Adaptation toolkit

Integrating Adaptation to Climate Change into Secure Livelihoods

2. Developing a climate change analysis

1. The basic approach

A key part of assessing the likely climate risk to a livelihood is to understand the degree of change that will occur in both trends and variability of climate and the likely exposure to these. This is essentially the focus of this toolkit module (see Fig 6, Module 1). Effective adaptation in turn reduces climate risk.

As stated in module 1, this integrated approach emphasises the need to build on:

- innovative or new techniques to combine climate science with local knowledge of climate/climate change,
- disaster risk reduction tools, such as PVCA,
- as well as longer-term sustainable livelihoods approaches, such as participatory technology development and community/land use planning,

Focusing on fast or extremely fast onset climate factors without understanding the longer term, slow onset factors risks promoting activities that could increase long-term vulnerability. 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 (see also Fig 5 below). Given the multiple external factors that impact on livelihoods, it is important to demonstrate that adaptation is a response to the observed and predicted effects of climate change[1].

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

- what **climate science** (both the meteorological/weather 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 the **community or local knowledge** of those most directly affected by these processes

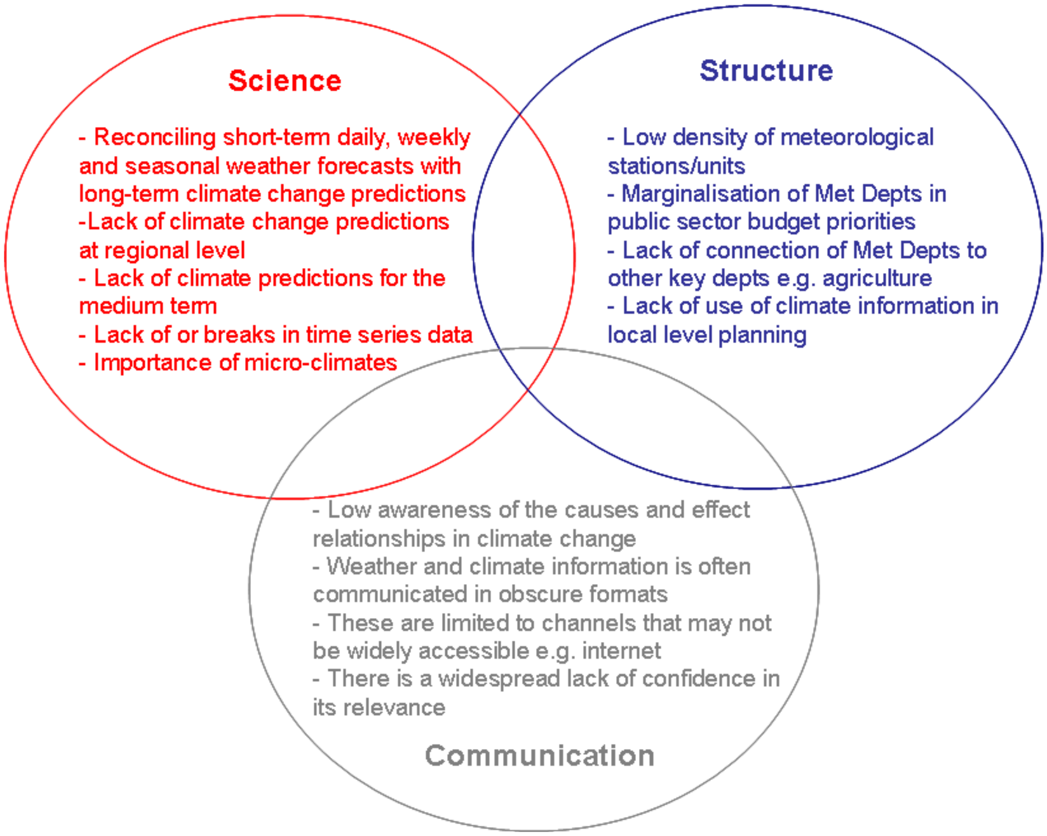
2. Challenges in accessing climate science

In many circumstances, accessing good quality climate science will present considerable challenges. Climate science concepts and data are complicated, often working in probabilities and uncertainties rather than concrete predictions. These need to be simplified and clarified so partners can take information from knowledge centres to communities at risk in a form that can be easily interpreted and used at community level. There may be existing experience of this science to community linkage, such as through agricultural extension systems, which can be used and built upon.

[1] It also may be important to show that adaptation is a response to man-made climate change e.g. in accessing funding for climate change adaptation, but 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 “man-made” variation

The basic challenges break down into three groups - science, structure and communication - which overlap and inter-relate to a significant degree and include:

Fig 1. Challenges in accessing climate science



2.1 Science

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 understand the likely impact of extremely fast, fast and slow onset climate factors.

Short-term weather and seasonal forecasting focuses on daily, weekly and seasonal predictions up to a maximum of 2 years in advance, although typically seasonal forecasts aim at 6 -12 months ahead. Climate change modelling is typically focused on the long-term (50 – 100 years ahead). Although weather forecasting has improved within a seasonal timeframe and models are starting to provide information 20-30 years ahead, this still leaves a gap or “time of maximum climate uncertainty” (see Fig 2 below) between 1 and 20 years ahead, exactly the period over which most projects operate, given their management cycles of 3-5 years per phase.

Likewise although increasing in resolution, the definition of GCMs has been too coarse (typical refinement is 90,000 km² or 300 x 300 km) to provide predictive capacity at the national or even regional levels. As meteorological science improves, so progress towards reduce this uncertainty gap will be made and a more seamless system will emerge. For instance, the latest GCMs[2] are using definitions of 1,600 km² (or 40 x 40

[2] Likely to start providing climate data in 2010

km) and there has been some replication of GCMs at regional level (regional climate models or RCMs) to develop likely scenarios (see Fig 2 below). In order to provide reasonably reliable predictions on the future frequency and occurrence of cyclones, 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. However as these improve the use of integrated short, medium and long-term climate predictions will become more feasible (see also Fig 2 below).

Fig 2. PRECIS

PRECIS (Providing Regional Climates for Impacts Studies) has been designed for use by local meteorological offices or research institutes. Regional climate models (RCMs) are now being run for:

- East Africa (ICPAC Nairobi)
- Southern Africa (Universities of Sussex and Cape Town)
- South Asia (Pakistan, India, Nepal, Bhutan, Bangladesh, Sri Lanka by the Indian Institute of Tropical Meteorology)
- Northern South America (Brazil, Peru, Ecuador, Venezuela, Suriname, Guyana, Colombia by CPTEC Brazil)
- The Caribbean and Central America (Institute of Meteorology of Cuba, University of West Indies in Barbados and Jamaica)

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 25 x 25 km and so can give more details climate predictions at both regional scale and in the medium term.

See the PRECIS website for more information

2.2 Structure

Local meteorology institutions are often poorly resourced, understaffed and lack facilities to generate timely climate data and early warning systems. While they may have good historical records, these are frequently not computerised, access facilities may be limited and their ability to develop a grid of weather stations that can provide reliable ongoing data across most geographical and agro-ecological zones restricted. This often results in a lack of or limited integration of the meteorology department into the planning and operations of other relevant ministries, such as agriculture, transport, environment and local government. With the rapid increase in concern about climate change, meteorological staff already find themselves in considerable demand, which then makes them difficult to access, particularly by organisations not based in capital cities.

2.3 Awareness and 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 relevance or accuracy.

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 can make them difficult to understand. As a result, there are considerable challenges to integrating this information successfully into livelihood strategies.

3. Developing a climate change analysis

Given these challenges, an analysis process that combines climate science with community knowledge of past changes and assessment of likely future changes may well rely more on community knowledge. This is not a problem so long as this can be verified with climate data or information from other sources e.g. agricultural extension experts verifying that a particular season identified as a drought year by the community was a poor season.

The focus will therefore be on combining:

(a) **historical data** from meteorological departments, academic departments, weather stations, etc

(b) **seasonal forecasts** for the next year from meteorological departments and early warning systems

(c) **community knowledge** of past changes

(d) what **longer-term climate science** can say about future climate change from climate change models

to develop a "most-likely scenario" of where climate trends are emerging and how these might then develop in future.

3.1 Key issues and assumptions when developing the analysis will include:

i) Global temperature rise. Given the levels of 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 and
- the impact of that mitigation on ongoing climate change,

climate change predictions should be tied to those changes that are likely to result from a 2°C global temperature increase by 2050[3].

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 they are a relatively scarce resource. Even when this is possible, an understanding of what climate science can and cannot provide is needed to avoid unrealistic expectations. More often, climate data will 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, etc, is changing, over the past 30 years but particularly over the past 10 years. Long-term climate science will only be available on a regional scale e.g. East Africa at best and so can be used in

[3] 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 roller coaster" of uncontrollable climate change. If this happens, adaptation is likely to focus on mass migration and emergency relief measures.

multiple locations. Historical data and seasonal predictions will be more location, or agro-ecological zone, specific.

iv) Predictions should be made 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 (i.e. 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 decadal climate cycles so that e.g. 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.

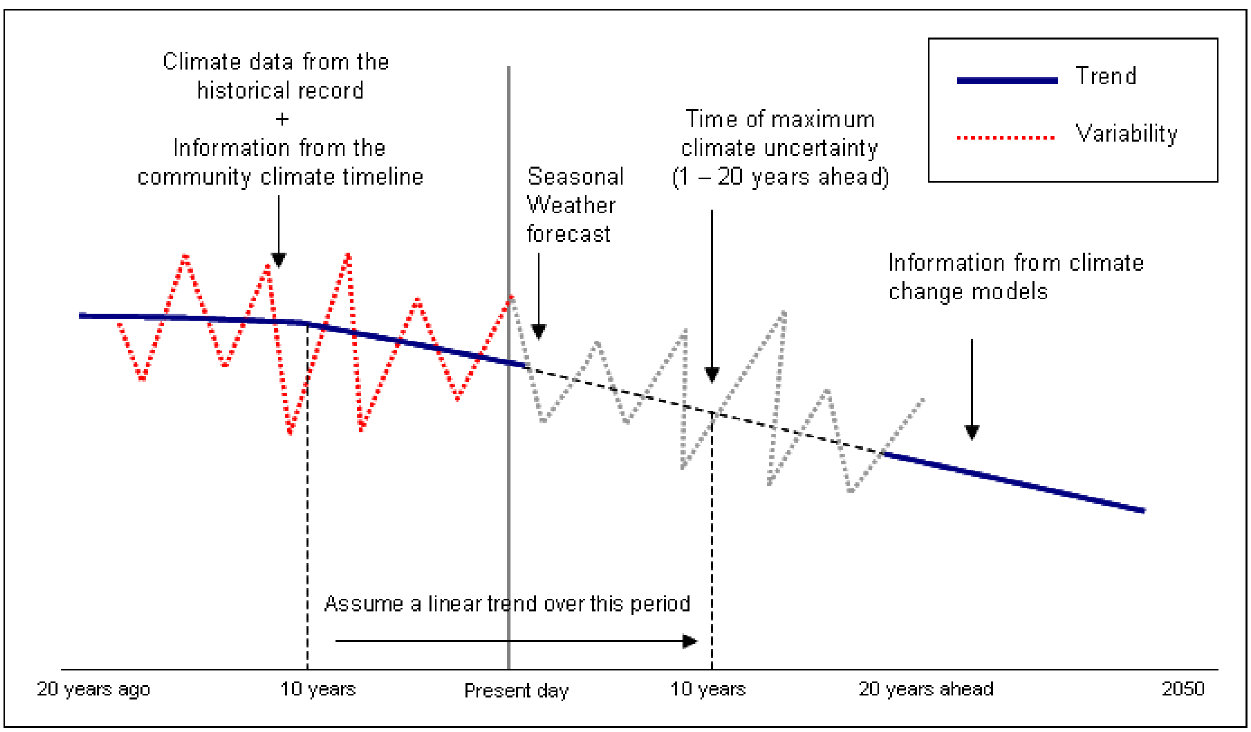
v) Updating information – given the speed at which climate science is progressing, a sustainable link with information sources is important so that as e.g. climate models and decadal forecasts improve in providing information at regional or national levels or in the next 10-20 years, the analysis can 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.

3.2 Key steps in developing the analysis

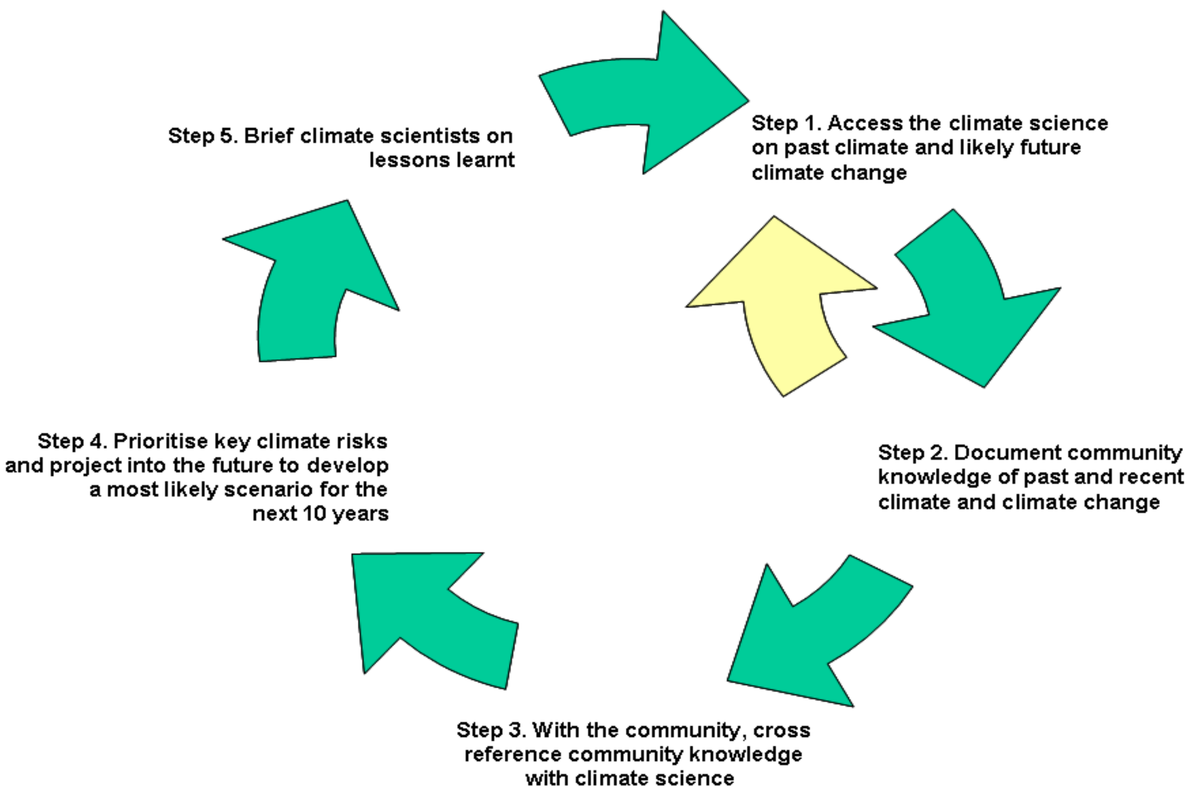
A major challenge in terms of predicting the medium term (5 – 10 year ahead) impact of climate change is the lack of reliable climate science over this time scale.

Fig 3. Developing a climate change timeline – a graphical representation of the key issues



The gap between seasonal forecasting and climate modelling corresponds to the period over which most development projects are implemented (see Fig 3 above), so developing a "most-likely" scenario[4] for the next 10 years is largely aimed at reducing this problem. The process follows 5 basic steps, the first accessing climate science followed by 3 steps at community level and a final link back to climate science (see Fig 4 below).

Fig 4. Five steps to developing a climate change analysis



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

The challenges in accessing climate science have been discussed (see Fig 1 above). 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 than can give both (a) changes in **variation** from year to year of climate factors (especially extremely fast/fast onset) and (b) changes in the overall **trend** (slow onset factors).

[4] 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.

Historical data up to the present day should be collected on the direction of current climate trends and changing variability identified by meteorologists and climate change experts, so climate variability factors will include, where relevant:

- increased number of higher intensity of rainfall events
- increase number of dry spells (> 5 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

and 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
- and so on

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

a) **Magnitude**: such as the intensity of past cyclones or droughts and therefore their likely intensity in future

b) **Area affected**: the geographic area covered by the disturbance

c) **Frequency**: whether climate variations are becoming more volatile, such as more frequent droughts

d) **Duration**: the length of each disturbance and how this may be changing

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

Fig 5. 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, OND) and late (January–March, JFM) parts of the growing season, 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 in each village 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 out the remaining places. The workshops took place in the village primary school, lasted 3 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:

- Firstly, 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 Nin˜o.
- And 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, the 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% across the 2 years and 18.7% 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 Nin˜o 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: Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe - Anthony Patt, Pablo Suarez and Chiedza Gwata (PNAS, August 2005)

A number of key ways to engage meteorological science will improve ongoing access to scientific data and translating it into a useful resource that can be understood by community, including:

a) Linking with national meteorological offices and other relevant knowledge centres (such as universities, research-focused NGOs, etc) to discuss with them what they do and do not know about past and expected future impacts of climate change in the country.

b) Filling as many knowledge gaps as possible with this 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 Nino/La Nina-related events

   and how this information can become an easily used resource. Getting meteorologists to describe complex climate science in a simple and understandable way will be a major challenge:

   - 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 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

   are all likely to be required. 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, such as 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 Figs 5 and 6).

d) Ensure if possible that climate change experts are engaged in the process of developing relevant resources for local communities (these could include video, radio programmes, information via mobile phones, climate field schools and other communication tools) to make sure that information availability is sustainable, incorporates new climate change knowledge as it becomes available and is correct (within an accepted understanding of variability). This also increases the understanding of climate experts on how they can make this information easier to comprehend at the community level.

Fig 6. Climate Field Schools, Indonesia and The Philippines

Climate field schools (CFSs) were first developed in Indonesia, modelled on the farmer field school approach 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 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 8 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 extensionists were trained by Meteorology Department staff to act as intermediaries/trainers and a number of modules were developed and field tested, including:

1) Elements of weather and climate – including the difference between weather and climate
2) Rain formation processes
3) Understanding terminology used in seasonal forecasting
4) Understanding probability concepts
5) Use and calibration of non-standard weather/climate measurement tools
6) Use of climate forecast information in planting strategies
7) Using water balance concepts to estimate irrigation requirements and flood risks
8) 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% 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 challenges identified were translating climate information into user-friendly language for farmers and integrating this into effective adaptation.

Christian Aid partner KLIMA has been replicating CFSs in the Municipality of Dumangas, The Philippines. Here the CFS is also patterned on the Integrated Pest Management Programme (Ministry of 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 (PAGASA - who 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.

Source: Communicating Climate Forecast to Farmers through Climate Field Schools: the Indonesian Experience – Rizaldi Boer, Kusnomo Tamkani and A.R. Subbiah; and Christian Aid Philippines

e) Develop links that will maximise the sustainability and access on a needs-basis between the sources of climate science and the community. Climate science is a rapidly changing sector and as climate models become better at explaining and predicting the complexity of climate change, so the information that the community can access in planning livelihood adaptation will improve and current levels of uncertainty decline. This should integrate the seasonal cycle into the process of access to information e.g. cyclone vulnerable areas need information before each cyclone season, farmers need information before the rainy season (especially if drought is likely) 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-resource based livelihoods, have developed a high degree of local qualitative (i.e. descriptive) knowledge but this is rarely formalised. It is important to capture this:

- to take advantage of its location-specific value
- to fill in knowledge gaps that conventional climate science cannot meet (for reasons identified in Fig 1)
- to ensure that the climate change analysis is verified, agreed and owned by the community

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

Fig 7. Seasonal analysis chart, India

In Purulia (West Bengal), community groups analysed the way in which seasons had changed over the past 5-6 years, the agreed time over 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 blue) were either greatly shortened in time or disappearing:

Season	Timing	Typical conditions	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 which 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
Main monsoon and	July – September	30 - 35°C, increased humidity, main growing season	
harvest rains	October/ November	Mainly showers, cloudy weather with vivid blue skies, lower humidity and temperature – a "happy time"	Harvest rains seem to have diminished
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 talked of there being a trend over the last 5-6 years toward only 3 seasons – winter, summer and monsoon (as per the “emerging conditions” column) – rather than the 6 they used to experience. This was something that even older community members highlighted as 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, 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 (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 which are more drought tolerant, increased use of ponds for supplementary irrigation as well as fish farming.

Source: Climate Change Review of DRCSC, Christian Aid

This information can be generated through:

- focus group discussions on community history
- semi-structured or structured interviews with key informants
- development of community charts (see Figs 7 and 10)
- or timelines (see Fig 9)

and should highlight:

a) For the past 30 years (or as far back as possible), highlight any extreme weather events, such as severe droughts and floods as well as any 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 indication as to whether the experienced change 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 are accessed as they will 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 – urban, to other rural areas), particular coping mechanisms used, members of the community most severely affected and why. 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 inter-relationships that may have occurred between these

e) Minimise bias (see Fig 8). The major challenge in accessing community knowledge will be the subjectivity with which memory of climate is remembered. 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 last 10 years.

Fig 8. A note on bias in collecting community knowledge on climate change

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 contains 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**, which 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% certain" are routinely 40% wrong. Linked to this is **clustering illusion** or a tendency to see patterns where none actually exist. So caution needs to be exercised e.g. 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.

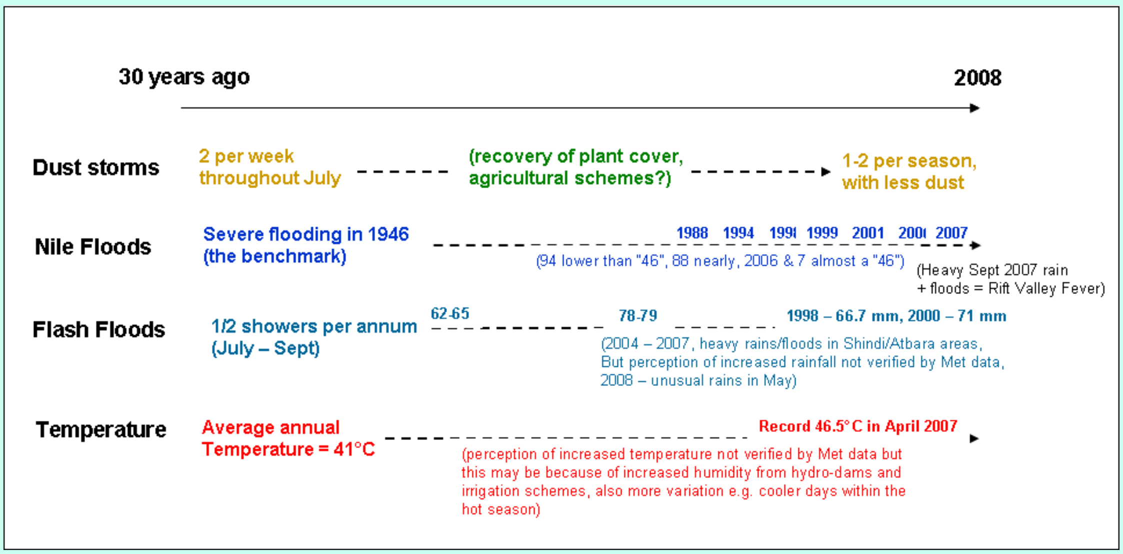
Step 3. Cross-referencing local knowledge with climate science

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

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 e.g. mistaking a "normal" decadal climate cycle with climate change.

Fig 9. 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 last 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. Also involved in the discussion were two staff from Atbara Meteorological Station, who 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), which 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 trend and variability, (b) continue the process to determine what the likely scenario for the next 10 years will be, (c) 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 CC Innovation Fund 2007-8, Christian Aid

Step 4. Projecting into the future

Unlike probabilistic weather forecasts that give a percentage likelihood of something happening, the community needs an agreed “most-likely scenario” with which to guide future adaptation. This can be achieved by:

a) Prioritising the 3-4 (maximum) factors that are considered the highest priority climate change threats to livelihoods i.e. those causing most damage to livelihoods. These can be identified by listing all climate factors affecting livelihoods identified in step 2 and pairwise ranking to limit the approach to priority issues and avoid the complexity that would result from trying develop a projection for everything (this might be difficult in some circumstances, as in Fig 10 below)

b) Using the earlier 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

c) For each of the priority climate factors, allow for discussion amongst the community members. This is not an exact process but the analysis must be agreed to be credible

d) Follow the logic of the graph (see Fig 3 above) 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

e) For communities with pre-existing community development plans, the analysis should be consistent so that it can be easily integrated into these plans. Detailing the likely impact on resources and features identified in community maps is a useful tool in this respect.

f) 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 livelihoods impact e.g. diversion of rivers reducing irrigation water resources rather than reduced rainfall

Step 5. Reporting back lessons learnt to climate scientists

Report the process back to climate scientists (primarily in meteorology departments/institutions, but also 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 (a) obtain feedback to be used in refining the process and (b) influence the future plans of climate science organisations in addressing some of the constraints encountered in addressing climate science (as per Fig 1).

Finally:

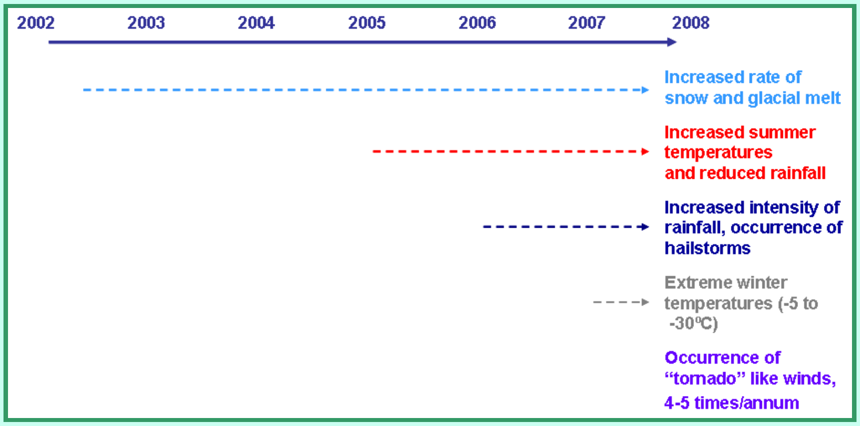
- climate science contains a high degree of uncertainty and new improved information is being developed rapidly, so a climate change analysis will need to be regularly reviewed in the light of both experience and new climate science. The process should be viewed as a cycle (as per Fig 4) rather than a linear series of steps.
- it may well be both useful and essential to partially repeat a step e.g. 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 yellow arrow in Fig 4)
- community consultations should ensure that they are gender-balanced and the most vulnerable are included. If this is difficult to achieve with just one consultation process, it may have to be repeated with e.g. women/women-headed households or landless labourers separately to ensure that their priorities are included

Fig 10. 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 highlighted 6 main factors:

Changing climate	Livelihood Risks
Increased rate of snow and glacial melt	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 risks 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 (July 2008 flood caused €400K infrastructure/housing damage and some fatalities) 5. Long-term loss of irrigation water resources associated with glacial retreat
Increased summer temperatures and reduced rainfall	1. Summer drought reduces wheat yields by 50% (from 3.5 mt/ha) 2. Hay and fodder crops are reduced and herders are attempting to destock (keeping 2 well-fed rather than 10 poorly-fed sheep)
Increased intensity of rainfall, occurrence of hailstorms (4-5 cm hailstones)	1. Increased intensity rainfall and hailstorms damage 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 -30ºC)	1. The associated loss of hydropower energy sources leave households without access to insulation, efficient heat sources (e.g. fuel efficient stoves) and renewable energy (e.g. passive and PV solar) 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 (> 20 m/sec)	1. Increase soil erosion during dry periods, exacerbated by lack of strategically-located wind breaks 2. Direct damage of infrastructure and housing (esp. 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)	1. Loss of fruit crops e.g. 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 bees and honey production (climate associated with/amplifying impact of bee colony collapse caused by varroa mite/bee viruses)

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 6 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, 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 7 to 2. 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 3 factors and changing seasonality were unprecedented and both young and old agreed that they were most likely related to climate change. On colder winters, they were less certain as older members could remember similar conditions 25-30 years ago. The occurrence of localised strong winds was so recent, they were unsure as to whether this phenomenon would continue.

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

Annex. External information - web resources and references

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

Adaptation Learning Mechanism (ALM) shares guidance and tools for developing and implementing adaptation initiatives, including a list of materials available for immediate download or online browsing.

Capacity Strengthening of LDCs for Adaptation to Climate Change (CLACC) are 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 15 countries in the South, 12 in Africa and 3 in South Asia.

Famine Early Warning Systems Network (FEWSNET) provides information on food security (including weekly climate and 6 day precipitation forecasts) for West, East and Southern Africa, Central America, the Caribbean and Afghanistan.

Intergovernmental Panel on Climate Change (IPCC) – the IPCC site has download links for the 4th IPCC Assessment Report (2007), a comprehensive assessment of the physical science basis (Working Group 1), impacts, adaptation and vulnerability (Working Group 2) and mitigation of climate change (Working Group 3).

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. In particular, the Database on Local Coping Strategies 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.

National Action Plans for Adaptation Database (NAPA) provides information on all aspects of NAPAs and NAPA development, including a useful Risk Assessment and Adaptation Resources page with links to adaptation resources and guidelines.

National Communications to the UNFCCC usually contains information on national circumstances, vulnerability assessment, financial resources and transfer of technology, and education, training and public awareness.

UNDP Climate Change Country Profiles - 52 country-level climate data summaries intended to address the climate change information gap for developing countries by making use of existing climate data to generate a series of country-level studies of climate observations. Each report contains a set of maps and diagrams demonstrating the observed and projected climates of that country as country average time series as well as maps depicting changes on a 2.5° grid and summary tables of the data. A narrative summarises the data in the figures, and placing it in the context of the country's general climate.

ii) Priority B. Other useful sources for wider research

Assessments of Impacts and Adaptations to Climate Change - Data, Methods and Synthesis Activity (AIACC) facilitates access to extensive data, software and bibliographic resources related to climate impacts, adaptation, and vulnerability across multiple sectors. The Data, Methods and Synthesis Activity is part of the AIACC Program. This involves a second generation of assessments is emerging which focuses on these and similar questions while engaging stakeholders in the assessment process to help focus research on local and regional priorities. Second-generation assessments examine vulnerability by analyzing exposures to stresses, including climate change, the sensitivities of exposed people and systems to the stresses, their capacities to cope and adapt, and their resilience or recovery potential. They also evaluate the range of response options for reducing risks.

CRiSTAL (Community-based Risk Screening Tool - Adaptation & Livelihoods) is 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 (GECAFS) is an international, interdisciplinary research project focussed on understanding the links between food security and global environmental change. The GECAFS goal is to determine strategies to cope with the impacts of global environmental 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.

IDS Climate Change and Development Centre 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 ORCHID (Opportunities and Risks for Climate Change and Disasters) adaptation tool for assessing development projects. IDS also run the Climate and Disaster Governance platform which aims to identify governance options which could help reduce climate and disaster risk to poor communities and keep development on track.

International Institute for Environment and Development Climate Change Programme 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.

ODI Climate Change, Environment and Forests Programme (CCEF) 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.

iii) Reference books

The Earthscan Reader on Adaptation to Climate Change - E. Lisa, F. Schipper and Ian Burton (Eds) (Earthscan, 2009)

Just One Planet - Poverty, Justice and Climate Change - D Mark Smith (Practical Action, 2006)

Understanding Climate Change Adaptation: Lessons from community-based approaches – Jon Ensor and Rachel Berger (Practical Action, 2009)

iii) Reference documents[5]

A Blueprint for the Integrated Assessment of Climate Change in Cities – Dawson et al, Working Paper 104 (Tyndall Centre for Climate Change Research, February 2007)

Climate Change and Food Security – P. Gregory, J. Ingram and M. Brklacich (The Royal Society, Oct 2005)

Climate Change and the Greenhouse Effect – A Briefing from the Hadley Centre (Dec 2005)

Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries – UNFCCC (2007)

How to do a VCA – A Practical Step-by-Step Guide – Red Cross/Red Crescent (2007)

Linking Climate Change Adaptation and Disaster Risk Reduction – Paul Venton and Sarah La Trobe (Tearfund, 2008)

Mapping climate vulnerability and poverty in Africa – ILRI/TERI/ACTS (May 2006)

Migration and Climate Change – IOM Research Series No. 31 (2008)

Red Cross/Red Crescent Climate Guide (Nov 2007)

UN Climate Change Factsheets (Sept 2007)

[5] These are **all** available on the Christian Aid intranet – go to SALT Adaptation References – or ask your local Christian Aid Office to assist with soft copies. Please forward details of any good websites or references to Richard Ewbank (Climate Change Programme Coordinator) at rewbank@christian-aid.org for inclusion into future toolkit updates and revisions.