Adaptation toolkit

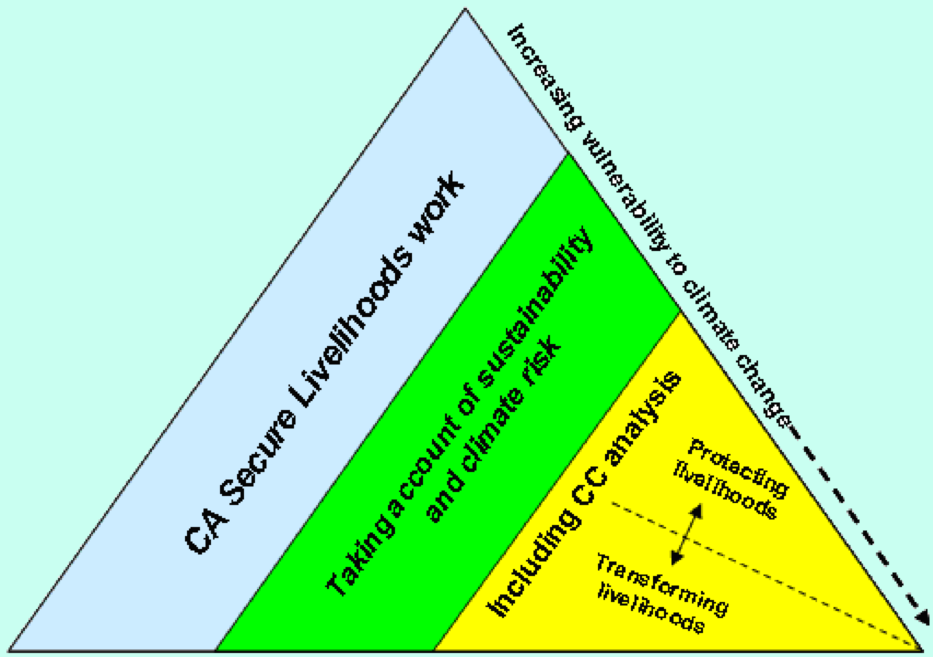
Integrating Adaptation to Climate Change into Secure Livelihoods

1. Framework and Approach

1. Climate change and livelihoods – the basic framework

Both existing poverty and the likelihood of the most severe effects of climate change falling on developing countries highlight the critical importance of adaptation to its impacts. Without substantial intervention to improve the adaptive capacity of the poorest and most marginalised, the likelihood of reaching both global and specific national poverty reduction objectives will be severely compromised or even reversed.

Fig 1. Christian Aid's Adaptation Framework



The triangle represents the whole of Christian Aid's current secure livelihoods work. The smallest (yellow) triangle covers work that aims to protect and/or transform poor women's and men's livelihoods, based on an explicit climate change analysis. Christian Aid will only describe work in the yellow triangle as climate change adaptation. The more vulnerable poor women and men are to climate change impacts, the greater the need to move our livelihoods work into this yellow triangle. The middle (green) triangle shows livelihoods work which explicitly addresses sustainability, including climate risk and vulnerability, but that has not (so far) included a more detailed climate change analysis. Over time, all our secure livelihoods work should build in an analysis of sustainability and move to either the green or yellow triangles[1]. Adaptation is about empowering people to cope with the impacts of climate change. This includes both severe shocks as a result of short-term climate variability, where our entry point will typically be through disaster risk reduction work; and ongoing degradation of livelihoods as a result of longer-term more gradual climate change, where our entry point will typically be through livelihoods development programmes. Climate change adaptation therefore learns from and draws on the complementary strengths of both disaster risk reduction and livelihoods programming.

Source: Climate Change - A framework for Christian Aid programme responses, March 2008

[1] Burton refers to Type 1 adaptation – reactive adaptation to mainly climate variability – and type 2 adaptation – proactive adaptation to climate change, mainly changing trends. Whilst the green triangle conforms to the definition of type 1 adaptation, the yellow triangle requires a forward-looking analysis of both climate trends and variability so can be considered "enhanced" type 2 adaptation

Given the already-observed impact of increased weather variation, much of which is now being attributed to man-made climate change, there are limits to adaptation beyond which other strategies, such as migration, become the preferred options. This is already happening as a result of conflict, economic deprivation and other factors – climate change has already and will in future add to these.

However the purpose of this toolkit is to provide guidance on the adaptation of livelihoods where they currently exist - for **in-situ adaptation** - generally before the more extreme coping mechanisms emerge. To the extent that environmental migrants transfer their livelihood from a rural to an urban setting, the basic tools described can still apply.

2. Focus of the toolkit

For the purposes of this toolkit:

- the focus is on livelihood adaptation but the overlap with mitigation should be acknowledged when it arises
- in restricting the scope to livelihoods, it does not address issues such as adaptation of health and other services, although these will clearly impact on livelihoods as e.g. malaria spreads to highland areas previously malaria-free
- the toolkit focuses on planning for adaptation and does not include detailed guidance on other issues such as advocacy[2] and monitoring and evaluation.
- the focus within planning is on developing an analysis of future climate change that can then be integrated into mainstream livelihoods work. This includes both (a) a project-specific analysis of climate change and how this fits into the options available for livelihoods development (module 2) and (b) the development of specific national-level climate change document, think-piece or strategy that may be developed as a resource for CPSP or partner strategy development (module 3)
- the toolkit is primarily aimed at Country Programme and partner staff focusing on disaster risk reduction and livelihood adaptation to climate change

3. Rationale for adaptation

Given that adaptation to changing weather patterns is as old as agriculture, why are specific activities and/or interventions needed to adapt to the challenges of climate change? There are a number of key factors that lead to the conclusion that past adaptation is not enough by itself to cope with future climate change:

a) Magnitude of impact – a level of change in climate due to greenhouse gas emissions is now irreversible in the short to medium term. However, the overall magnitude of impacts on poor people and poor countries will depend on climate change adaptation and mitigation decisions taken now. Business as usual - ignoring climate change issues in addressing poverty reduction or leaving them as environmental add-ons in the development process - risks leaving the impacts of climate change to undermine or even reverse efforts to reduce poverty. Incremental interventions put in place now to ultimately mainstream climate concerns into poverty reduction and development will significantly reduce these impacts on poor people and poor countries in the years to come.

[2] See Christian Aid's Southern Campaigns Toolkit for further guidance on climate change advocacy

b) The time-scale of climate change - while much can be learned from traditional coping mechanisms and these should form the basis of enhanced adaptation, especially where spontaneous adaptation has already taken place, climate change is creating impacts beyond expected climate conditions. This reduces the effectiveness of both individual and community coping mechanisms and the development assistance designed to strengthen them in two ways:

   - in the short-term, variation is now occurring outside normal or expected limits, so increasing the likelihood of weather varying from very wet to very dry, extended dry spells within rainy seasons, increased intensity of rainfall episodes and so on.
   - in the medium to long term, climate trends are changing so that the average situation that will move towards higher temperatures and therefore lower (or in some cases higher) rainfall, increased frequency of more severe storm events, etc. Long-term change in climate trends will in turn change (and often increase) short-term climate variability.

c) The geographic scale of climate change – climate change, especially changing climate trends, will happen across a larger geographical scale than current climate variability. This will limit coping mechanisms that previously relied on a localised response, e.g. agricultural communities in an area affected by a poor season trading out of the short-term food insecurity episode through contact with nearby food surplus areas. As this larger-scale climate change occurs, so these coping mechanisms become less viable.

d) Time-scale and geographic scale combined – the risk of generating maladaptation feedbacks, where a rational short-term response to vulnerability to climate variability creates an accelerated vulnerability to long-term climate change, needs to be minimised. So diversifying livelihoods into charcoal production as a result of drought-induced reductions in crop yield could reduce catchment protection of forest cover and increase vulnerability to both drought and flooding in the long-term; increasing the use of off-season irrigation in coastal farming areas to alleviate decreasing main-season rice yield reduces freshwater flushing of soils and increases saline intrusion from rising seas levels, thus reducing longer-term viability of agriculture generally. Adaptation must therefore respond to both short-term and long-term climate risks and consider upstream and downstream impacts.

e) Climate change, sustainability and poverty - climate change is just one aspect, albeit the one with the greatest potential for global impact, of a development process that relies on over-exploitation of natural capital – land, forests, atmosphere and so on. The concepts of open access and common property resources and their over-exploitation are well known when applied to local assets such as forest reserves and fish stocks, but equally apply to the atmosphere. So the treatment of the atmosphere as an unlimited sink for greenhouse gases emphasises the need for climate change adaptation to form part of an approach which in turn reinforces sustainability and a development path which protects natural resources and reduces the vulnerability and lack of resource-use rights of the poorest and most marginalised.

Climate change adaptation and mitigation (the reduction of greenhouse gas emissions) are usually presented as separate issues requiring quite different approaches. In a development context, this division can be artificial. For example, agricultural adaptation may result in an increase in soil organic matter through increased use of manures or the adoption of more agroforestry-based techniques. This in turn increases the capacity of agriculture[3] to capture and store carbon from the atmosphere thereby reducing greenhouse gas (GHG) concentrations. Other livelihood strategies may well show similar linkages between the two, especially in an urban context where decentralised renewable energy projects can provide new or more reliable electricity supplies, which in turn increase the resilience of small-scale productive enterprises (SMEs). Where these linkages and co-benefits occur, advantages should be maximised.

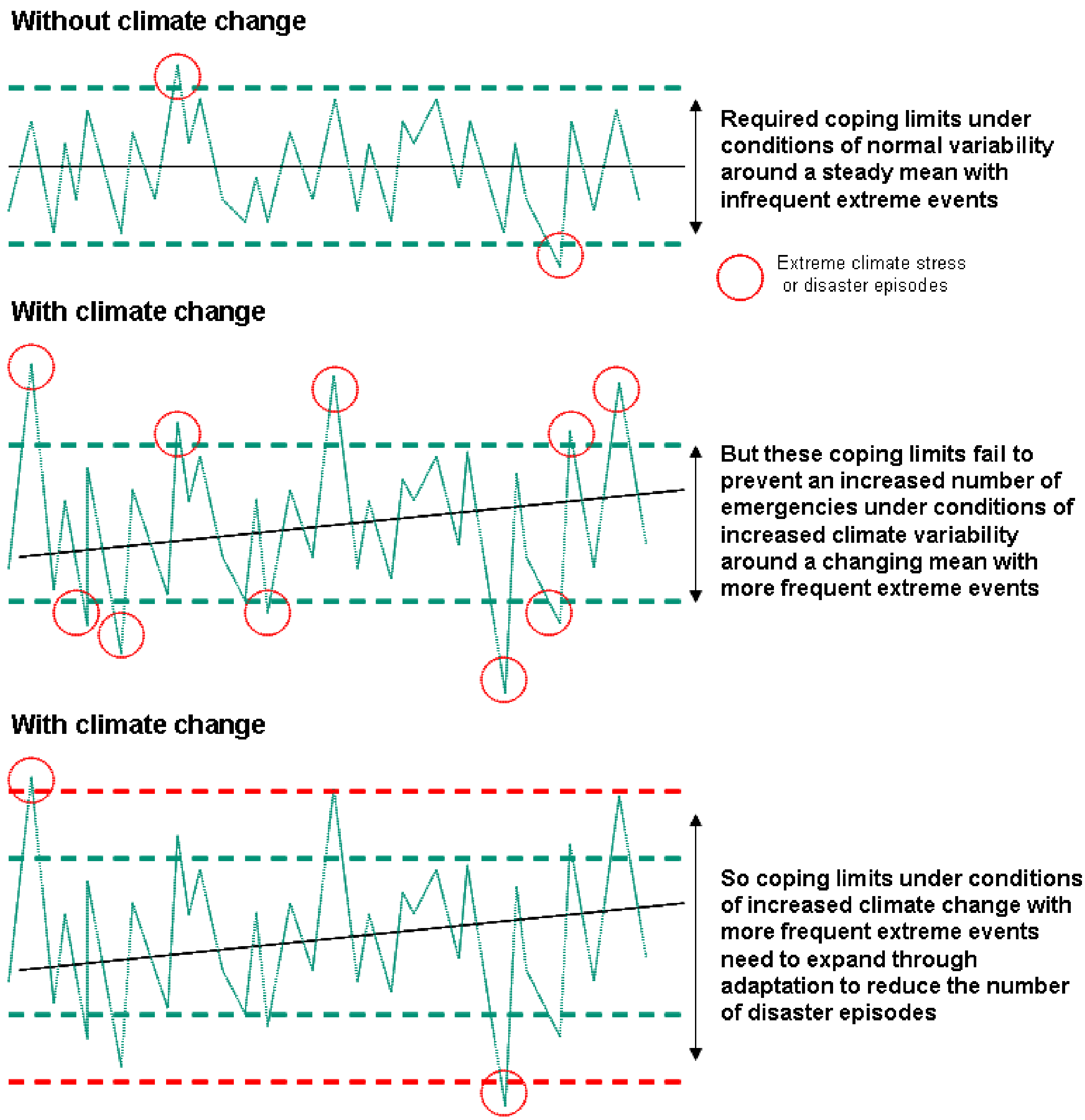
The degree to which mitigation is successful will influence the degree of adaptation required. The best adaptation is ultimately effective mitigation of greenhouse gases - the earlier progress is achieved in reducing GHG emissions, the lower the scale of adaptation required both now and in the future. However some climate change is inevitable. Communities across the world, and especially those in more climate-vulnerable areas and livelihoods, are already experiencing unprecedented changes. Even if GHG emissions ceased immediately, there is still an estimated further increase of 0.5 - 1°C[4] in the global climate system - and both changing trends and increased variability will require those affected to increase their resilience by expanding their livelihood coping limits (see Fig 2 below).

Without climate change, variation would generate occasional emergencies but would be mostly within existing coping limits. The “with climate change” situation shows how existing coping limits cannot prevent an increase in emergencies. If coping limits are not expanded (as per the second diagram), the number of disaster episodes will multiply and make operating a sustainable livelihood increasingly difficult. This will result in increased poverty and ultimately stress migration and so coping limits need to be considerably expanded (to the red dashed lines in the third figure) to maintain the same resilience to both changing average conditions/trends and increased variability and limit the number of extreme climate stress episodes to the same as the “without climate change” situation.

[3] Globally agriculture produces 13% of greenhouse gas emissions. An estimated 74% of these emissions are generated by agriculture in developing countries and 90% of the mitigation potential will be based on increasing the carbon sequestration capacity of soil (FAO, April 2009). A further 18% of emissions are related to deforestation, mainly of tropical forests

[4] Average global temperature has increased by 0.8ºC from pre-industrial times; with an additional 1ºC already built into the system, the global economy has only 0.2ºC worth of increased emissions before it breaches the critical 2ºC limit.

Fig 2. Impact of climate change on livelihood coping limits



4. The nature of climate risk

4.1 Speed of onset

For livelihoods and adaptation, the speed of onset of a particular climate-related event or trend is a critical factor:

Fig 3. Speed of onset

Extremely fast onset (days/weeks), including:	Fast onset (weeks/months), including:	Slow onset (months/years), including:
- Intense cyclones/ hurricanes and associated storm surges - Localised high wind episodes/tornados - Increased risk of river and flash flooding/ mudflows - Erratic and intense rainfall, hailstorm and/or lightning strike episodes - Landslide risks from increasingly intense rainfall events* - Extreme temperature episodes - Snow storms, instability of snowfields and avalanche risk Key: Dark blue – wind and water-related Blue – water-related Light blue – snow/ice-related Red – temperature-related Orange – acidification plus temperature Green – ecosystem-related	- Increased windspeeds - Increasingly erratic rainfall and heightened risk of flood - Increased drought risk in rainfed farm and rangelands - Increased intensity of rainfall during the monsoon/rainy season and increased erosion risks - Increased seasonal river and streamflow variability - Water table fluctuation and changing water resources for both rural and urban areas - Increased temperatures and evapotranspiration - Increased variation in snowfall and consequently increased streamflow variability - Increased melt season temperatures increasing meltwater streamflow	- Average windspeed and cyclone frequency and strength - Sea-level rise, coastal erosion - Saline intrusion into soils and aquifers - Changing rainfall patterns and seasonality - Declining average water availability and increased water stress - Declining rangeland water resources, leading to overstocking and erosion around remaining water resources - Higher temperatures/ increasing aridity - Rising average temperatures, particularly in high-altitude zones - Retreat and disappearance of mountain glaciers and glacier-based water resources - Coral bleaching - Desertification - Changes to current upwelling in large marine ecosystems, and potential threats to fisheries - Altitudinal and horizontal shift in natural and agro-ecosystem zones - Changing ecology and hydrology, affecting farmers and agro-ecosystems - Declining resilience of forest resources and habitat for native fauna

* - often inter-related with earthquake-related landslides

So:

- Extremely fast onset factors are those that in both the ability to predict and their duration occur over days and weeks. They are therefore more amenable to short-term weather forecasting (1 – 14 day forecasts)
- Fast onset changes occur over a timescale of weeks or months and are therefore more amenable to seasonal forecasting (typically 3 months – 1 year)
- Slow onset factors happen over months and years and tend to be measured using multi-seasonal (or decadal[5]) forecasting and climate change models (or global circulation models – GCMs) (currently 2050 – 2100)

When relating this to the standard categories of climate change hazard[6]:

- Category 1: Discrete recurrent hazards, as in the case of transient phenomena such as storms, droughts and extreme rainfall events
- Category 2: Continuous hazards, for example increases in mean temperatures or decreases in mean rainfall occurring over many years or decades
- Category 3: Discrete singular hazards, for example shifts in climatic regimes associated with changes in ocean circulation

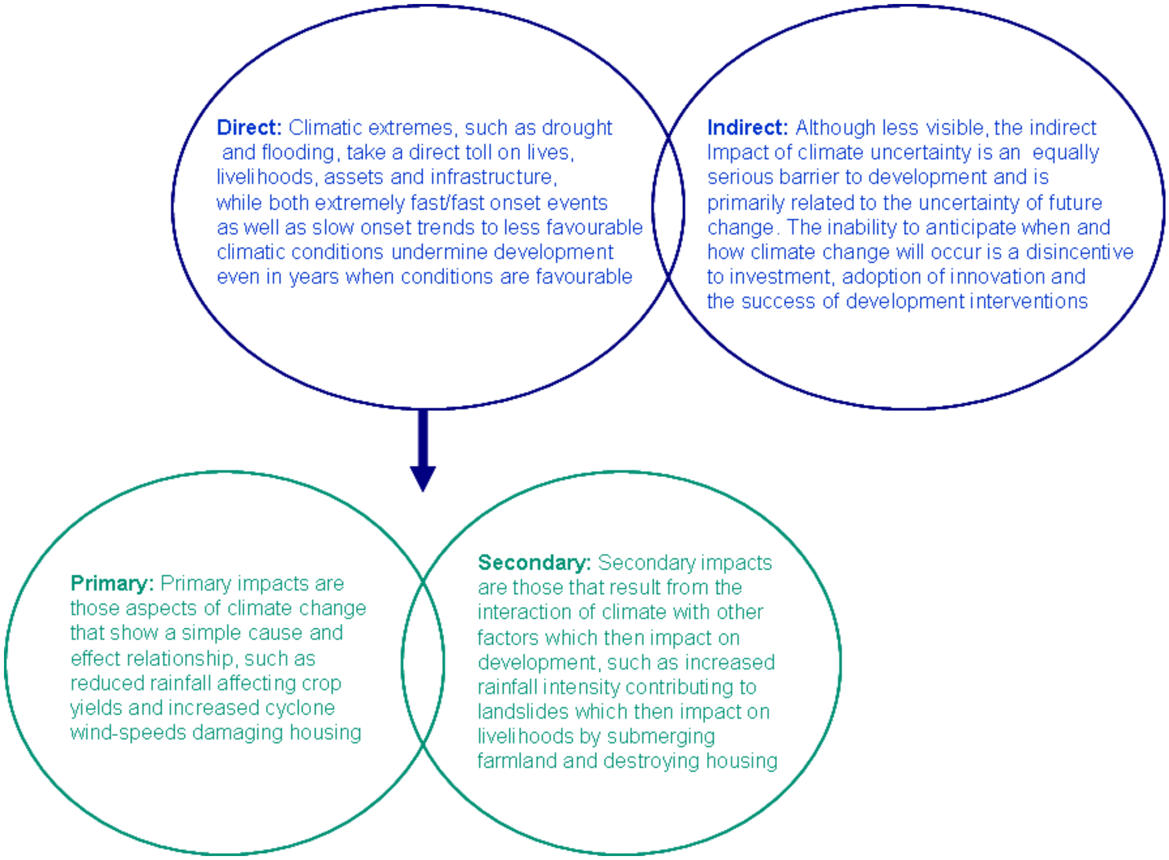
extremely fast and fast onset risks are therefore category 1, while slow onset risks are category 2. Category 3 refers to major irreversible climate shifts (also referred to as tipping points) to that are currently predicted on a decadal or millennial time scale – these will become increasingly important if the 2ºC increase level is breached. Other climate features will include magnitude, area affected, frequency and duration (see module 2, page 8).

4.2 Direct and indirect impact

How then do these affect livelihoods and development? The impacts of climate change on development are felt in both direct and indirect ways. Direct factors can be further sub-divided into primary and secondary as follows (see Fig 4 below. Impacts vary from region to region and depending on the level of temperature increase, see Annex 3):

[5] Decadal forecasting/modelling is still in its infancy but there is an emerging emphasis on being able to improve forecasting 5 – 10 years ahead. Information on decadal time scales is expected to become available in the next 2-3 years
[6] Nick Brooks, Tyndall Climate Centre (2003).

Fig 4. Direct and indirect, primary and secondary



Climate directly impacts food production, shelter and other livelihoods. Both severe climate shocks and incremental climate change can push vulnerable households into a persistent poverty trap, particularly when their individual coping responses involve selling off productive assets such as livestock, equipment or land. In terms of indirect impact, the inability to accurately predict future climate risks will result in short-term planning and conservative risk management that buffers against climate variability, but often at the expense of efficient resource use, productivity and can even accelerate resource degradation, resulting in maladaptation. This indirect impact of climate change highlights the need to reduce uncertainty by improving the development of climate science and the community's ability to integrate it into their decision-making processes.

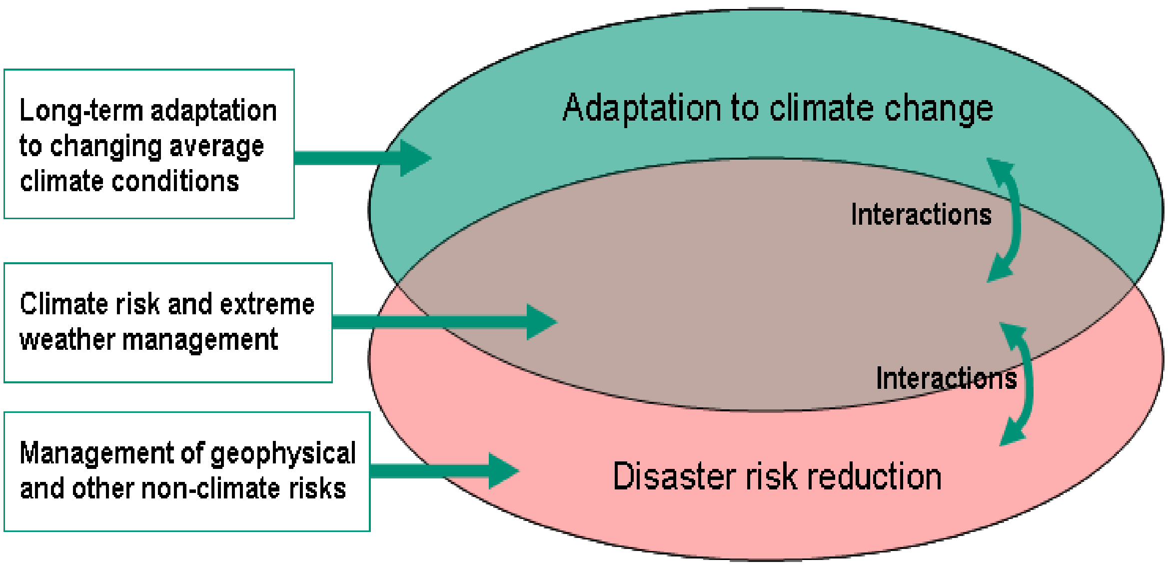
Primary impacts show a simple cause-effect relationship whereas secondary impacts demonstrate the complexity created as climate interacts with other risk factors. Both primary and secondary climate impacts are unlikely to be the sole factor affecting a particular livelihood or aspect of development. Climate is one risk factor among others affecting livelihoods, such as insecurity, earthquakes/tsunamis, disease factors, etc.

Climate risks interact both:

a) with these other livelihood risks and

b) with each other – slow onset climate factors will exert a gradual impact on livelihoods so that when extremely fast/fast onset factors occur, communities fall into a humanitarian crisis faster and then need extended recovery periods to recover after the crisis has passed but the **key feature that marks out climate change from disaster risks** is the nature of slow-onset climate factors and the need to understand their likely impact at least 10-15 years into the future. This highlights the need to integrate longer-term livelihoods development with disaster risk reduction (DRR) and humanitarian support (see Fig 5 below).

Fig 5. The overlap between DRR and climate change adaptation[7]



5. Climate change analysis in the project context

5.1 Four stages to adaptation

Adaptation is often described as either scenario-led or vulnerability-led. In reality, it is both – adaptation needs to be informed by likely climate scenarios as well as the vulnerability that will result.

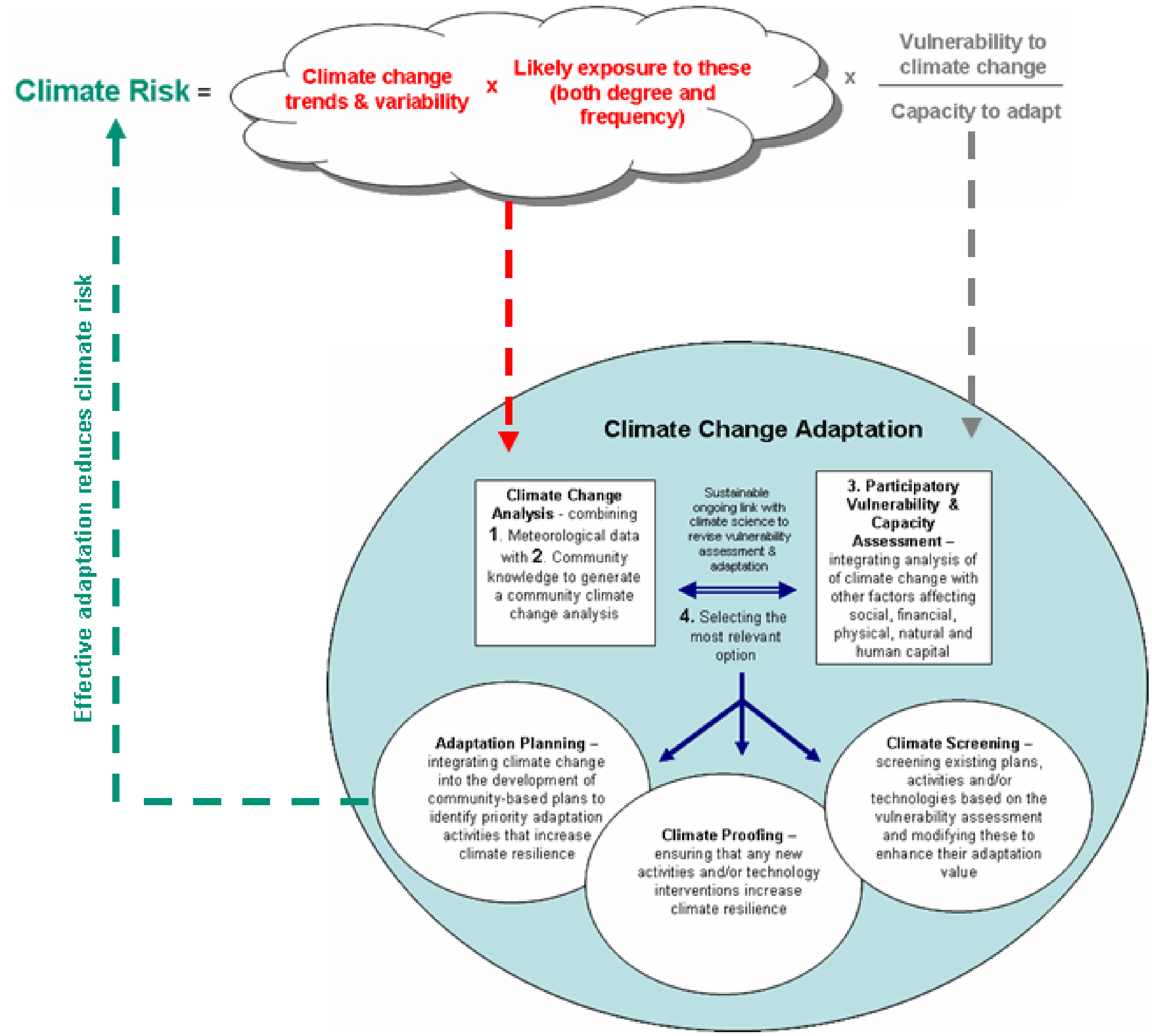
In the classic risk reduction equation (see Fig 6 below), **climate risk** is a function of changing climate and likely exposure to this change, and the degree of vulnerability to this exposure divided by the capacity to adapt. As both climate change trends and variability and likely exposure (in red in the cloud) are largely beyond the influence of any particular livelihood choice other than migration, increasing the capacity to adapt is therefore the primary response in reducing the climate risk that a livelihood is subjected to.

Using this to then determine the essential stages needed to either climate screen existing projects or plan new more climate resilient interventions leads to four basic stages (see Fig 6 below) to integrate climate change. The first two focus on developing a climate change analysis combining what is available in terms of (1) both short-term weather and longer-term climate science with (2) the local or indigenous knowledge of those communities and individuals most directly affected. This can then be used to inform (3) the participatory vulnerability and capacity assessment (PVCA), which may

[7] Based on a figure in "Convergence of Disaster Risk Reduction and Climate Change Adaptation: A Review for DFID - Dr. Tom Mitchell (IDS) and Dr. Maarten van Aalst (Red Cross)"

focus on several priority factors increasing vulnerability, including climate change. Given the rapidly improving ability of meteorology departments and other climate science institutions to provide increasingly accurate predictions about both short and long-term climate change at the local level, it is important to maintain links with these sources so that the climate change analysis and the PVCA can be regularly updated with the latest information.

Fig 6. Adaptation at project level – an overview



Following the PVCA, the final stage (4) is to select the most appropriate option across a spectrum[8] from screening existing projects to ensure that they are not increasing vulnerability to climate change to a more in-depth community adaptation planning process in which village or community development plans are developed or enhanced to strengthen climate resilience across all sectors and areas of a community and include both short-term responses to fast/extremely fast onset climate factors as well as longer-

[8] Shown as 3 options for simplicity

term planning to adapt to slow onset climate factors. Collectively this approach is often referred to as community-based adaptation.

5.2 Community-based adaptation

Community-based adaptation (CBA)[9] builds on a number of development practices that have been in widespread use for some time, such as village action or development planning and participatory land use planning. It should therefore be seen as consistent with these existing and ongoing approaches rather than a new methodology that requires a radical transformation. As such, adaptation responds to climate risks assessed in a developmental framework, rather than just to 'dangerous' anthropogenic climate change as defined by the United Nations Framework Convention on Climate Change, and so responds to and plans for both the low level incremental impacts of climate change (addressed in the "normal" stage of the climate risk cycle, see 5.3 below) as well as high-level disaster-related impacts (addressed in the "emergency" and "recovery" stages of the climate risk cycle).

Some key CBA principles include -

a) It is a **community-led** process - CBA operates at a community level. The focus is usually on vulnerable communities but can be applied in any community. CBA is about the community making choices, not having them imposed from outside, and should therefore enhance the ability of the community to have a wider range of choices in the future, establishing a community-owned vision of what their climate-resilient community should look like.

b) Other change processes such as environmental degradation, weak governance and poor access to land and resources, often exacerbate risks faced by communities from climate-related causes.

c) CBA complements **both the development and disaster communities**, and it adopts methods and tools from both. Likewise, as both development and disaster communities are trying to learn more about incorporating climate adaptation into their own activities, the different languages of the climate adaptation, development and disaster communities need to be translated and shared.

d) The CBA plan is a living entity **subject to revision** particularly as new climate science becomes available and new adaptation priorities and funding to address them emerges.

A key part of integrating climate change into community-based planning will be to build in a risk cycle management approach.

5.3 Climate risk cycle

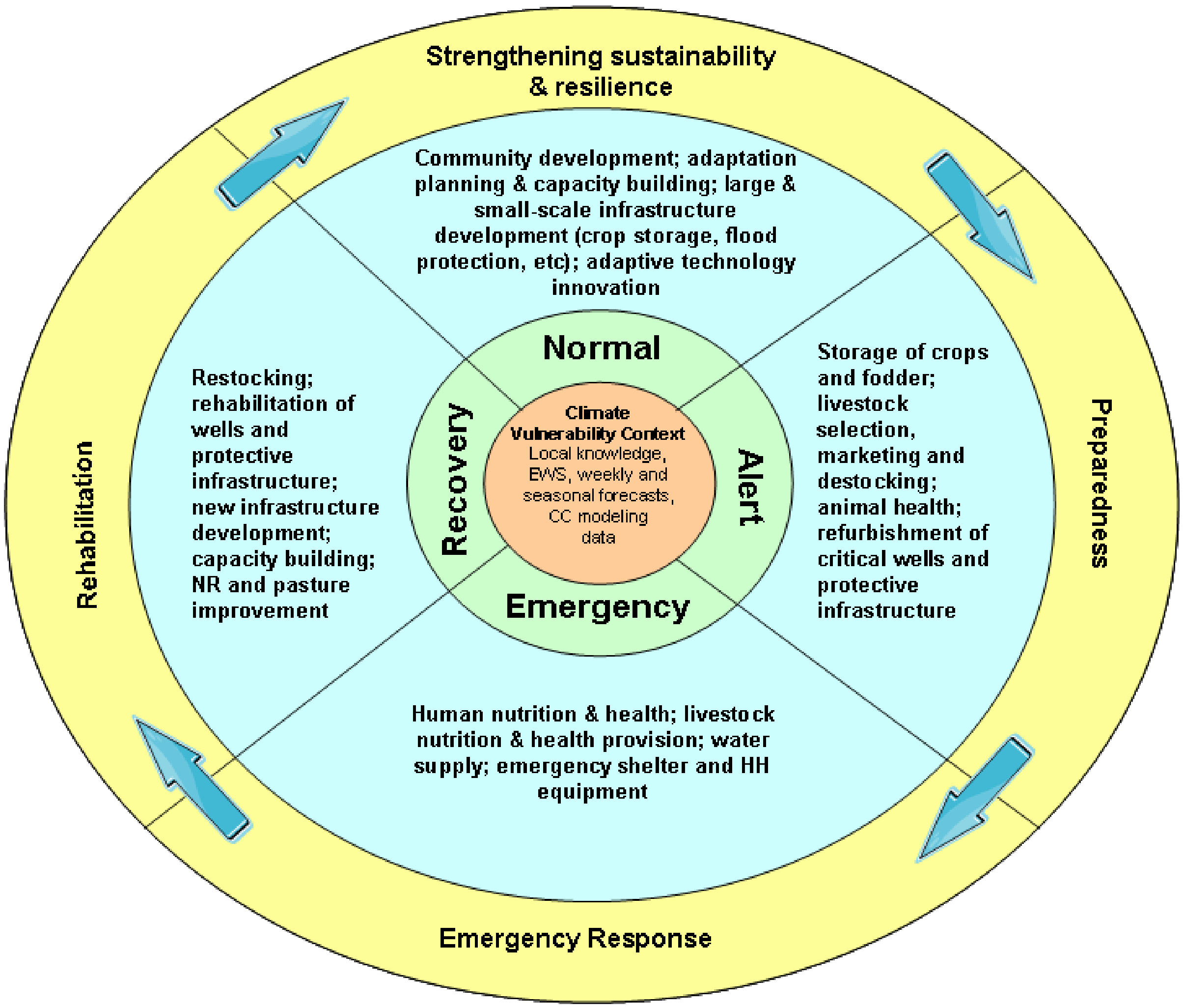
A climate risk cycle management approach[10] takes as a basic starting point the inevitability of variation and changing trends and therefore the need to be proactively planning for future change, including inevitable emergencies (see Fig 7 below). So if longer-term development is more resilience-focused, both the immediate impact of an emergency event and the recovery time from it are reduced.

An inherent assumption in earlier risk cycle management approaches was that risks associated with variation cycle around a constant mean but climate change results in a

[9] See also "Community-based adaptation: A vital approach to the threat climate change poses to the poor" by Saleemul Huq and Hannah Reid, IIED Briefing
[10] This is based on earlier approaches, such as drought cycle management

changing mean as well as increased variability (as described in section 3 and Fig 2 above), so a climate risk cycle will need to build this into the approach. If a community moves through a complete cycle and returns to the "normal" stage, climate change will mean that it is a slowly changing normality and so this needs to be integrated into community-based planning or community-based adaptation.

Fig 7. Climate risk cycle management



Some basic features when using a climate risk cycle approach to adaptation planning include:

- Building in a climate risk cycle management approach to the implementation of adaptation plans - the community determines which party of the cycle it is in and therefore the mix of adaptation/livelihood activities that need to be implemented. This therefore needs a sustainable link between both short-term weather forecasting/early warning institutions and longer-term climate change prediction capacity (these may not be completely different sources of information) to enable the determination by the community of **specific indicators** that trigger transition from one part of the cycle to the next and therefore which part of the cycle it is in and which interventions to implement. Indicators that are used to move from normal to alert and alert to emergency critically depend on effective early warning systems.

- It is more than likely that some adaptation will already have been implemented, so the extent that spontaneous adaptation by the community has been successful should be regarded as valuable experience that forms the basis for further planning.

- For planning in the **proactive part** of the cycle (normal and alert), the community-based adaptation plan distinguishes between priorities to be implemented in both the short (1-2 years) and the longer term (2-10 years). This should differentiate between:

    - changes in structure: activities that address infrastructure (roads, flood defences, etc – these are more likely to be relevant to all wealth ranks but not necessarily)

    - changes in livelihoods: activities that protect or transform livelihoods (e.g. identifying more drought-resistant crops/crop varieties).

  Both of these can be supported by establishing a community-based adaptation fund to support livelihood projects or receive funds for infrastructure development.

- Situations may well occur in which a community moves from alert back to normal which, as long as it does not result in so many false alarms that community confidence in the system is eroded, is not a bad thing. However, moving from recovery back to emergency (the **reactive part** of the cycle) risks a community being caught in a **recovery trap** which if repeated results in a downward spiral of diminishing assets and income and increasing vulnerability and poverty.

The aim of any risk cycle management approach is to maximise the time a community spends in the top right-hand half of the cycle (normal – alert) and minimise the time spent in the bottom left-hand half (emergency – recovery).

Annex 1. Acronyms

CBA -	Community-based adaptation
CC -	Climate change
CFC -	Climate field school
CPSP -	Country Programme Strategy Paper
DRR -	Disaster risk reduction
EWS -	Early warning systems
GCM -	Global circulation model
GEF -	Global Environment Fund
GHG -	Greenhouse gases
ICRAF -	World Agroforestry Centre
IPCC -	Intergovernmental Panel on Climate Change
MDG -	Millennium Development Goals
NAPA -	National Action Plans of Adaptation
N/TFP -	Non/Timber Forest Products
PRECIS -	Providing Regional Climates for Impacts Studies
PRSP -	Poverty Reduction Strategy Paper
PVCA -	Participatory vulnerability and capacity assessment
SME -	Small and medium enterprises
SSN -	SouthSouthNorth
UNDP -	United Nations Development Programme
UNFCCC -	United Nations Framework Convention on Climate Change

Annex 2. Glossary

Adaptation - any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for reducing the anticipated adverse consequences or taking advantage of any benefits associated with climate change (based on Stakhiv 1993).

Adaptive capacity - the ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities or to cope with the consequences (IPCC 2007).

Attribution - the process of determining whether a particular effect or impact is the result of a particular cause, or of some other factor.

Climate change - statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period (typically decades or longer) and resulting from anthropogenic (man-made) greenhouse gas emissions (IPCC 2007).

Climate change mitigation - technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks (see also **greenhouse gas** below) (IPCC 2007).

Climate hazard - potentially damaging physical manifestations of climatic variability or change, such as droughts floods, storms, episodes of heavy rainfall, long-term changes in the mean values of climatic variables, potential future shifts in climatic regimes and so on (Brooks, N 2003).

Climate impacts - consequences of climate and climate change on natural and human systems.

Climate model - A numerical representation of the *climate system* based on the physical, chemical, and biological properties of its components, their interactions and *feedback* processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity (i.e., for any one component or combination of components a hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical, or biological processes are explicitly represented, or the level at which empirical parameterisations are involved (IPCC 2007).

Climate trend - the general direction in which climate factors, such as average annual temperature or rainfall, tend to move over time

Climate variability - variations from the mean state (and other statistics, such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events (IPCC 2007).

Coping capacity - The ability of people, organisations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters (UNISDR 2009).

Decadal climate cycles – variations in climate that oscillate on a multi-year or even multi-decade timescale, often as a result of ocean-atmosphere interactions (see also El Nino below)

Disaster risk management - The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster (UNISDR 2009).

Disaster risk reduction - the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR 2009).

Early warning system - the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss (UNISDR 2009).

El Niño – or El Niño Southern Oscillation (ENSO), is a complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts over many months, such as altered marine habitats, rainfall changes, floods, droughts and changes in storm patterns (UNISDR 2009). El Niño and La Niña are defined as sustained sea surface temperature anomalies of magnitude greater than 0.5°C across the central tropical Pacific Ocean, El Niño being a warming and La Niña a cooling event. El Niño events are associated with wetter weather in Peru/Ecuador and East Africa and drier conditions in South-East Asia, northern Australia and Southern Africa. La Niña events generally cause the opposite and are associated with increased Atlantic cyclones. Climate change may increase the strength and frequency of the oscillation.

Extreme weather event - an event that is rare within its statistical reference distribution at a particular place. Definitions of ‘rare’ vary, but an extreme weather event would normally be as rare as or rarer than the 10^{th} or 90^{th} percentile. By definition, the characteristics of what is called ‘extreme weather’ may vary from place to place. Extreme weather events may typically include floods and droughts (IPCC 2007).

Forecast - definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area (UNISDR 2009)

Greenhouse gas - a gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the Earth’s surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than the surface. The net effect is a local trapping of part of the absorbed energy and a tendency to warm the planetary surface. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth’s atmosphere (IPCC 2007).

Hazard impacts – impacts related to dangerous phenomena, substances, human activities or conditions that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR 2009).

Indigenous knowledge – also referred to as local knowledge, is the ancient, communal, holistic and spiritual knowledge that encompasses every aspect of human existence (Brascoupé and Mann, 2001)

Livelihoods - a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is **sustainable** when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation: and which contributes net benefits to other livelihoods at the local and global levels in the long and short term (Chambers and Conway 1992). A **secure livelihood**

reduces poverty and marginalisation; equips and empowers an individual, household or community to protect and claim their rights to the resources and assets essential for their livelihood; strengthens them against the impact of disaster; and deepens their understanding of and ability to respond to climate change (derived from Christian Aid Secure Livelihoods Strategy 2007–11).

Maladaptation - actions that increase vulnerability to climate change. This includes making development or investment decisions while neglecting the actual or potential impacts of both climate variability and longer-term climate change (Burton et. al, 1998).

Maladaptation feedbacks – consequences of actions taken to reduce short-term vulnerability which then accelerate medium or long-term vulnerability to climate change.

Resilience - the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR 2009).

Scenario - a plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from *projections*, but are often based on additional information from other sources, sometimes combined with a *narrative storyline* (IPCC 2007*)*.

Triangulation - the verification of information gained from one source or methodology with that gained from one or more other sources or methodologies.

Vulnerability - the extent to which a natural or social system is susceptible to sustaining damage from hazards caused by climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system to changes in climate. Hence, a highly vulnerable system is one that is highly sensitive to modest changes in climate and one for which the ability to adapt is severely constrained (IPCC 2007).[11]

[11] Definitions and figures that are unattributed are generally based on original material, multiple information sources and/or adapted substantially to ensure they relate to the Christian Aid context (or a combination of these). See also reference list in Annex 2.

Annex 3. Climate change impact by region and temperature

(a) Regional impact and vulnerability

Region	Likely regional impacts of climate change	Vulnerability, adaptive capacity
Africa	• By 2020, between 75 million and 250 million people are projected to be exposed to increased water stress due to climate change. Coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems. • Agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020. • Local food supplies are projected to be negatively affected by decreasing fisheries resources in large lakes due to rising water temperatures, which may be exacerbated by continued overfishing. • Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5-10% of Gross Domestic Product (GDP). Mangroves and coral reefs are projected to be further degraded, with additional consequences for fisheries and tourism.	• Most vulnerable due multiple stresses and low adaptive capacity is low due to low GDP per capita, widespread poverty (the number of poor grew over the 1990s), inequitable land distribution and low education levels. There is also an absence of safety nets, particularly after harvest failures. • More than one quarter of the population lives within 100 km of the coast and most of Africa's largest cities are along coasts vulnerable to sea level rise, coastal erosion, and extreme events. • Individual coping strategies for desertification are already strained, leading to deepening poverty. • Dependence on rain- fed agriculture is high. • Adaptive capacity is likely to be greatest in countries with civil order, political openness, and sound economic management. Some adaptation to current climate variability is taking place; however, this may be insufficient for future changes in climate.
Asia	• Glacier melt in the Himalayas is projected to increase flooding, and rock avalanches from destabilised slopes, and to affect water resources within the next two to three decades. This will be followed by decreased river flows as the glaciers recede. • Freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s. • Coastal areas, especially heavily-populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers. • Climate change is projected to impinge on the sustainable development of most developing countries of Asia, as it compounds the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation, and economic development. • It is projected that crop yields could increase up to 20% in East and South-East Asia while they could decrease up to 30% in Central and South Asia by the mid-21st century. Taken together, and considering the influence of rapid population growth and urbanisation, the risk of hunger is projected to	• Adaptive capacity varies between countries depending on social structure, culture, economic capacity and level of environmental degradation. • As a region, poverty in both rural and urban areas has decreased in Asia. • Capacity is increasing in some parts of Asia (for example, the success of early warning systems for extreme weather events in Bangladesh), but is still restrained due to poor resource bases, inequalities in income, weak institutions, and limited technology.

	remain very high in several developing countries. • Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle associated with global warming. • Increases in coastal water temperature would exacerbate the abundance and/or toxicity of cholera in South Asia.	
Latin America	• By mid-century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savannah in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America. • In drier areas, climate change is expected to lead to salination and desertification of agricultural land. Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones soya bean yields are projected to increase. • Sea-level rise is projected to cause increased risk of flooding in low-lying areas. Increases in sea surface temperature due to climate change are projected to have adverse effects on Mesoamerican coral reefs, and cause shifts in the location of south-east Pacific fish stocks. • Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.	• Some social indicators have improved over the 1990s, including adult literacy, life expectancy, access to safe water. • Other factors such as infant mortality, low secondary school enrolment, and high income inequality contribute to limiting adaptive capacity. • Some countries have made efforts to adapt, particularly through conservation of key ecosystems, early warning systems, risk management in agriculture, strategies for flood drought and coastal management, and disease surveillance systems. However, the effectiveness of these efforts is outweighed by: lack of basic information, observation and monitoring systems; lack of capacity building and appropriate political, institutional and technological frameworks; low income; and settlements in vulnerable areas, among others.
Small Island States	• The projected sea level rise of 5 mm/yr for the next hundred years would cause enhanced soil erosion, loss of land, poverty, dislocation of people, increased risk from storm surges, reduced resilience of coastal ecosystems, saltwater intrusion into freshwater resources and high resource costs to respond to and adapt to changes • Coral reefs would be negatively affected by bleaching and by reduced calcification rates due to higher carbon dioxide levels; mangrove, sea grass bed, and other coastal ecosystems and the associated biodiversity would be adversely affected by rising temperatures and accelerated sea level rise • Small islands, whether located in the tropics or higher latitudes, have characteristics which make them especially vulnerable to the effects of climate change, sea-level rise and extreme events. • Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources, e.g., fisheries, and reduce the value of these destinations for tourism. • Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island	• Adaptive capacity of human systems is generally low in small island states, and vulnerability high; small island states are likely to be among the countries most seriously impacted by climate change. • Declines in coastal ecosystems would negatively impact reef fish and threaten reef fisheries, those who earn their livelihoods from reef fisheries, and those who rely on the fisheries as a significant food source. • Limited arable land and extensive soil salination make agriculture on small islands, both for domestic food production and cash crop exports, highly vulnerable to climate change. • Tourism, an important source of income and foreign exchange for many islands, would face severe disruption from climate change and sea level rise.

	communities. • Climate change is projected by mid-century to reduce water resources in many small islands, e.g., in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods. • With higher temperatures, increased invasion by non-native species is expected to occur, particularly on mid- and high latitude islands.	

Source: derived from IPCC 4th Assessment Report 2007

(b) Impact as average global temperatures increase