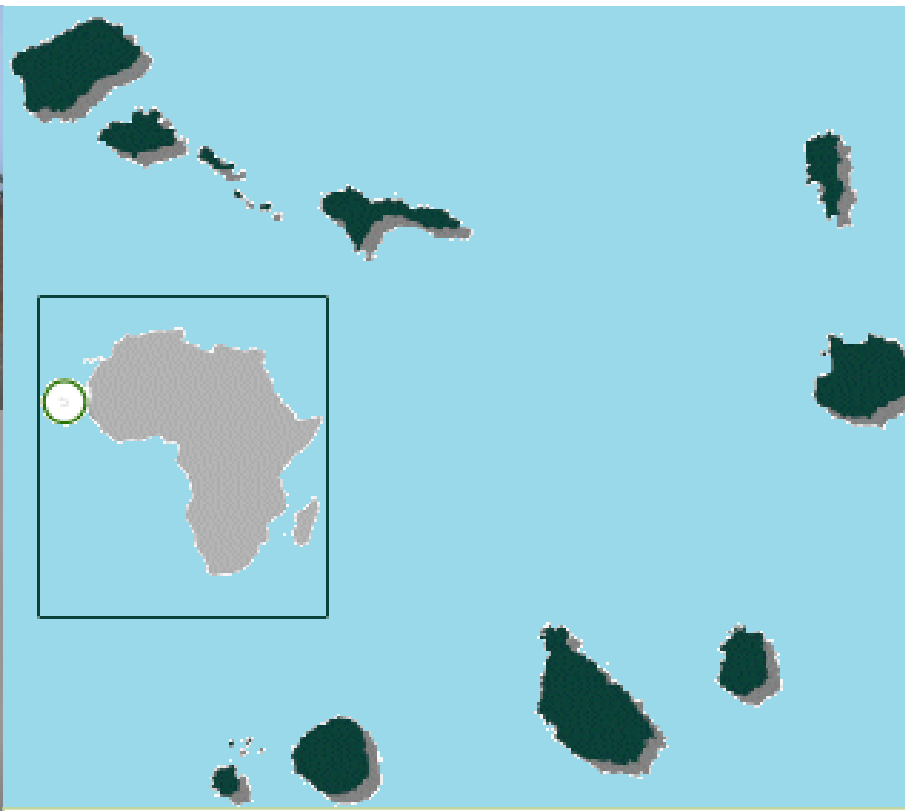
REPUBLIC OF CAPE VERDE

SECOND NATIONAL COMMUNICATION ON CLIMATE CHANGE OF CAPE VERDE

UNITED NATIONS FRAMEWORK CONVENTION FOR CLIMATE CHANGE



MINISTRY OF ENVIRONMENT RURAL DEVELOPMENT AND MARINE RESOURCES

NATIONAL INSTITUT OF METEOROLOGY AND GEOPHYSICS

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SECOND NATIONAL COMMUNICATION OF CAPE VERDE ON CLIMATE CHANGE

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TECHNICAL SHEET

SECOND NATIONAL COMMUNICATION ON CLIMATE CHANGE OF CAPE VERDE

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The process was completed thanks to the involvement of several institutions, national and international consultants, companies, private sector associations, NGOs and other sources that contributed to the preparation of this document.
Attached is the list of entities who attended the workshops held under the project.

Ministério do Ambiente, do Desenvolvimento Rural e dos Recursos Marinhos

FOREWORD

In a climate change and sustainable development context, the Republic of Cape Verde has ratified the UN Framework Convention on Climate Change (UNFCCC) on 29 March 1995, and it entered into force on 22 June of that year. In addition the country ratified the Kyoto Protocol on December 5, 2005. As a Contracting Party to the Convention, with common yet differentiated principles, Cape Verde has committed to formulate a National Communication to the Conference of Parties. In 2000 Cape Verde submitted its First National Communication and its National Strategy and Action Plan on Climate Change.

The Second National Communication takes stock of the national circumstances with regard to greenhouse gas emissions, ability to mitigate such emissions, vulnerability to climate change, mitigation measures and programs, past and future strategic adaptation actions, transfer of clean technologies at sector level, the state organization on climate change related issues aiming at meeting the objectives of the Convention, as well as the constraints and challenges encountered.

The preparation of the Second National Communication was conducted using a participatory approach, from the perspective of sustainable development arelated to the millennium development goals and the fight against poverty in Cape Verde.

The document is a key tool that includes adaptation measures to technology transfer strategies for each vulnerable sector identified as well as the establishment of priorities for implementation of adaptation actions and measures under the Clean Development Mechanism. These actions and measures must take into account the country's vulnerabilities against a likely sea level rise, increasing temperature, decreased rainfall and increase of extreme weather events.

Aware of the lack of national financial resources to implement the required adaptation and mitigation projects and to import clean technologies, the country once again, counts on the support from Annex I countries to the Convention, in order to effectively meet the objectives aimed to Climate Change impacts.

Grants from GEF and UNDP allowed a group of national experts to present this communication, with the assistance of several institutions such as international organizations, civil society, NGOs, multisector teams, national and international consultants, among others, which gave a valuable contribution throughout its development, validation and publication process,.

In this context we should also , mention Cape Verde's development partners who through funding and implementation of renewable energy projects, allowed the country to initiate the introduction of mechanisms to reduce greenhouse gas emissions in the future.

This communication demonstrates the firm commitment of Cape Verde to discuss an extremely relevant and strategic global issue. With the presentation of its Second National Communication report, Cape Verde is complying with its obligations under the United Nations Framework Convention on Climate Change, and will make continued efforts to honor its commitment to the Convention with a view to create and contribute to a healthy and productive environment for generations to come.

Dr. José Maria Fernandes da Veiga
Minister of Environment, Rural Development and Marine Resources

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EXECUTIVE SUMMARY

Cape Verde ratified the UN Framework Convention on Climate Change (UNFCCC) on March 29, 1995 and it came into force on June 22 of that year. As a Contracting Party to the Convention, Cape Verde has then undertaken to formulate a National Communication to the Conference of Parties (COP). In 2000, it submitted its First National Communication (FNC) and its National Strategy and Action Plan on Climate Change. To develop these tools, several studies prepared by the different sectors relating to greenhouse gas (GHGs) inventories, vulnerability assessment, adaptation and mitigation measures were taken into account. On December 5, 2005 Cape Verde ratified the Kyoto Protocol.

The strategy recognizes the need for implementing additional measures in all sectors, with particular regard to transport, energy production and consumption and emission control from agriculture and forests.

In 2005, the Government of Cape Verde received a funding from UNDP/GEF to develop its National Adaptation Programme of Action (NAPA) for Climate Change. The main objective of the NAPA wasto identify priority adaptation options based on urgent and immediate needs and concerns of the most vulnerable populations to the adverse effects of climate variability and change.

Data on greenhouse gas emissions, which are included in this 2nd National Communication, are based on the National Greenhouse Gas Inventory with reference to the year 2000. Other information, including the chapter on the national circumstances, also relates to year 2000 in order to facilitate interpretation and improve consistency. However, data on policies and measures and projections are based on studies that are the basis for the preparation of the draft (November 2002) of the National Climate Change Programme.

- **National circumstances**

Cape Verde is located between parallels 17º 12' and 14º 48' North latitude and meridians and 22º 44' and 25° 22' west longitude. It consists of ten islands, nine of which are inhabited, and several uninhabited islets, divided into two groups by their location relative to the prevailing winds: the Barlavento (windward) group to the North, including from West to East the islands of Santo Antao, Sao Vicente, Santa Luzia (uninhabited), São Nicolau, Sal, Boavista and the Sotavento (leeward) group to the south, formed from East to West by Maio, Santiago, Fogo and Brava.

According to the preliminary results of the Fourth Population and Housing Census, 2010, the population of Cape Verde totals approximately 501,648 inhabitants (including present residents and absent residents), with an average annual growth of 1.2% from 2000 (434,625) to 2010 (491,575). Sotavento is the most densely inhabited area, with approximately 323,917 inhabitants, while Barlavento counts around 127,658 inhabitants.

Cape Verde´s population is manifestly young, with 31.6% of the population between 0-14 years (2010 RGPH preliminary results) and only 6.5% over 65 years. Life expectancy is set at 71 years

(67 for men and 75 for women). Infant mortality rate was 20 ‰ in 2004 (44 ‰ in 1990 and 26 ‰ in 2000).

The Population Growth Rate –depending on migration flows- in 1990-2000 (last census data) was approximately 2.4%. In 2010 it dropped to 1.2%.

Most of the population lives in urban areas (303,776 inhabitants), representing approximately 62% of the total, while the remainder live in rural areas (187,799 inhabitants), and accounting for 38% of the total. The most urbanized cities, Sao Vicente, Praia and Sal achieved rates of around 92.6%, 96.6% and 92.9% respectively. Despite the higher population density is in the cities of Praia and Mindelo, the fastest growth occurs in Praia.

The nation´s capital is Praia, located on the Santiago Island, where is the Seat of the Government, of the executive, legislative and judiciary powers. All together these islands occupy a total 4.033 km^2 land area and 734.000 km^2 of Exclusive Economic area (EEZ). The coastline is relatively large with around 1.020 km of white and black sand beaches which are alternated with cliffs.

Cape Verde is a sovereign, unitary and democratic republic, governed by the Constitution, which both guarantees the respect for human dignity and acknowledges the inviolability and inalienability of Human Rights as the foundation of the entire human community, peace and justice. In the organization of the political power, it acknowledges and respects the unitary nature of the state, a pluralist democracy. The country maintainsseparation and interdependence of powers, independence of the courts, existence and autonomy of local government and decentralization of public administration.

The political setting is dominated by the presence of the African Party for the Independence of Cape Verde (PAICV) currently in power, the Movement for Democracy (MPD), the largest opposition party, and UCID, the minority party. The Head of State is the President of the Republic and the National Assembly is headed by the President of the National Assembly. The executive branch of the government is headed by the Prime Minister. The government of Cape Verde is divided into various ministries, directorates and institutes that assist in policy implementation in different sectors

Civil Society Organizations (CSOs) have been implicated in specific sectors of development, particularly in civic, economic, cultural and environmental areas. However, some challenges are still faced , namely leadership issues, resource availability and capability limitations to meet the current challenges.

Regarding governance, some gains have been achieved. Under the Ibrahim index, a mechanism of the Mo Ibrahim Foundation, which aims to analyze the quality of governance in Africa, Cape Verde positioned in second (78 out of 100 points), behind Mauritius, within 53 African countries assessed in 2007.

Under the Minister of Environment, Rural Development and Marine Resources is the National Institute of Meteorology and Geophysics (INMG), as well the Directorate General for Environment (DGA), which is responsible for designing, implementing and coordinating environment related

issues. The DGA was the first agency responsible for coordinating the implementation of the UN Framework Convention on Climate Change (UNFCCC) in Cape Verde. In an attempt to find new ways of working, the government decided that the DGA should maintain its central role in the process, but it should promote the participation of national institutions, including the INMG as authority for its implementation, involving the civil society and private sector. Thus, the INMG has taken over the leading role in the processes related to the development of the National Adaptation Programme of Action for Climate Change (NAPA) and the Second National Communication on Climate Change in Cape Verde.

The country exhibits a vulnerability shared by most island states, with coastal areas that requires special attention in the face of potential negative impacts resulting from global climate change. Indeed, any rise in sea level will dramatically affect coastal areas and the population, considering that approximately 80% live in these areas, as well as the loss of habitat, biodiversity and fisheries.

For an island country that is making efforts to develop tourism as its main source of income, the reducition of their coastlines due to a possible rise in sea level and extreme events is likely to be a huge constraint to development.

In climate terms, Cape Verde is located in a region where the variability of the Azores subtropical acts as regulatory factor of rainfall anomalies, by controlling the seasonal oscillation characteristics of the maritime and continental trade winds during the dry months (November to June). In the rainy season (July to October), there is the oscillatory movement of the Intertropical Convergence Zone (ITCZ), characterized by Southeast winds and disturbances from the East. Between December and February the islands are affected by air masses from extra-tropical latitudes. The spatial-temporal distribution of rainfall is affected by regional phenomena and remote influences as dominant forms of variability. This Atlantic region is under the influence of various atmospheric systems, including the band of convective activity of the ITCZ, disturbances and waves from the west, depressions and tropical cyclones, subtropical anticyclonic circulations and equatorial low pressures, which determine the type of movement. The archipelago of Cape Verde is under the influence of four systems that affect the regional climate: subtropical anticyclone of the Azores; equatorial low pressures; cold ocean current from the Canaries; thermal depression over the African continent during summer. According to rainfall data observed at surface, Cape Verde has three distinct seasons, determined by the activity and intensity of the dominant regional weather systems: a transition season (November to February), a dry season (March June), a rainy season (July to October). However, these seasons do not have limiting dates to begin and end, and are often so faint that the first two are mixed. From the 1960s to date, the rainy season has been reduced to barely August and September.

With an average 225 mm/year rainfall, approximately 20% of the water from rainfall is lost through surface runoff, 13% infiltrates, recharging aquifers, and 67% evaporates. Annual temperatures have a low temperature range. The annual average temperature is around 25º C for coastal areas, reaching 19º C in areas above 1,000 meters of altitude. The minimum values, between 20ºc and 21º C, occur from January to April, and the maximum values of 26º C to 28º C in August-September.

The country's arable land is estimated at 10% of the total area and is mainly concentrated on the major agricultural islands. 9% of this area is irrigated and the rest is limited to rain-fed agriculture, being 19% in wetlands, 42% in sub-humid areas and 39% in arid areas.

Of the total arable land, around 68% has vocation for rain fed crops, 26% for agriculture, forestry, pastoral activities and 6% for irrigated crops in the alluvium of streams or slopes. The island of Santiago has approximately 58% of the land dedicated to agricultural soils followed by Santo Antao, Fogo and São Nicolau (White Paper on the State of the Environment, 2004).

From the energy point of view, Cape Verde islands are composed of independent systems, characterized by their small size and distance from supply centers. Furthermore the lack of domestic conventional energy resources causes strong dependence on foreign energy.

Electricity (domestic consumption) and fuel (aircraft, water desalination) are energy products increasingly essential to the current socio-economic system.

According to the National Home Energy (PNED), the estimates carried out indicated gas oil as the most important fuel in terms of internal consumption (41%), followed by wood and other biomass (19.4%), and finally fuel (16 %). With regard to domestic energy, the most consumed fuel in urban areas is gas (69.49%), followed by firewood (22.43%) and other residues (7.67%). In rural areas, the first fuel is firewood, which accounts for 85.72% of the fuel for cooking.

Butane gas experienced a substantial increase in recent decades, both in rural and urban areas (from 1980 to 1990, consumption increased by 330% and between 1990 and 2000, it stood at 40%). 2001 recorded a negative variation, possibly by the increase in gas prices. Currently, gas is used as the main source of domestic energy (56.8% of households), being the main source of energy in the country for cooking purposes.

Market supply is controlled by the companies *Shell Cabo Verde* and *Enacol*. They are responsible for supplying the country based on an agreement signed with the Government.

Energy efficiency and technological innovation are considered by Cape Verde (Energy Strategic Plan) an alternative resource in the field of renewable energy. Solar and wind power resources are abundant in Cape Verde. Thus, photovoltaic panels are used primarily in telecommunications and water extraction (as occurs on the Island of Maio). Wind power is more widely used in the extraction of water with pumps and to a lesser extent in electricity generation and, more recently, to support desalinated water production.

The country highly depends on foreign energy, of which 99% is imported. Yet, several projects to address this need have being identified, which once implemented will represent a 30% reduction (20,000 ton / year) in imports of petroleum products, thus decreasing the country´s dependence on fossil fuels.

- **Information on GHG Inventory**

Cape Verde submitted its first GHG inventory along with the First National Communication in 1999, based on 1995 data. The second inventory follows the *Guidelines for the preparation of national communications* by *Parties not included in Annex I* and represents an evolution of the previous guidelines. GHG whose emissions and removals by sinks are estimated in this document are CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. Some other gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and other non-methane volatile organic compounds (NMVOCs), although they are not direct greenhouse gases they still have influence on chemical reactions that occur in the atmosphere. Information on anthropogenic greenhouse gas emissions has also been included where available. In 2000, anthropogenic greenhouse gas emissions in Cape Verde were estimated at 306.80 Gg CO_2, 3.28 Gg CH_4, N_2O 0.301Gg and 0.653 ton Gg HFC-134a. Between 1995 and 2000 the total CO_2 emissions increased by 11.7% and total CH_4 emissions and N_2O emissions increased by 8.8% and 12.0% respectively. Gas emissions with indirect impact on climate change were also evaluated. Indeed, in 2000 these emissions were estimated at 2.03 Gg NOx, 16.87 Gg CO and 2.74 Gg NMVOC. In terms of CO_2eq, using the equivalence factor *Global Warming Potential (GWP*) of 21 for methane and 310 for nitrous oxide. The direct GHG emissions in Cape Verde for 1995 and 2000, increasing by 11.3% in the period.

- **Ability to reduce greenhouse gas emissions**

Considering that the period between 1995 and 2000 anthropogenic emissions in Cape Verde of the main Greenhouse Gases (CO_2 11,7% ; CH_4 8,8% and N_2O 12,0%) increased and that on the whole there was a 11.3% increase in direct emissions several mitigation strategies should be taken into consideration to reduce potential adverse impacts on the environment.

As a major user of fossil fuels, which is the main source of GHG emissions, Cape Verde makes the energy sector to account for 92.9% of CO_2 emissions by burning fossil fuels. In 2000, only the transport sub-sector accounted for 48.0% of CO_2 emissions in the energy sector and 44.5% of total CO_2 emissions, the remainder being divided between other sub-sectors of energy industries (31.4%) general industries (6.8%) and other uses (10.2%) and land change use and forestry sector (7.1%).

The amount of the local biomass is scarce and its availability has rapidly decreased due to prolonged droughts and some inappropriate cuts. However, there is a potential for wood energy from forests, generated as part of the forestation programs undertaken in 1975 to date by the State Cape Verde.

Given the population growth and economic development the country has been preparing in order to create sectoral strategic intervention mechanisms as a way of building capacity for mitigation of GHG by increasingly using renewable energy potential (wind, sun, geothermal power, water, hydrogen, cogeneration, tides, etc.) and clean technologies.

The use and production and promotion of renewable sources of energy will promote better energy conservation practices in the population and could also considerably reduce the use of fossil fuels in the various energy sub-sectors, such as transport and housing due to air conditioning, refrigeration.

The country's energy plan for the next 10 years, aims at mitigating GHG emission, the proposal aims to achieving a renewable energy penetration rate of 25% by 2011, 50% by 2020 and having at least one of the islands using 100% renewable sources of energy; and at the same time promoting energy conservation and efficiency in the energy sector; fighting against fraud and energy losses; expanding electricity production capacity; single power plants; increasing efficiency production and distribution; and increased responsiveness to energy needs; Sector openness. ensuring 95% electricity coverage by 2011, 100% by 2015 and ensuring a higher quality and reliability in energy access and reducing the cost of electricity.

- **Vulnerability to climate change**

Cape Verde is located in a region where the variability of the Subtropical High Pressur Zone acts as regulatory factor of rainfall anomalies and controls the seasonal oscillation characteristics of the maritime and continental trade winds during the dry months (November to June). During the rainy season (July to October), there is the oscillatory movement of the ITCZ, characterized by southeast winds and disturbances from the east. Between December and February the islands are affected by air masses from extra-tropical latitudes. The subtropical anticyclone region, characterized by high pressure, divergence and subsidence in air circulation, influences and characterizes the air masses that penetrate Cape Verde region the whole year. The Azores anticyclone is a very stable system, which dominates the tropical and subtropical North Atlantic, resulting in flows between north (N) northeast (NE) and east (E), often very intense from NE, called trade winds. It is affected by the predominance of subsidence movements called "the trade wind inversion, which acts as a strong opponent of the vertical development of clouds (Riehl, H. 1979), accentuated by a cold stream from the Canary Islands. At altitude, the movement is dominated by the east flow, characterized by the presence of the African easterly jet (AEJ) and the Tropical Easterly jet (TEJ). Located at 600 hPa with maximum speeds of 10 m/s between 10° and 15° N, the AEJ is the result of supply of heat by thermal depression, while the TEJ, which is located at 200 hPa, meridionally lagged toward the equator, is fed by deep convection. This dynamic seasonal movement in the West African coast, with the subsequent meridional movement of the ITCZ, sets the rainfall pace on the West African coast and therefore on Cape Verde region. The phenomena that most affect the environment and climate in Cape Verde region are directly related to the variability of the Azores anticyclone, cold stream from the Canary Islands, oscillation of the intertropical convergence zone, formation of depressions and tropical cyclones, persistence of the "harmattan" during the dry season, random spatial-temporal rainfall, temperature fluctuations, severe squall lines, frequent haze episodes and the jet streams at altitude.
Critical changes in temperature can further affect the already fragile environment, helping to increase or prolong episodes of drought, heat waves and causing dust, contributing to erosion and land degradation.

Movement conditions favor the development of high-energy systems, for example, tropical cyclones, squall lines and convective cells. These phenomena whose main source of energy is the surface temperature of the sea water, the possibility of increased temperatures in the sea water (T>25°C) associated with the presence of atmospheric disturbances in the trade winds are favorable conditions for intensification of these weather phenomena. Anomalies in the intensity of these

systems can help constitute climate risk phenomena to the archipelago, namely torrential rains and prolonged droughts. Among the main sectors affected by these phenomena are agro-sylvo-pasture, water resources, tourism and coastal areas, transport, health and economy. Wind intensification means increased intensity in coastal erosion, change in the coast morphology, disappearance of beaches, degradation of marine and coastal environment, change in the intensity of ocean currents, increased intensity of coastal degradation due the change in the amplitude of waves and tidal aggression, and thus the degradation of the environment causing populations to migrate from the coast to the inner part of the islands.

Agricultural productivity has shown great sensitivity to changes in interannual rainfall, including starting and ending dates of the rainy season. Thus, yields can be significantly affected by negative anomalies, drought, which will pose serious threats to the economy. On the other hand, the reverse occurs with the positive anomalies of rainfall. Pest outbreak and movement may be constrained by variability in temperature and rainfall. This also applies to the health sector, with the spread of diseases related to regional climate variability. In this case the problem must be addressed at regional level.

A possible increase in the sea level could severely affect coastal areas and cause damage to tourism and economy. It is estimated that during the 20^{th} century, the sea level is raising an average of 1.7 mm per year, i.e. 17cm in 100 years. Current world projections anticipate a sea level rise by 30 to 50cm in the 1990-2100 period. Considering the reality of an island state, where most of its population lives on the coastline, almost every national coastal area and its ecosystems are vulnerable to any change either in temperature, rainfall or in the sea level variation, including incidents resulting from extreme sea events. Rising sea levels would have a direct impact on coastal submergence and erosion, increased flooded lands and salinity of small estuaries, streams and coastal waters.

Several vector-borne diseases prevail in West Africa, including malaria, sleeping sickness, dengue fever, or even the nearly eradicated yellow fever. Rainfall, temperature and humidity play an important role in the occurrence of these vectors. Reduced rainfall and desertification may limit the growth of these species. But dry weather does not automatically decrease these insects in areas of growth.

A possible increase in extreme weather events (erratic rainfall, in particular) could increase the prevalence of the diseases, affecting human health and migration of animals to areas where forage is more accessible. The risk of contact with other disease carriers consequently may lead to the outbreak of new diseases.

With regard to sea level, the islands of Cape Verde have shown to be very vulnerable to any increase. Compared to 1980-1999, by 2090 climate models project an increase in the region according to the following three levels, from 0.13 to 0.43m (SRES B1), 0.16 to 0.53m (SRES A1B scenario) and 0.18 to 0.56m (SRES A2). However, due to the facts reported above, there is considerable uncertainty about these projections.

Models indicate the African continent is likely to continue having a warming of about 1° to 4°C over the 21st century, with more or less regionalized warming. If this happens, one assumption is that warming leads to higher evaporation of soil moisture, leading to its reduction in the inner part of the continent, in the event there is not a corresponding increase in rainfall. In the case of Cape Verde, the islands would suffer an increase in rainfall in July-October season. However, the variability of rainfall across Africa during the 21st century presents great uncertainty, with some global climate models suggesting wetter conditions and, others drier. This uncertainty is partly due to different climate parameterizations and sensitivity of each model.

- **Adaptation to climate change**

Considering the timeline of the relatively recent manifestation of this issue, a real evaluation was not carried out under this document; it was decided to make an analysis of a set of measures implemented (torrential control works, soil and water conservation works, forestation, among others) to address adverse soil and climatic conditions.

Thus, over time, and very particularly in the post-independence period, given the adverse effects of climate variability, adaptation measures implemented by successive governments and populations were especially aimed at creating conditions to ensure the subsistence level in terms of water availability and food security, given the bad years of agricultural production, namely: Soil and water conservation techniques (rain water collection – community and household reservoirs; improvement of water supply through: boreholes, wells, galleries, captation dikes, water catchment infrastructure and desalination units; implementation of land preparation techniques for agroforestry systems and an extensive forestation program in arid and semi-arid areas, with the introduction of drought-resistant species; implementation of drip irrigation systems; construction of dams); Adaptation techniques of agricultural production systems (introduction and production of new crops better adapted to our climate conditions; diversification of crops, in particular horticultural crops); adaptation techniques and measures to coastal erosion effects: (ban on the extraction of aggregates; use of break water; harmonization and integration of costal management activities); law enforcement; Coastal area integrated management and protection project.

Although an extensive evaluation of the impact of all these measures has not been made, nevertheless its positive effects are visible, both from environmental and landscape changes and socio-economic point of view.

- **State organization in Climate Change related issues**

Climate change impacts worldwide, particularly in developing countries and island states such as Cape Verde. Therefore the Government was required to pay special attention to this issue, by creating vital conditions for the country to enter a new phase of environmental policy implementation to face climate change. Indeed, the Second National Environment Programme of Action (PANA II) for the 2004-2014 period was designed and is being successfully implemented in partnership with public and private sectors, NGOs, national and international research organizations aiming to provide an overall strategic guidance for a balanced use of natural resources and

sustainable management of economic activities. Resources were mobilized through budgetary support to implement PANA II and protocols were signed for Municipal Environmental Plans. Similarly, sectoral programs and projects are being implemented in the sectors such as education, health, land use, water resources, biodiversity, fisheries, agriculture, energy, industry, etc. Environmental education is being addressed in a comprehensive manner, as a cross mechanism to support implementation of all programs and to change behavior and consumption patterns. Significant progress is highlighted in the institutional and legal fields through the structuring of the coordination and management system, development of an environmental information system as well as strengthening of the regulatory process for environmental legislation.

Special attention will be assigned to institutional capacity strengthening in the environment sector, aiming at consolidating organizational structures to meet the challenges and ensure the implementation of PANA II and international conventions and protocols. In addition efforts will be made to consolidate national environmental information systems and monitor environmental quality, build the capacity of staff in environment issues, environmental inspection and impact assessment.

Full implementation of UN environment conventions, particularly those related to biological diversity and fight against desertification, drought and climate change effects should deserve special attention from the Government.

Cape Verde ratified the Framework Convention on Climate Change in March 1995 and which entered into force on June 22, 1995, as a non-Annex I party. It is also the first PALOP country to create the Designated National Authority and to have a Clean Development Mechanism (CDM) certified by the Executive Secretary of UNFCCC CDM.

By Resolution No. 16/2009 of June 2, the Interministerial Committee on Climate Change was established, serving also as the Designated National Authority to coordinate government actions under the UN Framework Convention on Climate Change and Kyoto Protocol as well as its subsidiary instruments.

Chapter I

NATIONAL CIRCUMSTANCES

CHAPTER 1 – NATIONAL CIRCUMSTANCES

1.1 Country characterization

1.1.1 Government

Cape Verde is a sovereign, unitary and democratic republic, governed by the Constitution, which both guarantees the respect for human dignity and acknowledges the inviolability and inalienability of human rights as the foundation of the entire human community, peace and justice. In the organization of the political power, it acknowledges and respects the unitary nature of the state, pluralist democracy, separation and interdependence of powers, independence of the courts, existence and autonomy of local government and decentralization of public administration. The political setting is dominated by the presence of the African Party for the Independence of Cape Verde (PAICV) currently in power, the Movement for Democracy (MPD), the largest opposition party, and UCID, the minority party. The Head of State is the President of the Republic and the National Assembly is headed by the President of the National Assembly. The executive branch of the government is headed by the Prime Minister. The government of Cape Verde is divided into various ministries, directorates and institutes that assist in the implementation of policies in different sectors. Civil Society Organizations (CSOs) have been implicated in specific sectors of development, particularly in civic, economic, cultural and environmental areas. However, some challenges are still faced in some sector, such asleadership, availability of resources and limitations of capabilities to meet the current challenges. Regarding governance, some gains have been achieved. The Ibrahim index, a mechanism of the Mo Ibrahim Foundation, which aims to analyze the quality of governance in Africa, Cape Verde positioned in second (78 out of 100 points), behind Mauritius, within 53 African countries assessed in 2007.

Under the Minister of Environment, Rural Development and Marine Resources is the National Institute of Meteorology and Geophysics (INMG), as well the Directorate General for Environment (DGA), which is responsible for designing, implementing and coordination environment related issues. The DGA was the first agency responsible for coordinating the implementation of the UN Framework Convention on Climate Change (UNFCCC) in Cape Verde. In an attempt to find new ways of working, the government decided that the DGA should maintain its central role in the process, but it should promote the participation of national institutions, including the INMG as authority for implementation, involving the civil society and private sector. Thus, the INMG takes over the leading role in processes related to the development of the National Adaptation Programme of Action for Climate Change (NAPA) and the Second National Communication on Climate Change in Cape Verde.

1.1.2 Geographic and climate profile

1.1.2.1 Land characterization

Cape Verde archipelago is located between the Equator and the Tropic of Cancer, between parallels 17º 12' and 14º 48' North latitude and meridians and 22º 44' and 25° 22' west longitude.

The country consists of 10 islands, nine of which are inhabited, and several uninhabited islets, divided into two groups by their location relative to the prevailing winds:

- The Barlavento (windward) group to the north, consisting from west to east of the islands of Santo Antao, Sao Vicente, Santa Luzia (uninhabited), São Nicolau, Sal and Boa Vista. Also belong to that group the islets of Branco and Raso located between Santa Luzia and São Nicolau, the islet of Pássaros off the bay opposite to the city of Mindelo, Sao Vicente, the islet of Rabo de Junco off the coast of the island of Sal, and the islets of Sal Rei and Baluarte off the coast of the island of Boa Vista;

- The Sotavento (leeward) group to the south, consisting from the east to the west of the islands of Maio, Santiago, Fogo and Brava. Also belong to the group the islet of Santa Maria located opposite to Praia, capital of Cape Verde on the island of Santiago, the islet Grande, Rombo, Baixo, de Cima, Rei Luis Carneiro and Sapado located approximately 8 km from the island of Brava, and the islet of Areia along the coast of that island.

The larger islands are Santiago located southeast the archipelago, and Santo Antao, located farthest northwest. The country´s extreme points are: Ponta do Sol, Santo Antao Island, north (17° 11' N - 25° 05' W), Ponta Nho Martinho island of Brava, south (14° 49 'N - 24° 42 'W), Ilhéu do Roque Rock Island, island of Boa Vista on the east (16° 05' N - 22° 40' W) and Ponta Floor Morgado, island of Santo Antao, west (17° 03 'N - 25° 21' W).

The nation´s capital is Praia, located on the Santiago Island, where is the Seat of the Government, of the executive, legislative and judiciary powers. Al together these islands occupy a total land area of 4.033 km^2 and 734.000 km^2 of Exclusive Economic Area (EEZ). The coast line is relatively large with around 1.020 km of white and black sand beaches which are alternated with cliffs.

This natural setting denotes the vulnerability shared by most small island states, with coastal areas that require special attention in the face of potential negative impacts resulting from global climate change. Indeed, any rise in sea level will dramatically affect coastal areas and the population, considering that approximately 80% of the population lives in these areas, as well as the potential loss of habitat, biodiversity and fisheries.

For an island country that is making efforts to develop tourism as its main income, reduction of coastlines due to a possible rise in sea level and the impacts of extreme events could likely be huge constraints to development.

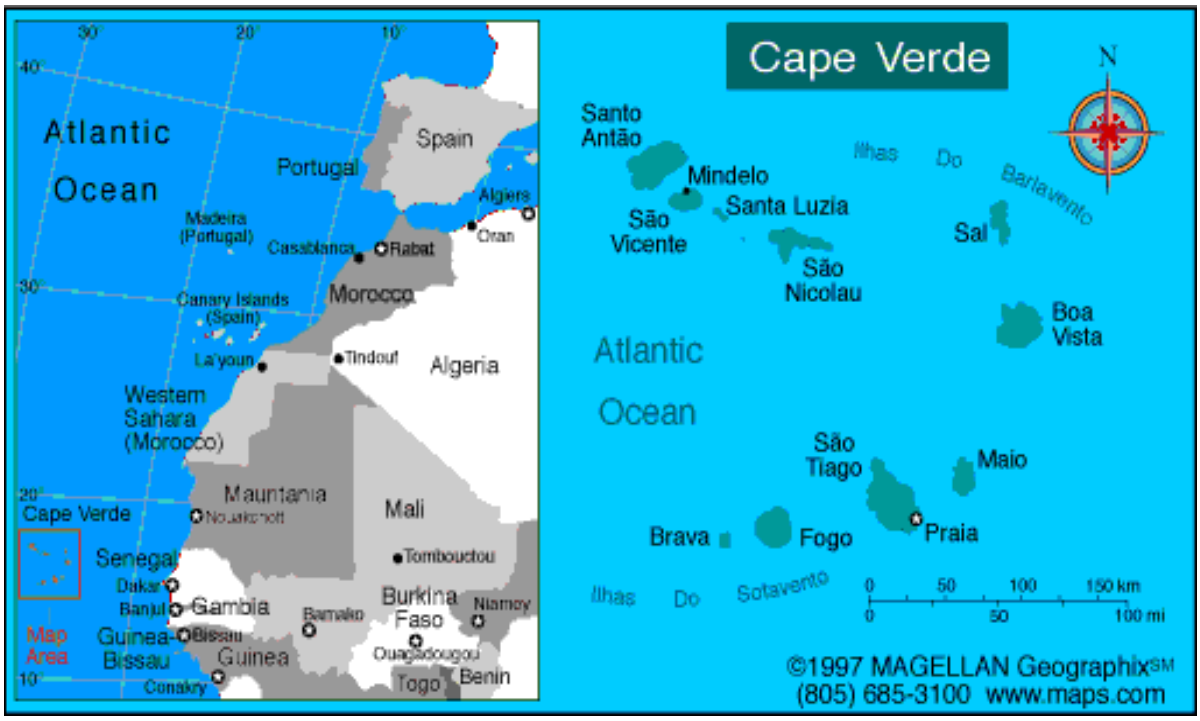


Figure 1. Geographic location of Cape Verde

1.1.2.2 Climate Characterization

Cape Verde is located in a region where the variability of the Azores subtropical acts as regulatory factor of the anomalies of rainfall, by controlling the seasonal oscillation characteristics of the trade winds with maritime and continental features during the dry months (November to June). In the rainy season (July to October), there is the oscillatory movement of the ITCZ, characterized by southeast winds and disturbances from the east. Between December and February the islands are affected by air masses from extra-tropical latitudes. The spatial-temporal distribution of rainfall is affected by regional phenomena and remote influences as dominant forms of variability.

Cape Verde Islands are under the influence of various atmospheric systems that are potentially determine the region´s climate characterization, including the Azores subtropical anticyclone, the low equatorial pressures, cold ocean current from the Canary Islands and heat depression over the African continent during the summer. The anticyclonic region is characterized by high pressure, divergence and subsidence in air circulation. Its location has influence on the air masses that penetrate Cape Verde throughout the year. Considered an action center in the atmosphere the Azores anticyclone is a stable system that dominates the entire tropical and subtropical regions in the North Atlantic and originates flows between Northeast and East. Frequently, trade winds persistently from the NE blow with more intensity for long period. When blowing directly from the continent, they make the air masses continental with reduced humidity. When they are parallel to the West North African coast they allow the maritime influence to be determinant. During the rainy season, the region is frequently disturbed by winds from the East or Southeast. The cold sea current from the Canary Island that influences Cape Verde moves with Norheast flow along the African West coast towards the islands, thus contributing to soften temperatures in the region and eventually affect rain variability. The sea surface annual average temperature is 24ºC under strong influence by the cold current from the Canary Islands (below 21º) and varies between 22ºC and 24ºC from July to November and 21ºC and 23ºC from December to June.

Cape Verde region is affected by the predominance of a subsidence movement called "the trade wind inversion", which acts as a strong opponent of the vertical development of clouds (Riehl, H. 1979), accentuated by a cold stream from the Canary Islands. Inversions occur almost throughout the year, with an estimated 90% frequency (Carvalho, 1973). According to data from surveys carried out by the National Institute of Meteorology and Geophysics of Cape Verde, the average baseline height of the inversion is between 380 and 850m and the climax rarely exceed 1,420m. At altitude, the movement is dominated by the east flow, characterized by the presence of the African easterly jet (AEJ) and the tropical easterly jet (TEJ). Located at 600 hPa with maximum speeds of 10 m/s between 10° and 15° N, the AEJ is the result of supply of heat by thermal depression, while the TEJ, which is located at 200 hPa, meridionally lagged toward the equator, is fed by deep convection.

The dynamics of seasonal movement in the West African coast, with the subsequent meridional movement of the ITCZ, sets the rainfall pace on the West African coast and therefore on Cape Verde region. According to Leroux (2001), rainfall in Cape Verde region is of the maritime trade wind type (Type I): a dry season and a rainy season. There is, however, a shorter and less humid period, characterized by advection of cold air from middle latitudes, i.e. dominated by the so-called "wintering" phenomenon. Northeast trade wind variability affects convections over the islands. In rainy years, zonal flow is less intense in region and the northern meridional component is less intense than the southern component. Rainfall may be related to the variability of the zonal component at the 850 hPa over the archipelago and with the intensity of tropical jet at the 200 hPa. The meridional component at the 850 hPa intensifies over Cape Verde and equatorial region and decreases in the NE trade winds region. At the 200 hPa, rainfall intensity is likely to depend on the variability of the meridional flow over the islands, Africa and western equatorial region. At these levels, an wave train structures emerge as dominant modes, confirming the existence of influences of extra tropical wave systems, especially in the transition period, which coincides with cooler temperatures in the northern hemisphere.

According to the rainfall data observed at the surface, Cape Verde has three distinct seasons, determined by the activity and intensity of the dominant regional weather systems, identified in a transition season (November to February), a dry season (March June), a rainy season (July to October). However, these seasons do not have limiting dates to begin and end, and are often so faint that the first two are mixed. From the 1960s to date, the rainy season has been reduced to barely August and September. The figure 2 below depicts the average rainfall distribution in Cape Verde regarding two different periods: (1961-1990) and (1976-2009). With an average 225 mm/year of rainfall, approximately 20% of water from rainfall is lost through surface runoff, 13% infiltrates, recharging aquifers, and 67% evaporates.

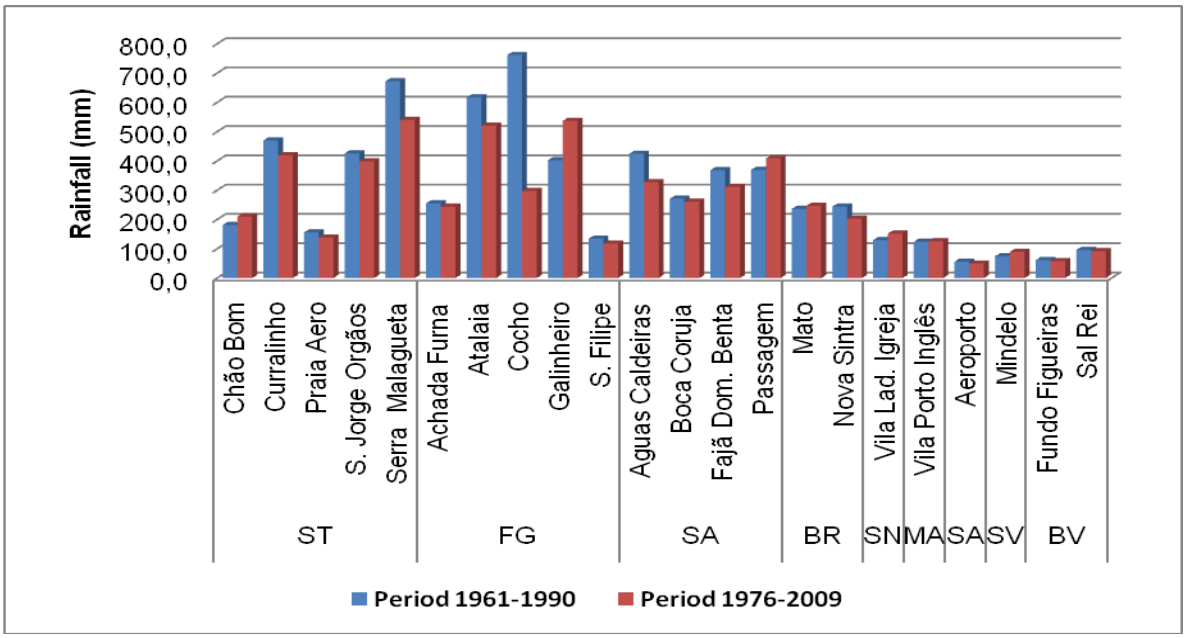


Figure 2. Average rainfall distribution in Cape Verde, months of July August September October

Source: INMG,2010

With respect to Sea Surface Temperatures (SST), the results obtained with the establishment of dominant patterns of field variation have identified a spatial pattern to the north with action centers with contradictory signs, suggesting a still insecure association with the North Atlantic Oscillation (NAO), and another on the equator, which may possibly correspond to the transfer of heat across the equator. The greatest variability is associated with transequatorial transfer of heat. The greatest variability is associated with fluctuations in temperature related to the Canary current. Annual temperatures indicating have a low temperature range. The average annual temperature is around 25ºC for coastal areas, reaching 19ºC in areas above 1,000 m. The minimum values between 20ºC and 21ºC, correspond to January to April, and the maximum values of 26ºC to 28ºC in August-September. The monthly lowest temperature is usually recorded between December and February and differs from one island to another.

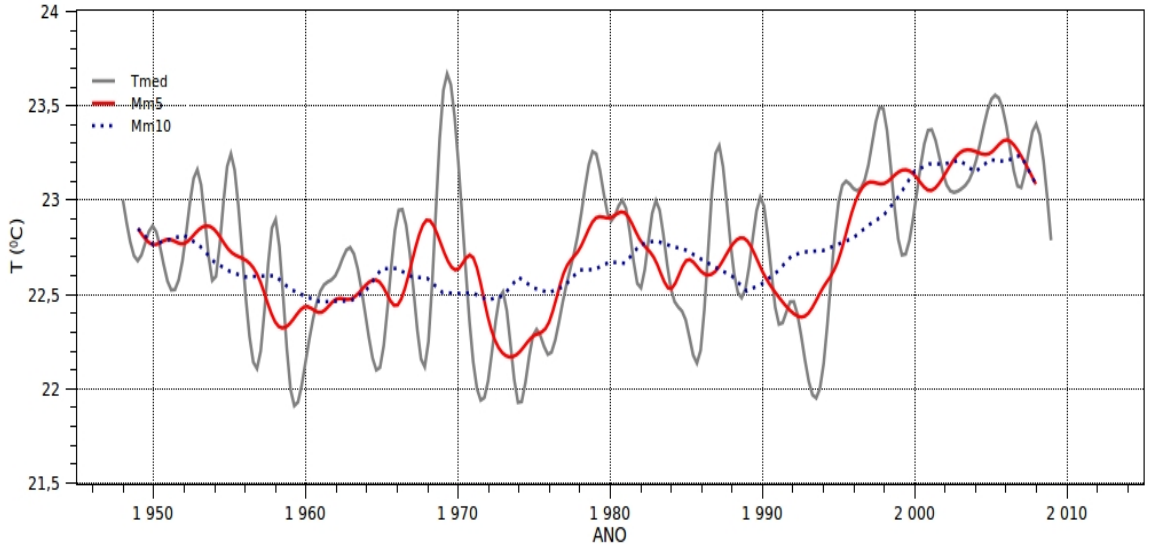


Figure 3. Variation of the average annual temperature

Source: INMG,2010

Base on the Figure 3 it can be stated that in Cape Verde the trend is for increased temperature extremes. According to forecasts, there is a propensity for a sharper rise in the coming years, which will impact on other climate parameters such as evapotranspiration.

1.1.2.3 Topography

Of volcanic origin, the islands generally have quite uneven topography, with steep, deep and ramified valleys. However, the eastern islands (Sal, Boavista and Maio) have similar topographies, with predominantly flat areas from where isolated erosive volcanic cones raise.
The land is generally hilly, especially in younger islands, including the islands of Fogo, Santiago, Santo Antão and S. Nicolau, and relatively flat in the older islands namely Sal, Boavista and Maio, culminating in very high altitudes (2829m – Fogo; 1.979m - S. Antão; 1.395m – Santiago; 1340 m - São Nicolau).
Dimensions and configurations of the topography are different from one island to another resulting in their wide-ranging landscapes. These settings highlight the following features: vast flat and wavy areas, slopes, valleys, mountains on high altitude islands and mountains and hills (typical volcanic cones).
The highest point in Cape Verde is located on the Fogo Island (2.829m) as well as the single active volcano in the country whose last eruption dates back to 1995.

1.2 Natural resources

1.2.1 Land resources, Agriculture Soils and Cultivated Areas

In Cape Verde rain-fed agriculture, totally dependent on rainfall, is practiced mainly from July to October, and irrigated agriculture is practiced throughout the year, divided into cool and warm seasons. Of the total area (403,000 ha), near 10% corresponding to 41,841 ha is potentially arable, of which 95% (around 38,000 ha) is under rainfed agriculture and less than 5% is under irrigation system (2004 Agriculture Census). The area under irrigation has increased over the years, from around 1558 ha in 1995 to near 1850 ha in 2000 and 3000 in 2004 (RGA, 2004 and PDH, 2003). Table 1 shows the evolution of cultivated areas under rainfed and irrigated agriculture for the years 1995, 2000 and 2004. It is estimated that arable land is 38,000 ha for rainfed agriculture and between 3000 and 5000 ha for irrigated agriculture.

The volcanic soils, are mostly mineral soils, skeletal, poor in organic matter and nitrogen, mainly those located on slopes where rain-fed agriculture is practiced. There are no soils with high organic matter content (nitrogen), which can be classified as organic soils, a fact which inhibits the occurrence of Histosols, soils that are composed mainly of organic materials, in the country.

Arable Area (ha)		**Cultivated Area (ha)**					
Rainfed	**Irrigated**	**Rainfed**			**Irrigated**		
		1995	**2000**	**2004**	**1995**	**2000**	**2004**
38000	3000-5000	31066	30626	32948	1558	1850	3000

Table 1. Arable and evolution of cultivated areas under irrigated agriculture and rainfed agriculture (1995 - 2004) in Cape Verde
Source: Adapted from RGA, PEDA 2004, FAO 2004

The irrigated area is limited to 3,476 ha, consisting of micro- perimeters essentially irrigated by gravity from springs or capture systems through wells or galleries. Forests consist mainly of Prosopius juliflora, Parkinsonia aculeata and various acacias, covering an area equivalent to 75,000 ha. Land distribution according to climatic zones is 67% for arid zones (2.698km^2), 16% for semi-arid (631km^2), 14% for sub-humid zones (581km^2) and 3% corresponding to wetlands (123km^2).

1.2.2 Water resources

Cape Verde is included in the list of countries living in absolute scarcity, that is, with less than 500 m³/year of fresh water per capita to meet the country´s needs in terms of agriculture, industry, energy and environment. Excepting desalinated water, water resources in Cape Verde derive from rainfall, surface water and groundwater. Water balance (INGRH, 1997) indicates that groundwater resources are estimated at 124 million m^3 per year. Of this total, the technically exploitable quantity is estimated at 65 million m^3 per year, in a year with regular rainfall, and 44 million m^3 per year during periods of drought. Surface water resources are estimated at 181 million m^3 per year. These resources are underexploited due to the lack of efficient capture and storage devices. Several tests were conducted in some parts of the country, aiming to capture water from high clouds with mesh networks, including in Santiago, S. Vicente and S. Nicolau. In 2007, 82% of the population living in Cape Verde, approximately 403,000 people, had access to drinking water, although there are disparities among the population in urban centers (93% = 274,000 inhabitants) and rural areas (66% = 130,000 inhabitants).

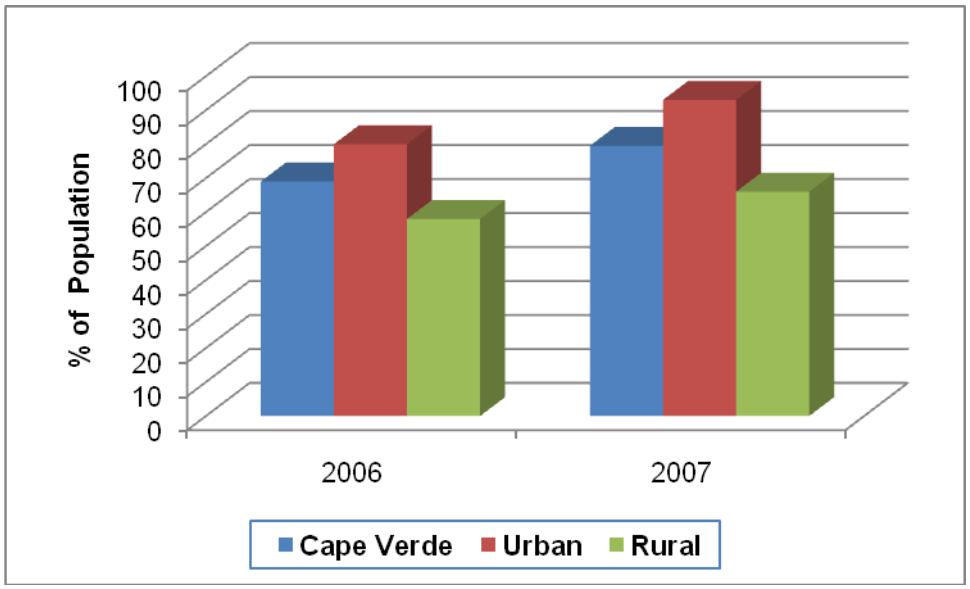


Figure 4. Access to drinking water (% of the population)

Source: Report on the State of Environmental Quality, 2008

2007 CWIQ data confirmed that Cape Verde has already met the seventh MDG, Target 10. The goal was to halve by 2015 the proportion of people without access to clean water, i.e. reaching 71% of the population with access to water safely.

In terms of Soil and Water Conservation Infrastructure, there are 2,065 wells and boreholes, 1.196 springs, 2.475 reservoirs, 826 fountains and 409 captation dikes. Most water points are found on the island of Santiago, followed by Santo Antao. 2008 data indicate that the volume of water exploited

was 19,096 m^3/day. It is important to highlight the recent construction of the first dam in Cape Verde - Poilão dam on Santiago Island, with 1.700.000 m^3 of storage capacity.
Another source of water is the recovery of waste water. But the only municipalities that have treatment plants are S. Vincent (5.000 m^3/day), Praia (14.000 m^3/day) Tarrafal Santiago (1.910 m^3/day), Sal (Santa Maria Station-1.000 m^3/day), Santa Cruz (1.500 m3/day and on Boavista island AEB offers a containerized treatment plant with a 1000 m^3/day capacity, in order to treat the waste water produced by hotels in the town of Sal Rei. Only 22% of wastewater generated in Praia and 44% in S. Vincente is collected and forwarded to the respective treatment plants. In S. Vincente (PHD, 2001) the quantities of waste water used were 1400 m^3/day for a treatment potential totaling 2,250 m^3/day.

Pollution of surface and groundwater differently originated. The document on Biodiversity (DGA, 2003, p.40) reports cases of aquifer pollution by pesticides and chemicals. The salination of groundwater, particularly in coastal areas, is posing threats especially in irrigated areas, thereby making them non-productive.

1.2.3 Soils

Soils are generally of volcanic origin, with steep slopes, derived from volcanic on impervious basalt formations favoring surface runoff in rainy seasons, which makes it difficult to practice agriculture. They are formedfrom basalt substrates, phonolite, lapilili, and volcanic tuff, excepting the eastern islands, which are calcareous. They have propensity to alkalinity and low concentration of organic matter. Moreover, they are rich in mineral elements that are often prone to meteorization and erosion. Of the approximately 403,000 ha that make up the country, about 219,000 ha (54%) are marginal or uncultivated land. Based on the indicators studied, land occupation is distributed as follows: 11% for Agriculture, 5% for tourism, 21% forested, 15%, declared protected areas.

The activity putting more pressure on land and other environmental components is still present, in certain regions of the country, the practice of free grazing and overstocking of livestock in relation to the availability of pasture, as well as extraction of aggregates for construction, in particular to meet the need of several tourism enterprises. Spontaneous and illegal construction, coupled with the fact that there are no appropriate instruments for land management, increases pressure on threatened land by promoting poor public health conditions, because these constructions do not meet the minimum hygienic conditions. However, the National Guidance for Land Management is in the final stage of preparation, the (Scheme Regional Planning) EROT's and MPD's that will introduce the reforms and adjustments to meet the needs and thus solve the complete disorganization in land management. The future calculation of the clandestine construction rate indicator will guide decision making and planning.

1.2. 4 Biodiversity

Despite being a small island state, with poor and ecologically fragile natural resources, Cape Verde hosts a wide range of ecosystems, according to topographic and climatic diversity. Natural vegetation is rare, especially in arid and low regions. However, during the rainy season, the atmosphere changes completely with the appearance of herbaceous plants that cover altitude areas. These characteristics have determined the modes of occupation and the actual use of space by local communities, making the archipelago to face economic, social and environmental vulnerabilities, posing critical challenges to the country and population.

The Millennium Ecosystem Assessment considers climate change one of the main factors affecting ecosystems and. changes observed show evidence that climate change is already affecting biodiversity (Walther et al. 2002, Parmesan & Yohe 2003, Rehfisch & Crick 2003, Root et al. 2003, Crick 2004). The main expected changes for the island ecosystems are: sea level rise, increased frequency and / or intensity of storms, reductions in rainfall, increased temperatures. These effects include delayed breeding (Crick et al. 1997; Crick & Sparks, 1999; Ollason & Thompson 2001), changes in timing of migration (Braslavska & Sparks, 2001) and population distribution (Berry et al. 2001. Rehfisch & Austin 2005).

Natural and anthropogenic environmental pressures that create situations of imbalance are the main causes of free grazing, with cattle and goats to take actions more prevalent in the devastation of the vegetation and species habitat degradation, hunting with the use of explosives, the exploitation of firewood and harvesting of herbaceous species, shrubs and trees, the unregulated use of endemic species as fodder for medical use and as a source of energy, and uncontrolled extraction of aggregates in riverbeds and beaches. Land biodiversity counts approximately 3,251 species currently distributed in 2,097 groups and 634 fungi genera (62 species), plants (1170 species, including lichens) and animals (2019 species). Among the 540 species (16%) are endemic. Approximately 20.3% of these species are included in the red list of endangered or extinct species.

Marine Biodiversity is characterized by major species groups and strategic ecosystems. There some species and ecosystems with regional and global ecological importance, endangered species worldwide, many unknown endemic species.

All of them have great economic and scientific tourism potential. Simultaneously, a considerable portion of these resources are an important source of income, ensuring job for the national population.
The seas of the islands provide important ecological functions as spawning sites for small and migratory pelagic species and migration path and feeding area for several fish species especially tuna. The island platform is the spawning ground for cetaceans (*Megaptera novaeangliae*), coastal areas of sandy beaches used by *Caretta caretta* for nesting and provide protection and food to a variety of turtle species (*Chelonia mydas, Erethmochelys imbricata, Lepidochelys olivacea*).
Degradation of plant and animal biodiversity in the country is directly related to: free grazing, where goats and cattle play the main role; hunting, firewood extraction and harvesting of herbaceous species, shrubs and trees, uncontrolled use of endemic species for medical use and as energy source; uncontrolled extraction of aggregates and the use of explosives in fishing.

The status of the biological diversity is described in the "First Red List of Cape Verde" published in 1996, which mentions some statistics that Gomes et al. (1998) consider alarming: “more than 26% of angiosperms are threatened, as well as more than 40% of Bryophytes, over 65% of the Pteridophytes and more than 29% of lichens, vegetation. Regarding fauna, more than 47% of birds, about 25% of terrestrial reptiles, and 64% of beetles, over 57% of Arachnids, and over 59% of land mollusks. Although biodiversity conservation in Cape Verde is a priority, there are no studies linking it with climate change.

Thus, according to the red list, the following are the endangered species in Cape Verde:

Endangered species	%
Angiosperms	26
Bryophytes	40
Pteridophytes	65
Lichens	29
Birds	47
Terrestrial reptiles	25
Coleoptera	64
Arachnids	57
Terrestrial mollusks	59

Table 2. Percentage of endangered species according to the Red List of Cape Verde

Source: Environmental Information System

1.2.4.1 Flora

Island flora is sensitive, (Vitousek 1988, quoted by Leyens & Lobina 1996), because of the fairly small spread area before man´s intervention, and the absence of predators, leading to the formation of small populations with a limited genetic diversity. These factors combined with the anthropogenic nature has shaped the current state of the archipelago´s vegetation in terms of abundance and full coverage of populations, species and their specific differences. Human impact on the vegetation in its various forms is made through direct misuse of species and indirectly by destroying their habitats.

Depending on the climate and type of vegetation, the following bio-climate areas are identified: **(1) Arid area (ZAE I)** - from the coast to 200 m of altitude, the vegetation is usually the steppe herbaceous type; **(2) Semi-arid area (ZAE II)** - located between 200 and 400 m of altitude, is a marginal area for agriculture (livelihoods in years of good rainfall). The natural vegetation is somewhat different from the arid zone and is more diverse; **(3) Sub-wet area (ZAE III)** – located between 400-600 m of altitude, appropriate for agriculture, consisting of different tree and shrub species; **(4) High-altitude wet area (ZAE IV)** -Located above 700 m of altitude is the most productive area in terms of agriculture and fodder production. This area is considered to have vital importance to the infiltration of rainwater and groundwater recharge.

Plants identified in these areas are classified in Angiosperms, Gymnosperms (there are only introduced species), Pteridophytes and Bryophytes. The vascular flora in Cape Verde is represented by 755 spontaneous taxa (Duarte, 1998). Because of its geographical location, Cape Verde´s flora has in its composition elements from different regions, being the most represented the Macaronesia (Canary Islands, Madeira and the Azores) and African countries (Senegal, Gambia, Mauritania and Morocco). Human action has always had a great impact on the composition of the island flora. Over 50% of the Cape Verde flora (331 taxa) was probably introduced by Man. The indigenous flora is represented by 224 species, of which 85 are currently considered endemic species of Cape Verde. Endemisms are represented by 85 species belonging to 11 families and 17 genera. The family with

the highest species diversity is Asteraceae (composite) with 10 species, including *Sonchus daltonii Webb* and *Artemisia gorgonum webb*.

1.2.4.2 Fauna

The indigenous fauna comprises coral reefs species, mollusks (bivalves, gastropods and cephalopods), arthropods (insects, arachnids and crustaceans), fish (large pelagic, demersal and small pelagic species), reptiles and birds, and probably some marine mammal species. The marine fauna has a very small number of indigenous forms, where sponges, with 257 species, and corals are the most representative in terms of endemic marine animals (13).
The most popular animals represent classes of vertebrates, being the fish, birds and reptiles classes the most representative. Marine waters are populated by a large variety of species; the largest concentration is located on the eastern islands - Sal, Boavista and Maio. These islands are on tuna's migration route, and over few months of the year these species are relatively abundant, in particular Yellowfin and Bigeye tuna. Among the migratory tuna Skipjack stands out.
There are five species of turtles, approximately a hundred and five species of marine and terrestrial birds, of which about forty-two breed locally, and twenty-four species and cultivars are endemic. Mammals and wild amphibians are represented by whales and dolphins. Among invertebrates, particular attention to coral reefs, mollusks (gastropods, and cephalopods lamellibranch), crustaceans (shrimps, crabs, lobsters...), arthropods, represented by insects, freshwater arachnids and crustaceans (all extinct) and extramarine freshwater mollusks which are found in wetter areas.
There are four species of lobster: S*cyllarides latus, Panulirus echinatus, Palinurus regius and Panulirus Charlestoni* (endemic species of Cape Verde, commonly known as pink lobster). Among the species considered useful are *Passer yagoensis, Sylvia conspicillata, Halcyon leucocephala, Tito alba detorta, Corvus ruficollis, Egretta Garcetti* and *Alauda razae*. Rare or endangered species include marmoratus, *Falco peregrinus* and *Buteo Bannerman, Falco tinnunculus* and Corvus. In land environment there is a species of *Cercopithecus aethiops*, five species of bat and one frog species (Bufo regularis)- They all have been introduced in the ecosystem.

The indigenous avifauna is represented by 41 taxa (forms) that breed on the islands, subdivided into five endemic species and eight subspecies (Hazevoet, 1996, Tosco, 2005), totaling 13 endemisms, or 58% of the total avifauna of the country. Over 50% of indigenous bird species are included in the "Red List of Birds of Cape Verde", 19.5% of which are endangered or critically endangered, 12.2% are rare, 4, 8% are vulnerable, 4.8% unspecified and 29% at low risk (Hazevoet, 1996). The main threat is all the harvesting of eggs and chicks by local communities for consumption and medicinal use.

The Government is aware of the threats posed by degradation of the country´s biological resources. This is reflected in the Environment Core Law, which includes "protection of fauna and flora of Cape Verde," and publication of some Regulatory Decrees. This situation that back in 1996 was considered alarming has deteriorated, in particular for species such as Alauda razae, whose population size was reduced from 250 individuals in 1992 to 92 in 1998, as well as Himantopus himantopus, whose population, estimated at 75 individuals in 1990, was reduced by approximately 70% in 5 years (Hazevoet, 1999). The vulnerability of marine species, especially in coastal areas, has increased despite the existing governmental measures to minimize pressure on them and their habitats. Notwithstanding such measures, the marine environment has experienced changes as a result of overharvesting of commercial species, extraction of sand and sediment deposition on coastal areas.

Category	Nº indígen. taxa (includ. endemic)	Nº extinct or endang. taxa	Nº endemic taxa	Nº endangered endemic taxa
Lichens	320	93 (29.1%)	7	1 (14.3%)
Bryophytes	39	21 (53.8%)	-	-
Bryophytes (mosses)	110	39 (35.5%)	15	6 (40%)
pteridophytes	32	21 (65.6%)	-	-
angiosperms	240	64 (26.7%)	84	45 (53.6%)

Table 3. Plant Biodiveristy status in Cape Verde

Source: National Strategy and Action Plan of Biodiversity, 1999

Category	Nº indígen. taxa (includ. endemic)	Nº extinct or endang. taxa	Nº endemic taxa	Nº endangered endemic taxa
Molluscs Freshwater Extramarines	12	8 (66.7%)	4	3 (75%)
Land freshwater molluscs	37	21 (56.8%)	15	10 (66.7%)
Freshwater crustaceans (shrimp)	4	4 (100%)	-	-
Arachnids	111	64 (57.7%)	46	36 (78.3%)
Insects (beetles)	470	301 (64%)	155	128 (82.6%)
Terrestrial reptiles	28	7 (25%)	25	7 (28%)
Birds	36	17 (47.2%)	13	8 (61.5%)

Table 4. Animal Biodiveristy status in Cape Verde

(Source: National Strategy and Action Plano f Biodiversity, 1999)

1.2.5 Rocks and Minerals

Volcanic materials are the most common in Cape Verde and directly influence the genesis of its soils, including alkaline rocks such as:basalts, basanites and basanitoides; basaltic Rocks, altered or very easy to alter such as ; phonolite and trachyte rocks; sediments of terrestrial and marine facies; tuff facies, tuff-breccia and pyroclastic materials; materials accumulated in extrusive volcanic cones;

• Patch of sedimentary rocks; alluvial and colluvial materials;

Minerals, as soil and rocks do not havegreat economic interest. However if incorporated in some of the black sand beaches magnetite and ilmenite are found in appreciable quantities On every island large non-metal deposits of different nature can be found (ornamental and non ornamental industrial rocks). Ornamental rocks predominantly sedimentary are found on several islands, especially in plain islands (Boavista, Sal and Maio). In most cases deposits indicate an economically unviable exploitation due to their small size and lack of or physical characteristics appropriate to industrial processing and commercialization. Non ornamental rocks, the case of basalts, limestones, sands,

clays, gypsum and pozzolan, have undoubtedly the best potential. On the island of Santo Antao pozzolan is already explored.

1.3 Population and Urban profile

According to the preliminary results of the Fourth Population and Housing Census, 2010, Cape Verde has approximately 501,648 inhabitants(including the present resident and absent), with an average annual growth of 1.2% in 2000 (434,625) to 2010 (491,575). Sotavento is the most populous area, with about 323,917 inhabitants, while Barlavento, the least populated, counts approximately 127,658 inhabitants. Most of the population lives in urban areas (303,776 inhabitants), representing about 62% of the total, while the remainder live in rural areas (187,799 inhabitants), and representing 38% of the total. The most urbanized cities, Sao Vicente, Praia and Sal have achieved rates of around 92.6%, 96.6% and 92.9% respectively. Although the higher population density is in the cities of Praia and Mindelo, the fastest growth occurs in Praia.

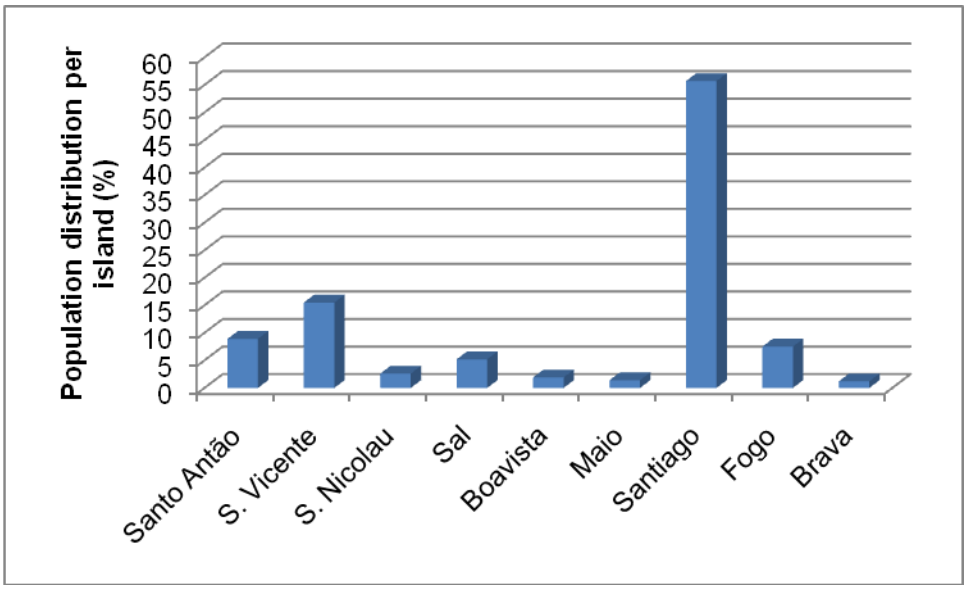


Figure 5. Population distribution per island

(Source: INE, Preliminary results of IV PHCensus, 2010)

Cape Verde´s population is manifestly young in its age structure, with 31.6% of the population between 0-14 years (2010 RGPH preliminary results) and only 6.5% over 65 years. Life expectancy is set at 71 years (67 for men and 75 for women). Infant mortality rate was 20 ‰ in 2004 (44 ‰ in 1990 and 26 ‰ in 2000). The Population Growth Rate –depending on migration flows- in 1990-2000 (last census data) was approximately 2.4%. In 2010 it dropped to 1.2%.

1.4 Social and economic development

Cape Verde is a poor country and vulnerable to climate change and external factors since it imports approximately 90% of its consumption needs. Gini Index for Cape Verde is 0, 57.

1.4.1 Poverty evolution and inequality in the last decades

In 2004 and 2007 surveys were conducted by the World Bank, INE and DGP that indicated a decline in population size in absolute poverty between 1988-89 and 2001-02, from 49% to 37%.

Table 5 presents poverty data based on goods/assets. Note a 11.7 percentage point drop, from 36.5% in 2001-02 to 24.9% in 2006. Poverty remains a critical issue and it is mainly due to the weak productive sector and inability to generate jobs income and well being of populations.

Years and difference	Expected poverty in 2006 based on consumption distribution and increase in 2001 GDP per capita	Expected poverty in 2006 based on consumption distribution and increase in 2001 consumption per capita	Reduction in pover Based on assets bet 2001 and 2006	Reduction increase poverty based on as between 2001 and 2006
National				
2001-02	36.7	36.7	36.5	36.5
2006	28.7	26.9	24.9	28.0
Difference (2001-06)	- 8.0	- 9.8	- 11.7	- 8.5
Urban				
2001-02	25.0	25.0	24.9	24.9
2006	17.5	16.0	17.2	19.3
Difference (2001-06)	- 7.6	- 9.0	- 7.8	- 5.7
Rural				
2001-02	51.1	51.1	50.8	50.8
2006	42.5	40.3	31.3	28.6
Difference (2001-06)	- 8.6	- 10.8	- 19.5	- 22.2

Table 5. Poverty incidence, alternate methods, Cape Verde (2001-2006)

Source: Authors using IDRF (2001/02) and QUIBB (2006)

1.4.2 Number and proportion of the poor in Cape Verde

Data from the Household Income and Expenditure / Living Conditions Survey conducted by the National Institute of Statistics in 2001-2002, indicated that 37% of the total population was poor, mostly (62%) living in rural areas. Approximately 54% were considered very poor, accounting for 20% of the total population. Of these, about 51% were women. In 2002, approximately 95,000 households lived in Cape Verde, of which around 27,000 were poor, representing 28%. Of the 27,000 poor households, 13,000 were very poor, representing about 14% of total households in Cape Verde. Of the nearly 173 million poor people in Cape Verde, about 89,000 are women and 84,000 are men. The poor population is very young, with a considerable number of dependent individuals, i.e. children under 15 (49%) and elderly people aged 65 and more (6%). Thus, of the resident poor people, about 84,000 are less than 15 years old and about 10,000 are 65 years old or more.

1.4.3 Child malnutrition

Cape Verde produces less than 15% of its food needs. According to the available information on dietary intake show that it is hypocaloric, with an important deficit of vitamins and minerals.
Five out of every hundred children have chronic energy deficiency, most notably among children from poor families (7%) than among non-poor families (4%). Likewise, according to the IDRF, about 14% of the children in this age group have growth retardation, 16% among poor children and 12% among the non-poor. Chronic malnutrition in children under 5 has evolved (although very little in 12 years) from 16.2% in 1994 to 15% in 2006. Acute malnutrition accounting for 5.6% in 1994 has evolved to 7% in 2006.

To reverse the situation from a perspective of gradual improvement of the nutritional situation in the country, the National Programme for Food Security is pursuing the following goals and objectives: a) contribute to the definition of the main political guidelines which should support priorities, strategies and activities to improve the Cape Verdean population´s well-being, (b) establish coordination mechanisms for projects and activities underway in field of nutrition, (c) Identify areas with problems and find solutions, (d) integrate nutrition activities in the National Development Plans.

With regard to household gender and size the data released by INE showed that the poverty rate is lower (21.3%) in households headed by men than in those headed by women (33%). Families with five or six people make up 21.08% of poor people in Cape Verde and households with seven or more individuals reach 43.05%. These results demonstrate the government policy success in fighting poverty, placing Cape Verde in a prominent position in meeting the Millennium Development Goals (MDGs). Reducing extreme poverty is one of the goals. It is expected to halve the proportion of population living in extreme poverty between 1990 and 2015. Against the MDGs, Cape Verde has the challenge of removing from extreme poverty around 47,000 inhabitants. For this purpose operations under the National Program to Fight Poverty (PNLP) and specifically the Programme to Fight Poverty in Rural Areas (PLPR) have a leading role. This later has substantially facilitated employment generation and income, as well as education and professional training activities. PNLP is based on the following guiding principles: reducing poverty in lasting and sustainable manner, (ii) fighting poverty in a decentralized framework, and (iii) promoting participation and coordination of efforts in fighting poverty.

The National Programme to Fight Poverty aims to promote lasting and sustainable reduction of poverty in the country, with the following specific objectives:i) promote integration of poor groups in the development process; ii) improve social indicators of the poor; iii) build institutional capacity for planning, coordination and monitoring of poverty alleviation activities.

1.4.4 Education profile

The indicators that characterize the education profile in the country show that a) the net literacy rate in primary education has stabilized, going from 71.5% in 1990/91 to 95.1% in 2005/2006, b) in primary education the parity index is one girl for one boy, which puts the country within the MDG goals; c) among new enrollees in primary education, 80.6% attended pre-school, that points to a trend towards more widespread access to this subsystem; d) in secondary education there is an increase in enrollment of 58.1% in 2005/2006, with a slight advantage for the female students, around 61,8% and the percentage of trained teachers increased from 67.2% in 2000/01 to 81.4% in 2005/06; f) the transition rate from primary to secondary has increased by 10.1 % from 70.7% in 2000/01 to 80.8% in 2005/06; g) the percentage of success in this level of education increased from 62.1% in 2001/02 to 65, 2% in 2005/06; h) school dropouts increased slightly from 9.4% in 2001/02 to 10.6% in 2005/06 to 8.6% for girls and 13 % for boys, and markedly higher in secondary education with 15.8% and 23.5% for girls and boys, respectively. According to the 2006 CWIQ data, the literacy rate in Cape Verde is 78.7% - 71.9% for women and 86.5% for men. By region, it appears that 84% relates to the urban and 74% to rural areas. Youth literacy rate is above 93% in all municipalities. Public expenditure on education and training accounted for about 23% of expenditure under the State general budget for 2007.

1.4.5 Health profile

Regarding health sector progress is considerable, supported by indicators allowing us to conclude that Cape Verde will reach the Millennium Development Goals in reducing child mortality and improving maternal health. Indeed, in 2006, 74% of households had facilitated access to health services; between 2000 and 2007 the infant mortality rate dropped from 29.8% to 25.3%, being the goal 18.7% in 2015. In the same period the rate of child mortality dropped from 39.6% to 32.8%. Regarding maternal mortality, although it cannot be stated whether the trend is increasing or not, it evolved from 30% in 2003 to 14.5% in 2005.

HIV / AIDS prevalence was estimated at 0.8% in 2005, being 1.1% for men and 0.4% for women, continuing these more exposed than men to sexually transmitted diseases (72% of men and 46% of women say they had protected sex). The main means of transmission is sexual intercourse, with 90% of the cases; women are more vulnerable, with 58% of cases.

Malaria is not endemic, tuberculosis remains endemic in the country, determined by attitudes and behaviors and socio-economic conditions; diseases that could be prevented by vaccination are decreasing in frequency.
There remain, however, regional disparities and increasing demand for specialized care, which increases costs due evacuations in the country and to other countries.

Services	2006 CWIQ			2007 CWIQ		
	CV	Urban	CV	Urban	CV	Urban
% users	16,1	18,2	13,5	16,5	19,4	12,8
Hospital	45,0	46,1	43,3	46,0	48,6	40,7
Health center	35,3	34,2	37,2	37,7	34,3	44,6
Private office	13,2	16,6	7,3	13,2	17,4	4,8
Health unit	4,0	0,6	9,8	3,0	0,6	7,8
USB	0,5	0,0	1,4	0,5	0,1	1,2
Pharmacy/point of sale	0,1	0,0	0,2	1,6	1,8	1,1
Doctor	1,4	1,9	0,4	0,6	0,9	0,2
Other health agents	0,2	0,1	0,2	0,1	0,0	0,3
Other	0,4	0,5	0,2	0,3	0,2	0,5

Table 6. Health Indicators in Cape Verde (most demanded services)

Source: QUIBB-CV, INE, 2007

Regardless of having had a health condition, 16% of the population sought health care facilities, being hospitals and health centers (38%). the main choices (46%) The level of satisfaction of health services despite having declined by 5 percentage points for 2006 is 84%. The main reasons for dissatisfaction relating to Health Services have to do with the "long waiting time", "very expensive" and "treatment without success.

	2006			2007		
% of Satisfation	CV	Urban	Rural	CV	Urban	Rural
	89	89	89	84	84	83

Table 7. Level of satisfaction of Health Care Services

Source: CWIQ-CV, INE, 2007

	2006			2007		
% de Insatisfaction	CV	Urban	Rural	CV	Urban	Rural
	11,2	11,1	11,5	16,5	16,3	17,0

Table 8. Level of insatisfaction of Health Care Services

Source: QUIBB-CV, INE, 2007

1.4.6 Access to Basic sanitation services

In 2006, only 34.5% of households reported having disposed waste water through septic tanks or sewer, or approximately 66/100 families improperly disposed waste water, mostly near the house (38.4%) or in nature (26.5%). Nationally, about 42% of households have no access to a minimum and adequate excreta disposal service, thus using nature to satisfy their physiological needs. This situation is worse in rural centers (62.6%), against 28.1 in urban centers. Regarding the use of the domestic solid waste collection system in Cape Verde only 59.7% of households utlises refuse collectors and garbage containers, and 27.3% dump it into nature. This picture gets worse in rural centers where only 21% of households dispose their domestic solid waste into containers and refuse collectors, 53.4% dump it into nature.

1.4.6.1 Water and sanitation

According to the chart below, the percentage of population with access to safe drinking water rose from 42% in 1990 to around 85% in 2006, 77% in rural areas and 93% in urban areas; however, differences persist in relation to rural areas and misuse of resources and means.

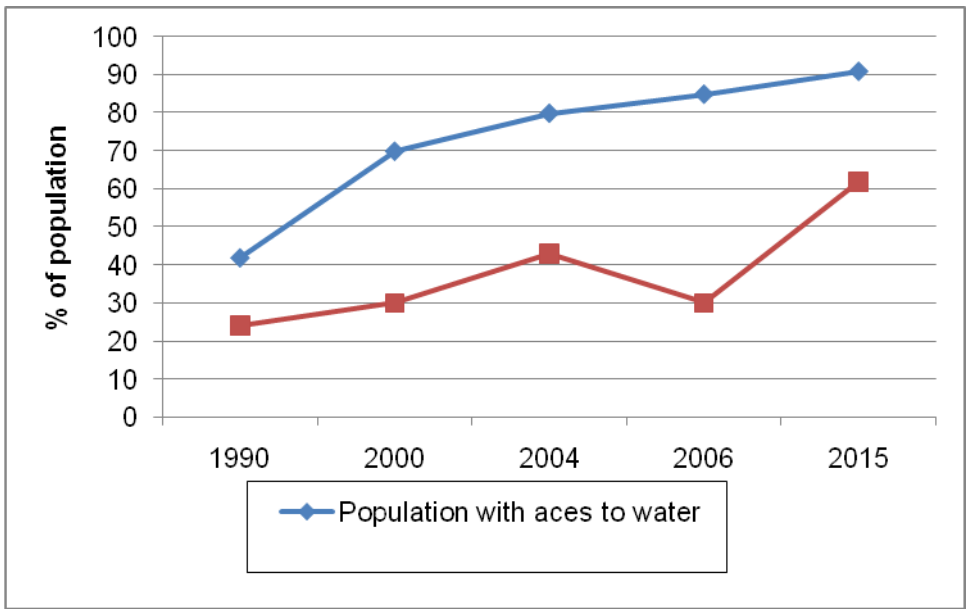


Figure 6. Aces to water and sanitation

Source: 2006 OMD Report

1.5 Economic profile

In recent years, there has been a positive economic growth in Cape Verde. Growth in the Gross Domestic Product (GDP) averaged 5.7% over the 2000/05 period, 10.8% in 2006 and 6% in 2008. GDP per capita grew significantly from $ 2,080 (USD) in 2000 to $ 3450 (USD) in 2008, according to data from the World Development Indicators Database in April 2009. Tourism has been the fastest growing sector in recent years. Between 2002 and 2006 it increased by 26% (19,247 million Escudos). In 2007, tourism contribution to GDP was 19.2%, reflecting some dependence of the economy on the sector and increasing its vulnerability to external shocks.

Life expectancy in Cape Verdeans is 68.5 years for men and 76.3 years for women. Poverty dropped from 49% in 1989 to 27% in 2007. These facts helped the country to graduate from the Least Developed Group of Countries (LDCs) to Medium Development Countries (MDC) in 2009.

The predominance of the tertiary sector is explained by the weak expression in the primary sector due to structural limitations of agriculture and the scarcity of other natural resources. Fisheries, which has some potential, however is still at the stage of embryonic development. Summarizing, the primary sector accounts for 13% of GDP, employing around 16% of the workforce. The secondary sector accounted for 19% of GDP and 18% of employment. The weak expression of the secondary sector is explained by the small size of the internal market and the near absence of an export-oriented industrial activity.

Under good governance, the Ibrahim Index ranked Cape Verde second (78 out of 100 points), behind Mauritius, a total of 53 African countries assessed in 2007, and the United Nations indicated that the country stood at 121st position with a rate of 0.708 of Human Development in 2008. All these positions reflect the socio-economic situation of the country, considered from the year 2009 as Medium Development Country (MDC), with an average annual income per capita of $ 3,450 (USD) (2008). The structure of the Cape Verdean economy is differentiated by the predominance of the tertiary sector, which represents near 68% of the GDP and absorbs 66% of employment, approaching the typical structure of developed economies, despite its deep structural constraints

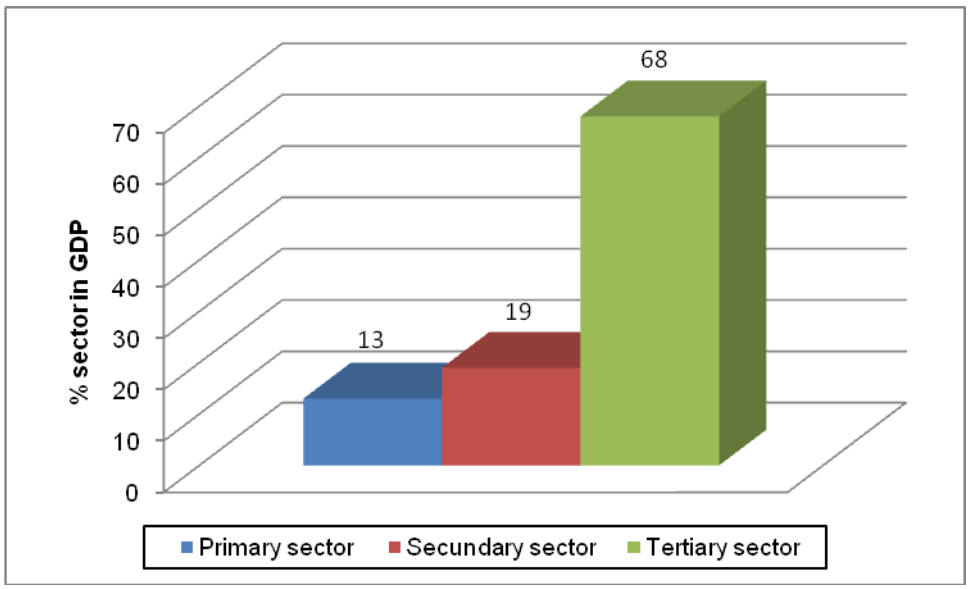


Figure 7. 2008 GDP structure

Source: INE - CWIQ, 2008

Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Final Consumption	12551,6	13953,3	14701,2	15716,1	17182,2	18970,7	20989,4	21777,0	23229,2	25486,9	27701,0
FBCF	5747,7	5142,5	6260,6	5721,6	5761,9	7038,0	6373,8	6939,9	8377,4	8338	10376,5
Exist Var	184,8	149,6	-202,7	214,2	-13,5	594,8	-180,2	-6,3	-164,5	-32,9	3189,2
Exports	2125	2159,1	2475,2	3030,6	3120,8	3568,6	3921,2	3637,2	4243,9	3137,3	1886,7
Imports	9187	9126,7	10134,6	10582,2	10764,8	13072,4	12761,9	12879,7	15189,7	15473	15189,7
Total	11422,1	12277,8	13099,7	14100,3	15286,6	17099,7	18342,3	19468,1	20496,3	21456,3	27963,7

Table 9. GDP from demand point of view, 1994-2004

(constant prices), unit: million ECV)

Especifications	Years										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP	100	100	100	100	100	100	100	100	100	100	100
Agriculture	11,87	11,95	10,67	9,35	8,35	10,55	10,59	10,09	9,20	8,98	8,53
Industry	20,28	20,62	21,79	20,81	20,05	18,99	17,65	16,53	17,85	17,28	17,05
Services	67,85	67,43	67,54	69,84	71,60	70,46	71,76	73,38	72,97	73,74	74,42

Table 10. Disaggregates the GDP by economic sectors 1994-2004

Table 10 disaggregates the GDP by economic sectors, showing the growing importance of the service sector in the Cape Verdean economy. In 2004 the service sector contributed with 74.42% of the GDP, the tourism sector with 17.05% and agriculture stood at 8.53%.

In short, the economic geography of Cape Verde identifies the following factors as important potential for development: a) human resources with a relatively adequate level of training; b) an exclusive economic zone of about 734,000 km² representing some economic potential; c) a geographical location in the middle of the Atlantic that allows for excellent North/ South Atlantic linkages; d) preferential access to major world markets. However, the country also faces serious constraints hindering its development since it is too far from major markets and therefore exposed to high costs of external communications; it faces difficulties in relation to the economy of scale,

particularly as regards the implementation of infrastructure due to its geographical dispersion (nine inhabited islandsn and it has a weak agricultural base, resulting from the lack of water and a reduced agricultural area (10%). In this context and given the country's vulnerability to external shocks, Cape Verde´s development is heavily influenced by the evolving global economy.
Note that in 2000 the economy registered imbalances in public accounts as well as in the balance of payments with a consequent drop in net foreign assets, which led the authorities to take restrictive measures aimed at restoring these imbalances. Moreover, in 1997 the international financial crisis impacted the country, and the authorities adopted restrictive measures once again. As of 2000 the economy continued its course GDP growth.

At the sub-regional level, Cape Verde is a member of the African Union and Economic Community of West African States (ECOWAS). In 2002 the country endorsed the NEPAD initiative. At the international level, Cape Verde has signed a strategic partnership with the European Union in 2008. After Cape Verde´s admission was approved by the General Council of the World Trade Organization (WTO) on December 18, 2007 in Geneva, Cape Verde became the 153th member of this Organization as of July 23, 2008. Cape Verde admission to the WTO concluded a set of policy options and economic reforms initiated with the exchange agreement with Portugal, the political-military approach to NATO, the Special Partnership Agreement with the European Union, and supported the country's graduation to the group of Medium Income Countries. In addition it provides the Macaronesian region a wider range of business relationships, making the country one of the main points of entry and departure in relations between the EU and Africa and a platform between Africa and the American Continent. All these international commitments are reflected in different national strategic frameworks grouped within the Strategy for Growth and Poverty Alleviation (GPRSP) adopted in 2008.

1.6 Industrial profile

Cape Verde´s industrial performance is weak; its stagnant industrial structure is poorly organized to take advantage of new technological environment. Without a new competitive structure the risk of industrial marginalization is substantial. With approximately 20% of the total GDP of the country in 2004, the sector represents a modest part of the economy of Cape Verde. The country's growth over recent years has not allowed the industry to play a more important role, with a growth rate in the sector below the national average. The economy of Cape Verde is today rather service-oriented than industrial.

(% of the GDP)	**1994**	**2003**	**2004**
Agriculture	12,8	6, 8	6,8
Industry	19,8	19,7	20,2
Services	67,4	73,4	73,0
(growth rate)	**1994-04**	**2003**	**2004**
Agriculture	5,4	1,5	1,5
Industry	5,6	4,5	4,5
Services	6,1	5,7	6,4

Table 11. Disaggregates the GDP by economic sectors 1994-2004

1.6.1 Performance in exports

Even if the overall role of industry in the economy is modest, its contribution to exports is important, for approximately 90% of the country´s exports to the EU and consist mainly of manufactured goods accounting for 58% of the country´s total exports. These figures did not consider tourism, which is not counted as an export product, but whose impact on the balance of payments is similar to the export of goods. For imports, note that approximately 60% of national imports from Europe and worldwide are industrial goods.

1.6.2 Nature of industrial activities

Figure 8 depicts the number of industrial enterprises by area of business. It appears that wood, furniture and metal industries account for a large percentage of them. However data show that this activity is mainly artisanal in Cape Verde and is related to microcompanies. As shown in Figure 4, timber and furniture sectors lag far behind in terms of manpower compared to the number of companies. Also, the metal sector - which excludes machines - consists mainly of car workshops. Industry in Cape Verde consists of a limited number of small sized enterprises. Enterprise census data (2004) indicate a total of 460 operational enterprises in the industry, only 30 of them employ more than 21 workers. Interestingly, the highest number of relatively large companies (11 companies) is engaged in agro-food, clothing and leather goods.

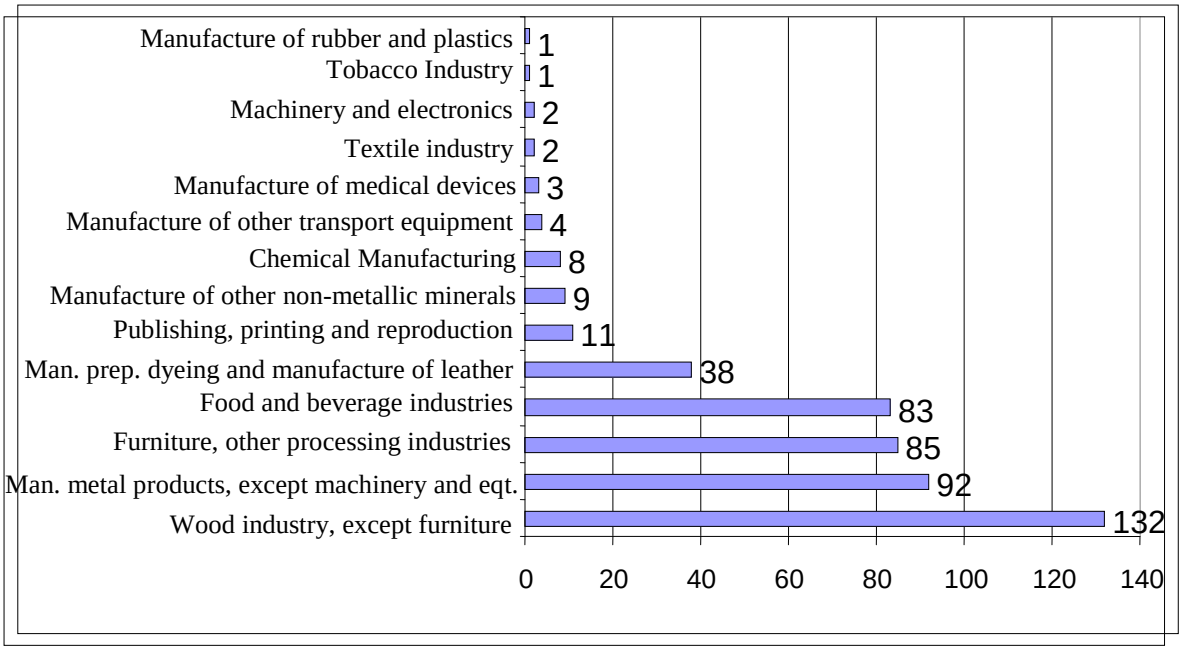


Figure 8. Activity distribution by number of companies (2002)

Source: INE, Enterprise census

1.6.3 Foreign Direct Investment (FDI)

Based on information regarding Foreign Direct Investment (FDI), index of industrial development and condition of access technologies and global markets, it appears that Cape Verde had a performance below the average of developing countries in the field of attraction in all activities and

industry represents only a tiny fraction. The tourism sector is the dominant sector of the FDI , which is weak in activities that require a high technological intensity. Industrial investments are concentrated just in the sectors (i) agro-food, including fish processing, (ii) clothing and footwear and (iii) building materials.

1.6.4 Mineral resources

Although the importance of natural resources has drastically declined in the new industry global context, they should never be overlooked. With a 4033 km^2 area and very low rainfall rates, the country is poor in arable land - which is one of the limitations of the agro-industrial sector. In 2004, mining continued to play a minor role in the economy. However, the country produces a certain amount of minerals used in the preparation of construction materials: clay on the islands of Boavista, Sal and Sao Vicente, plaster in Maio; limestone in Boa Vista, Sal and Santo Antao, pozzolan in S. Antão, and finally, salt on the islands of Maio and Sal.

In the rural sector, emphasis is placed on the transformation of domestic products supported by small agricultural product processing and/or storage units (wine, cheese, and canned fish). The livestock sub-sector with the production of meat and milk is particularly targeted.

The priority for development in this sector has been fighting poverty and thus meeting the basic population needs.

1.7 Energy

The islands of Cape Verde, from the energetic point of view, are composed of independent systems, characterized by their small size and distance from supply centers. Furthermore the lack of conventional energy resources causes a critical dependence on foreign energy. Electricity (domestic consumption) and fuel (aircraft, water desalination) are energy products increasingly vital for the current socio-economic system.
According to the National Home Energy (PNED), the estimates indicate diesel oil as the most relevant fuel in the internal consumption (41%), followed by firewood and other biomass (19.4%), and finally fuel (16 %). With regard to domestic energy, the most consumed fuel in urban areas is gas (69.49%), followed by firewood (22.43%) and other residues (7.67%). In rural areas, the first fuel is firewood, which represents 85.72% used for cooking. The highest demand in the country for fuel wood is on the island of Santiago (50%). Firewood is used by 39.5% of households as the main energy source for cooking. A large percentage (85%) of firewood use is collected mainly by women and only 13.3% is purchased. Successive increases in gas prices in recent years have led to increased firewood consumption by households, mainly in rural areas, where there is more concentration of poor people. Traditionally Cape Verde is not a charcoal producing or user country. Production is limited to the islands of Maio, Boavista and Sao Vicente for sale mainly in the capital.

Butane gas experienced a substantial increase in recent decades, both in rural and urban areas (from 1980 to 1990, consumption increased by 330% and between 1990 and 2000, it stood at 40%). 2001 recorded a negative variation, possibly by the increased gas price. Currently, gas is used as the main source of domestic energy (56.8% of households), being the most used energy source in the country to cook food. The market supply is controlled by companies Shell Cabo Verde and Enacol. They are responsible for supplying the country based on an agreement signed with the Government. Energy efficiency and technological innovation are considered by Cape Verde (Energy Strategic Plan) an alternative resource in the field of renewable energy.

The country highly depends on foreign energy, of which 99% is imported. Yet, several projects are ongoing, that once implemented, will represent a 30% reduction (20,000 ton/year) in imports of petroleum products.
Public electricity remains the main source of energy used by Cape Verdean households for lighting, accounting for 58%, followed candled (18.7%) and oil (15.4%). The use of electricity is strongly linked to family income, thus the lower income households use candles and oil (National Home Energy-PNED- Cape Verde). Illegal electricity accounts for 5.5% of the connections to public network. Incandescent lamps are the most frequently used (73.3%), with only 7.8% of households using fluorescent lamps. Appromately 61.4% do not use low energy bulbs
Despite the capacity for power generation nationally by using renewable energy sources is 3.2%, in fact it does not reach a percentage point. This is because the technologies used are not all operational due to breakdowns lacking qualified technical staff for equipment maintenance. The weight of other alternative energy sources (mainly wind and solar) in the context of domestic energy, is weak, although there are excellent conditions for their use. The wind, still represents a very small percentage in the total energy consumed, used for electricity production. The investment and adoption of renewable energy technologies and alternatives for reducing dependence on fossil fuels is one of the strategies addressed in the Energy Policy of Cape Verde.

1.8 Transport

In the sixties, and especially after independence in 1975, Cape Verde initiated an air and maritime inter- island transport expansion process, through state companies. The country, thanks to this measure, gained in mobility and accessibility, while conditions were created for private initiative, especially in the maritime transport sector. In 1992, a loan agreement was signed to co-finance the Transport Infrastructure Programme (PIT) and support the Government in the overall coordination of interventions in transport and infrastructure sectors. Under this project funds were used to rehabilitate and modernize ports, airports and roads as well as for the preparation of technical studies and actions for improved sector management. The program also aimed to develop the private sector of public works, thus increasing the number of domestic firms and therefore the weight of this sector in the economy of the country.

1.8.1 Road Sector

1.8.1.1 Networks and Infrastructure

Roads in Cape Verde are ranked in National Roads and Municipal Roads. In general terms, in 2005 Cape Verde had a 1,675 km long paved road network (asphalt concrete, bicouche, cobblestone pavement and cobblestone) which, in terms of conservation, approximately 30% were in good condition, and the remainder had more or less severe deficiencies. For improved sector management in terms of licensing, regulation and supervision, a Road Institute was established, the public agency responsible for network planning and management, representing the state as the Road Authority.

1.8.1.2 Road transport

The road fleet grew between 1991 and 1999 at an average annual rate of 14%. This growth reflects a rapid renewal of the fleet. Governmental measures were implemented aimed at reducing levels of car accidents, among which we highlight the legal requirement for seat belt use and prohibiting the use of mobile phones by drivers. Legal limits were also determined for maximum levels of alcohol intake. Periodic motor vehicle inspection was implemented and conditions were legally defined for vehicle inspection licensing to private entities. Intercity passenger transport is, for more than 15

years, fully covered by the private sector. However, the urban passenger transport was only fully liberalized in May 2002, with the extinction of the state company Transcor.

Vehicles	1995	2000	2006	TCMA 95/06
Automobiles	8048	15971	28851	12,3%
Heavy	2004	3466	6216	10,8%
Motoryicles	931	1425	2854	10,7%
TOTAL	10983	20862	37921	11,9%
Registered				
Automobiles	1249	2433	2131	5,0%
Heavy	220	385	471	7,2%
Motoryicles	102	139	491	15,4%
TOTAL	1571	2957	3093	6,4%

Table 12. Licensed vehicles

Source: Strategic Transport Plan 2011

1.8.2 Maritime-port system

1.8.2.1 Port network and infrastructure

Because of the island nature of the country, maritime transport plays a highly relevant role. Besides the three international ports (Praia, Mindelo and Palmeira) all islands have port infrastructure capable of ensuring sea accessibility.Cape Verde is in conditions to become a regional and international passenger and cargo hub. Studies for the development of a transshipment system clearly show this strategy is feasible, and its importance for the country development. Both goods and passenger movement have recorded a significant growth momentum, most notably cargo operations (+19.2% annually since 1995).

Regions	Ports	Islands
Barlavento	Porto Novo	Santo Antão
	Porto Grande	São Vicente
	Tarrafal S. Nicolau	São Nicolau
	Palmeira	Sal
	Sal Rei	Boavista
Sotavento	Porto Inglês	Maio
	Praia	Santiago
	Vale dos Cavaleiros	Fogo
	Furna	Brava

Table 13. Main Ports in Cape Verde and location per region/islands

1.8.3 Air transport sector

1.8.3.1 Airport system

The airport system consists of 3 airports international airports and 3 airfields: Amílcar Cabral Airport, Sal; Praia Aeroport da, Santiago; São Pedro Airport de, em São Vicente; Rabil Airport, Boavista; Preguiça Airfield, São Nicolau; São Felipe Airfield, Fogo and Maio Airfield, Maio.

Airport infrastructure is managed by the public company ASA - Airports and Air Safety. The company is also responsible for monitoring and managing airspace, including Sal oceanic FIR. Institutionally, Cape Verde meets the international legal and technical-commercial standards. This framework (including the Aeronautical Code, regulations under the Chicago Convention and establishment of the Institute for Civil Aviation) laid down the principles, rules and procedures for participants in international civil aviation and facilitated the signing of international cooperation agreements The recent international cooperation agreements proved useful to Cape Verde with respect to both aircraft to refuel and passenger flow, including tourists.

1.8.3.2 Air transport

Air transport services, both domestic and international, are provided by the national flag carrier, TACV Cape Verde Airlines and other private companies. While the international lines are balanced, the lines between the islands are mostly unprofitable. There are other foreign airlines regularly operating in the country, providing regular links with key international partners, and charter tours to the airports of Sal, Santiago and Boavista. Some companies make technical stops on the island of Sal.

Criterion	Unidad	Valor absolute (2000)	Valor absolute (2004)	Source
Population	Nº	440.000	469.456	INE
Area	Km^2	4.033	4.033	REQA-2008
GDP	Mio ecv	30.323,7	37.521,3	INE
GDP per capita	Esc	68.917,5	79.926,08	INE-CV (national accounts)
Weight of informal sector in GDP	%	35%	40%	Several (estimate)
Weight of agriculture in GDP	**%**	7,7%	6.11%	INE
Weight of Fisheries in GDP	**%**	0,71	0,52	INE
Weight of industry in GDP	**%**	26,1	26,7	INE
Weight of water and electricity in GDP	**%**	4,1	5,0	INE
Weight of construction sector GDP	**%**	14,7	16,05	INE
Weight of trade	**%**	14,7	16,07	INE
Weight of hotels and restaurants in GDP	**%**	3,2	4,1	INE
Weight of transport sector in GDP	**%**	12,61	10,3	INE
Weight of communication sector in GDP	**%**	5,9	6,2	INE
Weight of Banks in GDP	**%**	2,4	2,7	INE
Weight of government services in GDP	**%**	11,3	12,5	INE
Weight of other services in GDP	**%**	1,4	1,4	INE
Weight of duties and taxes /imports in GDP	**%**	6,3	6,0	INE

Table 14. National Circumstances

Source: INE - Cape Verde, National Accounts

1.9 Special Circumstances

This item will address the special circumstances related to the specific needs and concerns arising from the negative effects of climate change and/or impact resulting from the implementation of response measures, in accordance with article 4, paragraph 8 of the UN Framework Convention on Climate Change.
Some studies have been produced on specific sectoral vulnerabilities against possible negative impacts that may result from Climate Change effects. Although studies have covered the main areas of economic development, regarding the selection criteria Water Resources, Tourism and Agro-silvopastoril / Coastal Zones were considered as priority sectors, needing immediate adaptation measures to minimize negative impacts. Other sectors such as Health and Biodiversity were also analyzed for vulnerability.

1.9.1 Coastal areas

Cape Verde has a 2,000 km coastline with urban and industrial areas, areas of intensive tourism as well natural, rural and fishing areas. The Exclusive Economic Zone (EEZ) of Cape Verde comprises an area of approximately 734,000 km^2. The coastal area is a dynamic area with biological, chemical, physical and geological features in constant change, including relevant biodiversity ecosystems, highly productive and that offer habitat for many marine species, which are particularly vulnerable to climate change in the perspective of a possible rise in sea level resulting from global warming. Note that the geomorphological characteristics of the islands define a set of landscapes, where lowlands in the coast stand out (Table 15) that, nationally, have a great vulnerability to a possible rise in sea level associated with extreme and adverse climate situations, as are cases of storms with strong winds, heavy rains and tidal waves.

Islands	Vulnerable areas
Sal	Baía de Palmeira, Baía de Santa Maria, Buracona, Baía de Murdeira, Ponta de Sino e Costa de Fragata
Boavista	Baía do Sal Rei
Maio	Ribeira da Lagoa
Santiago	Port of Praia, Coastal Area od Praia Baixo, Port of Calheta de São Miguel - Port Formoso; Baía de Cidade Velha, Caniço, Porto de Praia Baixo e Baía do Tarrafal
Santo Antão	Cidade do Porto Novo, Vila das Pombas – Porto do Paúl, Baía de Janela, Baía de Monte Trigo, Ponta de Sol e Cruzinha
S. Vicente	Baía de S. Pedro, zonas balneares da Baía das Gatas e do Calhau
S. Nicolau	Baías do Tarrafal, Preguiça e Carriçal
Brava	Baía de Furna

Table 15. Vulnerable islands and areas

1.9.2 General implications of a possible rise in sea level in coastal areas

The Cape Verdean legislation, Law No. 44/VI/2004, July 12 (OG No. 20, series I) provides that the strip of land 80 m wide on the seaside belongs to the state of Cape Verde, although private use is permitted by specific regulations and authorization. In turtle nesting beaches, the Directorate General for Environment established a 150 m protection strip as a protection measure and upon an internal order. Although most of the Cape Verdean population and hence of economic activities concentrate in the coastal area (around 90%), the size of population is still unknown per coastline

unit length (PLC), an important parameter for defining the potential effects caused by rising sea level. For management purposes and policy making related to better response to rising sea level, the PLC parameter should be used in conjunction with other information such as coastal geomorphology, types of land use and economic activities besides historical data.

In Cape Verde, the main effects of a possible rise in sea level would be, among others, increased coastal erosion, partial flooding depending on the tides, increased salinity in wells and boreholes located in the lowlands of the rivers, displacement of people to inner parts of the islands, abandonment of some tourist facilities located in areas affected by tides. In some coastal areas the negative effects are already evident, caused by strong human pressure, combined with poor management of coastal resources and exacerbated by natural factors (wind, runoff, rainfall, tides, etc.), with the consequent degradation of coastal structures, erosion and destruction of beaches. In order to restore and recover some of the potential of coastal areas, pilot adaptation projects were designed, especially that for Coastal Adaptation to Climate Change being implemented on the Island of Maio, more precisely in Ribeira de Lagoa.

Cape Verde's ports play an important role in inter-island sea transport (cargo and passenger) in national and international trade and would be directly affected by changes in sea level which would bring negative impacts on structures and port operations. Generally speaking, coastal areas in Cape Verde are vulnerable due to the geomorphological characteristics that define the different coastal landscapes and topographical settings from one island to another. Both hilly and shallow islands have vulnerable coastal areas against the occurrence of extreme weather events resulting from the adverse effects of climate change. However, to minimize local impacts, the existing legislation should be strictly enfored, in order to reduce human pressure along the coast to prevent the total degradation of natural coastal protection that serves as a land / sea interface.

Chapter II

NATIONAL INVENTORY OF GREENHOUSE GAS EMISSIONS

CHAPTER II – GREENHOUSE GASES INVENTORIES

The preparation of inventories is a constant exercise that should be conducted to disclose the national circumstances in which the country evolves, in terms of GHG emissions. Cape Verde submitted its first national GHG inventory along with the First National Communication in 1999, based on 1995 data. The Second Inventory, follows the g*uidelines for the preparation of national communications* by *Parties not included in Annex I* represents an evolution of the previous guidelines and previous inventory.

As basic a technical guideline technique, we used the manual "Revised 1996 IPCC Guidelines for National Greenhouse Inventories," published in 1997, referred from now as the revised 1996 Guidelines. The lack of required basic information was the major constraint encountered during this exercise, since there is not are no reliable statistical data. In some cases, the information available had been gathered for other purposes, requiring adjustements, with a consequent increase in the uncertainty of the data.
Even with the limitations imposed by scarce financial resources and unavailability of information, we have tried to present a final product as complete as possible., For better comparability and consistency with the IPCC methodology, and as calculation tool, we used the software provided by the UNFCCC Secretariat, which strictly follows the 17/CP.8 resolution on compilation of inventories of countries not included in Annex I to the Convention on Climate Change.

2 Greenhouse Gases Emission for the Year 2000

As required by the Climate Convention, the inventory should include only GHG anthropogenic emissions and removals. Likewise, the inventory did not provide information on CFCs and HCFCs, gases that deplete the ozone layer and whose emissions are already controlled by the Montreal Protocol. GHGs whose anthropogenic emissions and removals were estimated in this inventory are CO_2, CH_4, N_2O, HFCs, PFCs and SF6. Some other gases such as carbon monoxide (CO), nitrogen oxides (NOx) and other non-methane volatile organic compounds (NMVOCs), although not being direct greenhouse gases, have influence on chemical reactions that occur in the atmosphere. Information on anthropogenic emissions of these gases has also been included where available. We are providing below a summary of GHG anthropogenic emissions and removals dissaggregated by gas..

In 2000 anthropogenic greenhouse gas emissions in Cape Verde were estimated at 306.80 Gg CO_2, 3.28 Gg CH_4, 0.301 Gg N_2O and 0.653 t HFC-134a. Between 1995 and 2000 the total CO_2 emissions increased by 11.7% and total CH_4 and N_2O emissions increased by 8.8% and 12.0% respectively. Emissions having indirect greenhouse effects on climate change were also evaluated. In 2000, these emissions were estimated at 2.03 Gg NO_X, 16.87 Gg CO and 2.74 Gg NMVOC. In terms of CO_2eq, based on the *Global Warming Potential* (GWP) equivalence factor of 21 for methane and 310 for nitrous oxide, Figure 11 below depicts the direct GHG emissions in Cape Verde for 1995 and 2000, showing an 11.3% increase in this period.

The gross emissions of GHG in Cape Verde for 2000 are presented in the table 16 below.

Table 16 : Result of country data in the IPCC Software for Inventory GHG 2000

Country	**Cape Verde**
Inventory Year	**2000**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	**306,796**	**0,000**	**3,279**	**0,301**	**2,028**	**16,871**	**2,739**	**0,000**
1. Energy	**284,953**	**0,000**	**0,297**	**0,008**	**2,021**	**16,784**	**1,527**	**0,000**
A. Fuel combustion (sectoral approach)	284,953		0,297	0,008	2,021	16,784	1,527	0,000
1. Energy Industries	96,223		0,007	0,001	0,261	0,040	0,013	0,000
2. Manufacturing industries and construction	20,800		0,003	0,000	0,059	0,102	0,004	0,000
3. Transport	136,658		0,013	0,002	1,497	3,802	0,739	0,000
4. Other sectors	31,271		0,274	0,005	0,203	12,840	0,772	0,000
5. Other (please specify)	0,000		0,000	0,000	0,000	0,000	0,000	0,000
B. Fugitive emissions from fuels	0,000		0,000		0,000	0,000	0,000	0,000
1. Solid fuels			0,000		0,000	0,000	0,000	0,000
2. Oil and natural gas			0,000		0,000	0,000	0,000	0,000
2. Industrial processes	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**1,167**	**0,000**
A. Mineral products	0,000				0,000	0,000	0,000	0,000
B. Chemical industry	0,000		0,000	0,000	0,000	0,000	0,000	0,000
C. Metal production	0,000		0,000	0,000	0,000	0,000	0,000	0,000
D. Other production	0,000		0,000	0,000	0,000	0,000	1,167	0,000
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0,000		0,000	0,000	0,000	0,000	0,000	0,000
3. Solvent and other product use	**0,000**			**0,000**			**0,045**	
4. Agriculture			**1,921**	**0,293**	**0,007**	**0,087**	**0,000**	**0,000**
A. Enteric fermentation			1,767					
B. Manure management			0,150	0,000			0,000	
C. Rice cultivation			0,000				0,000	
D. Agricultural soils				0,292			0,000	
E. Prescribed burning of savannahs			0,000	0,000	0,000	0,000	0,000	
F. Field burning of agricultural residues			0,004	0,000	0,007	0,087	0,000	
G. Other (please specify)			0,000	0,000	0,000	0,000	0,000	
5. Land-use change and forestry [1]	**21,843**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
A. Changes in forest and other woody biomass stocks	21,843	0,000						
B. Forest and grassland conversion	0,000	0,000	0,000	0,000	0,000	0,000		
C. Abandonment of managed lands		0,000						
D. CO_2 emissions and removals from soil	0,000	0,000						
E. Other (please specify)	0,000	0,000	0,000	0,000	0,000	0,000		
6. Waste			**1,061**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
A. Solid waste disposal on land			1,029		0,000		0,000	
B. Waste-water handling			0,032	0,000	0,000	0,000	0,000	
C. Waste incineration					0,000	0,000	0,000	0,000
D. Other (please specify)			0,000	0,000	0,000	0,000	0,000	0,000
7. Other (please specify)	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
Memo items								
International bunkers	**287,968**		**0,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
Aviation	201,631		0,000	0,000	0,000	0,000	0,000	0,000
Marine	86,337		0,000	0,000	0,000	0,000	0,000	0,000
CO_2 emissions from biomass	**127,159**							

[1] If you have completed the LUCF section of Table 7As, these data will appear here automatically. If, however, you have used the IPCC Good Practice Guidance and Categories therein, apply the mapping back procedure for this sector and insert the correspond

Table 16. The gross emissions of GHG in Cape Verde for 2000

In accordance with the guidelines for inventories, exports of fuels for international air and maritime traffic are not part of the inventory. Cape Verde contributions to International Bunkers are presented in Table 17.

International Bunkers	1995	2000	Variation 1995-2000
	Gg CO_2		%
Aviation	211,85	201,63	-4,8
Navy	18,00	86,34	379,8

Table 17. International Bunkers

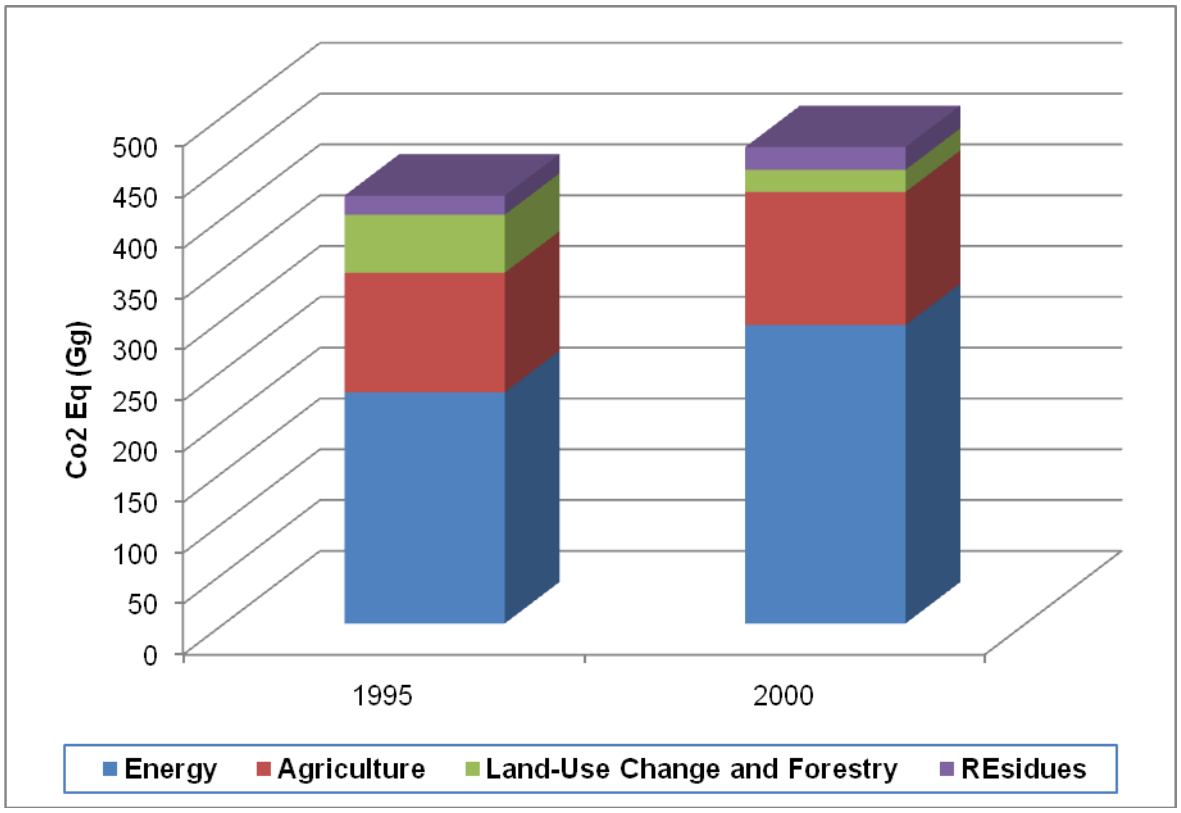


Figure 9. CO2eq emissions in Cape Verde, in 1995 and 2000

2.1.1 Carbon Dioxide (Co_2) Emissions

CO_2 emissions are the result of several activities. In general, the main source of emissions is the energy use of fossil fuels, which applies also in Cape Verde, a strong user of these fuels. The Energy Sector is responsible for 92.9% of CO_2 emissions, with the remainder being attributed to the use of firewood.

Figures 10 and 11 summarize CO_2 emissions and removals in Cape Verde, for the Energy Sector (divided into in subsectors) and Land-Use Change and Forestry.

Energy Sector includes emissions from burning of fossil fuels, whose emissions in 2000 increased by 31.0% compared to 1995 emissions. In 2000, only the transport sub-sector accounted for 48.0% of CO_2 emissions in the Energy Sector and 44.5% of total CO_2 emissions.

The Sector of Land-Use Change and Forestry decreased by 61.7% mainly due to the replacement of firewood and charcoal with butane.

Sectors	1995	2000	Participation in 2000	Variation 1995-2000
	Gg		%	
Energy	**217,52**	**284,95**	**92,9**	**31,0**
Energy industries	62,10	96,22	31,4	54,9
Industries in general	21,12	20,80	6,8	-1,5
Transport	106,90	136,66	44,5	27,8
Other uses	27,40	31,27	10,2	14,1
Land-Use Change and Forestry	**57,08**	**21,84**	**7,1**	**-61,7**
Total	**274,60**	**306,80**	**100,0**	**11,7**

Table 18. CO2 Emissions in Cape Verde

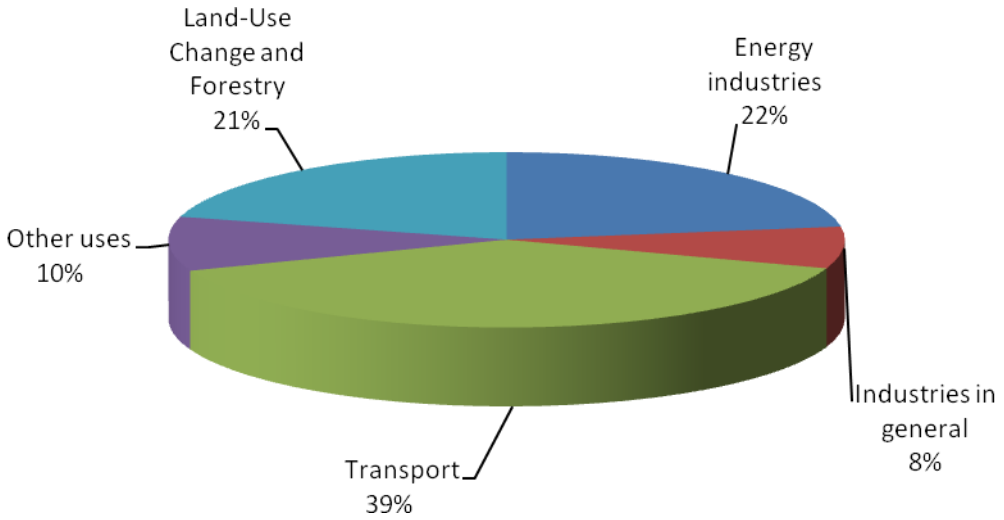


Figure 10. CO_2 emissions in 1995

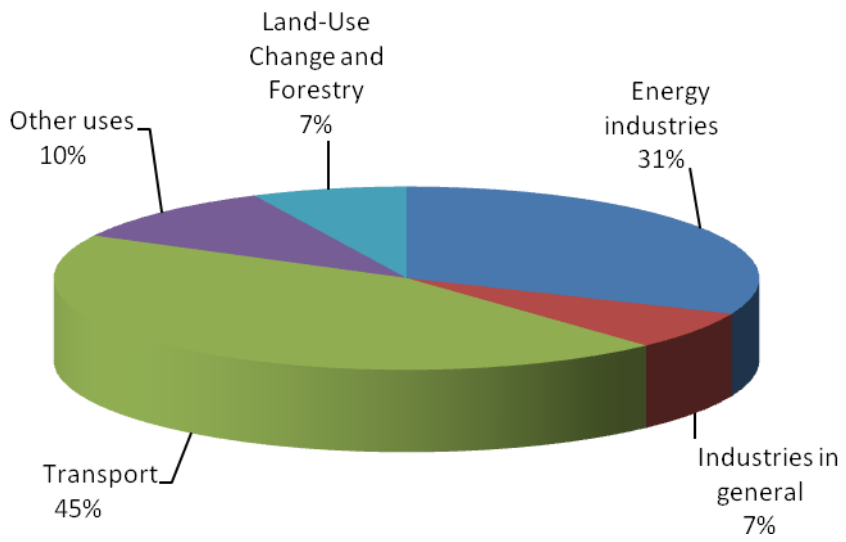


Figure 11. CO_2 Emissions in 2000

2.1.2 Methane (CH_4) Emissions

CH_4 emissions are the result of several activities, including dumps, agricultural activities, burning of fossil fuels, sewage treatment.
In Cape Verde, the agriculture sector, which includes husbandry, accounts for most methane emissions (58.6% in 2000), whereas the major contribution resulting from enteric fermentation (eructation) of ruminant livestock. Annual methane emissions associated with enteric fermentation were estimated at 1.767 Gg, 53.9% of the overall agriculture sector. The remaining emissions in the sector are the result of handling animal wastes and burning of agricultural waste. Emissions from the sector increased by 8.7% in the 1995 – 2000 period.

In the energy sector, methane emissions occur due to incomplete burning of fuels. In 2000, CH_4 emissions in the Energy Sector accounted for 9.1% of total CH_4 emissions, which declined by 16.1% compared to 1995 emissions, primarily by reducing the use of firewood and charcoal.
Emissions in the waste sector accounted for 32.4% of total CH_4 emissions in 2000, and the disposal of solid waste accounts for 97.0% of that value. In the 1995-2000 period, CH_4 emissions in the Solid Residue and Sewage Sector increased by 18.9%.

Sectors	1995	2000	Participation in 2000	Variation 1995-2000
	Gg		%	
Energy- burning of fuel	**0,354**	**0,297**	**9,1**	**-16,1**
Energy industry	0,006	0,007	0,2	11,8
Energy - use in industry	0,003	0,003	0,1	-15,4
Energy - use in transport	0,010	0,013	0,4	24,1
Energy- Other uses	0,334	0,274	8,4	-17,9
Agriculture	**1,767**	**1,921**	**58,6**	**8,7**
Enteric fermentation	1,626	1,767	53,9	8,6
Manure Handling	0,139	0,150	4,6	7,9
Burning of residues	0,001	0,004	0,1	226,8
Residues	**0,893**	**1,061**	**32,4**	**18,9**
Solid residues	0,861	1,029	31,4	19,6
Effluents	0,032	0,032	1,0	0,0
Total	**3,013**	**3,279**	**100,0**	**8,8**

Table 19. CH4 emissions in Cape Verde

Figures 12 and 13 summarize national CH_4 emissions in Cape Verde for 1995 and 2000.

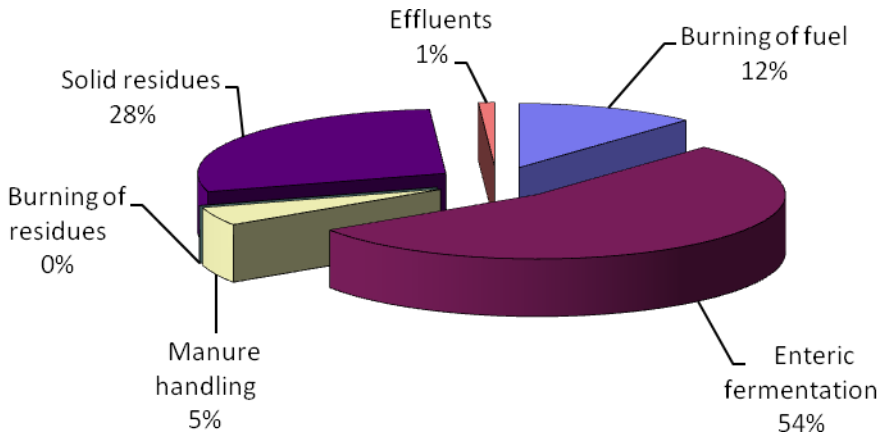


Figure 12. CH_4 Emissions in 1995

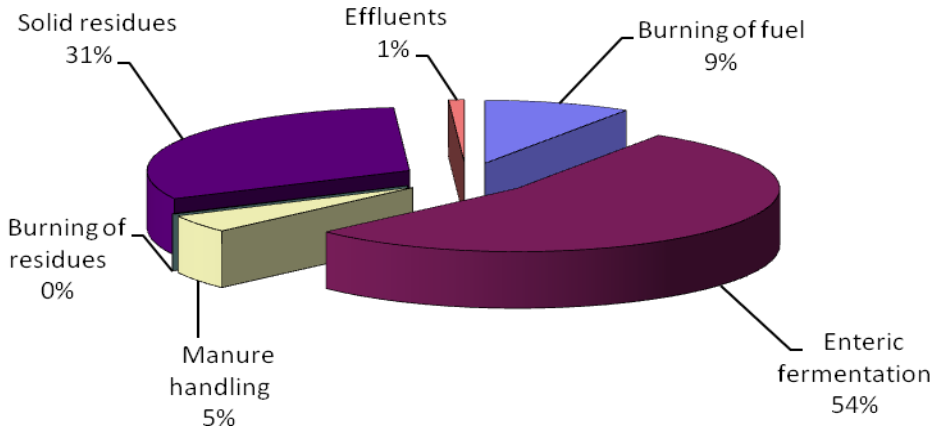


Figure 13. CH4 Emissions in 2000

2.1.3 Nitrous Oxide (N_2O) Emissions

Nitrous oxide (N_2O) emissions are the result of several activities, including agricultural practices and the burning of fossil fuels.
In Cape Verde N_2O emissions occur predominantly in the agriculture sector (97.3% in 2000), primarily by deposition of animal waste in the nature. N_2O emissions in the sector increased by 12% between 1995 and 2000. In 2000 N_2O emissions in the Energy Sector accounted for only 2.7% of total N_2O emissions, being the most due to imperfect burning of fuels.

Sectors	1995	2000	Participation in 2000	Variation 1995-2000
	Gg		%	
Burning of fuels	**0,009**	**0,008**	**2,7**	**-6,0**
Energy industries	0,001	0,001	0,3	55,9
Energy - use in industry	0,000	0,000	0,1	-11,0
Energy - use in transport	0,001	0,002	0,5	28,9
Energy -Other uses	0,007	0,005	1,8	-17,0
Agriculture	**0,260**	**0,293**	**97,3**	**12,6**
Agriculture soils	0,260	0,292	97,2	12,5
Burning of residues	0,000	0,000	0,1	249,2
Total	**0,268**	**0,301**	**100,0**	**12,0**

Table 20. N2O Emissions in Cape Verde

Figures 14 and 15 summarize national N_2O emissions for 1995 and 2000.

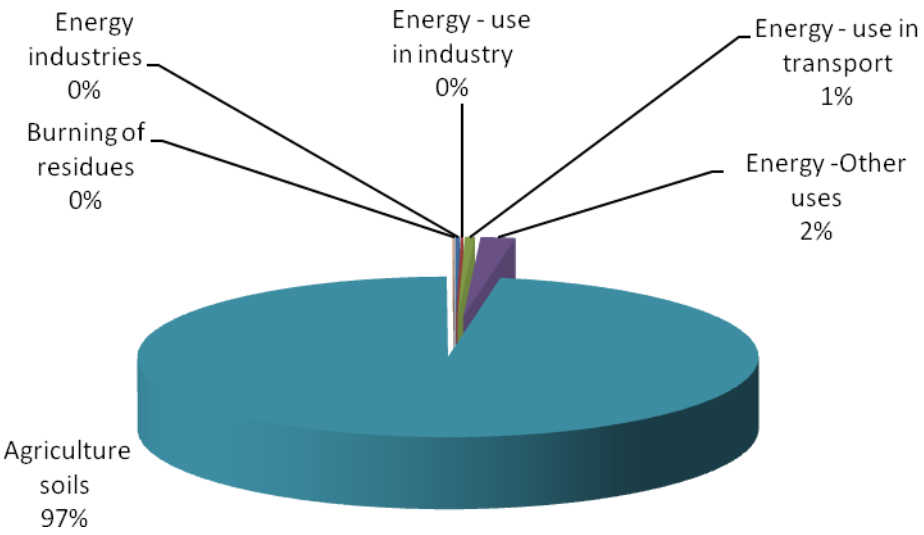


Figure 14. N_2O emissions in 1995

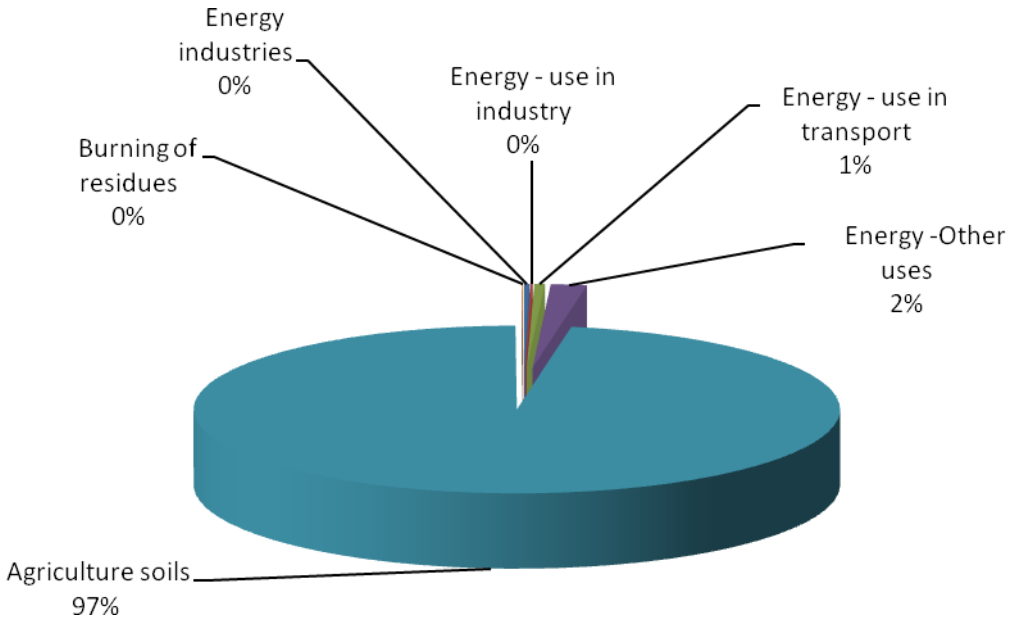


Figure 15. N_2O emissions in 2000

2.1.4 Hydrofluorocarbon emissions (HFCs)

HFCs do not originally exist in nature; they are rather synthesized by human activities.
Although Cape Verde does not produce HFCs, in 2000 653 kg of HFC-134a was imported for use in the refrigeration sector. However, there was no evidence of use in other applications, such as

manufacture of foams and fire extinguishers. For 1995 no reference was made to imports of this product, possibly for lack of information.

Sector	1995	2000	Participation in 2000	Variation 1995-2000
	Tons		%	
Consumption in refrigeration equipment	-	0,653	100	-
Total	-	**0,653**	**100**	-

Table 21. HFC-134a emissions

2.1.5 Indirect Greenhouse Gases

Several gases impact on chemical reactions that occur in the troposphere and thus play an indirect role in enhancing radioactive effect. These include nitrogen oxides (NO_X), carbon monoxide (CO) and other non-methane volatile organic compounds (NMVOC). These emissions, in most cases, result from human activities.

NO_X emissions almost exclusively (99.6%) result from imperfect combustion of fuels in the Energy Sector. NO_X emissions increased by 24.2% between 1995 and 2000.

In addition, CO emissions almost entirely (99.5%) result from imperfect burning of residues in the Energy Sector. The remaining is the result of imperfect combustion of waste in the Agriculture Sector. CO emissions dropped by 11.2% between 1995 and 2000, since they are strongly associated with the use of firewood and charcoal whose application has significantly declined due to their gradual replacement with butane.
Likewise NMVOC emissions result mostly from imperfect burning of fuel, but a significant portion emerge from the food and beverage industry (42.6% in 2000), the remainder are from use of solvents (1, 6% in 2000).

2.2 Anthropogenic Greenhouse Gas Emissions and Removals Broken Down Into Sectors

2.2.1 Energy Sector - Emissions by burning of fuels

In this sector all anthropogenic emissions due to energy production, processing and consumption were estimated. They include both emissions from burning of fuel and emissions due to leakages in the production, processing, distribution and consumption chain.
In addition, in this sector were included CO_2 emissions by carbon oxidation contained in fuels during burning, either in the production of other forms of energy such as electricity, or in final consumption. Were also accounted for emissions of other greenhouse gases that occur during combustion process (CH_4, N_2O, CO, NO_X, NMVOC).
In the case of biomass fuels (firewood, charcoal), CO_2 emissions were not included in this inventory. Renewable fuels do not produce net emissions and emissions associated with the non-renewable component were included in the Land-Use Change and Forestry Sector.

CO_2 emissions in Cape Verde resulting from fuel combustion were estimated using two different IPCC methods: the Reference Approach or Top-Down, based on which CO_2 emissions are

calculated from fuel supply, and Sectoral approach or Bottom-Up based on which CO_2 emissions are calculated from final energy consumption in each sector. Only CO_2 emissions related to fossil fuels were considered in this chapter, since the emissions due to burning of non-renewable biomass were analyzed in the chapter on Land-Use Change and Forestry.

Emissions estimates are based on production data and consumption by energy source. Based on information gathered from different institutions, state services, and private individuals, it was possible to establish an energy balance for the country that however is not produced in official statistics. This exercise can serve as guidance in the coming years, not only for inventories, but also as an instrument for internal control. In order to recalculate the inventory for 1995, which was published along with the First National Communication in 1999, an energy balance also prepared for this year as well, complementing it with some adjustment hypothesis.

Cape Verde energy balances for the 1995 and 2000, calculated for the Second Inventory, are attached hereto.

For all fuels, the measurement unit used is tonne of oil equivalent - TOE. For wind power, was considered as primary energy (wind) the same amount withheld for the secondary energy produced (electricity) that is a 100% efficiency process.

Due to lack of information on stocks these were not included in the balance. For 1995, in the absence of sector consumption data, data were allocated proportional to 2000. For firewood and charcoal use, it was considered the information that butane is being increasingly used as substitute. Thus, for the consumption of firewood and charcoal data were used inversely proportional to the increase of butane use which provides information for both years.

Toe value:

1 standard TOE = 10.000 Mcal = 0,041868 TJ

Conversion of electrical power in Toe:

1 MWh = 0,086 Toe

Top-Down method= Reference Approach

The use of the Top-Down methodology allows for calculating CO_2 emissions based solely on energy supply in the country. Emissions are estimated from a balance involving domestic production of primary fuels, net imports of primary and secondary fuels and internal variability of stocks of these fuels. The methodology assumes that, once introduced in the national economy in a given year, the carbon contained in fuel either is released into the atmosphere or is withheld in some way (e.g., by increasing the stock of fuel, incorporation to non-energy products or retention, partially non-oxidized). The great advantage of Top-Down method, therefore, is the fact that it does not need detailed information on how the fuel is used by end users or on fuel intermediate transformation.

Bottom-Up method= Sectorial Approach

CO_2 emissions are dependent on fuels carbon content and they can be calculated with reasonable accuracy, at a high level of aggregation, as proposed in the Top-Down methodology. Still, The Revised 1996 IPCC -guidelines (published in 1997) also recommends making calculations for CO_2 emissions in a more disaggregated level, the same level adopted for calculating emissions of other greenhouse gases. Following this guideline, CO_2 emissions from fuel combustion were calculated for the various economy sectors.

From this point calculations are made, which for Cape Verde, where fuel losses have not been considered, the same result is achieved as the top-down for CO_2.

Fuel		Carbon content	Carbon oxidation fraction
Gasoline	Gasoline	18,9	0,99
Jet-A1 (jet kerosene)	Jet Kerosene	19,5	0,99
kerosene	Other Kerosene	19,6	0,99
Gas (diesel oil)	Gas / Diesel Oil	20,2	0,99
Fuel oil	Residual Fuel Oil	21,1	0,99
Butane (GLP)	LPG	17,2	0,99
Charcoal	Solid Biomass	29,9	0,87

Table 22. Carbon Contents and oxidation fraction per type of fuel

2.2.1.1 Emissions of other greenhouse gases by burning of fossil fuels

The remaining GHG estimated were: carbon monoxide (CO), methane (CH_4), nitrogen oxides (NOx), nitrous oxide (N_2O) and non-methane volatile organic compounds (NMVOC). These gases were treated in a generic way, such as "non- CO_2" gases and were estimated for all fuels, including those derived from biomass.

For non- CO_2 gases emission factors for each case were introduced in the software, considering sectors and fuels, based on IPCC default data, since no information was available regarding the use and exact characterization of equipments .

2.2.2 Industrial processes Sector

For this sector were estimated anthropogenic emissions resulting from production processes in industries which are not results from fuel combustion, as these were addressed in the Energy Sector. In this sector we considered only food production and beverages subsectors and the use of hydrofluorocarbons (HFCs), since other industries such as cement, steel or chemical industry, potential greenhouse gas precursors do not exist in Cape Verde.
Hydrofluorocarbons (HFCs) were developed in the 80s and 90s as alternative substances to CFCs and HCFCs, whose use was being eliminated for they are substances that deplete the ozone layer. HFCs do not contain chlorine and therefore do not affect the ozone layer. However, they are greenhouse gases.
In Cape Verde only HFCs uses connected to the refrigeration sector were evaluated.
In Food and Beverage Sector, NMVOC emissions occur in many transformation processes from primary products such as bread production, animal feed, beer and coffee roasting. Emissions in the country were estimated based on national production data, adopting the default emission factors.

2.2.2.1 Use of solvents and other products

The use of solvents, in general, favors its evaporation, which sets emissions of NMVOC. This inventory identifies the most significant sectors in solvent application. Yet, we aware of the high uncertainty degree off these estimates.

Industrial Sector accounts for a portion of CO_2 emissions by burning of fossil fuels. Beyond these emissions, which are addressed in section 3.1, some industries produce greenhouse gases as a result of their production processes.

2.2.2.2 Food and beverages

In industrial food processing and beverage production emissions of non-methane volatile organic compounds (NMVOC) may occur. IPCC presents emission factors for some subsectors. In the absence of additional information, these factors have been adopted in this inventory.
In the production of alcoholic beverages, NMVOC emissions may occur during fermentation of cereals and fruit. To estimate these emissions IPCC emission factors have been used as well.
For 1995, as no data were available on food and beverage production, a correlation was made with the economically active population - EAP - to estimate the values.

Data	1995 *	2000	2001	2002	2003	2004
Total population	386.184	436.800	444900	452800	460.600	468.200
Urban population	196.954	235.521	242.814	250.276	257.945	265.849
Urban Percentage	51%	54%	55%	55%	56%	57%
Economically active population	132.618	150.000	153.000	155.700	159.000	178.000

* Urban population estimated based on the perceived percentage growth. EAP estimates based on the total population.

Table 23. Population Data

Source SNI

Food production process	Production		Emission Factor
	1995	2000	
	ton		kg NMVOV / ton
Meat, fish and poultry	5.208,00	5.890,60	0,3
Bread	12.109,27	13.696,40	8
Animal feed	8.665,45	9.801,20	1
Coffee roasting	77.295,15	87.426,00	0,55

Table 24. Production process and emission factors

Source: IPCC, 1996 revised version

Beverage	Production		Emission Factor
	1995	2000	
	hL		kg / hL
Whine	102,38	115,8	0,08
Beer	13.735,70	15.536	0,035
Distilled beverage	58.786,97	66.492	15

Table 25. Emission factors per type of beverage produced

2.2.2.3 Emissions related to hydrofluorcarbon consumption (HFCs)

In refrigeration and air conditioning, HFCs are being used as one of the main alternatives to CFCs as refrigerant fluids. That was virtually the only sector in which there was use of HFCs during the period covered by this inventory.
As the use of HFCs in the country is still small, it was decided to use the simplified methodology (Tier 1), which allows estimating the potential of emissions, according to the formula.

Potential of Emissions = Production + Imports- Exports – Destruction

Since there is no production, export or destruction of gases from Cape Verde, the potential of emissions equaled the amount imported in 2000, 653 kg of HFC-134a for use in refrigeration.

2.2.2.4 Use of solvents and other products

This chapter presents the series of NMVOC emissions from solvent use in Cape Verde.
Following the methodology approach the following activities identified in Cape Verde are highlighted: Foam Processing and Printing Industry.

2.2.2.5 Polystyrene foam processing

Foam production occurs through the action of a blowing agent. In the case of polystyrene foam, used primarily in insulation and packaging areas, this agent is pentane. As for flexible foams water is used as a blowing agent.
According to CORINAIR (1996), the blowing agent is incorporated into the foam at a 6% rate before expansion (First Brazilian GHGs Inventory). Thus, to quantify NMVOC emissions in these activities the series regarding the production of EPS foam is required.
1995 production was estimated based on EAP.

Activity	1995	2000
	ton	
Foam production	140,49	158,9

Table 26. Foam production

2.2.2.6 Printing industry

A simple methodology proposed for the quantification of NMVOC emissions in this activity requires knowledge of the historical series of consumption of ink found in press, publishing / editing and packaging sector (probably the major sectors) and others. Thus, given the absence of consolidated statistics in these sectors and aiming to provide an estimate, it was decided to use the average emission factors per capita observed in other countries, associating them with the economically active population.
Based on the First Brazilian GHGs Inventory, which used an average emission factor for this activity of 0.7 kg/person/year, average emissions per capita for a selected set of countries, mainly from Europe, it was chosen for Cape Verde a lower value of 0.3 kg/person/year.

	1995	2000
EAP	132.618	150.000
NMVOC - Gg emissions	0,039785	0,045000

Table 27. Data on economically active population and NMVOC (Gg) emissions

2.2.3 Agriculture and livestock Sector

Enteric fermentation in herbivorous ruminant animals, which is part of their digestion, is one of the largest CH_4 emitters in the country. The systems for handling animal wastes can cause CH_4 and N_2O emissions.
Burning of agricultural wastes, imperfect because it is made naturally in the field, produces CH_4, N_2O, NOX, CO and NMVOC emissions. The CO_2 emitted is not considered a net emission, since through photosynthesis, the same quantity is necessarily absorbed during plant growth. In Cape Verde the practice of burning agricultural waste is almost restricted to corn and beans.
N_2O emission in soils occurs as a result of the application of nitrogen fertilizers, both of animal and synthetic origin and deposition of waste on grassland. Also plant residues left in the field, a source of nitrogen, are considered sources of nitrous oxide emissions.
Agriculture and livestock are gathered in this sector, where GHG emissions occur through several processes. The enteric fermentation in ruminant animals is one of the sources of the most important methane emissions in the country. Also in livestock farming, systems for handling animal manure are responsible for methane and nitrous oxide emissions.
The imperfect burning of agricultural residues causes emissions of methane, nitrous oxide, nitrogen oxides, carbon monoxide and other volatile organic compounds. In Cape Verde this practice occurs mostly in corn and beans cultivation.
Emissions of nitrous oxide in agricultural soils occur primarily by deposition animal waste on pasture and also by soil fertilization practices. These latter include the use of synthetic fertilizers and products for handling animal manure.
Finally, emissions also occur as result of imperfect combustion which occurs during the burning of specific natural vegetation.

2.2.3.1 Livestock

2.2.3.1.1 Enteric fermentation

Methane production is part of the normal digestive process of ruminant animals, occurring in smaller quantities in other herbivorous animals.

Animal population	1995	2000	Waste
	heads		kg N/head/year
Non-dairy cattle	21.728	22.108	40
Poultry (chicken, duck and turkey)	274.330	308.725	0,6
Ovine animals	9.010	9.861	12
Caprine animals	112.997	131.287	40
Swine	69.718	74.002	16
Others (horse, mule, donkey,)	13.957	15.530	40

Table 28. Animal population in Cape Verde

2.2.3.1.2 Manure handling

When organic material from animal waste wastes is decomposed under anaerobic conditions, methanogenic bacteria can produce substantial quantities of methane. These conditions are favored when the waste is left in liquid form (in lakes, ponds and tanks).

Handling system	Bovine	Poultry	Swine	Ovine	Others*
Pasture	10%	0%	0%	15%	0,2
Daily Spread	90%	100%	100%	85%	0,8

Table 29. Pasture handling systems and Daily Spread per animal category

Estimates of CH_4 emissions were made using the simplified methodology using default emission factors.
Handling of animal waste can also produce N_2O emissions during processing, depending on the system used. The waste processed is eventually used as fertilizer, in case of daily spread system. N_2O emissions induced after adding animal waste to the soil, including those of grazing animals, were estimated in the section addressing emissions resulting from nitrogen addition to agricultural soils.
N_2O emissions estimates were made using the methodology recommended by the Revised 1996 IPCC Guidelines considering the contribution of the handling systems used. Default values were used.

2.2.3.1.3 Field burning of agriculture residues

Although the burning of waste releases large amounts of CO_2, it is not considered a net emission, because, through photosynthesis, the same amount of CO_2 is possibly absorbed during plant growth. However, during the combustion process, other gases than CO_2 are produced. Emission rates of these gases depend on the type of biomass and conditions. In combustion with flames, N_2O and NO_x gases are produced, and CO and CH_4 are formed under burning conditions with predominance of smoke.

In Cape Verde, this practice exists, especially in maize and bean cultivation during the preparation of the land for the rainy season.

Crop	1995		2000		Relation/ crop	Fraction of dry matter	Fraction burnt in the field	Fraction oxidized	Fraction of C in the waste	N/C
	ha	1000 ton	ha	1000 ton						
Corn	31.066	8,166	30.626	24,341	1	0,4	0,1	0,9	0,47	0,02
Beans	27.080	1,808	28.140	7,310	2,1	0,3	0,1	0,9	0,5	0,05

Table 30. Data on maize and bean cultivation

2.2.3.2 N_2O emissions from agriculture fields

The use of nitrogen fertilizers is seen as the major cause for the increase of global N_2O emissions from agricultural fields. N_2O emissions also occur by using animal manure as fertilizer and through atmospheric deposition of NH_3 and NO_x.

N_2O emissions from agricultural soils were subdivided into three categories according to the IPCC Guidelines.

- N_2O emissions from animal waste on pasture;
- other sources of direct N_2O emissions, which include the use of synthetic fertilizers, nitrogen from animal waste used as fertilizer, biological fixation of nitrogen and harvest residues;
- indirect sources of N_2O emissions from nitrogen used in agriculture, including volatilization and subsequent atmospheric deposition of NH_3 and NO_x from the use of fertilizers and leaching of soils and nitrogen runoff from fertilizers.

2.2.3.2.1 N_2O emissions due to grazing animals

Animal waste deposited in soils by animals during grazing are considered the most important sources of N_2O emissions by agricultural soils.
To estimate N_2O emissions IPCC default factors were adopted for the nitrogen content in animal waste and for N_2O emission factor by the amount of nitrogen deposited.

2.2.3.2.2 N_2O emissions by other direct sources

- **Use of synthetic fertilizer**

A portion of the synthetic nitrogen fertilizers used is released to the atmosphere as N_2O. In the absence of specific studies on emission factors IPCC default factors were used.

Use of chemical fertilizer	
1995	**2000**
kg	
69.735,98	87.169,98

Table 31. Use of nitrogen fertilizers in Cape Verde

- **Using of manure as fertilizer**

Based on the experience of experts who monitor the practices used in Cape Verde, it was considered that only animal wastes handled using the daily spread the system are applied to fields as fertilizer. For N_2O emission factors IPCC default values were adopted.

2.2.3.2.3 Biological nitrogen fixation

In Cape Verde, although the process has been investigated there are insufficient data for the required analysis using the IPCC methodology

- Harvest residue

The nitrogen contained in crop residues that are incorporated into the soil is also a source of N_2O emission. However, no estimates were made accordingly.

- **Soils with high organic matter content**

In Cape Verde the existing soils are not noteworthy in terms of high organic matter content.

2.2.3.2.4 N_2O emissions by indirect sources

- **Atmospheric deposition of NH_3 and NO_x**

Part of the nitrogen contained in synthetic fertilizers and animal waste used as fertilizer volatilize as NH_3 and NO_x. That portion is deducted when estimating emissions from direct sources. It happens that some of these NH_3 and NO_x gases are deposited back on the land´s surface what is likely to cause N_2O emission if this deposition occurs on agricultural soils. It is impossible to determine in which area this deposition will in fact occur, and may even be in the oceans. Likewise, NH_3 and NO_x originated from other sources such as combustion can be deposited on agricultural soils. Therefore, the uncertainty involving this part of emissions is quite substantial. I was decided to use the criterion of considering the overall deposition corresponding to volatilized gases from agricultural soils. Thus, IPCC default factors were used.

- **Leaching and nitrogen runoff**

Part of the nitrogen that is used in agricultural soils through synthetic fertilizers or animal wastes is leached and through runoffs it can penetrate into the sea. In these conditions N_2O emissions also occur that are categorized as indirect emissions from fertilizer application. IPCC default factors were used for this calculation.

EF1	0,0125 kg N_2O-N/kg N applied
EF3	0,02 **k**g N_2O-N/kg N excreted
EF4	0,01 kg N_2O-N/kg NH_3-N e NO_x-N issued
EF5	0,025 kg N2O-N/kg N
Fraction of de N excreted and applied to the soil by grazing animals- $Frac_{GRAZ}$	0,02 kg N_2O-N/kg N excreted
Fracção de N excretada emitida como NO_x e NH_3 - $Frac_{GASM}$	0,2 kg NH_3-N e NO_x-N/kg manure applied
Fraction of nitrogen used as synthetic fertilizer that volatizes as NH_3 e NO_x - $Frac_{GASFS}$	0,1 kg NH_3-N e NO_x-N/kg fertilizer applied
Fraction of nitrogen added to the soil that is lost by leaching or runoff- $Frac_{LEACH}$	0,3 kg N lost by leaching or runoff / kg fertilizer

Table 32. Factors used for emissions from soil

2.2.4 Land-Use change and forestry Sector

For estimates in this sector, it was decided to evaluate only the growth of planted forests and removal of firewood for the direct use or charcoal production.
For the growth of trees the value of 1.8 ton/year was adopted, considering green matter. For conversion of dry matter, it was considered a 30% level of moisture and the value of 0.7 was applied for growth in that year.

Regarding data of the planted area for the 2000 inventory, the area initially reported by PAFN on forestation in Cape Verde indicated a value almost twice the most current IFN data, probably due to mortality of plantations. To estimate in 1995 on the same basis it was decided to apply the same reduction occurred in PAFN data for this year, as shown in the following table.

Information source	2000	1995
	ha	
PAFN Data - forestation	82.094	76.016
IFN Data - correction	44.089	40.825

Table 33. Correction of planted areas in Cape Verde

Data on firewood and charcoal, both for residential and industry use has had special attention in this inventory. Given the lack of studies in order to maintain a more accurate figure on consumption in 1995, it was considered that from 1990 to 2000, there was a reduction in the use of firewood and an increase in the use of butane gas, according to studies on the energy sector, indicating a fuel replacement. Therefore, to calculate firewood and coal for 1995, an inverse proportionality with butane (LPG) was used, as shown in the following table.

Consumption	2000	1995	Variation 95-00
	tons		%
Household firewood	92.782	113.558	-18
Household charcoal	165	202	-18
Industrial firewood	2.873	3.516	-18
Industrial charcoal	561	687	-18
Total	96.381	117.963	-18
Butane	10.500	8.579	22

Table 34. Firewood calculation for 1995

It was estimated that one ton of wood produces 333 kg of charcoal, that 1 ton of firewood = 0.33 TOE and 1 ton of charcoal = 0.646 TOE. Thus, it was possible to estimate the amount of firewood that is used for charcoal production, and the coal produced was subsequently used in the energy balance.
It was decided to consider the fraction of 50% of carbon in dry matter.

2.2.5 Waste and sewage Sector

Solid waste disposal and treatment of domestic or industrial sewage can produce GHGs emissions. Methane (CH_4) emission occurs due both to disposal of solid waste and anaerobic sewage and wastewater treatment. Emissions of nitrous oxide (N_2O) also occur due to domestic sewage treatment.
For applying the methodology proposed by IPCC it is necessary to know the total urban population, conditions of effluent treatment and waste disposal. This involves determining the volume of waste produced, concentration of organic matter, methods of solid waste disposal and sewage treatment systems. Note that the limited information in the sector, the degree of uncertainty is quite high.

2.2.5.1 Disposal of solid waste

Waste dumps, landfills, and others produce methane when the waste is under favorable conditions. This production varies from place to place, depending on factors such as quantity of waste, age of the deposit, the presence of anaerobic environment, acidity, constructive conditions and handling.

The greater the control conditions and dump depth, which improve their health conditions, higher, however, is the potential for methane emission. In general, the location conditions of solid waste disposal in Cape Verde are precarious and there is lack of detailed survey of these conditions or average composition of the waste. Therefore, Revised 1996 IPCC default values were used.

It was used the rate of 0.54 kg/hab/day of waste production to be applied to the urban population and to determine the total waste. Of that amount, 60% is disposed in dumps, which have an average correction factor of 0.6 of methane MCF, with a fraction of organic component (DOC) of 0.12 and a portion of DOC that actually degrades of 0.77. Of total carbon that is released, 50% escapes as methane

2.2.5.2 Sewage treatment

Effluents with a high organic content, such as domestic sewage, are sources of nitrous oxide emissions depending on the nitrogen content in food. Note that in this inventory estimates of emissions for this category have not been made.

2.2.5.3 Domestic and commercial sewage

It was decided to use the annual 13,505 kg DBO production per thousand inhabitants, according to the IPCC default value for Africa. By IPCC default, 5% is treated in biodigesters, with 0.8 MCF. Thus the emission factor of 00,01 kg CH_4/ kg DBO_5.

2.2.2.4 Industrial sewage

In Cape Verde, effluents of food and beverage industrial production have not been evaluated for they are not significant.

2.3 CONCLUSIONS

In 2000, GHG anthropogenic emissions in Cape Verde were estimated at 306.80 Gg of Carbon Dioxide (CO_2), 3.28 Gg of methane (CH_4), 0.301 Gg of nitrous oxide (N_2O) and 0.653 tons of hydrofluorocarbons (HFC-134a). Between 1995 and 2000 total CO_2 emissions increased by 11.7% and CH_4 and N_2O by 8.8% and 12.0%, respectively.
In terms of CO_2eq for the period between 1995 and 2000 there was a 11.3% increase in GHG direct emissions in Cape Verde.

Similar to many countries, Cape Verde is also a major user of fossil fuels which are the main source of GHG emissions, causing the Energy Sector to account for 92.9% of CO_2 emissions, while the remaining is the responsibility of the sector of Land-Use Change and Forestry.
Note that Energy Sector includes emissions from burning fossil fuels, whose emissions in 2000 increased by 31.0% in comparison with 1995 emissions. In 2000, only the transport sub-sector accounted for 48.0% of CO_2 emissions in the Energy Sector and 44.5% of total CO_2 emissions.
For 1995 and 2000, the Sector of Land-Use Change and Forestry has a 61.7% reduction in CO_2 emissions due to increased use of butane gas instead of firewood and charcoal.
CH4 emissions are the result of several activities, including waste dumps, agricultural activities, burning of fossil fuels and sewage treatment.

In Cape Verde, the Agriculture Sector, which includes livestock activities, is responsible for most methane emissions (58.6% in 2000) being the major contribution arising from enteric fermentation

(eructation). Annual CH_4 emissions associated with enteric fermentation were estimated at 1.767 Gg, 53.9% of the Agriculture Sector. The remaining emissions in the sector are the result of handling animal wastes and burning of agricultural residues. Emissions from the sector increased by 8.7% in the 1995-2000 period.

In the Energy Sector, CH_4 emissions are due to imperfect combustion of fuels. In 2000, CH_4 emissions accounted for 9.1% of total CH_4 emissions, which decreased by 16.1% compared to 1995 emissions, primarily due to the reduction in the use firewood and charcoal.
Emissions from the Waste sector accounted for 32.4% of total CH_4 emissions in 2000, and solid waste disposal accounts for 97.0% of that value. In the 1995-2000 period, emissions of CH_4 from the Waste and Sewage Sector increased by 18.9%.
Nitrous oxide (N_2O) emissions are the result of several activities, including agricultural practices and the burning of fossil fuels.

In Cape Verde, N_2O emissions, occur predominantly in the agriculture sector (97.3% in 2000), primarily by deposition of grazing animal waste. N_2O emissions in the sector increased by 12% between 1995 and 2000.
In 2000, the N_2O emissions in the Energy Sector accounted for only 2.7% of total N_2O emissions, mostly due to imperfect burning of fuel.
HFCs do not exist in nature, they are synthesized solely by human activities.
Cape Verde does not produce HFCs, but in 2000 653 kg of HFC-134a were imported for use in the refrigeration sector. However, there have been uses in other possible applications, such as manufacture of foams and fire extinguishers. In 1995 no reference is made regarding the imports of this product, probably for lack of information.

Several gases impact on chemical reactions that occur in the troposphere and thus play an indirect role in enhancing radioactive effect. These include nitrogen oxides (NO_X), carbon monoxide (CO) and other non-methane volatile organic compounds (NMVOC). These emissions, in most cases, result from human activities
NO_X emissions almost exclusively (99.6%) result from imperfect combustion of fuels in the Energy Sector. NO_X emissions increased by 24.2% between 1995 and 2000.

In addition, CO emissions almost entirely (99.5%) result from imperfect burning of residues in the Energy Sector. The remaining is the result of imperfect combustion of waste in the Agriculture Sector. CO emissions decreased by 11.2% between 1995 and 2000, since they are strongly associated with the use of firewood and charcoal whose use has significantly declined by its gradual replacement with butane.

Likewise NMVOC emissions result mostly from imperfect burning of fuel, but a significant portion emerge from the food and beverage industry (42.6% in 2000), the remainder are from use of solvents (1, 6% in 2000).

2.4 DIFFICULTIES ENCOUNTERED

The difficulties encountered in the preparation of this Greenhouse Gas Inventory under Cape Verde SCN-MC are mainly related to (i) technical level related to data management: collection, missing data for some areas, dispersion of data, confidentiality of specific data, no database and using the English version of IPCC software for inventory hampers data processing of by certain categories of information sources due to translation and (ii) temporal level associated with time management: The term / period (30 days) to complete sector based inventories is insufficient to overcome and

address all issues related to data collection, analysis and compilation to produce a complete bibliography.
The following aspects should be stressed which in one way or another hindered the inventory preparation process:

- Activity data dispersion at of various economic agent level;
- Non-regularity of data collection and record. There are few institutions which out fill out data record forms. In most cases, data are only available in hard copy making it difficult to locate them in the respective archives;
- Absence of local emission and conversion factors, which requires the use of those provided by IPCC or sub-region countries;
- Lack of sector disaggregated data, implying a loss of time in their separation and classification by category;
- Non-compliance with the deadline undertaken to provided the requested data;
- Failure in publishing sub-sector data;
- Inconsistency in data, leading to the use of estimates to produce data.

2.4.1 Energy Sector

- The lack of basic information required by the IPCC methodology was the greatest obstacle encountered in this survey because there remains a paucity of reliable statistical data, as it is the case, for example, of disaggregated data on consumption of the productive sectors of the economy;
- lack of local emission factors.

2.4.2 Industrial Processes Sector

- confidentiality of some data;
- data are not detailed;
- lack of data on production of specific items;
- lack of consistent data on activities such as ink application, dry cleaning, polyurethane and polystyrene foam processing, printing industry, extraction of edible vegetable oils, household use, asphalt aeration and wood preservation.

2.4.3 Agriculture and livestock Sector

- incomplete and sketchy data, particularly with regard to the actual amount of animals per categories, cultivated areas, production and crop yields, agricultural inputs, etc.;
- lack of data on the synthetic fertilizers used in Cape Verde;
- existence of some actual data starting in 2004;
- lack of emission factors and parameters concerning the various national agricultural activities.

2.4.4 Land-Use Change and Forestry Sector

- research data: irregular surveys;
- lack of publication of the forest survey;
- dispersed sources of data on forested areas.
- unavailability of detailed data;
- Incongruent information on firewood areas, productivity, consumption, etc.

2.4.5 Waste Sector

- lack of data on the quantity of wastewater that is released into the public network and sea;
- lack of data on treatment of industrial liquid waste.

2.5 RECOMMENDATIONS

Under the UN Convention on Climate Change, a National GHG Inventory is a country's key tool that will serve to identify mitigation projects that may be listed in the CDM opportunities.
Energy balance is important not only for the inventory but also to provide data on how the country is evolving in terms of GHG emissions from the energy sector. Similar to other countries, for this sector, Cape Verde must include in its activity program a annual energy balance with accurate information on losses that occur for various reasons (in power distribution, lost or spilled fuel, adjustments etc.).

Sector assessment such as the use of forests can be the basis for national medium and long term planning in terms of energy, allowing it to better prepare the future.
In general, and bearing in mind that the greatest difficulty in preparing this inventory has been collecting data on different sectors, we recommend the creation of files, either by keeping records in hard copy or gathering these to transform them into electronic copies to function as a database. The use of this technical support for data management will allow different users to make consistent analysis of and proper identification of literature sources.

It should be emphasized that the more information on industry activities in the country, the better. Nevertheless, it becomes necessary to strengthen statistical data to enable gathering and publishing reliable and credible data.

2.5.1 Specific Recommendations

In order to strengthen and improve the quality of the next GHG inventories, the following specific recommendations should be made:

1. Establish a database, containing the required information for the preparation of GHG inventory. The existence of a database will speed up the inventory process and facilitate the updating of data and allow regular monitoring of GHG emissions;

2. Assess in detail the quality of sub-sector and sector data for use in preparing the GHG inventory providing estimates with greater accuracy, thus reducing possible uncertainties associated with the results of the inventory;

3. Consider the preparation of GHG inventory as an annual activity, which means that efforts to reduce GHG emissions can be monitored in a more accurate and controlled manner;

4. Provide additional support to enable completion of studies or research to generate the information needed to create quality inventories;

5. Conduct studies to refine estimates of trees outside forests, including trees in urban and rural areas;

6. Build capacities of local experts in order to initiate studies to determine the emission and conversion factors to ensure improved quality of national GHG inventory.

7. Incorporate in the forthcoming agriculture and livestock census, concerns related to Agriculture Sector inventories;

8. Record detailed data on food production, through the number of bakery products and total national consumption;

9. Conduct a survey on the composition of municipal solid waste;
10. Prepare the national forest inventory to better understand the potential for carbon sequestration;

11. Create an effective mechanism for monitoring the evolution of cultivated areas and controlled burn to allow improved assessment of the Land-Use Change and Forestry Sector.

Chapter III

ABILITY TO REDUCE GREENHOUSE GAS EMISSIONS

CHAPTER III – ANALYSIS OF MESURES TO REDUCE GREENHOUSE GASES EMISSIONS

Considering that the period between 1995 and 2000 anthropogenic emissions in Cape Verde of the main Greenhouse Gases (CO_2 11,7% ; CH_4 8,8% and N_2O 12,0%) increased and that on the whole there was a 11.3% increase in direct emissions several mitigation strategies should be taken into consideration to reduce potential adverse impacts on the environment.

The main source of GHG emissions is the use of fossils fuels. For Cape Verde the energy sector accounts for 92.9% of CO_2 emissions by burning fossil fuels. In 2000, the transport sub-sector accounted for 48.0% of CO_2 emissions in the energy sector and 44.5% of total CO_2 emissions, the remainder being divided between other sub-sectors energy industries (31.4%) general industries (6.8%) and other uses (10.2%) and also the LULUCF sector that contributes with 7.1 % of total CO2 emissions.
Local biomass is scarce and its availability has rapidly decreased due to prolonged droughts and some inappropriate cuts. However, there is a potential for wood energy from forests, generated as part of the forestation programs undertaken in 1975 to date by the State Cape Verde.

Given the population growth and economic development the country has been preparing in order to create sectoral strategic intervention mechanisms as a way to build capacity for mitigation of GHG by increasingly using local energy potential in terms of natural resources (wind, sun, geothermal power, water, hydrogen, cogeneration, tides, etc.) based on clean technologies.

The use of these types of energy production will promote better conservation and energy efficiency and considerably reduce the use of fossil fuels in the various energy sub-sectors, such as transport and housing due to air conditioning, refrigeration.

The country's energy plan for the next 10 years, with a view to mitigating GHG effects provides for:

- Achieving a renewable energy penetration rate of 25% by 2011, 50% by 2020 and having at least one of the islands 100% renewable
- Promoting energy conservation and efficiency in the energy sector
- Fighting against fraud and energy losses.
- Expanding electricity production capacity
    - Single power plants
    - Increase in efficiency in production and distribution.
    - Increased responsiveness to energy needs
- Sector openness
- Ensuring 95% electricity coverage by 2011, 100% by 2015 and ensuring a higher quality and reliability in energy access and reducing the cost of electricity

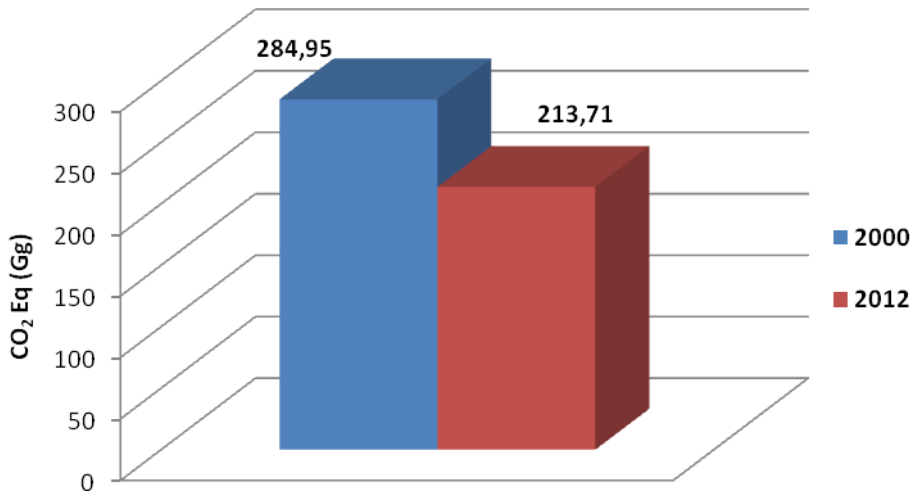


Figure 16. Evolution of CO_2 emissions– Energy Sector– Period 2000 – 2012

Figure 16 indicates for 2012 a reduction in terms of CO_2 emissions in the energy sector with the penetration of renewables thus contibuting to a decrease in the import and use of fossil fuels for industrial production, electricity, among others.

3.1 Residential Subsector

The residential sector consumed 45,816 Toe in 2000 accounting for 43.7% of the net domestic consumption, mainly consisting of 9486 Toe of butane, 1283 Toe of kerosene, 30,655 Toe of wood and other biomass and 4393 Toe for electricity.

Note that for 1995 and 2000, the Land Use Change and Forestry sector registered a 61.7% reduction in CO_2 emissions due to increased use of butane gas instead of firewood and charcoal.

The category "Low Voltage" includes mainly the residential sector, "special low voltage" includes services (restaurants, hotels, shops, etc.) and small businesses whose consumption does not exceed 50 kW. In the category of medium voltage large consumers are included- industries, hotels, some government departments etc.

Efficiency is beige achieved through the use of lighting from solar panels and low energy light bulbs, improved stoves and insulation.

The integrated design of commercial buildings, including feedback and monitoring technologies such as smart meters, integrated solar PV in buildings.

3.1.1 Electricity production

Electricity production is based on the use of diesel and fuel oil generators. Approximately 80% of the national productive capacity is concentrated on the islands of Santiago, S. Vicente and Sal.

The system of non-commercial energy supply relates primarily to the consumption of woody biomass and other waste fuels that do not go through commercial channels. It is estimated that most of the fuel consumed in rural and peri-urban areas is self-collected.

In the absence of refineries and industrial complexes that include primary or secondary energy transformation processes in other energy sources, the only transformation activities in the country including producing electricity from fossil fuels and production of charcoal from wood.

Note a substantial increase in electricity generation in Santiago, Sal and Boavista that during the 1995 - 2008 period has doubled. This growth was driven by strong demand in the tourism sector in Sal and Boavista and expansion of rural electrification coupled with a strong economic momentum in Santiago.

Electra is the largest national consumer of fuels (diesel and fuel oil) accounting for approximately 30% of domestic consumption of diesel and almost 100% of fuel. Electra in 2000 operated 18 power plants with a thermal electrical power output of approximately 54,817 kW and three wind plants with an installed capacity of 2,400 kW across the country. Some municipalities also own and manage micro-power plants to supply electrical power to small isolated localities.

However, the weight of diesel fuel in electricity production tends to decrease as a result of the replacement of electricity with diesel fuel for production in almost all the islands provided for in projects in the pipeline, including the single central plant in Santiago, Fogo and Santo Antao.

Primary and secondary sources from fossil fuels remained during the period assessed as the main energy sources accounting for respectively 85%, 85.7% and 91.4% of total energy supply in 1995, 2000 and 2008.

The contribution of the wind energy converted into electricity totaled 1769 Toe in 2000, slightly less than in 1995 which was 1,773 Toe. In 2008 there was a clear decrease in production of only 1212 Toe.

3.1.2 Electricity distribution

Almost all cities, towns and villages have electrical power, either by networks or micro-plants. The national electricity coverage rate was 52% in 2000 (80% in 2008).

3.2 Transport Sector

Electricity distribution is made through electrical underground and air networks using two levels of voltage, medium voltage, 20 kV and low voltage, 400V (there are other operating voltage levels, namely: 6kV, 15kV and 10kV; they are being replaced with 20kV, the nationally standardized voltage).

Distribution networks, upon urban centers expansion, have developed substantially; however, this lacks adequate technical and economic requirements, sometimes leading to excessive losses.

The transport sector consumed in 2000, 45,248 Toe, accounting for 43.1% of total domestic consumption of final energy. This volume includes 7469 Toe of gasoline and 23,603 Toe of diesel consumed in road transport, 6788 toe of diesel fuel consumed in shipping and 7397 Toe in Jet A1.

Transport-related technologies tend to develop in different directions: more energy and environmental efficient engines. Note that a sustainable funding system for road maintenance is in force. Transport planning and land management are articulated with the energy and environmental policy.

For the transport sub-sector strategic guidance seeks a transportation system equipped with adequate infrastructure and well-managed transport services to the highest quality and efficiency standards.

To reduce GHG emissions in the transport sector in the 2000-2020 period an average 10% decrease is expected in fossil fuel consumption, with the implementation of a program to improve energy efficiency of the land and sea transport fleet, optimization of urban and interurban transport, as well as by adding low pollution and power consumption mini buses in urban circuits.

For effective reduction of GHG emissions in the transport sector the following assumptions should be taken into account:

- Improving the energy efficiency of inland transport, maritime and air transport fleets;
- Streamlining urban and interurban transport;
- Adding low consumption and low pollution minibuses in urban circuits;
- Adding to hybrid vehicles the fleet of;
- Developing a study on a sustainable system of inter-island and international routes.

3.3 Water production

Drinking water supply in major urban centers in Cape Verde depends on seawater desalination, being this sector a major energy consumer, and accounting for approximately 7.1% of domestic consumption of final energy in 2000.

In 2000 were produced approximately 2,205,634 m^3 of water and 1858 Toe of electricity were spent and 5634 Toe of fuel oil.

3.4 Agriculture, forestry and fisheries

Changes in temperature and rainfall patterns will impact agro-forestry sector's development. These systems will have to adjust to new cultures and technologies adapted to new climate conditions and gain greater resilience and response to extreme events such as drought.

Climate change impacts call for improving and selecting cultivars which best adapt to local conditions and replacing some crops with those less demanding in water.

The two-sector activities that most contribute to GHG emissions are livestock management through enteric fermentation and manure, and use of chemical fertilizers and organic nitrogen in agriculture. Although these emissions are insignificant, we propose the following controlling options:

i) Management of ruminant livestock that lead to the reduction of methane per unit of production and improved productivity through:

- Genetic improvement and reproduction improvement;
- Improved food quality and nutritional balance in order to increase food digestibility (food chemical and/or mechanical treatment**).**

ii) Improved efficiency in nitrogen fertilizer utilization to decrease N_2O emissions by:

a) Technical measures for fertilizer control such as use of improved technology for nitrogen application in appropriate time and location, application of nitrogen according to crop needs, streamlining the use of animal manure, and optimization of irrigation and farming practices to reduce nitrogen leaching into groundwater;

b) Market based programs: regulating the types of nitrogen fertilizers to be imported should be the responsibility of agricultural services;

c) Regulatory measures: establishment of limits for of nitrogen fertilizer use and coordination of supports to agriculture with environmental policy objectives;

d) International programs: Support targeted to technology transfer in agriculture;

e) Voluntary actions: management practices that enhance soil carbon sequestration capacity of agricultural soils.

3.5 Land use change and Forestry

In this sector, options for mitigating CO_2 emissions are directly linked to burning of wood for energy purposes, it is therefore appropriate to highlight the role of forests as important sources of CO_2.
It is proposed an increased rate of CO_2 sequestration from the atmosphere by enhancing natural sinks through forestation activities to increase forested areas, including urban areas and proper management of existing forested areas associated with sustainable promotion of agro-forest-pastoral systems. It is also proposed to promote the use of advanced remote sensing for better analysis of the potential for carbon sequestration and forest management.

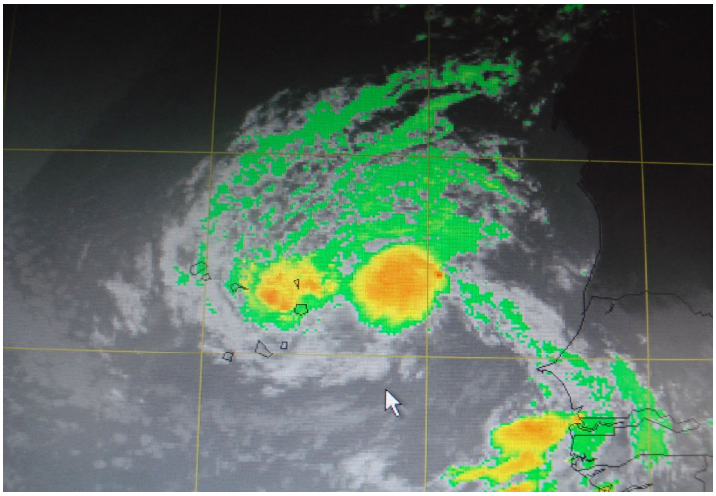
3.6 Solid residues

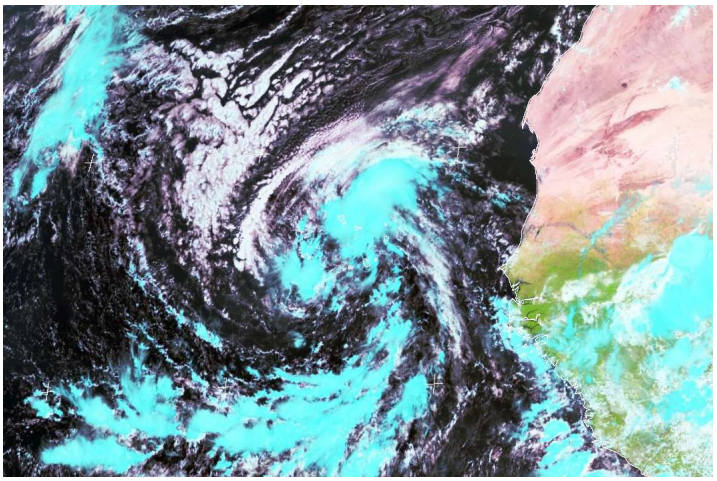
Since this sector has great potential for CH_4 emission, conditions should be created to recover CH_4 from waste incineration landfill for energy production via organic material composting processes of waste water recycling and waste minimization.

Some measures that are already being implementing in the country can be found in section 6.2 of this report.

Chapter IV

VULNERABILITY TO CLIMATE CHANGE





CHAPTER IV- VULNERABILITY TO CLIMATE CHANGE

4.1 Current climate variability

4.1.1 Research problems and objectives

Since 2000, in response to several proposals presented, fundings have been mobilized aimed at pilot projects for developing extended weather forecasts as a management tool to improve crop productivity, impact assessment and adaptation to climate change. Initially, attempts were made in order to improve weather forecasts at the regional level for local consumption. Then efforts were made to extend these forecasts for a longer period to get timely information on critical agriculture periods. Later, forecasts pointed to possible climate changes during the 21st century, indicating that actions should be anticipated to prevent possible negative impacts of these changes on food security with broader goals, all sectors are now linked to climate change and variability, such as food security, public health, changes in land use and socioeconomic development. Compounded with these are the negative impacts of potential changes in global climate as a result of increasing concentrations of greenhouse gases in the atmosphere.

4.1.2 Proximation

The current climate characterization is based on data for the 1948-2009 period. Based on models of the data observed and simulated data available in the IPCC distribution scenarios were anticipated on the present and future climate.

In describing the present climate and its variability, levels of variability were identified as well as certain coefficients of monthly variation for the maximum and minimum temperatures and rainfall.

Linear charts were developed based on observed data, to show the actual changes in rainfall from one year to another. Other tests were used to determine the relationship between temperature and rainfall in Cape Verde, as well as long-term trends. The study presents the simulation results of the main climate parameters over the Cape Verde region, using the dynamic downscaling technique, which consisted in using the Regional Numerical Weather Prediction Model, included in the Atmospheric General Circulation Model (AGCM). In numerical simulations, we used the ETA regional model developed by the NCEP AGCM ECHAM4.5 aligned to the model developed by the Max Planck Institute. With Eta model projections were generated and the results were compared with the scenarios proposed by IPCC.

4.2 The current climate

4.2.1 Atmospheric circulation in Cape Verde region

The spatial-temporal distribution of rainfall is affected by regional phenomena and remote influences as dominant forms of variability.
Cape Verde is located in a region where the variability of the Azores subtropical acts as regulatory factor of the anomalies of rainfall, by controlling the seasonal oscillation characteristics of the trade winds of maritime and continental features during the dry months (November to June). In the rainy season (July to October), there is the oscillatory movement of the ITCZ, characterized by southeast winds and disturbances from the east. Between December and February the islands are affected by

air masses from extra-tropical latitudes. The archipelago of Cape Verde is under the influence of four systems that affect the regional climate:

- subtropical anticyclone of the Azores;
- equatorial low pressures;
- cold ocean current from the Canaries;
- thermal depression over the African continent during summer.

The subtropical anticyclone region, characterized by high pressure, divergence and subsidence in air circulation, influences and characterizes the air masses that penetrate Cape Verde region the whole year. The Azores anticyclone is a very stable system, which dominates the tropical and subtropical North Atlantic, resulting in flows between north (N) northeast (NE) and east (E), often very intense from NE, called trade winds. It is affected by the predominance of subsidence movements called "the trade wind inversion, which acts as a strong opponent of the vertical development of clouds (Riehl, H. 1979), accentuated by a cold stream from the Canary Islands.

At altitude, the movement is dominated by the east flow, characterized by the presence of the African Easterly Jet (AEJ) and the Tropical Easterly Jet (TEJ). Located at 600 hPa with maximum speeds of 10 m/s between 10° and 15°N, the AEJ is the result of supply of heat by thermal depression, while the TEJ, which is located at 200 hPa, meridionally lagged toward the equator, is fed by deep convection. This dynamic seasonal movement in the West African coast, with the subsequent meridional movement of the ITCZ, sets the rainfall pace on the West African coast and therefore on Cape Verde region.

4.2.2 Evolution of climate parameters

4.2.2.1 Temperature and rainfall temporal variation

The annual cycle is defined mainly by three periods comprising a dry season from March to June, a rainy season from July to October, and a transition season, less humid, influenced by the intrusion of middle and high latitudes, between December and February. From the data observed over the season, September is presented as the wettest month in the archipelago, while the months of March, April and May, very sporadically in abnormal years, register some rainfall (Figures 17, a), b) and c). The cycle for the average temperature and rainfall tends to have an annual variation, according to a single standard for the islands.

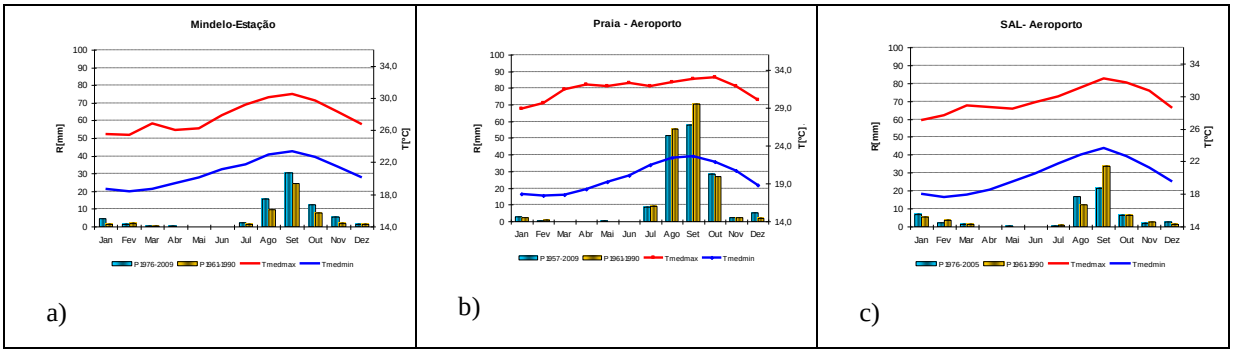


Figure 17. Annual rainfall and temperature cycle in Mindelo (a), Praia (former AFM) (b), and Sal (airport) (c).

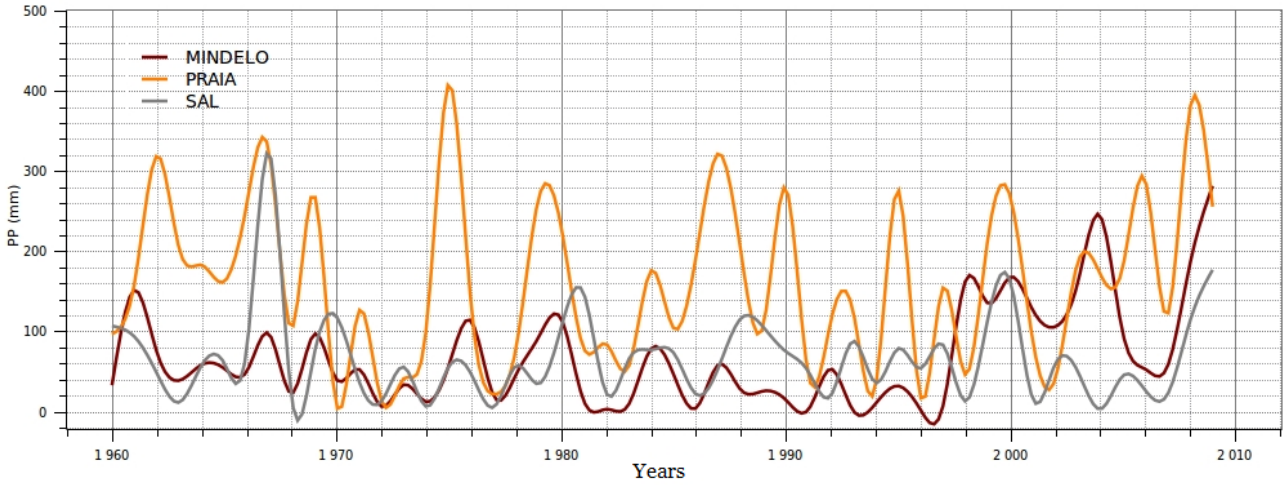
The presence of two distinct periods in the annual temperature and rainfall cycle is related to the factors that influence the climate in Cape Verde and have a direct bearing on the intensity, location, interaction between the centers of action in the atmosphere in this region

4.2.2.2 Rainfall

The period between July and October is determined mainly by the occurrence of easterly waves, which depending on its intensity may or may not be accompanied by rainfall. They are generally accompanied by well organized convective clouds, with the occurrence of heavy showers and thunderstorms. This period coincides with the intensification and approach ITCZ zone, partially impacting on the amount of rainfall in this time of year. Season rainfall data recorded in Cape Verde show that September accounts for the highest rainfall rates.

In the period from December to February rainfall is associated with the formation of jet streams at 700 hPa levels originated when at the northeast of the Canary Islands a depression is formed, and low pressure at altitude, which extends to the southwest region of Cape Verde, facilitating the penetration of polar air. On Sotavento severe winters do not have much expression, but the rainy season is well defined by registering the highest amount of rainfall.

Interannual rainfall variation charts for the 3 seasons show that, within the frequent annual fluctuations of rainfall variation, there is a trend for a remarkable increase in rainfall since mid-1990s as shown in Figure 18.



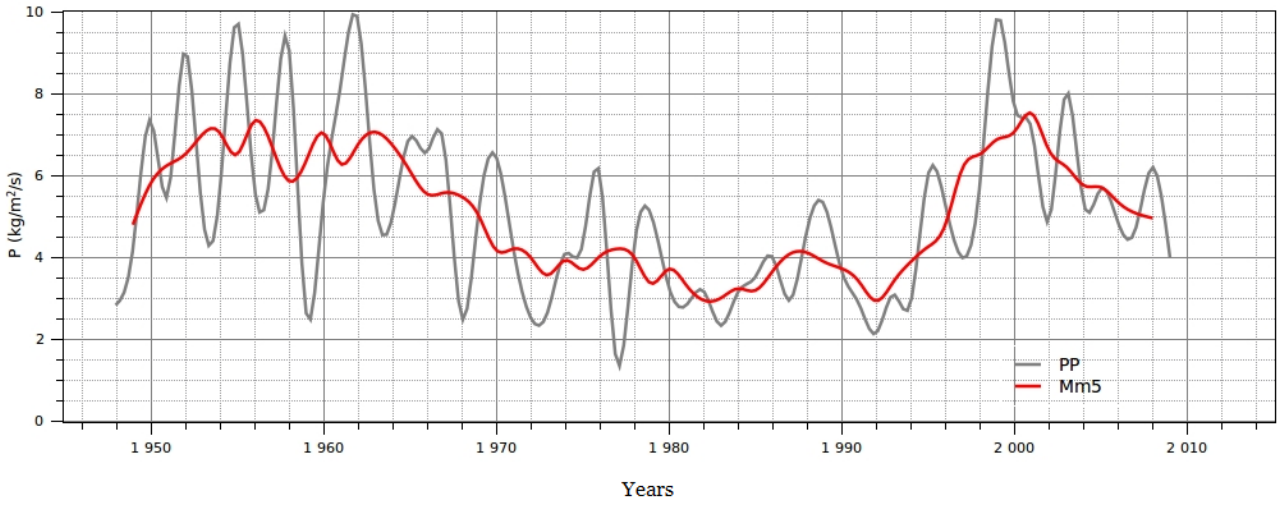


Figure 18. Interannual rainfall variability in S.Vicente, Santiago and Sal from 1960 to 2009, and rainfall rates for the study area, moving average line

Statistical analysis of annual rainfall between 1960 and 2009 shows that on the southern islands rainfall is more frequent and with some regularity over the years. This slight increase in rainfall can be directly linked to average temperature rising trend in the archipelago, which can be proven by the series of stations in Sal, Praia and Mindelo. This increase in the amount of rainfall is identified by the positive values in the graphs on the anomalies of rainfall amounts, and rainfall ratio of over the 1948-2009 period, with the prevalence of positive anomalies, from 2000.

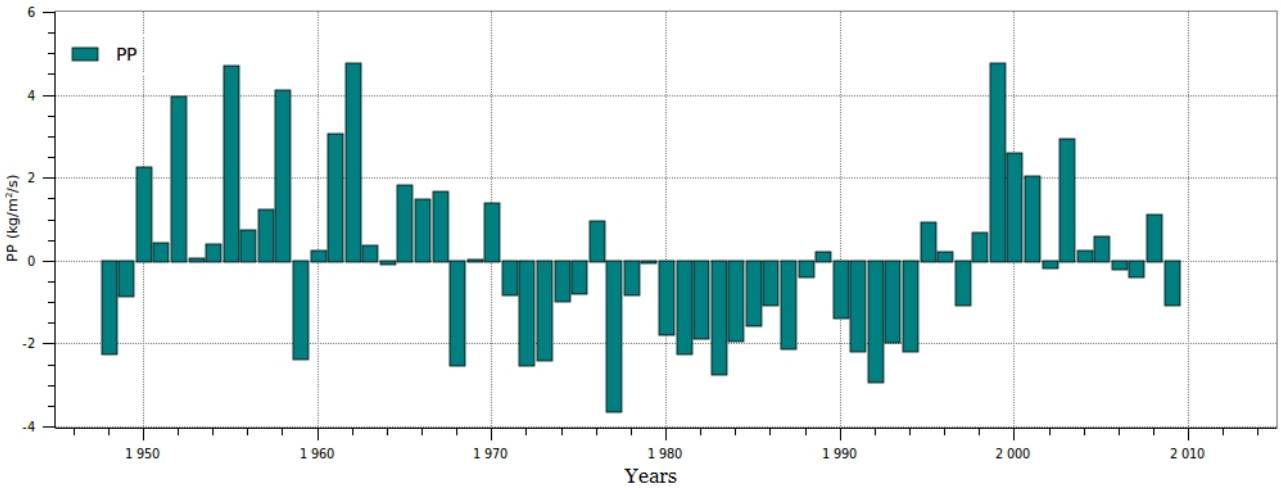


Figure 19. Anomaly of rainfall ration in the 1948- 2009 period

4.2.2.3 Temperature

The series of temperature in Cape Verde (Mindelo, Praia and Sal), from 1960 to 2009, suggest the existence of a growing trend of average annual temperature from 1990, with values above the climatologically normal for 1961-1990. The spatial variation shows that the average temperature increases approximately 2°C when we move towards the south (Figure 20).

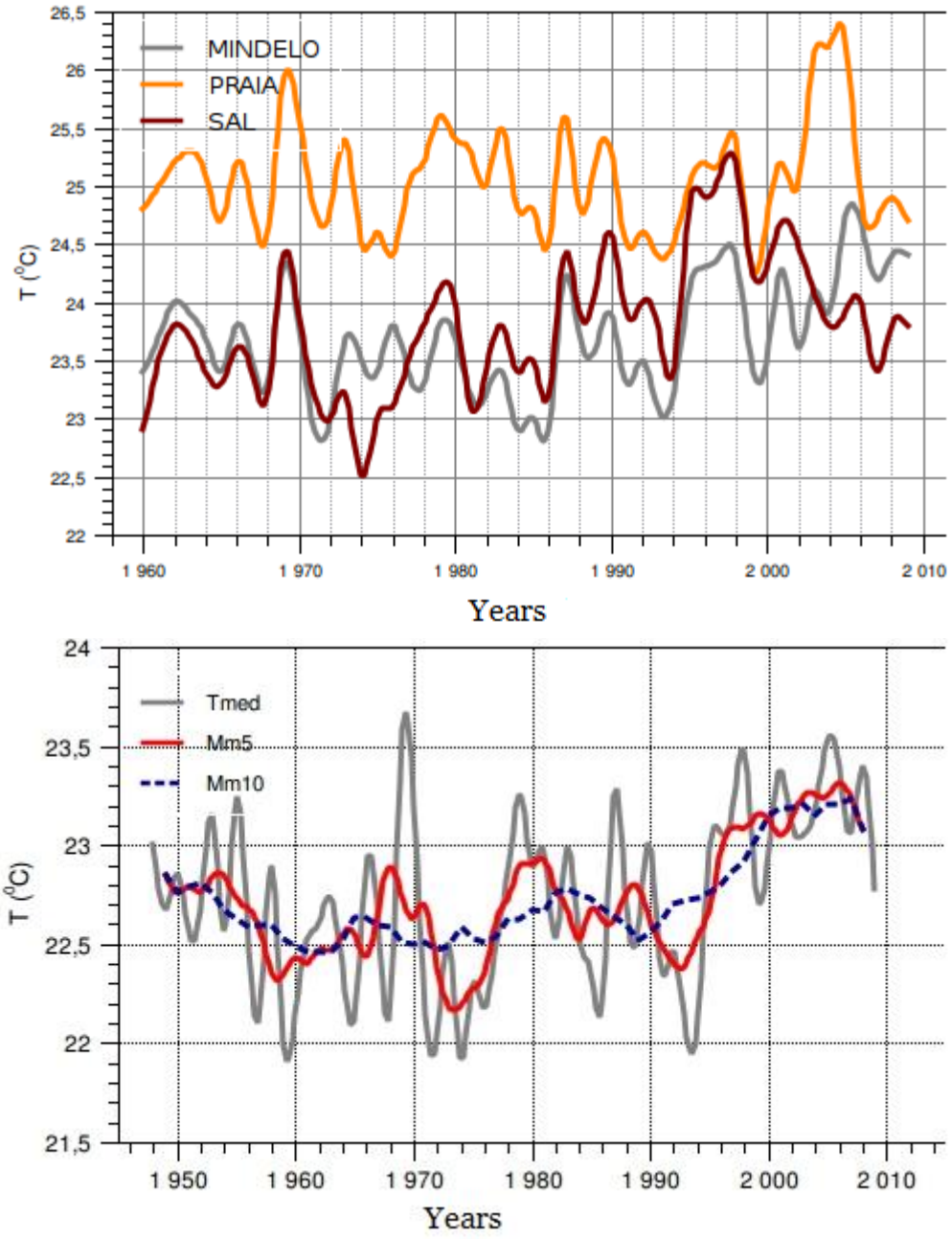


Figure 20. Average annual temperature variation in stations in Mindelo, Praia and Sal

The temporal evolution of the average monthly temperature in the 1948-2009 period demonstrates an increasing trend over the past 15 years. According to figures (21; 22; 23; and 24), this seasonal

trend is also for all quarters (JFM, AMJ, JAS and OND). In JFM and AMJ quarters, the average temperature has greater variability, with greater temperature range, while the lowest variability occurs during JAS and OND periods. This occurs because the JAS quarter is the hottest period, with no cold air mass inputs and there is an increased occurrence of rainfall, which act as thermal regulator.

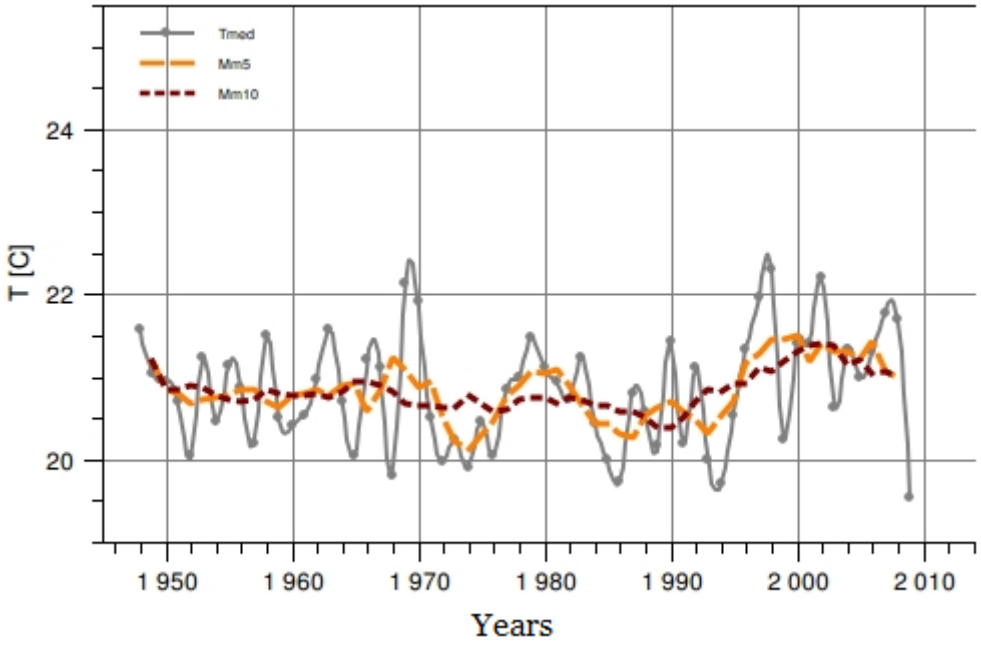


Figure 21. Seasonal variations of temperature – months JFM (1948-2009)

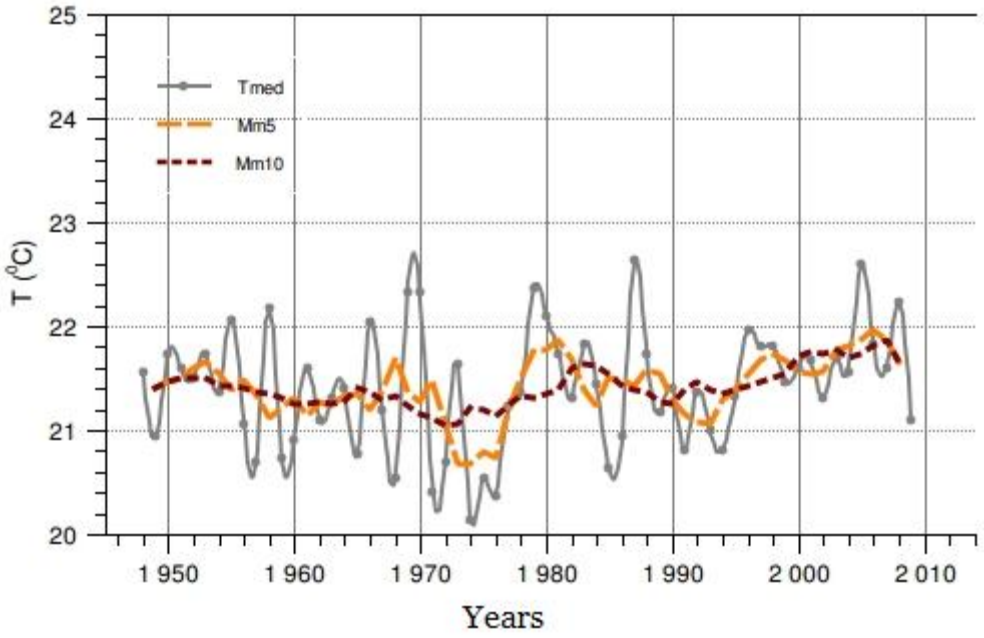


Figure 22. Seasonal variations of temperature – months AMJ (1948-2009)

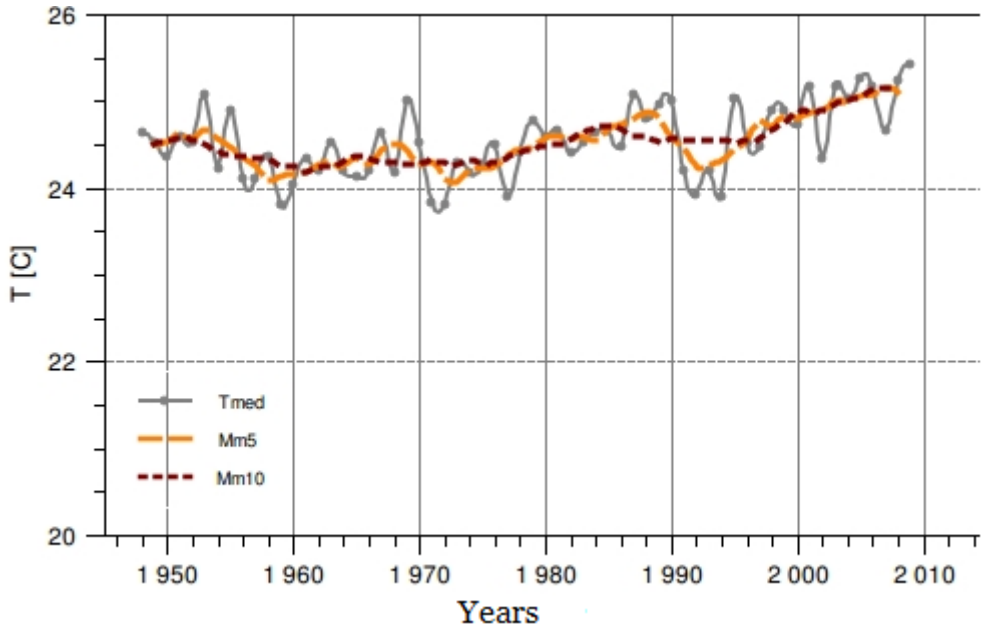


Figure 23. Seasonal variations of temperature – months JAS (1948-2009)

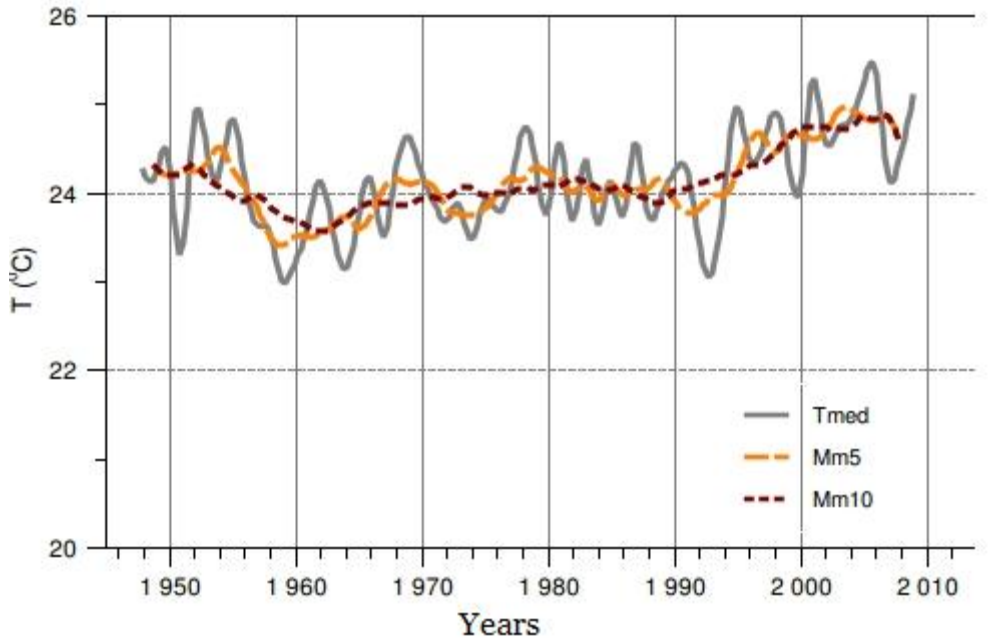


Figure 24. Seasonal variations of temperature – months OND (1948-2009)

The positive anomalies observed from 1995 indicate that average monthly temperatures during this period are above the climatologically normal by an average of 0.4ºC.

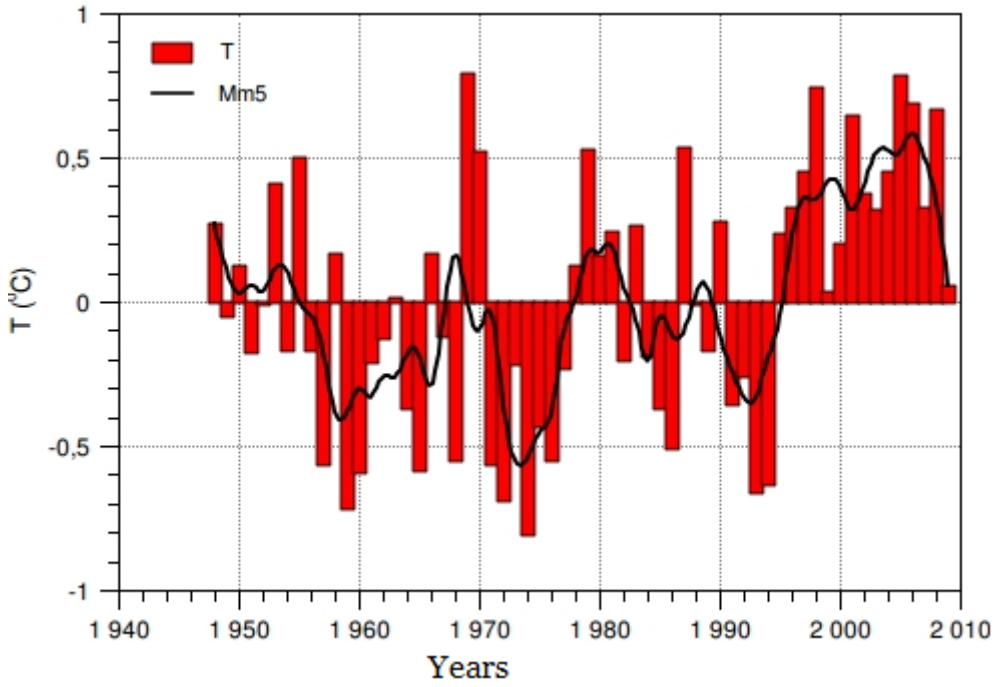


Figure 25. Average temperature anomalies in the study area

Decadal rainfall and average temperature variation suggests the existence of a strong correlation between these two parameters (Figure 26). Based on the chart, note that when there is an increase in average temperature, there is a tendency for increased rainfall, and vice-versa.

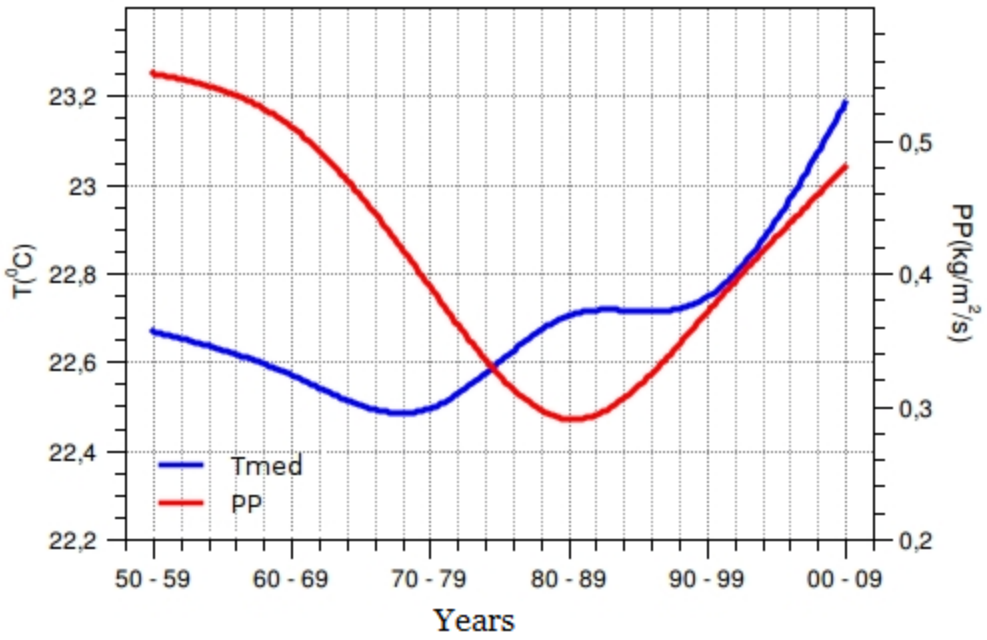


Figure 26. Decadal variation of average temperature and rainfall ratio in the study area

4.2.2.4 Relative Humidity

On average, the relative humidity in Cape Verde ranges from 60% during day time, with higher temperatures, and 90% during the night or cloudy and rainfall periods, with lower temperatures. The highest values occur between July and October, and may exceed 85% during the night or when the intertropical convergence zone reaches its extreme position to the north, thus reaching the islands. Minimum temperatures coincide with the predominance of winds from the east and northeast, together with suspended dust and low humidity.

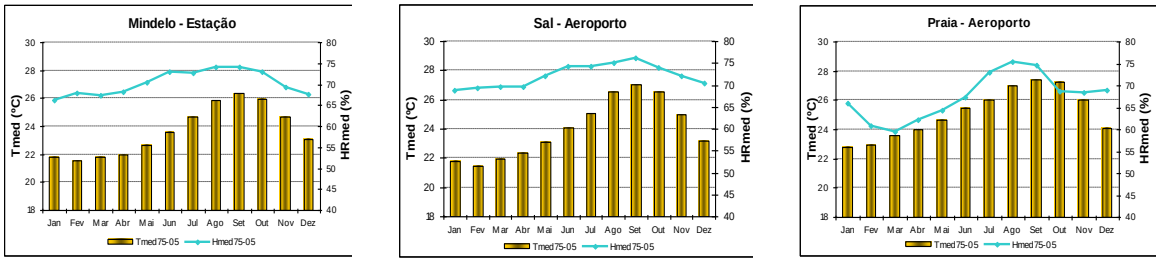


Figure 27. Annual relative humidity and average air temperature in stations in Mindelo, Sal and Praia

4.2.2.5 Wind

Consistent with the pressure field and since the archipelago is on the periphery of the Azores anticyclone, NE trade winds are the main winds in Cape Verde, with frequencies ranging from 60% to 80% per year (Figure 28). SE and SW winds occur periodically with the approach of the ITCZ during the July to October rainy season. During the dry season winds are predominantly from the continent, being responsible for the transport of desert dust, a phenomenon called "dry fog" (haze). During this period, visibility often reaches values below one thousand meters and the relative humidity is below 35%. In relation to the wind intensity, the trend is an annual variation with average speeds ranging between 6 and 7 m/s.

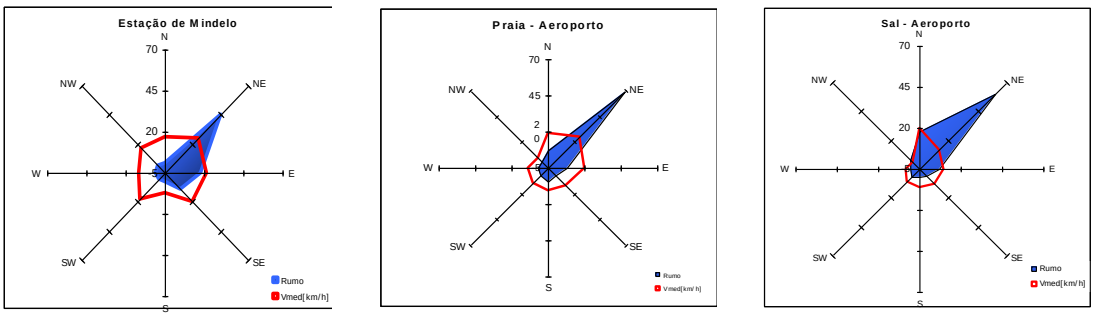


Figure 28. Distribution of wind direction in Cape Verde, in stations in Mindelo (a), Praia (b) and Sal (c)

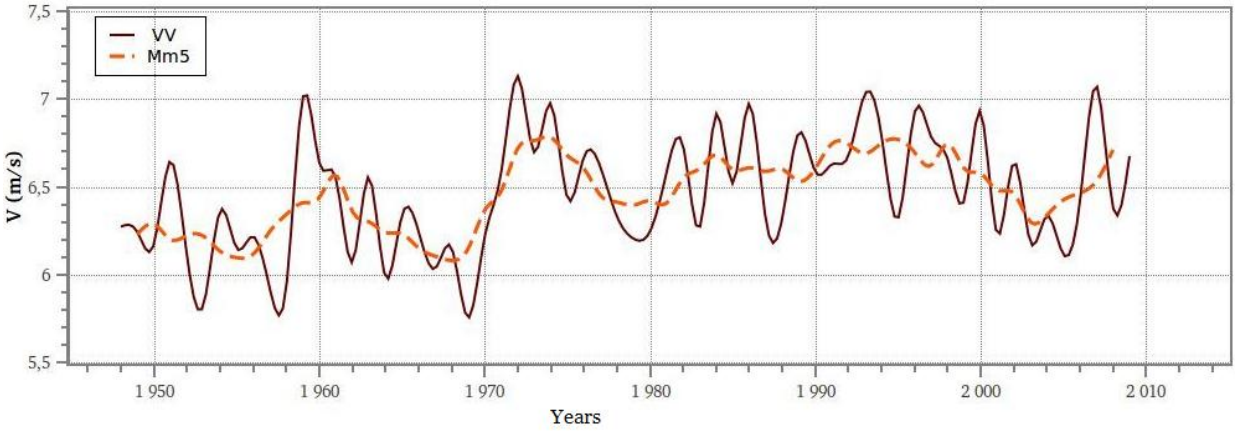


Figure 29. Average annual wind intensity variation in the study area

The seasonal pattern of the wind intensity during the study period shows periodic oscillations, but there are no trends for a significant change in variability (Figure 30). The main intensity periods are JFM and AMJ, where the average speed varies between 6 and 10 m/s. The minimum values are recorded during the JAS period and the wind starts to increase again during the OND period.

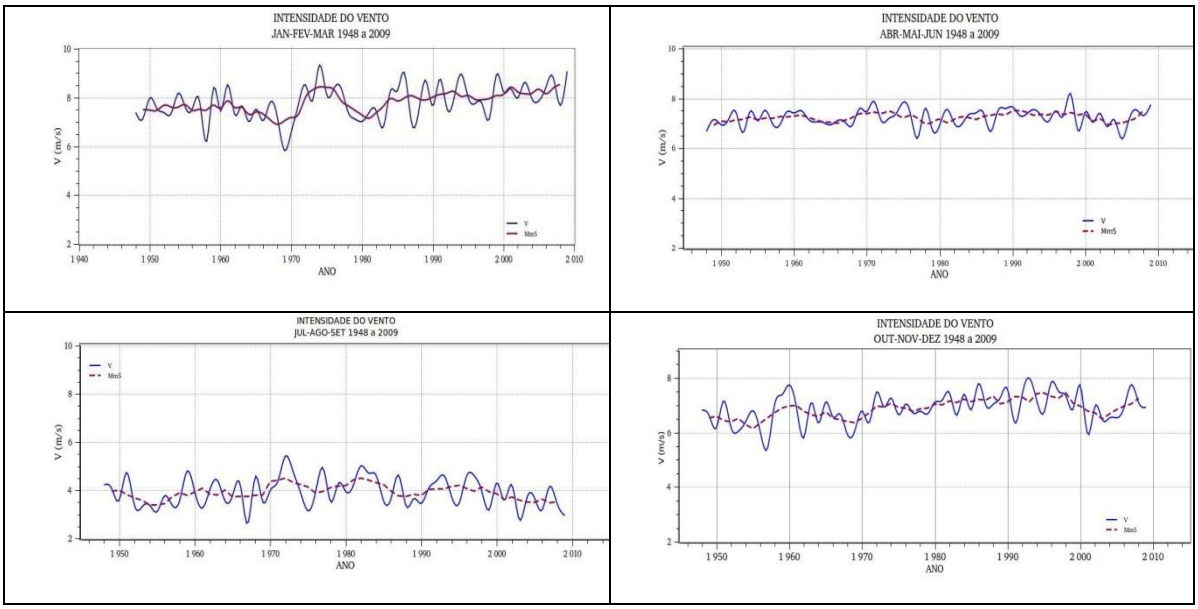


Figure 30. Seasonal variation of the wind intensity during JFM, AMJ, JAS and OND from 1948 to 2009

As regards wind variation at altitude, according to studies by Soares (2004), the meridional wind is the most relevant factor of the rainfall variability on the islands. When the north meridional to the surface is stronger than that from south, convergence occurs farther south and smaller is the ITCZ displacement to the northern hemisphere, a fact which causes anomalies in rainfall over the islands. The reverse also occurs and rainfall is more abundant.

4.2.2.6 Cloudiness and Insolation

Although not uniform, the annual cloudiness variation has two separate types: increased cloudiness, between July and October, where the height of cloud base is lower during the night and morning, and less cloudiness in the afternoon and early evening, between March and June. The seasonal insulation pattern is, as usual, inversely correlated with cloudiness (Figure 31). On some islands, it is affected by constant cloudiness (low clouds) during almost the whole year. The maximum average insolation occurs between March and June, while the minimum is recorded in August-September.

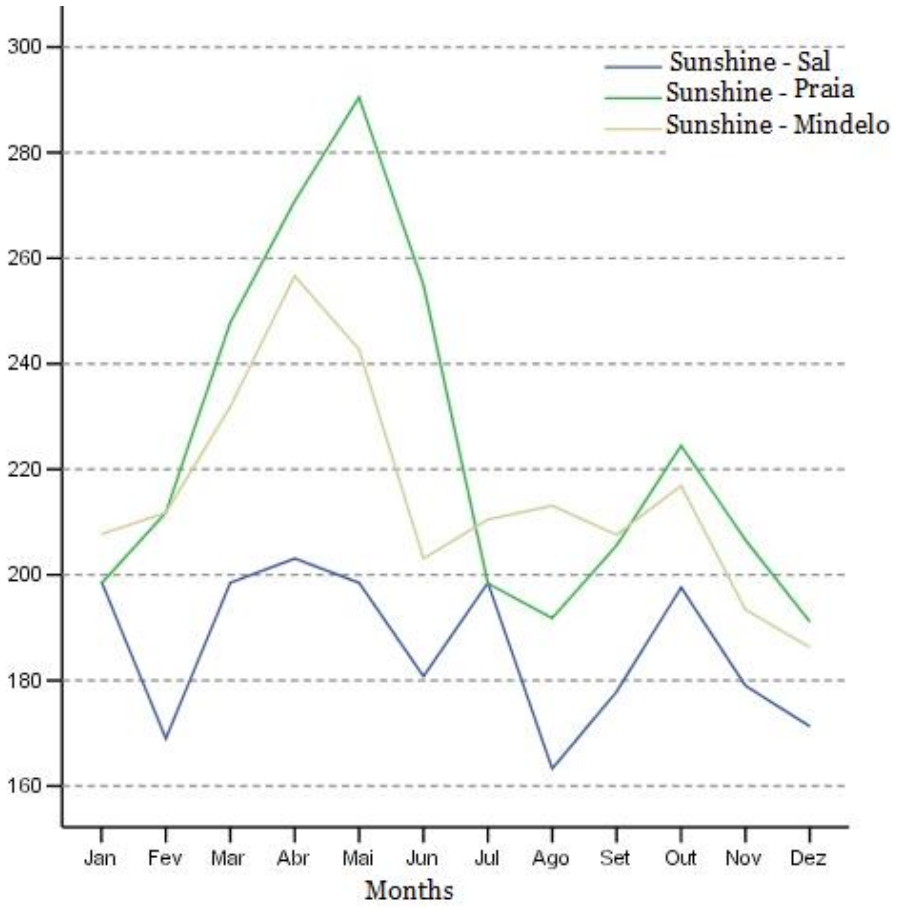


Figure 31. Annual insolation chart per hours - Stations in Sal (blue), Mindelo (grey) and Praia (green)

4.2.2.7 Haze

In Cape Verde haze occurs when in the atmospheric circulation over the region an east or east-northeast chain is established on the African continent, between 15^{o} and 25^{o} north latitudes and a thermal depression is formed at 10^{o}-20^{o} north on the continent, reinforced by the growth of the Libyan anticyclone over northern Africa.

In these situations, the sky is mainly not cloudy, with low stratocumulus clouds, the wind blows from the northeast at speeds ranging from 18.5 and 33.3 km/h. Large quantities of suspended solids

are transported from the African continent towards the Atlantic by the E/ENE stream. The most intense episodes reduce visibility to between 2 and 4 km, and sometimes to less than 1 km. This situation remains generally between 4 and 8 days, lasting sometimes for more than two weeks. Data collected between 1976-2005 in Figure 32, show that 1981, 1989, 1994 and 2000 were years with the highest number of haze days, all with periods above 150 days. Periods with less dust activity occurred between 1970 and 1980, 1984 and 1988 and between 1996 and 1998, and the annual average is 100 days.

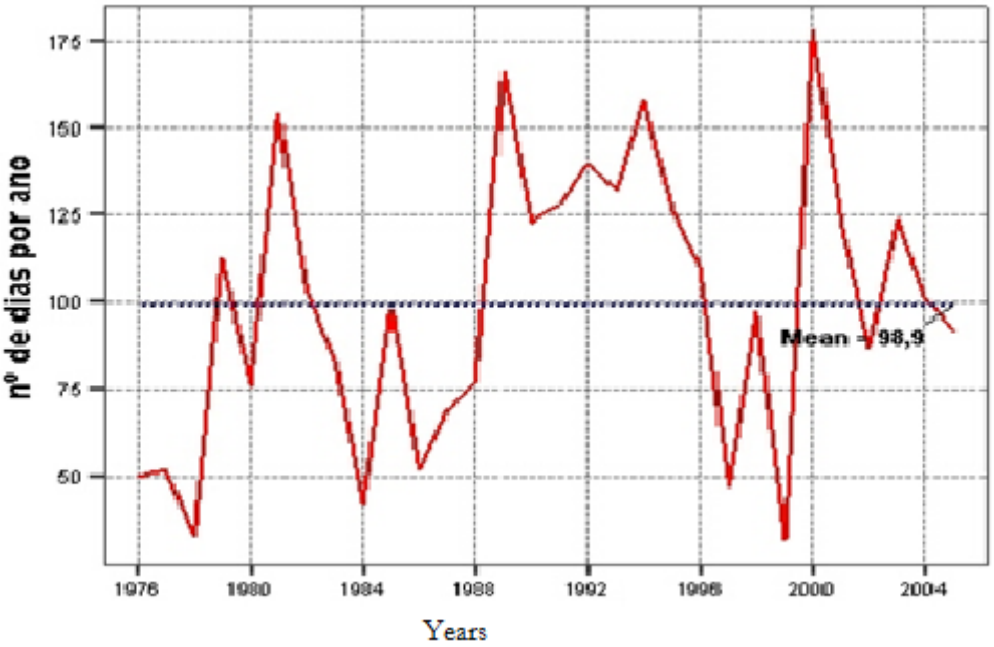


Figure 32. Annual chart of haze days, between 1976 and 2005

4.2.3 Phenomena associated with climate variability

The phenomena that most affect the environment and climate in Cape Verde region are directly related to the variability of the Azores anticyclone, cold stream from the Canary Islands, oscillation of the intertropical convergence zone, formation of depressions and tropical cyclones, persistence of the "harmattan" during the dry season, random spatial-temporal rainfall, temperature fluctuations, severe squall lines, frequent haze episodes and the jet streams at altitude.

Critical changes in temperature can further affect the already fragile environment, helping to increase or prolong episodes of drought, heat waves and dust, contributing to erosion and land degradation.

A possible increase in the sea level could severely affect coastal areas and cause damage to tourism and economy. Movement conditions favor the development of high-energy systems, for example, tropical cyclones, squall lines and convective cells. These phenomena whose main source of energy is the surface temperature of the sea water, the possibility of increased temperatures in the sea water

(T > 25°C) associated with the presence of atmospheric disturbances in the trade winds are favorable conditions for intensification of these weather phenomena.

At altitude, the movement is dominated by the east, arising the maximum values of wind intensity characterized by the location of the African Easterly Jet (AEJ) and the Tropical Easterly Jet (TEJ).

Anomalies in the intensity of these systems can help constitute climate risk phenomena to the archipelago, namely torrential rains and prolonged droughts. Among the main sectors affected by these phenomena are agro-silvopasture, water resources, tourism and coastal areas, transport, health and economy.

Wind intensification means increased intensity in coastal erosion, change in the coast morphology, disappearance of beaches, degradation of marine and coastal environment, change in the intensity of ocean currents, increased intensity of coastal degradation due the change in the amplitude of waves and tidal aggression, and thus degradation of the environment causing populations to migrate from the coast to the inner part of the islands.

4.3 Impacts of climate variability

Agricultural productivity has shown great sensitivity to interannual change in rainfall, including the dates when the rainy season begins and ends. Thus, yields can be significantly affected by negative anomalies, drought, which will have serious implications on the economy. On the other hand, the reverse happens with the positive rainfall anomalies. The outbreak and movement of plagues may be conditioned by variability in temperature and rainfall. This also applies to the health sector, with the spread of diseases related to regional climate variability. In this case the problem must be addressed at regional level.

4.4 Global phenomenon and regional dynamics

Rainfall patterns in West Africa are linked to the seasonal movement of the intertropical convergence zone, where the hot and dry tropical air from the northeast join the warm and moist masses of air from the south associated with the monsoon. The semi-arid zone, where the archipelago is located, is marked by a single rainy season (July-September), sometimes by a second rainy season (January-February) by the influence of higher latitude phenomena. The rest of the year is dry, due to dust episodes from the Sahara desert. Temperature variations in the oceans, which are sensitive to global climate change, will undoubtedly impact on the monsoon in the western coast of Africa.

In addition to these phenomena, the overall effect of surface continental processes (vegetation, soil moisture, water cycle or albedo) on the monsoon dynamics may have affected this region. However, it should be noted that interactions/retro- actions between the continental dynamics and climate are poorly understood. Considerable variations in rainfall (lower on the coastal area and higher in the North - South axis) corroborate this: scarcity periods in the last fifty years have identified a clear break in 1968-1973, 1982-84 and 1997. Since the mid-1990s, there has been a return to better

rainfall and of positive anomalies of sea water in the east Atlantic coast and the further west coast of Africa.

Another climate variable is particularly related to the fact that climate changes in West Africa and the Sahel region in relation to temperature have been faster than global warming. Temperature increase ranged between 0.2 C and 0.8°C since late 70s. This trend is particularly strong in terms of maximum and minimum temperatures.

4.5 Scenarios for change

4.5.1 Uncertainties

There is huge uncertainty in climate projections regarding rainfall for West Africa. Recent tests have demonstrated the limited ability of climate prediction models to West Africa. A comparison of the Sahel climate observed between 1961 and 1990 and the climate simulated by six general circulation models recommended by the IPCC illustrates this deficiency. Contrary to the actual situation in relation to the observed data, the models show a marked rainy season over most of the year, along with a considerable discrepancy (140-215 mm/year) of the estimated total annual rainfall.

4.5.2 Vulnerable coastal areas and ecosystems

Current world projections anticipate a sea level rise by 30 to 50 cm in the 1990-2100 period. Considering the reality of an island state, where most of its population lives on the coastline, almost every national coastal area and its ecosystems are vulnerable to any change either in temperature, rainfall or in the sea level variation, including incidents resulting from extreme sea/weather events. Rising sea levels would have a direct impact on coastal submergence and erosion, increased flooded lands and salinity of small estuaries, streams and coastal waters.

4.5.3 Spatial changes in diseases

Several vector-borne diseases prevail in West Africa, including malaria, sleeping sickness, dengue fever, or even the nearly eradicated yellow fever. Rainfall, temperature and humidity play an important role in the occurrence of these vectors. Reduced rainfall and desertification may limit the growth of these species. But dry weather does not automatically decrease these insects in areas of growth. A possible increase in extreme weather events (erratic rainfall, in particular) could increase the odds for these insects to survive longer also increasing, affecting human health and migration of animals to areas where forage is more accessible. The risk of contact with other disease carriers consequently may lead to the outbreak of new diseases.

4.5.4 Soil resource and land handling

Soils in Cape Verde are fragile, poor in carbon and plant nutrients. Maintaining soil fertility through organic or inorganic sources is the key for sustaining agriculture. Whereas soils are inherently fragile and prone to degradation compounded with the nature and variability of rainfalls, with torrential summer rains, water absorption is very difficult, especially if it is uncovered.

Due to the characteristics of the national land, runoff is substantial, with large annual losses of soil. The loss of soil (which contains most of the plant nutrients) through water and wind erosion is a major setback to agricultural sustainability and food security in the country. Considering the evolution of extreme weather events, considerable reduction in rainfall and rise in temperature may lead to environmental catastrophe. Thus, controlling erosion in Cape Verde would be based on maintaining the vegetation at soil surface, cleaning the fields after the storms and implementing reforestation programs.

4.6 Building up scenarios

Decreased annual rainfall (-20 to -10 %) combined with temperature increase up to 2.5ºC, will expose a large proportion of rural population to food insecurity and drastically affect the economy. Agriculture in rainfed conditions will no longer be viable in many areas. To adapt to these changes the following measures have been suggested:

- Crop diversification and increased use of crops better adapted to drought;
- Water mobilization techniques and supplementary irrigation;
- Use of drip irrigation techniques;
- Husbandry development que o milho não será mais adequado;
- Vegetable and fodder production of to improve soil condition and animal productivity;
- Use of more efficient harvest timing.

However, for improved adaptation there are strategies that are related to building up scenarios to predict future climate change and variability. This is the first step in representing the future climate, for a probabilistic vision on the condition of the atmosphere and to determine the uncertainties related to the effect of increasing concentrations of some gases in the atmosphere and global climate.

4.6.1 The current scenario

As far as temperature is concerned, the average annual temperature has increased by 0.6°C since 1960, an average rate of 0.14°C per decade. The rate of increase is faster in the wet season, ASO at 0.23°C per decade. Yet, there is insufficient daily observational data available to identify trends in daily temperature extremes.

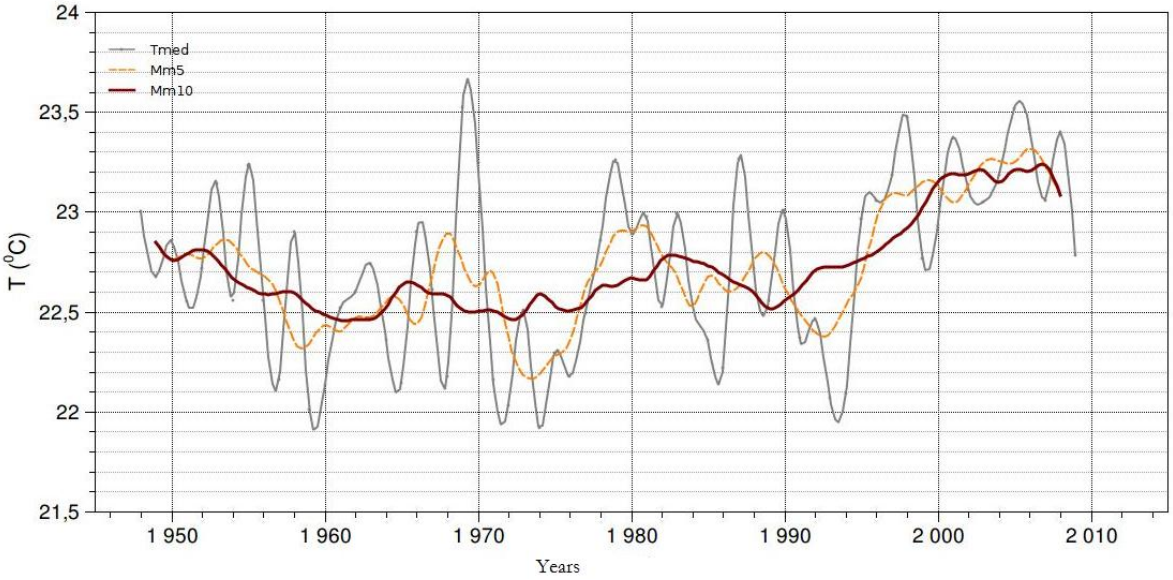


Figure 33. Average temperature in Cape Verde (1948-2009)

The figure 33 above clearly illustrates the increase in average temperatures (5 years) during the period from 1970 to present, with an upward curve in the past years.

For rainfall, the average annual rainfall over Cape Verde has not changed with any consistent trend since 1960. Some unusually high rainfalls have occurred between November and February, which are unusual for this season which is normally very dry. For this parameter there are insufficient daily rainfall observations available from which to determine changes in extreme rates of daily rainfall.

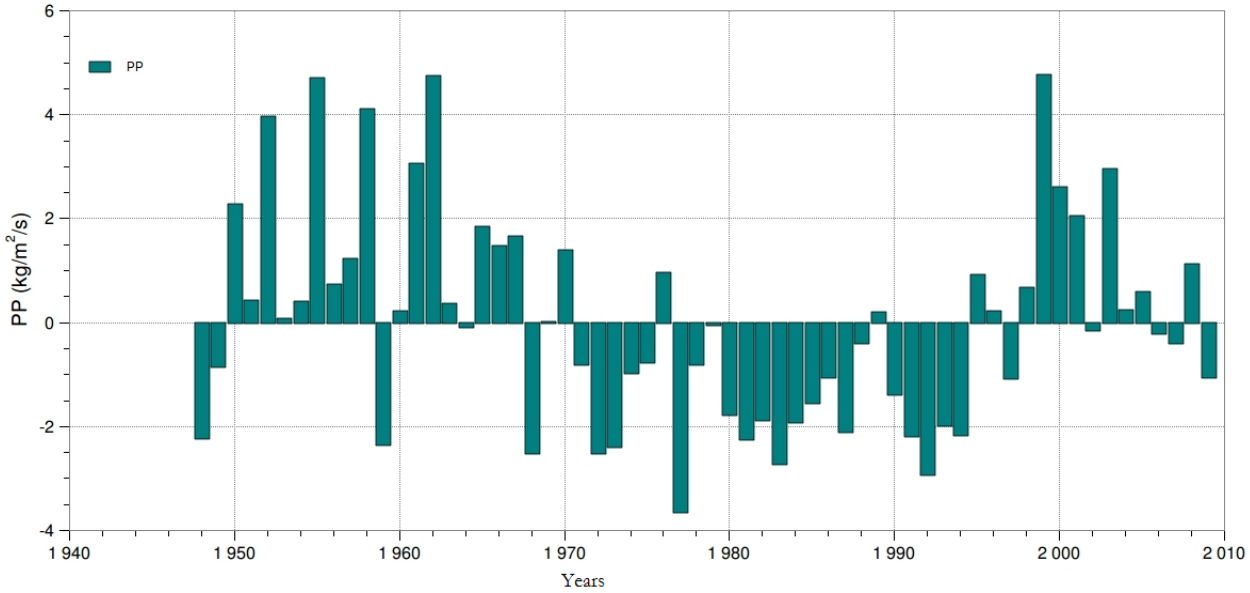


Figure 34. Rainfall Anomalies Cape Verde (1948-2009)

The figure 34 above depicts the rainfall anomalies Cape Verde (average in the box for the territory) in the 1948-2009 period. It also clearly shows the rainfall periods above and below the average and identifies the drought periods in 1970, 1980 and early 1990.

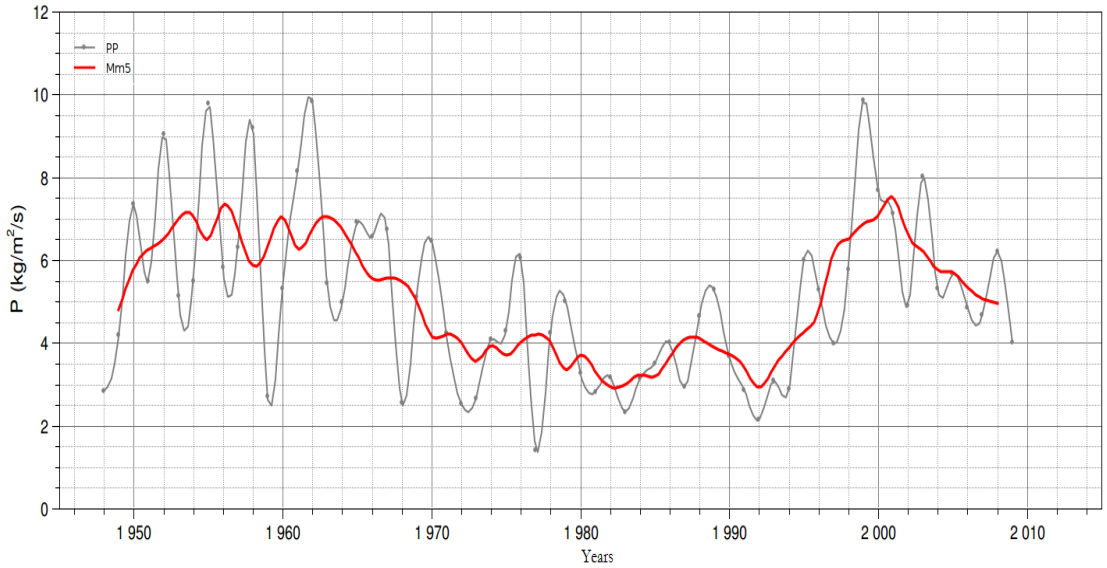


Figure 35. Anual Variation Rainfall in Cape Verde (1948-2009)

The figure 35, above shows the annual variation in rainfall in Cape Verde ($kg/m^2/s$) and five-year average.

4.6.2 The future scenario

The Global Circulation Models (GCM) do not have a fine enough resolution to capture small islands such as Cape Verde, therefore projections are based on calculations over ocean surface and do not account for the physical influences of the Islands' land surface (Christensen *et al.*, 2007). On the other hand, climate models present significant errors in simulating the position of the Inter-tropical Convergence Zone (Christensen *et al.*, 2007), causing significant systematic errors in the rainfall simulated in this region, and increased uncertainty associated with projected climate changes.

Regional and local atmospheric disturbances are poorly captured by GCMs and thus determining potential changes in intensity and tracks of tropical cyclones in the future is very uncertain. Whilst "evidence" indicates that tropical cyclones are likely to become, on the whole, more intense under a warmer climate as a result of higher sea-surface temperatures, there is great uncertainty regarding changes in storm frequency and tracks and their interactions with other features of climate variability (such as the El Niño Southern Oscillation) which brings uncertainty at the regional scale (Christensen *et al.*, 2007). Uncertainty on potential changes in tropical cyclone contributes to increased uncertainties in determining future wet-season rainfall.

The models projected an increase in average annual temperature from 0.7 to 2.5 ºC by 2060 and 1.2 to 3.7 ºC by 2090. It appears that the projection interval for 2090 in either emissions scenario is 1.0 to 2.0 ºC. The rate of temperature increase will be similar in all seasons. All projections indicate a substantial increase in the frequency of days and nights that are considered "hot" in the current climate. Moreover, projections indicate that every year "hot" day ('Hot' day or 'hot' night is defined by the temperature exceeded on 10% of days or nights in current climate of that region and season.) will occur in 16-32% of days in 2060, and 23-51% by 2090. "Hot" days to current standards may be rising faster during the ASO. However, note that the interval between the model projections is too large when considering the results of the estimated occurrence of 39-100% of days in this season anticipated for 2090.

As regards nights considered "very warm" for the annual climate (1900-1990), they are expected to occur in 23-49% in 2060, and 31-79% in 2090. Hot nights that are considered standards for each 1970-1999 season are expected to occur in 37-100% in each season in 2090. Moreover, all projections point to a decrease in the frequency of days and nights considered "cold" (Cold' days or 'cold' nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season). Cold days and cold nights will not occur in any of the projections for 2090, and will only occur in the lower emission scenarios for 2060.

With regard to rainfall, the projected annual average across the country from the different global circulation models are not consistent and do not indicate whether there will be increased or decreased rainfall. In partially dry season (NDJ) and dry season (FMAMJ), particularly in MJJ, the model ensemble tends to decrease rainfall, which in absolute terms (mm) are almost nonexistent, and do not represent a large proportion of the total annual rainfall. Between them, the models project a very high discrepancy in the change of season (ASO), ranging between -77% and 87%. Changes in the proportion of total "heavy" rain events ("heavy" rain is defined as a total daily rainfall exceeding the limit that is exceeded by 5% the average of rainy days in the region's climate and season) vary irregularly between increases and decreases. The same occurs in projections of rainfall for 5 consecutive days.

4.6.3 The sea level

The islands of Cape Verde are likely to be vulnerable to sea-level rise. By 2090 the sea-level in this region is projected by climate models to rise according to the following 3 levels: 0.13 to 0.43m under Special Report on Emissions Scenarios (SRES) B1, 0.16 to 0.53m under SRES A1B scenario, and 0.18 to 0.56m under SRES A2. However, for the reasons stated above, there is important uncertainty related to these projections.

4.7 Trends, Probabilities and Consequences

4.7.1 Trends

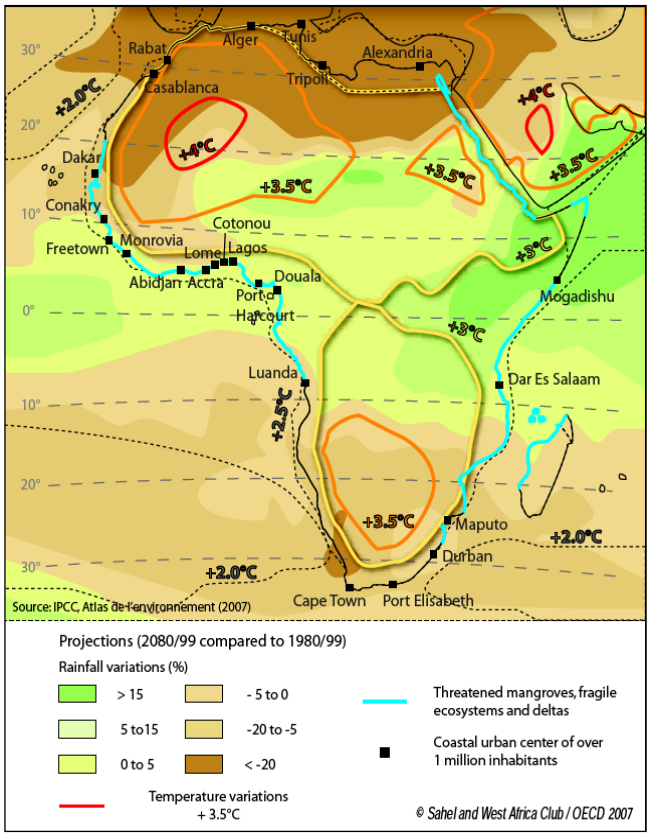
In Cape Verde, there was a temperature drop between 1960-1980 (~ 0.15°C), accompanied by dry periods. On the other hand there was an increase in temperature between 1980 and 1990 (~ 0.21°C) followed by a period with no variation. After 1990, there was a temperature increase at a 0.04º C/year rate. Although slight, there was a return of rainfall, more frequent in recent years. Thus,

there is in Cape Verde a close relationship between temperature and rainfall. Projections, using the "downscaling" method with the ECHAM model conditions, indicate an increase in temperature in Cape Verde by 0.4 -0.7°C for 2020 and this growth is expected to maintain for an increase by 0.5-1.0ºC by 2090. This means that global models were overestimating the temperature rise in Cape Verde.

Regarding rainfall, based on the close correlation between temperature and rainfall, the country will be more humid and receive more rainfall, with drier intermittent periods. Although the surface observations in Africa are poor, the existing network indicates that temperatures have increased over the 20th century and during this period, periodic drought has occurred in large areas.

4.7.2 Probabilities

Warming of 1-3°C in the African continent is expected to continue throughout the 21st century, with greater warming on a regional basis. The warming is expected to increase evaporation leading to reduced soil moisture if there is not a corresponding increase in precipitation. Precipitation changes in Africa during the 21st century have considerably more uncertainty, with some GCMs suggesting wetter conditions and others drier conditions. This uncertainty is partially due to the different model parameterizations and climate sensitivities in GCMs, which can lead to different simulations of precipitation under the same forcing. One approach has been to use regional climate models that can simulate precipitation processes better than GCMs because of finer scale and better physical parameterizations.



The figure 36, source IPCC Atlas de l'Envirronement (2007) depicts the annual projections for temperature and rainfall in Africa and its coastal area as well as the vulnerability of their ecosystems and population. Data are projected for the 2080-99 period, compared with the 1980-90 period. Here, projections for Cape Verde indicate an increase between 2ºC and 2.5ºC in temperature and rainfall variation by around 0-5%. Assuming these projections, Cape Verde would maintain its average rainfall despite the rise in temperature, differing from the correlation defended between these two parameters. This justifies the existing uncertainty regarding trainfall projections.

Figure 36. Anual Variation Rainfall in Cape Verde (1948-2009)

Given the decadal variability in African rain that has been observed during the 20th century, there is no reason to believe that this pattern will not continue under high greenhouse gas concentrations this century. But, there are several factors that should be taken into consideration:

- Direct effects of global warming on rain intensity and spatial/temporal variability on the African continent, especially as it relates to the start and end date of the growing season;

- Direct effects of global warming on the Atlantic and Indian Ocean temperatures that can impact rain anomalies on decadal timescales during the 21st century;
- Direct effects of desertification, deforestation and land-use change;
- The effects of intensity of space-time variability of rainfall on a regional basis.

4.7.3 Vulnerability and needs

As most of the small island states the Cape Verde economy suffers from a poor natural resource base, including serious water shortages and poor soil for agriculture on almost of the islands. The economy is service oriented with commerce, transport, tourism, and public services accounting for about three-fourths of GDP. Nearly 70% of the population lives in rural areas and the share of food production in GDP is low. About 82% of food has to be imported. The fishing potential is not yet fully exploited. The country annually runs a high trade deficit financed by foreign aid and remittances from emigrants.

Droughts and floods associated with climate change will have a negative impact on food security in Cape Verde. Droughts will have an immediate and negative impact because of lower household yields. Yet, considering the changing demographics and increasing population in urban areas, it will be necessary to increase agricultural production and road networks and drainage systems will need to be improved if precipitation increases.

A long-term monitoring system for climate change should be developed using the existing technologies (satellites, surface observations and others) and investing/replacing infrastructure where needed for a close monitoring of natural and physical systems vulnerable to anthropogenic climate change, aiming at protecting populations.

Investments should be made in human resources to increase the numbers of scientists who will study, monitor and report climate change in the coming years. Relevant policymakers need to be informed and updated about the occurrence of regional climate change so that national policies can address the potential impacts and recommend solutions. In this context, there should be public outreach programs targeted to the general Cape Verde population so that they can understand the phenomena related to recent and future climatic change as well as its consequences in a context that allows for possible adaptation.

Capter V
ADAPTATION TO CLIMATE CHANGE

CHAPTER V – ADAPTATION TO CLIMATE CHANGE

5.1 Evaluation of Climate Change Adaptations

Adaptation relates to the group of initiatives and measures to reduce vulnerability of natural and human systems, given the current and expected Climate Change (CC) effects. The adaptation assessment is considered to be an assessment of system and private group ability to adapt to specific constraints.

Considering the timeline of the relatively recent manifestation of this issue, a real evaluation was not carried out under this document; it was decided to make an analysis of a set of measures implemented (torrential control works, soil and water conservation works, forestation, among others) to address adverse soil and climatic conditions.

Thus, over time, and very particularly in the post-independence period, given the adverse effects of climate variability, adaptation measures implemented by successive governments and populations were especially aimed at creating conditions to ensure the subsistence level in terms of water availability and food security, given the bad years of agricultural production, namely:

Soil and water conservation techniques

- Rain water collection – community and household reservoirs;
- Improvement of water supply through: boreholes, wells, galleries, captation dikes, water catchment infrastructure and desalination units;
- Increase of land preparation techniques for agroforestry systems and an extensive forestation program in arid and semi-arid areas, with the introduction of drought-resistant species;
- Implementation of drip irrigation systems;
- Construction of dams.

Adaptation techniques of agricultural production systems

- Introduction and production of new crops better adapted to our climate conditions;
- Crop diversification, in particular horticultural crops.

Adaptation techniques and measures to coastal erosion effects

- Ban on extraction of aggregates;
- Use of break water;
- Harmonization and integration of costal management activities;
- Law enforcement;
- Coastal area integrated management and protection project.

Although an extensive evaluation of the impact of all these measures has not been made, nevertheless its positive effects are visible, both from environmental and landscape changes and socio-economic point of view.

5.2 Strategies and Adaptation Measures

5.2.1 Background

To developadaptation strategies, it is necessary first to understand the direct and indirect interactions between different climate factors and the productive sectors of the society.

Thus, the approach used was the same as previously applied in the preparation of National Programme of Action for Adaptation to Climate Change (NAPA) completed in late 2007 with support from UNDP/GEF and involvement and participation of a broad range of national and international partners.

Therefore, the assessment focused on vulnerabilities and their impacts induced by a set of phenomena and extreme climatic and anthropogenic factors, including:

- ✓ Decreased rainfall and duration of the rainy season;
- ✓ Intense and prolonged droughts, changing micro-climates;
- ✓ Increased episodes of intense rainfall, increasing runoff and erosion;
- ✓ Increased frequency of tropical storms;
- ✓ Increased solar radiation and potential evapotranspiration (ETP);
- ✓ Frequent episodes of extreme temperature variations;
- ✓ Increased sea level;
- ✓ More aggressive waves and extreme high tides, with high waves;
- ✓ Strong intensity of ocean currents;
- ✓ Increased temperature and decreased humidity;
- ✓ Periods of heat and dust; occurrence and persistence of haze episodes;
- ✓ Uncontrolled extraction of aggregates in coastal areas, non compliance on the coastal area;
- ✓ Marine and coastal pollution;
- ✓ Construction of large scale tourism developments and other on the sea shore.

Studies on current and future CC adverse effects in Cape Verde pointed to rainfall variability and randomness as a distinguishing characteristic of the climate conditions in the country that cross-impact the main socio-economic development sectors.

Associated with the natural conditions, the continuous increase in population and consequent increase in water consumption, as well as strong demand for fast-growing economic sectors such as agropastoral, tourism, construction, industry, among others, cause a strong pressure on water resources which makes this vital resource a key factor in building the country's strategy and climate change adaptation measures.

5.2.2 Objectives of the Climate Change Adaptation Strategy

Overall, the National Climate Change Adaptation Strategy aims to Increase resilience of the country to climate variability and achieve the development goals set out in its Growth and Poverty Alleviation Strategy, by introducing measures that in the long term, aim at reducing the effects of GHG.

Therefore, sector intervention strategies should be guided by the following strategic objectives:

- Promote integrated water resources management to ensure water for: people, food production, ecosystems and tourism industry;
- Develop adaptability of agro-production and silvopasture systems to improve agricultural production and promote food security of populations;
- Protect coastal areas against environmental degradation caused by extreme weather events and human disturbance in order to ensure a balanced management of its resources.

5.2.3 Priority Strategic Axes

To achieve each of the strategic objectives indicated above, and in a perspective of global and integrated management of different aspects relating to the effects of climate change, the implementing process of the National Climate Change Adaptation Strategy should be based on the following four strategic intervention policy axes to address climate variability and climate change issues:

i. Stakeholders capacity building in adaptation to climate change and climate variability from a systemic, institutional and individual perspective;
ii. Investment, conservation and protection activities in the field;
iii. Research to improve population and ecosystem resilience;
iv. Stakeholders Information, Education and Mobilization on climate change and variability risks.

The figure on the next page is a schematic representation of the national climate change adaptation strategy and climate variability in Cape Verde.

i) Stakeholders capacity building in adaptation to climate change and climate variability from a systemic, institutional and individual perspective

Addressing the challenges caused by climate variability and change presupposes that the different actors in various socioeconomic sectors must develop new knowledge, attitudes and practices. And this is why capacity building was considered a strategic cross-cutting adaptation measure. Adaptation is viewed as knowledge, asset or favorable institutional framework acquisition process, which should enable stakeholders to develop new skills in order to undertake new responsibilities, attitudes and values, in light of climate change and variability.

But achieving such changes is more than adopting simple ad hoc measures. It demands a global strategic approach and gradual intervention in the short, medium and long term

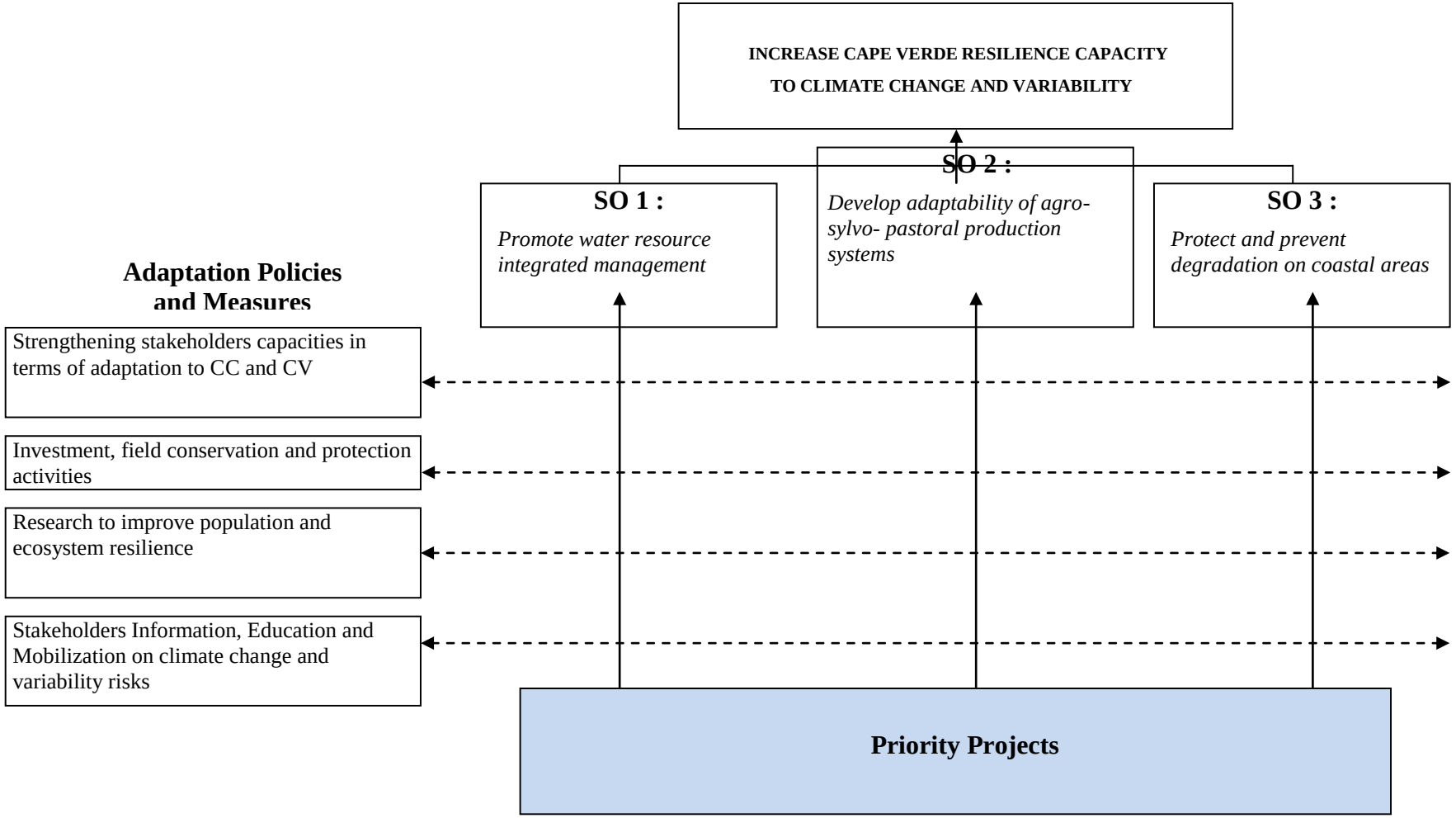


Figure 37. Scheme of the National Climate Change and Variability Strategy of Cape Verde

To implement this strategic priority, efforts should be largely based on the NCSA Project (National Capacity Self-Assessments), the first phase of which Cape Verde has completed. The needs in terms of UNFCCC implementation capacity building were addressed in detail under this project.

ii) Investment, conservation and protection activities in the field

This results-oriented strategy and its adaptation measures aim at real impacts. This is why investments in activities through conservation and resource protection measures will be prioritized.

By implementing this strategic priority, which will account for most of the cost of priority projects, Cape Verde reaffirms its policy choice in helping the populations in their continued adaptation efforts. This will consist of large-scale replication of the best local practices and taking the responsibility for major investments that local people are incapable to assume.

iii) Research to improve population and ecosystem resilience

Participatory research/actions should have practical applications to meet the needs of local communities, contributing to vulnerability reducing policies. Adaptation research/actions bring together representatives of affected local communities, policy makers and researchers under a common "learning by doing" process, as well as scientific and local knowledge on testing and validation of adaptation strategies. The links between researchers, policy makers and communities that are the focus of these activities help ensure that the research sponsored by the strategy implementation is rather based on the user demand than offers by research institutions.

iv) Information, Education and Stakeholders Mobilization on Climate Change and Variability Risks

Information, education and community mobilization activities complement each other. They are developed both from capacity building and research practices. The distribution and implementation of knowledge generated by capacity building and research activities will be strategic for program ownership and continuity.

With this cross-cutting strategic priority, the national strategy will support the development of teaching materials (illustrated and in the national language) targeted to local populations (including risk groups), political authorities (including local), and researchers. It will also support communication and networking activities nationally and regionally. This will be primarily by promoting knowledge sharing and supporting Cape Verde's effective participation in the process. Thus, efforts will be made to assist national stakeholders to better organize themselves to produce "responses" to climate change and build common positions on specific issues related to the strategic management of climate change and its impacts in Cape Verde.

Also note that the National CC Adaptation Strategy, as provided for in the NAPA, is based on a group of guiding principles, which are closely linked to the Growth Vision and Fight against Poverty in Cape Verde:

Program approach, which is geared by the Strategy for Growth and Poverty Alleviation, as well as sectoral programs for water resource integrated management and agricultural development. Its covers the 2008-2015 period.

Inclusive approach favors the poor and local management, in order to face the needs of the most vulnerable populations who frequently depend on natural resources. This approach is based on

decentralization;

Approach by additional costs, developing priority projects based on the achievements of the intervention sector, as well as those made by ongoing programs and projects. This approach avoids duplication and has the advantage of ensuring the necessary synergies and mobilizing substantial co-funding;

Subsidiarity, as a basis for establishing a partnership. This is to involve all stakeholders (government, NGOs, local communities, FTP, and others), based on their comparative advantages;

Achieving results on the ground, basing on a group of performance and impact indicators, as well as a result-oriented monitoring and evaluation plan.

5.2.4 Global adaptation measures by sectors

5.2.4.1 Initial remarks

Following the vulnerability assessment related to the behavior of different parameters and their impacts under climate change, through vulnerability and sectoral adaptation studies developed and shared and discussed with partners in several meetings, a set of adaptation measures were proposed for all the sectors assessed - Water Resources, agro-sylvo-pasture, Coastal Areas/ Tourism, Biodiversity, Fisheries, Energy/Industry and Health. Their main features are highlighted below.

5.2.4.2 Water resources

In Cape Verde, due to irregular, intense and poorly distributed rainfall, coupled with a poor infiltration, water resources are a limiting factor for the country's socio-economic development. The increase in population, urban development and increased irrigation needs, tourism and industry, coupled with the recent drought years have brought shortages, which tend to worsen over the time.

5.2.4.3 Agro-sylvo-pastoral Sector

The agricultural sector is extremely vulnerable, given the scarcity of natural resources (water and soil), couple with the inappropriateness of the operating system and climate and geological conditions. Rainfall variability (insufficient and/or poorly distributed in space and time) together with the high ETP rates, cultivable area and water and soil availability are key factors for good agricultural yield. Water balances have reduced both the production capacity of rainfed lands and yields and outputs. The load capacity of forestry and grazing areas, and livestock has also been affected.

5.2.4.4 Tourism/Coastal Area

The coastal area is very sensitive to changes in climate, particularly sea level rise. Thus, Cape Verde, as a small island country, is under direct threat of natural phenomena related to this sea level rise. Similar to volcanic islands, the archipelago has a relatively small appropriate space for human habitat and economic activities, therefore many buildings are concentrated on coastal areas.

5.2.4.5 Biodiversity

The vulnerability of marine species in Cape Verde, especially on coastal areas has increased, despite the existing legal measures to minimize the pressure on them and their habitats. Notwithstanding such measures, the marine environment has experienced changes as a result of overharvesting of commercial species, extraction of aggregates and sediment deposition on coastal areas as a result of activities in the inner parts of the islands.

5.2.4.6 Fisheries

Cape Verde does not possess a significant biomass of fish stocks, as in neighboring African coast regions. The EEZ covering 734,000 km^2, which by its volcanic and mountainous nature determines a continental shelf up to 200m, is reduced to approximately 5.394 km^2 and possesses a potential not exceeding 44,000 ton/year.

5.2.4.7 Energy/ Industry

The trend toward expansion, accelerated economic growth and growing demand for tourism environment are factors that have increased energy consumption in the country, creating strategic planning and infrastructure challenges. Thus, the need to promote efficiency in the energy sector, behavioral change for resource use and increased penetration of alternative energy sources selected as strategies for building an energy-independent future.

Regarding industry, there are no contracts in the country related to waste disposal, consequently contamination of land adjacent to these spaces, with a relevant bearing on both human health and environment. This issue mainly relates to the use of old or obsolete technologies. Moreover, in the construction sector, extraction of aggregates has been high, constituting a major environmental problem to address.

5.2.4.8 Health

Currently, the country is in an epidemiological transition, and there is a progressive increase in non-transmissible diseases (hypertension, stroke, diabetes, cancer, etc...) compounded with infectious diseases. Globally, the most used indicators assess climate change impacts relate to vector-borne diseases (malaria and dengue) and water-borne diseases or those related to poor hygiene, exaggerated exposure to environmental factors and malnutrition. For Cape Verde, as indicators were considered the reappearance of yellow fever, dengue, malaria, diarrheal diseases and some viral infections, while also considering the possibility of accidents and injuries in cases of heavy rain and flooding.

5.3 Summary of the main impacts and proposed adaptation measures to CC

The tables in ANNEX III provide a summary of the main impacts related to a set of natural and anthropogenic phenomena that can produce climate change, as well as proposed options for adaptation. The tables also show some difficulties/barriers the respective sectors face in implementing such options.

5.4 Priority selection and scoring according to NAPA methodology

Based on data provided in tables attached, a multisector team has defined as priority sectors Water Resources, Agro-sylvo-pasture, Tourism/Coastal Areas, Biodiversity, Fisheries and Energy.

Also, a set of priority cross cutting measures were identified which should be included in different priority projects, namely:

i Strengthening technical, material and institutional capacity;

ii Promoting increased information dissemination on CC;

iii Raising awareness of the society on the need for balanced and sustainable management of natural resources;

iv Promoting/strengthening environment community friendly organizations.

For the measures selected, according to NAPA guidelines, the multisector team has identified potential scoring criteria based on the general criteria proposed by the LEG (LDC Expert Group), further complemented with specific analysis under other national and sectoral strategies and development plans - Main Strategic Options, DECRP (Strategy and Poverty Alleviation Paper), the Millennium Development Goals (MDGs) and also PANA II (National Action Plan for the Environment 2004-2014) sectoral plans and Strategic Plan for Agricultural Development by 2015. Finally the team used the following selection criteria:

- Contribution to the settlement of immediate and urgent problems related to CC adaptation;
- Capacity to contribute to poverty alleviation;
- Largest number of beneficiaries;
- Synergies between the different environmental policy tools;
- Cost/benefit.

Then the team selected the analysis techniques, among the 3 (three) main techniques: Cost-Benefit Analysis (CBA), Cost-Effectiveness (CEA) and Multicriteria Analysis (MCA). Given the inherent difficulties in obtaining basic data for applying the first two, the third criterion has been selected.

5.5 Adaptation priority needs

After completion of the multi-criteria analysis options were obtained for adaptation measures in priority sectors as indicated in the tables below (35 and 36) and tables of priorization sector on the annex IV:

1st Position	Build mobilization, supply and storage infrastructure and for groundwater recharge
2nd Position	Promote action to combat desertification and for watershed protection, through forestation and other techniques
3rd Position	Diversify income-generating activities in rural areas
4th Position	Modernize and expand drip irrigation technology
5th Position	Improve and monitor water quality
6th Position	Promote environmentally sustainable production techniques
7th Position	Implement micro-credit for small farmers as an incentive
8th Position	Develop semi –intensive livestock
9th Position	Use closed pipes in water supply channels
10th Position	Intensify and diversify production of fruit and vegetables
11th Position	Use cultivars and species adapted to climate conditions
12th Position	Support the implementation of prevention measures, protection and supervision on the occurrence of forest fires and crimes
13th position	Promote applied research of technological packages to address the negative impacts of climate change

Table 35. Scoring of Agro-sylvo-pastoral and Water Resources sectors

1st Position	Diversify activities and measures to change behavior of populations living of coastal resources;
2nd Position	Support diversification of alternate activities to artisanal fishing (training, equipments, micro-credit,…);
3rd Position	Continue implementing activities for preservation and management of protected areas;
4th Position	Rehabilitate and/ or build infrastructure to protect coastal areas ;
5th Position	Modernize equipment and artisanal fisheries;
6th Position	Support initiatives related to the use of renewable energies (solar and wind), particularly in rural communities;
7th Position	Modernize stations network for climate and maritime monitoring;
8th Position	Encourage production and fixation of endemic plants;
9th Position	Preserve and sustainably use medicinal species;
10th Position	Promote research on endangered and vulnerable species to CC;

Table 36. Scoring of Tourism/Coastal Areas, Biodiversity, Fisheries and Energy

Out of the options/measures identified above the following were selected as priority and consequently used as indicators in the preparation of priority projects under NAPA:

- Diversify activities and measures to change behavior of populations living of coastal resources;
- Promote actions to protect watersheds to improve and ensure food security;
- Promote and diversify income generating activities in rural areas;
- Modernize and expand drip irrigation technology;
- Promote environmentally sustainable production techniques;
- Use cultivars and species adapted to climate conditions;
- Diversify activities and measures to change behavior of populations living of coastal resources;
- Support diversification of alternate activities to artisanal fishing (training, equipments, micro-credit,…);
- Continue implementing activities for preservation and management of protected areas;
- Rehabilitate and/ or build infrastructure to protect coastal areas
- Modernize equipment and artisanal fisheries
- Support initiatives related to the use of renewable energies (solar and wind), particularly in rural communities;
- Modernize stations network for climate and maritime monitoring;
- Encourage production and fixation of endemic plants;
- Preserve and sustainably use medicinal species;
- Promote research on endangered and vulnerable species to CC.

5.6 Recommendations for initiatives and policies of Science, Technology and Innovation (ST&I)

The identification and prioritization of the measures previously presented are options for global measures for all priority sectors. Afterward, a detailed analysis was conducted of some of these measures specifically for agriculture, water resources and coastal areas, from a science, technology and innovation (ST&I) perspective, and considering aspects such as vulnerability, impacts and adaptation.

As a result matrices providing a set of recommendations were developed to serve as the basis for the development of initiatives and policies with regard to vulnerability, impacts and adaptation, and from a ST&I perspective. Here is presented only a summary for a component adaptation and for the three sectors mentioned above (see Annex V).

5.7 Needs for technology transfer in adaptation related issues

Similar to the methodology used to identify adaptation measures, a survey of needs regarding technology transfer for adaptation was conducted with the participation of various partners and stakeholders. This survey covered areas such as agriculture, water supply, coastal area and energy. Please note that in some areas Cape Verde has the technology and can also "export" to other countries (see ANNEX VI).

5.8 Awareness program of stakeholders on climate change impacts

Regarding Promotion and Strengthening of Stakeholders Training, Information and Awareness the following deficiencies were identified:

- Insufficient information on Climate Change Convention, Kyoto protocol and all issues related to climate change;
- Insufficient awareness and training of an important portion of the population on the effects and negative impacts of CC on the most vulnerable sectors;
- Lack of awareness of farmers /fishermen due to their low education level;
- Poor dissemination of information by the media and relevant institutions on ”Climate Change” issues;
- Lack of information /training in school curricula.

Therefore the following objectives are set:

1. Promotion of awareness activities on the negative CC effects and impacts on the most vulnerable sectors
2. Increased education level of farmers/fishermen through adult education and take advantage to disseminate information on CC;
3. Development of training/information campaigns related to CC related issues;
4. Disseminate information on the existing national law, international protocols and conventions related to CC;
5. Introduce information on CC related issues in school curricula.

To reach these objectives a group of activities should be implemented, including:

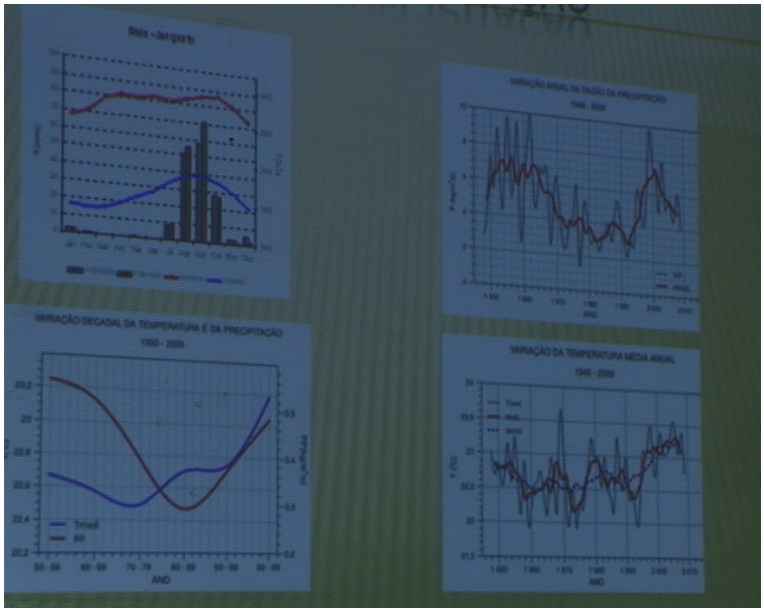
- Development of documents on CC related issues, as well as thematic brochures, documentary films, radio programs, among others.
- Training and/or retraining of staff at central and municipal levels, as well as NGOs and Community Associations;
- Information and awareness campaigns targeted to a wide range of stakeholders: policy makers, deputies, locally elected officials, technical staff, and students from different levels

of education (Primary, secondary and college), private operators, NGOs, community associations and general population.

- Holding of conferences and brainstorming on CC related issues attended by distinguished specialists;

5.9 Proposed priority projects

The proposed priority projects listed in ANNEX VII and to be implemented in the short and medium term should take into account the strategic objectives set out in the National Strategy on Climate Change and should respond to the needs for technology transfer for adaptation and mitigation, particularly for priority and vulnerable sectors in need of urgent action to tackle the adverse impacts of climate change. They should also allow implementing the recommendations for the already identified policy and initiatives of Science, Technology and Innovation.



Chapter VI

STATE ORGANIZATION IN CLIMATE

CHAPTER VI - STATE ORGANIZATION IN CLIMATE CHANGE RELATED ISSUES

Climate change worldwide, particularly in developing countries and island states such as Cape Verde, called the government´s attention to this issue, creating essential conditions for the country to enter a new phase of environmental policy implementation to face climate change.

Indeed, the Second National Environment Programme of Action (PANA II) for the 2004-2014 period was designed and is being successfully implemented in partnership with public and private sectors, NGOs, national and international research organizations aiming to provide an overall strategic guidance for a balanced use of natural resources and sustainable management of economic activities.

Resources were mobilized through budgetary support to implement PANA II and protocols were signed for Municipal Environmental Plans. Similarly, sectoral programs and projects are being implemented in the sectors such as education, health, land use, water resources, biodiversity, fisheries, agriculture, energy, industry, etc.

Environmental education is being addressed in a comprehensive manner, as a cross mechanism to support implementation of all programs and to change behavior and consumption patterns.

Significant progress is highlighted in the institutional and legal domains through the structuring of the coordination and management system, development of an environmental information system as well as strengthening of the regulatory process for environmental legislation.

Special attention will be assigned to institutional capacity strengthening in the environment sector, aiming at consolidating organizational structures to meet the challenges and ensure the implementation of PANA II and international conventions and protocols. In addition efforts will be made to consolidate national environmental information systems and monitor environmental quality, train staff in environment issues, environmental inspection and impact assessment.

Full implementation of UN environment conventions, particularly those related to biological diversity and fight against desertification, drought and climate change effects should deserve special attention from the Government.

Cape Verde was the first country in the group of African Portuguese Speaking countries to ratify the Framework Convention on Climate Change, dated of March 1995 and which entered into force on June 22, 1995, as a non-Annex I party. It is also the first PALOP country to create the Designated National Authority and to have a Clean Development Mechanism (CDM) certified by the Executive Secretary of UNFCCC CDM.

By Resolution No. 16/2009 of June 2, the Interministerial Committee on Climate Change was established, serving also as the Designated National Authority to coordinate government actions under the UN Framework Convention on Climate Change and Kyoto Protocol as well as its subsidiary instruments.

The Interministerial Committee for Climate Change is made of the following institutions:

- Directorate General for Environment, under the Ministry of Environment, Rural Development and Marine Resources;
- Directorate General for Planning and Management the Ministry of Environment, Rural Development and Marine Resources;
- National Institute of Meteorology and Geophysics;
- Directorate General for Industry and Energy under the Ministry of Economy, Growth and Competitiveness;
- Directorate General for Infrastructure, Transport and Telecommunication;
- Directorate General for Road Transport under the Ministry of Home Administration;
- Directorate General for International Relations under the Ministry of Foreign Affairs, Cooperation and Communities.

In addition, the Ministers of Environment and Economy are the President and Vice-President of the Committee, respectively. The alternate members are appointed by the respective.

The Directorate General for Environment is the Executive Secretary of the Committee and providing it technical and administrative.

The Interministerial Committee for Climate Change may request for collaboration from public or private bodies and entities representing the civil society to fulfill its mandate.

Therefore, the Interministerial Committee for Climate Change has the following responsibilities:

- Give opinion as necessary on proposed sector policies, legal tools and rules having relevant component for the development of adaptation and mitigation measures to climate change and its impacts;
- Give inputs to Government positions under the Framework Convention on Climate Change and Kyoto Protocol, and all subsidiary tools to which Cape Verde is a party;
- Define eligibility criteria besides those designated by the Kyoto Protocol bodies responsible for CDM according to the national sustainable development strategies;
- Assess opinions on project activities resulting in reduced emissions and considered eligible for the CDM and approve them as necessary;
- Coordinate with civil society entities to promote public and private activities to fulfill commitments made by the Government of Cape Verde under the Climate Convention, Kyoto Protocol and subsidiary tools.

6.1 Actions completed or planned to implement the Convention and Kyoto Protocol

Cape Verde ratified the UN Framework Convention on Climate Change (UNFCCC) on March 29, 1995 and it came into force on June 22 of that year. As a Contracting Party to the Convention, Cape Verde has then committed to formulate a National Communication to the Conference of Parties (COP). In 2000, it submitted its Initial National Communication (INC) and its National Strategy and Action Plan on Climate Change. To develop these tools, several studies prepared by the different sectors relating to greenhouse gas (GHGs) inventories, vulnerability assessment, adaptation and

mitigation measures were taken into account. On December 5, 2005 Cape Verde ratified the Kyoto Protocol.

By Resolution nº 3/2000 of January 31 the Government approved the national Strategy and Action Plan on Biodiversity and the National Sanitation Policy with Resolution nº 29/2003 of December 29. In 2004 it established the National Strategy on Food Security and its five-year program.

Other resolutions: No. 3/2005 of February 21, approving the Fishery Resources Management Plan, No. 14/2005 of April 25, approving the Second Program of Action for the Environment, PANA, 2004-2014 as a national policy instrument in the field of Environment, Resolution 16/2005 of 9 May, approving the Strategic Plan for Agricultural Development by 2015 and the 2005-2008 Action Plan.

In 2005, the Government of Cape Verde has received through the UNDP/GEF a funding to develop its National Programme of Action for Adaptation to Climate Change (NAPA), aiming at establishing priority adaptation options based on immediate and urgent needs and concerns of the most vulnerable populations to the adverse effects of climate variability and change.

Under the implementation of commitments made at the Rio Convention (CBD/CCD/CCC), in 2007 the Government of Cape Verde, with GEF and SNU support, produced the NCSA project, National Capacity Self-Assessment for Global environmental Management in order to assess national capacities in managing global environment, and strengthen individual, institutional and system capacities aiming at improved environmental management in the context of poverty alleviation and sustainable development.

6.2 Programs and Actions related to Sustainable Development

Some of the programs and activities for sustainable development in Cape Verde are related to renewable energy and conservation and/or energy efficiency. These programs will contribute to Cape Verde's cleaner energy matrix (25% penetration rate) by 2012, thus contributing to stabilizing concentrations of greenhouse gases in the atmosphere and developing long term sustainable development:

Cabeólica Project (wind power):

Island	Installed Power (MW)	Annual Energy Production	Penetration Percentage (%)
Santiago	10	30.1 – 40.3	17
São Vicente	6	25.1 – 31.5	36
Sal	8	28.2 – 36.3	33
Boa Vista	4	14.8 – 17.3	46
Cape Verde	28	98.2 – 125.4	25

Photovoltaic Plant Project:

Photovoltaic Plant in Santiago

- Installed power-5MW; Energy produced: 8.128 MWh.
- Cost: 2.063.168.415,00 ECV.
- Starting operating date: 2010
- Annual fuel savings: approx. 1,8 thousand tones = 136 million ECV/year.

Photovoltaic Plant in Sal

- Installed power -2,5MW; Energy produced: 4.064 MWh.
- Cost: 1.029.537.413,00 ECV.
- Starting operating date: 2010

6.3 Energy saving programs

The country´s strategic plan for the next 10 years includes a series of actions:

- Achieving a renewable energy penetration rate of 25% by 2011, 50% by 2020 and having at least one of the islands 100% renewable (Brava);
- Promoting energy conservation and efficiency in the energy sector;
- Increasing electrical energy production capacity by establishing single plants, increasing production and distribution efficiency, increasing the response capacity to energy needs;
- Ensuring a electrical energy coverage rate of 95% by 2011 and 100% by 2015 and ensuring increased energy quality and reliability;
- Strengthening institutional and legal capacity.

The Government of Cape Verde has recently established an Energy Security Fund, aiming at promoting research and adoption of new energy technologies in the country. It has also approved a statute including legal and tax incentives for the implementation of micro projects in buildings, private houses and hotels. Initially, in partnership with the country´s municipalities, some public buildings will be covered by a micro program that intends to provide these buildings with a 120 KW renewable capacity to be distributed by them. The Government has also implemented a joint logistics company, with the aim of ensuring security in energy supply and updating the distribution network and the fuel subsector effectiveness, as well as controlling fraud and theft of electricity.

6.4 Mitigation Actions and Programs to Climate Change

With the rapid development on some islands (Santiago, Sal, Boavista, these last two due to tourism), demand for energy and water has increased faster than Electra's production capacity.

The different ongoing programs seek to increase and replace fossil fuels having high carbon content per unit of energy produced with lower or near zero carbon content sources. These forms of energy aim to help the country mitigate the effects of climate change and assist Cape Verde in reaching the final objective of the UN Framework Convention on Climate Change.

This is the case of four wind farms on the islands in Santiago, Boavista, S. Vicente and Sal, a public-private project including the Government of Cape Verde, Electra and the English company Infraco.

With a total installed capacity of 28 MW, wind energy accounts for 25% of power generation in 2012 and will make Cape Verde the leading country in the region as regards wind power generation. By implementing this project (to be completed in 2012) Cape Verde will reduce fossil fuel imports by approximately 20 thousand tons per year, accounting for approximately 30% of imported fuel and saving € 13,000,000 per year. Regarding greenhouse gas emissions a decrease in at least 50,000 tons of carbon equivalent shall be achieved.

It will also be installed on the islands of Sal and Santiago photovoltaic systems for energy generation. On Sal phase 2.5 MW will be installed in the first phase and 2.5 MW in the second phase.

For the island of Santiago (5 MW) the two plants will ultimately achieve a 4% penetration rate of the energy generated, the highest rate in the world.

With the implementation of this project (September 2010) the country will experience a drop in CO_2 emissions of 15,000 tones. The project cost is 27 million Euros and is a Portuguese-funded credit line.

For street lighting 36 microgenerators are being installed on the islands of Sal, Santiago, S. Antao and Fogo to produce power through solar panels. Also in partnership with the municipalities, solar panels will be installed in several buildings which will account for 25% of the energy consumed.

Through the Directorate General of Industry and Energy, studies are being developed to perceive wave geothermal and energy potential in Cape Verde.
The project consists in establishing artificial lakes for power generation and will start in 2011, covering S. Santiago and Vicente.

The project for photovoltaic energy production in S. Vicente, accounting for 3 MW of public network power, will be implemented in 2012.

Other private sector projects are being implemented namely: Production of energy via a mini water plant on the island of Santo Antao and ELECTRIC to Porto Novo also in Santo Antão, accounting for 1 MW of wind energy.

A pilot project for rural lighting in the Ribeira dos Bodes and Ribeira Fria in Porto Novo, Santo Antao Island was developed by the Association for Environment Defense and Development (SAD). The project will install two sets of 5 kW of photovoltaic panels and two wind generators of 10 KW. The total power is 30 KW with 267 tons per year of C02 emission decrease. The estimated project cost is € 198.070.70.

Private project (company SENAG)

Sustainable Power and Water concept for the Island of Maio
Integrated system for energy and water production. Final objective – provide Maio island with 100% of renewable energies.

First phase: Stand-alone System and Wind-Diesel-Desalination with 10 MW capacity and 4000 m3/day. The penetration rate at this stage is 45% of wind power and a decrease of 11.000 tones/year in C02 emissions.

Second phase- make Maio 100% renewable by converting Diesel in bio-diesel decrease of 24.000 tones/year in C02 emissions.
Estimated cost: 46 million Euros

Project Mudeira ELA (Energy-Waste- Water)

Installations: Incinerator of 6000 tones/year
Wind farm: 1 MW
Desalinator: 1200 m3/day
Energy produced = 3000 MWh/year
Drop in CO_2 emission= 14000 ton CO_2/year
Project estimated cost: 5 million Euros

In preparation:
Project ELA Santiago (Energy-Waste-Water)
Installation: Incinerator 20000 tones/year
Wind farm:: 10 MW
Water production– 3000 m3/day
Drop in CO_2 emission = 40000 tones CO_2/year.
Project estimated cost: 25 million Euros

Project APP- Aguas Ponta Preta for the fishing villages in Tarrafal and Monte Trigo in S. Antão from renewable sources.

PV power- 40 KVA
Microwater power 75 KVA
Investment 160.000.000 ECV (75% EU)
Starting date- March, 2008

Project Águas e Energia da Boavista, joint company (Electra 10%, SDTIBM, 10%, BUCAN Group 48% and CASSA Group 32%) from renewable sources

Installed capacity- 2.000 m3/day
Electrical plant -5 MW

Project on Sal island, introduction of bio-fuel from residues produced by the tourism sector.

- Cooking oils
- Energy agriculture with regenerated waste water (jatropha, sunflower and sugarcane)

6.5 Programs and measures on impacts and vulnerability to Climate Change and adaptation measures in Cape Verde

In 2005, the Government of Cape Verde has received a funding from UNDP/GEF to develop its National Adaptation Programme of Action (NAPA) for Climate Change, to identify priority adaptation options based on urgent and immediate needs and concerns of the most vulnerable populations to the adverse effects of climate variability and change.

Studies on the adverse current and timely Climate Change effects in Cape Verde pointed to rainfall variability and randomness as a distinguishing characteristic of the climatic conditions in the country that in a cross-cutting manner impacts all socio-economic development sectors. Poor spatial-temporal rainfall distribution, associated with frequent occurrences of haze and natural and environmental constraints require "soft" intervention actions based on of priority adaptation measures to mitigate the direct impacts of biophysical phenomena.

Therefore, under climate change variability and impacts, NAPA Cape Verde has identified three priority sectors (Water Resources, Agro-syilvo-pastoral, Coastal Areas/ Tourism) which should take into account the four main intervention measures:

1) Strengthening of capacities;
2) Investment, conservation and protection activities in the field;
3) Research to improve population and ecosystem resilience;
4) Stakeholders Information, Education and Mobilization on climate change and variability risks.

To implement Cape Verde NAPA the expected contribution from GEF is $ 3,410,000. However, it is necessary to mobilize other financial resources in order to enable the country to start the adaptation process in accordance with the selected intervention priorities.

6.6 Promotion of scientific research and systematic observations for monitoring Climate Change

Research activities in Cape Verde until recently were concentrated in some public institutions. However since the establishment of the University of Cape Verde, this task was also included in the set of duties of universities.

6.6.1 Cape Verde Atmospheric Observatory

In 2006-2007 the Institute of Meteorology and Geophysics of Cape Verde, in partnership with the University of York, Heslington, Uk, Max-Planck-Institut für Biogeochemie, Jena, Germany, the Leibniz-Institut für Troposphärenforschung, Leipzig, Germany, has developed the Project for the Atmospheric Observatory located in S. Vicente, Cape Verde, called regional station, and in 2008 it became Global Station of the GAW (Global Atmospheric Watch). The program is supported by the World Meteorological Organization.

This station is designed to undertake long-term ground and ocean-based observations in the tropical Eastern North Atlantic Ocean region.

It monitors O_3, CO, NO, NO_2, NO_y and VOCs. It also collects samples of dust for aerosol physical and chemical characterisation (PM10, PM2,5, PM1). In addition, observations the following greenhouse gases CH4, CO_2, N2O, CO, SF6, O2, N2.

6.6.2 ECOWAS Center for Renewable Energy and Energy Efficiency ()

This center will contribute towards increasing access to modern energy services and improved energy security in ECOWAS Member States, thereby supporting the region's economic and social development in an environmentally benign but sustainable manner in renewable energies in Cape Verde and its member countries. It is the first ECOWAS institution to be installed in Cape Verde.

6.6.3 SICLIMAD Project Climate Information System for Development Support in Cape Verde

The project aimed to create a climate information system to efficiently address climate change and variability related issues in Cape Verde, including scenarios, impacts and adaptation measures. It is thus a support system for economic policy makers in the struggle for sustainable development and poverty alleviation. It also intended to contribute to better understanding of the climate system, its interaction mechanisms, how they are reflected on the local climate and the expected impacts on the various ecosystems, quality of life, economy and natural resources.The Project aimed also to implement in Cape Verde a regional Weather and Sea State Forecast, based on the Regional Atmospheric Modeling System (developed in the Colorado University by Cotton et al., 1989, and on the Simulating Waves Nearshore model adjusted for the ocean region where Cape Verde is located.

6.6.4 Seasonal Forecast

Rainfall seasonal forecasts for the West African subregion is prepared each year in the African Centre of Meteorological Application for Development (ACMAD) with the participation of Cape Verde experts for the period from July to September, after the results of the PRESAO consensus meeting. The forecast is based primarily on the characteristics of the atmosphere, the anomalies of

sea surface temperature (SST), the probability estimates of rainfall of Global Centers models (ECMWF and IRI) and regional and local statistics.

6.6.5 Long term forecasting of the Archipelago of Cape Verde using the "downscaling" technique of ETA model

The study presents simulation results of the main climatic parameters for the 2010- 2012 period over Cape Verde region using the dynamic downscaling technique, which consists of using Numerical Weather Prediction (SRM), linked to the Atmospheric General Circulation Model. In numerical simulations ETA model was used. It was developed by the NCEP linked to MCG ECHAM4,5 model developed by the Max Planck Institute.

6.6.4 Project- Air quality and its relationship with climate change in Cape Verde

This project aims at characterizing the air quality in Cape Verde and creating conditions to investigate the cause-effect relationship between pollutants, as well as between greenhouse gas emissions and climate change.

Based on High Resolution meteorological model and on multivariate statistical models, a system of weather forecasting, dispersion and transport of air pollutants and impacts on quality of life and environment is to be established. A second component relates to collecting data and information to support decision makers in defining appropriate strategies under the UNFCCC and the PQ.

6.6.5 Project "Mitigation and impact assessment of volcanic hazards on land and human activities" MIA-VITA

It started in 2008 and has a four year term. It aims at monitoring and developing low cost integrated tools and methodologies to mitigate volcanic hazards through:

1. Hazard assessment by integrating the hazard map in the GIS (that will be developed for the purpose);
2. Mainstreaming low cost monitoring strategies (equipment and techniques);
3. Vulnerability assessment based on geological and human activity charts;
4. Assessment of socio-economic impacts of volcanic eruptions (agricultural production, infrastructure, etc);
5. Data transmission strategies and communication with the affected population during crisis situations;
6. Crisis management (coordination with Civil Protection services).

6.7 Education, training and public awareness building

Despite the issues related to climate change are complex, sometimes hard to understand by many, and limited amount of material available in Portuguese, efforts have been made to expand information to all layers of the population through lectures, workshops, publications and textbooks, radio TV campaigns, education and training of national technical staff.

Several other environmental education programs implemented in Cape Verde are in line with the objectives of the Framework Convention on Climate Change. In particular, we highlight the National Environmental Education Program.

The Environmental Education sector has set as underlying principle "an informed and committed population to the environment and sustainable development." To achieve this objective, it is necessary to create a cross-sector education system flexible enough to incorporate innovations and teaching techniques appropriate to environmental awareness. In addition, the establishment of an inter-sectoral dialogue as a useful tool in setting priorities and planning projects and environmental education and awareness activities is also required.

Environmental Education in Cape Verde has been restricted to short-term projects and to specific activities, both in formal and in non-formal education system. Thus, under PAIS - Education and Environment, action plans are recommended for different levels of formal and informal education system which will be implemented over a 10 year period, as the required institutional conditions are created for implementation.

6.8 National Capacity Self-Assessment for Global Environment Management Thematic profile in Climate change area

In the implementation of commitments made under the Convention, with support from the Global Environment Facility (GEF) and the SNU, the government of Cape Verde initiated the project to assess national capacities in the field of global environment management and strengthen their individual, institutional and systemic capacities in order to deliver better environmental management under poverty alleviation and sustainable development. In this context, the capacity self-assessment for global environment management project (NCSA), through this report, will enable the formulation of a strategy and an action plan aimed at strengthening capacities for compliance with international conventions, particularly those relating to climate change, biodiversity and desertification.

Linking Global Environment Management and Sustainable Development is essential for a country like Cape Verde. The "scenarios" of human and economic development, taking into account the vulnerability and environmental context of a small island developing state (SIDS), must be evaluated and implemented using a strategic, integrated, synergistic and long-term vision.

It is necessary to overcome policies and transform them into practical and real actions, especially in capacity building activities in environmental management. The NCSA-GEM arises in this context to develop national capacities at the individual, institutional and systemic levels in priority areas established by the Rio Conventions, and thus support the implementation of PANA II as a national tool for environmental management.

The United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Unit (UNEP) seek to jointly implement the of Resource Efficient and Cleaner Production Programme (RECP) in Cape Verde as part of its global program, already running in over 47 developing and transition countries. In these countries, the capacities are being built and/or enhanced to stimulate the development and implementation of RECP methods, practices, technologies and policies, through activities such as information dissemination, vocational training,

evaluation of facilities and demonstration projects, advice and support to environmentally sound technology transfer. The RECP applies concepts of preventive environmental management and process methods, products and services and thus achieve an optimal use of natural resources (energy, materials and water), the minimization of waste and emissions (air, water and soil) as well as healthy and safe workplaces and communities.

The first RECP activity in Cape Verde was a vocational training program in Cleaner Production, delivered in Praia for approximately two dozens of industry participants and consultants in the region of Sotavento. The training, organized with the Chamber of Commerce of Sotavento support was delivered by a Brazilian specialist from the SENAI Center for Cleaner Production. This training workshop was preceded by a public awareness building workshop.

6.8.1 National and regional capacity building

Cape Verde has special needs relating to institutional structures to deal with to climate change related issues.

Various training and capacity building courses have been conducted, with the Ministry of Science and Technology of Brazil, in Clean Development Mechanism, Technology Transfer, Vulnerability, Mitigation and Adaptation to Climate Change, including the Preparatory Meeting to the Conference of Parties.

Some training initiatives and capacity building under climate change were conducted in partnerships with international institutions, namely:

6.8.2 CPLP Climate Change organization Network (RELAC)

International cooperation is vital in addressing climate change and its adverse effects. The Community of Portuguese Speaking Countries is a dialogue platform for countries with clearly established affinities that should be explored to address Climate Change.

In this context, a Climate Change organization Network of Portuguese Speaking Countries (CPLP). This network intends to be helpful in linking CPLP countries, exchanging views and experiences and developing joint proposals to facilitate and promote the fight against climate change under the UN Framework Convention Climate Change and Kyoto Protocol.

6.8.3 CIICLAA – International Climate Research and Applications Center for CPLP Countries and Africa

Its mission is to foster, encourage and stimulate basic and applied research related to global change in those countries, particularly with regard to climate change, its impacts and risks, ensuring the transfer of knowledge and technologies, advanced training and local capacity building as foundations of free and independent societies.

A fundamental research component is the application of weather and climate information to support sustainable development in aspects relating weather and climate with life quality and economic

profitability. Thus, priority will be given to projects contributing to health and human lives preservation, to improve profitability of some productive activities and in particular those contributing to support economic sustainability and more vulnerable to extreme weather events and climate variability and change. This Centre has its main hub in Cape Verde.

6.8.4 Inclusion of climate change in social, economic and environmental policies.

The different plans and programs developed by the Government of Cape Verde aim mainly to integrate climate change related issues in social and economic policies and sustainable development.

In 1994 the first National Action Plan for the Environment was prepared for the 1995-2004 period. Although not formally approved or widely publicized, PANA I has stimulated some awareness on environmental concerns. Subsequently, several national plans were developed.

In 1999 the then Executive Secretary for the Environment produced the National Strategy and Action Plan on Biological Diversity which aimed to raise the society awareness on the role and challenges related to biodiversity, its responsibilities toward future generations and to make it determined to sustainably use natural resources.

In late 2001, efforts started to develop the Second National Environment Programme of Action (PANAII), a document which served as the guiding framework for interventions in the environmental sector for the 2004-2014 period. PANA II was intended to provide general strategic direction to guide a balanced use of natural resources and sustainable management of economic activities. In addition, PANA II was accepted and embraced by all Public Services, recognized and shared by the entire Capeverdean population, including the private sector. PANA II embodies the development guidelines established by the Sustainable Development Summit held in Johannesburg in September 2002.

In 2004 the White Paper on the Environment was developed. It is an requirement of the Environment Act establishing that every 3 years in a White Paper on the State of the Environment in Cape Verde should be prepared. This document summarizes the status of management of natural resources and environment in Cape Verde and assesses how stakeholders (public, private, NGOs, civil society) have been using natural resources in their interaction with the environment.

The national Action Plan on Climate Change Adaptation was prepared in 2007. This document aimed to identify priority adaptation options according to the urgent needs and concerns of the most vulnerable populations under climate change and variability.

Other key plans were developed such as the Biodiversity Action Plan, the National Strategy for Food Safety, the Strategic Plan for Agricultural Development (2015), management plans for natural parks of Sierra Malagueta on the island of Santiago, Monte Gordo, S. Nicolau in 2008, and Fogo, in 2009. Plans for managing parks as a management tool for protected natural areas, seek to fight desertification, preserve biodiversity and mitigate the effects of climate change in an integrated and synergistic manner, in addition to creating the conditions for adaptation.

6.9 Development of Technologies to reduce and prevent emissions

In Cape Verde, there are four areas where it is possible to significantly reduce GHG emissions:

- Energy distribution and generation;
- Construction sector;
- Transport sector;
- Industry sector.

6.9.1 Development of Technologies to reduce emissions in energy distribution and generation in Cape Verde

According to the Directorate General for Energy, the energy sector has the main potential for reducing emissions, through the use of smart energy networks, the so-called smart grids, which may allow reaching a "total integration of renewable energy sources in progress in the country".

The Energy Efficiency Program is being implemented with the distribution of approximately 300,000 low energy light bulbs in Cape Verde.

6.9.2 Development of Technologies to reduce emissions in the Construction Sector

For this sector, construction of smart building is increasing. The Project developed by the Directorate General for Energy, in partnership with several municipalities, aims to install in some buildings selected by their respective City Halls solar panel ceilings with a production capacity of up to 25% of the total consumption.

The Government has approved the establishment of legal and tax incentives for the implementation of microgeneration projects on buildings, private house and hotels.

6.9.3 Development of Technologies to reduce emissions in the Transport Sector

In this particular, the Government of Cape Verde is implementing a project for updating the car fleet by reducing import duties and providing other incentives.

Also related to this project, the Government is importing led free gas.

6.9.4 Development of Technologies to reduce emissions in the Industry Sector

In this sector, the Government, UNIDO and UNEP are implementing a joint Resource Efficient and Cleaner Production Programme in Cape Verde.

The first RECP activity in Cape Verde was a vocational training program in Cleaner Production, delivered in Praia for approximately two dozens of industry participants and consultants in the region of Sotavento. The training, organized with the Chamber of Commerce of Sotavento support

was delivered by a Brazilian specialist from the SENAI Center for Cleaner Production. This training workshop was preceded by a public awareness building workshop.

6.10 Sink protection

All countries should review their policies and implement the commitments already set out in Article 4 of the Convention, especially those concerning "the protection of sinks and reservoirs, establishing measures for the protection of biodiversity and populations.

It is vital for the Protocol credibility and proper development that projects and initiatives to reduce $C0_2$ emissions of do not cause other serious environmental damage or create adverse incentives. Funding sources should be studied in Cape Verde through the CDM and other appropriate mechanisms for programs (not just projects) that aim to reduce $C0_2$ emissions from forest fires occurred on Santo Antao and Fogo Islands, and combat their underlying causes.

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LEGISLATION

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Decree-law nº 81/2005, of December 5-establishes the Environment Information System and its legal framework.

Decree n.º 82/87, of August 1 – establishes the rules for water quality and prevention of water-borne diseases.

Decree-law nº31/2003, of September 1 – establishes the key requirements for solid and industrial residues disposal, aiming at protecting public health and environment.

Decree-law nº7/2004, of February 23- establishes the rules for waste water disposal.

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Resolution n.º 29/2003, of December 29- approves the National Sanitation Policy.

Other sources:

http://www.sia.cv.

http:// www. ine. Cv

ANNEX

ANNEX I- List of participating entities in the development of the Second National Environment Programme of Action of Cape Verde

National and regional workshops

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ANNEX II - ACCRONYMS AND SYMBOLS

ACCRONYMS

10/CP.2 - Decision 10 of the second Conference of Parties to the Convention

17/CP.8 - 17Decisão the eighth Conference of Parties to the Convention

AEJ: African easterly jet

AGCM: Atmospheric General Circulation Model

CBA: Cost-Benefit Analysis

CDM - Clean Development Mechanism

CDM: Clean Development Mechanism

CEA: Cost-Effectiveness

Clean Development Mechanism

COP: Conference of Parties

CORINAIR - Program for Inventory and Data Harmonization of Air Emissions (Coordination of Information on Environment)

CWIQ: Core Welfare Indicator Questionnaire

DECRP: Strategy and Poverty Alleviation Paper

DGA: Directorate General for Environment

EAP: Economically Active Population

ECHAM: European Centre Hamburg Model (global climate model)

ECOWAS: African Union and Economic Community of West African States

EEZ: Exclusive Economic Zone

EF - Emission Factor

EROT: Scheme Regional Planning

ETP: Potential Evapotranspiration

ETP: Potential Evapotranspiration

FDI: Foreign Direct Investment

FDI: Foreign Direct Investment

FNC: First National Communication

GAW: Global Atmospheric Watch

GCM: Global Circulation Models

GDP: Gross Domestic Product

GEF - Global Environment Facility

GHGs: Greenhouse Gas

GPRSP: Strategy for Growth and Poverty Alleviation

GWP: Global Warming Potential

IDRF: Survey on Family Income and Expenditure

IFN - National Forest Inventory

INE: National Institute of Statistics

INGRH: National Institute of Water Resources Management

INMG: National Institute of Meteorology and Geophysics

IPCC: Intergovernmental Panel on Climate Change

ITCZ: Intertropical Convergence Zone

LDC: Least Developed Group of Countries

LEG: LDC Expert Group

LPG - Liquefied Petroleum Gas

LULUCF: Land Use and Land Use Change and Forestry

MCA: Multicriteria Analysis

MDC: Medium Development country

MDG: Millennium Development Goals

NAO: North Atlantic Oscillation

NAPA: National Adaptation Programme of Action

NAPA: Programme of Action for Adaptation to Climate Change

NCEP: National Centers for Environmental Prediction

NCSA: National Capacity Self-Assessments

NEPAD: New African Partnership for Development

NGOs : Non-governmental organization

PAFN - National Forestry Action Plan

PAIS: Inter-sectoral Environmental Plan

PALOP: African country portuguese speaking

PANA II: Second National Environment Programme of Action

PANA II: National Action Plan

PEA - Economically Active Population

PIT: Transport Infrastructure Programme

PLC: Coastline Unit Length

PLPR: Programme to Fight Poverty in Rural Areas

PNED: National Home Energy

PNED: National Home Energy

PNLP: National Program to Fight Poverty

PRESAO: Seasonal Forecast

RECP: Resource Efficient and Cleaner Production Programme

RGPH: General Population Census

SAD: Association for Environment Defense and Development

SIDS: Small Island Developing State

SRES: Special Report on Emissions Scenarios

SST: Sea Surface Temperatures

ST&I: Science Technology and Innovation

TEJ: Tropical Easterly jet

UNDP: United Nations Development Program

UNFCCC - UN Framework Convention on Climate Change

UNFCCC: UN Framework Convention on Climate Change

WTO: General Council of the World Trade Organization

WTO: World Trade Organization

QUIBB: Questionnaire Unified Indicators of Well-Being of Cape Verde

SYMBOLS

CFCs - Chlorofluorocarbons

CH_4 - Methane

CO - Carbon Monoxide

CO_2 - Carbon Dioxide

CO_2eq - Carbon equivalent

Gg - Gigagram

GWP - Global Warming Potential

HCFCs - Hidrofluorclorocarbonos

HFCs - hydrofluorocarbons

kg - Kilogram

MWh - Megawatt hour

N_2O - Nitrous Oxide

NH_3 - Ammonia

NMVOCs - non-methane volatile organic compounds

NOx - Oxides of Nitrogen

O_3 - Ozone

PFCs - Perfluorocarbons

SF_6 - Sulfur hexafluoride

Toe - tonne of oil equivalent

Ton - Tonne

ANNEX III – Summary of the main impacts and options for adaptation measures to CC

Sectors/ Vulnerable systems	Summary of impacts	OPTIONS FOR ADAPTATION MEASURES					Difficulties/ constraints
Water Resources	Increased spatial and temporal variability in relation to rainfall and an expected increase in extreme events (droughts, floods, heatwaves and dust, ...); Decreased water availability to promote socio-economic development; Aquifer over-exploitation and saltwater intrusion in watersheds and aquifers; Acceleration of erosion and desertification processes, and shoreline erosion ; Degradation of water quality and sanitation conditions; Increased poverty and water – borne diseases; Increased conflicts over water;	Build mobilization, supply and storage infrastructure and for groundwater recharge;	Promote actions to combat desertificatio n and for watershed protection, through forestation and other techniques;	Improve and monitor water quality;	Modernize and expand drip irrigation technology;	Use closed pipes in water supply channels for irrigation	Management System, Training, Research and Extension Services; Monitoring and Evaluation System; Legislation; Infrastructure;

Sectors/ Vulnerable systems	Summary of impacts	OPTIONS FOR ADAPTATION MEASURES					Difficulties/ constraints
Agro-sylvo-pastoral	Reduction in wet season duration and increased dry season; Increase in arid and semi-arid areas against humid and sub-humid areas; Increased incidence of pests and disease vectors; Possible decrease in certain foliar fungal diseases and increase in other diseases; Low agricultural and animal production and productivity (rain fed and irrigated crops) and; Decreased soil regenerative capacity and subsequent abandonment of agricultural lands Food and forage shortages and animal malnutrition; Increased heat stress in animals; Decrease in rural population income and consequent rural exodus.	Promote environmentally sustainable production techniques; Intensify and diversify production of fruit and vegetables; Use cultivars and species adapted to climate conditions;	Diversify income-generating activities in rural areas;	Implement micro-credit for small farmers as an incentive; Develop semi – intensive livestock;	Promote applied research of technological packages to address the negative impacts of climate change	Support the implementation of prevention measures, protection and supervision on the occurrence of forest fires and crimes	Extension services Management and supervision Promotion and implementation of plans and measures Activity diversification Training, information and reserach Product valorisation Incentives Monitoring and evaluation system Human resources Awareness building and co-accountability in NR management

Sectors/ Vulnerable systems	Summary of impacts	OPTIONS FOR ADAPTATION MEASURES					Difficulties/ constraints
Coastal Areas / Tourism	Change in the morphology due to coastal erosion, destruction of natural protection land / sea; Salt water intrusion in rivers and coastal aquifers located within less than 500 m from the shore; Abandonment of water points due to salination; Reduced agricultural potential for production in coastal lowlands; Abandonment of agricultural lands along the coast; Change in ocean currents intensity; Increased intensity of coastal degradation due to changes in wave amplitudes and tide aggression;; Increased damage to coastal ecosystems such as coral reefs; Flooding of coastal areas, destruction and damage to infrastructure, increased economic losses; Destruction of coastal tourist products; Loss of interest in the country as a tourism destination; Loss of family income; migration of populations from the coast;	Rehabilitate and/ or build infrastructure to protect coastal areas	Diversify activities and measures to change behavior of populations living of coastal resources, in particular extraction of aggregates;	Modernize stations network for climate and maritime monitoring;	Promote sustainable use of coastal resources (for urban, commercial and industrial purposes) based on a Integrated Management Plan	Enforce laws on aggregate extraction in coastal areas	Protection infrastructure; Compliance with Laws; Training, information and awareness building; Establishment of land management and planning Master Plans; Monitoring and evaluation systems; Establishment of sanitation facilities with integrated and participatory management; Financial resources; Establishment of partnerships; Establishment of alternative activities;

Sectors/ Vulnerable systems	Summary of impacts	Options for adaptations measures					Difficulties/constraints
Biodiversity	Reduced geographic distribution of species; Increased opportunity for expansion of invasive species; Changes in ecosystem and community structure and composition; Changes in coastal habitats due to sea level rise;	Proceed with preservation and protected area management actions	Encourage production and fixation of endemic plants	Promote research on endangered and vulnerable species to CC	Preserve and sustainably use medicinal species	Establishment of a a national biodiversity observatory	Ecosystem preservation and rehabilitation; M&E system; Training, Information and Awareness building; Research; Extension programs; Human and financial resources;
Fisheries	Decline in fishing activity as a result of decrease in resources Change in migratory species route; Decrease in employment and household income; Degradation and loss of marine habitat and food insecurity; Change in food chain; Abandonment of fishing areas; Disappearance of fishing beaches and piers; Destruction of port infrastructure; Decreased visibility, damages to air and maritime navigation;	Modernize equipment and artisanal fisheries;	Support diversification of alternate activities to artisanal fishing (training, equipments, micro-credit,…)	Promote training and technical and technological capacity building of fishermen	Promote research on fishery potential and stock evaluation; Promote studies on the establishment of marine protected areas;	Feasibility assessment to introduce fish-farming;	Infrastructure; Funding; Research; Extension program; Supervision systems; Trained human resources; Sector organization;

Sectors/ Vulnerable systems	Summary of impacts	OPTIONS FOR ADAPTATION MEASURES					Difficulties/ constraints
Energy/ Industry	Increased energy consumption due to a possible increase in temperature; Increased greenhouse gas emission; Increased air and noise pollution; Increased incidence of respiratory diseases; Increased CO_2 radioactive strength; Loss of industrial infrastructure on coastal areas;	Reproduce in official charts wind and solar potential in the country;	Create an incentive system for balanced energy use, particularly for renewable energy (solar and wind);	Rearrange the geographical location of power stations with a view in a land planning perspective;	Establishment of a center for technology transfer, responsible for promoting and disseminating new technologies	Adequacy of environmental legislation in the country's socio-economic situation; Development and implementation of Cape Verde industrial code; Creation of a supervisory body for industries that produce greenhouse gases;	Legislation and Regulation; Management and Monitoring System; Training / Research Systems for new transfer technologies System of incentives and establishment of friendly policies; Trained human resources; Financial resources; Infrastructure;

Sectors/Vulnerable Systems	Summary of impacts	OPTIONS FOR ADAPTATION MEASURES					Difficulties/ Constraints
Health	Establishment of adequate conditions for the spreading of infectious disease vectors; Increase in cases of malaria, diarrheal diseases and other virus induced diseases; Increased risk for recurrence of other diseases such as yellow fever and dengue fever, Increased vulnerability to accidents and traumas related to intense rainfall and floods;	Adoption of a technical manual on potentially epidemic diseases and training in this field;	Regulate the aspects regarding collection, packaging and circuit of the samples collected under potentially epidemic disease control;	Conducting research for improved understanding of the situation and periodic assessments of the health sector vulnerability to climate change	Use of resources and proven strategies to promote and encourage increased levels of sanitation	Set an IEC program for potentially epidemic diseases	Development of regulatory manuals; Risk management system; System for promotion and use of sanitation resources; Trained human resources; Financial resources,

ANNEX IV (a) Priorization of the Agro-silvo-pastoral and Water Resources Sectors

Nº	Options / Priority Measures	Ranking
Option 11	Construct infrastructures for collection, supply and storage of water and recharge of phreatic sheets;	1st
Option 9	Strengthen the actions of fight against desertification and protection of watersheds, through reforestation and other CSA techniques;	2nd
Option 5	Diversify income generating activities in the rural areas;	3rd
Option 4	Modernize and diffuse localized irrigation technologies;	4th
Option 12	Improve and control water quality ;	5th
Option 3	Invest strongly on Environmentally Sustainable Production techniques ;	6th
Option 8	Implement micro-credit for small cattle raisers as a form of incentive;	7th
Option 7	Develop semi-intensive cattle raising	8th
Option 13	Use closed piping in water supply systems,	9th
Option 2	Intensify and diversify vegetable and fruit production;	10th
Option 1	Use varieties and species that are adaptable to edafo-climatic conditions;	11th
Option 10	Support implementation of measures for prevention, protection and fiscalization of fire occurrence and forest delicts;	12th
Option 6	Promote applied research of technological packages to face the negative impacts of climate changes;	13th

ANNEX IV (b) Prioritization of the Tourism/Coastal Zones, Biodiversity, Fisheries and Energy Sectors

Nº	Options / Priority Measures	Rating
Option 2	Diversify the activities and measures of reconversion of populations that live off the exploration of coastal resources;	1st
Option 9	Support the diversification of alternative activities to artisanal fishing (training, equipment, micro-credit, among others);	2nd
Option 4	Continue the actions of preservation and management of protected areas;	3rd
Option 1	Rehabilitate and/or construct infrastructures for protection of coastal zones;	4th
Option 8	Strengthen the equipment and modernization of artisanal fishing;	5th
Option 10	Support implementation of initiatives of use of renewable energies (solar and wind) in particular at the level of rural communities;	6th
Option 3	Modernize the network of climate and maritime monitoring stations ;	7th

Option 5	Stimulate production and establishment of endemic plants;	8th
Option 7	Conserve and use medicinal species in a sustainable way ;	9th
Option 6	Promote research on species that are threatened and vulnerable to the MCs.	10th

ANNEX V – Recommendations for ST&I initiatives and policies related to: AGRICULTURE AND LIVESTOCK, WATER RESOURCES AND COSTAL AREA

ST&I related to AGRICULTURE and LIVESTOCK	Component- ADAPTATION
Production and Productivity	- Agro-climatic and agro-ecological zoning; - Land and water management in watersheds, creating environmental services and benefiting agriculture - Early warning systems implementation for seasonal climate events; - Establishment of environmental monitoring systems (historical series of regional temperature increase, atmospheric CO_2 concentration, etc.) - Rural Extension with a view to raising awareness of farmers on the potential impacts of climate change and guidance on adaptation measures; - Incentives for municipal and / or inter-municipal programs to recover degraded areas (reclamation) - Development and adoption of technologies for managing land use and plant breeding, considering the integrated production and incentives for mixed farming systems (integrating crop-livestock-forest) - Product quality control system (ex. microtoxins); - Development and incentives to adopt integrated production systems enabling farmers to engage in mitigation efforts, with the possibility of using certification stamps; - Improve water efficiency and groundwater recharge by conservative agriculture with conservationist features - Improved systems for food storage and waste reduction through control of pests and rodents, human training, hygiene, transport, drying technology - Animal and plant breeding for new climatic conditions and increased incidence of pests and diseases; - Establishment of a genebank;
	- Organization of the production chain to meet commercial standards, including family farming standards; - Increased storage, conservation and efficient distribution capacity of farm products; - Research under public policies for building new tools and mechanisms to ensure sustainability of small / medium family farming and supply chain of agricultural products in general;

ST&I related to AGRICULTURE AND LIVESTOCK	Component- ADAPTATION
Environment	- Develop farming and handling techniques adapted to each type of soil and engineering techniques to integrate watersheds; - Adoption of practices promoting and preserving biological diversity; - Decrease controlled burn in farming avoiding forest fires and risks to health; - Adoption of incentives for forested areas maintenance and expansion, of integrated agro-forestry systems, as well as supervision on land use in accordance with the provisions of law;
Socioeconomic	- Development of Rural Extension services with a view to adapt the productive sector to climate change effects, seeking advice on adaptation measures; - Changes in production patterns of farmers in order to increase production value with less risk; - Agricultural insurance for small farmers;

ST&I related to WATER RESOURCES	Component- ADAPTATION
Flood control	- Criteria for contigency plans
Variability of water availability	- Mechanisms for dispute management
Water shortage for public supply	- Criteria for contigency plans
Decreased water quality	- Correction and reclamation technologies
Aquatic Biota	- Reclamation techniques
Coastal areas	- Proposed studies on reclamation structures

ST&I related o COASTAL AREA	Component -ADAPTATION
Populations on Coastal Areas	- Definition of imminent risk areas and drafting of legislation to prevent illegal occupation;
Infrastructure	- Development of construction techniques characterized by short execution time and low cost - Review of technical rules for coastal and marine works to safer structures as they relate to extreme climate events
Economic activities	- Demarcation of areas suitable for new crops and new marine areas - Demarcation of areas suitable for energy generation projects based on renewable sources; - Transport logistics associated with geopolitics under climate change;
Natural environments	- Promote training of staff on issues related to coastal and marine environments and technological innovation; - Review and fine-tuning of technical rules for seashore occupation considering extreme climate events; - Development of methods for predicting waves from atmospheric circulation models;
Publci services / Political and Administrative aspects	- Improve statistical methods for predicting extremes of environmental parameters, as well as for describing temporal permanence and variability; - Design supply networks and roads in emergency or disaster situations; - Implementation of new institutional models for intra and inter-governmental coastal management; - Definition of a public awareness building policy on extreme and progressive events resulting from climate change; - Development of guidelines to improve emergency procedures; - Provision of vocational training on coastal environment - Promotion of cooperation projects among universities and central and municipal planning bodies for coastal area vulnerability assessment; - Coordination within the government of the different municipal initiatives
Strategic Management	- Use of improved and calibrated numerical models to specific situations; - Implementation and improvement of operational wave and sea level predicting systems based on atmospheric circulation models; - Characterization of storm wave transformation from the ocean to the coast; - Include marine and coastal issues in the MCT / MEC Tree of Knowledge for proper research evaluation on responses in emergencies.

ANNEX VI – Climate Change Adaptation and Technology Transfer Needs

Agricultural sector

Regarding this sector, the following needs have been identified: :

- Changes in ground topography to improve water mobilization and prevent wind erosion;
- Changes in farming practices to preserve the nutrients;
- Use technique for different crops;
- Soil erosion Control;
- Windbreak;
- Change of planting and harvesting times;
- New cultivars;
- Drip irrigation (Cape Verde has the technology);
- Reforestation in arid and semi-arid areas (Cape Verde has the technology);
- - Protected agriculture and hydroponics;
- - Methods for pest control;
- Techniques to increase value-added production;
- Techniques to ensure food safety and quality;
- Aquaculture techniques.

Coastal Areas

Concerning Coastal Areas the needs were divided into *Hard Structures* and *Soft Structures*:

Hard structures

- Sea walls and dikes, breakwaters, more resistant materials, artificial reefs.

Soft structures

- Restoration of dunes or wetlands;
- Beach nourishment;
- Retreat;
- Early warning system foe evacuation;
- Salt tolerant crops;
- Advanced draining systems;
- Desalination system;
- Updated zoning and spatial occupation techniques as regards coastal areas;
- Navigation techniques and leak control;

Water supply

In this sector, the following needs have been identified:

- Increase the number and capacity of reservoirs

  - Desalination (reverse osmosis techniques and more efficient techniques from energy point of view)

  - More efficient use of groundwater

  - Other improved soil and water conservation techniques;

  - Hydroponics techniques

  - Techniques for water reuse

  - Flood warning Systems

  - Crops more tolerant to drought

  - More efficient irrigation techniques

  - Techniques to prevent (early warning) and to avoid salt water intrusion

  - Early Warning System

  - Reduction of losses in the water distribution system

Energy Sector

For this sector the following needs have been identified:

Fuel – Heat generation

- Solar
- Biodiesel (depending on the input)
- Geothermal

Transversal technologies

- Smart Grids
- Storage (batteries)
- Energy efficiency (industry and buildings)
- Conservation of energy (industry and buildings)

Social technologies

- Clean cooking fuel - LPG, wood, ethanol
- Rural Eletr. & energy efficiency for low income households
- Solar (low temperatures) for low income households

Others

- Tidal Energy
- Conversion of ocean thermal energy
- Sanitary Landfill

Updated afforestation technologies

- Protection technologies for carbon sinks
- Forestations and reforestation techniques

Electricity generartion technologies

Solar

- Photovoltaic (Si)
- Solar energy concentration

Wind

Water

- Small scale

Hydrogen

- Fuel cells
- Production and stock

ANNEX VII – Proposed priority projects

ADAPTATION PROJECTS
Title: **Modernization and Diversification of Agricultural Production**
Specific objective: Adapt agro-sylvo-pastoral production systems to climate change and variability aiming at reducing food insecurity
Components/Outcome: **Component 1: Capacity building of stakeholders on adaptation to Climate Change and Climate Variability from a systemic, institutional point of view.** Outcome 1: Stakeholders are better organized and trained on sustainable production techniques. Outcome 2: Planning policies and tools of the agro-sylvo-pastoral sector consider climate change related vulnerability and impacts. **Component 2 : Investment, conservation, and protection activities in the field** Outcome 1: Agro-sylvo-pastoral production and productivity capacity is increased. Outcome 2: Vulnerable production bases (watersheds, forests, etc.) are protected. **Component 3 : Research-actions on cultivars adapted to the current climate conditions** Outcome 1: New agro-sylvo-pastoral techniques are tested and innovative adaptation mechanisms are implemented. **Component 4 : Mobilization, Information and Awareness Building of stakeholders on the risks associated with Climate Change and Climate Variability** Outcome 1: Stakeholders are aware of and with positive attitudes in relation to the aggravating vulnerability factors (landslides, forest fires, deforestation, etc.) to climate change and variability are adopted.
Estimated Cost ($US): 2.500.000
Title: Protection and Integrated Management of **Coastal Areas**
Specific objective: *Increase* coastal area adaptation capacity to Climate Change through integrated management of coastal resources to mitigate the current situation.
Component 1 : Stakeholders capacity building on coastal area management to adapt to Climate Change and Variability; Outcome 1: Government, local and community structures are qualified to significantly contribute to coastal area management. **Component 2 : Investment, conservation and protection activities in the field** Outcome 2: Coastal area adaptation capacity is increased and stress on coastal resources is diminished. **Component 3 : Research-action in terms of use and extraction of aggregates on coastal areas** Outcome 3 : Alternatives to the use of coastal resources (aggregates) in construction are tested **Component 4 : Mobilization, Information, Awareness building** Outcome 4: An early warning system is established and the populations at risk are aware of their statute and ready to manage possible hazards.
Estimated cost ($US): 2.000.000
Title: Integrated and Sustained Improvement of **artisanal and coastal fisheries**
Overall objective: Contribute to the fight against poverty of artisanal fishermen´s households and other operators' in coastal fishery. ***Specific objectives:*** (i) Ensure in a sustained manner the use of fishery products; (ii) build technical, operational and management capacity of operators in artisanal and coastal fishery
Main Expected Outcomes: (i) Improvement of the living conditions of artisanal operators and marketing agents, (ii) modernization of the means of production, (iii) improvement of hygiene and sanitation marketing conditions of fish products, (iv) Reduction of accidents and loss of life in artisanal fisheries, (v) Further integration of fisheries with other local income generating activities, including tourism.

Estimated Cost ($US): 1,100,000
Title: **Strengthening and Rehabilitation of the National Network for Climate, Meteorological and Weather Observation**
Specific objectives: Ensure improved support to economic weather and climate dependent activities, especially those related to tourism, fisheries, transport (air and sea) and water sports through a constantly updated weather system which will include a support system for economic policy makers in the efforts towards sustainable development and poverty alleviation; Contribute to specialized training of technicians with college degrees in Cape Verde on Climate Change related areas and their impacts.
Main expected outcomes: Setting up of a regional weather and sea state forecasting system based on ETA downscaling models as well as the already installed RAMS and SWAN models, using the M9 and Grads software and 3 fist class servers in addition to ISDN internet. The climate monitoring network and warning system in place.
Estimated cost ($US): 5,800,000
Title : **Rehabilitation of the National Climate Forecasting and Modeling Center**
Specific objectives*:* The main objective of this Project is the establishment of conditions for the improvement of the quality of weather forecast for the short, medium and long terms. Based on these forecasts, products will be adjusted to the specific needs of different social and economic sectors in Cape Verde, mainly civil aviation, agriculture, fisheries, energy, industry, tourism and warning systems among others. Ensure improved support to economic weather and climate dependent activities, especially those related to tourism, fisheries, transport (air and sea) and water sports through a constantly updated weather system which will include a support system for economic policy makers in the efforts towards sustainable development and poverty alleviation; Contribute to specialized training of technicians with college degrees in Cape Verde on Climate Change related areas and their impacts.
Main expected outcomes**:** Setting up of a regional weather and sea state forecasting system based on models on regional scale with improved research conditions and tools through high resolution regional climate models to generate Climate Change scenarios. The outcomes from both weather projections and climate scenarios will help develop adaptation or mitigation strategies required to minimize the adverse effects of a global, regional and local climate change. ***Estimated cost ($US)****: 7,***300,000**
Title: **Development of Income generating Activities for Vulnerable Populations**
Specific objectives*:* Increase the adaptation capacity of vulnerable populations to Climate Change and variability by diversifying their income-generating activities through micro-credit.
Main Expected Outcomes: Support to beneficiaries in identifying and developing alternative projects on Climate Change and Vulnerability; establishment of credit lines for vulnerable populations; capacity building of the beneficiaries on organization and management; technical assistance to beneficiaries; monitoring and evaluation; Information / Awareness building of beneficiaries on the effects and negative impacts of Climate Change
Estimated cost ($US):**1,250,000**
Title : Water Resource Mobilization and Management **Project**
Specific objective: More equitable water distribution to farmers
Components/Outcomes: **Component 1: Capacity building of structures and human resources on water mobilization and management from a systemic, institutional and individual point of view.** Outcome 1: Stakeholders are better organized and trained in what concerns water availability and use, in addition to technical assistance for irrigation infrastructure.

Outcome 2: Establishment of sector´s planning policy and tools considering aspects related to Climate Change vulnerability and impacts. **Component 2: Investment and infrastructure conservation activities for improved water mobilization.** Outono 1 : Increased water mobilization. Outcome 2: Infrastructure protected. **Component 3 : Research-action on drip irrigation techniques** Outcome 1: Experimental approach and innovative adaptation mechanisms implemented. **Component 4 : Mobilization, Information and Awareness building of farmers on the resource obtained** Outcome 1 : Extension programs developed.
Estimated Cost ($US): 7, 500, 000
Title:
Objectives: Development and implementation of item 7 of the MDG on environmental sustainability; Contribute to the improvement of living conditions of populations; contribute to sustainable development based on participatory and integrated development of natural resources. Promote the appropriate use of natural resources and use of biological and mechanical facilities; Evaluation of sustainable production of natural resources through product diversification and improvement; support rural communities to better anticipate and meet their development with sustained resources management
Outcomes: Mechanical and biological techniques are built and techniques are implemented to reduce overgrazing. Managers and technicians are well trained in forest management. Techniques for improving soil productivity, increase and diversify agro-forestry-pastoral and product development are approved. Improved accessibility to water is provided. The population is educated and trained in sustainable management of natural resources. Population uses techniques and methods for natural resources sustainable management
Estimated cost ($US): 2, 700, 000
MITIGATION PROJECTS TO GREENHOUSE GAS EMISSIONS
Title: **Rural Electrification with Solar and Wind Energy - Village Lagoa - Santiago Island, Municipality of Tarrafal – Project ADAD.**
Specific objective: Installation and use of alternative energy through a hybrid system with capacity to produce 17KW of power for each location, 7 10Kw in wind and solar energy so as to provide these locations with improved energy efficiency. The use of the hybrid system will compensate and balance the energy production at these locations given the heavy cloudiness and reduced insolation during December, January and February
Outcome: System installed and ready to guarantee domestic electricity and public lighting to the localities benefited. Improved energy efficiency ensured, using for public lighting LED technology (28watts - 50,000 hours of life) and in residential houses using energy-saving 14 and/or 17 watts lamps, with 10,000 hours of life
Estimated cost (USD): 1,000, 000
Title: **Installation of a Solar Photovoltaic Plant– National Electrification Network- Energy Sector**
Specific objective: Increase the penetration rate of renewable energies and electrify rural areas. This project will help reduce greenhouse gas emissions. Annual fuel savings, decrease in fossil fuels for electricity generation and industrial contribution to mitigate CO_2 emissions will be expected.
Outcome: Renewable energy penetration rate increased and electricity production system improved nationally.
Estimated cost (USD): 18, 000, 000
***Title*: Collection of non- degradable waste**

Specific objective: Avoid soil contamination and damages to public health by pollutant (heavy metals) dispersion. Establishment of storage conditions in proper landfills and/or exports and recycling.
Outcome: Conditions for waste collection, storage and treatment created
Estimated cost (USD): 1, 000, 000
***Title*: Greenhouse Gas Emission Reduction Program – Transport Sector**
Specific objective: Promote an effective reduction in GHG in the transport sector based on training and awareness building of users, purchase equipment to control exhaust pipe emissions. Promoting the use of electrical, gasoline or hybrid cars. Improve energy efficiency of road, maritime and air transport fleets; Reduce the use of urban and interurban transport; introduce low-power consumption and low emission buses in urban routes. Modernize the transport fleet in all sub-sectors and eliminate the obsolete vehicles
Outcome: The transport sector with profit. Car fleet updated; Urban pollution and greenhouse gas emissions reduced.
Estimated cost (USD): 8, 000, 000
***Title:* Reforestation of marginal zones to coast areas with drought resistant species–CO_2 sink**
Specific objective: Reforest marginal areas with resistant plants such as Jatropha curcas which serve as sinks for carbon, and produce bio-fuel from the seeds. Preserve and protect soil and water, and restore the ecosystems in these areas
Outcome: Reforested area contributing to reduce CO_2 emissions both as sink and source of seeds supply for bio-fuel. Ecosystems restored and life of the coastal populations improved
Estimated cost (USD): 1, 200, 000
***Title:* Expanding Wind Power Plants– National Network**
Specific objective: Substantially increase the penetration rate of wind power in the country. Reduced greenhouse gas emissions as a result of decreased use of fossil fuels.
Outcome: Increased penetration rate of wind power in electricity production system and water pumping on wells. Reduced consumption of fossil fuels resulting in reduced pollution by CO_2 emissions
***Title:* Increased energy savings– use of new technologies**
Specific objective: Energy saving program through co-generation (water and energy power plants), such as the massive introduction of low energy light bulbs in domestic and industrial sub-sectors; in civil construction eco-friendly housing projects
Outcome: *Energy savings achieved*, energy cost reduced, improved use of other technologies for energy production and civil construction.
Estimated cost (USD): 800, 000
***Title:* Desalinated Water Production from Co-Generation- use of exhaust gases**
Specific objective: Produce desalinated water from a cogeneration system using waste heat developed by a diesel group through exhaust gas discharges and cooling water. In taking advantage of this energy source the overall efficiency of the system can increase from 30-40% to over 80%.
Outcome: Reduced consumption of fossil fuels in desalinated water production and reduced GHG emissions.
Estimated cost (USD): 2, 300, 000

Title: **Promoting and expanding efficient wood ovens**
Specific objective: Design and implement a manufacturing and marketing project of Kenyan stoves. Reduce CO_2 emissions from firewood burning; widely distribute prototypes of "Jiko" stoves with high heat performance; reduce energy deficits by promoting energy savings.
Outcome: Reduced CO_2 emissions. Structural deficits in wood energy reduced. Energy savings promoted.
Estimated cost (USD): 650,000
Title: **Improving ruminant feed. Reducing methane emissions**
Specific objective: Reduce methane emissions from enteric fermentation; determine technical and economic feasibility of straw treatment and other agricultural waste products for ruminant feed; improve the nutritional value of roughages and the productivity of ruminants in terms of meat and milk; evaluate the effect of improved food digestibility; evaluate the effect of meat and milk productivity on methane emission per unit of production in the enteric fermentation process
Outcome: Methane emission reduced; ruminants food and digestibility; meat and milk productivity increased; treatment models defined.
Estimated cost (USD): 600, 000
Title : **Cooperation projects between the University and Municipal Planning Bodies for vulnerability assessment**
Specific objective: Establish operational principles to conduct research that will enable evaluating various aspects from those related to Climate Variability
Components/Outcomes: **Component 1: Capacity building of stakeholders to conduct research on adaptation to Climate Change and Climate Variability.** Outcome 1: Development of related research, such as methane and N0x production in livestock, or others, according to the needs identified by the municipal bodies. Outcome 2: Development of planning policies and tools in the sector agro-sylvo-pastoral sector according to climate change vulnerability and impacts. **Component 2 : Research investment activities through inter-institutional collaboration protocols** Outcome 1: Increased work capacity in this system. **Component 3: Awareness building of stakeholders on research needs associated with Climate Change and Climate Variability risks** Outcome 1: Stakeholders aware of the risks and with positive attitudes as regards the needs for research on the aggravating factors of vulnerability to climate change.