

# Adaptation to Climate Change in Semi-Arid Environments

## Experience and Lessons from Mozambique



ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT SERIES  
ENVIRONMENT [CLIMATE CHANGE] BIOENERGY MONITORING AND ASSESSMENT





# Adaptation to Climate Change in Semi-Arid Environments

## Experience and Lessons from Mozambique

Stephanie Adgley

OneWorld Sustainable Investments, Cape Town, South Africa

Alemneh Dejene

Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

Andrew Matlick

Food and Agriculture Organization of the United Nations (FAO) Maputo, Mozambique



Government of  
Mozambique



oneWORLD



The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned. The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

ISBN 978-92-5-107135-9

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to [copyright@fao.org](mailto:copyright@fao.org) or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

**© FAO 2012**

**Front cover photos** Left: FAO Mozambique  
Middle: FAO Mozambique  
Right: FAO Mozambique

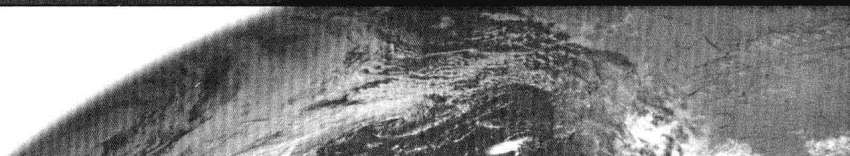
**Back cover photos** Left: FAO Mozambique  
Middle: FAO Mozambique  
Right: FAO Mozambique

**Background image in this page** Illustration elaborated from  
"L'Encyclopédie Diderot et D'Alembert"

**Copies of FAO publications can be requested from** Sales and Marketing Group - Communication Division  
Food and Agriculture Organization of the United Nations  
Viale delle Terme di Caracalla - 00153 Rome, Italy

**E-mail:** [publications-sales@fao.org](mailto:publications-sales@fao.org)  
**Fax:** (+39) 06 57053360  
**Web site:** <http://www.fao.org>





## FOREWORD

Southern Africa is one of the regions most vulnerable to the impacts of climate change. Mozambique, one of the least developing countries in the region and with 2 700 km of coastline, is already experiencing the devastating effects of the increasing frequency of droughts, floods and cyclones on agricultural livelihood (crops, livestock, forest and fisheries) in rural and coastal areas.

Climate change is also expected to have a significant impact on the Limpopo River Basin and its tributaries which enter the Chicualacuala District in the Gaza Province and flow across the vast areas of semi-arid plateau of the southern provinces of Mozambique towards the Indian Ocean. Aware of the urgent need to address the high vulnerability of the population in the Limpopo River Basin, the Government of Mozambique chose the District of Chicualacuala to initiate the United Nations Joint Programme (UNJP) on Environmental Mainstreaming and Adaptation to Climate Change for the period between 2008 and 2011 (total of US\$7 million). The Programme, which is funded by the Government of Spain through the MDG F, has recently been extended until August 2012.

The Ministry for the Coordination of Environmental Affairs (MICOA), through its partnership with FAO and the other partner UN agencies (UNDP, UNEP, UN-Habitat, UNIDO and WFP) has lead responsibility in the coordination of the largest component of the UNJP which builds the resilience of community and ecosystems to climate change and diversification of livelihood options. The collaboration of Provincial and District Government technical staff has been crucial to the success of project implementation. This publication documents the experiences, successes and challenges being faced in implementing the adaptation interventions in one of the remote districts where very few development agencies are operating. It identifies, at farm and community level, adaptive interventions that have been tested and applied and which have shown positive impact on productivity, broadening of the livelihood basis, and improving resilience to climate change. It also draws attention to those interventions that are not so promising and whose sustainability and expansion are questionable.

Valuable lessons learned are highlighted in several areas crucial for the success of future projects and programmes in climate change adaptation. These include: project design and implementation, institutional arrangement and coordination,

gender role, water harvesting and small-scale irrigation, crop and horticulture development, forest and rangeland management, livestock management, integrated small animals and fish farming and livelihood diversification. There is an urgent need to fund and implement programmes in support of national and local development plans that also serve to build climate resilience. Activities should continue building on the progress made by the UNJP in integrating adaption into local and national development plans guided by the needs of the beneficiaries. Programmes and projects in building climate resilience in southern Mozambique will be crucial in our efforts to improve food security, reduce poverty and maintain social stability. This further underscores the need to seek a follow-up intervention on the basis of the lessons learned from the project experiences highlighted in this publication.

We trust that this publication: “Adaptation to Climate Change in Semi-Arid Environments: Experience and Lessons from Mozambique” will serve as a useful guide to policy-makers at all levels of government, field practitioners and international development partners (both multilateral and bilateral agencies) in our joint effort to find new approaches and innovations to address the serious and urgent challenge of climate change.

Finally, in spite of some of the constraints faced in its implementation, we conclude that the “Delivering as One UN” at country level is still a conceptually sound and viable option in addressing complex environmental and climate change issues which require a cross-sectoral approach and collaboration. The Government of Mozambique, through MICOA, will do its part in improving this implementation mechanism for future climate change adaption programmes and projects.

Ana Paulo Samo Gudo Chichava  
Vice-Minister for the Coordination of Environmental Affairs (MICOA)  
Government of Mozambique  
Maputo, Mozambique

---

## ABSTRACT

Southern Africa and Mozambique are highly vulnerable to the impacts of climate change. The region is frequently exposed to droughts, floods, variable rainfall and heat, which are expected to worsen, and sensitivity to such exposure of the natural resource-based livelihood system is very high. The project area is remote and highly underdeveloped and the population is poor, food insecure, and not resilient to the impact of climate shocks. Due to water scarcity, not sufficient for humans and livestock except in a few communities along the Limpopo River, livelihood options are limited. Livelihoods are underpinned almost entirely by the little available water, agricultural lands and rangelands, and natural forests, and current practices and usage are threatening to become unsustainable. Existing coping mechanisms and safety nets are heavily reliant on the natural resources base, and livelihoods are seriously at risk under the projected climate changes. Urgent action is required to strengthen resilience now and into the future, when climate change will present significant additional stress.

In response to this need, the Government of Mozambique (six ministries and national institutes) led by MICOA and the United Nations (six agencies) initiated a United Nations Joint Programme (UNJP/JP) for environmental mainstreaming and adaptation to climate change, with the latter component implemented in a remote district of southern Mozambique, Chicualacuala. This publication gives an account of the Government of Mozambique/FAO-led interventions on strengthening smallholder agriculture, community-based natural resources management, and livelihood diversification in the face of current and future climate-related stresses. It provides the rationale behind each of the activities, innovations and successes, but also barriers and challenges encountered over the three-year project period. The lessons learned are critically analysed, and the opportunities for replication and scaling-up, and for filling in some of the gaps during follow-up interventions, explored.

The key elements which are essential for climate change adaptation in semi-arid southern African regions such as Chicualacuala, include improved access to water for human, livestock and productive purposes, strengthening of dryland crop production by improving soil fertility and water holding capacity, integrated crop-livestock-agroforestry production practices, small-scale crop irrigation where possible, development of the livestock industry (rangeland and nutritional management, health services, processing, and small animals), sustainable community forest management and regulation, and tried and tested

options for livelihood diversification (e.g. beekeeping). Supportive technologies which will make a significant contribution include renewable energy, district-level climate information and communications, and a local centre for development of climate-adaptive technologies.

To ensure success and sustainability, a project such as this UNJP should be supported by careful and considered project design and formulation, sufficient time in the project design and inception phases, a phased approach to implementation with feedback loops built in to accommodate learning, and full involvement of the communities and intended beneficiaries from the start.

With some adjustments, the “Delivering as One UN” approach working closely with the national and local partners is considered to be conceptually sound and should guide future directions in UN climate change adaptation programmes.



---

## ACKNOWLEDGEMENTS

This publication is the result of over six months of work by FAO and could not have been realized without the invaluable assistance of a large number of people and institutions at various levels. We would first like to thank the partner ministries and government institutions involved in the UNJP for their important contributions and comments that provided balance and greatly enriched the final document. Thank you very much to the Ministry for the Co-ordination of Environmental Affairs (MICOA) for creating an enabling environment which opened doors for FAO staff and consultants to successfully conduct this work. At MICOA, the support of Erasmo Nhachungue (National Director for Planning and Studies) and focal point for the UNJP has been fundamental. The other key national partners that are actively contributing to the UNJP and have been supportive to this effort include Berino Silinto and Domingos Mosquito at the National Institute of Meteorology; João Ribeiro and Marta Manjate at National Disaster Management Institute, and Eulalia Macome at the Ministry of Agriculture (MINAG).

The Support of the District Government of Chicualacuala where the UNJP is operating has been crucial and we would like to express our gratitude to Antonio Rafael dos Santos (District Administrator), Manuel Namburete (Director of the District Service for Economic Activities), Carlos Cossa (Chief of Mapai Administrative Post), and Samuel Cossa (former Chief of Mapai Administrative Post). The warm welcome given to us by the rural communities and some of the in-depth discussion held with men and women farmers in the targeted communities provided a deeper insight into the problems linked to climate change that the rural communities are facing. At the provincial level, the support and encouragement of the Provincial Directorate of Agriculture provided essential guidance and technical backup. Thank you especially to Raimo Baraca (Provincial Chief of the Forestry and Wildlife Service (SPFFB)), Mario Beca (Senior Technician of the SPFFB) and Luis Banze (Chief of the Provincial Livestock Service).

The UN implementing partners for the UNJP have been fully supportive of this initiative and we would extend our deepest appreciation to Julieta Matediane (focal point at UNDP); Ana Menezes (Country Coordinator and focal point at UNEP); Jaime Comiche and Leonardo Guiruta (Country Coordinator and focal point respectively at UNIDO); Silva Magaia Manuela Muianga (Country Coordinator and focal point respectively at UN/HABITAT), Sérgio Maló at

UN-Habitat and Nadia Vaz and Raul Cumba, focal points at WFP. We would also like to express our gratitude to Anna Kontorov (UNEP, Kenya, focal point) whose comments have been most helpful.

The FAO Representation in Mozambique has played a key role in supporting this idea and work at all stages. We gratefully acknowledge the encouragement and support of Julio de Castro, FAO Representative to Mozambique, Margarida Marques (Programme Coordinator), Luisa Patrocnio (Livestock Expert), José Matsinhe (Agronomist), Carla Cuambe (Forester), Sérgio Chacha (Veterinary Technician in Chicualacuala), Campos Ferro (Forest Technician in Chicualacuala) and Leonardo Manhique (Agricultural Technician in Chicualacuala).

We would also like to express our appreciation to FAO staff members who provided technical backstopping missions to UNJP and have given us useful inputs in the areas of their respective expertise. In particular, special thanks go to Martin Ager (Water Management) and Kwaku Agyemang (Livestock Management) at the sub-Regional office for Southern Africa as well as Susan Braatz (Forest Management) and Theo Friedrich (Crop Management) at FAO headquarters

The OneWorld Sustainable Investment, Cape Town, South Africa, has been an important partner in this work. We would particularly like to thank Belynda Pettrie for her support.

**Alemneh Dejene,**  
Senior Officer, Environment  
and Climate Change  
Adaptation, FAO, Rome

**Andrew Mattick,**  
Programme Coordinator,  
FAO (UNJP), Mozambique

# LIST OF ACRONYMS AND ABBREVIATIONS

CA	Conservation Agriculture
CBNFM	Community-based Natural Forest Management
CERUM	Multiple Use Resource Center
CRiSTAL	Community-based Risk Screening Tool – Adaptation and Livelihoods
CSO	Civil Society Organization
CVCA	Climate Vulnerability and Capacity Analysis
ENSO	El Niño Southern Oscillation
ESAN II	Nutrition and Food Security Strategy
FAO	Food and Agriculture Organization of the United Nations
FfW	Food for Work
FMD	Foot-and-Mouth Disease
GCM	Global Circulation Model
GoM	Government of Mozambique
HDI	Human Development Index (UNDP)
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
ICS	Institute for Social Communication
IIAM	<i>Instituto de Investigação Agrária de Moçambique</i> / Institute of Agricultural Research of Mozambique
INAM	<i>Instituto Nacional de Meteorologia</i> / National Institute of Meteorology
INGC	<i>Instituto Nacional de Gestão de Calamidades</i> / National Disaster Management Institute
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LDC	Least Developed Country
LIMCOM	Limpopo River Basin Commission
MDG	Millennium Development Goal
MDG F	Millennium Development Goals Achievement Fund
MICOA	<i>Ministério para a Coordenação da Acção Ambiental</i> / Ministry for Coordination of the Environment
MINAG	<i>Ministério de Agricultura</i> / Ministry of Agriculture
NAPA	National Adaptation Programme of Action
NGO	Non-Governmental Organization

OMM	National Women's Organization
PEDD	<i>Plano Estratégico Distrital de Desenvolvimento</i> / Strategic Development Plan for the District
SDAE	<i>Serviço Distrital de Actividades Económicas</i> / District Department for Economic Activities
SETSAN	Technical Secretariat for Food Security and Nutrition
UNAC	<i>União Nacional dos Camponeses</i> / National Farmers Trade Union
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention for Climate Change
UN-HABITAT	United Nations Human Settlements Programme
UNIDO	United Nations Industrial Development Organization
UNJP/JP	United Nations Joint Programme
WFP	World Food Programme

# CONTENTS

iii	Foreword
v	Abstract
vii	Acknowledgements
xi	List of Acronyms and Abbreviations
1	<b>1 - INTRODUCTION</b>
5	<b>2 - CLIMATE CHANGE AND VARIABILITY IN SOUTHERN AFRICA AND MOZAMBIQUE</b>
9	<b>3 - CLIMATE IMPACT ON AGRICULTURE AND NATURAL RESOURCES AT DISTRICT AND COMMUNITY LEVELS</b>
12	3.1 Exposure to climatic hazards and sensitivity of natural resource base
13	3.2 Water resources
14	3.3 Farmland: soil resources and cultivation systems
15	3.4 Farmland: food crops
16	3.5 Pastures: livestock
18	3.6 Forests
21	<b>4 - CLIMATE IMPACT ON LIVELIHOODS, COPING STRATEGIES AND ADAPTIVE CAPACITY</b>
21	4.1 Community level coping strategies
23	4.2 Adaptive capacity
26	4.3 Gender and adaptive capacity
31	<b>5 - THE CASE FOR CLIMATE CHANGE ADAPTATION IN THE DEVELOPMENT CONTEXT</b>
33	<b>6 - THE "JOINT PROGRAMME" AND FAO ADAPTATION INTERVENTION</b>
33	6.1 Joint Programme on Environmental Mainstreaming and Adaptation to Climate Change in Mozambique
36	6.2 Adaptation to climate change: FAO and joint FAO interventions
29	6.3 Highlights of the FAO adaptation intervention
39	6.3.1 Multipurpose integrated water resources management systems
40	6.3.2 Small-scale crop irrigation schemes
43	6.3.3 Conservation agriculture
43	6.3.4 Animal traction (draft)
44	6.3.5 Livestock health
46	6.3.6 Grazing management and animal husbandry
46	6.3.7 Community-based natural forest management (CBNFM)
48	6.3.8 Agroforestry



50	6.3.9 Integrated fish and small animal farming
51	6.3.10 Beekeeping
52	6.3.11 Agroprocessing and marketing
53	6.3.12 CERUM
54	6.3.13 Meteorological data and communications
55	6.3.14 Biogas generation and composting using animal waste
57	<b>7 - LESSONS LEARNED</b>
57	<b>7.1 Project formulation, institutional arrangement and coordination</b>
57	7.1.1 Programme design and implementation
60	7.1.2 Programme management and coordination
60	7.1.3 Partner issues: UN and Government
62	7.1.4 Programme design: top-down versus bottom-up
63	<b>7.2 Key lessons learned from FAO adaptation interventions and future directions</b>
64	7.2.1 Improving access to water resources
65	7.2.2 Crop farming
66	7.2.3 Crop-livestock integration
68	7.2.4 Livestock farming and processing
69	7.2.5 Community-based natural forest management
70	7.2.6 Diversification
71	7.2.7 Renewable energy to support agricultural development
72	7.2.8 Climate information, communications, and technology development
73	<b>7.3 Scaling up</b>
74	7.3.1 Social cohesion and gender
75	7.3.2 Key interventions for scaling up
76	<b>7.4 Conclusion</b>
77	<b>8 - REFERENCES</b>

# INTRODUCTION

Southern Africa is considered to be one of the most vulnerable regions in the world to the impacts of climate change (Boko *et al.* 2007). In particular, semi-arid areas characterized by marginal rainfall amounts restricting rainfed crop yields, highly seasonal rainfall with long dry seasons, unpredictable rainfall in the growth season, and scarcity of potable water for humans and livestock, are already experiencing the impacts of warming and shifting rainfall patterns. There is mounting evidence that climatic extremes such as droughts and floods are increasing in frequency and intensity across the region (INGC 2009).

Climate change is already, and will increasingly play a pivotal role in food security (Easterling *et al.* 2007; FAO 2007, 2010). It will likely alter the functioning and resilience of ecosystems such as rangelands and forests, which underpin the livelihoods of dryland inhabitants and which already provide important safety nets in times of need. In this respect, the achievement of the Millennium Development Goals (MDGs), particularly MDG-1 (eradicate extreme poverty and hunger) and MDG-7 (ensure environmental sustainability) (United Nations 2010), may well be jeopardized by the impacts of climate change (Chapman *et al.* 2011).

As an additional stressor, climate change will impact most strongly on those who are already food-insecure, subject to existing high levels of climate variability and stress, and unable to cope with, or adapt to, the added pressure. Many countries in southern Africa, notably the Least Developed Countries (LDCs), are over-reliant on rainfed agriculture for food production, have a large poor rural population engaged in subsistence farming, and poorly developed infrastructure. Southern Africa is one of the two regions likely to suffer negative impacts of climate change on several crops (e.g. maize and sorghum) that are very important to large food-insecure populations (Lobell *et al.* 2008).

Within southern Africa, Mozambique is one of the poorest countries (it is classified as a Least Developed Country, LDC) with a massive developmental backlog; it has the second-lowest Human Development Index (HDI) in the region (UNDP 2010). A prolonged civil war coupled with large-scale emigration



set the country back severely until the late 1990s. Poverty, food insecurity and malnutrition are pervasive, and combined with disease pressures such as malaria and HIV/AIDS are placing great strain on households and their ability to not only sustain themselves, but also to deal with, and recover from, climate-related and other hazards (INGC 2009). The underlying reasons for poverty and food insecurity are to a large extent structural, and must be addressed through development of the agricultural sector and investments in the socio-economic improvement of poor rural communities (IAASTD 2009).

Mozambique is highly exposed to harmful climatic events including droughts, massive floods, and cyclones. The impacts of climate hazards on the population and infrastructure are compounded by the widespread deep poverty and lack of resilience. Due to the severe limitations facing the government, where roughly half the national budget depends on foreign assistance, these burdens are not easily dealt with. The main objective of the Government of Mozambique (GoM) is to reduce absolute poverty through sustainable social and economic development and growth. Although some significant progress has been made, including reductions in absolute poverty and improvements in food security based on raised agricultural production, these achievements are not homogeneous across the country (Republic of Mozambique 2010).

The interior regions of southern Mozambique, such as parts of the Gaza Province have a long dry season (rainfall that ranges from 500 to 600 mm annually) suffer from deep poverty (62.5 percent, Republic of Mozambique 2010), lack of access to water, limited livelihood opportunities with heavy reliance on subsistence farming, and exposure to high temperatures, severe droughts and occasional floods and cyclones. The natural resource base is under significant pressure from localized overgrazing, wildfires and rapid deforestation. The ability of the local communities and officials to deal with this situation is tested to the limit, and coping mechanisms rely heavily on migration and unsustainable use of natural resources. In the recent past, insufficient rains in the south have resulted in reduced crop production and availability of water for humans and livestock. The nutritional and health status of communities in the southern interior, which suffer the highest HIV/AIDS prevalence nationwide (Republic of Mozambique 2010), is fragile (Republic of Mozambique 2006). It is thus imperative to strengthen the preventive and adaptive capacity of the local population that is necessary to improve their current and future resilience under conditions of climate change.

Recognizing the need to identify and prioritize adaptation measures to reduce the vulnerability of communities and sectors, MICOA through the National

Directorate of Environmental Management (DNGA) and in coordination with the NAPA Team, conducted a participative evaluation of 31 districts to determine which districts should be included in the pilot phase of the NAPA programme (MICOA, 2007). The district of Chicualacuala is one of the prioritized districts. The actions undertaken by the UNJP described in this paper are fully aligned with the following specific objectives of the NAPA:

- strengthen the early warning system in the country;
- strengthen the capacities of family farmers to deal with the adverse effects of climate change;
- improve the knowledge and strengthen the management of river water;
- promote actions to limit erosion and to develop sustainable fishery activities;
- promote public education activities and information dissemination on climate change;
- improve the coordination between the various groups that work on issues related to the evaluation of climate change vulnerabilities and hazard risk reduction;
- promote the integration of climate change into decentralized district planning.

This first part of the paper discusses the dynamics of climate change and its consequences on the natural resources base and on well-being and livelihoods of the inhabitants of the arid and semi-arid regions of southern Mozambique. The second part of the paper draws out practical experiences and lessons learned through the joint climate change mainstreaming and adaptation programme, with particular emphasis on the efforts of the Government of Mozambique and FAO-led interventions in strengthening smallholder agriculture, community-based natural resources management, and livelihood diversification in the face of current and future climate-related stresses. The pilot nature of large parts of the programme present a valuable opportunity to document and critically assess successes and challenges, and contribute towards the scaling-up and follow-up of climate change adaptation programmes and projects in Mozambique and other regions with similar agro-ecological conditions.