



**DEVELOPMENT WORKSHOP**  
Desenvolvimento Comunitário  
Human Settlements & Development

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# **WATER RESOURCE MANAGEMENT UNDER CHANGING CLIMATE IN ANGOLA'S COASTAL SETTLEMENTS**

**IDRC PROJECT NUMBER: 107025**

**5<sup>TH</sup> PROGRESS REPORT**

**01 NOVEMBER 2014 TO 30 APRIL 2015**

**DEVELOPMENT WORKSHOP ANGOLA**

**Luanda - 31<sup>TH</sup> May 2015**

**(Revised 16 October 2015)**

# 1 SYNTHESIS

The current report is the 5<sup>th</sup> six-monthly report covering the period from the first of November 2014 through to the end of April 2015. This period covers the first semester of the last planned year of the project.

Most of the overall project objectives have been broadly met by the end of this reporting period but some of the specific sub-tasks have not been achieved. DW has not yet secured the counterpart funding that had been planned to be received from the UN's Global Environment Facility to be channeled through the Angolan Ministry of Environment. The current project had been embedded in the Angolan country program submitted by the Government to GEF, but financing has not yet come through the pipeline. For this reason DW has had to cut back on the implementation of some activities. A revised work-plan is being developed to map of the "achievable" within the current project framework.

The current reporting period coincides with Angola's principal rainy season. As the project's research on climatic data has illustrated, Angola's coastal climate has become increasingly variable and unpredictable over the last three decades. Extreme events, such as short intense rainstorms, floods and long periods of drought are characteristics of this variability. The south of the country is in the third year of a prolonged drought but the western coastal cities of Benguela, Lobito and to a lesser extent Luanda, suffered a series of devastating storms and heavy flooding through February, March and April 2015. DW's work to date had produced preliminary risk assessments for these three cities. DW also used near-real-time satellite imagery to track the approaching storms during this period and provided the Ministries of Environment and Territorial Administration with advice on projected storm and flood-risks. However, when the storms hit the Benguela and Lobito coastal areas, the subsequent flooding destroyed hundreds of homes in the areas that DW had mapped to be high risk settlements. Access to water supplies and other basic services were also affected by the serious flooding. Approximately 90 persons lost their lives in these two urban areas.

During the critical weeks of the most serious flooding, DW sent their research team to Lobito and Benguela to work with the municipal authorities in mapping the damage within the coastal settlements. The tragedy in these recent months has highlighted the importance of carrying out risk assessments and producing municipal risk maps as an essential component of coastal settlement adaptation strategies.

The Ministry for Territorial Administration has the responsibility of training municipal administrators and building the technical capacities of local governments across the country. DW has targeted its advocacy work at building a partnership with the Training Centre (IFAL) of the Ministry with the objective of engaging IFAL as a partner to disseminate the current project results and build the capacity of municipalities across the country in risk mapping and CC adaptation planning.

The specific objectives that have been achieved to date are as follows:

- 1 Reconstructing lost data so as to improve knowledge about rainfall patterns and hydrology in coastal areas of Angola and develop a framework for future continuous data collection and analysis. This work involved reconstructing lost data from historic rainfall data and satellite-based estimates was the focus of the early stage of the project.

- 2 Improved information about settlement patterns and population in three of Angola's urban coastal areas, and assess the risks, impact and vulnerability from flooding and erosion at present and under future climate scenarios, especially for vulnerable social groups. This component of the project has focused on the mapping of the coastal settlements and projection of demographic and environmental risk data. This has been largely completed during this current semester of the project.
- 3 The improvement of water access in Angola's urban coastal areas, assess the impact of climate change on water supply issues, especially for vulnerable social groups, and develop options for better water management mechanisms for these areas. This component involves producing material necessary for adaptation planning for the communities and urban municipalities in the targeted coastal areas. Research outputs are being prepared for use in training courses for personnel from local government. Posters are being produced. This work began in the current reporting period and will continue in the final phase of the program.

Activities have involved establishing relations with relevant institutions. Contacts have been made with climate scientists (in Spain and South Africa) with an interest in rainfall variability in Angola. Relations were reinforced with the new local institution, CETAC, and with climate scientists at Angolan Universities. Relations have also continued to be developed with the Institute of Water resources.

## **2 RESEARCH FOCUS OF CURRENT REPORTING PERIOD:**

During the reporting period from November 2014 through April 2015 the project team had planned on completing the research work in Lobito and Benguela municipalities. The engagement of the research team in this geographic area coincided with a series of major storms that resulted in serious flooding in the month of March 2015. Development Workshop was therefore able to provide local government and municipal authorities in implementing an impact study of damage and risks.

The Lobito & Benguela floods highlighted, to Government policy makers, the importance of the research that DW was implementing and underlined the lessons on adaptation to climate change that the program advocates.

During the reporting period, new satellite imagery that DW had been waiting for, became available. This allowed the GIS team to focus on updating the mapping and demographic data for Luanda, that feeds into the risk-mapping in the final stage of the program.

DW also worked on the preparation of two peer-reviewed papers that were submitted to the World Bank conference in Washington in March 2015 and the Global Water Congress in Edinburgh in May 2015.

### **3 RESEARCH FINDINGS**

#### **3.1 Improve Knowledge on Rainfall Patterns and Hydrology in Coastal Areas**

The baseline work and historic data on rainfall patterns and hydrology were assembled and analyzed in the first two years of the current project. A paper has been completed about annual, seasonal and monthly means of rainfall and about variability of rainfall in Angola. This paper uses station data, both historic and recent and has been made available to Angolan partner institutions in Portuguese.

##### **Summary of activities in this period.**

The project team continued to use of remote sensing products that are now available in near-real-time from Internet sources. The project team has observed that there are still some difficulties in using these remote sensing methods to correlate accurately with heavy rainfall events in coastal Angola. However during the current reporting period these methods were used by the project team in providing advice on flood risks to the Ministries and Municipalities of Lobito and Benguela.

Written records of notable climate events and notable flooding, erosion or drought events have continued to be collected from newspapers, emergency bulletins and food security bulletins. There have been a number of high rainfall events this year in coastal Angola, and detailed information has been collected about severe events in Lobito, Benguela and to a lesser extent Luanda during the reporting period. This is being used to show the impact of heavy rains and to link back to satellite-based rainfall estimate methodologies.

Information has continued to be extracted from paper documents held by Development Workshop from the post-Independence period (newspapers, emergency bulletins, food security bulletins). More recent information from local newspapers, held as scanned information, has been extracted, and this is continuing as more sources of information are identified. During this six-month period of the project there have been some notable heavy rainfall events, and attention has been directed to collecting a wide range of information about these.

The use of oral histories from key informants, local residents who witnessed the flooding, is linked to other methods such as extracting images from Google Earth before and after the flooding, and collection of media reports and photos and videos of events. Case studies of this type show that local people have clearer information than is contained in press reports or official reports, and that this can assist analysis of the factors contributing to environmental risks.

The database of notable water and other climate related events continues to be updated. Information that has been collected from various sources about important water and climate-related events is being inputted into a database for each year. The database shows the type of event (flooding, drought, river or flood erosion, sea erosion from high seas), the date, the location and the source of information. This is on-going as more information becomes available.

### 3.2 Production and Dissemination of Information about Settlement Patterns, Population Densities and Water Resource Management Relative to Policy, Socioeconomic and Climatic Dynamics

#### Summary of activities in this period.

In the absence of published demographic data and maps, Development Workshop, from the beginning of the project depended on using remote sensing information from satellites and information from the household questionnaire surveys to build their own geographic information systems for each of the urban areas in the study. In the early phase of the project the areas have been mapped and information on the past urban area has been collected and analysed and data are now available on average household size in different housing areas. Structures in each zone have been counted and estimates of population have been made. The maps are layered allowing for viewing of different combinations of indicators. Areas that are at risk from flooding and erosion under plausible range of future changes, areas at risk from sea-level rise and salt-water intrusion (under present and possible future conditions) have been mapped.

In late 2014, during the current reporting period the Angolan Statistics Institute published its first findings from the recent 2014 National Census (the first since 1971). The research team was able to compare the estimates that Development Workshop's GIS unit has produces from their participatory mapping approach. The data from the two sources can be closely correlated suggesting that the method of population estimate from the methodology developed by Development Workshop provides good estimates of population.

The table below correlates data from remote sensing estimates and census information for the municipalities of Luanda over 30 years. The data shows that Luanda has been growing at over 7% per year, making it the fastest growing city in Africa.

Município	1983		2000		2008			2014	
	População	Densidade /Ha	População	Densidade /Ha	População	Densidade /Ha	Taxa Annual (2000 - 2008)	População	Densidade /Ha
Cacuaco	12,923	0.23	113,310	2	860,600	15	28.8%	882,398	28
Cazenga	215,105	56	920,864	239	1,182,600	306	3.2%	862,351	233
Ingombota	97,824	102	187,831	196	129,700	135	-4.5%	2,107,648	182
Maianga	161,663	65	520,308	211	529,000	214	0.2%		
Rangel	132,270	210	195,418	310	176,600	280	-1.3%		
Samba	27,369	0.79	217,892	6	503,000	15	11.0%		
Sambizanga	123,655	87	568,561	401	473,800	334	-2.3%		
Viana	34,592	0.26	63,591	0.47	1,060,100	8	42.1%		
Kilamba Kiaxi / Belas	118,441	18	362,277	57	892,200	62	11.9%	1,065,106	101
Icolo e Bengo								74,644	0.24
Quissama								25,086	0.02
<b>Luanda Total</b>	<b>923,842</b>	<b>3.80</b>	<b>3,150,052</b>	<b>13.0</b>	<b>5,823,200</b>	<b>23.3</b>	<b>7.9%</b>	<b>6,542,944</b>	<b>0.347</b>

Satellite images of all three urban areas were obtained at the start of the project. During the current reporting period new satellite images of Luanda became available (without cloud cover) when cloud cover decreased after April 2014. (Rainfall is highest in April in Luanda but is much less from May onwards.) The project’s GIS team is now working with this new imagery and re-adjusting the demographic model, re-mapping settlement typologies and projecting new risk maps on this basis. This process involves mapping of new rooftops on the satellite images to make a count of the number of structures in each delimited zone (to be then used in conjunction with data on number of people per structure to estimate population numbers and densities of an area) was carried out for Luanda. Lobito/Benguela and Cabinda are growing at a much slower rate so it has been decided that the project will only do fine-tuning or correlation of the demographic data (if required) once the detailed census data is published at the end of 2015.

During the current reporting period the project team has focused on the urban municipalities of Lobito and Benguela with the aim of completing the research and data analysis component of the program. Coincidentally DW’s focus on this region coincided with the severe climate events that resulted in disastrous flooding in these cities in March and April 2015. (see photos)



The following risk maps were produced on Lobito and Benguela during this reporting period:

Fig 1 Lobito Sea Level Rise

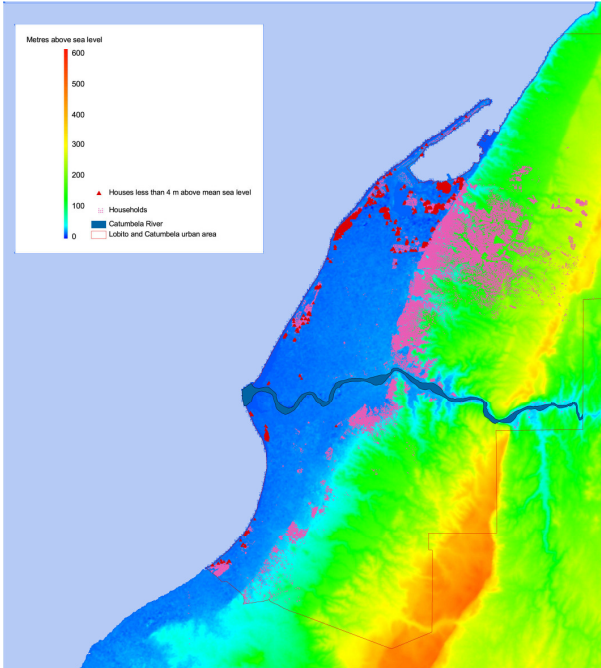


Fig 2 Lobito houses affected by flooding

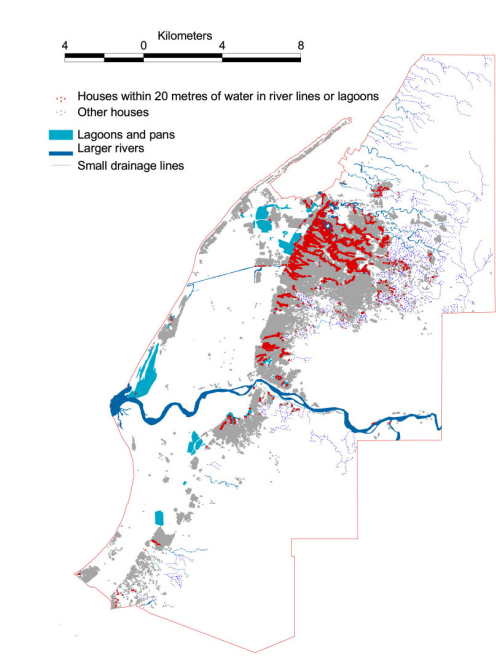


Fig 3 Lobito houses on steep slopes

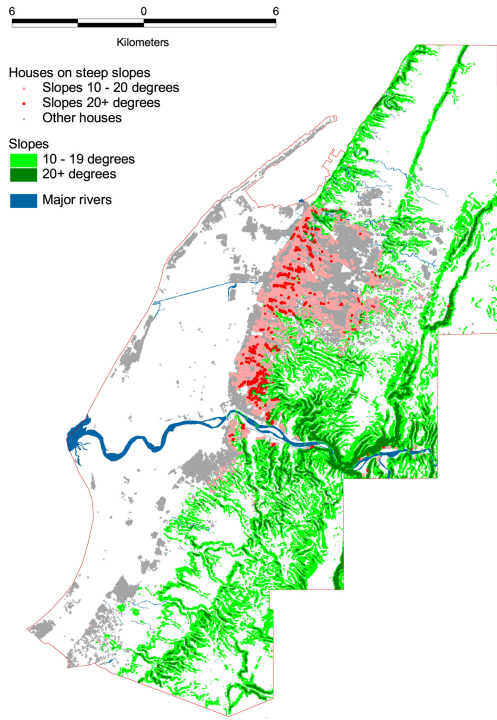


Fig 4 Benguela sea level rise

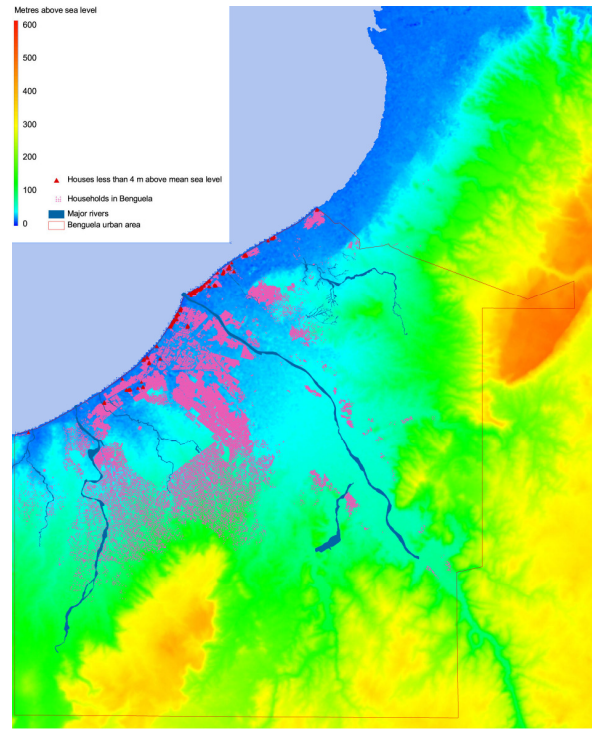
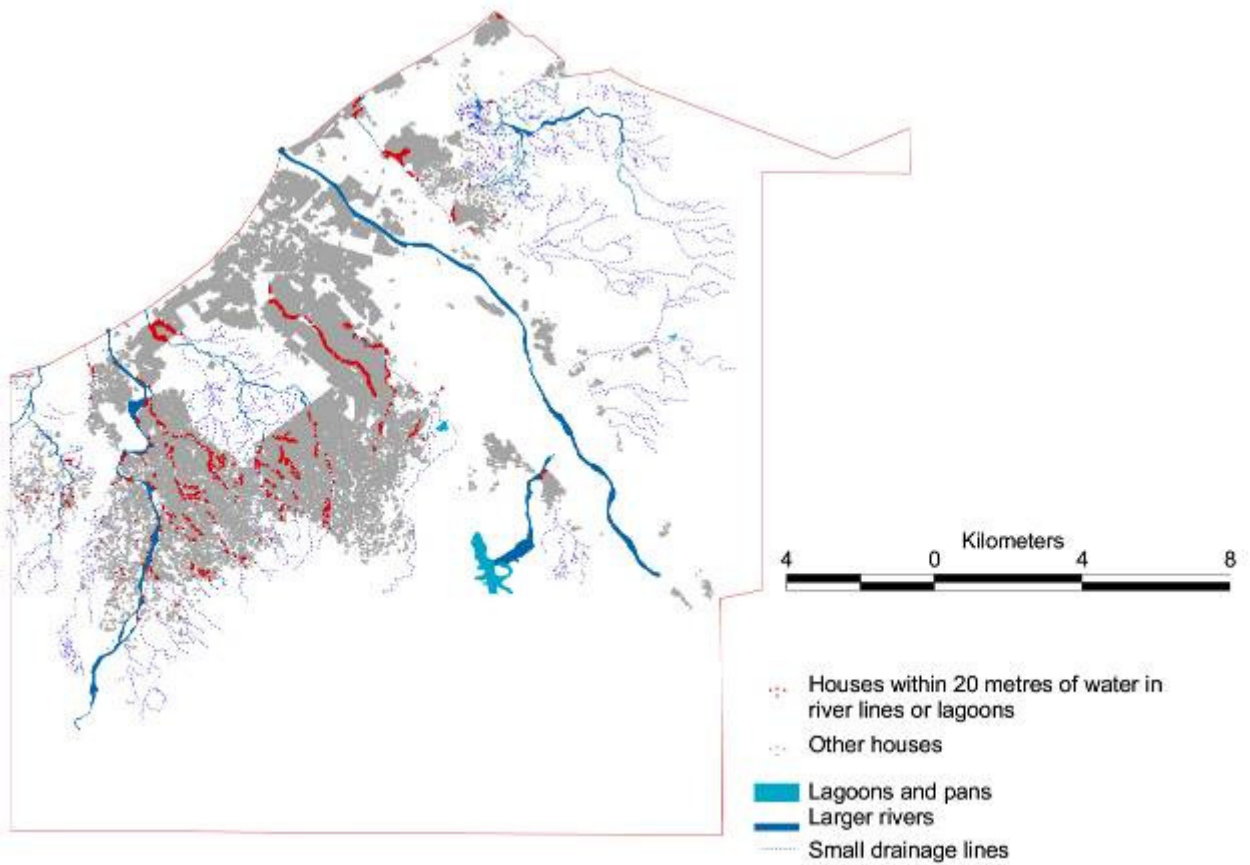


Fig 5 Benguela houses at risk of flooding



## **4 PROJECT IMPLEMENTATION AND MANAGEMENT**

### **4.0. Progress Summary**

The scope of the project remains unchanged and progress continues to be made in the fifth six-month period. There has been no change in the approach or methodology, and the fact that the examination of the available rainfall and hydrological data show gaps and raise questions confirms the rationale of applying the methodology of using field surveys, key informant interviews and oral histories to help fill in the gaps in the “hard data”.

Development Workshop has maintained close collaboration with the Ministry of Environment’s Climate Change and Adaptation Department and has supported the preparation of their proposal to the Global Environment Facility with a view of obtaining matching funds using IDRC’s contribution as counterpart funding that GEF requires. To date this matching funding has not been secured. DW may have to readjust project plans if the GEF funding is not secured in the very near future.

### **4.1 South-South Exchanges and Visiting Scholar Programme**

A relationship has been developed with the Climate Systems Analysis Group at the University of Cape Town. CSAG are interested in daily meteorological data for any station in Angola for a recent 10 year continuous period as an input to modelling, and Development Workshop is seeking this data from a number of stations. Collaboration with the Climate System Analysis Group at the university of Cape Town depends on Development Workshop being able to secure additional financing for the project. Funding has been obtained from the Centre for Tropical Ecology and Climate Change (Centro de Ecologia Tropical e Alterações Climáticas –CETAC) based in Huambo to send a member of Development Workshop’s climate change research team will attend the Climate Systems Analysis Group’s 2015 winter training course in Cape Town.

### **4.2 Consolidation of Relationships with Relevant Government and Civil Society Institutions**

The present project was designed in close collaboration with the Angolan Ministry of Environment’s Climate Change Adaptation Department with the aim of linking with their GEF supported programs. DW shared the findings and results with the Ministry on a regular basis and participates in all of the Ministry’s workshop and training events. The National Institute of Water Resources, made a presentation as part of the program during who are also interested in using the results of this project.

Strong relations have been established with the Centre for Tropical Ecology and Climate Change (Centro de Ecologia Tropical e Alterações Climáticas –CETAC) based in Huambo. This institution is charged with analyzing climate and meteorological information for Angola. Previously there has been no institution with this remit and INAMET did not consider it part of its duties. Development Workshop’s paper on rainfall aroused interest and further discussions have taken place with CETAC about how this may form the basis for future climate analysis by CETAC.

Development Workshop participated in a national civil society event on Climate Change in December 2014 organised by the Angolan Council of Churches. The findings of the research were presented at the 2<sup>nd</sup> National Conference on Environment and Sustainable Development at Mandume University in the southern coastal city of Namibe (an area severely affected by climatic variation).



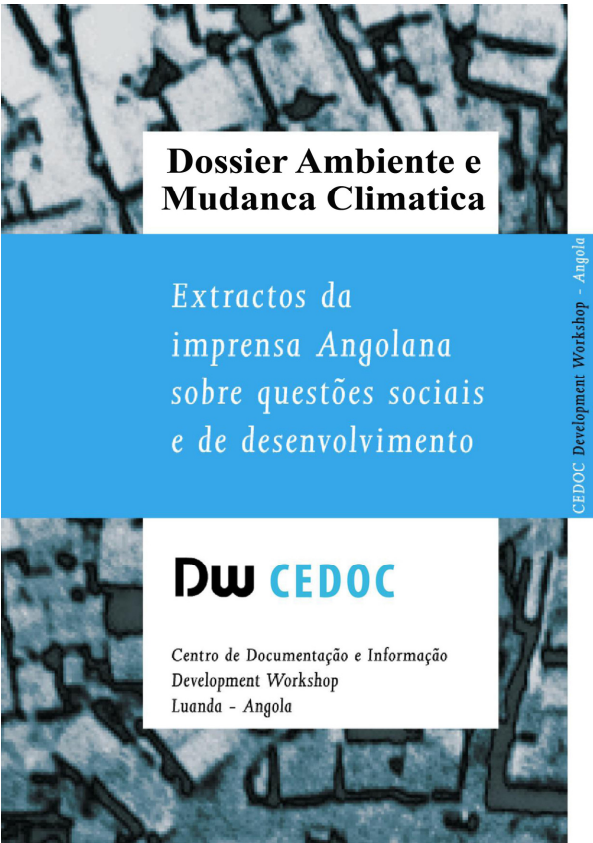
A strategic meeting was held in April 2015 with the Institute for the Formation of Local Municipal Administrations. An agreement was made for Development Workshop to provide training for the technical staff of municipalities in participatory mapping for developing adaptation plans. This will provide an opportunity for lessons and methodologies developed in the current project to be scaled up across the country and achieve a significant impact.

**4.3 Relevant Media Scan and Information Mapping for Correlations**

**Summary of activities in this period.**

Information from media scanning has been inputted into the data-base on unusual climate events has been updated until the end of 2014.

DW publishes a monthly media scan which includes a section on Climate Change and Environmental issues. The information is sourced daily from the public private and community media, journals and newspapers. Annual compilations of information are published annually on these thematic areas and made available through the Internet.



#### **4.4 Financial Mobilisation**

In the initial budget design it was foreseen that Development Workshop would need to mobilise a further US\$ 200,000 in order to carry out the project as planned. It has become evident in the first reporting period of the project that this ambitious research project will require more financial resources than anticipated. The weak existing climatic data and the actual scale of the accelerating growth of Angolan coastal cities means that the project team needs to re-assess budget requirements. DW is therefore seeking a further US\$500,000 for the project. The Angolan Ministries of Environment and Water & Energy have committed to assist us in mobilizing additional resources for the project. A Global Environment Facility (GEF) Project Identification Form (PIF) was developed some time ago entitled "Addressing Urgent Coastal Adaptation Needs and Capacity Gaps in Angola". This was eventually recommended for clearance by the GEF CEO in the second half of 2013, and was approved by the GEF council during the first part of 2014 (GEF identification number 5230). Discussion have begun regarding the implementation of this project with the strong expectation that the work already carried out and in progress by Development Workshop will feed into this project. This is a full size project. The United Nations Environment Programme (UNEP) is the lead agency with the United Nations Development Programme (UNDP) as the secondary UN agency.

<http://d7.thegef.org/geffsp>

Applications have continued to be made to potential bilateral and corporate donors. The commitment from IDRC to support the project provides potential project financiers with confidence in the quality and pertinence of the proposal and has opened doors for future support. In March 2014 DW made an application to the NEPAD Climate Change Fund for Euros 200,000 but this was unsuccessful.

An application was made in September 2014 to the Climate and Development Knowledge Network's Climate Compatible Development Impact Research Fund (in the UK). Information was recently received that this application was also not successful.

#### **4.5 Budget Forecast Variance**

It had been anticipated that DW would have been able to secure additional counterpart funds which would have been applied to the budget lines where expenditures have been the greatest such as Travel. New funds have not yet been secured, which may mean that DW will request permission from IDRC to readjust some of the lines in the budget and extend the project for an additional four months as a no-cost extension.

## 5 PROJECT OUTPUTS AND DISSEMINATION

A Climate Change program website has been launched through DW's Internet domain. <http://www.dw.angonet.org/content/climate-change> The site contains project documents, events, such as workshops and debates and other related documentation.

Presentation of project results were made on 5 December, 2014 at a national Workshop on Urban Studies in Luanda <http://www.dw.angonet.org/forumitem/workshop-de-estudos-urbanos-em-angola-0>. DW also participated in the national civil society Conference on Climate Change in December 2014 organized by the Angolan Council of Churches.

Presentation of preliminary project results have been made to CETAC (the Centre of Tropical Ecology and Climate Change) and to the National Institute of Water Resources.

The findings from the current research were presented by DW's director at the World Bank's Conference on Land and Poverty held in Washington DC from March 23 to 27, 2015. The paper titled Climate Change and Land Markets in Coastal Cities of Angola – the case of Luanda, was published by the World Bank. <http://www.dw.angonet.org/forumitem/climate-change-and-land-markets-angola>

After an agreement made with IFAL in April 2015, preparations are being made for dissemination of project results to local government bodies, particularly to raise their awareness about environmental risks. To make this more sustainable, the information will be partly disseminated through the Institute for Training of Local Government (IFAL - Instituto de Formação da Administração Local) who will incorporate project results into their long-term training materials. Preparations include production of posters and other material, and discussions with IFAL about the modalities of incorporation into their materials.

IDRC's Water & Climate Change program in Ottawa asked Development Workshop's director to prepare two presentations on its current and past research programs for the 2015 World Water Congress in Edinburgh. A peer reviewed paper is also being prepared for a special journal issue on IDRC's Water & Climate Change research internationally. DW's director was invited to be the keynote speaker for one of the themes on Water Governance and Markets at the Edinburgh Congress.

### **Achievement of Milestones**

#### ***Satellite images, rainfall data, vegetation, geology and hydrology data obtained:***

Most work on data gathering was done in previous reporting periods. However new satellite imagery was obtained for Luanda during the current period and extensive work has been done on updating maps, settlement typologies and risk mapping using the new images.

#### ***Relations with partner institutions outside Angola established:***

A relationship has been maintained with the Climate Systems Analysis Group at the University of Cape Town by securing a training position for one of DW's climate project staff in the 2015 winter training program in Cape Town.

Forum on Water in Portuguese – Speaking Countries – presented paper at annual in 2014 in Lisbon.

***Relationships with national government and local government institutions established:***

A good relationship has been maintained during the reporting period with the Ministry of the Environment (National Environment Directorate), National Water Department (Direcção Nacional de Águas- DNA), National Institute of Water Resources (Instituto Nacional de Recursos Hídricos) and the Centre for Tropical Ecology and Climate Change (Centro de Ecologia Tropical e Alterações Climáticas –CETAC) based in Huambo.

***Scanning the public, independent and community media being put in place:***

Information in the local media on environmental issues continues to be extracted and copied, and is being analysed during this reporting period and monthly media abstracts are posted on the DW WebSite: <http://dw.angonet.org/pt-pt/cedoc>

***Written records of notable climate events and notable flooding, erosion or drought events (newspapers, emergency bulletins, food security bulletins) from post-Independence period in the relevant coastal urban areas and the relevant river basins will have been collected.***

These have been collected in previous reporting periods.

***Oral histories from key informants of notable climate events and notable flooding, erosion or drought events from recent years in the relevant coastal urban areas and the relevant river basins, along with information on contextual information such as changes in vegetation and settlement patterns will have been collected.***

Oral history collection in Benguela and Lobito focus on recent disastrous high rainfall events that have occurred in March 2015 in these cities.

***A database of notable climate events and notable flooding, erosion or drought events from recent years in the relevant coastal urban areas and the relevant river basins (from the collected oral histories and written records, organised and referenced spatially and temporally and with source information) will have been created.***

During the current reporting period the database has been updated and records continue to be added.

***Annual, seasonal and monthly means and variability of rainfall for each relevant station will have been calculated and mapped from existing rainfall data and satellite-based measures of cloud cover and precipitation. Graphs of annual variations will have been made.***

This activity took place in previous reporting periods.

***Information on annual variations and database of notable events will have been used to identify linkages between events (such as high rainfall events and flooding) linkages to ENSO and fluctuations in the Benguela Current. (This will involve looking for trends and, in cooperation with climate scientists, seeking correlations with outside factors).***

The full use of satellite-based rainfall estimates has not been possible. It has proven difficult to correlate satellite estimates with metrological data collected on the ground by INAMET stations.

***Using existing river flow data, oral histories and written records, trends and variability in key river basin parameters will have been analysed. A description of key river basin parameters of basins affecting urban coastal areas of Angola, and possible implications of climate change on these basins, will have been made.***

Historic documentation from the colonial era have been obtained but this activity has not produced useful results in the current reporting period.

***Luanda: Satellite images of Luanda will have been obtained. Zones of the urban area with similar dates of construction and social characteristics will have been defined and delimited using examination of satellite images, local observation and interviews with key informants.***

During the current reporting period up-to-date images for Luanda were obtained for zones of the urban area have been defined, including new areas of the city.

***Luanda: The data on number of structures and on number of people per structure will have been used to make an estimate of population, population densities and population trends.***

With the new good quality up-to-date satellite images have become available for Luanda, and data from the Census and the information on the number of people per structure are available from the household survey, the demographic model for Luanda is being updated. Structures in each zone have been counted and estimates of population have been made. Estimates of population agree closely with the preliminary results from the recent National Census (the first since 1971), which suggests that the method of population estimate from the methodology developed by Development Workshop provides good estimates of population. New risk maps are being prepared but will not be available until the final reporting period.

***Luanda: Present-day satellite images and any previous mapping of the urban area will have been used to map the current urban area and past growth of the area.***

The present urban area has been mapped and information on the past urban area is being collected and will only be available during the final reporting period.

***Luanda: Demographic analysis will have been completed, including population figures by area and figures on trends and future scenarios maps of the urban areas, the extent of urban areas at different dates, and maps of growth and densities of population.***

Information from the household questionnaire survey has been analysed and data are now available on average household size in different housing areas. Up-to-date good quality satellite images are now available for the roof-top counting. Population estimates are being made and will only be available during the final reporting period.

***Luanda: Household surveys will have been carried out, ensuring that each identified zone is covered. This will provide information on the number of people per household, social indicators, land values, and experience of flooding and climate variation, water access, use and price.***

The household survey was carried out in an previous reporting period.

***Luanda: The clustering of socio-economic indicators in the defined areas will have been checked statistically to refine the definition of zones.***

Data have been analysed and a revised settlement typology map is being prepared and will only be available during the final reporting period.

***Luanda: Socio-economic description and mapping of, social characteristics and indicators, distribution of population and poverty levels will have been completed.***

A report and maps are being prepared and will only be available during the final reporting period.

***Luanda: Satellite images and field observation will have been used to map the main and critical features, and to delimit and map flood areas that have experienced flooding,***

Risk maps with layers that allow viewing of different combinations of indicators are being prepared in the form of posters for distribution to each programme area and will only be available during the final reporting period.

***Luanda: Areas that are at risk from flooding and erosion under plausible range of future changes, areas at risk from sea-level rise and salt-water intrusion (under present and possible future conditions) will have been mapped. This will have been cross-checked with oral history of past events and their impact.***

Good quality up-to-date satellite images have become available and areas at risk have been mapped. Posters are being prepared and will only be available during the final reporting period.

***Luanda: Description of, and mapping of, environmental vulnerability will have been completed, which will include maps of risk zones under present and future conditions***

***and descriptions of events and risks and impacts; .also a comparison with population distributions and social conditions.***

Good quality up-to-date satellite images have become available and areas at risk have been mapped. Posters are being prepared and will only be available during the final reporting period.

***Luanda: Key informant surveys about water supply systems in the relevant coastal urban areas will have been carried out. The structure and use of the water supply system will have been observed, noted and mapped. .***

The relevant information has been collected about the water system and will only be mapped and made available during the final reporting period.

***Luanda: A rapid survey of prices of water in various areas will have been carried out and this information will have been mapped.***

The survey of water prices has been carried out and data have been analysed and will only be available during the final reporting period.

***Luanda: Tests of the quality of water will have been carried out.***

Testing of water quality is in progress and will only be available during the final reporting period.

***Luanda: From the household survey, key informant interviews, observation, water quality data and price mapping, how water is supplied will have been documented, describing the supply chains, prices at various stages of the supply chains, organisation of water markets, quality, reliability and price (and variation of these attributes by season and by year).***

Information from the household questionnaire survey has been collected in an earlier reporting period.

***Luanda: An assessment will have been made of how present and possible future climatic conditions (variability and possible trends) impact on water supply systems for urban areas and thus on water markets, water access and affordability.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Luanda: Mapped information will have been superimposed to examine correlations, in each urban area, between different variables. A series of maps will have been produced, that combine the maps that form part of the other outputs, using the maps as layers, to***

***allow analysis of the possible geographical overlap between different hazards and between hazards and socio-economic vulnerability.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Satellite images of Cabinda will have been obtained. Zones of the urban area with similar dates of construction and social characteristics will have been defined and delimited using examination of satellite images, local observation and interviews with key informants.***

Defining the typology of urban areas of Cabinda has been carried out in a previous reporting period.

***Cabinda: Counting of rooftops on the satellite images will have been carried out, to make a count of the number of structures in each delimited zone***

Roof-top counting has been carried out in a previous reporting period.

***Cabinda: Present-day satellite images and any previous mapping of the urban area will have been used to map the current urban area and past growth of the area.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Demographic analysis will have been completed, including population figures by area and figures on trends and future scenarios maps of the urban areas, the extent of urban areas at different dates, and maps of growth and densities of population.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Household surveys will have been carried out, ensuring that each identified zone is covered. This will provide information on the number of people per household, social indicators, land values, and experience of flooding and climate variation, water access, use and price.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: The clustering of socio-economic indicators in the defined areas will have been checked statistically to refine the definition of zones.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Socio-economic description and mapping of, social characteristics and indicators, distribution of population and poverty levels will have been completed.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Satellite images and field observation will have been used to map the main and critical features, and to delimit and map flood areas that have experienced flooding, slopes that have experienced erosion in the past.***

This activity was completed in an earlier reporting period..

***Cabinda: Areas that are at risk from flooding and erosion under plausible range of future changes, areas at risk from sea-level rise and salt-water intrusion (under present and possible future conditions) will have been mapped. This will have been cross-checked with oral history of past events and their impact.***

This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Description of, and mapping of, environmental vulnerability will have been completed, which will include maps of risk zones under present and future conditions and descriptions of events and risks and impacts; .also a comparison with population distributions and social conditions.***

The satellite images and field observation have been used to prepare a map that shows important physical features. This has been used to map flood risk areas and areas that have experienced flooding, and urbanised areas that are on slopes. This map has layers that allow viewing of different combinations of indicators. This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Key informant surveys about water supply systems in the relevant coastal urban areas will have been carried out. The structure and use of the water supply system will have been observed, noted and mapped.***

This information is being presented in the form of a poster and will only be available during the final reporting period.

***Cabinda: A rapid survey of prices of water in various areas will have been carried out and this information will have been mapped.***

A rapid survey of water prices has been carried out. The resulting information is being written up and mapped. This information is being presented in the form of posters and will only be available during the final reporting period.

***Cabinda: Tests of the quality of water will have been carried out.***

Testing of water quality has not been done due to budget constraints.

***Cabinda: Mapped information will have been superimposed to examine correlations, in each urban area, between different variables. A series of maps that combine the maps that form part of the other outputs, using the maps as layers, to allow analysis of the possible geographical overlap between different hazards and between hazards and socio-economic vulnerability.***

A base map is being prepared and the data for the various layers have been compiled and analysed. This information is being presented in the form of a poster and will only be available during the final reporting period.

***Benguela and Lobito: - Satellite images of Benguela and Lobito will have been obtained. Zones of the urban area with similar dates of construction and social characteristics will have been defined and delimited using examination of satellite images, local observation and interviews with key informants.***

This was completed in an earlier phase of the project.

***Benguela and Lobito: - Counting of rooftops on the satellite images will have been carried out to make a count of the number of structures in each delimited zone***

Roof-top counting has been carried out, by zone in an earlier phase of the project

***Benguela and Lobito: - Present-day satellite images and any previous mapping of the urban area will have been used to map the current urban area and past growth of the area.***

This was completed in an earlier phase of the project.

***Benguela and Lobito:- Demographic analysis will have been completed, including population figures by area and figures on trends and future scenarios maps of the urban areas, the extent of urban areas at different dates, and maps of growth and densities of population.***

During the current reporting period information from the household questionnaire survey has been analysed and data are now available on average household size in different housing areas. Roof-top counting has been carried out. Population estimates have been made.

***Benguela and Lobito: - Household surveys will have been carried out, ensuring that each identified zone is covered. This will provide information on the number of people per household, social indicators, land values, and experience of flooding and climate variation, water access, use and price.***

The household surveys in Benguela and Lobito took place soon after the national census has been completed, with a sample size of 1500. A questionnaire was used with questions about number of people per household, social indicators, land values, and experience of flooding and climate variation, water access, use and price.

***Benguela and Lobito: - The clustering of socio-economic indicators in the defined areas will have been checked statistically to refine the definition of zones.***

Data have been analysed and maps prepared (see Figs 1 through 5 in the current report)

***Benguela and Lobito: Socio-economic description and mapping of, social characteristics and indicators, distribution of population and poverty levels will have been completed.***

Information from the household questionnaire survey has been analysed for this purpose and a working paper on the social characteristics of Luanda, the distribution of population and poverty levels has been prepared.

***Benguela and Lobito: Satellite images and field observation will have been used to map the main and critical features, and to delimit and map flood areas that have experienced flooding, slopes that have experienced erosion in the past.***

The satellite images and field observation have been used to prepare a map in an earlier phase of the project.

***Benguela and Lobito: - Areas that are at risk from flooding and erosion under plausible range of future changes, areas at risk from sea-level rise and salt-water intrusion (under present and possible future conditions) will have been mapped. This will have been cross-checked with oral history of past events and their impact.***

The satellite images and field observation have been used to prepare a map that shows important physical features. This has been used to map flood risk areas and areas that have experienced flooding, and urbanised areas that are on slopes. This map has layers that allow viewing of different combinations of indicators.

***Benguela and Lobito: Description of, and mapping of, environmental vulnerability will have been completed, which will include maps of risk zones under present and future conditions and descriptions of events and risks and impacts; .also a comparison with population distributions and social conditions.***

The satellite images and field observation have been used to prepare a map that shows important physical features. This has been used to map flood risk areas and areas that have experienced flooding, and urbanised areas that are on slopes. This map has layers that allow viewing of different combinations of indicators. (see Figs 1 through 5 in the current report)

***Benguela and Lobito: - Key informant surveys about water supply systems in the relevant coastal urban areas will have been carried out. The structure and use of the water supply system will have been observed, noted and mapped.***

Information about the water-supply system has been collected in an earlier phase of the project.

***Benguela and Lobito: - A rapid survey of prices of water in various areas will have been carried out and this information will have been mapped.***

A rapid survey of water prices has been carried out. The resulting information is being written up and mapped.

***Benguela and Lobito: - Tests of the quality of water will have been carried out.***

Testing of water has not been conducted due to budgetary constraints.

***Benguela and Lobito: - From the household survey, key informant interviews, observation, water quality data and price mapping, how water is supplied will have been documented, describing the supply chains, prices at various stages of the supply chains, organisation of water markets, quality, reliability and price (and variation of these attributes by season and by year).***

This information is being presented in the form of a poster and will only be available during the final reporting period.

***Benguela and Lobito: Mapped information will have been superimposed to examine correlations, in each urban area, between different variables. A series of maps that combine the maps that form part of the other outputs, using the maps as layers, to allow analysis of the possible geographical overlap between different hazards and between hazards and socio-economic vulnerability.***

A base map is being prepared and the data for the various layers have been compiled and analysed. This information is being presented in the form of a poster and will only be available during the final reporting period.

***The evaluation will be underway.***

This will be prepared in the last reporting period of the project.

***Reviews of policy developments in areas of climate change, water and poverty alleviation, and public awareness in these areas, based on information from local media, will have been completed.***

This will be carried out in the last reporting period of the project.

***Making information available to local policy-makers will be underway. Influencing of public policy change will be underway, by feeding results into national forums that already exist (such as the National Urban Forum, the National Water Forum and the high-level working groups on climate change adaptation) and specific partners such as Provincial Governments and Municipalities.***

Preparations are being made to

***Finalisation of outputs will be underway.***

Draft reports are being reviewed.

***Preparation of presentations and easy-to-read poster format documents on findings of the project for use by local government and civil society organisations will be underway***

Posters are being prepared for use in talks to local government and for use in courses by the Instituto de Formação da Administração Local.

***Preparation of data-sets to be available in public domain will be underway***

Discussions have been held with bodies such as CETAC and the Instituto Nacional de Recursos Hidricos about potential use of data-sets and the conditions for their use.

***Preparation of a monograph on the findings of the project in Portuguese and English will be underway***

This is being prepared.

***Preparation of papers on the findings of the project in peer-reviewed journals will be underway***

A article for a peer-reviewed journal has been prepared on invitation from IDRC connected with the 2015 Edinburgh World Water Congress. An article (in Portuguese) is also planned for Angolan journal.

	<b>Months 1 – 6</b>	<b>Months 7 - 12</b>	<b>Months 13- 18</b>	<b>Months 19 - 24</b>	<b>Months 25- 30</b>	Months 31 – 40
Preparation. Obtaining satellite images. Obtaining rainfall data Obtaining river flow and vegetation data	<b>XXXXXX</b>				<b>XXXXXX</b>	
Rainfall and river-flow activities (specific objective 1)		<b>XXXXXX</b>	<b>XXXXXX</b>	<b>XXXXXX</b>		
Activities in Luanda (in specific objectives 2 and 3)	<b>XX</b>	<b>XXXXXX</b>			<b>XXX</b>	
Activities in Cabinda (in specific objectives 2 and 3)	<b>XX</b>	<b>XXXX</b>	<b>XXXXXX</b>	<b>XX</b>		
Activities in Benguela and Lobito (in specific objectives 2 and 3)	<b>XX</b>		<b>XXXXXX</b>	<b>XXXXXX</b>	<b>XXXXXX</b>	
Finalisation of outputs and dissemination					<b>XXX</b>	<b>XXXXXX</b>
End of project Evaluation						<b>XX</b>

## **6 IMPACT**

The project has contributed to the development of the Angolan public policy development on adaptation to climate change, Partnership with IFAL can ensure that project strategies on preparing municipal adaptation plans are replicated across the country.

## **7 RECOMMENDATIONS**

A four month no-cost extension is requested from November 2015 through February 2016 in order to recover lost time due to project staffing constraints.