followed a two-stage process. The first 'socialisation' phase covered eight months and focused on increasing farmer knowledge on climate and the use of seasonal forecast information to develop a cropping strategy. The second 'institutionalisation' phase covered a further 32 months and focused on putting this strategy into operation and capacity-building farmer groups to integrate climate and forecast information into their farming activities. In order to prepare for the implementation of these two stages, agricultural extension workers were trained by Meteorology Department staff to act as intermediaries/trainers. A number of modules were developed and field tested, including:

- Elements of weather and climate – including the difference between weather and climate.
- Rain formation processes.
- Understanding terminology used in seasonal forecasting.
- Understanding probability concepts.
- Use and calibration of non-standard weather/climate measurement tools.
- Use of climate forecast information in planting strategies.
- Using water balance concepts to estimate irrigation requirements and flood risks.

- Quantifying the economic benefits of using climate forecast information.

CFSs took a strongly participatory 'learning-by-doing' approach, with farmers putting module information into practice over the agricultural season and reflecting on their experience through a continuous process of group discussions and analysis with extension staff to inform subsequent action and strategy revision. When the process was evaluated, 78 per cent of farmers felt that their ability to integrate climate and forecast information into their cropping strategies had increased significantly (7/10 or better). The key implementation challenges identified were: translating climate information into user-friendly language for farmers; and integrating this into effective adaptation.

CFSs have also been replicated in the Municipality of Dumangas, the Philippines. Here the CFS is also patterned on the Integrated Pest Management Programme (Ministry of Agriculture), with two aims:

- To know the importance of climate in plant propagation, growth and development as well as its relationship to plant pests and diseases.
- To incorporate weather and climate information in decision making in agriculture.

Farmers and farmer groups are taught to develop a deeper appreciation of the impacts of climate and weather in their farming activities and how to base their decisions on scientific forecasts obtained from the Philippine Atmospheric, Geophysical and Astronomical Services Administration, which interprets data, and the Climate Change and Forecasting Centre which disseminates it. Increasing social awareness of climate change and strengthening the meteorology network has been a crucial part of the process.

Sources: Rizaldi Boer, Kusnomo Tamkani and AR Subbiah, 'Communicating Climate Forecast to Farmers through Climate Field Schools: Indonesian Experience', 2003, and Ronaldo B Golez, 'Climate Forecast Application in the Municipality of Dumangas, Iloilo' 2009.

Therefore, the second step in developing a climate change analysis is to document community knowledge to identify key events in the community history, generally over the past 30 years and more specifically over the past 10 years.

This information can be gathered through:

- focus group discussions on community history;
- semi-structured/structured interviews with key informants;
- development of community charts (Boxes 5 and 7) or timelines (Box 6).

The information obtained should:

- a) Highlight (for the past 30 years or as far back as possible) both extreme weather events, such as severe droughts and floods, and non-extreme weather events and trends, such as late onset of rains or increased occurrence of dry spells within rainy seasons, that the community recognises as having either a positive or negative impact on livelihoods.
- b) Highlight any of these events that are clearly outside existing experience or unprecedented. This will give an

Box 5. Seasonal analysis chart, India

In Purulia, West Bengal, community groups analysed the way seasons had changed over the past five to six years, the agreed time during which group members felt that changes in seasonality had emerged. While there was little access to past seasonal forecasts to confirm their perceptions, there was general agreement that the intermediary seasons (in red) were either greatly shortened or disappearing.

such as warmer winters, hotter summers and extended hot spells within the monsoon season that caused visible heat stress in crops and other plants.

In the past, the main monsoon rains tended to bring heavy rain early in the day, which then subsided to allow working in the paddy fields, with rain often resuming in the evening. The current trend is for constant rainfall for extended periods followed by hot, dry spells. This affects work patterns, making cultivation of supplementary crops

Season	Timing	Typical conditioning	Emerging conditions
Summer	April/May	Hot and dry, 30-40°C	Summer tending to hotter temperatures (high rather than low 30s), curtailed abruptly by early rains in May
Early rains	June	Early planting rains that break the heat of the summer	When rains arrive, they arrive earlier (April-May) and tend to be constant over 6-7 days with little respite, followed by hot, humid dry spells Harvest rains seem to have diminished
Main monsoon and harvest rains	July–September October/November	30-35°C, increased humidity, main growing season Mainly showers, cloudy weather with vivid blue skies, lower humidity and temperature – a ‘happy time’	
Dew	November	Cooling temperatures, dry but with morning dew on plants	Dew season seems to be disappearing
Winter	December/March	Cold dry weather, 10°C or lower	Winter tends to be shorter and warmer, rarely dropping below 10°C
Spring	March	Warming, dry weather	Spring seems to be disappearing as winter passes rapidly into summer

Farmers spoke of a trend over the past five to six years towards only three seasons – winter, summer and monsoon (the ‘emerging conditions’ column) – rather than the six they used to experience. Even older community members said this was unprecedented, citing problems with the timing of traditional ceremonies in the harvest rains period. They had never experienced this before. Changing conditions within the three main seasons – summer, monsoon rains and winter – were also noted,

(which are an increasingly important adaptation strategy) difficult. In terms of livelihood response, the community highlighted crop diversification (including increased cultivation of maize, groundnuts, cowpeas and vegetables), moving from hybrid 60-day to traditional 30-day rice varieties that are more drought tolerant, increased use of ponds for supplementary irrigation as well as fish farming.

Source: *Climate Change Review of DRCS*, Christian Aid.

- indication as to whether the event is really climate change or part of a decadal cycle (a climate feature that cycles over a multi-year period). Make sure the knowledge of older members of the community is accessed because they should be able to remember older events and can confirm whether a more recent event really is unprecedented.
- c) Discuss and record any key local responses associated with these events, such as any temporary migration (rural to urban, or to other rural areas), particular coping mechanisms, community members most severely affected and the reasons for this. These can provide further information as to the relative severity of a particular event.

- d) For the most recent 10 years, increase the level of detail and highlight ‘good’, ‘average’, ‘poor’ and ‘very poor’ seasons and significant climate features and note any relationships that may have occurred between these.
- e) Minimise bias (explained in more detail in Section 4). The major challenge in accessing community knowledge is the subjectivity of memory. Inevitably, community perceptions and memories will vary and be open to bias in recalling past climate conditions, so participatory discussions or interviews should be planned with an understanding of how this might reduce the reliability of information collected, so as to minimise its effect. Older

members of the community can help reduce bias with their longer experience of earlier climate and how this compares with more recent events over the past 10 years.

Step 3. Cross-referencing local knowledge with climate science

To verify climate science and local knowledge and reduce the likelihood of bias, both need to be cross-checked.

Triangulating the community timeline or chart with climate science (whether made available through direct contact with climate scientists as in climate field schools or through partner staff/trainers) can verify and correct where possible the community’s assessment of past change and add the information available on future change from both seasonal forecasts and climate change models. This process will also strengthen **attribution** of changing climate variability and trends to man-made climate change and reduce the likelihood of errors such as mistaking a normal decadal climate cycle with climate change.

Step 4. Projecting into the future

Unlike probabilistic weather forecasts that give a percentage likelihood of something happening, communities need an agreed ‘most-likely scenario’ with which to guide future adaptation. This can be achieved by:

- a) Determining three to four factors that are considered the highest priority threats; that is, those causing most damage to livelihoods. Identify these by listing all climate factors affecting livelihoods identified in step 2. Then use pairwise ranking to limit these to priority issues, and thus avoid the complexity that would result from trying to develop a projection for everything. (This might be difficult in some circumstances, as in Box 7 overleaf.)
- b) Using the assumption that the direction of change experienced over the past 10 years will continue for the next 10 years, do this for both trend and variability, but use any available long-term climate modelling information as a guide to whether this assumption needs to be adjusted.

Box 6. Climate timeline, Sudan

Atbara Partners Consortium members developed a climate timeline as part of a workshop to review a climate change awareness-raising project. The members determined the main climate features that affected their lives and livelihoods and discussed the trend over the past 30 years, but with a focus on the past 10 years as this was (a) easier to remember and (b) a time in which there was agreement that changes away from the normal variation had occurred.

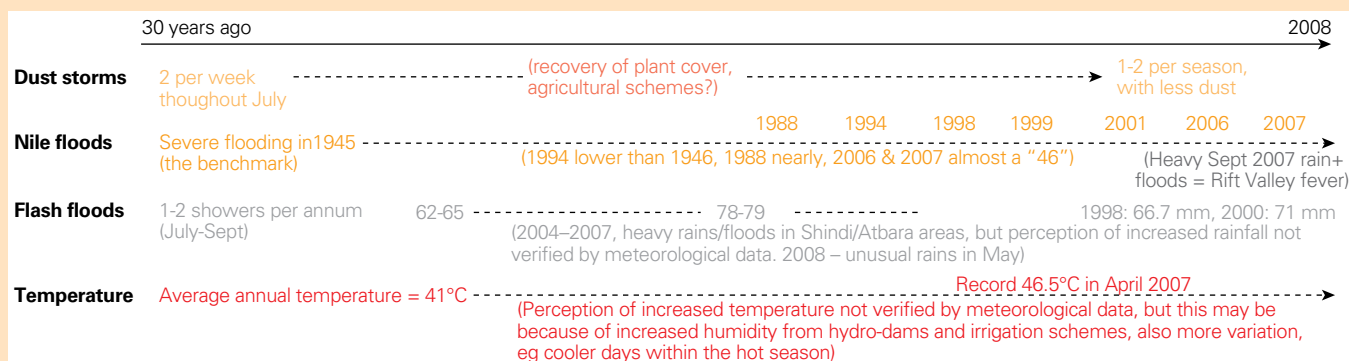
Two staff from Atbara Meteorological Station were also involved in the discussion. They questioned consortium members’ perceptions, corrected dates and gave statistical evidence from their records.

The notable disagreements centred on rainfall patterns, with meteorologists conceding that with limited rain stations and the localised nature of flash floods, these

could be missed in the records. Increased average temperatures were not verified by the statistics, but members’ perceptions could be linked to increased humidity (which feels hotter) and increased variation (hence the 2007 record high), that was suggested as an emerging pattern by the climate scientists. The challenges agreed by the consortium are to:

- (a) deepen the analysis to include differences in trends and variability;
- (b) continue the process to determine what the likely scenario for the next 10 years will be;
- (c) determine how this will affect the vulnerability of their livelihoods; and
- (d) what therefore the consortium should do in terms of project development and implementation.

Source: *Review of the Climate Change Innovation Fund 2007-8*, Christian Aid.



Box 7. Changing climate and livelihood risks in Kyrgyzstan

As part of a review of emerging climate change and disaster risks, local leaders and members of Village Disaster Teams in the Issykul area of Kyrgyzstan highlighted six main factors.

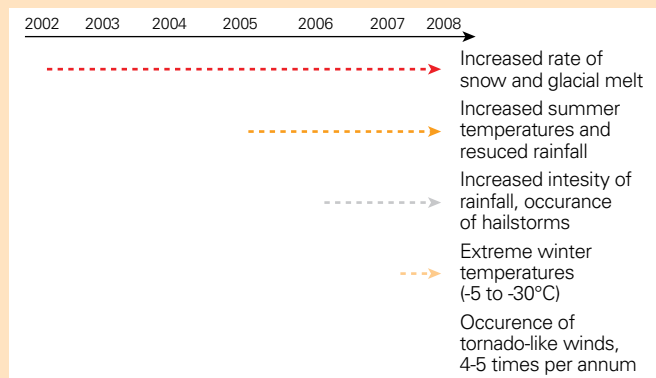
Changing climate	Livelihood risks
Increased rate of snow and glacial melt	<ol style="list-style-type: none"> 1. Increased rate of snowmelt causes mudflows and expands the waterlogged area (possibly also related to rising groundwater). Waterlogging has resulted in large 'cracks' in pasture areas, increasing erosion and landslide risk. 2. Houses located close to water sources are vulnerable to flooding and damage as flood channels expand and flood incidents increase. 4. Increased risk of sudden flood episodes caused by melt lakes breaking and releasing trapped meltwater into lower valleys (a July 2008 flood caused €400k infrastructure/housing damage and some fatalities). 5. Long-term loss of irrigation water resources associate with glacial melt.
Increased summer temperatures and reduced rainfall	<ol style="list-style-type: none"> 1. Summer drought reduces wheat yields by 50 per cent (from 3.5 metric tonnes/hectare). 2. Hay and fodder crops are reduced and herders are attempting to destock (eg keeping two well-fed rather than 10 poorly-fed sheep).
Increased intensity of rainfall, occurrence of hailstorms (4-5cm hailstones)	<ol style="list-style-type: none"> 1. Increased intensity of rainfall and hailstorms damages crops and orchards. 2. Damage to mudbrick houses as rainfall dissolves and cracks walls. 3. Also associated with localised flooding incidents, waterlogging and landslides.
Extreme winter temperatures (-5 to -30°C)	<ol style="list-style-type: none"> 1. The associated loss of hydropower energy sources leave households without access to insulation, efficient heat sources (eg fuel-efficient stoves) and renewable energy (eg passive and PV solar), and liable to high energy prices as they buy additional increasingly expensive coal. 2. Winter wheat is no longer cultivated due to frozen ground. 3. Reliance on livestock housing and purchased fodder increases due to extended cold winter spells.
Recent occurrence of tornado-like winds, 4-5 times/annum (>20m/sec)	<ol style="list-style-type: none"> 1. Increase soil erosion during dry periods, exacerbated by lack of strategically-located wind breaks. 2. Direct damage of infrastructure and housing (particularly roofs). 3. Reduction of forest resources as trees near houses, roads and electricity wires are cut to avoid wind damage.
Changing seasonality (spring/autumn 15 days shorter)	<ol style="list-style-type: none"> 1. Loss of fruit crops (eg cherry trees blossom in April, but then lose crop as cold snaps destroy emerging fruit). Apricots used to be a major export from the area, but have declined significantly in recent years. Only apples have proved resilient. 2. Communities have experienced increased occurrence of hypertension, flu-like diseases, pneumonia and strokes, which they attribute to changing seasons. 3. Loss of bee and honey production (climate associated with/amplifying impact of bee collapse caused by Varroa mite/bee viruses).

continued...

- For each of the priority climate factors, allow for discussion amongst the community members. Obviously, this is not an exact process but the analysis must be agreed to be credible.
- Follow the logic of the graph in Figure 3, but use a way of recording that the community can easily understand. They will probably want to use less mathematical ways of representing their view of past and future climate (such as the seasonal analysis chart or climate timeline). Innovative ways of documenting the analysis can then be shared to inform and guide further practice.
- For communities with pre-existing community development plans, the analysis should be consistent so that it can easily be integrated into these plans. Detailing the likely impact on resources and features identified on community maps is a useful tool in this respect.
- Given the focus on anthropogenic or man-made climate change, it is important to ensure that the most likely scenarios are related as far as possible to climate change, rather than other factors that may have a livelihood impact, for example, irrigation water resources being reduced by diversion of rivers, rather than reduced rainfall.

... continued

Community members could not prioritise the emerging climate risks, stating that this depended on the time of the season and the fact that risks tended to be inter-related with each other and others (such as earthquakes), making it difficult to put them in order of importance. However they were clear about the rate at which different climate factors had emerged over the previous six years.



In terms of attributing these to climate change and reducing associated livelihood risks, both the community and local government staff highlighted a number of challenges in predicting changing climate factors, including:

- Traditional methods of forecasting weather (such as using wind direction to anticipate rain, or how leaves change colour to determine whether autumn will be warm or cold) are no longer effective.

- The State Agency on Hydrometeorology's services have been severely reduced since 1990. In the Karakol area, the number of weather gauges has declined from seven to two. There are no high mountain weather stations and much of the equipment used is obsolete (1970s vintage). As a result, both short-term and seasonal forecasts are inaccurate at local levels.
- Obtaining compensation for wind damage has been undermined by lack of weather forecast data to confirm the occurrence of sudden high-wind episodes.
- Mobile monitoring systems are used to check river embankments and irrigation structures, but lack of maintenance and waterlogging reduces the effectiveness of drainage structures.
- Glacier and melt lake monitoring is confined to one observational helicopter flight/annum, which is not enough to accurately predict flood and other risks.
- Community access to information on the causes and likely effects of long-term climate change is very limited.

However, the community felt that the first three factors and changing seasonality were unprecedented and both young and old agreed that they were most likely to be related to climate change. On colder winters, they were less certain because older members could remember similar conditions 25 to 30 years ago. As the occurrence of localised strong winds was so recent, they were unsure whether this phenomenon would continue.

Source: Christian Aid, *Climate Change Review of DRR in Kyrgyzstan*.

Step 5. Reporting back lessons learnt

The process should be reported back to climate scientists (primarily in meteorology departments and institutions, but also relevant academic institutions or specialised climate/climate change organisations) so that they are aware of:

- the results of the exercise;
- the constraints and challenges encountered; and
- the community priorities that future climate science could address.

This will be important in developing or strengthening climate science/community linkage and highlighting the importance of increased resources for this. It is also useful to obtain feedback to be used in refining the process and to influence the future plans of climate science organisations in addressing access constraints (as per Box 2).

Finally:

- Climate science contains a high degree of uncertainty and new and improved information is being developed rapidly, so a climate change analysis will need to be regularly reviewed to take into account both experience and new climate science. The process should be viewed as a cycle (Figure 2) rather than a linear series of steps.
- It may be both useful and essential to partially repeat a step. For example, if an important climate issue is revealed in community climate discussions but was not covered in meetings with or information accessed from climate scientists, these scientists should be consulted again to see if they can provide further information (as show by the grey arrow in Figure 2).
- Community consultations must be gender-balanced and the most vulnerable must be included. If this is difficult to achieve with just one consultation process, it may have to be repeated. For example, women, women-headed households or landless labourers may need to be consulted separately.

ANNEXES

Annex 1. Web resources

i) Priority A. Very useful web resources (try these if you only have limited time for background research)

Eldis Climate Change Adaptation

www.eldis.org/go/topics/dossiers/climate-change-adaptation

Provides a summary of current thinking on climate adaptation issues with access to relevant, up-to-date resources and publications for researchers, practitioners, and policy formers. The guide is divided into four sections: an introduction to climate change adaptation; organisations working on climate adaptation issues; documents and publications related to seven themes in climate adaptation; adaptation resources organised by region of focus. Eldis also runs the Community-Based Adaptation Exchange (<http://community.eldis.org/.59b70e3d>) to share online resources and bring together and grow the CBA community.

UNFCCC Adaptation

<http://unfccc.int/adaptation>

The main access point for the Nairobi Work Programme, the National Action Plans for Adaptation (NAPAs) for most least developed countries and the Local Coping Strategies Database. The Nairobi Work Programme on impacts, vulnerability and adaptation to climate change was developed to help countries improve their understanding of climate change impacts and vulnerability and to increase their ability to make informed decisions on how to adapt successfully. The Local Coping Strategies Database is intended to facilitate the transfer of long-standing coping strategies/mechanisms, knowledge and experience from communities that have had to adapt to specific hazards or climatic conditions to communities that may just be starting to experience such conditions, as a result of climate change.

World Meteorological Organization

www.wmo.int

A specialised agency of the UN. It is the UN's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. WMO RCOF Products (www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.htm) links to the various regional climate outlook forums that provide seasonal forecasts around the world.

Adaptation Learning Mechanism

www.adaptationlearning.net

Shares guidance and tools for developing and implementing adaptation initiatives, including a list of materials available for immediate download or online browsing and a useful interactive map to link to regional adaptation resources and references.

Famine Early Warning Systems Network

www.fews.net

Provides information on food security (including weekly climate and six day precipitation forecasts) for west, east and southern Africa, Central America, the Caribbean and Afghanistan.

International Institute for Environment and Development

www.iied.org/CC/index.html

Focuses on improving the understanding of climate change impacts for poor developing countries including both policy makers and poor groups; improving the decision making capacities in vulnerable developing countries to cope with impacts of climate change; improving the negotiating capacities of poor developing countries in the climate change negotiations through analysis of issues relevant to them; improving the sustainable livelihoods opportunities of poor communities in developing countries in light of possible climate change impacts.

IDS Climate Change and Development Centre

www.ids.ac.uk/climatechange

Aims to drive forward collaborative research and policy analysis, building programmes and delivering high quality knowledge services, teaching and training. Research themes include climate change adaptation, low carbon development, international environmental law, development economics, social protection, sustainable livelihoods and migration. IDS have also developed the Opportunities and Risks for Climate Change and Disasters (ORCHID) adaptation tool for assessing development strategy.

Climate and Disaster Governance

www.climategovernance.org

Also run by IDS, and aims to identify governance options that could help reduce climate and disaster risk to poor communities.

ii) Priority B. Other useful resources for wider research

National Communications to the UNFCCC

http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php

Contains information on national circumstances, vulnerability assessment, financial resources and transfer of technology, and education, training and public awareness.

Climate and Development Knowledge Network

www.cdknowledge.net

Aims to help decision-makers in developing countries design and deliver climate compatible development. It provides demand-led research and technical assistance, and channels the best available knowledge on climate change and development to support policy processes at the country level.

CRiSTAL (Community-based Risk Screening Tool – Adaptation & Livelihoods)

www.cristaltool.org

A screening tool for existing livelihoods projects which enables project planners and managers to (a) understand the links between local livelihoods and climate; (b) assess a project's impact on livelihood resources important for climate adaptation; and (c) devise adjustments to improve a project's impact on these key livelihood resources.

Global Environmental Change and Food Systems

www.gecafs.org

An international, interdisciplinary research project focused on understanding the links between food security and global environmental change. The goal is to determine strategies to cope with the impacts of such change on food systems and to assess the environmental and socio-economic consequences of adaptive responses aimed at improving food security. It focuses specifically on southern Africa, the Indo-Gangetic Plain in south Asia and the Caribbean.

Capacity Strengthening of LDCs for Adaptation to Climate Change

www.clacc.net

A group of fellows and international experts working on adaptation to climate change for least developed countries. Their aim is to strengthen the capacity of organizations in poor countries and support their initiatives in sustainable development through the network of fellows in 12 countries in Africa and three in south Asia. The Knowledge tab links through to various reference documents on adaptation.

ODI Climate Change, Environment and Forests Programme

www.odi.org.uk/ccef/index.html

Seeks to inform the processes of policy change in tropical forestry in ways which improve the livelihoods and well-being of the forest-dependent poor, whilst also securing the long-term future of forest resources.

UN International Strategy for Disaster Risk

www.unisdr.org

Aims to build disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters.

IFPRI Climate Change

www.ifpri.org/book-775/ourwork/researcharea/climate-change

Analyses the complex interrelations between climate change and agricultural growth, food security and natural resource sustainability.

Annex 2. Literature resources

i) Reference books

Lisa Schipper and Ian Burton (editors), *The Earthscan Reader on Adaptation to Climate Change*, Earthscan, 2008.

D Mark Smith, *Just One Planet: Poverty, Justice and Climate Change*, Practical Action, 2006.

Jonathan Ensor and Rachel Berger, *Understanding Climate Change Adaptation: Lessons from Community-Based Approaches*, Practical Action, 2009.

ii) Reference documents⁷

General information

- *Climate Change and the Greenhouse Effect – A Briefing from the Hadley Centre*, Met Office, 2005.
- *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*, UNFCCC, 2007.
- 'Climate Change at a Glance', UN Climate Change Factsheets, United Nations 2007.
- *Red Cross/Red Crescent Climate Guide*, 2007.
- Jemima Jewell, Helen Clarkson, James Goodman, et al, *The Future Climate for Development*, Forum for the Future, 2010.

Community-based adaptation

- Community-based adaptation to climate change, *Participatory Learning and Action 60*, IIED, 2009.

Climate change and agriculture

- PJ Gregory, JS Ingram and M Brklacich, Climate change and food security, *Philosophical Transactions of the Royal Society B*, 360, pp2139-2148, 2005.
- Gerald C Nelson, Mark W Rosegrant, Jawoo Koo, et al, *Climate Change: Impact on Agriculture and Costs of Adaptation*, International Food Policy Research Institute, 2009.
- Casey Brown and James Hansen, *Agricultural Water Management and Climate Risk*, International Research Institute for Climate and Society, 2009.
- Jonathan Ensor, *Biodiverse Agriculture for a Changing Climate*, Practical Action, 2009.
- Martin Parry, Alex Evans, Mark W Rosegrant, et al, *Climate Change and Hunger: Responding to the Challenge*, World Food Programme, 2009.

Climate change and water

- BC Bates, ZW Kundzewicz, S Wu, et al, editors, *Climate Change and Water*. Technical Paper VI, IPCC, 2008.
- John H Matthews and Tom Le Quesne, *Adapting Water to a Changing Climate*, WWF, 2008.

Climate change and cities

- Richard Dawson, Jim Hall, Stuart Barr, et al, *A Blueprint for the Integrated Assessment of Climate Change in Cities*, Tyndall Centre for Climate Change Research, 2007.
- David Satterthwaite, Saleemul Huq, Mark Pelling, et al, *Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and Middle-income Nations*, Human Settlements Discussion Paper Series, IIED, 2008.

Disaster Risk Reduction and Participatory vulnerability and Capacity Assessment

- Edward Turvill and Honorio De Dios, *Participatory Capacity and Vulnerability Analysis Training Pack*, Oxfam Disaster Risk Reduction and Climate Change Adaptation Resource, 2009.
- *How to do a VCA: A Practical Step-by-Step Guide for Red Cross and Red Crescent staff and volunteers*, Red Cross/Red Crescent, 2007.
- John Twigg, *Characteristics of a Disaster-Resilient Community: A Guidance Note*, DFID DRR Interagency Coordination Group, 2007.
- Marcus Moench, Sara Ahmed, Daanish Mustafa, et al, *From Risk to Resilience, Moving from Concepts to Practice: A Process and Methodology Summary for Identifying Effective Avenues for Risk Management Under Changing Climatic Conditions*, ISET Working Paper 8, 2008.

Region-specific reports

- PK Thornton, PG Jones, T Owiyo, *Mapping Climate Vulnerability and Poverty in Africa*, Report to the Department for International Development, ILRI/TERI/ACTS, 2006.
- Gordon Conway, *The Science of Climate Change in Africa: Impacts and Adaptation*, Grantham Institute for Climate Change, 2009.
- Matt Huddleston, Bernd Eggen, Felicity Liggins, et al, *Storm Shelter: Managing Climate Risks in Africa*, Met Office Hadley Centre and Barclays Social Intelligence Series, 2009.
- Mostafa Tolba and Najib Saab, editors, *Arab Environment Climate Change: Impact of Climate Change on Arab Countries*, Arab Forum for Environment and Development, 2009.
- Luis Jose Mata and Carlos Nobre, *Impacts, Vulnerability and Adaptation to Climate Change in Latin America*, UNFCCC, 2006.
- *Climate Change and Food Security in Pacific Island Countries*, FAO, 2008.
- Nic Maclellan, *The Future is Here: Climate Change in the Pacific*, Oxfam Australia and Oxfam New Zealand, 2009.
- *The Waters of the Third Pole: Sources of Threat, Sources of Survival*, Aon Benfield UCL Hazard Research Centre, China Dialogue, Humanitarian Futures Programme, King's College London, 2009. (A report on the Hindu Kush Himalaya region.)

iii) Christian Aid resources

Christian Aid Climate Change Resources (www.christianaid.org.uk/resources/policy/climate_change.aspx) includes a variety of research and advocacy resources on various climate change issues.

For **Christian Aid staff only**, the reference documents listed above in (ii) above can be found on the intranet in the PIL Shared Climate Change/Reference/Adaptation Toolkit References folders. This includes Christian Aid's PVCA Guidelines and the Renewable Energy Toolkit.

REFERENCES AND NOTES

1 These links also connect to useful general information on climate and climate change in these regions.

2 Such as Nu-GEM, likely to start providing climate data in 2010. See UK Met Office Unified Model www.metoffice.gov.uk/research/modelling-systems/unified-model for more information.

3 As reported in the High Level Taskforce's 3rd Newsletter, July 2010, www.wmo.int/hlt-gfcs/documents/HLT_newsletter_No_3_en.pdf

4 Why chose a 2°C increase? Because the evidence suggests that this is the maximum level we can permit before positive feedbacks in the climate system trigger a 'climate rollercoaster' of uncontrollable climate change. If this happens, adaptation is likely to focus on mass migration and emergency relief measures. This is a reality acknowledged by the Copenhagen Accord agreed at COP15 which set the 2°C average global temperature increase limit.

5 There is an ongoing debate as to whether we should plan for a 'most likely' scenario or a 'worst case' scenario. The problem with adapting to a 'worst case' scenario is that (a) it has a tendency to become unlimited as ever more severe worst cases are developed and used to justify additional expenses, and (b) resources for adaptation are scarce and unlikely in the short term to become less scarce. Therefore funding adaptation in one area to a worst case scenario will probably mean no resources for adaptation in other areas.

6 For example, this was evident after Hurricane Mitch in Central America, where farmers who had strengthened their long-term resilience through organic farming recovered faster than their conventional counterparts (see Eric Holt-Giménez, et al, *Measuring farmers' agroecological resistance to Hurricane Mitch in Central America*, World Neighbours, 2000.)

7 These references are particularly recommended for their accessibility and clarity. Please forward details of any further good websites or references to Richard Ewbank (Climate Change Programme Coordinator) at rewbank@christian-aid.org for inclusion into future toolkit updates and revisions.

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