Climate Change and Poverty in Mozambique

realities and response options for CARE

Dr. Charles Ehrhart and Michelle Twena, November 2006

Background report
CARE International Poverty-Climate Change Initiative
“Temperatures in certain areas of Manica Province were normally low, and the sun shining used to be as rare as the gold that is explored there. Nowadays, things have completely changed: it has become as hot as other places in Mozambique where sunstroke is common. Villagers living in the north of Inhambane Province say that … the period between severe droughts has declined from 12 or 13 years to 5. This severe drying trend is also reflected in declining supplies of water in systems (e.g. wells) built during the last 10 to 15 years.”

- Eduardo Telhano, CARE International in Mozambique, Emergencies Coordinator
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Foreword

Climate change is already occurring. No one will be immune from its overall impacts. Nonetheless, it will have a disproportionate effect on the lives of poor people.

Worldwide average surface temperatures have increased by an estimated 0.8°C (1.4°F) between 1900 and 2005. The past decade was the hottest of the past 150 years and perhaps the last millennium. The hottest 22 years on record have occurred since 1980, and 2005 was the hottest of all. The nearly universal consensus amongst scientists is that this warming trend has been triggered by the emission of carbon dioxide and other greenhouse gases by human activities (e.g. industrial processes, fossil fuel combustion and land use changes such as deforestation). Moderate projections of future warming suggest a global increase of 1.4°C (2.5°F) to 5.8°C (10.4°F) by 2100. In some areas, such as Southern Africa and the Sahel, the rise in temperatures could be double these averages. Regardless of how fast or how much the climate will eventually change, it is already:

- Altering hydrological cycles. In many semi-arid and arid regions around the world, less rain is falling, and that which does is evaporating faster due to climbing temperatures. Meanwhile, many areas which have long been susceptible to flooding are getting even more rain.

- Altering weather patterns. In other places, total rainfall hasn’t changed so much, yet the timing and duration of rains has. In other words, seasons have become less predictable and, in many cases, more volatile.

- Raising sea levels. Melting ice caps are expected by conservative climate change models to result in an average sea level rise of 9 to 88 centimeters by 2100.

- Increasing the intensity, and frequency, of extreme weather conditions and events such as torrential rains, droughts, tropical storms, cyclones and hurricanes.

With the launch of our Poverty-Climate Change Initiative in July 2006, CARE International (CI) has begun adapting its worldwide programming to these climate change realities. The first step is a seven-month internal process of learning about, reflecting upon and planning an appropriate response to climate change. The process begins and ends with those staff in Country Offices (COs) who are working directly with the people CARE serves.

This “country profile” is one in a series of six developed together with COs in Africa, Asia and Central America which examines current climate conditions, climate change projections and practical implications for CARE’s programming. As such, it is meant to help COs learn about the importance of climate change and kick-start their response. At the same time, country profiles are intended to communicate the kinds of support from Regional Management Units, Members and the CI Secretariat that COs think they will need to meet this unprecedented challenge. In other words, these country profiles are intended to have direct use-value for nearly everyone in CARE. Main messages coming out of the country profiles will be presented in a summary report.

It was difficult to select countries to highlight in this relatively small series of six profiles. Interest from COs was high, and the case to include specific countries was frequently strong. The main selection criteria were the extent to which local populations may be affected by climate change and the extent to which conditions (and projections) in different countries fit together to illustrate a range of climate change impacts.
Niger (Sahel), Tanzania (East Africa), Mozambique (Southern Africa), Nepal (Central Asia/Southwest Monsoon Region), Indonesia (Southeast Asia/Northeast Monsoon Region) and the four small countries comprising CARE’s Central America Region – namely, Guatemala, Honduras, El Salvador and Nicaragua – were chosen. This decision was informed by the Intergovernmental Panel on Climate Change’s Special Report on the Regional Impacts of Climate Change (IPCC 1997) the Regional Climate Change Index (RCCI), and other peer reviewed sources.

The RCCI is a comparative index designed to identify those regions which will be most affected by climate change. The identification of these ‘hot-spots’ is based on regional mean precipitation change, mean surface air temperature change, and change in precipitation and temperature interannual variability.

Calculated for 26 land regions from the latest set of climate change projections by 20 global climate models for the A1B, A2 and B1 IPCC emission scenarios, the RCCI identifies Central America as the most prominent tropical hot-spot for climate change (Giorgi 2006). The highlands of Central Asia will also be very hard hit. Though Africa may undergo fewer changes than Central America or Central Asia – and East Africa less than Southeast Asia – the consequences may be even more severe “because of factors such as widespread poverty, recurrent droughts, inequitable land distribution, and over-dependence on rain-fed agriculture” (IPCC 2001: 489, 491).

The country profile you are about to read examines these consequences and what CARE can do under such conditions to ‘create a world of hope, tolerance and social justice, where poverty has been overcome and people live in dignity and security.’

Dr. Charles Ehrhart
Coordinator
Poverty-Climate Change Initiative¹
CARE International

¹ In addition to this series of country profiles and a summary report, CI’s Poverty-Climate Change Initiative will also be producing:
  o A review of ways in which other civil society organizations perceive and are addressing climate change
  o An inventory of CI members and country offices that are already undertaking poverty reduction/Disaster Risk Reduction activities related to climate change; areas of relevant expertise that already exist within CI members and country offices; and current or potential partnerships that could advance CARE’s work on climate change
  o An overview of funding opportunities and trends amongst donors
  o A final report including recommendations from the Poverty-Climate Change Task Force

CARE-Austria, Canada, Denmark, Netherlands, USA and the Tanzania Country Office are funding these activities. The Coordinator is being advised and supported by a Task Force composed of representatives from each of CI’s regional offices and funding members. In addition, a Climate Change Learning Group has been formed to backstop the Task Force, aid in disseminating important information and spearhead the implementation of decisions. Membership in this Learning Group is open to all CARE staff. For further information, contact the Coordinator at: charlesehrhart@gmail.com
1 Executive summary

According to the United Nations’ panel of climate experts, Africa is “highly vulnerable” to the impacts of climate change “because of factors such as widespread poverty, recurrent droughts, inequitable land distribution, and over-dependence on rain-fed agriculture” (IPCC 2001: 489, 491). Historical data shows that the continent is already undergoing climate change. This has serious implications for water resources, food security, the spread of disease, the productivity of natural resources, sea-level rise, and desertification (ibid.: 489). Large-scale events (such as the ongoing drought in the Horn of Africa, the 1998 floods in East Africa and the 1997/8 and 2000 floods in Mozambique) illustrate ways in which many communities are already suffering from less predictable and more extreme weather patterns.

As the poorest country in Southern Africa – a region that is projected to become substantially hotter and drier – Mozambique is likely to feel the impacts of climate change more than most. Diverse climatic conditions, corresponding to the country’s varied topology, mean that national trends are likely to mask considerable variation at the sub-national level.

Extreme events are likely to pose the greatest climate change threat to Africa (WGCCD 2005). In Mozambique, they are likely to take the form of drought, floods and tropical storms – all of which are expected to become more frequent, intense and unpredictable (IPCC 2003). Recent extreme weather conditions and events highlight the country’s vulnerability to climatic hazards. The 1997/8 El Niño, for example, led to drought and flooding, and triggered a national food emergency with severe food shortages, ‘skyrocketing’ food prices, and extensive food, cattle and cash crop losses (US National Drought Mitigation Center 1997).

It is, therefore, no wonder that Country Office (CO) staff draw strong linkages between climate change, their mission and activities – especially those concerned with food security, natural resource (including forest, soil and water) management, and humanitarian response to emergencies. Staff recommend for their CO to mainstream climate change considerations in all programming so as to maximise the sustainability of development outcomes and ensure continuing support from donors. In addition, staff feel climate change should inform the CO’s LRSP – including decisions about where CARE International in Mozambique (CARE-Mz) works and the types of projects it prioritises.

Staff think CARE should begin to position itself strategically on the issue of climate change and, eventually, undertake mitigation, adaptation and advocacy activities. Although CARE in general, and CARE-Mz in particular, already have many of the skills, experiences and relationships necessary to address climate change, the way forward is not without substantial challenges. In order to support the CO in its efforts, staff suggest that CARE International (CI) should develop tools to help bring current and future projects in-line with climate change realities.

The CO’s capacity to utilise such tools will require ongoing technical support – especially when first introduced. At both national and international levels, CARE should participate in and/or establish networks with other development-oriented NGOs to share practical experience and refine its ways of working. If it does so, CARE will be at the forefront of those institutions who understand – in the words of the U.K.’s Foreign Secretary, Ms. Margaret Beckett – that “Dealing with climate change is an imperative for today, not an option for tomorrow” (Beckett 2006).
2 Climate change impacts

2.1 Regional projections

Climate change will affect people in Africa more than anywhere else in the world due to the nature of changes they are facing, deteriorating terms of trade, inappropriate policies, high rates of population growth, the inequitable distribution of land, over-dependence on natural-resource based livelihoods and over-reliance on rain-fed agriculture (IPCC 2001: 489, 491; IPCC 1997: 6; Hulme 1996).

Africa’s climate is already changing. In general, the continent is becoming warmer and drier. Rainfall is becoming less predictable. Meanwhile, storms, droughts and floods are becoming more common and intense.

As illustrated in Figure 1, Africa’s average temperature rose at a rate of 0.05°C per decade from 1900 to 2000 for a total increase of 0.7°C (IPCC 2001: 493). Temperatures are due to rise by a further 0.2 to 0.5°C per decade, with the greatest warming occurring “over the interior or semi-arid margins of the Sahara and central southern Africa” (ibid. 494).

In addition to getting hotter, these regions are also likely to get drier. Under moderate warming estimates, a 5-15 per cent reduction in rainfall during the growing season (November to May) is projected for southeast Africa (ibid. 489, 494).

As the IPCC points out, these changes are likely to have serious implications for water resources, food security, the spread of disease, the productivity of natural resources, sea-level rise, and desertification (ibid.:489). Recent events, such as the poor rains in southern Africa 2001-3, demonstrate that communities may already be suffering the consequences of less predictable weather patterns. Indeed, the resulting failed harvests triggered a food and humanitarian crisis which threatened the lives of up to 16 million people in Malawi, Swaziland, Zambia, Mozambique and Zimbabwe (Wiggins 2005).

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1 “Climate” typically refers to weather conditions averaged across 30 years (a period recommended by the World Meteorological Organization). Dissimilarities are always found when two 30-year periods are compared. Therefore, the intended meaning of “climate change” can be confusing. The United Nations Framework Convention on Climate Change (UNFCCC) addresses this problem by defining climate change only as that which is induced by human activities (e.g. industrial processes, fossil fuel combustion and land use changes such as deforestation) (Washington 2004: 33).
Figure 2: Vulnerability to climate change in Africa
(source: Anna Ballance, 2002)
2.2 Climate change in Mozambique

Mozambique’s weak socio-economic infrastructure and geographic location make it particularly vulnerable to the impacts of climate change (MICOA 2003: 59). Projected regional trends mask considerable variation in the expected impacts at the national and sub-national level, due to the country’s diverse topology and climatic conditions. For example, the main concern for arid and semi-arid regions will be rising temperatures plus reduced rainfall, while sea-level rise, storm surge and coastal erosion will be more problematic in low-lying coastal areas. The following section explores in further detail what climate change will mean for Mozambique in terms of predicted changes in temperature, rainfall patterns, frequency and intensity of extreme weather events (and conditions), and sea-level rise.

2.2.1 Temperature and rainfall patterns

Research by the Government of Mozambique suggests that mean air temperatures will rise by at least 1.8 to 3.2°C nationwide by 2075 (MICOA 2003: 71).\(^3\) Precipitation is predicted to fall by 2 to 9 per cent, which will take greatest effect between November and May (during which period the IPCC forecasts there will be a 5 to 15 per cent drop in regional rainfall). As this coincides with the growing season, it will have an especially pronounced impact on crop yields. Other expected changes are a 2 to 3 per cent increase in solar radiation, and a 9 to 13 per cent rise in evapotranspiration.

2.2.2 Extreme weather events and conditions

Extreme events are likely to pose the greatest climate change threat to Africa (WGCCD 2005). In Mozambique, they will take the form of drought, flooding and tropical cyclones that are expected to become more frequent, intense and unpredictable (IPCC 2003). The recurrence of slow-onset, extreme weather conditions, such as droughts and floods, and sudden events, such as tropical cyclones, highlight the country’s vulnerability to current climatic hazards.\(^4\) Droughts are most common in the south, and tend to manifest themselves slowly over time, lasting for periods of up to three to four years. Floods have a shorter time perspective, but can prevail for several months, occurring most frequently in central and southern regions, along river basins, in low-lying regions, and in areas with poor drainage systems, (MICOA 2003: 59). They are linked not only to heavy rainfall, but also to water drainage from rivers in upstream neighbouring countries. Tropical cyclones are concentrated in coastal zones. They generally occur in the summer and last for a few days, but can be particularly devastating – bringing gales, torrential rain and storms which cause floods, landslides, and coastal and inland erosion (ibid.: 61).

To demonstrate the human implications of extreme events, the floods in 2000/1 affected 2.5 million people (the majority of whom were displaced), and triggered a US$167 million emergency relief campaign (IPCC 2001: 507, 515). They claimed the lives of 755 people, caused considerable damage to infrastructure, property and livelihoods, and reduced national growth from roughly 8 to 2 per cent (Red Cross/Crescent 2006: 2; Christie and Hanlon 2001). Further examples of the

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\(^3\) Based on the assumption that carbon dioxide levels double from 1975 levels by 2075 (MICOA 2003: 63).

\(^4\) It is also important to note that droughts and extreme events can be interlinked – some droughts have been associated with El Niño (1972-3, 1982-3, 1991-2 and 1994-5) and others with La Niña episodes (2000 and 2001) (ibid.). El Niño and La Niña are linked to warming and cooling in Equatorial Pacific waters.
expected effects of climate change in terms of extreme events are summarised in Box 1.

### Box 1: Expected major effects of climate change

*Source: Adapted from MICOA 2002*

<table>
<thead>
<tr>
<th>Sector and geographical region impacted</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flooding</strong></td>
<td>Loss of life, crops, ecosystems, property, human and animal habitats, outbreak of pests and diseases, displacement of people, movement of land mines, destruction of infrastructure (communication networks, schools, hospitals, houses, etc.), land degradation and erosion.</td>
</tr>
<tr>
<td>Agriculture, forests, water resources, health, livestock, coastal resources, tourism, ecosystems and infrastructure. Affecting flood plains of main river basins, such as Limpopo, Incomati, Pungue, Save, Zambezi, Umbeluzi, Maputo and Buzi.</td>
<td></td>
</tr>
</tbody>
</table>

| **Drought** | Crop failure, water scarcity, drying of water reservoirs (dams, fish ponds, lakes, rivers), famine, loss of human and animal lives, stress on marine organisms, loss of biodiversity, environment degradation, increased risk of bush fires, saline intrusion and erosion. |
| Agriculture, water resources, ecosystems, health, food security, livestock. Affecting southern regions in particular. | |

| **Tropical cyclones** | Loss of life and livelihoods from collapsing structures; damage to structures due to sub-standard construction (e.g. rural community houses, school blocks, hospitals, etc); destruction of crops, forest plantations and trees; and increased risk of bush fires in the dry season. |
| Countrywide impacts, especially coastal areas during the rainy season. | |

While local coping strategies may be able to deal with such shocks in the short-term, few Mozambicans will be able to adapt to more frequent and severe climate events without assistance.

#### 2.2.3 Sea-level rise

As global warming causes polar ice caps to melt and oceans to swell, the IPCC predicts sea-level rise of up to 96 centimetres by 2100. This will have particularly dramatic consequences for Mozambique, where the country’s 2,700km-long coastline is home to two-thirds of the population and much of its infrastructure (e.g. large cities, fertile soils, fisheries, wetlands, industry, commercial centres, harbours and tourist destinations). The ‘region of rivers’ in central Mozambique, running between Mozambique Island and Bazaruto Island, is particularly threatened by the accentuated erosion and wide-scale flooding associated with sea-level rise (MICOA 2003: 66). The Beira coastal area is especially vulnerable; not only is it the location of Mozambique’s second largest city, but the harbour provides the nearest port to several of southern Africa’s land-locked countries (e.g. Malawi, Zimbabwe and Zambia). The city is situated below high water level and has already experienced property and infrastructure (e.g. roads) loss due to erosion (ibid.: 65).

As summarised in Box 2, sea-level rise will have a considerable impact on these and other coastal communities and the resources and ecosystems they depend upon for their livelihoods.

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5 Coastal population density is around 120 inhabitants per km² compared to 2 per km² elsewhere in the country (MICOA 2003: 6). This disparity is to some extent a legacy of the civil war, as coastal regions were generally considered safer than inland areas (UNCED 1992)
**Box 2: Impacts of sea-level rise**

Source: IPCC 2001, MICOA 2003

- Land loss
- Coastal erosion
- Damage to coastal structures and properties
- Loss of coastal and marine ecosystems (e.g. mangroves, fish, coral, sea beds, wetlands)
- Saline intrusion in fresh water bodies
- Inundation of low-lying coastal areas (of up to 43km² at the Beira coast)
3 Climate change and poverty

Poor people are particularly vulnerable to climate change because poverty:

- Is often linked to a higher reliance on natural resources. This makes poor people more sensitive to changes affecting the environment and can lead to degradation of natural resources – thus creating a vicious circle of increasing vulnerability to climate change (Tschakert 2006)
- Constrains people’s adaptive options/capacity.

Climate change is an ‘underlying cause of poverty’ in that it triggers – or worsens – a wide range of immediate and intermediate causes of poverty. Slowly changing climatic conditions and more frequent extreme events are likely to pose a threat to food and livelihood security, water supply, and human health. Because different social groups will feel the impacts of climate change disproportionately, there may also be consequences for social cohesion and gender equality. In areas where marginal groups struggle to gain access to increasingly degraded and scarce natural resources, climate change can lead to displacement and violent conflict. These issues are discussed in further detail below.

3.1 Food security

Despite its recent economic recovery, Mozambique remains one of the poorest countries in the world. Over half the population lives in absolute poverty (54 per cent in 2004) and two in five children under the age of five suffer from malnutrition (41 per cent) (IFAD 2006, WFP 2006). Even in light of this year’s successful rainfall and predicted good harvest, the World Food Programme plans to feed almost half a million people during the second half of 2006. Eighty per cent of Mozambicans live in rural areas where agriculture and livestock are of central importance to their livelihoods (MICOA 2003: 18). As the sector is dominated by rain-fed, subsistence production and food security is extremely vulnerable to climate variability and change.

3.2 Livelihood productivity

Climate change will affect food security by reducing livelihood productivity and opportunities. The impacts will be mostly negative in Mozambique. Erratic weather will undermine rain-fed agricultural systems; heat stress on crops will reduce yields; increases in carbon dioxide concentrations will decrease the protein content of vegetation (with implications for both human and livestock health and productivity); rising rates of evapo-transpiration will increase pressure on water supplies (especially in areas where river runoff is reduced and shallow wells become unreliable); rates of disease will rise for humans, plants and livestock; salt water incursions will contaminate water supplies and damage ecosystems; sea-level rise will claim land in low-lying, populated coastal areas; environmental services will decline (e.g. water and biodiversity); and higher ocean temperatures, salinity and acidity will devastate marine organisms and fisheries. Given the importance of agriculture for the vast majority of the population, impacts specific to the sector are outlined in more detail in Box 3.

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6 Only 2 per cent of agriculture is managed by commercial enterprises (MICOA 2003: 18).
Box 3: Impacts of climate change on agriculture
Sources: IPCC 2001, MICOA 2003

**Agriculture**
- Unpredictable rainfall will lead to uncertainty in cropping patterns
- Areas with less rainfall will lose water through evapo-transpiration and require irrigation
- Flooding will cause nutrient leaching, soil erosion and water logging
- Changing pest and disease patterns
- Prolonged dry spells may extend beyond normal patterns
- Predicted fall in the nutritional content of biomass and grains, including maize
- Increase in quantity of foliage in rangelands, but fall in quality (nutritional content)
- Shifts in agro-ecological zones
- Increased weed competition with crops for moisture, nutrients and light

**Livestock**
- Favourable condition for ticks, snails, blood-sucking insects and pests outbreaks
- Eruption of new pests and diseases
- Reduced productivity (draught power, milk and meat) as increased carbon dioxide reduces protein available from vegetation
- Livestock deaths due to heat waves

In addition, many climate change impacts on livelihoods will be felt *indirectly*. For instance:
- Livestock distribution and productivity will be affected through changes in the prevalence of (vector-borne) livestock diseases, and in the quantity and quality of rangeland (IPCC 2001; MICOA 2003: 35)
- The distribution of the tsetse fly will shift southwards (IPCC 2001: 507).
- Impacts on agriculture may also affect health. For instance, the nutritional content of biomass and grains (e.g. maize) is predicted to fall as the increasing carbon in the atmosphere causes more rapid plant growth but also reduces protein content. This is likely to reduce human and animal health (MICOA 2003: 70).

### 3.3 Livelihood opportunities

Some climate change coping strategies worsen people’s long-term prospects for escaping poverty. Box 4 illustrates how this may already be happening in the region.

Box 4: Climate change and livelihood opportunities
Source: Paavola 2004

A study in Tanzania found that farmers’ ways of coping with *current* climate variability, which are analogous to common practices in Mozambique, were increasing their vulnerability to *future* poverty and climate change:

<table>
<thead>
<tr>
<th>Current coping strategies</th>
<th>Expanding cultivation; reducing fallow; switching crops; engaging in wage employment; charcoal, timber and brick production; temporary/permanent migration (to gain access to land or markets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term consequences</td>
<td>Farming practices and reliance on forest resources have led to:</td>
</tr>
<tr>
<td>Medium-term consequences</td>
<td>→ Soil erosion</td>
</tr>
<tr>
<td></td>
<td>→ Deforestation</td>
</tr>
<tr>
<td>Long-term effect</td>
<td>→ Reduced water retention</td>
</tr>
<tr>
<td></td>
<td>→ Increased flooding after rains</td>
</tr>
<tr>
<td></td>
<td>→ Reduced water flow between rains</td>
</tr>
<tr>
<td></td>
<td>→ Eroded natural resource base may not be able to provide the same safety-net for livelihoods in future times of crisis</td>
</tr>
</tbody>
</table>

Producing charcoal, for example, may be a successful short-term solution when poor rains lead to crop failure, but in the long-term, deforestation can increase rates of soil erosion, reduce water retention, and leave land more prone to future flooding (Paavola 2004). Migration may improve access to employment opportunities, but
can also lead to a loss of cultural and social security (Eriksen et al., forthcoming). Children dropping out of school to assist their parents pursue alternative livelihood options (e.g. collecting wild foods or engaging in casual employment) may secure their immediate survival, but may erode their ability to build resilience through education in the future (Eriksen et al. 2005). Short-term coping strategies to deal with current climate conditions can therefore limit the availability of livelihood opportunities in the long run. Furthermore, as biodiversity comes under increased threat from climate change, existing coping mechanisms may also become less reliable (Jallow 1995); for example, a study in Kenya found that wild foods used by pastoralists in the south were becoming increasingly scarce (Campbell 1999).

3.4 Water resources

The availability of freshwater in Mozambique is expected to decrease by over half from 1990 levels by 2025 (UNEP/GRID-Arendal). Although water scarcity is unlikely to occur (as predicted for neighbouring South Africa and Malawi), water stress will become an increasing problem (see Figure 2). This is cause for significant concern in a country where under two-fifths (39 per cent) of the population currently have access to drinking water (CARE 2005).

Box 5 details how climate change is expected to affect precipitation, potential evaporation and runoff in three major Mozambican river basins. The combined effect is striking: precipitation is expected to fall by up to a fifth, evapo-transpiration is predicted to rise by up to a quarter, and runoff may decrease by up to 40 per cent. In addition to these changes, rising temperatures will also reduce soil moisture, lower water table levels and slow aquifer recharge rates, which will place even further pressure on increasingly scarce water resources.

<table>
<thead>
<tr>
<th>River basin</th>
<th>Change in precipitation (%)</th>
<th>Change in potential evaporation (%)</th>
<th>Change in runoff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zambezi</td>
<td>-10 to -20</td>
<td>10 to 25</td>
<td>-26 to -40</td>
</tr>
<tr>
<td>Ruvuma</td>
<td>-10 to -5</td>
<td>25</td>
<td>30 to -40</td>
</tr>
<tr>
<td>Limpopo</td>
<td>-5 to -15</td>
<td>5 to 20</td>
<td>-25 to -35</td>
</tr>
</tbody>
</table>

These changing trends in water supply are likely to have further socio-economic repercussions. For example:

- Changes in water supply may lead to power shortages due to reduced rainfall in hydropower regions
- The cost of realising the UN Millennium Development Goals is likely to rise as poor access to water impacts negatively on health and livelihood productivity

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7 From approximately 4,000 m³ per capita in 1990 to well approximately 1,700 m³ by 2025 (UNEP/GRID-Arendal).

8 See: [http://maps.grida.no/go/graphic/water_availability_in_africa](http://maps.grida.no/go/graphic/water_availability_in_africa)
Water stress may exacerbate political tensions, raising the scope for conflict within and across national borders (see Section 3.4).

3.5 Human health

Climate change directly affects human health through the injuries, deaths and disease associated with extreme events. It indirectly affects health through changes in water quality, air quality, food availability and quality, and the range, frequency and severity of disease, as summarised by Box 6. There is growing evidence to suggest that climate-driven threats to health are already on the increase, for example, floods (specifically the 1997-98 El Niño event) have been associated with epidemics of diarrhoea and cholera, and have led to higher transmission rates of malaria (WHO 1998, IPCC 2001). Research suggests that populations living on the Indian Ocean are likely to be at a greater risk of cholera infection as extreme events such as El Niño become more frequent and generate increasingly favourable conditions for transmission of the disease (Birmingham et al. 1997, Shapiro et al. 1999, IPCC 2001).

Climate change will place additional stress on those households living with HIV/AIDS by, amongst other things, challenging livelihoods and reducing the nutritional value of crops. High rates of HIV/AIDS infection in Mozambique will also reduce the capacity of many households to adapt to climate change.

| Box 6: Impact of climate change on health |
| Sources: IPCC 2001, WGCCD 2005 |
| - Direct health impacts of weather-related disasters (floods, storms, drought) |
| - Heat stress |
| - Lack of drinking water |
| - Expansion in the range, frequency and severity of diseases such as malaria, cholera, dysentery, meningitis, shistosomiasis, Rift Valley Fever and diarrhoea |
| - Impacts on food security |
| - Loss of biodiversity leading to reduced availability of medicinal plants |
| - Air pollution |
| - Demographic changes shift balance of vulnerable populations demanding different health services |

3.6 Scarcity, conflict and displacement

Climate change is projected to cause an additional 50 million environmental refugees by 2010 and 150 million by 2050 (Myers 1994). The IPCC points out, “Growing water scarcity, increasing population, degradation of shared freshwater ecosystems, and competing demands for shrinking natural resources distributed over such a huge area involving so many countries have the potential for creating bilateral and multilateral conflicts” (2001: 498, Gleick 1992). At the same time, it is important to stress that climate change will not cause conflict in itself, but will “affect the parameters that are sometimes important in generating...conflict” (Barnett and Adger 2006: 3). The interactions between climate change and factors affecting violent conflict are explored in further detail in Box 7.
Box 7: Relationship between human insecurity, violent conflict and climate change
Source: Barnett and Adger 2006: 2

<table>
<thead>
<tr>
<th>Factors affecting violent conflict</th>
<th>Interactions with climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulnerable livelihoods</td>
<td>Climate change impacts on water availability, coastal regions, agriculture, extreme events and diseases. It exposes livelihoods to risks, increasing their vulnerability. Vulnerability is affected by high resource-dependency, and is higher in more environmentally and socially marginalised areas. Some of these climate driven outcomes are long term and chronic (such as declining productivity of agricultural land), while others are episodic (such as floods).</td>
</tr>
<tr>
<td>Poverty (relative/chronic/transitory)</td>
<td>Poverty and relative deprivation are affected by the spatial differentiation of climate impacts and the sensitivity of places to them. Climate change may directly increase absolute, relative and transient poverty by undermining access to natural capital. It may indirectly increase poverty through its effects on resources sectors and the State.</td>
</tr>
<tr>
<td>Weak states</td>
<td>Climate change risks are likely to increase the costs of providing public infrastructure such as water resources and urban infrastructure. So, it may decrease the State’s ability to create opportunities and provide important freedoms, as well as decrease the State’s own capacity to adapt.</td>
</tr>
<tr>
<td>Migration</td>
<td>Relocation, demographic and spatial changes are all adaptive responses to climate change. However, climate change is unlikely to be the sole, or even the most important ‘push’ factor in migration. Large-scale movements of people may increase the risk of conflict in host communities.</td>
</tr>
</tbody>
</table>

3.7 Gender

As the main natural resource users and managers in rural Mozambique, the adverse effects of climate change are likely to be felt disproportionately by women. However, as vulnerability to climate change depends on control of financial, physical, natural, human and social capital, and because women typically have less access to and control over these resources than men, they are likely to have lower adaptive capacities (Lambrou and Piana 2005).

Research into the consequences of extreme weather events for women has found that:
- Women’s economic insecurity increases more than men’s
- They take longer to recover from economic loss than men
- Gender barriers provide an obstacle to involvement in reconstruction work
- Natural disasters often lead to a sustained increase in the workload of women (e.g. due to male migration, reduced access to resources, more time spent travelling to collect water and search for fuelwood) (Lambrou and Piana 2005: 15-19).
4 International and national responses to climate change

By signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, the international community (comprised of over 180 nations, including the United States) officially acknowledged that human activities were contributing to climate change, and pledged a commitment to achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, Article 2).

4.1 The national response to climate change

The Government of Mozambique ratified the Convention on 24th August 1994, and as part of the international process, published its Initial National Communication (INC) to the UNFCCC in 2003. The document presented an inventory of national sources of greenhouse gas emissions, provided an assessment of vulnerability and adaptation to climate change impacts, and suggested policy options for mitigation and public awareness-raising. The Ministry for Co-ordination of Environmental Affairs (MICOA) was responsible for compiling the report and remains the focal point for the government’s climate change response. It is currently in the process of developing a National Adaptation Programme of Action (NAPA), which seeks to prioritise projects contributing to the national adaptation effort in order to qualify for funding from the Global Environment Facility through the United Nations Environment Programme.

4.2 Stakeholder participation

Although a participatory approach is one of the key guiding principles of the NAPA process, there has been limited evidence of stakeholder consultation or civil society involvement (The Red Cross/CVM was the only NGO invited to participate in the NAPA). Actors involved have largely been government-based, though there have been significant inputs from academia. Civil society has been almost absent from the process. According to a MICOA representative on the NAPA team, NGOs were contacted by letter at the start of the process and invited to participate, but only one – the Environmental Working Group – responded positively and was involved in public consultations and meetings. There is certainly scope and justification for wider stakeholder involvement in the climate change process in the future.

4.3 Mainstreaming climate change

The Government of Mozambique does not appear to be taking climate change seriously. Indeed, there is very little discussion around climate change and its implications for a wide range of relevant policies, including Government’s current Poverty Reduction Strategy (PARPA II). That discussion which does exist is largely confined to MICOA (the main government body responsible for environmental issues). However, even within MICOA, climate change evidently takes a back seat to the push for economic growth. For instance, on- and offshore concessions are being sold to exploit natural gas without requiring emissions offsets. Lack of appropriate oversight and questionable practices are largely due to limited capacity within MICOA. This is likely to worsen in the near future when DANIDA withdraws direct financial support to the institution.

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5 The scientific consensus is that rising concentrations of ‘greenhouse gases’ in the atmosphere are responsible for climate change. The main six gases covered in international agreements are: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

11 This is an obligation of all 49 Least Developed Countries.
The one exception to the pattern of Government institutions failing to see the significance of climate change is, arguably, the National Institute for Disaster Management (INGC). The INGC was one of very few third-world participants in the 2005 World Conference on Disaster Reduction in Kobe, Japan, to link climate change and disaster management (UNISDR 2005). This is encouraging. Nonetheless, limited organizational capacity and resources for follow-through tend to prevent the INGC from taking pro-active measures to reduce disaster risks.
5. Climate change and CARE

There are three major ways for CARE to address climate change:

- Helping to reduce the amount of greenhouse gases in the atmosphere. In so doing, CARE would be helping to lessen, or “mitigate,” the extent to which our climate ultimately changes.
- Advocating for governments and other institutions to do their part in mitigating climate change and facilitating adaptation by poor communities.
- Helping especially poor and vulnerable communities “adapt” to emerging climate change realities.

These options are described in greater detail, and assessed with regards to the Mozambican context, below.

5.1 Mitigation - Description

Institutions like CARE are already implementing projects that mitigate climate change whilst contributing to poverty reduction and environmental conservation. These projects:

- Reduce GHG emissions
- Actively sequester GHGs in ‘sinks’ and/or
- Aim to protect demonstrably threatened carbon ‘sinks.’

Projects aiming to reduce GHG emissions typically swap inefficient and/or dirty energy technologies for more efficient and/or cleaner alternatives. Headline projects often focus on ‘big wins,’ such as switching municipalities from coal or diesel generators to a CO2-free power source. However, some NGOs are already tapping into the UNFCCC’s Clean Development Mechanism (CDM) to help poor households adopt technologies that improve their lives. Box 6 provides an example of how this is being done in an African context.

Box 8: Kuyasa Low-cost Urban Housing Energy Upgrade Project, South Africa
Source: [http://www.southsouthnorth.org](http://www.southsouthnorth.org)

SouthSouthNorth and the Cape Town Municipality have used the UNFCCC’s Clean Development Mechanism to finance improvements in the heat retention and energy efficiency of 2,300 low-income housing units. This has proven to be an affordable, replicable and scaleable model for upgrading homes, lowering energy expenditures and reducing CO2 emissions.
Other reduced-emissions projects are spreading fuel-efficient stoves, new charcoaling technologies and biogas systems in poor communities.

Sequestration projects seek ‘capture and store’ carbon. They can target CO2 that would otherwise be emitted by large-scale power plants. They can also pull CO2 out of the atmosphere and lock it up in trees, other vegetation and soil. The latter type of project, classified as ‘Agriculture, Forestry and Other Land Use’ (AFOLU), can make a substantial contribution to reducing poverty.

Box 7 presents a typical AFOLU design in which low-income farmers are encouraged to switch from clear-cut, mono-crop farms to multi-story, agro-forestry systems. In so doing, households can:
  o Get paid for growing trees. Simply put: the more trees farmers grow » the more carbon they sequester » the more money they receive.
  o Reduce erosion and improve soil quality. This can yield bigger, and more sustainable, crop harvests.
  o Grow ‘non-timber forest products’ (NTFPs), including fruits, fibres and firewood, alongside traditional crops. Amongst other benefits, NTFPs can provide households with a source of income between harvests and when harvests fail.

**Box 9: Nhambita Community Carbon Project, Mozambique**

*Source: [http://www.planvivo.org/projects/projects.html](http://www.planvivo.org/projects/projects.html)*

The Nhambita Community Carbon Project, operating in the buffer zone of the Gorongosa National Park, Mozambique, uses the *Plan Vivo* model created by BioClimate Research and Development. It is helping improve livelihoods by establishing agro/forestry systems that provide significant income for carbon sequestration and other benefits such as fruit, timber, fodder, and fuel wood, and improved soil structure.

Other project components are enhancing local organisational capacity, building participants’ understanding of forest stewardship/conservation, and supporting novel income generating activities.

The destruction of terrestrial carbon sinks, such as forests and peat bogs, is estimated to constitute up to 25 per cent of global GHG emissions. In order to reduce this figure, some projects are being established to protect demonstrably threatened carbon sinks. At its core, this type of project is about giving natural resource managers – be they rural communities or government authorities – resources to forestall the destruction of carbon sinks. This approach is controversial. Critics contend that avoided deforestation is too hard to monitor and may simply shift extractive activities, etc. from one place to another. Nonetheless, a number of NGOs (including CARE in Indonesia) have received funding to explore its potential. Early results look promising, and the idea is slowly gaining support.

### 5.2 Mitigation - Assessment

Following an internal process of learning about and reflecting on the implication of climate change for Mozambique, CARE staff recommended that their Country Office:
  o Explore how ‘global carbon markets’ can be tapped in support of CARE-Mozambique’s core mission to reduce poverty. Specific areas of interest include how carbon financing can support/ motivate: improved agricultural practices, the diversification of on-farm incomes (through non-timber forest products) and the conservation of forest resources
  o Reduce emissions generated by CARE projects and operations

In addition, staff suggested that:
  o The CO work with the Government of Mozambique to sell carbon credits on a large scale as a significant source of development revenues
  o CARE Members (especially CARE USA) undertake advocacy within their own countries aiming to mitigate climate change
CARE-Mz is committed to working with small-holder farmers to manage their natural resource base more sustainably. AFOLU projects are complementary to this objective in that they can help the poorest households make better use of – whilst earning supplementary incomes from – their land. Meanwhile, the CO has long been concerned about the overexploitation of forests to meet domestic energy needs. Indeed, forest degradation is common; and this has negative implications for many rural households that depend on forests for their livelihoods and as a living ‘safety net.’

The Olima wo Suka project is a good example of the CO’s emphasis on ‘conservation farming’ which aims to increase soil fertility and harvests through mulching and composting (see Appendix 2). Participating communities have already decreased slash-and-burn practices as a result of these techniques. Meanwhile, the VIDA project has put together a concept paper incorporating carbon sequestration Payments for Environmental Services (PES) in its work to encourage the planting of native, cashew and citrus trees, etc. (see Appendix 3). As such, both are outstanding examples of “multiple-benefit” (i.e. carbon sequestration/climate change mitigation, long-term poverty reduction and natural resource conservation) projects.

CARE-Mz is in the planning stage of further multiple-benefit projects around:
- Cabo Delgado/Nampula and, possibly northern Inhambane (non-timber forest products and alternative/sustainable income generating activities);
- Quirembos (fuel efficient cook stoves and, perhaps, improved charcoaling processes, selective tree cutting and/or fuel-woodlots)

Carbon markets provide an opportunity to ‘cash in’ on activities that the CO was already interested in implementing. Fortunately, the CO has many of the skills (e.g. agro-forestry extension, environmental education and alternative income-generating activities), experiences and relationships to make AFOLU and wood-fuel projects work. However, there are two critical shortcomings; namely:
- Technical knowledge about how to leverage multiple-benefits from agro-forestry systems and how to measure above and below ground carbon sequestration
- Business savvy about how to market and sell quantified reductions in carbon emissions (so-called ‘carbon credits’).

In the short-term, the best strategy to redress these weaknesses may be to partner with specialised institutions. In the medium-term, it may be possible and preferable for CARE Mozambique to build many of these skills in-house.

The key question may appear to be whether the CO should implement projects designed to mitigate climate change. Given CARE’s mission and core competencies, perhaps it shouldn’t. However, the right question to ask is whether activities in-line with the CO’s current priorities either sequester carbon or reduce GHG emissions. If so, it may be a mistake to ignore the potential contribution of carbon PES to their viability and/or sustainability.

‘Bio-fuels’ may be a special case. The Government of Mozambique is investing heavily in the promotion of *jatropha* as a bio-fuel crop to feed the (primarily) European transport sector. The soaring demand for plant-based fuel is coming when world grain stocks are at the lowest level in 34 years and when there are 76 million more people to feed each year (Brown 2006). Simply put, a collision is imminent between the world’s 800 million affluent automobile owners and poor people who have to purchase food. Given the rate at which cars consume fuel, higher grain prices appear inevitable. “The only question is when food prices will rise and by how much” (ibid.).
For the more than 2 billion poorest people in the world, many of whom spend half or more of their income on food, rising grain prices can quickly become life threatening. The broader risk is that rising food prices will spread hunger and generate political instability in low-income countries like Mozambique that routinely experience food insecurity.

Both the amount of arable land and water for irrigation in Mozambique are declining due to global warming. As these resource’s come under increasing stress, it would seem foolhardy for the Government of Mozambique to prioritize growing fuel for foreign cars rather than food for local communities. This is not to say that growing *jatropha* is necessarily a threat to food security in Mozambique. However, the risk is great. Therefore, it seems prudent that CARE:

- Avoid promoting commercial bio-fuels *at least* until social and environmental standards for sustainability, and a credible system to certify compliance, are established
- Encourage the Government of Mozambique to demonstrate that commercial bio-fuels can be grown in a way that does not undermine food security and establish an appropriate regulatory framework

In sum: there are alternatives (such as improved fuel efficiency) to growing fuel for cars whilst there are no alternatives to food for poor people. In contrast, the possibility of low-income households growing *jatropha* to supplement or meet their fuel requirements may merit action research. Experiences in Tanzania demonstrate that *jatropha* can be grown so that it does not compete with/displace food crops (e.g. in hedgerows). However, costs to grow fuel were – at least in this context – too high for most households to sustain.

Aside from implementing projects that mitigate climate change, staff felt steps should be taken to limit the CO’s ‘carbon footprint’ (i.e. reduce emissions generated by all CARE projects and operations). This could be done – as it has by other organisations – through a combination of information sharing, awareness raising and office policies. A list of best practices (minimise office equipment left on overnight, reduce travel, etc.) could be distributed to COs.

### 5.3 Adaptation - Description

"Adaptation policies have had far less attention than mitigation, and that is a mistake...we need to think now about policies that prepare for a hotter, drier world, especially in poorer countries.” (Frances Cairncross, Chair of the U.K. Economic and Social Research Council, quoted in Tearfund 2006).

The effects of climate change are already being felt by many of the world’s poorest communities. Even in the unlikely event that GHG emissions suddenly begin to shrink, feedback within climate systems means past emissions will still be taking their toll 1,000 years from now. In other words, climate change is an inevitable part of our future. It is, therefore, crucial that adaptation form a central part of the world’s response to climate change.

Many efforts have been made to define what is meant by adaptation to climate change. According to Smit et al. (1999; 2000) and the IPCC (2001), adaptation refers to the “adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts”. More specifically, it refers to “processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate” (IPCC, 2001).
CARE’s *prima facie* priority lies in reducing the vulnerability of poor communities to current, as well as projected, climate variability and change. Many donors think the way forward is to deploy cutting-edge technology and build big infrastructure. But the experience of NGOs like CARE suggests that investing in disaster risk reduction and adaptive capacity at the local level is, in many cases, far more effective. As a bonus, these activities yield immediate benefits that reach beyond the objective of tackling climate change.

Therefore, development-oriented NGOs are already helping vulnerable communities by:

- Reducing climate-associated risks (i.e. tackling people’s exposure to hazards)
- Enhancing the adaptive capacity of poor households, their networks and institutions
- Mainstreaming climate change considerations in all assistance programmes

### 5.3.1 Reducing climate-associated risk

Disaster Risk Reduction (a.k.a. Risk Management) entails the “systematic development and application of policies, strategies and practices to minimise vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development” (UN/ISDR 2002).

This pro-active, long-term approach to addressing natural disasters is already advocated by CARE (n.d.), as well as the Red Cross and Red Crescent (2005), the World Bank (Burton and van Aalst 2004), and DFID (2005). It can strengthen traditional strategies to cope with adverse climate conditions or introduce new ways to deal with unprecedented threats.

### Box 10: Climate risk reduction activities

**Source:** Red Cross and Crescent 2005: 9

Examples of activities that reduce climate risk:

- Building drainage systems
- Reforestation and replanting of mangroves
- Substituting cows for camels
- Adopting new crops and agricultural methods
- Water harvesting, and
- Radio early warning systems

### 5.3.2 Strengthening adaptive capacity

According to the IPCC (McCarthy *et al.* 2001), vulnerability to climate change is determined by *exposure, sensitivity* and *adaptive capacity* — each of which is, in turn, heavily influenced by economic, cultural and political factors. Thus, the poorest people are often more exposed to climate hazards, more sensitive to their impacts and least equipped to deal with their consequences. The human disaster in New Orleans that followed Hurricane Katrina is illustrative: poorer communities often occupied the most flood-prone areas (they were most *exposed*), had the least robust housing (making them more *sensitive* to hurricane damage), and lacked access to resources and supporting institutions that might have helped them avoid the worst impacts of the hurricane (e.g. access to early warning systems, capacity to evacuate their properties quickly and resources to find alternative accommodation). Indeed, many people who couldn’t afford insurance stayed home to protect their property from looters despite the risk this posed to their lives. Loss of assets subsequently reduced their ability to recover and adapt after the event, putting them at greater risk of future disasters.

*Coping* is about dealing with relatively short-term conditions, like a drought. In contrast, *adaptation* is about adjusting to long-term situations, such as a fundamental change in drought frequency. *Adaptive capacity* refers to the ability of poor households, their networks and institutions to manage the effects of such change (Tschakert 2006).
CARE and other NGOs can enhance poor people's adaptive capacity by helping build their assets (e.g. human, social, political, natural, financial, and physical capital) whilst breaking down the barriers they face to effective action (e.g. poor governance and discrimination).

5.3.3 Mainstreaming climate change considerations

As an underlying cause of poverty, climate change has dramatic implications for the direct costs and feasibility of achieving the Millennium Development Goals that underscore CARE’s programming. Thus, some NGOs are integrating:

- policies and measures that address climate change into development planning and ongoing sectoral decision-making, so as to ensure the long-term sustainability of investments as well as to reduce the sensitivity of development activities to both today’s and tomorrow’s climate (Eriksen et al., forthcoming).

In other words, these institutions are ‘mainstreaming’ climate change considerations throughout their programmes by:
- Responding to emergent threats and opportunities triggered by climate change
- Climate proofing development and emergency relief activities

Responding to challenges and opportunities (a.k.a. ‘mainstreaming’ at the strategic level): Climate change will reshape the constellation of challenges and opportunities we currently face to achieving the Millennium Development Goals. Water and sanitation, health, livelihoods, social equity, food security, conflict and displacement will be especially affected. Indeed, each of these sectors will need to carefully recalibrate what it does and how in light of climate change impacts (e.g. diminishing water supplies, expanding disease vectors and/or ecological fragility). In addition, CARE Members and Country Offices will have to reassess where the need for assistance is greatest and what needs to be done.

Climate proofing (a.k.a. ‘mainstreaming’ at the project level): ‘Climate proofing’ is about acting with both climate change realities and projections in mind. For example, Water Aid expects key aquifers in Tanzania and Ethiopia to dry up or subside as a result of the slower recharge rates associated with climate change. In response, deep boreholes are being considered even where shallower – and substantially less expensive – wells might currently suffice (de Waal 2005).

In the context of emergency relief and rehabilitation, the principle of climate proofing is commonly called ‘intelligent recovery.’ It may justify helping people move out of flood-prone areas. It should also shape less dramatic, but similarly important, decisions. The 1999/2000 Mozambique floods illustrate the danger of foregoing due consideration of climate change. Indeed, the hybrid seeds handed out to survivors were ill-suited to the country’s increasingly chaotic, but generally drying, climate. The intolerant plants withered and died during the next year’s drought; and this added to the suffering of communities that intervention was intended to assist.

More and more donors are demanding that development projects and emergency relief operations pass the litmus test of climate proofing.

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12 For more information on how climate change will affect achievement of the MDGs, see Reid and Alam 2005
5.4 Adaptation - Assessment

CARE-Mz recognises climate change as an ‘underlying cause of poverty,’ and staff recommend that the CO should continue:
- Reducing communities’ exposure to climate-related hazards (through DRR programming, etc.)
- Strengthening communities’ adaptive capacity

In addition, staff think the CO should ‘mainstream’ climate change considerations into:
- Strategic level planning about what kinds of activities are prioritised and where
- Project planning so as to ‘climate proof’ interventions in various sectors

The Government of Mozambique, in its Initial National Communication to the UNFCCC (2003, 87), identifies the following adaptation activities for the country:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Proposed Adaptation Measures</th>
<th>Comprised area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture (Crop maize)</td>
<td>Adjustment in management practices such as changes in crop types, season and location of farming or development of intensified and mechanised farming; Promotion of drought tolerant crop varieties and livestock in drought vulnerable areas; development of infrastructure for irrigated agriculture; Monitoring and control of migratory and seasonal pests and diseases; Promotion of yield increasing technologies e.g. manure and other crop.</td>
<td>Chokwe</td>
</tr>
<tr>
<td>Water resources</td>
<td>Development of integrated water master plan for each river basin; Construction of small dams; Public awareness campaign in water conservation; Rehabilitate flood forecasting and warning systems and mapping of flood and drought prone areas.</td>
<td>Limpopo, Incomati, Pungue, and Zambezi Rivers</td>
</tr>
<tr>
<td>Coastal Resource</td>
<td>Inventory of the coastal zone and development of a data centre; Strengthening the institutional and legal framework in coastal areas; Establishment of coastal zone management centre; Integrated coastal zone management</td>
<td>Beira</td>
</tr>
<tr>
<td>Grassland</td>
<td>Alternative grazing systems; Changes in stocking rates; Changes in the timing of the grazing period; Changes in the genotype of the livestock and farming of improved animal feeding grass</td>
<td>Chokwe</td>
</tr>
<tr>
<td>Forest</td>
<td>Extensive and intensive forestation, using species compatible with the foreseen climate.</td>
<td>Chokwe</td>
</tr>
<tr>
<td>Meteorology/Hydrology</td>
<td>Strengthen capacity in long-lead climate forecasting; Promote the uptake and use of meteorological information and warnings especially in disaster prone areas.</td>
<td>Chokwe</td>
</tr>
</tbody>
</table>

As a starting point, CARE-Mz should contribute to the further framing of national adaptation priorities (see section 5.5, Advocacy) – ideally with input from the communities we serve. Second, the CO should look for ways to support the implementation and evolution of Government’s National Adaptation Plan of Action (NAPA).

Reducing climate-associated risks: Tropical storms, droughts and floods often strike Mozambique. The intensity and frequency of all three are increasing whilst, in many parts of the country, the effectiveness of people’s traditional coping mechanisms is eroding. Tropical storms have country-wide impacts, though the greatest threat is to coastal zones. El Niño events are worsening. Some scientists fear they may become a permanent condition. Regardless, the droughts they cause will continue hitting southern Mozambique hardest. As weather patterns generally become more erratic and volatile, the country’s central and southern zones will be most affected.
Communities in these areas are especially vulnerable to distinct climatic hazards and may merit special consideration and Disaster Risk Reduction/Management assistance. Such activities would complement CI’s growing commitment to:

- design, implement, monitor, and influence development, relief and rehabilitation programmes and interventions in ways that avoid or limit the adverse impacts of hazards and minimize related disasters; as well as ensure effective response to the impact of hazards (CARE n.d.).

CARE-Mozambique has substantial experience implementing activities that reduce communities’ exposure to some climate-related hazards, including the promotion of:

- Farming systems adapted to drought and disease
- Conservation farming
- Water harvesting and management systems
- Diverse income generating activities which provide incentives for the conservation of local natural resources

The last example may be an important area for further work as studies cited by the CO indicate that poor harvests can drive a huge increase in the unsustainable exploitation of natural resources – especially forests. As a coping mechanism, this is troubling. As a default adaptation strategy, it could prove disastrous. Therefore, CARE should continue helping vulnerable communities develop alternative income generating activities. The IDEMU project, which promotes apiculture, illustrates one way to raise incomes and add economic value to forest resource conservation.

A lot of the CO’s ‘development work’ is already linked to emergency programming, with DRR as a central objective. These experiences should be gleaned for lessons learnt and shared with other COs. CARE-Mozambique also has experience targeting especially vulnerable areas of the country for DRR activities. Integrating climate change projections into regular ‘vulnerability mapping’ exercises could enrich this practice and provide a means of integrating climate change considerations at a strategic level.

**Strengthening adaptive capacity:** Though this area of intervention was not singled out as being of special interest to the CO, staff implicitly recognise its importance. Perhaps it is regarded (quite reasonably) as an inseparable part of a community-based approach to climate risk reduction. If so, the CO seems well prepared to develop and demonstrate cutting-edge practices. Indeed, it could focus on one or two sectors – such as water – where it is already trying to strengthen stakeholders’ capacity for sustainable development and modify activities in light of changing climatic conditions. This would add substantial value to CARE’s philosophy of Integrated Water Resource Management (IWRM).

Different social groups have different adaptive capacity, and any activity (from income generation to health, to education) that redresses inequity is a step in the right direction. Nonetheless, targeted interventions will provide the biggest ‘bang for the buck.’ Social mapping would be an excellent way for the CO to identify especially vulnerable social groups. Participatory techniques similar to those often used by CO staff could be used to identify best bet activities (seeking to build and/or preserve adaptive capacity).

CO staff drew special attention to the plight of households living with HIV/AIDS. Infection rates are extremely high in Mozambique, and associated illness – as well as social stigma – has a tremendously adverse impact on adaptive capacity. At the very least, this suggests the importance of extending HIV/AIDS programming to areas especially hard hit by climate variability and change.
Mainstreaming climate change considerations: CARE-Mz would like to integrate climate change into its work at both strategic and project levels. Staff suggested that they could begin by treating climate change as an underlying cause of poverty. This would be a practical way to bring climate change into deliberations around LRSPs, and it may sharpen decision-making about the kinds of activities the CO chooses to prioritise. However, some form of vulnerability mapping would still be needed to inform decisions about where the CO chooses to prioritise working.

At the same time, the CO would like to integrate climate change into current and future projects so that intervention outcomes are more resilient and can make a lasting contribution to reducing poverty. This implies that taking climate change into account should become a fundamental part of the project design process. One way to do this may be through better understanding and use of climate change scenarios. Whilst ‘mainstreaming’ should be a medium-term goal, it could begin sooner by incorporating climate change considerations into two or three current projects. In order to do so, though, technical support would be necessary. Support may also be required to help the CO monitor and evaluate its efforts at mainstreaming (indicators could help COs know when they are making progress, identify shortcomings, etc.).

5.5 Advocacy - Description

In the past, CARE’s programming focused narrowly on effecting change at the grass roots. Yet, the causes of poverty and injustice frequently stem from decisions by national legislatures, international organizations, and other powerful institutions. ‘Advocacy’ is about engaging and changing these actors whose beliefs, attitudes and behaviour profoundly impact so many peoples’ lives.

Over time, CARE has come to define advocacy as “the deliberate process of influencing those who make policy decisions” (CARE Policy and Advocacy Unit n.d.: 1). Its objective may be to change bad policies or promote new ones. Regardless, CARE’s advocacy work is always:

- Grounded in field experience
- Rooted in a rights-based perspective

A solid grounding in field experience ensures that CARE’s agenda for change reflects real-life priorities: both those of especially vulnerable social groups and institutions trying to help them more effectively. CARE’s operational nature also gives it credibility and opportunities to monitor the implementation of policies.

CARE’s rights-based perspective is similarly significant. It drives CARE to work directly with poor communities in identifying chronic, systematic violations of their rights, analysing sources and causes, and developing appropriate responses. In so doing, it lends CARE’s voice special legitimacy and its positions special force in policy arenas.
5.6 Advocacy - Assessment

CARE-Mz recognises that advocacy can influence government policies, and that doing so is an important way of pursuing both climate change mitigation and adaptation goals. Staff suggested that their voice might be amplified by forming a national-level coalition of CSOs interested in climate change. They also suggested that CARE Members (especially CARE USA) advocate that their governments support international policy frameworks aimed at mitigating climate change and helping poor countries adapt to unavoidable impacts.

The CO's current capacity to engage in advocacy activities is limited. However, the situation will soon improve when it's Governance and Partnership Coordinator comes on board. The Coordinator should be able to help CARE:

- Leverage it's excellent relations with government at national, provincial and district levels
- Prioritise policy change objectives
- Clarify who should be targeted by advocacy activities and when key windows of opportunity exist to inform policies

The CO will prioritise advocacy topics and messages within the next seven to twelve months. Climate change may be selected. If so, there is a great deal of potential to collaborate with likeminded CSOs in an effort to influence government, donors and others concerned with poverty reduction. Indeed, the International Institute for Environment and Development (IIED) has been supporting a ‘Capacity Strengthening in the Least Developed Countries for Adaptation to Climate Change’ (CLACC) Fellow in Mozambique for several years; and one of their goals is to establish a national chapter of the Climate Change and Development Working Group (CCDWG) responsible for the highly regarded ‘Up in Smoke’ reports. In addition, the Mozambique chapter of the Red Cross and Red Crescent Societies is participating in that organization’s programme on climate change (as CARE-Mz is participating in CI’s). CI and the Red Cross/Red Crescent are already beginning to collaborate on climate change at a global level, and doing the same at country level would seem ideal.

If a local chapter of the CCDWG is established, members could share their field experiences with government, provide policy recommendations and monitor implementation. Several subjects for advocacy stand out, including:

- Government’s high-risk strategy of promoting jatropha for the European bio-fuels market
- Ministries’ limited understanding of what climate change means for their mandates and programmes
- The lack of consideration in Government’s National Adaptation Plan of Action (NAPA) for different social groups’ relative vulnerability to climate change (e.g. women’s greater vulnerability vis-à-vis men)
- The further framing of national adaptation priorities (where, what and who)
- Greater emergency preparedness by Government institutions alongside greater efforts to address the root causes of food and other emergencies
- Standards of intelligent recovery that are likely to reduce the impact of storms, floods and droughts in the future

As such, advocacy would play a strategic role in supporting and scaling-up activities undertaken by CARE in Mozambique.
6 Conclusions

Because of the limited resources they have at their disposal, and because of the formidable barriers they face to effective action, Mozambicans are amongst the most vulnerable people to climate change in the world. This is particularly true of people living in drought and flood prone areas. Though it is difficult to ascribe any specific event to global warming, people in those communities with which CARE-Mz is working frequently claim their climate is changing in unprecedented ways. Staff have corroborated these conclusions and noted how:

- Temperatures are rising and rainfall is getting rarer in Manica Province
- Droughts are occurring every 5 years instead of 12 to 13 in Northern Inhambane Province
- Rains have become unpredictable in Moma and other parts of the country

CARE-Mz staff draw strong linkages between climate change, their mission and current activities – especially those concerned with food security, natural resource (including forest, soil and water) management, and humanitarian response to emergencies. As a result, they agree that the CO should position itself strategically vis-à-vis climate change and undertake mitigation, adaptation and advocacy activities. A number of cross-cutting factors conspire in CARE’s favour, including:

- Good relations with government at national, provincial and district levels
- A history of working with organisations, such as the International Institute for Tropical Agriculture, that have complementary mandates and skills
- Strong donor interest in Mozambique and donors’ increasing interest in climate change
- An excellent reputation amongst communities and donors for emergency rehabilitation, agriculture and NRM programming including, it is worth noting, on climate change (the CO is listed by USAID as one of its “partners in climate change activities”)
- Strong staff skills in relevant areas (such as conservation farming and water resource management)

On the basis of this firm foundation, staff want to mainstream climate change by taking it into account at strategic and project levels. This implies using climate change projections to inform the next iteration of the CO’s LRSP. It also entails using climate change science to inform the Design, Implementation, Monitoring and Evaluation (DIME) of projects that reduce people’s vulnerability to climate-related risks and other projects contributing to the MDGs.

In order to start mainstreaming climate change, the CO will need training in appropriate methodologies and technical support in applying them. Colleagues in Tanzania specified their need for:

- Guidelines stipulating how climate change can be factored into the design, implementation and monitoring of future programmes
- A methodology for assessing the extent to which current programmes are affected by/impact climate change and how they can be adapted to both climate proof and climate friendly

It would seem that staff in Mozambique have similar need of a ‘toolkit,’ as well as experience sharing within and beyond CARE, to help them mainstream climate change.

Much more support will be necessary, at least in the medium-term, for the CO to undertake effective mitigation and advocacy activities. Given the nature and extent of current staff skills, it may be possible to build the CO’s capacity for mitigation
activities through intensive, short-term (>5 years) technical support provided within the context of a project (i.e. ‘learning by doing’). It seems that the CO’s preferred advocacy activities would have very different needs. Indeed, this may require low-intensity, long-term (if not ‘continuous’) technical support to determine appropriate stances vis-à-vis bio-fuels, the incorporation of climate change science in public policies, emergency response preparedness, etc.

Some financial support would be required if the CO is to get involved in advocacy activities. This could be generated through projects. Regardless, CARE will need to work with partners in order to be as effective as possible. At present, their number is limited. Building awareness, understanding and useful skills in other CSOs may therefore be a necessary part of the CO’s approach to addressing climate change. If it does so, CARE will be at the forefront of those institutions who understand — in the words of the U.K.’s Foreign Secretary, Ms. Margaret Beckett — that “Dealing with climate change is an imperative for today, not an option for tomorrow” (Beckett 2006).
Appendices

Appendix 1

Analysis of country programme and staff recommendations

As part of the Poverty-Climate Change Initiative, CARE Mozambique’s Senior Management Team participated in a ‘mini-workshop’ examining climate change and its linkages to poverty and CARE-Mz activities. The ACD organised a follow-up session exploring how the CO would like to proceed and identifying strengths, weaknesses, opportunities and threats to doing so. The results, as reported by the CO, are presented below.

A.) What the CO is committed to doing

Overall, CARE Mozambique has been working with the small-holder farmer to manage their resources more sustainably. This has included extension work and training in sustainable agriculture practices. Our project, Olima wo Suka, is a good example of working on conservation farming to increase soil fertility and yield through mulching, composting. The communities have also decreased slash and burn through their understanding of these techniques. I have attached the project proposal for you for more details. At moment within VIDA and OWS project under OWS approach, CARE is helping to mitigate CC impact either by carbon sequestration encouraging farmers to leave trees in their fields, either by promoting sustainable agricultural practices that reduce the impact of irregularity of rains on crop production, reduce Evapo transpiration and soil erosion, increase water conservation (mulch, cover crops) and reduce chances for forest degradation by promoting improved fallow which prevents opening new fields. OWS could integrate fodder production for livestock.

As another area, VIDA and other projects are encouraging carbon sequestration through tree-planting (cashews, native trees, citrus trees, etc).

On the mitigation side, we are committed to working on the non-timber harvesting activities (in Cabo Delgado/Nampula -- possibly in northern Inhambane) as an alternative income generation but also for communities to value their forests, in terms of climate risk reduction, we are doing quite a bit in adopting new crops (drought and disease resistant), we’re also doing quite a bit of work in water harvesting and productive use of water. Quite a bit of our work has been helping communities in diversifying their income (farm, non-farm) as part of community adaptation. For example, our IDEMU project highlighted apiculture as a way for communities to value forests and have another source of income. A lot of our work also has links to emergency programming and mainstreaming emergency mitigation throughout our programming. Currently, our drought-related activities are focused on irrigation, water and drought resistant varieties in a chronically vulnerable area.

In terms of future programming, we have been looking at diversification of practices near protected areas (Quirimbas) in a concept paper for Sail Foundation with WWF. We have been examining the issue of fuel-efficient stoves and also toying with the idea of looking at the charcoal industry. In addition, we could work with charcoal workers to help reduce deforestation with direct impact on reduction of environmental impact as well supporting women by reducing the time needed for firewood collection -however there are limitations to this because of the city’s demand for charcoal (could be fuel efficient stoves, but maybe something more - don't know what?). This could translate into selective tree cutting as well as plantation new trees. Expected impact is carbon sequestration, reduction of environmental degradation as well increase income for the community in the long-term. Another possibility is carbon sequestration projects to help the poorest use the one resource they have - land - to earn a steady income and protect them against the vagaries of life (climate, disease and politics). They offer a way of ensuring that any help we give the poorest to raise their incomes and asset base is not eroded or lost by subsequent disasters. CARE could learn from private companies like TCT (timber and furniture in Beira) who are an example for good forest management and are looking into getting carbon credits for their work. However, I (Michelle) have some concerns around the carbon sequestration projects because the process is not straightforward, it's a long time investment and would require quite a bit of management (maybe we don’t understand it very well?). However, if there is support in this area, it could be of great potential for CARE Moz.

Another possibility is assisting GoM to identify opportunities of selling carbon credits at a large scale as a source of income for the rural population and for the government. For example sasol might will need to invest in creating carbon credits since they are producing a lot of green house gases, however CARE can influence building
CARE INTERNATIONAL POVERTY-CLIMATE CHANGE INITIATIVE

regulations to include solar energy for warm water and cooling purposes (and other energy saving techniques) on every new development in Mozambique.

Within CARE, we could develop an environmental policy at office level - options for cutting energy and paper consumption for example.

The CO would like to do more work on influencing policies and advocate, but with our new Governance and Partnership Coordinator, we are still in the process of choosing our key advocacy topics over the next 9 to 14 months. We do know that advocacy can influence the decision-making at all levels, but just need help in this area. CARE could try and act as a facilitator to bring together civil society groups that have an interest in working on climate change issues. an advocacy group can be formed which provides the ministry with experiences from the field an recommendations on policy development (based on CARE Tanzania experience)

In terms of mainstreaming, we would like our program design to reflect climate change as more of an underlying cause of poverty and try to make more linkages in our programming for community adaptation. Overall, mainstreaming and consider climate change in all projects (including health - water, malaria; water projects - availability, quality; ... ) - as discussed can be in mitigation and do no harm but also in creating carbon sinks

B.) CO SWOT for responding to climate change:

Strengths
- CARE Mozambique has an excellent reputation in agriculture, rural development, natural resource management programming.
- We have had recognition of our work from donors and community members, therefore funding these types of activities is easier
- Successfully working on the emergency-rehabilitation-development continuum with continued capacity in emergency, 20 years presence in CARE Mozambique
- Strong staff capacity in agriculture, water and health
- Strong linkages/work at community level, especially in the area of conservation farming and productive use and management of water resources.
- Excellent links with government at national, provincial, district levels

Weaknesses
- Still difficult for us to work effectively on advocacy
- Still difficult for us to document and disseminate our experiences, particularly given the challenges with languages
- Current funding and pipeline issues
- Still improving our work with partners

Opportunities:
- Good relationships with government at various levels
- Good partnerships with organizations focused on economic/agriculture issues, such as IITA and others
- Strong donor interest in Mozambique overall (as you mentioned, CARE is on the USAID website as a partner in climate change)

Challenges:
- Limited conversations with government on climate change particularly since the focus is on economic development, education, water (as listed in PARPA II).
- Limited number of local partners to work with on these issues
- Lack of clarity around with whom to advocate to whom and when
- Lack of understanding of the governmental policies around environment, climate change (particularly from MICOA)
- Main concern around the government's promotion of jatropha and biofuel and the potential negative impacts that may have on the small farmer in terms of environmental issues and food crops.

C.) Requirements for support: Given that Tim, who has been our champion in this area is leaving, we need to still solidify the 2-3 staff who can help move this forward. It would be helpful to arrange another visit to discuss follow up with the Danish Embassy on environmental issues - as well as find other donors interested to support us. We would also like some support in reviewing program designs to see if we have highlighted climate change. A
much larger investment in the CO would be to help us look at this as a policy issue (and see if we could advocate effectively) - and financial resources to support that.

CARE Mozambique does have contact with Michaela Cosijn, who is working for SEED as a monitoring and evaluation consultant. She has done her masters in climate change - she has a very good knowledge of mozambican environmental law and of inhambane province in particular since she did a lot of environmental studies for Sasol in the area.

We would like to continue to have information shared with us and also examples from other COs and other organizations shared. And, one of the hot issues right now in Mozambique is the jatropha/biofuel debate. The Government of Mozambique is insisting on people planting jatropha, but it's not clear as to the implications. Some of the farmers CARE works with do plant jatropha. CARE would like to monitor whether jatropha has positive/negative effects on food/economic security but also knows that there may be very limited space to discuss/advocate with the government.
Appendix 2

Olima Wo Suka Project Concept Note (abridged)

A project designed to raise crop yield and income of smallholder farmers in Nampula province by introducing improved sustainable soil fertility and water management systems. The project emphasizes participatory farmer research and documentation to share within southern Africa (and possibly beyond)

What’s not working?
It is estimated that 71,000 tons of maize are exported from northern Moçambique to Malawi every year. This is approximately 10% of maize production in this region. In addition northern Moçambique exports about 3,000 tons of beans, 15,000 tons of sesame, 15,000 tons of peanuts, 5,000 tons of pigeon pea, 20,000 tons of cotton and 20,000 tons of Tobacco.

Despite this seeming abundance, agricultural productivity per unit area and per farmer is extremely low by international standards. Average crop yield is seldom above 1 ton per hectare and farmers market produce worth only $100 a year. Crop yield is roughly two thirds of that of neighbouring countries who themselves have very low crop yields by international standards. The use of modern inputs and mechanisation is almost non-existent (less than 2% use fertilisers or pesticides, around 5% use animal traction and less than 10% use some equipment). In addition, 95% of the land cropped is cropped by smallholder farmers while less than 4% is in the private sector.

The farming methods used are essentially extractive being based on the cutting down of forest to access fertile soils which are abandoned after a few seasons when they have become depleted of nutrients. Annual burning of both forest, fallow and crop land result in a further loss of soil nutrients and a further decline in soil fertility.

Inherent problems:
- Sandy soils. Most soils in Nampula province are sandy loams which are prone to erosion and which have an inherently low fertility. Without the addition of organic and inorganic fertilizers these soils rapidly become exhausted and eroded, cereal and cash crop production cannot continue and only cassava can be grown.
- Fertilizer that most farmers could not afford. Farmers in Nampula province pay roughly two times the world price for fertilizer ($50 a 50 kg bag) making it’s use only profitable on the most lucrative crops such as tobacco and vegetables Under these circumstances the ability of farmers to replace nutrients removed by crops becomes limited to the use of manure and compost.
- Erratic rainfall means that crops can suffer long periods of drought, reducing crop yield and quality.
- Population pressure is forcing families to seek new land for cultivation far from their homes

7.3.1.1 The consequences
- Increasingly large zones around villages are developing where land is infertile and largely abandoned.
- The continuous felling of forest to exploit the soil fertility under forests
- The need to walk increasing distances to fields.
- Increasing competition between farmers for the last remaining fertile soils with consequent conflicts over land tenure within communities.
- An increasing number of farmers (the old, orphans, female headed households or the chronically sick) who cannot walk to the now distant fields or through lack of social contacts are loosing out in the competition for gain the best land. As a consequence they are left with only the exhausted soils.
- Farmers become increasingly dependent on cassava as a food source as this is the only crop that will continue to produce on low fertility soils.
- A narrowing of the food base for the most vulnerable in the community. This can lead to a total food production collapse when the main staple food crop fails as happened in parts of coastal Nampula Province following an outbreak of Cassava Brown Streak Virus.

7.4 Agricultural production potential
Research conducted by CARE and other organisations in northern Moçambique has shown that:

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14 Results from Midterm Household Survey, VIDA II Project, CARE International in Moçambique, Maputo, Moçambique, September 2004
15 Censo Agro-pecuário, Instituto Nacional de Estatística, Maputo, Moçambique, August 2001
Groundnut yield can be tripled by the use of a combination of disease resistant varieties, early planting and correct plant spacing.

Sesame yield can be double by a combination correct variety, spacing and planting date.

Micro doses of triple super phosphate (50 kg / ha) will profitably double groundnut yield.

Use of planting basins filled with crop residue will increase maize and groundnut yield by 50%

The use of locally available botanical insecticides with double cowpea yield.

Switching to hybrid maize varieties will profitably increase maize yield by 25%

New short season varieties of sorghum yield 50% more than locally grown varieties in half the time and 50% more than maize.

The use of contour ditches and barriers raises crop yield.

Inoculating beans with rhizobium inoculum increases bean yield by 40%.

Short season varieties of cowpea that can produce two or three crops a year and are resistant to important diseases such as yellow mosaic virus have been selected.

Cassava varieties tolerant to the devastating cassava brown streak varieties have been selected.

A number of green manure crops have been identified that are locally grown. These include crotalaria, velvet bean (Mucuna), gliricidia, tephrosia, dual-purpose leafy cowpea varieties and perennial pigeon pea varieties.

Although there is still much research to be done, this basket of technologies, if used correctly, could form the basis of productive farming systems that would greatly improve the incomes of smallholder farmers.

7.5 The vision – the optimal combination of practices

The project will assist farmers adopt an integrated soil fertility and water management approach to crop production known as Olima Wo Suka (OWS) in the local Makua language. This will be done by providing training in OWS, inputs for demonstrations and the opportunity to conduct research into soil and water management related subjects. The approach is based on the implementation of a minimal tillage approach in which tillage is restricted to the preparation of rows of planting holes. Fertilizer and crop residues are placed in the same holes every year. As a result these holes become a centre of fertility in which crop growth can flourish. Soil fertility between the rows declines, thereby making it difficult for weeds to flourish. Compaction pans are broken up in the holes by deep tillage within the holes. As a result roots penetration and growth is facilitated allowing crops to access crop nutrient and water at depth. Inter row tillage is not practiced and weed growth and soil erosion is minimised by placing a thick mulch between the rows. This is produced from crop residues and plant material produced by cover crops grown as intercrops between rows of the principle crops.

Soil fertility is maintained by:

- A one year improved fallow consisting of gliricidia and pigeon peas,
- The use of grain legumes in the crop rotation,
- The cultivation of cover crops that are used to produce a thick mulch.
- The placement into planting holes of low rates of composted manure collected from stall fed small livestock. These are fed on gliricidia grown on contour barriers and in the improved fallow
- The placement of phosphate fertilizers and lime in the planting holes.
- And the Placement of crop residues into the planting holes during the dry season.

Water retention is increased through the use of:

- Permanent planting holes that tend to act as micro catchments collecting around crops rain water.
- Inter row mulches
- and contour barriers.

Pests will be management through the use of neem which will be extracted from trees grown as a wind break in the fire breaks cleared around the fields.

7.6 Likely Benefits

7.6.1 Economic

Appendix 2 presents two models, one showing the production and income from a farm using traditional production methods and one showing the production and income from a farm implementing OWS methods. Even if it were assumed that only half of the expected yield improvements accruing from adopting OWS are realised the farmer adopting OWS methods would still gain a 110% income improvement. This is with almost the same labour input and similar amounts of staple food produced in the two systems. Higher grain yield and the need for less labour to clear forest for crop production means that the OWS method allows farmers to switch land and labour from low value staple food crops into higher value cash crops. This results in a substantially high income without reducing staple food production.
7.6.2 Labour
Experience from Nampula Province in Moçambique and from Zambia and Zimbabwe indicate that after an initial investment in labour for preparing the planting holes there is a saving in labour compared with traditional farming systems. This is partly caused by a reduction in the demand for labour for land preparation but mainly by a reduction in the time needed for weeding. Mulches and cover crops such as cowpeas smoother weeds meaning that after an initial light weeding further weeding is not needed. In some cases farmers in Nampula province have stated that they did not have to weed crops grown with mulch between the rows. As planting and weeding are often women’s tasks this technology could reduce considerably the labour burden for women. The elderly and those families caring for people with chronic illnesses would also greatly benefit from the lower labour needs of the OWS system. Of equal interest to these families is the fact they could use these systems to maintain or even regenerate depleted soils. This would mean they would be able to produce food and an income from fields near their homes negating the need to walk long distance to the more fertile fields.

7.6.3 Nutrition
The reliance on grain legumes, a strict rotation with a range of crop types and the targeting of fertilizer use on high value crops such as peanuts and sesame will mean that families have a more diverse and nutritious diet. Thus soils that could only support cassava production would under this system also support the production of cereals such as sorghum and maize and oil seeds such as sesame. This increased availability and diversity of nutritious foods within participating families will have an impact on child nutrition.

7.6.4 Environment
The major impact of the introduction of the OWS system on the environment will be to eliminate the need to clear approximately half a hectare of forest a year for annual crop production. It is estimated that Nampula farmers clear 137,000 hectares of forest or secondary bush a year for agricultural purposes a year. This represents 3% of the forest and secondary bush cover in the province and that at that rate of forest clearing almost all forest in Nampula province will be lost by 2035. Adoption of OWS systems would preserve this forest cover preventing the loss of important wild life habitats and preserving forests as a source of income (such as from beekeeping). The mulching systems and contour barriers used virtually eliminate soil erosion preventing the siltation of rivers and improving percolation of rainfall into the soil. This in turn will raise water tables and the availability of water in wells.

The use of slow release fertilizers such as rock phosphate and lime will eliminate the rapid release of harmful chemicals into the environment that will occur from the use of more soluble forms of fertilizer. Triple Super Phosphate could cause environmental damage if it was applied in large quantities but at the rate to be used in this program it is considered that the impact on water quality will be minimal.

Neem is a natural pesticide that has a very low mammalian toxicity and very quickly degrades into harmless residues. It can be harmful to bees and fish and so it will not be used when crops are flowering and care will be taken to ensuring farmers are taught not to empty spray residues into rivers and ponds.

7.7 Research needs
Although much of this collection of technologies is based on sound research much needs to be done to develop recommendations that suit specific soils and climates and to test other promising technology that could be added to the OWS system. There is a need to:
- Test the responsiveness of crops to phosphate fertilizers over a wide range of soil and climatic types within Nampula province. In particular little is known of the response of sesame to phosphate and nitrogen fertilizers.
- Test the responsiveness of food crops such as maize and cassava to residual fertilizers applied to other crops in a crop rotation
- The response of crops to rock phosphate and lime over a range of soil types and reactivates. Soils in Nampula province range from relatively alkaline soils on the coast to acid soils in the interior. The value of adding lime and rock phosphate to these soils will therefore vary greatly.
- The impact of mulches, cover crops and improved fallows on the yield of crops.
- The value of using Rhizobium inoculants in combination with micro-nutrients such as Molybdenum on grain legumes needs to be assessed.
- The yield improvements derived from the use of permanent planting basins has been well documented but the changes in soil fertility and the physical properties of soil under these basins is not known.
- Only a few of the many species of cover crops available have been tested for their suitability to Nampula growing conditions.
7.8 Project objectives and Outputs

The goal of the project is to “Improve livelihood security of smallholder farmers in Nampula province” but more specifically the aim is to “Improve crop yield and production through the introduction of sustainable soil fertility and water management systems”.

To achieve this, the following outputs from the project activities will be required:

7.8.1 Output 1: Farmers adopt technology that will sustain soil fertility and conserve rainfall

Farmers will not adopt new technology if they do not understand how it works and cannot see it working. OWS is a sophisticated integrated soil fertility and pest management approach that will only give tangible results within years rather than months. There is therefore a need to provide farmers with intensive training and to establish long-term multi-season demonstrations and trials.

A training curriculum, materials and schedule will be developed by a small team of specialist consisting of the project manager, national Food and Economic Security Coordinator, the VIDA project manager, a designer and other staff as required. This team will train 10 extension staff in four phases:

- Preseason training in the principles of soil and water management
- Preseason training in training methodologies, research plot and demonstration layout and monitoring and evaluation
- Farmers field days, integrated pest management and second season activities
- Results evaluations and dry season activities

The extension staff will train 15 volunteer crop demonstrators each. The demonstrators will train farmers in four groups of approximately 15 farmers each. In this way 10 extension staff x 15 demonstrators x 4 groups x 15 farmers = 9,000 farmers will be trained each year. New demonstrators and farmers will be recruited every year with the result that after three years 450 demonstrators and 27,000 farmers will have been trained. The extension staff will receive the same training every year modified according to experience gained from the previous season and the availability of new technology.

The old demonstrators will assist the extension staff train new demonstrators and in doing this they will reinforce their knowledge of the OWS approach. They will then repeat the training they gave in the previous season to new groups they have formed in the dry season. It is anticipated that they will form at least one new group each year in addition to the four groups they formed in the first year. By the end of three years the demonstrators will have trained 6 groups with 90 members. In total it is anticipated that at least 33,750 farmers will directly benefit from this program. It is anticipated that for every farmer trained at least two other farmers will copy at least part of the OWS package giving 67,500 indirect project beneficiaries.

<table>
<thead>
<tr>
<th>Seniority of Demonstrators</th>
<th>Groups / farmers trained</th>
<th>Total groups / farmers trained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>1st yr – 150 trained</td>
<td>600 / 9,000</td>
<td>150 / 2,250</td>
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<tr>
<td>2nd yr – 150 trained</td>
<td>600 / 9,000</td>
<td>150 / 2,250</td>
</tr>
<tr>
<td>3rd yr – 150 trained</td>
<td>600 / 9,000</td>
<td>900 / 13,500</td>
</tr>
<tr>
<td>Total groups / farmers trained</td>
<td>600 / 9,000</td>
<td>750 / 11,250</td>
</tr>
</tbody>
</table>

The extension staff will visit the new demonstrators once every two weeks and meet the old demonstrators at monthly meetings. These will be opportunities for giving demonstrators more training, prepare work plans for the coming month and collect monitoring data. Training will be done through demonstration sites, through exchange visits and field days.

7.8.2 Output 2: System developed that links farmers groups with researchers that results in the selection by farmers of technology that will sustain soil fertility and conserve rainfall

One of the groups established by each extension worker will be developed in a farmers participatory research (FPR) group. Each member of the group will conduct a simple experiment to investigate some of the topics mentioned above. Staff from the Moçambique Institute of Agronomic Research (IIAM) will conduct more detailed experiments at research stations. IIAM staff will be assisted by the OWS project to visit the FPR groups and develop a collaborative relationship with group members that will results in a two way flow of ideas about trials that need to be conducted by farmers and researchers.
Details of soil fertility and water management techniques to be used during the project:

- **Contour ditches and barriers** - Fields marked out with ditches and barriers along the contour and, depending on the steepness of the slope, 15 to 20 meters between barriers. These would capture surface runoff and silt during heavy rain allowing it to percolate into the soil and feeding crops below the barrier with water and nutrients in dry spells between rainy periods. The silt can be dug out of the ditches and used as a fertilizer. These contour ditches and barriers are essential if loss of nutrient rich topsoil by sheet and gully erosion is to be avoided. Perennial crops such a glicidica or pigeon pea can be planted on the barriers to both stabilize them and make use of the space they occupy. The glicidica would cut vigorously to form a low hedge. The clippings from this hedge can be used as a fodder for stall fed goats, or when the leaves are dried as a feed for chickens.

- **Permanent planting holes** – To minimise the need for tilling and to concentrate added crop nutrients and rainfall next to the crop plants the farmer will open planting whole in the dry season when labour demand is low and fill them with crop residue and fertilizers. The holes will be approximately 15 cm deep. The organic matter and fertilizers will be covered with soil and left until the start of the rains. Seeds will be sown into these holes at the start of the rains or when it the planting time is appropriate. The farmer will use the same whole every year increasing the fertility of the soil around the hole.

- **Micro dosing with phosphate fertilizers and lime** – Soils in Nampula are largely deficient in nitrogen and phosphorus. Potassium deficiency is less common. Groundnut would benefit from small, targeted doses of lime. This would reduce soil acidity, reduce the number of empty pods (pops) and improve the size and quality of nuts. It would also encourage nodule formation, which is generally poor in Nampula soils. Nitrogen can be supplied by nitrogen fixing cover crops and improved fallow. The phosphate and calcium would be supplied by applying small doses of crushed rock phosphate and lime and triple super phosphate. A bottle cap full of each would be applied to the planting holes of the sesame and groundnut crops. The maize and cassava would benefit from the residual fertilizer.

- **Intercropping with cover crops** – Crops such as leafy dual-purpose cowpeas or Mucuna beans will be established under maize, sorghum or cassava by planting them in January once the main crop has been well established. They will be allowed to grow freely through the dry season and will be left as mulch once they dry of in the latter part of the dry season. They will fix nitrogen, mobilise nutrients such as phosphates and calcium and repress weeds.

- **Mulch** – the cover crops, crop residue and weeds cleared before planting will form a thick mulch between rows of crop. This will protect the soil from erosion and provide the following crops with nutrients. Experience has shown that termites consume even the thickest mulch within three months taking the mulch below ground where it will eventually rot and provide future crops with nutrients.

- **Improved fallow** – Groundnuts would be intercropped with perennial varieties of pigeon pea and with Glicidica sticks. Experience has shown that pigeon pea can be sown every 5th row of groundnut three to four weeks after the groundnuts have been planted without any adverse effect on the groundnut yield. Glicidica sticks should not be planted into groundnuts before mid February if competition with the groundnuts for water is to be avoided. One row of glicidica in every ten rows of groundnuts should be planted. The pigeon pea and glicidica will be left to grow through the following year fixing nitrogen, mobilising phosphates and other nutrients and through the action of their deep roots breaking up hard pans, which may have developed in the previous cropping cycle. The pigeon pea will yield a valuable crop of peas each year without the need for any labour input and the glicidica will provide fodder for stall fed goats and feed for chickens.

- **Crop rotation** – A four year rotation consisting of an oil seed cash crop such as sesame or soyabean in the first year, food crops such as maize, sorghum and cassava intercropped with cover crops in the second year, groundnuts intercropped with pigeon pea and glicidica in the third year and pigeon pea and glicidica fallow in the forth year. This will ensure a balance of cash crop and food crops are produced and crop pests, diseases and weeds do not build up to serious levels.

- **Fire break** – A firebreak is cleared around the fields. These could be planted with economically important tree crops such as neem or cashew nut that would benefit from the clearing of the soil making the preparation of the firebreak economically attractive to the farmer.

- **Cultivation of Neem** – numerous experiments have show that neem will control pod-boring pests of grain legumes, flea beetle in sesame, aphids and caterpillars on vegetables, grain storage pests and maize and sorghum stalk borer.

- **Production of stall fed small livestock** – confining goats to stalls during the rainy season will prevent them from destroying crops, reduce the cost of labour for herding goats and make the collection of manure easier. Glicidica and elephant grass can be cut and carried to stall fed animals to provide feed. In the dry season they would be allowed to feed freely on crop residue, glicidica and natural pasture. The manure collected would be mixed with grass and crop residues and made into compost. This would be used for vegetable production.
Appendix 3
Nampula province community carbon swaps programme Concept Paper

This programme will use income generated from carbon swaps to develop a community managed funds that will:
• Pay farmers for the planting and maintenance of trees.
• Provide community organisations with funds to allow them to pay for:
  ▪ Training in sustainable agriculture methods,
  ▪ Acquisition of legally recognised land tenure and forest use rights for the community.
  ▪ Training of farmers in forest management techniques.
  ▪ Training of community organisations in forest product processing and marketing.
  ▪ Community managed development programmes

Nampula province with 3.2 million inhabitants and a population density of 40 / km² is the most populous province in Mozambique. It is also the most productive province producing approximately 36% of the nations staple food crops and most of it’s main exportable cash crops of maize, beans, cotton, groundnuts, sesame, tobacco and cashew nut. These crops are largely produced without the use of fertilizer and the farming systems depend on the use of slash and burn systems to maintain production and soil fertility. Charcoal production to supply the fuel needs of the major cities in Nampula province is also increasing resulting in an ever-increasing area close to roads and cities devoid of forest cover.

Primary forest in Nampula province has long since been removed. Of the 8.15 million hectares of land in Nampula province only 0.3% remains covered by primary forest. Of the rest 11.4% is under forest that has in the past been logged or used for farming, 36% is under scrub land recovering from agricultural use, 20% is degraded grassland with scatter cashew nut and mango trees and 32%is under some form of cultivation.

There are an estimated 175,138 families living in Nampula and Nacala cities, the two major cities of Nampula province. At least 80% of these households use charcoal or firewood as their primary source of fuel for cooking. It is estimated that each family will consume 150 kg of charcoal a month requiring an annual charcoal requirement of roughly 1.8 tonnes for each family or 250,000 tonnes for the two cities. Using a conversion rate of 23% (wet wood to charcoal) just over a million tonnes of timber needs to be cut a year to supply the Nampula province cities with charcoal. It is estimated that this requires the clearing of 10,000 hectares of woodland every year. Currently the provincial department of forests is only collecting taxes from the production of 1,200 tonnes of charcoal a year. It is estimate that to maintain production with a five-year production cycle farmers will have to clear a hectare of land every fifth year. Given the farming population in Nampula province it is estimated that 134,500 hectares of forest or scrubland are cleared annually in Nampula province. This represents 3.5% of the remaining forest and land under fallow with light tree cover. At that rate all remaining woodlands will have been cleared within the next 25 to 30 years.

Farmers in general and the poor in particular are highly dependent of forests, not only for new farming land but also for fuel, building materials and food. Forest also protect soils from degradation, maintain water tables and water sources. As soils under much of the forest in Nampula province is sandy and of low agricultural productivity there is a case for arguing that forest based enterprises might offer farmers a better livelihood than agriculture based systems.

The project will aim to both assist farmers produce crops sustainably from the land they have already opened reducing the need to cut down more forest for agricultural purposes and to the same time helping communities earn a living from forest products. These two processes, reduced demand for forests land for agricultural purposes and increased income from forests will mean that farmers will have less need to cut down forests and at the same time a greater incentive to preserve forests.

7.9 Programme Aims and Activities
The aim of this programme will be to assist farmers retain forest cover, develop forest based farming systems, plant trees for economic gain and reduce the use of charcoal in urban centres. To do this the following needs will have to be addressed.

To assist farmer’s plant trees they need:
• Source of seedlings or seed of fuel food, fodder, biofuel trees such Jatropha, cashew nut and fruit trees
• Technical advice on how to grow trees
• Security of tenure over the land they plant trees and concessions for the management and use of forest products.
• Financial support while the trees grow to harvest

To be able to manage existing forest resources farmers need:
• Legal rights over the use and management of forests.
• Assistance with processing and marketing of forest products such as furniture, baobab fruits to produce exotic oils, medicinal products and preserves. To do this farmers associations will need partnerships with private sector timber companies who have experience with managing mobile saw mills and marketing timber.
• Assistance with acquiring organic, fair trade and Forest Stewardship Council (FSC) certification Being community managed enterprises they will qualify for Forest Stewardship Council. This will allow them to market timber products such as garden and kitchen furniture in North America and Europe through DIY stores and Supermarkets as products from sustainably managed tropical forests.

To assist farmers reduce the need to clear forest for agricultural production they need:
• Research into methods for sustainably managing soil fertility and crop production. To do this CARE will work in partnership with the ICRAF Alternatives to Slash and Burn program and the Moçambican Institute of Agricultural research.
• Extraction of lime and rock phosphate from deposits in Nampula province in quantities sufficient to test the economic viability of using these sources of natural fertilizers.
• Training in the use of sustainable farming systems

To reduce the demand for charcoal there is need for:
• Assistance for the Department of forests to collect charcoal production taxes. Taxing char coal in the same way as other fuels are taxed will raise it’s price and make other fuel sources more competitive.
• The introduction of ceramic charcoal stoves that use less charcoal.
• Stimulate the conversion of charcoal use to gas use by providing first time gas users with a free gas burner.

The project will work with 1,000 community organisations representing 50,000 families helping them plant 10 million trees, sustainably farm 50,000 hectares and protect and allow the regeneration of 200,000 hectares of degraded forest within five years. The project will also have positive impact on the livelihoods of the expected 30,000 families who will buy ceramic charcoal burners or switch to over fuels over the course of the project.

It is estimated that this will result in the sequestration of 250,000 tonnes of carbon from tree planting, 750,000 tonnes of carbon from the use of improved fallows in annual cropping systems, 30,000,000 tonnes carbon from a combination of forest regeneration and the prevention of forest burning for agricultural purposes.
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