ORIENTATION AIDS

B.1 Information requirement and sources for adaptation to climate change

The information requirement for the climate proofing refers to the following points:

1. The hazards (or also potentials) which arise from climate change,
2. The reasons for the vulnerability of certain population groups and elements regarding these hazards, including existing adaptation potentials (strengths, resources),
3. already known or tested adaptation measures and
4. relevant policies and initiatives.

For compiling information the following is required:

- Scientific material (forecasts on climate change, vulnerability analyses, etc.) with
- accumulated local experience (signs of climate change, local trends and framework conditions, traditional adaptation strategies, etc.) and
- politico-strategic approaches (legislation, concepts, initiatives, etc.).

Research in pertinent literature and on the Internet, individual and group meetings as well as workshops, or participative analysis and planning processes at target group level are the most important instruments for compiling the necessary information for the climate proofing. The following table provides an overview of required information and possible sources. Here decisions are made according to information requirements in different planning processes of Welthungerhilfe.

Table B1-1: Overview of information requirement and possible sources for climate proofing in various planning processes

Planning process	Necessary information	Sources and methods of procurement
Regional or country programme	Effects of climate change on region/ country (threats and opportunities)	Literature and Internet research supplemented by dialogue with scientists, government representatives, partners and donors
	Damage and losses already incurred which were caused by weather events which will increase	
	Reasons for and level of sensitivity of target groups and assets relevant for Welthungerhilfe	
	National policy (for instance NAPA) and donor initiatives (for instance country concepts, project documents)	Literature and Internet research supplemented by dialogue with government representatives and donors
	Where appropriate information on tested adaptation measures and on potential for mitigation	Sector-related information, above all from ministries and the scientific community

Planning process	Necessary information	Sources and methods of procurement
Individual project:		
Preliminary phase (situation analysis)	Effects of climate change on project region (threats and opportunities)	Literature and Internet research supplemented by dialogue with scientists, weather services, specialist institutes, local authority administrations, international donor organisations, NGOs and representatives of the target group
	Damage and losses already incurred which were caused by weather events which will increase	
	Reasons for and levels of sensitivity and adaptation potentials of target group, amongst other relevant actors	
	National policies and specific initiatives in the project region	Analysis of literature and dialogue with government representatives, local authority administrations, donors, NGOs, etc.
	Adaptation and mitigation measures tested locally or under similar framework conditions	Literature and dialogue with the scientific community, ministries, local authority administrations, partners, target group, etc.
Initial phase (detailed project planning)	Specification of risk assessment for selected local or content-related areas	Supplementary analyses, dialogue with partners and target group (participative methods)
	If necessary, supplementation, respectively updating of information on policies and initiatives	Dialogue with government representatives, partners, local authority administrations, donors, NGOs, etc.
	If necessary, additional requirement, which is determined in the preliminary or initial phase	According to requirements

The following takes a more detailed look at individual aspects, such as the effects of climate change, frequent sensitivity factors and adaptation options as well as possible contributions towards mitigation.

B.2 The impacts of climate change

According to the IPCC (2007) from a global perspective climate change is expected to have the following effects:

- More frequent, more severe or newly occurring extreme weather events,
- less, more extreme and unreliable precipitation (changes and high variability),
- increase in sea levels by 0.18-0.59 m, without taking into consideration possible rapid changes in ice flow.

- Higher air and water temperatures: with regard to air temperatures the forecasts for average temperature increase from 1999 to 2099 are between 1.8°C and 4°C depending on the model. An increase of 0.2° C respectively is assumed for the next two decades.

The following table provides an overview of the most important consequences related to climate change (risks) for mankind and the natural environment. It is not necessarily complete, and in the specific project context other and additional aspects can be important.

Table B2-1: Overview of the most important effects of climate change in developing countries (→ Module A)

Effects of climate change and their consequences for mankind and the natural environment
More frequent, stronger or new incidences of extreme weather events ■ Destruction of life, infrastructure, natural resources, sources of income through hurricanes/ cyclones, floods, landslides; consequently malnutrition, increasing poverty, costs for reconstruction, etc. ■ Destruction of harvest or reduced agricultural production due to droughts; consequently malnutrition, diseases and increasing poverty ■ Health threats caused by heatwaves (heat, air pollution) ■ Health threats caused by floods (for instance cholera, dengue fever and malaria) In evaluating hazards caused by extreme events their intensity and frequency must be taken into consideration
Lower and less reliable precipitation ■ Water shortages (drinking water, agriculture, etc.) with consequences for productivity and health; can increase poverty and food insecurity and lead to conflicts ■ Productivity losses due to water shortages increase pressure on the use of natural resources (pasture, deforestation, etc.), and hence increase degradation of soils and natural resources and contribute to additional CO_2 emissions ■ Reduced drinking water quality jeopardises health as well as natural resources
Rise in sea levels ■ Increased flood and storm tide hazard on the coast ■ Salinisation of groundwater and wetlands in coastal regions with consequences for drinking water supply, soil quality and flora and fauna ■ Loss of agricultural areas, ecosystems and built-up land on the coast (erosion)
Higher temperatures (air and water) ■ Increased danger of diseases transmitted by mosquitoes, such as dengue fever and malaria ■ Increased health risk due to intensified UV radiation, skin infections, respiratory diseases as well as food infections (for instance salmonellae) ■ Increased vegetation and forest fire hazard ■ Loss of corals and fish beds due to higher water temperatures
Higher temperatures in cold regions ■ Better climatic conditions for agriculture ■ Fewer losses through frost (for instance llamas/vicuñas in the Andes)
Greater precipitation in semi-arid and arid regions ■ Better climatic conditions for agriculture

Module

B

Not all regions where Welthungerhilfe operates are equally affected by climate change. According to the Intergovernmental Panel on Climate Change (IPCC), Africa and the small island states are particularly at risk, as well as the megadeltas in Asia and Africa. The following climate risks are above all envisaged for the programme regions of Welthungerhilfe:[9]

Central America and the Caribbean:
Increasing intensity of hurricanes and changing rainfall patterns (torrential rainfall, droughts).

South American Andes Countries:
Melting glaciers (degradation of fresh water resources) and change in El-Niño/La-Niña phenomena with negative impacts on drinking water supply, agriculture and hydroelectric power plants.

African Countries:
Droughts lead to water shortages, loss of land suitable for farming and consequently a reduction in food production.

Central Asia:
Water shortages due to melting glaciers, with negative impacts for agriculture and the operation of hydroelectric power plants.

South/Southeast Asia:
Risk to population in coastal regions through rising sea levels; changes in monsoon patterns and retreating glaciers in the Himalayas.

With regard to this rough overview it must be taken into consideration that the effects can vary considerably from region to region, from country to country and to some extent even within a country. Therefore specific research on the already tangible changes and the forecasts for the specific region, the specific country or even the specific project area is necessary.

In the foreseeable future project planning will not be able to be based on extensive analyses of the impacts of climate change on the respective project region. Despite good progress in recent years, forecasts remain vague and uncertain (particularly in Africa). This applies to global and regional development, but even more so with regard to assessment of the effects of climate change on the microclimate in a specific project region. Uncertainty may vary considerably from region to region, and the information base in a first project area may be considerably better than in a second. But even when the data situation may be uncertain at first glance this is no reason for doing without adaptation, because there are enough opportunities for approximating climate hazards and risks. The following approaches complement each other and are presented below:

[9] The following list is from Welthungerhilfe's policy paper „The Challenge of Climate Change" from 2009 (p. 5-6). Compare the list with the regional effects in the 4th Result Report of the IPCC from 2007 (p. 11-12), Red Cross/ Red Crescent (2007) Climate Guide, p. 134-137, and OECD (2009) p. 42-45.

- Analysing climate risks that are known from the past and present,
- evaluating scientific information and forecasts on the effects of climate change, and comparing them with the empirical values of the target group,
- regularly updating and using short-range information on weather.

Analysis of the climate risks known from history and the present

Information about the past, for instance on climate-related natural disasters, agricultural tendencies in semi-arid and arid regions or on degradation processes reveal a lot about risks which may increase in the future. They are also helpful for identifying vulnerability factors of the affected population, natural resources and infrastructure as well as self-help and adaptation potentials.

In drawing up and analysing the data the following aspects should be taken into consideration: frequency and intensity of hazards, the direct and indirect impacts, the affected parties and their vulnerability factors, recognisable trends with regard to hazards and vulnerabilities. The past and present situations can be used for drawing important conclusions for future development.

The following are important sources of information for an overview of the disasters and weather-related risks in the past and present:[10]

- The United Nation‘s secretariat for disaster reduction (UN-ISDR) with global information on disasters and disaster risk reduction as well as numerous links: www.unisdr.org
- CRED/OFDA International Disaster Database EMDAT with statistical data on all disasters worldwide:[11] www.emdat.be
- The databases of the reinsurance companies Münchner Rück and Swiss Re: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx and http://www.swissre.com/rethinking/natcat/
- The website for disaster relief of the United Nations Office for the Coordination of Humanitarian Affairs (UN-OCHA): www.reliefweb.int
- The website of the Center for Hazards & Risk Research at the University of Columbia contains, amongst other things, disaster profiles for 13 countries around the region bordering onto the Indian Ocean: http://www.ldeo.columbia.edu/chrr/research/hotspots/
- Regional disaster reduction and disaster management organisations, such as
  - The UNISDR regional offices in Panama (Latin America), Bangkok (Asia and Pacific), Nairobi (Africa) and Cairo (Arab States)
  - The Central American Coordination Center for Disaster reduction CEPREDENAC with headquarters in Guatemala: http://www.sica.int/cepredenac/

[10] Most of the above-mentioned organisations not only deal with weather-related disasters, but also with the consequences and mitigation possibilities in the event of geological extreme events, such as earthquakes, tsunamis and volcanic eruptions, for which, for instance, other vulnerability factors are partly relevant. If necessary, this must also be taken into consideration in the research.

[11] See Cutter (2009) regarding the strengths and limits of these and other databases on natural disasters.

- The Caribbean Disaster Emergency Management Agency CDEMA: http://www.cdema.org/
- The Asian Disaster Preparedness Center ADPC in Bangkok: http://www.adpc.net/v2007/

- The national disaster management or disaster risk reduction institutions, ministries of agriculture and meteorological institutes
- Local offices of UNDP, EC/ECHO and other donors

Evaluating scientific information and forecasts on the effects of climate change and comparing them with empirical values of the target group

Global and regional data on climate change can be used for recognising trends in the project region, even if the regional and temporal precision of the assertions can vary greatly according to the different regions. At the same time, however, the same high requirement is not demanded for each project region, particularly with regard to the spatial precision of the assertions: while climate changes in some regions can be presented over large areas, in mountainous regions in particular, for instance, the development of precipitation patterns in individual valleys (microclimate) may differ considerably from the overlying tendencies. However, as a matter of principle – besides observing developments in the project region – it is important to also keep an eye on the effects on neighbouring regions, since changes there can also have an impact on the project region, for instance in mutual water catchment areas.

In most countries there are already studies or at least contact persons who can provide information on available knowledge. Where appropriate it may be worthwhile commissioning a local analysis or a special study (for instance the melting of a glacier on a specific mountain). The population is also often capable of recognising trends. The following table lists sources of information which are recommended for providing insight into scientific analysis.

Table B2-2: Sources of information providing insight into scientific analysis

Source	Aggregation level	Additional characteristics
IPCC (2007), 4th Assessment Report: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1	Global: data partly analysed for continents and regions	Official scientific basis: contains regional presentation of impacts and vulnerability analysis for each continent.
Climate Change Data Portal of the World Bank: http://sdwebx.worldbank.org/climateportal/	Global: data can be called up according to country	Compiles data of special countries, sectors and projects; country profiles for climate change and agriculture for 19 countries of Latin America and the Caribbean.
National UNFCCC: http://unfccc.int/national_reports/items/1408.php	Global: country reports of the governments	40 country reports from all over the world, 45 national adaptation programmes of action (NAPAs) from the least developed countries (LDC).
International Research Institute for Climate and Society (IRI): http://portal.iri.columbia.edu/portal/server.pt	Global, with regional focuses on Africa, Asia/Pacific, Latin America/Caribbean	Data and references to climate information, arranged according to regions or sectors.

The World Bank Climate Portal has references with links to other websites. Other highly aggregated sources of information are presented at GTZ (2009) Climate Change Information for Effective Adaptation.
Specific climate analyses have already been drawn up for several regions. A particularly interesting one is the regional climate model PRECIS, which was developed by the Hadley Centre, Great Britain, specially for developing countries (http://precis.metoffice.com/). Other models are listed at the GTZ (2009).
The initiative CORDEX of the World Climate Research Programme (WMO et al.) is interesting: within the framework of this programme regional climate forecasts are made and methods compared and evaluated, in order to be able to provide more detailed information on climate change to the IPCC and other interested parties in the future: http://wcrp.ipsl.jussieu.fr/SF_RCD_CORDEX.html

In some countries informative national studies[12] and strategy papers[13] are already available. Official contact organisations are generally the environment ministries, weather services, agricultural ministries, disaster reduction institutions and the UNFCCC Focal Points. In addition it is possible that more precise information is available for specific sectors (for instance agriculture) or regions, drawn up by universities, specialist institutes, ministries, donor organisations or NGOs.

[12] Examples are INGC (2009) for Mozambique and IDS (2007) for India.
[13] In 45 countries now within the framework of the UN Framework Convention, National Action Plans for Adaptation (NAPA) have been drawn up with the support of the UNFCCC, and these can be used as the basis for applying for financing for specific projects for adaptation to climate change. You will find information on NAPA and access to existing documents at http://unfccc.int/national_reports/napa/items/2719.php.

This information definitely has to be compared with the experiences of the target group, because how the observed or forecast changes specifically have an impact or are expected to have an impact (microclimate, local framework conditions) can only be verified at a local level. This particularly applies to developments which have been evident for a while or if problems which were already known become even worse (for instance water shortages).

Climate Service Center (CSC), Germany

The Climate Service Center was founded in 2009 by the German Federal Government as a facility of the Helmholtz-Gesellschaften, headquartered in Hamburg, in order to act as a bridge between science and practice to provide information on climate and climate change according to respective requirements. As supplementary services the center can carry out climate simulation and practice-oriented research projects upon request.

The Center can provide the following support for Welthungerhilfe:

- Support for the compiling and interpretation of data on climate change in specific regions or project areas,
- information on possible contacts in the region or country,
- specific climate simulation or research projects for specific regions/areas.

Similar national coordination points are planned throughout the world within the framework of the World Meteorological Organisation (WMO).

You can find further information on the CSC on the Internet: http://www.climate-service-center.de/

In the event of any queries contact can be established via the Knowledge Innovation Consultancy Unit at Welthungerhilfe headquarter in Bonn.

Regular updating of information base and use of short-term weather information

In project planning and implementation uncertainty can be taken into account in the following way: on the one hand information on the effects and impacts of climate change has to be updated on a situation-related basis (for instance on the basis of a new study or an experienced weather-related disaster) or regularly (for instance annual research). In addition shorter-term weather information can be used to detect possible patterns. For instance forecasts over several months for longer-term phenomena such as El Niño /La Niña or early warning systems for droughts can be useful. In addition, in many places there are early warning systems for short-term hazards such as storms, floods, landslides, etc.[14] Within the framework of the project, improved linking to regional or national weather forecasts, for instance for agriculture or the setting up of national or local early warning systems can considerably increase people‘s adaptability. Furthermore, the introduction of early warning systems improves the data basis and analytic capacities for improving local and national climate forecasts.

[14] IFRC (2008) examined the issue of using early warning systems for different periods of time (years, months, weeks, days and hours) with regard to climate forecasts and presented examples. http://www.climatecentre.org/downloads/File/reports/Early%20Warning%20Early%20Action%202008.pdf

Table B2-3: Selection of regional weather forecasts and early warning systems

Instrument	Geographical focus	Comment
World Weather: Information Service of the World Meteorological Organisation (WMO): http://worldweather.wmo.int/	Worldwide: can be called up on a country-specific basis	Official weather forecasts worldwide for individual countries
Humanitarian Early Warning Service (HEWS) of the World Food Programme (WFP): http://www.hewsweb.org/hp/	Worldwide	Monitoring the latest events and forecasts, amongst other things for the next 24 hours or five days. Includes link to WFP Seasonal and Hazards Calendar
SERVIR – Regional Visualization and Monitoring System: http://www.servir.net/	Mesoamerica and Africa	Links satellite data and other data to provide a basis for decision-making in the sectors water, climate, agriculture, disasters and health, etc.
FEWS-Net – Famine Early Warning System: www.fews.net	Worldwide	Amongst other things, provides short and medium-term information on food security and weather forecasts. Contains specific analyses and information on several countries
SATCA – Sistema de Alerta Temprana para Centroamérica: http://www.satcaweb.org/alertatemprana/inicio/alertatempranа.aspx	Central America	Compiles early warning systems for climatic (droughts, hurricanes, floods, including El Niño/La Niña) and geological phenomena (volcanic eruptions, earthquakes, tsunamis)
African Centre of Meteorological Application for Development: http://www.acmad.ne/index.htm	Africa	Amongst other things, publishes monthly weather forecasts and a bulletin on climate and health
Tropical Cyclone Programme of the WMO: http://www.wmo.int/pages/prog/www/tcp/index_en.html	North Atlantic, South Pacific, Indian Ocean	Provides information and forecasts about everything related to typhoons, hurricanes and tropical cyclones
Mekong River Commission: http://www.mrcmekong.org/index.htm	Mekong riparian countries	Water level monitoring and flood warning

For further information on the issue of early warning, see the early warning platform of the United Nations PPEW: http://www.unisdr.org/ppew/ppew-index.htm. You will find many links there – even though they are no longer very up-to-date – to weather services and early warning systems, arranged according to types of hazards. On the website of the World Meteorological Organisation (WMO) you can find the respective national weather services of all countries www.wmo.int.

B.3 Vulnerability analysis and adaptation options, focussing on the sectors agriculture, resource management and basic infrastructure

The vulnerability analysis covers all population groups, infrastructures and natural resources which are important for a planned project and at the same time are presumably affected by the impacts of climate change. Here the prime focus is on the respective target group of the project **(→ Modul A).**

There can be a wide range of factors which lead to vulnerability. The following table lists the population groups most frequently and severely affected by the effects of climate change, with typical vulnerability factors. Particularly affected are the population groups who live in poverty and consequently have neither the necessary financial nor codetermination opportunities for protecting their livelihoods against extreme natural events or being able to replace their losses.

Table B3-1: Affected population groups and their vulnerabilities

Population groups	Important vulnerability factors	
Small-scale farmers living from subsidence farming	Poverty as basic reason for vulnerability: lack of resources for food, precautionary measures and rebuilding, lack of access to knowledge, health, codetermination, insurances, etc.	■ Dependence on agriculture, no alternative sources of income ■ Lack of knowledge on resilient cultivation methods, for instance methods which conserve water or protect against erosion ■ Lack of access to drought-resistant seed ■ Insufficient or inadequate storage opportunities
Poor households run by women		■ Scarcely any access to weather-independent income ■ Generally dependent on one adult worker ■ Scarcely any access to information
Children as well as elderly, ill and disabled people		■ Bodily vulnerability to diseases and extreme natural events ■ Dependence on other peoples' help
Impoverished population in coastal regions and flood-prone regions, mountains, and other regions affected by extreme natural events		■ Lack of disaster risk reduction (knowledge, preventative measures, appropriate construction) and disaster protection (early warning, organisation, equipment) ■ Hazards frequently aggravated through degrading of resources, inappropriate settlement
Fishermen and small fishing enterprises		■ Dependent on fishing, but stocks depleted and no alternative/supplementary sources of income ■ Lack of information on rise in sea levels, no early warning for storms and storm tides

The table is not necessarily complete. Furthermore, not only the vulnerability factors should be investigated, but the strengths and resources of the population which can be used for adaptation and risk reduction should also be taken into consideration.

The interrelationships must be specifically compiled for the respective project region. Here, in addition to specific investigations on vulnerability to current and future climate risks, for instance poverty reduction analyses and strategies or information on the respective sectors such as agriculture, health, education, etc. can be helpful. An initial overview of various relevant aspects of the development of a country is, for instance, provided by the annually published UNDP Human Development Index.[15] Here historic data and the latest information on vulnerability enable a better understanding of the actual influence of climate change: frequently it is just one factor amongst many, such as deforestation which together contributes to compounding existing problems. See tables B3-2 to B3-4 below for typical vulnerability factors in the sectors agriculture, resource management and basic infrastructure.

In identifying and prioritising adaptation options the following should be taken into consideration **(→ Module A):**

- As far as possible not only the future risks but also existing ones should be taken into consideration. This enables the effect (for instance of improved climate information, drought-resistant means of production or slope stabilisation) to be immediately experienced and makes it easier for the measure to be accepted.
- Combine long-term measures with specific activities. This enables support, for instance for spatial planning which takes into account natural environmental conditions, to be increased through the parallel introduction of early warning mechanisms and emergency plans.
- In situations where climate change aggravates problems which are already known (for instance danger of flooding on rivers) there is frequently already local awareness and solution approaches which can be used for adaptation. It is more difficult where climate change causes new hazards, such as drought in the Amazon basin. Here more efforts will probably have to be factored in for raising awareness, carrying out analyses and developing strategies.
- Involve local government and administration in the planning process right from the outset. For many adaptation measures support from the decision makers is necessary. Furthermore, in many places – in addition to specific measures – the integration of adaptation to climate change as an inter-disciplinary issue into local development processes is important.[16] This can only be achieved if the personnel‘s awareness is appropriately raised and if they receive adequate training.
- In addition to this it may be necessary or worthwhile to promote cooperation with or raising the awareness of superordinated levels (ministries at provincial or national level).

[15] The index is in each case contained in the latest UNDP Human Development Report: http://hdr.undp.org/en/
[16] On page 169 (Table 12.2) the Policy Guidance of the OECD contains an overview of the role of local administrations and governments in adaptation measures.

Module

B

The following tables provide an overview of typical climate risks and adaptation options in the sectors agriculture, natural resource management and basic infrastructure.[17] These are envisaged as an orientation help for the specific compilation.

The tables are not intended to be complete. Also at this juncture no assessment of risks or prioritisation of options for action can be made. In addition to risks potentials for benefiting from positive effects of climate change are also listed. The affected population groups named are restricted to the target groups of Welthungerhilfe. Generally valid vulnerability factors, such as poverty, households run by women, children and ill people and elderly persons are not separately listed (see above Table B3-1).

The options for action in the table refer to the respective specifically mentioned risks. In addition the following applies to all risks in all sectors:

- The population and decision makers‘ knowledge of climate change and its effects and the options for action must be established, respectively improved,
- the respective village community or commune must be supported in efforts to take into consideration climate change in drawing up management or development plans,
- also many measures for combating poverty provide an important contribution towards adaptation – for instance improved self-organisation, access to microcredits and social security systems, improved basic training, established land rights, etc.

[17] The table was compiled on the basis of documents (IPCC (2007), USAID (2007), Tearfund (2009) etc.) and various practical examples.

Table B3-2: Climate risks and options for action in the sector "Agriculture"

Impact of climate change	Affected population or assets	Sensitivity factors	Risk	Options for action
Negative impacts				
Temperature increase with more hot days and nights, including increase in plagues and heatwaves	Traditional agricultural products	Not heat-resistant, vulnerable to plagues	Destruction through plagues and heat	Access to climate and weather forecasts, introduction of heat-resistant products and measures for protecting against plagues, creation of alternative sources of income
	Consequently small-scale farmers	Lack of know-how for climate development, combating plague, amongst other things adaptation options, no alternative income	Danger to life during heatwaves, harvest and income losses, food insecurity	
Irregular precipitation	Agricultural production	Dependency on certain precipitation cycles	Destruction in the event of different precipitation patterns	Adaptation of cultivation cycle, diversification and introduction of more resistant products and supplementary irrigation systems, access to weather forecast, creation of alternative sources of income
	Small-scale farmers	No access to precise weather forecast, lack of know-how regarding adaptation opportunities in choosing product, cultivation and irrigation methods, no alternative sources of income and reserves	Harvest and income losses, and consequently food insecurity	
Increase in extreme precipitation, resulting in flooding and landslides	Agricultural production on slopes and in flood regions	Lack of protection against landslides and floods; inadequate storage of harvests, interrupted trading/ transport routes and contamination of agricultural land through (industry) poisons caused by flooding	More frequent destruction through landslides or floods	Disaster risk reduction (for instance securing slopes, safe construction of buildings, disaster protection), early warning systems, relocating, respectively moving fields, seed reserves, creation of alternative sources of income
	Small-scale farmers with fields and/or houses on slopes and in flood regions	Lack of early warning and disaster risk reduction, no alternative sources of income and reserves	Danger to life, losses of harvest and income as well as belongings, and consequently food insecurity	
Increase in storms, hurricanes, cyclones, typhoons (above all intensity), also resulting in flooding (see above)	Agricultural production in regions endangered by storms (above all coastal areas)	Not storm-resistant	Frequent destruction of harvest through storms. etc.	Introduction of more stable products and seed reserves, introduction of simple methods for stabilising buildings, amongst other things infrastructure, early warning and disaster protection, creation of alternative sources of income
	Small-scale farmers in regions endangered by storms	No storm-resistant construction of buildings, amongst other things infrastructure, lack of early warning and disaster reduction, no alternative sources of income and reserves	Danger to life, destruction of harvest and income as well as worldly goods, and consequently food insecurity	

Impact of climate change	Affected population or assets	Sensitivity factors	Risk	Options for action
Increase in dry periods and droughts, including increase in forest/bush fires	Agricultural production	High water requirements	Smaller harvest or even crop failure through lack of water or fires	Introduction of heat and drought resistant products, introduction of water-saving cultivation methods, erosion control, soil protection, irrigation systems and stockpiling, early warning systems and emergency measures, preventing and fighting forest fires, creation of alternative sources of income
	Small-scale farmers in semi-arid and arid regions as well as in high mountain regions	Lack of access to drinking and commercial water, lack of early warning, lack of prevention and fighting of forest/bush fires, no alternative sources of income and reserves	Danger to life through lack of water, fire, crop failure and loss of income, and consequently food insecurity	
Rise in sea levels and consequently floods and salinisation of ground water	Agricultural production in coastal regions	Lack of protection against floods and penetration of salt water	Devastation through floods and losses through salinated water	Disaster risk reduction (above all safe construction of buildings, disaster protection and early warning systems), relocating, respectively moving houses and fields, coastal zone management (mangroves, etc.) creation of alternative sources of income, use of salt-resistant products, for instance rice
	Small-scale farmers with fields and/or houses in coastal regions	Lack of early warning and civil protection, no alternative sources of income and reserves	Danger to life, losses of harvest and income as well as belongings, and consequently food insecurity	
Positive impacts				
Impacts	**Favoured assets and population groups**	**Potential**	**Obstacles**	**Options for action**
Temperature increase with fewer cold days and nights Consequently adaptation of vegetation	Agriculture in cold regions, and consequently also farmers, including subsistence farmers	Cultivation of new products Higher productivity and harvest	Lack of know-how on climate development and appropriate products	Monitoring the microclimate, access to information on climate change, training in use of new products
	Animal husbandry in the mountains (e.g. llamas and vicuñas), and consequently also (small-scale) animal farmers	Lower death rates of livestock, higher stability of earnings	None	If necessary, promoting of animal husbandry in the mountains (e.g. Andes)

Supplementation to the central issues for the sector "Agriculture" as the basis for analysing the situation and monitoring, in: Welthungerhilfe (2008), Part III, page 104-105 (in accordance with central issue 9 on trends of the past ten years):

- Is a change in climatic framework conditions expected for the coming decades, which can have impacts on yields (water availability, danger of flooding, heat and plagues, salinisation through rise in sea levels)?

Table B3-3: Climate risks and options for action in the sector "Natural Resource Management"

Impact of climate change	Affected population or assets	Sensitivity factors	Risk	Options for action
Negative impacts				
Temperature increase with more hot days and nights, including increase in plagues and heatwaves	Groundwater and surface water		Higher evaporation	Water storage
Irregular precipitation	Groundwater and surface water		More frequent water excess or deficiency	Watershed management, incl. water catchment possibilities (polders)
Increase in extreme precipitation, resulting in flooding and landslides	Groundwater and surface water		Water quality can be impaired	Protection measures for water sources, soil conservation, erosion protection, reforestation
	Soil	Instable due to deforestation and degrading of resources, no capacity for water retention	Landslides and erosion of river banks due to heavy precipitation Soil can not be used when there are floods	
	Population	Lack of water purification or alternative drinking water reserves, contribution towards degradation of resources and erosion	Soiling of drinking water and water for domestic use, and consequently diseases, danger to life and loss of belongings and possibly also harvests	
Increase in storms, hurricanes, cyclones, typhoons (above all intensity), also resulting in flooding (see above)	Flora and fauna	Cannot withstand storms	Damage to or destruction of timber stand, etc.	
Increase in dry periods and droughts, including increase in forest fires	Groundwater and surface water		Decrease in water volume	Promotion of storage capacities and improved efficiency of water utilisation, monitoring of water quality, soil conservation, protection of natural resources through sustainable animal husbandry and agriculture, management of water catchment area
	Flora and fauna	Weakened by animal husbandry, deforestation and non-sustainable agriculture	Decrease in plant cover and biodiversity	
	Soil	Quality negatively influenced by over-utilisation (agriculture, animal husbandry, settlement) and deforestation	Soil degradation and even desertification	
	Population above all in semi-arid and arid regions		Lack of drinking water and water for domestic use and water pollution, and consequently illnesses, conflicts, etc.	
Rise in sea levels and consequently floods and salinisation of ground water	Groundwater and surface water in coastal regions		Salinisation	Desalinisation of drinking water, and water for domestic use, relocation of drinking water source, soil conservation, conservation of trees, mangroves, amongst other things planting or reforestation
	Soil		Salinisation, loss through rising sea levels	
	Population in coastal regions		Less availability of drinking water and water for domestic use	

Impact of climate change	Affected population or assets	Sensitivity factors	Risk	Options for action
Positive impacts				
Impacts	**Favoured assets and population groups**	**Potential**	**Obstacles**	**Options for action**
Temperature increase with fewer cold days and nights	Water	Temporarily more water through melting of glaciers		Consulting for utilisation of improved water supply, strategic development for a long-term decrease in water after glaciers melt
	Small-scale farmers in highland regions	Temporarily improved availability of drinking water and water for domestic use, better harvest		
Increase in extreme precipitation	Water	Temporary increase in volume of water	Faster water outflow, quality can be impaired	Improve storage of precipitation
	Population as well as flora and fauna in semi-arid and arid regions	Better water supply Water shortage can be reduced	Lack of water storage facilities, water quality can be impaired	

Supplementation to the central issues for the sector "Resource management" as the basis for analysing the situation and monitoring, in: Welthungerhilfe (2008), Part III, page 108 (supplementation of central issue 3):

- Are the resources used in a sustainable way (i.e. would they be available for an unlimited period of time if they were used with a constant utilisation intensity)? Does this also apply under changed underlying conditions caused by climate change (temperature increase, changed precipitation behaviour, increase in aridity and drought, rise in sea levels)?

Table B3-4: Climate risks and options for action in the sector "Basic infrastructure"

Impact of climate change	Affected population or assets	Sensitivity factors	Risk	Options for action
Negative impacts				
Increase in extreme precipitation, resulting in flooding and landslides	Simple houses, social infrastructure, water supply and waste water disposal, roads and paths	Location in known or new flood or landslide regions, non-resistant construction	Damage or destruction	Disaster risk reduction: risk mapping and land-use planning, physical improvement, introduction of improved construction for new buildings, relocation to higher ground, rain water drainage, resource protection, relocating, etc., early warning, short-term protection measures, evacuations
	Population and communes	Lack of early warning and disaster risk reduction, no appropriate land-use planning, contribution towards degradation of natural resources and erosion. No resources and/or lack of know-how for stable construction, no reserves for reconstruction	Danger to life, damage or destruction of belongings, loss of investments, disruption to water supplies, communication, transport routes, etc.	
Increase in storms, hurricanes, cyclones, typhoons (above all intensity), also resulting in flooding (see above)	Above all simple houses and social infrastructure	Lack of stability for increasing wind speeds	Damage or destruction (above all roofs)	Disaster risk reduction: introduction of simple techniques for stabilising simpler houses and for reinforcing roofs, early warning, short-term stabilisation measures and evacuations
	Population, communes	Lack of construction standards, respectively know-how/ resources for stable construction, no reserves for stable reconstruction	Danger to life, damage to or destruction of worldly goods and social infrastructure (above all schools and health centres)	
Increase in forest fires due to increasing aridity and higher temperatures/heatwaves	Above all simple houses	Highly combustible material	Destruction	Disaster risk reduction: prevention and fighting of forest fires, early warning and evacuations
	Population	Lack of resources for stable houses, lack of prevention and fighting of forest fires, no reserves for reconstruction	Danger to life, destruction of worldly goods	
Rise in sea levels and consequently floods and salinisation of ground water	Simple houses, social infrastructure, water supply and waste water disposal, roads and paths in coastal regions	Location in known or new flood regions, non-resistant construction, inadequate coastal protection	Damage or destruction	Coastal protection (natural or infrastructure), relocating infrastructure to higher ground, introduction or rehabilitation of a rain water drainage system, early warning and alternatively relocating
	Population in coastal regions, communes	No resources for relocating or improving construction, lack of early warning and preventive mechanisms, such as an effective rain water drainage system, destruction of the coastal protection through deforestation, excavation of sand, etc.	Damage and loss of worldly goods, loss of investments, disruption to water supplies, communication, transport routes, etc.	

Supplementation to the central issues for the sector “Basic housing”, “Road construction”, “Water and sanitation” as well as “Social Infrastructure” as the basis for analysing the situation and monitoring, in: Welthungerhilfe (2008), Part III, page 102-103:

- In accordance with central issue 9 on minimum requirements on the part of local authorities: Do special safety precautions (storm-resistant construction, relocation to higher ground with respect to floods, strengthening slopes, better ventilation to cope with temperature increase) have to be implemented when constructing houses because of the known natural hazards or because of the expected impact of climate change?
- Supplementation to central issue 6:
  What terrain will the road run through? Is there a danger of flooding or landslides, respectively can this arise because of the impact of climate change?
- In accordance with central issue 4 regarding failures of the supply system:
  Do the forecast impacts of climate change jeopardise the water supply and waste water disposal (volume and quality of water, jeopardising of supply system through floods or landslides)?
- In accordance with central issue 3 on facilities jointly shaped and used by the community: Are these facilities (above all schools and health centres, community buildings) safe in view of the known natural events or the natural events probable in the wake of climate change (storms, floods, landslides and also earthquakes, etc.)?

B.4 Possible contributions towards mitigation

Since developing countries have up to now only made a limited contribution towards climate change but are particularly suffering from its impact, adaptation to climate change is a priority for Welthungerhilfe for development cooperation in its programme countries. Nevertheless, in some projects there are potentials for contributing to mitigation through reducing emissions. The following checklist helps to identify these possible contributions.

Table B4-1: Check list of contributions to mitigation

Key questions for identifying contributions to mitigation	Ideas for projects
Contributions of project personnel How can energy be saved in the project, for instance in air conditioning systems or heating in vehicles and office, through maintenance or modernisation? Can renewable energies be used, for instance solar or wind energy? Can journeys by vehicle and flights be reduced through using modern communication technologies? Can emissions be reduced by using more efficient vehicles?	
Contributions of partners and the target group Can energy efficiency and the use of renewable energies be promoted at the partners and target group (households, industrialisation of agriculture, processing, transport, etc.)? Can the degrading of natural resources, in particular deforestation, be reduced? Can initiatives be promoted for nature reserve and buffer zone management for the conservation of CO_2 sinks? Can the release of methane through rice cultivation be reduced? Can the release of methane through raising cattle be reduced? Can the keeping of small animals (as an alternative to dairy farming) secure supplies of animal protein? Can materials which cause fewer emissions through production and transport be used in construction measures (schools, community buildings, and residential housing)?	
Special measures Can measures for the sustainable use of forests or afforestation be incorporated in compensation mechanisms, respectively payments for environmental services (for instance REDD+[18])?	

B.5 Criteria for prioritising the options for action

The following presents a series of criteria which should be taken into consideration in checking and prioritising options for action. The first three criteria are mandatory (a), i.e. all measures which are considered should be checked with regard to these criteria. The importance of the other criteria (b) may vary from project to project. These can therefore be used according to requirements for selecting measures for prioritising.

a. Binding criteria:

- The extent of the expected effect (effectiveness) for risk reduction, respectively adaptation to climate change at the target group: because of the requirement for impact orientation in development cooperation, the only measures that are suitable are those that lead to a tangible improvement of the target group's situation. Exceptions can be measures which represent a contribution towards mitigation, but should at least be expected to have a beneficial effect towards reducing greenhouse gases or raising awareness of climate change on the basis of cost-benefit considerations.

[18] Regarding REDD and REDD+ see the United Nation's website on the REDD Programme: http://www.un-redd.org

- Technical feasibility: the measure must be feasible from a purely technical point of view.
- Financial and temporal feasibility: only those measures may be planned which can be implemented with the existing resources and during the planned duration of the project.

b. Further relevant criteria

- Cost-benefit efficiency and financial risk: generally measures are selected which can achieve the greatest possible effect and as far as possible with the least (financial) effort and which have a low risk of losing the investments.
- Socio-cultural feasibility: for many measures it is necessary to clarify whether they can be taken on by society and continued to be actively used.
- Market-economic feasibility: a series of measures can only be successful if there is a societal, respectively an economic demand for them.
- Coherence: it is important for all projects that they complement initiatives of other actors and do not contradict national policies. However, in many projects this may already above all be ensured by the choice of partners and insofar no longer be necessary as a selection criterion.
- Sustainability: Generally measures are only worthwhile if investments and effects continue to exist after the end of the project. However, in the wake of adaptation to climate change a more useful time frame must be defined (see box).

Key questions on the temporal horizon regarding adaptation to climate change

1. Do the forecasts on climate change assume an unambiguous trend which is already tangible today or will soon be felt, and can already be addressed by the project today (for instance disaster reduction in the case of increasing danger of hurricanes and cyclones)?
2. Are there dangers which are only apparent in the distant future but which should nevertheless be taken into consideration in the project design (for instance if a region will become uninhabitable in the long-term because of rising sea levels)?
3. Are there differences between the short and long-term effects of climate change, and what does this mean for the project design (for instance if melting glaciers initially improve water availability but make it worse in the long term)?
4. What operating life do planned infrastructure investments have and what climate forecasts apply for this period of time?