Reducing Vulnerability, Enhancing Resilience:

The Importance of Adaptation Technologies for the post-2012 Climate Agreement

A Report by CIDSE and Caritas Internationalis

May 2009

Caritas Internationalis

CIDSE together for global justice

This report aims to raise awareness about the importance of adaptation technologies for adaptation to climate change and sustainable poverty reduction, and makes recommendations to Parties to the United Nations Framework Convention on Climate Change (UNFCCC) negotiations for effective support to adaptation technologies in the post-2012 climate change agreement.

The report was commissioned and supervised by the CIDSE-Caritas Internationalis Climate Change Policy Group. It is based on initial research carried out by Achala Chandani and Rafael Martins. Special thanks go to Liz Gallagher and Sol Oyuela from CAFOD as main authors of the final text.

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CIDSE – together for global justice

CIDSE is an international alliance of Catholic development agencies. Its members share a common strategy in their efforts to eradicate poverty and establish global justice. CIDSE's advocacy work covers global governance; resources for development; climate change; food, agriculture and sustainable trade; EU development policy and business & human rights.

The work of CIDSE is facilitated by a Secretariat based in Brussels, Belgium.

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Executive Summary

Technology is a crucial element of any strategy to adapt to climate change. In the context of adaptation, technologies are understood to include not only materials, machinery and equipment, but also various forms of knowledge and practice[1]. Adaptation technologies include hard and soft technologies, traditional, modern, high and future technologies. They vary from cheap and often locally available, to expensive and requiring international technology transfer[2]. Given the importance of adaptation for poverty reduction, CIDSE and Caritas Internationalis believe strongly that international cooperation should prioritise adaptation technologies that benefit those living in poverty. They are generally those technologies that are already known, that been developed in developing countries and can be transferred and diffused within and across these countries.

CIDSE-Caritas Internationalis principles for pro-poor adaptation technologies

Based on existing knowledge and practice, the following criteria for adaptation technologies have been identified as specifically benefiting those living in poverty:

- Technologies that are appropriate to the environmental, ethical, cultural, social and economical aspects of communities, and that and as far possible adopt locally available resources that can be readily used by local communities;

- Technologies that are already known, inexpensive and accessible, require few resources, are easy to maintain and have a minimum negative impact on the environment;

- Technologies that allow access to information on the potential impacts of climate change and that reduce vulnerability and strengthen people's resilience to extreme weather events, building on Disaster Risk Reduction (DRR) practices (such as early warning systems, improved shelters and seed banks);

- Technologies that empower the most vulnerable communities, such as traditional technologies based on indigenous cultural identities, knowledge and experience;

- Technologies that can be transferred and diffused within and across developing countries;

- Technologies that will not cause or lead to maladaptation in the long-term;

- Technologies that can provide synergy with mitigation, especially those involving land use practices such as agriculture and forestry, which offer adaptation and mitigation benefits while also contributing to food security and strengthened livelihoods.

1 UNFCCC (2006). *Technologies for Adaptation to climate change, unfccc.int/resource/docs/publications/tech_for_adaptation_06.pdf.* P4.

2 Kee, C. K (2007), EGTT contribution to the discussion on realizing the full potential of technologies, *unfccc.int/files/meetings/dialogue/application/pdf/chow__egtt_chair.pdf.* (powerpoint presentation).

3 CIDSE and Caritas Internationalis prefer the term technology 'sharing' to technology 'transfer'. In recognition of the terminology used within the Convention, however, this report refers to technology 'transfer'. We understand technology transfer in this context to include South-South, North-South and South-North cooperation at various levels.

Despite the importance of technology for the process of adaptation to climate change, negotiations at the United Nations Framework Convention on Climate Change (UNFCCC) have failed to properly address the issue of adaptation technologies. This is due to a number of factors, including fragmentation of discussions on adaptation throughout the UNFCCC and prioritisation of mitigation technologies in technology transfer negotiations[3]. As a result there is a lack of understanding of the range of existing adaptation technologies, as well as the challenges that need to be overcome for the effective implementation of adaptation measures. Given the importance of adaptation for poverty reduction and for protecting the right of people in developing countries to their sustainable development, CIDSE and Caritas Internationalis urge Parties to the negotiations to overcome these challenges, and ensure that the new international agreement on climate change provides adequate and appropriate support for technologies for adaptation.

CIDSE-Caritas Internationalis recommendations for the post-2012 agreement

1. **Parties should ensure the relevant parallel negotiating tracks take a joined up approach to technology and technological development for effective adaptation to climate change.** In the adaptation negotiating track the role of technology should be recognised, and in the technology negotiating track the use of technology for adaptation should be recognised.

2. Parties should recognise that research, development, demonstration, diffusion and transfer of existing adaptation technologies, including knowledge and skills, should be supported by **new funding which is additional to existing ODA (Overseas Development Assistance) targets.**

3. **Parties should work for coordination and policy coherence** for the effective implementation of adaptation technologies policies **across a proposed UNFCCC architecture:**

At an international level:

- Members of the proposed **Adaptation Executive Board** and **Technology Executive Board** (as proposed in the negotiations by the G77 and China) should be represented on each others respective Boards. Both Boards should jointly produce regular reports to the Conference of Parties (based on reports from the Technology Mechanism and information gathered from other adaptation institutions and processes e.g. the Nairobi Work Programme (NWP)) on their adaptation technologies related activities, including the identification of gaps and needs for the most vulnerable developing countries, and the identification of appropriate responses.

- The Adaptation Executive Board should take into account activities undertaken by institutions involved with adaptation i.e. Regional Centres, NWP etc.

At the developing country national level:

- **Synergies between National Adaptation Plans/Strategies, Poverty Reduction Strategies and Low Carbon Development strategies should be ensured,** in particular for the identification of priority actions to support the development and diffusion of adaptation technologies.

3 CIDSE and Caritas Internationalis prefer the term technology 'sharing' to technology 'transfer'. In recognition of the terminology used within the Convention, however, this report refers to technology 'transfer'. We understand technology transfer in this context to include South-South, North-South and South-North cooperation at various levels.

4. **Parties should agree on an international technology mechanism** for the effective implementation of adaptation technologies and which should prioritise the following:

   - **Overcoming barriers which prevent the diffusion of existing and future adaptation technologies,** including in particular Intellectual Property Rights barriers.

   - **Overcoming financial barriers which prevent the diffusion and adoption of high adaptation technologies**, such as sophisticated information and communication technology, early warning systems, geographic information systems and new crop varieties.[4] Adoption of such technologies will require capacity-building, and transfer of know-how on their use and maintenance.

   - **Research, development and demonstration of new adaptation technologies,** based on the identification of needs by national planning processes, such as National Adaptation Plans of Action (NAPAs) and Technology Needs Assessments (TNAs).

   - **Providing technical expertise and assistance to developing countries** to identify needs and develop strategies in the context of their NAPAs and TNAs.

   - **Ensuring progress in the development, diffusion and demonstration of adaptation technologies that require international cooperation** through Adaptation Technology Action Plans (ATAPs) that will identify policies, actions and funding requirements for a specific set of adaptation technologies.

5. **Parties should recognise that regional, national and local cooperation are key for the effective implementation of adaptation technologies, in particular:**

   - The **diffusion and adjustment of proven existing technologies** across and within developing countries, to enable the use of technologies in different contexts in response to local vulnerabilities.

   - The **enhancement of national and local capacities,** including public sector and civil society institutional capacity, knowledge and know-how for sustainable adaptation to climate change.

6. **Regional, national and local cooperation** should draw on the experience of and strengthen the work of **Regional Centres** of Excellence (as proposed by the G77 and China), the **Nairobi Work Programme**, existing **international DRR frameworks** (such as the Hyogo Framework) and other information-knowledge sharing platforms that are linked to civil society experiences. The activities undertaken by these institutions should be taken into account by the Adaptation Executive Board.

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4 It should be avoided that adaptation discussions increase the opportunity for agricultural high technologiesthat may receive attention from the private sector, such as genetically modified organisms (GMOs), but that will not support sustainable small-scale farming activities in developing countries. These approaches to agriculture are generally energy and resource-intensive and based on chemical inputs, which can negatively impact on the environment, and do not consider socio-economic issues, including risks of farmer dependency, or cultural values'.

Adaptation Technologies in the Post-2012 Agreement

Introduction

This report aims to raise awareness among Parties to the UNFCCC negotiations for the post 2012 climate change agreement about the importance of adaptation technologies for adaptation to climate change and sustainable poverty reduction, and the role that international cooperation can play in this process.

The report provides an overview of existing knowledge on adaptation technologies including definitions and types of adaptation technologies by category and vulnerable sectors. It draws on the experience of CIDSE and Caritas Internationalis partners in developing countries to illustrate the different ways in which vulnerable communities are coping with the impacts of climate change by the application of specific technologies. Given the importance of adaptation for poverty reduction, **CIDSE and Caritas Internationalis believe strongly that international cooperation should prioritise adaptation technologies that benefit those living in poverty**. They are generally technologies that are already known, that have been developed in developing countries and can be transferred and diffused within and across these countries.

The second section of this report looks at the status of adaptation technologies in international climate negotiations under the UNFCCC and shows how these are failing to adequately address the issue. It identifies the main challenges that need to be overcome to ensure that the post-2012 agreement effectively supports adaptation technologies, and provides a set of key recommendations to Parties to the Convention.

Section I

Key Concepts and Examples of Adaptation Technologies

1.0 Adapting to Climate Change

Whilst as a political concept, 'adaptation' can be perceived as something new, at a practical level it is not. Throughout history, societies have effectively adapted to climate variability by altering settlements, agriculture, and other aspects of their economies and lifestyle. Adaptation to the impacts of climate change is a critical concern for countries in all regions of the world[5]. The impacts of current climate change, however, are falling and will continue to fall disproportionately on those least responsible and with the least capacity to deal with them[6]. Enhanced international action to support adaptation to climate change in developing countries – alongside ambitious mitigation actions led by developed countries - is therefore a matter of justice and equity.

Whilst climate change is presenting specific additional challenges to development, it cannot be addressed in isolation. Adaptation aims to reduce the vulnerability of individuals and communities by building on and strengthening their existing coping mechanisms with specific measures and by integrating vulnerability reduction into wider policies[7]. Adaptation to climate change should therefore be coherent with broader sustainable development and poverty reduction strategies.

The adaptation process is essentially local, as the direct impacts of climate change are felt locally and responses should be tailored to meet the specific needs of affected communities. The starting point of any process of adaptation should be an analysis of key vulnerabilities of key regions and communities and the consequences of climate change for different social groups within communities. Capacity building of all sectors of society vulnerable to climate change is an essential aspect of any long-term adaptation strategy, focusing on local empowerment and building on local expertise and initiatives[8].

Effective adaptation, however, requires simultaneous actions from all levels - individuals, communities, development agencies, private companies and, importantly, government and public bodies at all levels. Local adaptation efforts should be provided with support and guidance from national policies and programmes, and national efforts should be supported by cooperation at the international level.

International cooperation on adaptation can and should ensure, inter-alia:

- Access to the best available information on the likely impacts of climate change
- Access to financial resources and adequate funding mechanisms for Least Developed Countries (LDCs) and developing countries to scale-up adaptation, and to improve local and national capacities
- Research, development, demonstration, diffusion of and access to technologies for adaptation suited to the specific needs and circumstances of different developing countries

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5 Parry, J, Hammill A and Drexhage J., Institute for Development Studies (2005), *Climate Change and Adaptation, a Summary.* P1.

6 Burton, I; Diringer, E; Smith, J. (2006). A*daptation to Climate Change: International Policy Options*. Pew Center on Global Climate Change. Arlington, USA. P 36.

7 Mitchell, Dr. T and Dr. Tanner T, Institute for Development Studies (2006) *Adapting to Climate Change: Challenges and Opportunities for the Development Community*, Tearfund. P5.

8 World Connectors. (2008). *Statement on Sustainable Development and Climate Change*. The Netherlands, June 2008, P 8.

For vulnerable countries and communities to best adapt to climate change, an important part of the solution will involve the use of technology, and its transfer from place to place.[9] Most adaptation methods involve the use of technology, which include not only materials or equipment, but also knowledge and practices. In the future as in the past, technology will play an important part in reducing society's vulnerability to changes in the climate.

1.1 Defining Adaptation Technologies

In the climate change context, adaptation has been defined as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities."[10] Technology has been defined as "a piece of equipment, technique, practical knowledge or skills for performing a particular activity."[11] Adaptation technologies can thus be defined as "the application of technology in order to reduce the vulnerability, or enhance the resilience, of a natural or human system to the impacts of climate change" (used in UNFCCC seminar on technologies on adaptation in Trinidad and Tobago in 2005).[12]

1.1.1 Different types of adaptation technologies

At the broadest level of classification, adaptation technologies can comprise hard technologies, such as seawalls and irrigation technologies, and soft technologies such as crop rotation patterns, knowledge, know-how and organisational capacity.[13] A successful adaptation strategy will in general utilise both hard and soft technologies, which, rather than applied in a one-off activity, will involve the application of a combination of these technologies in an ongoing interactive process[14]. The case of early warning systems (Boxes 1 and 2) illustrate this dynamic.

1. Combining Hard and Soft Technologies: Early Warning Systems

Over the last decade, disasters have affected about 2.5 billion people and claimed the lives of nearly 900,000 people. The number of disasters is increasing, with growing impacts on poor nations and communities.

It is not possible to prevent the occurrence of natural hazards but much can be done to build understanding and capacities to reduce the vulnerabilities to disasters. **Early warning systems** can be a highly effective tool for saving lives and property in natural hazard events: although the frequency of disasters has increased over the last fifty years, death tolls have declined owing to **early warning systems** and associated preparedness and response systems.

These systems rely on **hard technologies** such as measuring devices and information technology but also on **soft technologies** like knowledge and skills to strengthen awareness and promote evacuation or other related-action when a warning is given.

Despite the fact that considerable progress has been made in developing the knowledge and technical tools required to assess risks, generate and communicate forecasts and warnings, there are significant inadequacies in developing countries' early warning systems (i.e. Ocean tsunami in late 2004, Hurricane Katrina in the Gulf of Mexico in 2005). Such systems lack basic equipment, skills and financial resources required for its effective implementation. A major challenge is to integrate the knowledge and insight of relevant social and economic communities into the predominantly technically based existing systems.

International cooperation could play a key role in ensuring existing expertise and technical capacities in these early warning systems contribute to the creation of an effective global comprehensive early warning system - not as a monolithic centralised system, but as a network of systems. Such efforts should build on and enhance the methods that the Disaster Risk Reduction (DRR) community employs.

Sources: UN/ISDR (2007); UN/ISDR (2006); UNFCCC (2006).

2. Combining high end technology with community experience and knowledge: Community-based Disaster Risk Reduction in Central America

The capacity of communities to understand, analyse and map risk is a crucial first step towards reducing vulnerability and responding effectively to emergency events such as hurricanes, floods, and landslides.

In order to help communities analyse and reduce their own risk levels, Trócaire has developed a flexible and participatory methodology for community risk mapping - that can be applied at low cost. This approach to risk analysis harnesses the experience and perceptions of communities as well as employing GPS technology (Global Positioning System) and GIS software (Geographic Information System - ArcView). The tool creates geo-referenced risk maps to identify the most vulnerable families in a community relative to a particular natural hazard, through four main stages:

1. *Information Collection:* A census database is created and geo-referenced maps are produced identifying residential and agricultural areas and determining hazard levels in the selected community.

2. *Community Workshop:* Through the use of participatory techniques, a series of group activities are undertaken. Amongst other things the workshops define and identify capacity and vulnerabilities, analyse past experiences and future possibilities related to hazard, rank the vulnerability of and map community resources such as organisations and institutions.

3. *Data processing & map design:* Data gathered in the workshop is processed, a report is produced and geo-referenced maps showing hazard, vulnerability and risk are created.

4. *Presentation & Analysis of Results:* Outputs from Stage 3, above, are presented to the community and analysed with the objective of facilitating DRR contingency and development planning.

The methodology resulted in families carrying out risk analysis themselves, based on their own knowledge, experience and perspectives, generating changes in their knowledge, attitudes and practices and at the same time strengthening their risk management capacities.

In addition to their primary value as preparedness tools, feedback indicated that the workshops were also seen as an important platform for networking and discussion. Moreover, by working together, the participatory tools helped build confidence and trust within communities.

Source: Trócaire (2008)

9 UNFCCC (2006). *Application of environmentally sound technologies for adaptation to climate change.* Technical Paper FCCC/TP/2006/2. p.17.

10 IPCC (2007): Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press, Pages 7-22.

11 IPCC. (2000). *Methodological and Technological Issues in Technology Transfer*. Cambridge. UK: Cambridge University Press.

12 Vladu, I. F. (2005). *Technologies for adaptation to climate change under the UNFCCC process* (powerpoint presentation).

13 UNFCCC (2006). *Technologies for Adaptation to climate change*. P 18.

14 Ibid P9.

Within the soft and hard types of technologies, the literature classifies technologies for adaptation to climate change under four main categories: **traditional, modern, high and future technologies.**

- **Traditional** technologies consist of those approaches that have already been developed and applied to adapt to weather variability in traditional societies. These technologies are often related to specific local environmental and socio-economic conditions.
- **Modern** technologies are those that have been created after the industrial revolution in the late eighteenth century, such synthetic materials (plastics and fabrics), chemicals (fertilizer and pesticides) and water use (drip irrigation). These are also existing coping mechanisms, but often require more capital investment.
- **High** technologies are those that have been newly created and derive from scientific advances including sophisticated information and communication technology, earth observation systems and geographic information system (GIS). Such technologies usually demand intensive use of **resources and long-term investments.**
- **Future** technologies are those still to be invented and developed but that could play a role in the process of adaptation, like malaria vaccine.

1.1.2 Synergies between adaptation and mitigation technologies

In order to ensure sustainable development, the synergies between adaptation and mitigation technologies should be strengthened. This is particularly relevant for the agricultural sector, where sustainable agriculture practices can provide a good example of where technologies for adaptation and mitigation are interconnected. Practices of sustainable farming like organic farming and the conservation of agricultural biodiversity not only guarantee food security but also protect the environment and reduce greenhouse gas emissions (GHG) through traditional knowledge and local innovation. Agrobiodiversity is key for adaptation to climate change (see Boxes 3, 4 and 6).

3. Adaptation and Sustainable Development in Honduras

The Trócaire Pilot Project in Pespire, Honduras is working with local communities on the implementation of environmentally sustainable agricultural practices that facilitate adaptation to climate change while helping to improve local livelihoods.

Pespire is a region frequently affected by droughts, which results in significant food insecurity for small-scale producers in mountainous areas. Moreover, during the last 5 years rainfall patterns during the agricultural season (from June to October) have been extremely irregular. The frequency and intensity of rainfalls is expected to reduce even further as a result of climate change. Temperatures are also expected to increase. These changes will increase the vulnerability of livelihoods that are already extremely fragile.

In order to adapt to these changes, communities in Pespire are employing a number of strategies to enhance their resilience. The project encompasses adaptation and mitigation elements, including:

- Promotion of fuel efficient stoves in conjunction with reforestation (expected to promote indigenous species, more efficient fuel wood species and integrating reforestation within agricultural system);
- Promotion of indigenous fruit species that are resistant to drought for income generation during the dry season;
- Promotion of water harvesting and use of waste water;
- Promotion of soil and water conservation.

As a result:

- Livelihoods have become more resistant to drought;
- Agricultural production is higher and diversified;
- The consumption of wood fuel has been reduced;
- Reforestation and recovery of indigenous species.

Source: Trócaire (2008)

4. Sustainable Agriculture in Disaster-prone Areas in the Philippines

The Philippines is one of the most hazard-prone countries in the world and is regularly affected by typhoons, floods, landslides, earthquakes, tsunamis and volcanic eruptions. Due to climate change, people settled in over 7000 islands face sea level rise, salt water intrusion and an increase in the frequency and intensity of extreme weather events and droughts. Building the resilience and adaptive capacity of agricultural systems becomes increasingly important.

MASIPAG, a network of small-scale farmer's organisations, scientists and non-governmental organisations comprising around 35,000 farming families, is promoting farmer-led agricultural innovation.

Farmers are encouraged to limit their reliance on external inputs, such as fertilisers and pesticides, which contributes to family savings. As yields have increased, they have become less vulnerable to crisis, debts and food insecurity.

Farmers have also diversified their farming systems, resulting in increased resilience to irregular weather patterns. As most damage through typhoons and flooding occurs in the period close to rice harvest, farmers reduce this risk by planting a high number of different rice varieties. As each variety has a different harvesting time, the risk of a full crop failure is minimised. In typhoon belts facing strong winds farmers plant shorter rice varieties with bigger stalks and erected leaves. In flooding areas, farmers now plant medium to tall varieties with strong stalks. So far, farmers have collected over 750 traditional rice varieties and supported by scientists, they have developed more than 500 new varieties suited to the local conditions. For example, specially breed varieties tolerant to salt intrusion are now used in costal zones.

In drought-prone regions farmers diversity harvests through organic agroforestry. Trees mobilise water from deeper grounds and create a moister microclimate. Increasing humus content in soil improves the water holding capacity and thus the ability of plants to overcome water stress for a longer period.

Source: MISEREOR, MASIPAG (2009)

1.1.3 Adaptation technologies in vulnerable sectors

Despite the fact that current climate models do not allow for precise forecasting of the distribution of climate impacts at local levels, certain sectors are likely to be more vulnerable to these impacts than others. Key vulnerable sectors include coastal areas, water resources, agriculture, health systems and infrastructure. The effective implementation of adaptation technologies will play a key role in ensuring that resilience of each of these sectors is strengthened.

I) Coastal zones

A large part of the world's population lives in coastal zones and many of these locations are vulnerable to weather-related hazards such as storm surges, cyclones, flooding and coastal erosion. Although it is difficult to predict with precision the occurrence, frequency and intensity of weather events in different regions climate change will render these areas more risky. According to the UNFCCC (2006) communities settled in coastal zones rely on three different adaptation strategies, namely to retreat (planning for relocation and emergency management), to accommodate (improving existing infrastructure) and to protect (planning and regulation to protect vulnerable zones).

The public sector has played a key role in the implementation of adaptation strategies in coastal areas, as the impacts of climate change affects collective goods and systems under the governmental jurisdiction. Such adaptation measures have usually prioritised the use of **hard** structures in large-scale interventions. However, local communities also have a crucial role to play, as the experience of communities in Manikganj in Bangladesh illustrates (see Box 5). Local communities generally rely on the use of available and inexpensive materials to build protective structures.

5. Climate Change Adaptation in Flood and Cyclone Regions in Bangladesh

Rainfalls in Bangladesh are becoming more intense and it takes months for the water to recede. The number of days with heavy rainfall has also increased. Climate change has no positive impact in Bangladesh. Crops are lost due to floods and cyclones resulting in shortage of food. In Manikganj, a district near capital city Dhaka, floods and water-logging have damaged the entire crop of Amon (a rice variety produced during the monsoon) and one of the staples of the Bangladesh diet. It has been estimated that such events have impacted on the lives of 5 to 7 million people living in vulnerable conditions and for national food production. As a result, migration to towns is increasing.

Communities in Manikganj have already implemented the following measures to adapt to the effects of a changing climate:
In coastal areas:
- Mangrove plantation at riverbank/mudflat. Plantation of different fruit and timber trees in the raised bed to avoid saline water;
- Introducing rotational shrimp and paddy cultivation to protect land degradation. Introducing saline tolerance rice variety in the saline area;
- Harvesting rainwater at individual and community level for drinking water purposes;
- Planting local salinity tolerant plant species at roadside/homestead area;
- Homestead based integrated farming in a raised bed;
- Practicing crab fattening, bee keeping, earthworm cultivation, pigeon cultivation, handicrafts as alternative livelihood activities;
- Practicing diversified crop;
- Undertaking income generation activities for costal fishermen

In flood prone areas:
- Baira (floating garden) cultivation in the low lying and water-logging area;
- Introducing vegetable species that grow in the water;
- Cage fish cultivation;
- Undertaking alternative income generation activities;
- Introducing local varieties of rice that grow under the water;
- Building house including public utilities such as tube-wells, schools, community centres etc in the upper level by raised soil.

Source: Caritas Bangladesh (provided in 2009)

Traditional technologies such as afforestation have also been deployed in coastal areas to enhance people's resilience and improve their livelihoods (see Box 6).

6. Coastal Afforestation:
Bridging the Gap between Adaptation and Mitigation Measures

The village Sora located in the Satkhira district in Bangladesh is a remote rural village near the largest mangrove forest called the Sundarban.. This area grows almost exclusively brackish water shrimp, where the salinity of the adjacent rivers is above 15 parts per thousand (ppt) but increases up to 20 ppt during dry season (April and May) season. Increasing demand for biomass fuel, vegetation loss and increased salinity is causing the depletion of the Sundarban forest.

In order to address this deteriorating situation, Caritas Bangladesh has been working since 1999 with the UNDP on a coastal afforestation programme. The programme is helping local communities with embankment plantation activities. Various fast-growing timber species have been planted on both sides of a two kilometre-long embankment to protect the coasts, the village and the community from tidal surge and cyclones. It is to be noted that the coastal embankment was constructed during the Green Revolution era in 1965 with financial aid from the World Bank and technical support from the Dutch government.

The programme involves the participation of a women's group (called the Rupashi Mohila Dal) and a men's group (Ekota Purush Dal). A benefit sharing arrangement has been signed between the group members and three government agencies, the Ministry of Land, the Ministry of Environment and Forest and the Ministry of Water Resources.

While the project has paid for the protecting and guarding of the newly planted trees, currently both groups take care of the plantations themselves. This has helped build the capacity of local communities to protect riverbank erosion while also resulting in livelihood benefits. For example, after three years, the community has been able to harvest substantial quantities of keora fruit, three-fourths of which was distributed among the members, while the rest was sold in the market for around TK. 30,000 average/year. This income has been used to maintain the project (paying for the guards). The by-product of the afforestation such as branches and leafs has contributed to satisfy their energy needs.

Afforestation in embankment areas and riverbanks provides an example of an activity that increases the resilience of local vulnerable communities while contributing to local mitigation actions.

Source: Caritas Bangladesh (provided in 2009)

II) Water resources

More than 40% of the world's population live in water stressed regions and climate change will affect both water supply and water demand. On the supply side, likely changes in precipitation patterns will have major implications for flood protection, food production, water-based transportation and other forms of water-based livelihoods. On the demand side, an increase in average temperatures will increase people's needs for potable water while accelerating surface evaporation from rivers and lakes.

The deployment of technologies for adaptation will play a key role to address this challenge. Adaptation technologies are needed not only to allow access to water for poor communities but also to ensure sustainable and integrated watershed management. Agro-pastoralist communities in Kenya's Samburu region are managing droughts based on small-scale low input technologies (see Box 7).

7. Agro pastoralists in Kenya: managing droughts in the Samburu region

The Samburu region in Northern Kenya is generally arid and inhabited by ethnic groups. The availability of water resources has greatly declined in the last years with natural springs are either drying or water production has been reduced significantly.

Pastoralism is the dominant mode of livestock production in the northern part of Kenya. Over the years, and more so in the present days, pastoralists continue to experience notable climate change related challenges. The system relies on naturally available water, pasture and browse resources to support production of indigenous livestock breeds. Significant reduction in available water resources is now a stack reality owing to low rainfall and general environmental degradation. Pastoralists are depending more on coping mechanism for survival than in the past. Grazing management strategies known to be effective to combat drought are no longer working since previously dependable grazing grounds have been lost to erosion. Incomes and livelihoods are facing a real threat as a result of changing climatic conditions.

Dwindling water availability has now made it necessary for pastoralists to depend on underground rainwater harvesting tanks as groundwater is no longer reachable through the traditional shallow well system. Such technologies have been important to support their livelihoods and provide access to water. This technology among many others can be important to support low production targeting subsistence needs.

Source: Cordaid (2006)

The majority of adaptation technologies for the water sector, both hard and soft, are already in use and diffused across developed and developing countries. **Hard** measures involve building new infrastructure, such as reservoirs or improved piping systems to reduce leakage. **Soft** technologies include for example the provision of incentives for behaviour change, such as the introduction of new pricing forms. The main challenge lies in the successful transfer of such technologies within and across countries that lack the resources and knowledge to adopt them.

III) Agriculture

Climatic changes have major impacts on the agricultural sector, an important and strategic sector worldwide, and on which most developing countries are heavily dependent. Both **hard** and **soft** technologies are being implemented in the agriculture sector to address the adverse effects of climatic events. Examples of **hard** technologies include flood control, drainage and irrigation. **Soft** technologies include capacity building and training in extension services, farmer education on applied scientific research and new agricultural practices. The introduction of new forms of irrigation and diversified crop varieties with greater tolerance to drought or salty conditions over the years has built the resilience of farming communities to cope with climate change.

Traditional knowledge is a crucial soft adaptation technology for the agricultural sector. Farming communities have considerable experience of dealing with droughts, floods, and salinity. One example of successful traditional technologies is provided by methods such as floating agriculture (hydroponics) and diversification of cropping patterns to cope with long flood duration, which are common in many regions in South Asia.

Traditional technologies are also an important part of indigenous communities' cultural identity. Supporting such technologies contribute to the empowerment of rural communities by respecting traditional knowledge and local innovation, as the example of Andean indigenous strategies shows (see Box 9).

8. Andean Indigenous Small Farmer Strategies for Climate Risk Reduction: the use of bioindicators

Andean indigenous farmers have historically confronted climate hazards peculiar to high-mountain agro-ecologies through the observation of the natural environment and the interpretation of specific signs. Such observation has helped them to implement specific methods at particular moments of the agricultural cycle.

Signs observed by native Andean farmers can be divided in three groups. The first regards climactic indicators such as winds, the form and occurrence of the clouds and particular animal behaviour. A second group of signs relates to the behaviour of the trees that can only be verified by long-term study. These include the withering of the t'ankar tree, the form of growth of the leaves of the chillikchi or the form of flowering of the peach tree. A third group of signs are of exclusive social origin and arise when the communities interpret which particular individual - or group – behaviour on the margin of the norm will have negative repercussions on climate. These signs become metaphors for the relationship between society and nature, which our forms of academic knowledge are not able to comprehend.

By reading the signs and in accordance with a certain consensus fashioned first within the family and later in the entire community, actions are programmed both for the entire agricultural cycle and for its specific tasks.

The art of the peasant farmer lies in getting the forecast of the frequency, distribution and quantity of rainfall and a corresponding workplan. Although in general there is consensus within the community (for example, bringing forward the initiation date for planting potatoes) each family has the freedom to make decisions on the schedule of the tasks that will be carried out and the crops to prioritise. Also according to the forecast they will define the quantity of seed they will use, in order to manage the risk of a crop failure.

As rainfall is the most variable climactic factor on which production depends, peasant farmers constantly await a series of indicators during the same agricultural cycle. For example, *Jampiris farmers* (native healers) can forecast rain by observing the mists (*q'usqi*) in the first days of August. For example, in October, during the potato planting season, the presence of frogs during the opening of furrows and seed scattering indicates that there will be good rainfall and high yields. If, on the contrary, only spiders and crickets appear, it is said that production will be bad: "*Jamp'atu papa puqunanmanta yachan*" (the frog understands potato production). In contrast, during the wheat-planting season, at the end of November and beginning of December, it is the presence of spiders, and not frogs, that indicate a good crop.

The meteorological forecast also influences the selection of type of land, quantity and type of soil assigned to each crop variety. Andean agricultural systems prioritise soil management through a combination of traditional and hard technologies in large projects. Waterway management can be accompanied with the construction of terraces, reservoirs for rainwater in the highlands, large-scale forestation of native forage species and methods to slowdown hillside erosion in the high zones, which seek to control flooding and the sweeping away of fertile material towards the low plains.

Source: CAFOD, CENDA (2008)

IV) Public health

The effects of climatic variation on public health are extremely complex and depend upon many socio-economical, cultural and environmental factors. Effective responses need to take place across various levels, from individual and community level to national level. The implementation of adaptation technologies that reduce the overall level of population vulnerability to such effects will play a key role (see box 10).

The increased health risks are likely to be most acute in developing countries as climate-related infectious and vector-borne diseases are associated with hot weather conditions and given that public health systems are relatively weak in such contexts. A key factor in reducing future risks in developing countries is the strengthening of public health systems, including monitoring and surveillance.

Adaptation options for public health may include **hard** technologies like improving water treatment and sanitation systems, building storm shelters, urban planning to reduce heat islands. **Soft** technologies include the use of appropriate clothing and diverse hygiene measures. There is also a variety of successful experiences in climate-based early warning systems created to tackle the prevention of diseases including malaria, dengue, cholera, *meningococcal meningitis*, yellow fever, leishmaniasis and African trypanosomiasis among others. However, the effectiveness of these early warning systems depends on the effectiveness of disease surveillance and disease control programmes[15].

9. Introduction of Earthen stoves in Kalinchi: Improving Health and Reducing GHG Emissions

Kalinchi is a village in the Satkhira district and lies in close proximity of the Sundarban Forest – the largest mangrove forest in the world.
Communities in Kalinchi are dependent on the Sundarban for extraction of firewood. However, they are also relying on the mangrove for year round cultivation of shrimp, which has resulted in increased salinity in the crop fields. Salinity has caused the mangroves' plants and vegetation to die, resulting in a shortage of firewood along with other environmental problems.
To address this problem, improved earthen stoves were introduced in the area. Caritas organised training for 30 community members on the techniques of preparation and usage of earthen stoves to disseminate the benefits of such methods. As a consequence, around ten families have introduced the stove on their own initiative and found beneficial results.
The introduction of the earthen stove has impacted community members in several ways. With relatively less effort and consuming less firewood, people can now cook in a more comfortable environment. Since the smoke of the stove does not spread around the kitchen the cook has almost no chance to inhale harmful smoke resulting in positive impacts on health. Moreover, decreased demand for firewood is expected to have longer term environmental benefits, lessening the pressure on the nearby forest.
The demand for the stove is increasing in the region and community members have been making the improved earthen stove and selling it to villagers. There are also providing technical support which allows them to earn some extra income.

Source: Caritas Bangladesh (provided in 2009)

15 Ibid P30.

V) Infrastructure

Climate change threatens human settlements throughout the world. These settlements vary in size and structure, ranging from small villages in rural areas to mega-cities, and depend on different types of infrastructures like power and water supply, drainage, transportation systems, waste disposal, financial services, construction and manufacturing. These infrastructures are already under stress due to urbanization, extensive agriculture practices, social exclusion, poverty and other development drivers. The degree of vulnerability relies on complex-dynamic interactions between the built and natural environments and also influenced by socio-economic conditions.

Both hard and soft technologies will be necessary to improve the resistance and ability of different types of infrastructure to respond to climate change. Hard technologies will include improving energy efficiency and public transport systems. Soft technologies include land-use planning, environmental assessment, education, awareness raising, poverty alleviation and administrative reforms. Given the key role that governments play in the planning and development of infrastructure projects, capacity building activities will be required.

1.2 Principles for pro-poor adaptation technologies

Given the importance of adaptation for poverty reduction and for protecting the right of people in developing countries' to their sustainable development, CIDSE and Caritas Internationalis strongly believe that international cooperation should prioritise adaptation technologies that benefit those living in poverty. They are generally those technologies that are already known, that been developed in developing countries and can be transferred and diffused within and across these countries.

Based on the recollection of existing data on adaptation technologies done in section II, and on existing knowledge and practice, the following principles have been identified for identifying adaptation technologies that specifically benefit those living in poverty:

- Technologies that are appropriate to the environmental, ethical, cultural, social and economical aspects of communities, and that and as far possible adopt locally available resources that can be readily used by local communities;

- Technologies that are already known, inexpensive and accessible, require few resources, are easy to maintain and have a minimum negative impact on the environment;

- Technologies that allow access to information on the potential impacts of climate change and that reduce vulnerability and strengthen people's resilience to extreme weather events, building on Disaster Risk Reduction (DRR) practices (such as early warning systems, improved shelters and seed banks);

- Technologies that empower the most vulnerable communities, such as traditional technologies based on indigenous cultural identities, knowledge and experience;

- Technologies that can be transferred and diffused within and across developing countries;

- Technologies that will not cause or lead to maladaptation in the long-term;

- Technologies that can provide synergy with mitigation, especially those involving land use practices such as agriculture and forestry, which offer adaptation and mitigation benefits while also contributing to food security and strengthened livelihoods.

Section II

Adaptation Technologies in the post-2012 Agreement: Challenges and Recommendations

2.0 Introduction

The previous section outlined the key role that technology plays in most methods of adaptation to climate change. From a development perspective, the main challenge is to ensure that these technologies serve those in greatest need, the developing countries and most vulnerable communities, who are least responsible but most threatened by the problem. It is therefore vital that Parties to the UNFCCC acknowledge the importance of adaptation technologies for supporting developing countries to adapt to the impacts of a changing climate, and ensure that they are adequately and appropriately supported under the post-2012 agreement.

To date, discussions under the UNFCCC on adaptation have been very fragmented and subsequently negotiations on adaptation technologies have been patchy, lacking coherence between technology and adaptation negotiating tracks. Discussions under adaptation negotiating tracks have focused on frameworks and funding, whilst negotiations on technology have focused mainly on Research and Development (R&D) of technologies for low carbon development. There is currently a lack of awareness within the negotiations for the post-2012 agreement of the range of adaptation technologies that exist and that are crucial to developing countries adapting to a changing climate.

This section will provide an overview of the main settings where adaptation technologies are being addressed by the Convention. Against this background, the paper identifies the key challenges that should be overcome in current negotiations if adaptation technologies are to be effectively supported by the post-2012 agreement. Based on these challenges, we put forward a set of key recommendations for the Parties to the negotiations.

2.1 Adaptation technologies under the convention

Discussions on adaptation technologies under the UNFCCC currently take place within four different settings:

1) The Framework to enhance the implementation of Article 4.5[16] under the Convention

The framework was established in 2001 and provides a list of actions to serve as guidelines for governments and other actors engaged in technology transfer. The framework identifies five key areas of work for progressing technology transfer: technology needs and needs assessments; technology information; enabling environments; capacity-building; and mechanisms for technology transfer. Structures established under the framework include:

- **Technology Information:** A web-based technology transfer clearing house (TT:Clear), which includes technology-related material and programme descriptions of all five areas of work under the framework[17]. The objective of the clearing house is to facilitate the flow of information between different stakeholders to enhance the development and transfer of environmentally sound technologies (UNFCCC, 2006).

- **Mechanisms for technology transfer:** The Expert Group on Technology Transfer. The (EGTT) was established to provide scientific and technical advice on the advancement of the development and transfer of environmentally sound technologies and know-how. It makes recommendations for consideration to the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) to inform decisions by the Conference of Parties (COP) to the UNFCCC. Despite some initial consideration of adaptation technologies, the EGTT is yet to improve knowledge and understanding of adaptation technologies, to assess their potential and their limitations, and to elaborate on the related implications for climate policy.

2) Nairobi Work Programme

The overall objective of the Nairobi Work Programme (NWP) is to assist all Parties, in particular developing countries, Least Developed Countries (LDCs) and Small Island Developing States, in improving their understanding and assessment of impacts and vulnerabilities to climate change, in order to make informed decisions on practical adaptation actions and measures based on sound scientific, technical and socio-economic information.[18] Technologies for adaptation is a focal area of its work, including promoting the development and diffusion of technologies, know-how, and practices for adaptation. There is little evidence, however, that progress made on adaptation technologies through the NWP is filtering back into formal negotiations within the UNFCCC.

16 Article 4.5 of the United Nations Framework Convention on Climate Change states that 'The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organisations in a position to do so may also assist in facilitating the transfer of such technologies'. FCCC/INFORMAL/84GE.05-62220 (E) 200705.

17 For the latest work of the clearing house visit http://unfccc.int/ttclear/jsp/index.jsp

18 Decision 2/CP.11, annex, paragraph 1.

3) National Adaptation Programmes of Action (NAPAs)

NAPAs under the UNFCCC provide information about urgent technology needs of LDCs for adaptation and about existing community based adaptation technologies. They highlight initial vulnerabilities and potential impacts, and focus on tangible immediate measures which could lessen the impacts. NAPAs are a useful tool to identify the importance placed upon adaptation technologies at a country level, but given that the focus of the NAPAs is on urgent and immediate adaptation actions, not all adaptation technologies will be recognised.

4)Technology Needs Assessments (TNAs)

TNAs refer to identification and evaluation of equipment, techniques, practical knowledge or skills for addressing a particular purpose or activity and are identified in initial national communications. TNAs are country driven processes which establish national priorities. These therefore also provide a possible platform for recognising adaptation technologies under the UNFCCC process. To date, however, TNA's have mainly focused on mitigation technologies.

2.2 Adaptation Technologies in the post 2012-agreement: Challenges

The UNFCCC has so far failed to adequately address adaptation technologies. There is a risk that unless adaptation technologies feature more prominently in negotiations, the technology needs of the poorest and most vulnerable will be overlooked, further undermining their livelihoods. Furthermore, the complexity of the process of adaptation itself (i.e. the difficulties of preparing for uncertainty) contribute to the thinking that adaptation should be financed by development aid. If adaptation technologies are not prioritised in negotiations for the post-2012 agreement there is a risk that financing for such technologies will be available only through aid budgets.

A number of reasons explain why adaptation technologies have been marginalised by technology negotiations at the UNFCCC. At international climate negotiations, there is no single setting or body that has responsibility over adaptation technologies per se. In contrast, several processes and institutions tackle different elements of technologies associated with adaptation and therefore coherence and coordination over adaptation policy has been extremely difficult. For example, there is an apparent lack of coherence between the NAPAs and TNAs, which have identified almost completely different sets of adaptation technologies (Only 15 of 165 technologies for adaptation were identified by both NAPAs and TNAs[19]). The fact that DRR practices have not been effectively linked to adaptation technologies in the formal negotiations provides yet another example of the lack of coherence on adaptation technologies[20].

Technology discussions mainly take place within the 'technology transfer' negotiating track. However, this setting has failed to effectively address adaptation technologies. In contrast, technology transfer debates have been dominated by discussions on mitigation technologies and the importance of promoting R&D, with advanced developing countries as the main target. The fact that there are significant investment opportunities in the development of mitigation technologies has also played a role in prioritising such technologies over adaptation ones, which in general terms are unlikely to produce a profit margin[21].

19 UNFCCC. (2009). *Advance report on recommendations on future financing options for enhancing the development, deployment, diffusion and transfer of technologies under the Convention*. Note by the Chair of the Expert Group on Technology Transfer, Report FCCC/SB/2009/INF.2. P7.

20 Although recently the link between DRR and adaptation is becoming more explicit through workshops and through the NWP.

21 This is not to exclude the private sector entirely; there are profit margins to be found in the hard technology options available, but the majority of opportunities will need to be publicly funded.

The prioritisation of mitigation technologies in technology transfer debates has resulted in a lack of clear understanding of the range of existing adaptation technologies that exist and the key challenges that need to be overcome for their successful implementation. A lack of understanding on existing adaptation technologies has translated in a bias towards hard technologies (as identified in the NAPAs and TNAs), with insufficient attention given to soft technologies. Whilst traditional and soft technologies play a key role in adaptation policy outside formal negotiations, it is unclear how these are to be recognised and supported under the post-2012 agreement.

Moreover, little attention has been given to the identification of barriers that hinder the proper development and application of adaptation technologies. Innovation and development of adaptation technologies is very important and will require addressing barriers such as financing and IPR issues; however the diffusion of information, skills, know-how, goods and equipment within and between developing countries is now an urgent priority. Further innovation and development are important for adaptation technologies, diffusion of information, skills, know-how, goods and equipment within and between developing countries is an urgent priority. Current barriers include the lack of adequate policies and regulations; lack of financial resources, information and awareness; and lack of social and institutional capacity for effective implementation of adaptation technologies. Capacity building will play a vital role in overcoming these barriers and creating enabling environments for the adoption and use of adaptation technologies.

2.3 CIDSE-Caritas Internationalis recommendations for the post-2012 agreement

CIDSE and Caritas Internationalis recommend:

1. **Parties should ensure the relevant parallel negotiating tracks take a joined up approach to technology and technological development for effective adaptation to climate change.** In the adaptation negotiating track the role of technology should be recognised, and in the technology negotiating track the use of technology for adaptation should be recognised.

2. Parties should recognise that research, development, demonstration, diffusion and transfer of existing adaptation technologies, including knowledge and skills, should be supported by **new funding which is additional to existing ODA (Overseas Development Assistance) targets.**

3. **Parties should work for coordination and policy coherence** for the effective implementation of adaptation technologies policies **across a proposed UNFCCC architecture:**

   At an international level:
   - Members of the proposed **Adaptation Executive Board** and **Technology Executive Board** (as proposed in the negotiations by the G77 and China) should be represented on each others respective Boards. Both Boards should jointly produce regular reports to the Conference of Parties (based on reports from the Technology Mechanism and information gathered from other adaptation institutions and processes e.g. the Nairobi Work Programme (NWP)) on their adaptation technologies related activities, including the identification of gaps and needs for the most vulnerable developing countries, and the identification of appropriate responses.

   - The Adaptation Executive Board should take into account activities undertaken by institutions involved with adaptation i.e. Regional Centres, NWP etc.

   At the developing country national level:
   - **Synergies between National Adaptation Plans/Strategies, Poverty Reduction Strategies and Low Carbon Development strategies should be ensured,** in particular for the identification of priority actions to support the development and diffusion of adaptation technologies.

4. **Parties should agree on an international technology mechanism** for the effective implementation of adaptation technologies and which should prioritise the following:

   - **Overcoming barriers which prevent the diffusion of existing and future adaptation technologies,** including in particular Intellectual Property Rights barriers.

   - **Overcoming financial barriers which prevent the diffusion and adoption of high adaptation technologies**, such as sophisticated information and communication technology, early warning systems, geographic information systems and new crop varieties.[4] Adoption of such technologies will require capacity-building, and transfer of know-how on their use and maintenance.

   - **Research, development and demonstration of new adaptation technologies,** based on the identification of needs by national planning processes, such as National Adaptation Plans of Action (NAPAs) and Technology Needs Assessments (TNAs).

   - **Providing technical expertise and assistance to developing countries** to identify needs and develop strategies in the context of their NAPAs and TNAs.

   - **Ensuring progress in the development, diffusion and demonstration of adaptation technologies that require international cooperation** through Adaptation Technology Action Plans (ATAPs) that will identify policies, actions and funding requirements for a specific set of adaptation technologies.

5. **Parties should recognise that regional, national and local cooperation are key for the effective implementation of adaptation technologies, in particular:**

   - The **diffusion and adjustment of proven existing technologies** across and within developing countries, to enable the use of technologies in different contexts in response to local vulnerabilities.

   - The **enhancement of national and local capacities,** including public sector and civil society institutional capacity, knowledge and know-how for sustainable adaptation to climate change.

6. **Regional, national and local cooperation** should draw on the experience of and strengthen the work of **Regional Centres** of Excellence (as proposed by the G77 and China), the **Nairobi Work Programme**, existing **international DRR frameworks** (such as the Hyogo Framework) and other information-knowledge sharing platforms that are linked to civil society experiences. The activities undertaken by these institutions should be taken into account by the Adaptation Executive Board.

Annex I
Technologies for adaptation

I. Coastal zones[22]

Retreat	Accommodate	Protect
Increasing or establishing set-back zones	Emergency planning such as early warning and evacuation systems	Construction of hard structures such as dykes, sea-walls, tidal barriers, floodwalls, detached breakwaters, saltwater and intrusion barriers,
Relocating threatened buildings	New agriculture practices such as using salt-resistant crops, aquaculture	Soft options such as dune or wetland restoration and creation and periodic beach nourishment
Phasing out development in exposed areas and managing realignment	New building codes and strict regulation in hazard zones	Traditional / indigenous technologies such as wood walls, stone walls, coconut fibre stone units and coconut leaf walls
Creating upland buffers and rolling easements	Improved drainage systems increasing the pump capacity and diameter of pipes	
	Desalination systems	
	Hazard insurance	

22 UNFCCC (2006), Technologies for Adaptation to climate change. P13.

Ib Coastal zones[23]

Category	Technology
Traditional / indigenous technology	Restoration of coastal forests and coral reefs
	Monitoring coastal and coral erosion
	Sand dune restoration and construction
	Dykes, dams, levees, nets and dredging
	Community-based conservation programmes and aquaculture
	Sea walls, revetments and bulkheads
	Dykes and gryones
	Saltwater intrusion barriers
	Tidal barriers
	Reef protection
	Beach nourishment and dune restoration
	Protection and restoration of wetlands
	Littoral drift replenishment
	Afforestation
	Creation of drainage areas
Modern technology	Monitoring coastal and coral erosion
	Dykes, dams, levees, nets and dredging
	Detached breakwaters
	Dykes and gryones
	Saltwater intrusion barriers
	Tidal barriers
	Reef protection

23 UNFCCC (2009) *Advance report on recommendations on future financing options for enhancing the development, deployment, diffusion and transfer of technologies under the Convention: Note by the Chair of the Expert Group on Technology Transfer*, Report FCCC/SB/2009/INF.2. P 79.

Category	Technology
High technology	Monitoring coastal and coral erosion
	Dykes, dams, levees, nets and dredging
	Monitoring coastal and coral erosion
	Sea level and tide monitoring
	Coastal zone monitoring
	Impact assessment studies
	LiDAR (Light Detection and Ranging

II Energy[24]

Category	Technology
Traditional / indigenous technology	Use of biomass for small-scale energy production
	Use of solar energy for small-scale indigenous industrial processes
	Unspecified use of renewable energy
	Use of jatropha
Modern technology	Use of hydropower
	Unspecified use of renewable energy

III Health[25]

Category	Technology
Traditional / indigenous technology	Malaria protection and prevention
	Promoting a communications system to inform people of disease
	Improved water storage and transportation
	Health education
	Malaria protection and prevention

24 UNFCCC (2009) *Advance report on recommendations on future financing options for enhancing the development, deployment, diffusion and transfer of technologies under the Convention: Note by the Chair of the Expert Group on Technology Transfer*, Report FCCC/SB/2009/INF.2. P 79.

25 Ibid P80.

Category	Technology
Modern technology	Monitoring and improving sanitation and water control
	Improving heath treatment infrastructure
	Promoting a communications system to inform people of disease
	Database and information centre for climate-related diseases epidemics
	Unspecified vector disease control
	Improved water storage and transportation
High technology	Production of biopesticides
	Spatial information system for disease monitoring
	Improve health treatment infrastructure
	Unspecified vector disease control
	Early warning systems
	Medical research
	Improvement of collector and drain array and prophylactics

IV Early warning and forecasting[26]

Category	Technology
Modern technology	Agriculture and food security management system
	Natural disaster response systems

26 Ibid.

Category	Technology
High technology	Improved weather forecasting
	Early warning system for floods and droughts
	Unspecified early warning systems
	Unspecified monitoring systems
	Improved data gathering
	Improved hydrometeorological networks
	Improved communications systems
	Improved weather prediction tailored to the needs of health systems with regard to heat waves
	Early warning system for desertification
	Early warning system for famine
	Unspecified remote sensing and geographical information system (GIS) use

V Infrastructure[27]

Category	Technology
Traditional / indigenous technology	Improved technical design and construction
	Changes in roofing material
	Improved levee construction
	Establishment of building codes
	Windmills
	Burying electric cables
	Improved planning
	Use of local non-metallic construction material
	Unspecified coastal infrastructure improvement
	Unspecified urban infrastructure improvement

27 Ibid.

Category	Technology
Modern technology	Improved technical design and construction
	Changes in roofing materiel
	Improved levee construction
	Establishment of building codes
	Windmills
	Rehabilitation and construction of dams and dykes
	Rehabilitation of waterways
	Improving heath treatment infrastructure
	Construction of water gates
	Unspecified coastal infrastructure improvement
	Unspecified urban infrastructure improvement
	Rehabilitation of multiple use reservoirs
High technology	Implementation of communications infrastructure
	Rehabilitation and reconstruction of meteorological/climate stations

VI Terrestrial ecosystems[28]

Category	Technology
Traditional / indigenous technology	Afforestation, replanting and improved silviculture
	Watershed restoration and management (unspecified)
	Flood zone restoration and creation
	Protection and rehabilitation of degraded soil and lands (unspecified)
	Forest and brush fire prevention methods
	Promotion of agro-farming and forestry in semi-arid landscapes
Modern technology	Lake training
	Eradication of invasive flora species

28 Ibid P 81.

VII Water resources[29]

Category	Technology
Traditional / indigenous technology	Water harvesting
	Spate irrigation
	Control of sand encroachment
	Unspecified small-scale irrigation and harvesting for arid areas
	Gravity irrigation systems
	Maintenance and construction of reservoirs and wells
	Creation of safety zones and backup devices to control pollution
	Capture of water run-off
Modern technology	Drip irrigation
	Installation and maintenance of water pumps
	Groundwater recharge of wells
	Maintenance and construction of reservoirs and wells
	Wastewater treatment
	Establishment, maintenance and improvement of water supply infrastructure
	Solar power drilling systems
	River training
	Registry containing information on protected areas
	Additional pumps
	Sustainable urban drainage systems
	Water transfer
	Water quality control

29 Ibid.

Category	Technology
High technology	Desalinization
	Early warning flood systems
	Reverse osmosis
	Leakage detection systems
	Computer simulation of floods
	Online, searchable flood risk maps
	Diversify and improve aquaculture

VIIb Examples of adaptation technologies for water resources[30]

Category	Supply side	Demand side
Domestic use	Increase reservoir capacity (hard), desalinate water (hard), make inter-basin transfers (hard), Alter system operating rules such as pricing forms (soft)	Reduce leakage (hard), use non-water-based sanitation (hard), seasonal forecasting (soft), legally enforceable water quality standards (soft), water demand management (soft)
Industrial cooling	Use lower grade water (soft)	Increase water use efficiency and water recycling (hard)
Hydropower	Increase reservoir capacity (hard)	Increase turbine efficiency (hard), encourage energy efficiency (soft), energy demand management (soft)
Navigation	Build weirs and locks (hard), use alternative transport (hard)	Alter ship size (hard) and frequency (soft)
Pollution control	Enhance treatment works (hard), reuse and reclamation (hard)	Reduce volume of effluent to treat (soft), promote alternatives to chemical use (soft)
Flood management	Increase flood protection (hard), wetland protection and restoration (soft)	Improve flood warning and dissemination (soft), curb floodplain development (soft)
Agriculture	Better soil conservation (hard), better forecasting (soft), alternative tilling practices (soft), rain harvesting (hard)	Increase efficiency of irrigation use (hard), increase drought tolerant crops (hard), change irrigation water pricing (soft), change crop patterns (soft)

30 Ibid P 82.

VIII Agriculture, livestock and fisheries[31]

Category	Technology
Traditional / indigenous technology	Investigation of new techniques for live bait management
	Erosion control
	Development, use and treatment of fodder crops
	Implementation of irrigated crops and cropping techniques
	Zero-grazing techniques
	Improving grazing and pasturing of livestock
	Development of swamps for rice production
	Integrated farming practices
	Improvement of pluvial zone agriculture (unspecified)
	Soil conservation and land improvement
	Coastal zone protection
	Changing cultivars and crop varieties
	Improved water distribution networks
	Improving cultivation practices
	Crop rotation
	Bench terracing and contour cropping
	Construction of windbreaks
	Integrated pest management
	Dry farming
	Diversify and improve aquaculture
	Use of bioindicators

31 Ibid.

Category	Technology
Modern technology	Investigation of new techniques for live bait management
	Food processing and preservation
	Development, use and promotion of drought- and heat-resistant crops
	Implementation of irrigated crops and cropping techniques
	Genetic improvement of local bovine species
	Unspecified livestock improvement to deal with climate stress
	Unspecified modernization and diversification of agricultural production
	Changing cultivars and crop varieties
	Drip irrigation systems
	Improved water distribution networks
	Pest-resistant crops
	Sub-surface dams to use underground water
	Research and promotion of saline resistant crops
	Improve quality of fishery-related data
High technology	Installation of Device for Fish Concentration (DFC) on coastal zones
	New navigation technologies for fishing
	Development, use and promotion of drought- and heat-resistant crops
	Changing cultivars and crop varieties
	Pest-resistant crops
	Networks of early warning systems
	Promotion of new rice varieties
	Agricultural forecast modelling

VIIIb Examples of adaptation options for agriculture[32]

Response strategy	Some adaptation options and technologies
Use of different crops to match changing water supply and temperature conditions	Conduct research to develop new crops varieties
Change of land topography to reduce run-off, improve water uptake and reduce wind erosion	Improve distribution networks
	Subdivision of large fields
	Grass waterways
	Land levelling
	Waterway-levelled pans
	Brench terrace
	Tied ridges
	Deep ploughing
	Roughening of land surface
	Use of bioindicators
	Windbreaks
Introduction of systems to improve water use and availability and control soil erosion	Low-cost pumps and water supplies
	Dormant season irrigation
	Line canals or install pipes
	Use brackish water where possible
	Concentrate irrigation water during peak growth period
	Level fields, recycle tail water, irrigate alternate furrows
	Drip irrigation systems
	Diversions

32 UNFCCC (2006). *Application of environmentally sound technologies for adaptation to climate change.* Technical Paper FCCC/TP/2006/2. p.50.

Response strategy	Some adaptation options and technologies
Changes in farming practices to conserve soil moisture and nutrients, reduce run-off and control soil erosion	Conventional bare fallow
	Stubble/straw mulching
	Minimum tillage
	Crop rotation
	Contour cropping to slope
	Avoid monocropping
	Chisel up soil clods
	Use of lower planting densities
Change in timing of farm operations to better fit new climatic conditions	Advance sowing dates to offset moisture stress during warm period

IX Examples of infrastructure adaptation technologies[33]

	Hard technologies	Soft technologies
Building sector	Lay out cities to improve the efficiency of combined heat and power systems and optimize the use of solar energy	Limit development on flood plains or potential mud-slide zones
	Minimize paved surfaces and plant trees to moderate the urban heat island effects and reduce the energy required for air conditioning	Establish appropriate building codes and standards
		Provide low-income groups with access to property
Transportation sector	Cluster homes, jobs and stores	Promote mass public transportation
	Control vehicle ownership through fiscal measures such as import duties and road taxes as well as through quotas for vehicles and electronic road pricing	Use a comprehensive and integrated system of planning
	Develop urban rail systems	Link urban transport to land-use patterns
Industrial sector	Use physical barriers to protect industrial installations from flooding	Reduce industrial dependence on scarce resources
		Site industrial systems away from vulnerable areas

33 UNFCCC (2009) *Advance report on recommendations on future financing options for enhancing the development, deployment, diffusion and transfer of technologies under the Convention: Note by the Chair of the Expert Group on Technology Transfer*, Report FCCC/SB/2009/INF.2. P 79.

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In the context of adaptation, technologies are understood to include not only materials, machinery and equipment, but also various forms of knowledge and practice. Despite the importance of technology for the process of adaptation to climate change, the United Nations Framework Convention on Climate Change has failed thus far to properly address the issue of adaptation technologies.

This report aims to raise awareness amongst Parties to the UNFCCC negotiations for a post 2012 agreement about the importance of adaptation technologies for adaptation to climate change and sustainable poverty reduction. It draws on the experience of CIDSE and Caritas Internationalis partners in developing countries to illustrate the different ways in which vulnerable communities are coping with the impacts of climate change by the application of specific technologies, and makes recommendations for effective support to adaptation technologies under the post-2012 climate change agreement.

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