ACC DAR Adapting to Climate Change in Coastal Dar es Salaam

FINAL NARRATIVE REPORT

Project title: **Adapting to Climate Change in Coastal Dar es Salaam**

Project acronym: **ACC Dar**

Grant Contract Beneficiary: **Sapienza University of Rome (DICEA)**

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Partner in the Action: **Ardhi University of Dar es Salaam (ARU)**

Associate in the Action: **Dar City Council (DCC)**

Reporting period: **From 01/02/2013 to 31/08/2014**

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Data contribution and reviews to the successful submission of this report have been provided by all the project team members. The contents and the related figures are part of the project results.

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THIRD INTERIM NARRATIVE REPORT

1 DESCRIPTION

1.1. Name of beneficiary of grant contract: Sapienza University of Rome

1.2. Name and title of the Contact person: Prof. Silvia Macchi, Project Coordinator

1.3. Name of partners in the Action: Ardhi University of Dar es Salaam (ARU)

1.4. Title of the Action: Adapting to Climate Change in coastal Dar es Salaam (ACC DAR)

1.5. Contract number: 2010/254-773

1.6. Start date and end date of the reporting period: from 1st of February 2013 to 31st of August 2014

1.7. Target country(ies) or region(s): Tanzania, Dar es Salaam

1.8. Target groups: Dar's municipalities and their wards laying on the Ocean coast

Final beneficiaries: Inhabitants of Dar's coastal areas

2 ASSESSMENT OF IMPLEMENTATION OF ACTION ACTIVITIES

2.1 EXECUTIVE SUMMARY OF THE ACTION

ACC Dar project aims at improving the effectiveness of Dar's municipalities initiatives for supporting those coastal peri-urban dwellers partially or totally depending on natural resources in their efforts to adapt to climate change (CC) impacts. More specifically, the objective of the action is to improve the capacities of Dar's municipalities by providing them with enhanced methodologies for mainstreaming adaptation into their Urban Development and Environment Management (UDEM) strategies and plans, and by increasing their understanding of adaptation practices.

The Department of Civil, Building and Environmental Engineering, Sapienza University of Rome (SAPIENZA) is acting as the project coordinator, Ardhi University (ARU) as the local partner and the Dar City Council (DCC) as associate. The main stakeholders in the action are the three municipalities of Dar es Salaam region: Ilala, Temeke and Kinondoni.

This report covers the final project period from 1st of February 2013 until 31st of August 2014. The project activities are clustered under three work packages (WP): WP1, which was completed before this reporting period; WP2 and WP3, which ended their activities under the reporting period.

Three main activities have been carried out under the WP1 in order to **improve understanding in CC adaptation:** i) a survey on a sample of 6000 households that provided improved knowledge about livelihoods, CC concerns and adaptive strategies of those living in peri-urban areas within the coastal plain (activity 1.1); ii) an assessment of CC related activities already undertaken by the local government authorities (LGA) (activity 1.2); iii) a series of participatory activities performed using the forum theatre technique in order to explore local options of autonomous adaptation and raise awareness on CC issues (activity 1.3).

Activities under the WP2, that aim to **develop methodologies for designing adaptation initiatives,** have been implemented in three steps started during the first year project and completed under the reporting period.
As a first step, a methodology for exploring future scenarios of CC vulnerability in a forecasting approach was developed. The current conditions of the coastal shallow watershed were assessed on the basis of data from boreholes monitoring, and the main climatic and non-climatic drivers of seawater intrusion (i.e. urban sprawl and rainfall patterns) were analysed. This allowed for the formulation of a future scenario of seawater intrusion as a primary factor of vulnerability for peri-urban households within the coastal plain.
Secondly, in order to ensure that LGAs' adaptation initiatives be informed by people's aspirations for the future, a methodology for identifying societal adaptation objectives in a participatory way was developed. A community-based scenario exercise was carried out in one of the peri-urban target areas (in Kigamboni) combining backcasting scenario approach with forum theatre techniques. Through this process the community was able to provide indications of what kinds of action should be taken to change current environmental management and decision-making in order to achieve their vision for a desired future.
Lastly, the third step has been devoted to develop a methodology for integrating the CC concerns (from step 1) and the societal adaptation objectives (form step 2) into the existing UDEM plans and programs. As a result, mainstreaming guidelines were drawn up to be applied under WP3.

The WP3 aims **to build the LGAs' capacity** in understanding CC issues specific to peri-urban livelihood in the coastal plain and identifying effective measures for supporting the coastal peri-urban inhabitants in their efforts to adapt to CC. Activities under WP3 consists of a component that involved

LGAs' personnel in the implementation stage and a back-office component carried out by the project team.
More in detail, two cycles of residential training involving 38 officers from UDEM units within DCC, the three Dar's Municipalities and Ruvu Basin Authority were successfully carry out. The training programme was designed on the basis of the need assessment results. As a major result, five adaptation project proposals have been designed by the local officers involved in the training. Those proposals were discussed during the conference held in Dar es Salaam in September 2013.
At the same time, an excise for mainstreaming CC adaptation into existing local plans was conducted by the project team, following the guidelines drawn up under WP2. Four different types of UDEM plans were considered, and recommendations was developed as suggestions to improve the sustainability of planning provisions under conditions of CC and increasing urban sprawl, These recommendations were shared and discussed with the LGAs' representatives during the third international workshop held in Dar on June 2014.

For each of the three project WPs, the work-plan also includes an **International Workshop,** whose aim is threefold: to evaluate the achieved results with the support of external experts; to disseminate and share the results among academics and practitioners from EU and EAC; and to create network effects. The second and the third workshops were held during the reporting period. More in detail, the three International Workshops are:

I. "*Sub-Saharan cities under climate change. Exploring the adaptive capacity of peri-urban settlements in coastal Dar es Salaam, Tanzania"* , Dar es Salaam, 6-8 June 2012
II. "*Towards scenarios for urban adaptation planning. Assessing seawater intrusion under climate and land cover changes in Dar es Salaam, Tanzania*", Rome, 20-22 April 2013
III. *"Mainstreaming climate change adaptation into urban development and environmental management plans and programs",* Dar es Salaam, 9-10 June 2014

Working papers for each activity have been produced as well as a video showing in detail the methodology and the results of the participatory activities. The **dissemination** of the whole action has been ensured through a spread participation in international and national conferences, workshops, seminars and events related to CC and adaptation issues in order to present and validate the results achieved. All the project materials are available at the project web site www.planning4adaptation.it under the section "dissemination". More in detail, four sub-sections have been created as follows:

- "Papers", including working papers related to each project result and academic papers published in journal and conferences proceedings;
- "Maps & Database", including six land cover maps and related GIS files, an excel database from the household survey with the related questionnaire, and an access database containing georeferenced data about boreholes characteristics and groundwater quality from historical datasets and boreholes monitoring activity conducted under WP2;
- "News/Information Materials", including materials from the three project International Workshops as well as from the participation of the project team in other national and international workshops, forum, conferences related to CC and adaptation issues;
- "Monitoring and Evaluation", including results-oriented monitoring reports, technical reports and evaluation reports.

The strong commitment and the availability of the local authorities in Dar es Salaam at all institutional levels involved (DCC, Dar's municipalities, community leaders and street leaders) has been an asset that secured the project goals achievement.

2.2 ACTIVITIES AND RESULTS

Three work packages have been designed in order to secure success in all the activities of the action and to achieve the expected results. A WP "0" includes management and coordination activities. Each WP consists of several activities. The whole structure of the action and the functional relationship among all the sub-activities is shown by the following flow chart.

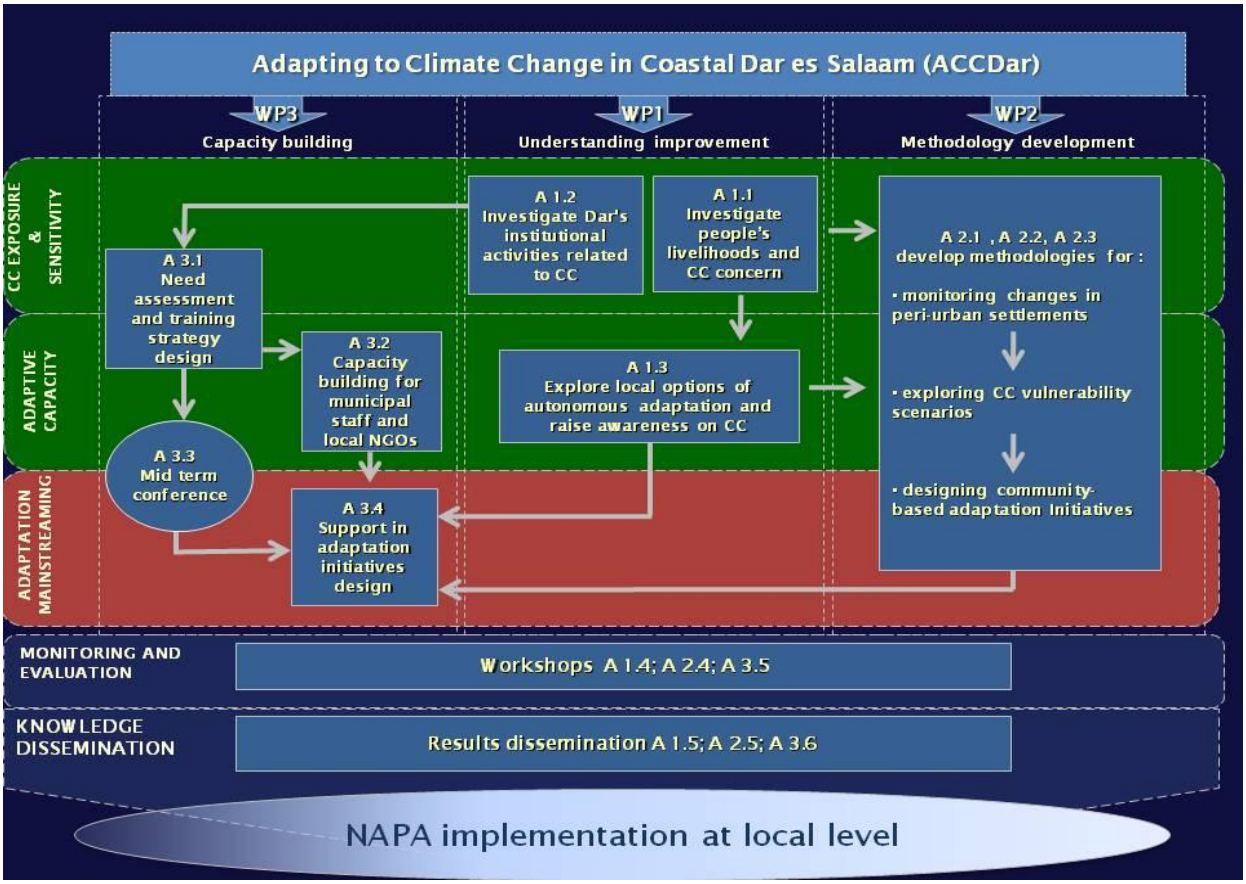


Figure 1 Project methodology chart

The project does not aim at preparing an additional plan, rather it seeks to build knowledge and develop methodologies with a twofold purpose: to mainstream adaptation objectives in current plans and programs related to UDEM and to contribute to improve their effectiveness.

WORK PACKAGE 2: "DEVELOP METHODOLOGIES FOR DESIGNING ADAPTATION INITIATIVES"

The activities foreseen within the WP2 of the project are addressed to the specific objective of developing methodologies for integrating adaptation activities into strategies and plans for UDEM in coastal unplanned and underserviced settlements.

Activity 2.2 "Develop methodologies for exploring CC vulnerability scenarios"

Objectives

The activity 2.2 main goal is to **develop methodologies for exploring the vulnerability of coastal peri-urban population under CC in a scenario approach**. The seawater intrusion into the shallow aquifer has been selected as one of the main factors of vulnerability, since there is evidence that this environmental phenomenon is already contributing to the degradation of the coastal watershed upon which rely a large part of peri-urban inhabitants for access to water.

More in detail the activity aimed:
a) to understand the seawater intrusion's temporal evolution over the past years and assess the current condition of salinization in the coastal watershed
b) to understand the local dynamics ruling the environmental phenomenon for developing future scenarios of seawater intrusion under changes in climatic and non-climatic factors
c) to assess current vulnerability of coastal peri-uban population to access to water, drawing on a methodology previously developed for a case study in Kinondoni district
d) to assess the future vulnerability of people under changes in climatic and non-climatic factors, as a basis for the formulation of the adaptation objectives that will inform the planning process under the next activities.

Description of the activity

A series of tasks have been performed by the technical team from SAPIENZA and ARU over the project's three years in the purpose of realizing the specific objectives from a) to c):

i. Literature review (performed during the first year)
ii. Collection of historical dataset (performed during the first year)
iii. Groundwater monitoring (performed during the second and concluded during the third year)
During the reporting period, the last monthly monitoring campaign was performed by ARU team, involving 33 boreholes located in proximity of the coastline to complete the whole groundwater monitoring activity. The entire monitoring network is shown in the map here below, while the Figure 2 summarizes the whole set of monitoring campaigns conducted and their main features.

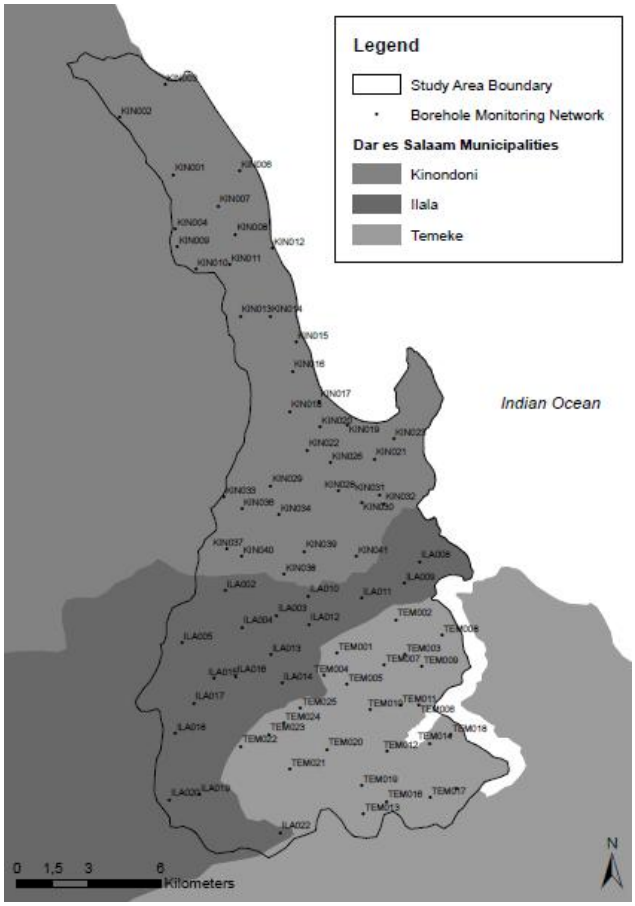


Figure 2 Boreholes monitoring network

Monitoring campaigns	Frequency	Data collected
Long-term monitoring activity involving the entire borehole network (79 boreholes)	Twice in 6 months: - June 2012 (after the *"long rainy season")* - November 2012 (before the "*short rainy season*")	SWL measure (using contact meters) Physical parameters in situ measure (using multiparametric probes): T, pH, EC, TDS Chemical parameters lab measure (laboratory analysis of collected water sample): Ca++, Mg++, Na+, K+, HCO3-, SO4--, Cl-, NO3--, F-, NH4+
Monthly monitoring activity involving a sub-group of the borehole network (33 boreholes, mainly located in the area close to the coastline)	Monthly: - September 2012 - October 2012 - March 2013	SWL measure (using contact meters) Physical parameters in situ measure (using multiparametric probes): T, pH, EC, TDS

Figure 3 The whole groundwater monitoring activity

iv. Design and set-up of a database gathering historical data and results from 2012 monitoring (performed during the second and concluded during the third year)

ARU team completed entering the data collected through the 5 monitoring campaigns and through the laboratory analysis results into the database developed by Sapienza.

v. Analysis of hydrochemical data
The analysis of the hydrochemical data collected through the project monitoring activity was carried out at Sapienza. Current level of seawater intrusion was assessed in order to identify areas where groundwater salinization is entirely or mainly attributable to seawater intrusion. More in detail, the study has proceeded according to the following steps:
- Elaboration of distribution maps for various parameters (TDS, Cl, SO4, and EC);
- Graphical representation in the form of a Piper diagram, in order to distinguish water types and identify the most significant groups;
- Data analysis using Cl—Y diagrams (cross plots) related to the theoretical freshwater-seawater dilution line;
- Hydrochemical facies analysis by Stuyfzand (1986, 1993) classification.

A representation of the steps of the analysis is reported in the Annex 1

vi. Study of the historical evolution of groundwater level
Sapienza team also studied prevailing trend in groundwater level within the coastal aquifer over the last ten year through the comparison of piezometric levels between 2003 and 2012 in order to improve understanding of the seawater intrusion dynamics (this is essential for the development of future scenarios of seawater intrusion under changes in climatic and non-climatic factors)

vii. Assessment of current trends in groundwater active recharge
The main climatic and anthropogenic dynamics influencing seawater intrusion evolution were assessed at Sapienza. Trends in rainfall were analyzed over fifty years while soil-sealing progression was assessed through the analysis of 2002-2012 land cover maps produced under activity 2.1. Two different scenarios of groundwater active recharge were hence calculated up to 2020, using the Most Frequent Value of Precipitation (MFVP) and Average Annual Precipitation Value (AAPV) respectively.

viii. Assessment of current trends in groundwater extraction
In order to estimate the groundwater extraction in the study area, household demand for water supply was calculated for years 2002-2011 using population estimation developed under activity 2.1. Four scenarios were considered that result from combining two hypotheses for the rate of households who satisfy their water need through groundwater extraction and two hypotheses for the quantity of per-capita water demand.

ix. Comparison of current trends of groundwater active recharge and extraction
Trends in groundwater active recharge (task vii.) and water supply withdrawal (viii.) were compared for years 2002-2011 in order to achieve a rough idea of the current hydrogeological balance in the coastal aquifer.

A simulation of the future rainfall patterns in Tanzania under global warming scenario RCP8.5 completed the above study. To this aim a Non-homogeneous Hidden Markov Model (NHMM) was developed using a 40-year record (1950-1990) of daily rainfall at eleven stations in Tanzania and reanalysis atmospheric fields of a number of meteorological variables affecting seasonal rainfall in Tanzania. Using NHMM, the best combination of atmospheric variables to construct a sufficiently accurate simulation of daily precipitation according to the gages considered was identified.

In order to realize the objective under d) (namely to assess the future vulnerability of people under changes in climatic and non-climatic factors), a new methodology was required to enable exploration of local communities' aspirations for the future as well as their potential for change. This is recognized as

a crucial step towards the formulation of the societal adaptation objectives that will inform the planning process under the next activities.
To this aim, a literature review was conducted at Sapienza in order to better understand the implications for adaptation planning of the two main approaches of scenario building: forecasting and backcasting. Differences between the two approaches in dealing with uncertainty and vulnerability issues and, consequently, in terms of potential for generating socially conservative versus transformative objectives for adaptation to climate change were explored, as highlighted in the table below.

FORECASTING APPROACH **Exploratory scenario** **(*What could happen?*)**	**BACKCASTING APPROACH** **Normative scenario** **(*How can a specific target be reached?*)**
Dominant role in informing CC impacts and vulnerability assessments for adaptation, especially at the national and regional levels	Its use in adaptation planning has not yet been widely experimented
Articulate different plausible societal developments Explore present-future pathways and possible societal consequences of a given phenomenon Understand problem boundaries, key trends and drivers	Generate desirable future visions Explore future-present pathways Individuate strategies, including system change actions, for achieving the desired future
The future, though uncertain, is strongly influenced by the current mechanisms Vulnerability is considered as an intrinsic individual characteristic that heavily influences the person's future trajectory Not suitable to support transformative planning processes, as it is based on dominant trends that may not apply in a specific local context Generate conservative adaptation objectives, i.e. extrapolated from the present conditions of vulnerability	The future is envisioned as a utopia, a desirable horizon beyond the current situation Vulnerability is considered as a contextual characteristic, determined by the complex system of relationships that the individual develops with society and the environment Suitable to support transformative planning processes, as it considers the present as just a starting state, thus detaching from the current drivers of vulnerability Can generate potentially transformative adaptation objectives
More suitable for the investigation of path-dependent systems, such as biophysical ones	More suitable for addressing the problem of decision-making when faced with highly uncertain systems whose trajectory depends on human choice

Figure 4 Forecasting vs backcasting scenario building approach

Achieved results

Once completed all the planned monitoring campaigns and the related laboratory analysis, the Access database including historical datasets collected was made public with free downloading on the project website at the following page:
http://www.planning4adaptation.eu/Docs/databases/ACCDAR_officialBMD.zip
The database lays foundation for systematic monitoring of the shallow aquifer's conditions. That information is crucial to inform LGAs' decision making in both water supply and urban development while improving knowledge on combined effects of changes in climatic and non-climatic factors.

The table below here offers a summary of the database contents.

Numbers and kinds of investigation and analysis results

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	June 2012	Nov 2012
G (mas)	32	6	52	15	8	6	5	4	1	54	0
depth	32	6	51	15	8	6	5	4	1	33	0
SWm	32	6	51	15	8	6	5	4	1	79	0
T C°	0	0	0	0	0	0	2	1	0	79	0
pH	32	6	52	15	8	6	5	4	1	79	0
EC uS/cm	32	6	52	15	8	6	5	4	1	79	0
Total Fitrate Residue mg/l	1	0	12	6	7	4	4	0	0	0	0
TDS mg/l	0	0	0	0	0	0	2	2	1	0	0
Carbonate Hardness mg CaCO3/	7	6	12	6	7	4	3	2	1	0	0
Non Carbonate Hardness mg CaCO3/	30	5	39	10	4	5	3	3	1	0	0
Ca mg/l	32	6	52	15	8	6	5	4	1	79	71
Mg mg/l	32	6	52	15	8	6	5	4	1	79	70
Na mg/l	32	6	52	15	8	6	5	4	1	79	70
K mg/l	32	6	52	15	8	6	5	4	1	79	70
Fe mg/l	26	5	47	15	8	4	5	3	1	0	0
Mn mg/l	25	5	21	10	7	2	4	2	0	0	0
NO3 mg/l	26	4	45	12	8	6	5	4	1	79	71
Cl mg/l	32	6	52	15	8	6	5	4	1	79	71
SO4 mg/l	32	6	52	15	8	6	5	4	1	79	71
PO4 mg/l	30	4	30	15	8	3	5	0	0	0	0
F	0	0	20	0	0	2	2	2	0	0	0
HCO3 mg/l	0	0	0	0	0	0	0	0	0	79	71
CO3 (mg/l)	0	0	0	0	0	0	0	0	0	0	23
P	0	0	0	0	0	0	0	0	0	0	71
ZN	0	0	0	0	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	0	0	0	0
NH4	0	0	0	0	0	0	0	0	0	0	71
MN	0	0	0	0	0	0	0	0	0	0	0

Figure 5 Summary of the database contents

The performance of tasks from v. to ix. led to achieve a set of relevant results, as described below. Firstly, areas where groundwater salinization is entirely or mainly attributable to seawater intrusion were identified. As shown in the map below here, those areas fall within the following wards:

- Kunduchi and Kawe, in the north of the investigation area;
- Ubungo, Mabibo, Manzese, Tandale, Ndugumbi and Makurumula, in the centre;
- Mikocheni and Msasani, on the eastern coast;
- Keko, Miburani, Yombo Vituka, Mbagala and Kurasini, in the south.

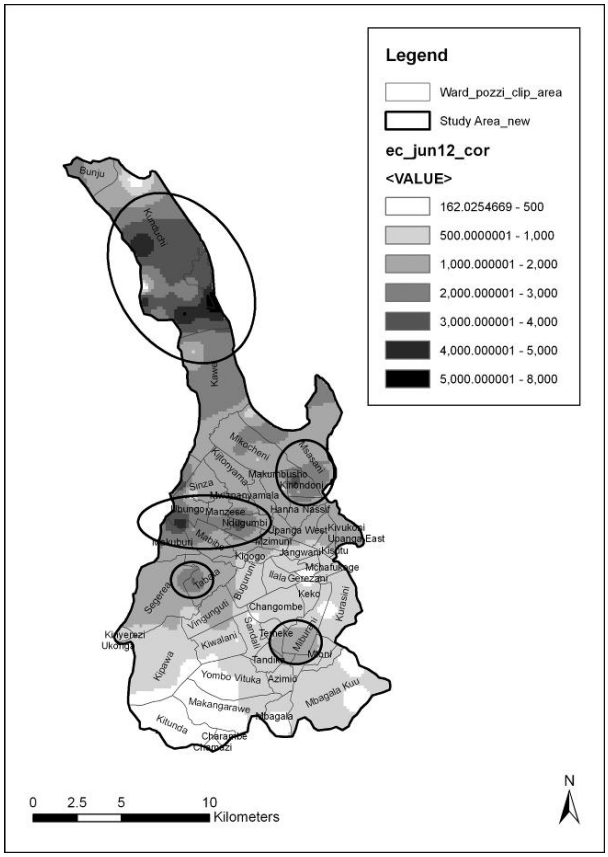


Figure 6 Map of groundwater salinity attributable to seawater intrusion in 2012

Secondly, an important lowering of piezometric levels over the period 2003-2012 was revealed, as shown in the map below. That phenomenon is diffused throughout the study area and locally related to the effect of seawater intrusion, because of the enlargement of the transition zone within the coastal aquifer.

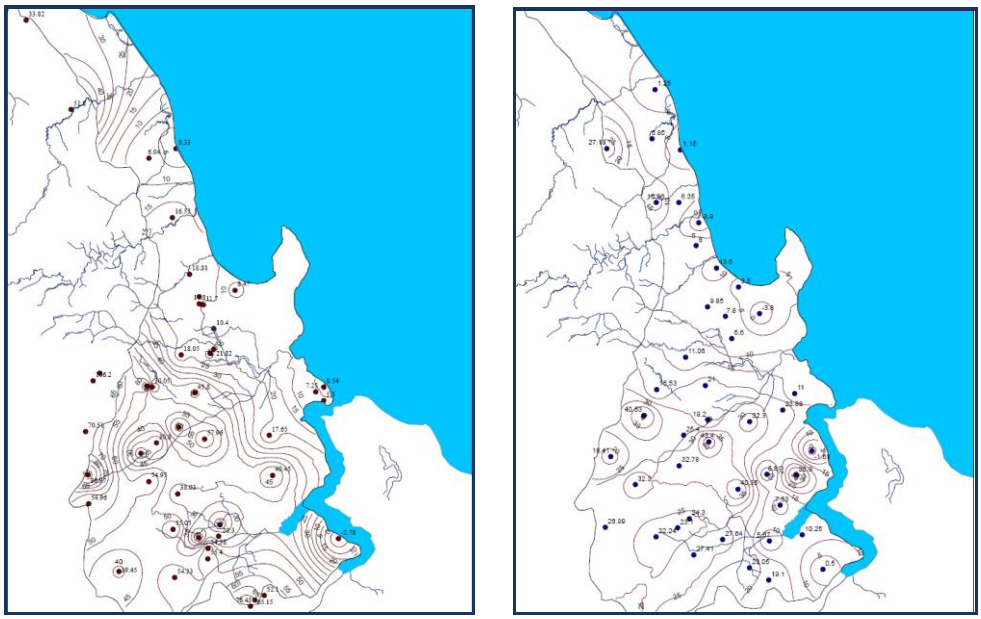


Figure 7 Historical evolution of groundwater

Thirdly, a decreasing trend in groundwater active recharge was assessed, due to a dropping in rainfall but even more importantly to a relentless expansion of built areas which results in a drastic reduction of natural soil and consequently of rainwater infiltration to the shallow aquifer.
It is worth noting that both of these factors are influenced by CC, which directly affects the evolution of precipitation while acting as a driver for urban sprawl. In fact, migration to the peri-urban areas has been found to be one of the most common strategies adopted by Dar es Salaam population to cope with environmental change.
Table below shows the scenarios developed up to 2020 as a projection from past trend into groundwater active recharge calculated for years 2002-2012.

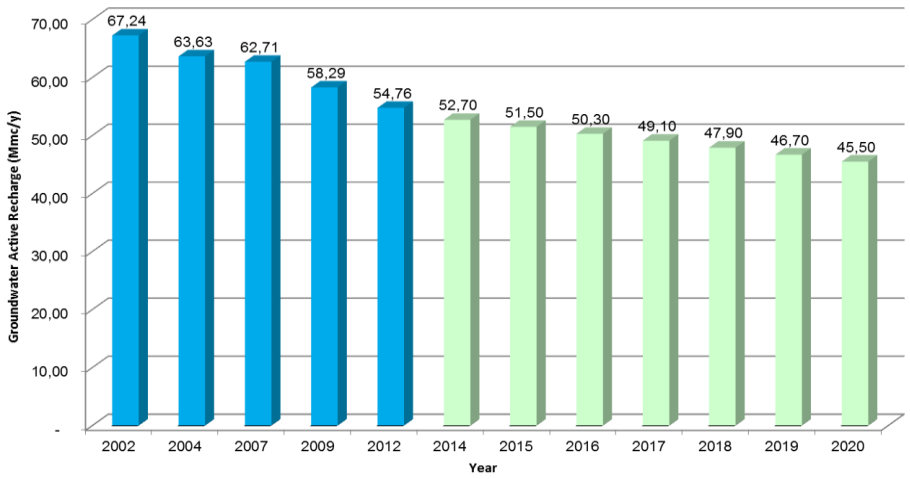


Figure 8 Groundwater active recharge evolution following the trend of the last ten years applying the MFPV

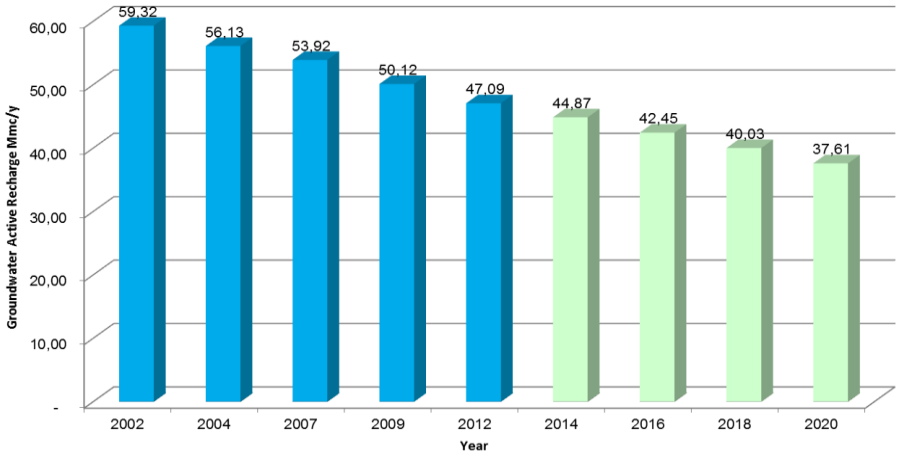
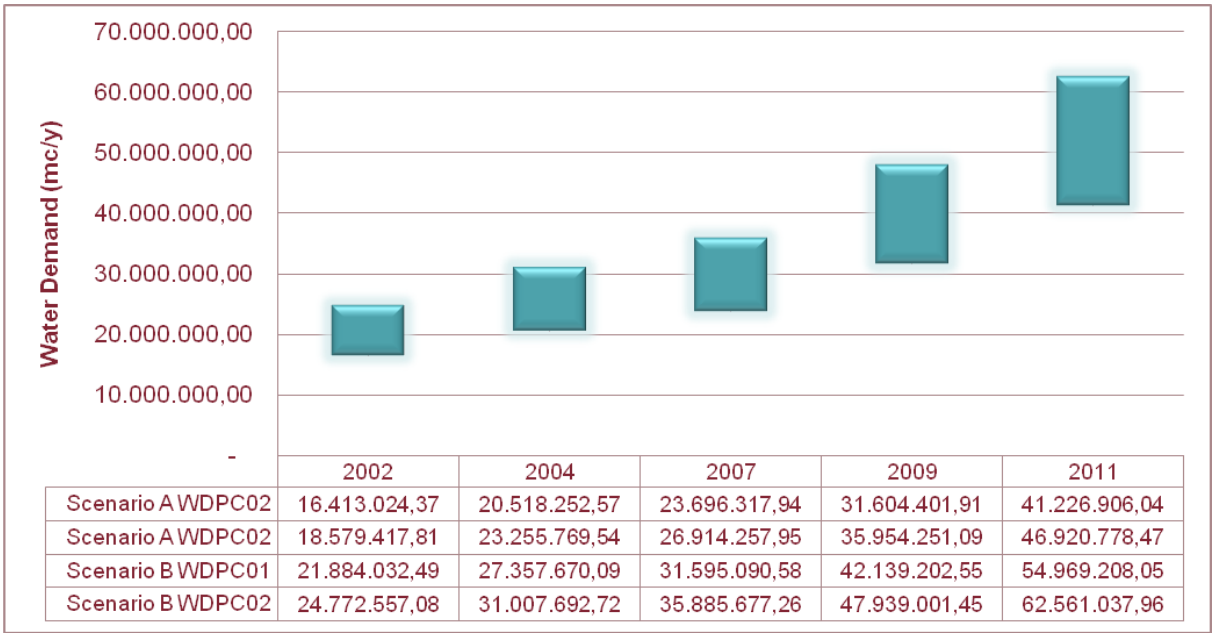


Figure 9 Groundwater active recharge evolution following the trend of the last ten years

Fourthly, it was assessed that groundwater exploitation for water supply by wells increased by over 150% for any considered scenario over the last ten years.



	2002	2004	2007	2009	2011
Scenario A WDPC02	16.413.024,37	20.518.252,57	23.696.317,94	31.604.401,91	41.226.906,04
Scenario A WDPC02	18.579.417,81	23.255.769,54	26.914.257,95	35.954.251,09	46.920.778,47
Scenario B WDPC01	21.884.032,49	27.357.670,09	31.595.090,58	42.139.202,55	54.969.208,05
Scenario B WDPC02	24.772.557,08	31.007.692,72	35.885.677,26	47.939.001,45	62.561.037,96

Figure 10 Water demand evolution

Lastly, it was established that current groundwater exploitation for water supply already exceeds the estimated active recharge, thus leading to a hydrogeological imbalance in the coastal aquifer.

These results should be considered as general trend rather than precise quantification. Nevertheless, they are sufficient to draw the conclusion that the coastal aquifer is increasingly sensitive to seawater intrusion mainly because of uncontrolled groundwater withdrawal by a growing number of households settled within the coastal plain. Moreover, hydrogeological unbalance in terms of groundwater level drawdown and seawater intrusion progression will increase even faster in the most densely populated and underserviced neighborhoods, given the influence of concentrated withdrawals.

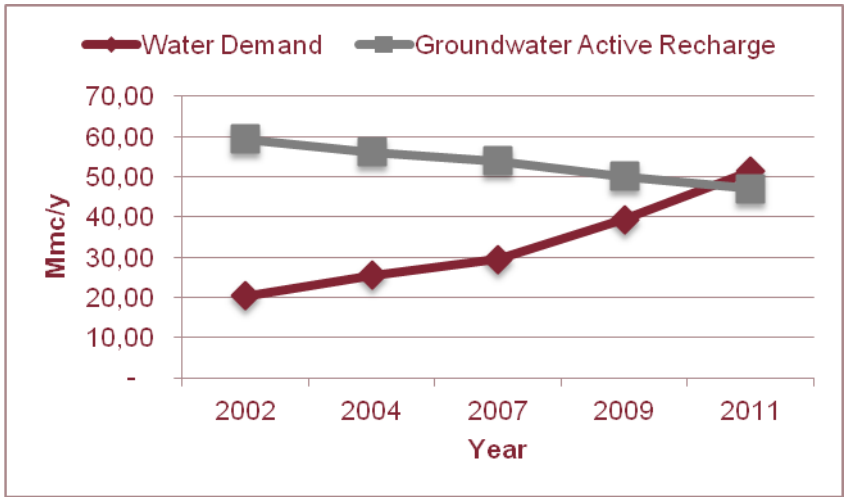


Figure 11 Groundwater Active Recharge vs Water Demand in the last ten years

The results for the downscaled simulations of future rainfall patterns, obtained through the NHMM developed under the project, indicate that in the XXI century Tanzania may be subjected to: (i.) a slight decrement in the number of wet days and seasonal rainfall amount from March to September; (ii.) a

reduction of annual total rainfall amount; (iii.) an increase in frequency and intensity of extreme rainfall. This will combine with trends in groundwater active recharge and extraction, thus leading to further degradation of the hydrogeological balance in the coastal aquifer as assessed above.

Results related to tasks v. to ix. are reported in detail in the Working Paper "*Analysis of the sensitivity to seawater intrusion of Dar es Salaam's coastal aquifer with regard to climate change*" and in the presentation on "*Groundwater Management in Dar es Salaam coastal acquifer under CC pressure*". Results related to "*Projecting Changes in Tanzania Rainfall for the 21st century: Scenarios, Downscaling & Analysis*" were presented at the third International Workshop.

The results achieved in the previous tasks show that the vulnerability of people relying on boreholes for accessing water is already very high and will definitely worsen in future under conditions of CC and increasing urban sprawl. A change in managing water resources is needed in order to stop the salinization of shallow aquifer while ensuring adequate access to fresh water to households settled within Dar es Salaam's coastal plain.

The results of the activity under point d) concluded that the risk intrinsic to the forecasting approach when applied to adaptation is that it favors a conservative approach to define planning objectives, as it assumes people's vulnerability as unchangeable (context-neutral) and sees adaptation planning as a way to secure current conditions of life against CC. The backcasting approach would be an antidote to such risk, as it focuses on people's aspirations for change thus transforming adaptation planning in an opportunity for shaping the way toward the desired future.
Consequently, the conceptual framework for vulnerability assessment was revised (as shown in the diagram below) in order to allow communities to play a role in the process and contribute to the formulation of the adaptation objectives that will inform the planning process in the next activity. In particular, a section devoted to participatory backcasting has been introduced as a bridge between the forecasting scenarios produced in the previous tasks and the identification of community-based adaptation initiatives to be performed in the next project's stage.

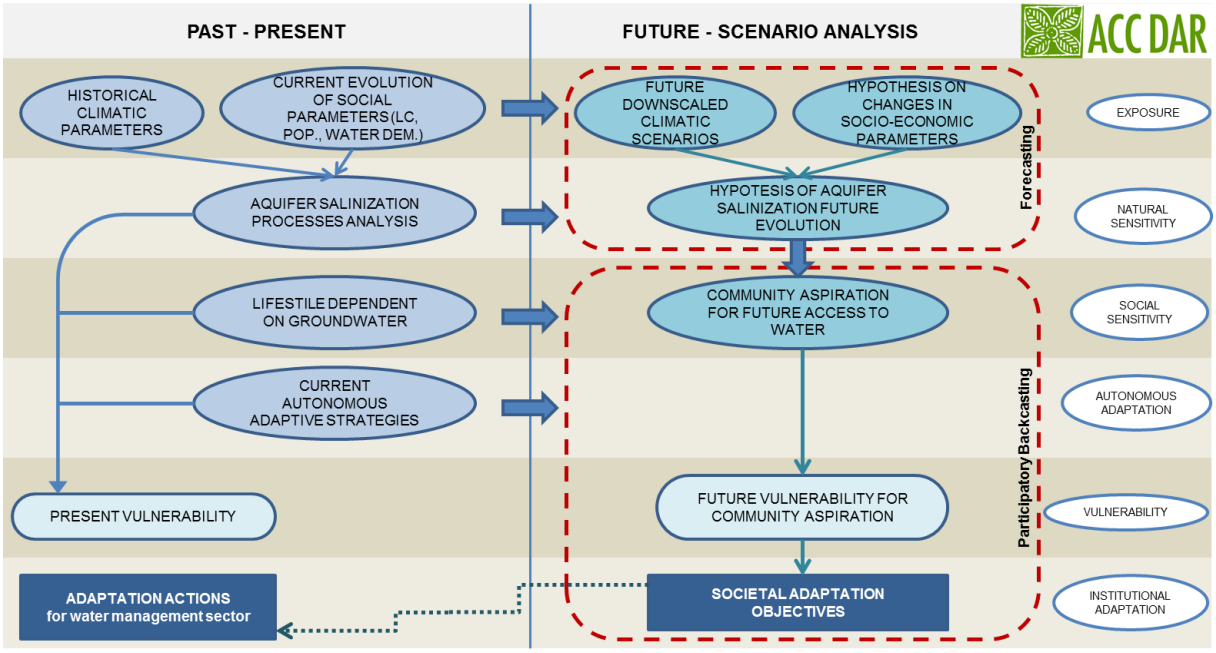


Figure 12 ACC Dar Workflow Activity Diagram

The core idea of the participatory backcasting methodology developed by the project team is to begin the process from the definition of a community shared future vision as regards access to water, and then look backwards from that future to the present situation in order to find out the challenges that might appear between ideal and present. Subsequently, the challenges is analyzed in order to identify possible strategies and actions for overcoming them and achieving the desired future (Figure 12)

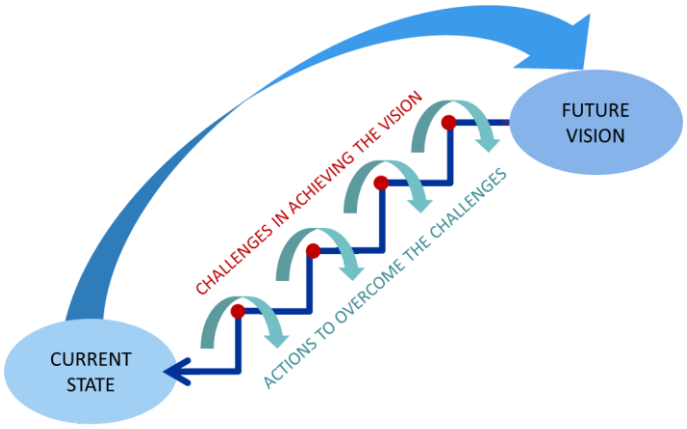


Figure 13 Conceptual model of backcasting methodology

Such methodology has the potential to support the definition of socially shared adaptation objectives, alternative livelihoods, potential agents of change and possible systemic transformative actions.
In particular, the creation of a community vision for future development as a starting point for the definition of societal adaptation objectives ensures that the objectives will be aligned with people's aspirations for the future and a systemic perspective will be maintained overall the scenario building process.
Community involvement in vision development fosters social learning, thus broadening the space for actions that incorporates different contextual values and preferences, and for the research on alternative livelihoods and potential agents of change.
By flexibly connecting future objectives with adaptation actions to be undertaken in the present, the development of future-present pathways highlights the need for system transformative actions.

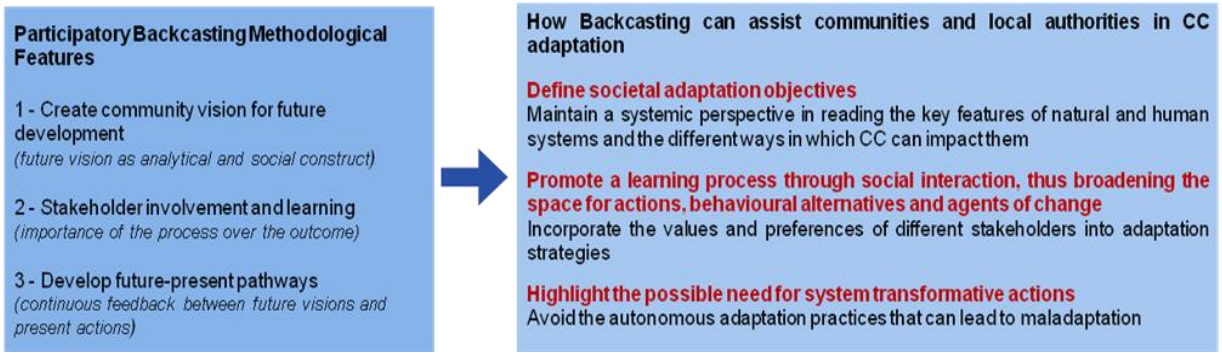


Figure 14 Particiaptory Backcasting Methodological Features

Furthermore, under this activity two initiatives were undertaken to ensure the **exchange of knowledge between the partners** and to **foster the collaboration among researchers from both universities**.
Firstly, a junior researcher from Ardhi University carried out one month internship at Sapienza during the phase of data analysis, including several joint activities at the university laboratories and a field visits to Rome's wastewater treatment plants. The researcher was selected at Ardhi among those who

performed the boreholes monitoring campaign in Dar es Salaam and the data entry in the Access database. He improved skills in the use of Schoeller diagrams, deficit values, composite diagrams and mixing lines.
Secondly, a senior researcher from Sapienza held a short course on "Seawater intrusion monitoring" at Ardhi University in September 2013, addressed to 20 Master and PhD students.

Links with other project activities

The methodologies and the tools identified in the framework of this activity are a first step to support the local institutions in mainstreaming adaptation concerns into existing plans as a strategy to reduce people vulnerability to seawater intrusion. They inform all the WP 3 activities: from the capacity-building to the design of the adaptation initiatives.

Moreover, the integrated use of the methodologies proposed in this study with the information provided by other project activities, related to the urban expansion (activity 2.1) and the degree of dependence of the population from groundwater resources (activity 1.1), enable LGAs to use the monitoring outputs in the framework of a broader assessment of population's vulnerability..

Activity 2.3 "Develop a methodology for designing community based adaptation initiatives"

Objectives

The activity aimed at developing a methodology for the participatory design of LGAs' adaptation initiatives. **The methodology for designing adaptation initiatives adopted CC mainstreaming as a guiding principle**. The idea was to integrate CC adaptation concerns into the existing plans and programs in UDEM sectors, rather than developing new ad hoc plans for adaptation.

In parallel, the activity aimed at **defining the adaptation objectives at the community level through the participatory backcasting approach to scenario analysis**.

The whole methodology will be used for preparing the four adaptation initiatives expected by the end of the project.

Description of the activity

To achieve these objectives the activities carried out during the reporting period include both: the community-based scenario exercise and the development of the mainstreaming methodology.

On the one hand, a **community-based scenario exercise** on the access to water issue has been carried out in Kigamboni area as an application of the backcasting methodology previously developed combined with the participatory technique of the Theatre of the Oppressed (already used in the framework of the WP1).

The whole activity was carried out by Sapienza and Ardhi researchers who participated during the activity 2.2 in the boreholes monitoring activity, together with the expert in forum theatre who led the participatory workshops under the activity 1.3

It consisted of two main phases:

1. the implementation of a Community Scenario Workshop, and
2. the preparation of the Theatrical Representation and performing a certain number of Forum Theatre events.

The *Community Scenario Workshop* was held from 9th to 14th of September 2013 and it was attended by 24 community youngsters, selected considering different criteria, such as:

- age (ranging from 18 to 35 years);

- gender (same number of men and women);
- sub-ward of origin (equally distributed in Kigamboni ward);
- level of education (ranging from primary school to high school);
- familiar economic condition (ranging from low to high income level, considering the average income in the Kigamboni ward);
- type of economic activity conducted by the family (agriculture, fishing or small "informal" businesses);
- involvement in community social activities; and
- previous experience in artistic activities (in particular, theatre).

During this phase the TdO expert helped the participants to develop a shared future vision as regards access to water issue and to stage different stories that identify problems, obstacles and challenges to achieve the vision.
Furthermore, one of the participants was trained to have the role of facilitator during the public forum theatre events.
This phase involved and was supported by a strong and very active NGO called Kigamboni Community Center.

During the second phase, the *Theatrical Representation* was prepared. The play was structured in different scenes that show the vision and the challenges that emerged during the workshop.
The show was performed eleven times, from 16th to 24th of September 2013 in several sub-wards of Kigamboni and partly also in Kunduchi and Somangira wards. The attendance of the inhabitants of the different sub-wards was approximately of 200 persons per event, as auditors or participating actively within the *Forum Theatre* session. We could say that around 2000 residents were involved within the participatory activity.

This phase involved the well-known local theatre and dance group called Club Wazo.

The whole activity was supported and authorized, and sometimes also joined, by the sub-ward leaders of the sub-ward involved.

Figure 15 Two moments of the participatory backcasting exercise

On the other hand, the methodology used for preparing the four adaptation initiatives draws on the results from a literature review conducted at Sapienza last year with a focus on the main approaches for mainstreaming adaptation into policies and planning. In addition, the feedbacks provided by the LGAs officers who participated in the training program under the activity 3.2 were considered.

Mainstreaming can be defined as the process of systematically integrating a selected value/idea/theme into policy domains, which in our case are UDEM sectors. When applied to CC adaptation, the mainstreaming approach is considered to guarantee more efficient use of financial and human resources

than occurs when adaptation is designed, implemented, and managed as a series of stand-alone measures. At an operational level, a mainstreaming strategy involves four types of change: procedural, organizational, normative, and policy reframing. The specific aim of those change ranges from climate proofing of development decisions to improvement of local capacity to adapt, depending on ways to interpret vulnerability. Coming to the UDEM sectors, three work streams can be distinguished: i) applied technological and infrastructure-based approaches; ii) human development and vulnerability reduction; and iii) investing in natural capital and ecosystem-based adaptation.

The literature also highlights a few threats that could undermine the effectiveness of mainstreaming effort. Firstly, one should expect that LGAs' officers will oppose resistance to required changes that threaten their value systems and interests, including power hierarchies. Secondly, LGAs can raise concern that the choice of mainstreaming implies a reduction of the funds dedicated to adaptation and that national government and donors may use adaptation mainstreaming to impose certain conditions to LGAs. Addressing these issues requires the involvement of LGAs' officers at any stage of the process, from the identification of the possible changes to the decision of which one should be prioritized for implementation.

Moreover, from the training results it emerges a clear indication to focus on those measures and actions already in place or under development that can be justified as necessary for adaptation with no or little changes, in order to ensure immediate access to adaptation funding. Rainfall harvesting interventions are an examples of that. Consequently, this was the major criterion used for choosing which among the existing planning measures should be taken into consideration for adaptation mainstreaming.

The workflow for this activity consisted of the following steps:

- Sharing insights on the strategic options to be considered in the mainstreaming process with the LGAs' officers (during the one-day conference held under activity 3.3)
- In-depth analysis of the five project proposals elaborated throughout the training (held under activity 3.2) to understanding values and interests of involved LGAs' officers as well as their expectations as regards CC adaptation
- Ad-hoc meetings with department heads at DCC, DAWASA and the three municipalities to identify and collect the existing plans and programs to be prioritized in the mainstreaming process
- Preparation of the draft guidelines for the first phase of the design process. Planning measures responding to the requirements made by the LGAs' officers were identified and assessed for determining the type of adjustments needed. Three sets of criteria for the plan analysis are considered, including: i) adaptation concerns (ACs), stemming from the analysis of the sensitivity to seawater intrusion of the coastal aquifer as well as the participatory backcasting exercise conducted in Kigamboni (activity 2.3); ii) potentials for autonomous adaptation (PAAs), which emerged through the household's questionnaire (activity 1.1) and the participatory workshops (activity 1.3) conducted in the previous project years; iii) mitigation related issues, including contribution to greenhouse gas emissions (GHG) and to carbon capture and sequestration (CCS)
- Preparation of the draft guidelines for the second phase of the design process. A series of amendment options are formulated to address the adjustment needs identified above, according to the three main work streams emerged from the literature review (technological, ecosystem-based, and social). The proposed amendments are hence assessed against a set of criteria (including effectiveness, efficiency, feasibility, knowledge base, equity and legitimacy) to identify those most suitable to be adopted. Crucial for the identification of assessment criteria were the results from the participatory backcasting exercise, which allowed to determine the main challenges faced by people in their daily struggle for access to freshwater as well as potential strategies for change. The last section of the second phase guidelines is devoted to recommendations for effective implementation of the chosen amendment options, including analysis of the major actors to be involved, threats and opportunities to be considered, and additional costs to be borne.

Achieved results

During the *Community Scenario Workshop* the participants developed a shared future vision as regards access to water and identified a certain number of challenges (and obstacles) in achieving the vision were identified (see Figure 15).

Current State	*Water access* - Lack of access to the municipal water supply system; Saltwater from private and community shallow wells; Freshwater purchased locally from street vendors (high cost of water) or in other areas (medium cost of water) and transported by women for many km *Use of water* - Mainly for domestic purposes
Future Vision	*Water access* - Diversification of water sources: Deep Community Borehole + Connection to the municipal water supply system. Other possible options: Rain water collection; Water Harvesting *Use of water* - Domestic and agricultural purposes
Challenges Identified	*Social challenges* - Difficulties in reaching an agreement within the community due to disillusion, disorganization, and low public participation *Economic challenges* - Low access to credit, due to scarcity of public funds and difficulties in returning private loans *Political challenges* - Corruption of politicians; Lack of communication between the community and political leaders (at the ward and district level) *Technical and environmental challenges* - Low technical support when building a borehole; Difficulties in designing the water supply scheme; Lack of communication between different sectors of the local authorities; Water pollution
Actions Proposed	Create a Community Water Association with a well defined project in terms of economic (e.g., collecting donations and searching for other private and public source of funding; sharing payment of water rates) and technical aspects (e.g., technical surveys; and security of the technical instruments purchased). Arrange a specific team that fosters community participation in the water issues. This team will try to get detailed information from the local Water Committee and brings them back to the community, in order to have more negotiating power with the political leaders. Raise awareness of laws, current budget, and implemented plans in the water sector, in order to understand the allocation of responsibilities among different local and municipal authorities. Demonstrate against local authorities and vote for a different leader at the next ward election. VS. Perform subversive actions (e.g., break a private pipe in order to draw water for free; force the ward leader to resign). Ask for more direct communication between community, politicians and technicians from different sectors (water, urban planning and design, energy).

Figure 16 Findings of the Community-Based Scenario Exercise

Later on with the *Forum Theatre* events the participants provided feed-back about possible actions to overcome the challenges represented in the show.

Through this participatory exercise the community was involved in the development of vulnerability scenarios. Vulnerability is not only changing with the context, but is also shaped by the community's aspirations. The core idea of participatory back-casting methodology adopted was to start by creating a desired shared vision of the future and to then look backwards to the present to determine what challenges will need to be faced and to assess the potential for change. Through this process the

community was able to provide indications of what kinds of action should be taken to change current environmental management and decision-making in order to achieve the desired future.

Results in detail are described in the working paper "A participatory backcasting scenario methodology for supporting climate change adaptation planning at community level: access to water in coastal Dar es Salaam", Faldi et al. 2014 and have been presented during the restricted session of the third International Workshop held in Dar es Salaam on 9th of June 2014.

As regards the **adaptation mainstreaming methodology,** the results from the literature have been published as a book chapter (*Macchi, S, Ricci, L (2014) "Mainstreaming Adaptation into Urban Development and Environmental Management Planning: a literature review and lesson from Tanzania"*). They provided the key principles that inform the methodology developed for assisting the design of adaptation initiatives under activity 3.4.

The proposed methodology is composed of *three main phases* described in the diagram below: i) assessing the selected planning provisions to identify adaptation needs; ii) identification of a set of amendment options for each planning provision under review; iii) choosing the most feasible or suitable amendment options and formulating recommendations for their implementation.

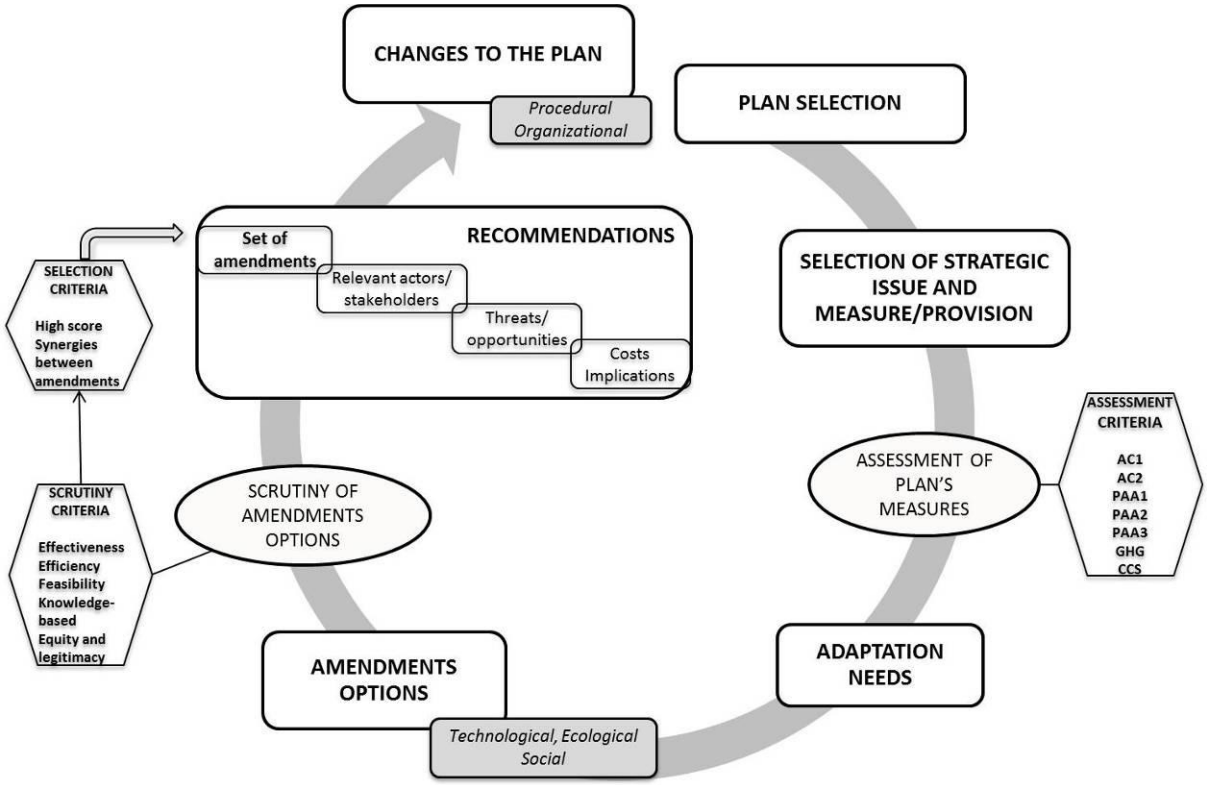


Figure 17 Adaptation mainstreaming methodology diagram

The proposed methodology is presented in the form of *guidelines*. During the phase of drafting the guidelines the methodology was tested on a planning measure chosen within the Temeke Municipal Council's Strategic Plan.

Attention was paid to produce a text easy to understand and to provide examples for each step, in order to facilitate the communication between the partners and subsequently with LGAs' officers.

From the texting exercise it results that each phase is expected to last approximately three weeks, considering two measures for each plan under examination. This entails quite an important effort to

screening one whole plan, which usually includes many measures. However, the analytical approach chosen offers a number of benefits when compared to faster intuitive reasoning. The most important one is definitely that any statement is accompanied by the criteria that led to its formulation, which makes statements debatable among many and easily revised to incorporate new insights and values.
Lastly, it is worth noting that the recommendations are provided in the form of amendments to the existing planning measures, which make them more handle able by LGAs' officers in the everyday work than broad spectrum statements.

The methodology is detailed in the working paper on "*Mainstreaming Adaptation Into Existing Urban Development and Environmental Management Plans: Guidelines and an Application to Four Plans and Programs in Dar es Salaam*" Shemdoe et al. 2014 and in the presentation held during the public session of the third International Workshop held in Dar es Salaam on 10th of June 2014.

Links with other project activities

The sets of criteria for the plan analysis rests on the results of many project activities, in particular, from the analysis of the sensitivity to seawater intrusion of the coastal aquifer (activity 2.2), from the participatory backcasting exercise conducted in Kigamboni (activity 2.3), from the autonomous adaptation options and strategies which emerged through the household's questionnaire (activity 1.1) and the participatory workshops (activity 1.3). At the same time the guidelines for the plan analysis are part of the methodology used for preparing the four adaptation initiatives under activity 3.4

Activity 2.4 "Second International Workshop"

Objectives

The second of the three international workshops planned as part of the implementation of the ACC Dar Project had the twofold aim of evaluating results of the methodologies developed under the activities 2.1 and 2.2 and providing an opportunity for disseminating and sharing information, exchanging ideas among researchers, and stimulating initiatives for international networking. More in detail, the objectives of the workshop have been to draw together a group of academics from Italy and Tanzania engaged in the development of scenarios of groundwater availability in coastal peri- urban areas under conditions of continuous urban sprawl and CC and to raise awareness on urban issues related to local planning for CC adaptation.

Description of the activity

The workshop, held in Rome from 20th to 22th of April 2013, was titled "***Towards scenarios for urban adaptation planning. Assessing seawater intrusion under climate and land cover changes in Dar es Salaam, Tanzania***". It has been organized with the same formula of the first one held in Dar es Salaam in 2012, including a restricted session for evaluation of the project results and a public event for dissemination and debate on the key issues.

The first day of the workshop focused on the evaluation of the results – both in terms of knowledge and methodologies - achieved under the project activities 2.1 and 2.2. Participants were the core research team from Ardhi and Sapienza Universities, the representatives of Dar City Council, the two selected evaluators and the ad hoc invited experts.

The second day of the workshop was a public session involving eleven keynote speakers introducing the ACC DAR Project and case studies from Sub-Saharan and Italian cities addressed to academics, students and practitioners about a variety of approaches to urban planning for CC adaptation.

Achieved results

First day: restricted session

In occasion of the international workshop three background papers have been prepared by the project research team and available on the project web site: "*Analysis of the Sensitivity to Seawater Intrusion of Dar es Salaam's Coastal Aquifer with Regard to Climate Change*", "*Monitoring Seawater Intrusion In The Coastal Aquifer of Dar es Salaam"*, and *"Investigating the Relationship between Land Cover and Vulnerability to Climate Change in Dar es Salaam*". The discussion during the morning was started by the two evaluation papers prepared by international experts external to the project team. Those papers are available at:
http://www.planning4adaptation.eu/Docs/monitoringEvaluation/Evaluation%20Report%20on%20Activity%202.1_Mtalo.pdf, and
http://www.planning4adaptation.eu/Docs/monitoringEvaluation/Evaluation%20Report%20on%20Activity%202.2_MD%20Fidelibus.pdf

The following questions arose from the morning session:

- Is the methodology adopted in WP 2.1 effective for advancing Land Cover Change assessment methods and understanding of its drivers in Dar es Salaam?
- Is the methodology adopted in WP 2.2 effective for exploring the current degree of seawater intrusion into in Dar es Salaam coastal aquifer, and its relationships with climatic conditions and urbanization processes?

Those questions framed the discussion among the experts during the afternoon.

Second day: open event

The open event hosted an audience of approximately 100 people. During the morning, all the presentations by the keynote speakers invited focused on two main issues concerning the monitoring of urban environmental changes: the seawater intrusion and the urban sprawl. The speakers presented during the morning case studies from Sub-Saharan and Italian cities to share experiences, possible good practices and strength the networking among the experts.

During the afternoon, a roundtable has been organized presenting some approaches to explore whether and how to integrate the use of scenario methods into the process for the identification of adaptation objectives. The debate was oriented mainly to answer to the following two key questions:

- Why and to what extent the approaches/tools presented are relevant for effective adaptation planning and/or CC vulnerability reduction?
- What questions remain unaddressed and should guide future research related to CC adaptation?

All the materials related to the second International Workshop, including papers, presentations and video recording, are published on the project website in the following page: http://www.planning4adaptation.eu/043_News_Information_Materials.aspx

The workshop proceedings will be published in the following months. The agreement with an editor is already signed.

Each one of the three international workshops held in the framework of the ACC Dar project offers the occasion to identify several networking opportunities among the participating universities. To this regard the participation of the two partner universities' representatives as keynote speakers in other international events on CC adaptation issues shall be considered an achievement.

In particular, Ardhi and Sapienza senior researchers participated to:

- the International Workshop "*Bearing the brunt of environmental change: understanding climate adaptation and transformation challenges in African cities*", held at the Royal Holloway, University of London, on 16th and 17th of April 2013, and

- the International Workshop "*Urban Impact of Climate Change in Africa 2nd International Conference "Planning with Scant Information*", held at the Polytechnic of Turin, on 13th of November 2013.

Links with other project activities

Some of the conclusions from the evaluations held during the restricted session and from the discussion during the open event provided valuable inputs for improving the project approach related to the following development mainly within the activities related to the design of the adaptation initiatives (namely activities 2.3 and 3.4)

WORK PACKAGE 3: "BUILD THE CAPACITY OF DAR'S MUNICIPALITIES "

The whole WP3 aimed **to build the capacity of Dar es Salaam's Local Government Authorities (LGAs) for the design of community-based adaptation initiatives** as part of the implementation of the NAPA action of the United Republic of Tanzania. The activities under WP3 specifically aimed to enhance the LGAs' capacities in: i) understanding CC issues related to Dar's coastal plain and peri-urban livelihood systems; ii) identifying effective measures for supporting the coastal peri-urban inhabitants in their efforts to adapt to CC; and, iii) integrating them into existing UDEM strategies and plans.

Activity 3.2 "Develop and implement a training programme"

Objectives

Following the capacity-building strategy designed in 2012, the objective of the LGAs capacity-building was **to foster changes within their own existing plans to mainstream adaptation initiatives enhancing their capacities in understanding CC issues, in developing of methodologies supporting adaptation in coastal unplanned and under-serviced settlements and avoiding maladaptation practices**. To comply with this aim the training included a wide range of information about CC and adaptation issues, provides skills to reach autonomously information and methodologies to analyse them, included tools for understanding adaptive capacities and monitoring changes in peri-urban areas, and methodologies for exploring CC vulnerability scenarios.

Description of the activity

The training was held in a residential way in Morogoro to avoid turn over and drop out of the participants from the LGAs as highlighted in the capacity building strategy in the previous interim narrative report.
The training involved key actors within the four Dar es Salaam's LGAs, namely the Dar City Council, Ilala Municipality, Kinondoni Municipality and Temeke Municipality. Officers from the Ruvu Basin Authority participated in the training due to the strong focus on adaptation strategies related to the phenomenon of the groundwater salinization as one of the main factors of vulnerability relying a large part of peri-urban inhabitants.
The participants have been drawn from the following departments: Agriculture and Livestock Development, Health, Urban Planning, Natural Resources, Waste Management, Works and Water .
The selection of the participants took place in agreement with the LGAs' directors taking into consideration the following criteria:
- staff dealing with activities pertinent to CC issues;
- preference to qualified females;
- already existing basic knowledge on CC;
- preferably not older than 50 years.

The training has been delivered under ARU's coordination and management. Furthermore a training director and two external trainers with a consistent experience in working with Dar's LGAs have been involved. Sapienza University supported the activities through developing the training programme, preparing the background materials and monitoring the whole course.

Achieved results

The two weeks of training have been delivered in March and in June 2013, involving respectively 38 officers in the first week and 35 in the second week.

Modules and topics of the training programme were covered as detailed in the table here below.

	Modules	Topics
FIRST TRAINING WEEK	Climate Change and Adaptation Principles and Practices	• CC causes, Impacts and adaptation Principles • CC Impacts and adaptation in Tanzania • Vulnerability to CC & Sectoral analysis in Tanzania • Adaptation Needs and priorities in Tanzania • Policy, Legal and Institutional aspects of CC in Tanzania
	Adaptive capacity	• Introduction to adaptive Capacity • Introduction to Household Survey for Adaptive Capacity Analysis • Monitoring of Adaptive Capacity • Design of Household Questionnaire Survey • Data analysis and Interpretation
	Adaptation mainstreaming	• Introduction of mainstreaming Approach • CC Implications for Local Plans and Programmes • Analysis of CC Implications for specific Plans and Programmes
SECOND TRAINING WEEK	Urban sprawl and CC	• Introduction to urban sprawl and CC • Land cover and land cover change in DSM • Land cover change and observed CC impacts in DSM
	Sea water intrusion	• Understanding Sea water intrusion • Borehole monitoring campaign • Assessing Current vulnerability to seawater intrusion Phenomenon • Sea water intrusion- current situation in DSM • Assessing Future vulnerability to seawater intrusion Phenomenon
	Institutional adaptation strategies	• Introduction to Institutional adaptation strategies to Urban sprawl and sea water intrusion • Group work • Group Work Presentation • Finalize institutional adaptation strategy

Figure 18 Modules and topics delivered during the training

The training methods used to carry out the course have been: lectures by the trainers expert on each topic, open discussion among the participants after each training session, working group.
Four group works have been carried out by the participants during the training following the tracks listed here below:

- Identifying the challenges in implementing some adaptation measures related to the observed CC impacts in their area of work;
- Preparing of a questionnaire to assess community-based adaptive capacities;
- Analyzing of CC implications and related adaptation measures to be addressed by including in the specific city/municipal plans and programmes;
- Assessing impacts on environment associated with urban sprawl

The main output of the whole capacity-building consisted in five adaptation initiative proposals designed by the LGAs involved in the training. The proposals were elaborated on the basis of a format suggested by the trainers, they were drafted by the participants during the second training session and

then finalized with the support of the trainers. They were discussed within the workshop held in September 2013, as described in the following paragraph.

The following table indicates the number of participants and the composition per working groups.

Name of Group	Number of participants	Composition
Dar es salaam City Council	8	Town Planner
		Environmental Health Officer
		Health Officer
		Technician
		Quantity surveyor
		Parking coordinator
Temeke Municipality	8	Agriculture officer
		Environmental Health Officer
		Environmental Management officer
		Municipal Waste Management Officer
		Water Engineer
		Municipal natural Resources Officer
		Disaster Management Coordinator
		Civil Engineer
Ilala Municipality	8	Environmental Health officer
		Municipal Fisheries
		Water Engineer
		Waste Management Officer
		Environmental Management officer
Kinondoni Municipality	8	Town Planner
		Forest Officer
		Principal Agriculture Training Officer
		Municipal Natural Resources Officer
Wami/Ruvu Water Basins	3	Hydrologist
		Env. Engineer

Figure 19 Working Groups Composition

A toolkit collects the materials and systematizes the methodology of the whole training with the aim to facilitate future improvements and replication of the capacity-building.

The strong commitment of the LGAs involved in the initiative was demonstrated by their active participation and by the fact that there were not any case of drop out of the course.

A working paper about the whole capacity-building action is available on the web site: *"Capacity building for Climate Change Adaptation at Local Government Level in Dar es Salaam."*

Links with other project activities

All the topics of the training programme and the background materials used are the results of the activities performed under the WP1 and 2 implemented during the first two years of the project.

The final work carried out by the LGAs were presented and discussed within the workshop organized under activity 3.3.

Furthermore, they provided useful information to inform the further steps under the activity 3.4.

Activity 3.3 " Mid term Conference "

Objectives

As part of the whole capacity-building strategy a one–day conference was held with the threefold aim to: i) provide an opportunity for **sharing and discussing the adaptation measures formulated by the LGAs**' representatives involved during the training; ii) **indentify the strategic options in order to mainstream them into their existing strategies and plans**, and iii) **enhance networking among Dar's LGAs on CC related issues**.

Description of the activity

The conference titled "***Towards Mainstreaming Climate Change Adaptation in Sustainable Development of Dar es Salaam City***" was held on 13th of September 2013 at the Karimjee Hall in Dar es Salaam. It involved the training participants, the trainers and the project partners' representatives and was focused on the CC adaptation measures designed by the trainees as final outputs of the training course.

Achieved results

During the morning session of the conference each one of the authorities invited presented respectively their adaptation project proposals as following:

- "*Empowering of Dar es Salaam Community on Adaptation to Climate Change",* Dar es Salaam City Council;
- *"Conservation of water resources along the coastal belt of Temeke as a strategy towards minimising salt water intrusion",* Temeke Municipality;
- *"Rainwater Harvesting in Schools to Demonstrate Adaptation to Climate Change in Peri-urban Areas of Ilala Municipality",* Ilala Municipality;
- "*Rain Water Harvesting as a Climate Change Adaptation Strategy for Reducing Seawater Intrusion in Coastal Area of Dar es Salaam",* Kinondoni Municipality
- "*Development of an adaptive mechanism to reduce salt water intrusion in coastal aquifers specifically Temeke Municipal",* Wami/Ruvu Basin Water Board

The project proposals and the presentations held during the workshop are available at: http://www.planning4adaptation.eu/043_News_Information_Materials.aspx

After each presentation an open debate among all the participants was chaired by the training director providing an opportunity to share ideas about the feasibility of the CC adaptation measures proposed.

During the afternoon session a SWOT analysis has been carried out by the participants to identify internal and external obstacles and opportunities with the aim to draw recommendations for mainstreaming CC adaptation in the existing plans and programmes?

Each LGA worked as a group to complete the SWOT analysis. Furthermore, they shared with the audience their results and their final recommendations in order to mainstream CC adaptation into their own institutional mandates, daily activities and plans.

At the end of the conference the attendance certificate related to the training course have been delivered to the participants.

Links with other project activities

The adaptation initiatives proposed by the LGAs, the discussion about them and the results of the SWOT analysis informed the design of institutional adaptation initiatives foreseen under the activity 3.4

Activity 3.4 "Support Dar's municipalities in designing adaptation initiatives"

Objectives

The activity aimed **to identify initiatives to be undertaken for an effective integration of CC concerns and related adaptation objectives into the planning documents** that shape the daily work at Dar es Salaam's local government departments.

These initiatives could range from i) improving existing decision-making procedures while feeding CC related information into decisional processes (including ex-ante assessments of programs and projects, integration of CC adaptation into government budget, ad-hoc reporting and audits, consultation with experts, and participation of stakeholders) to ii) amending formal responsibilities and mandates, creating new or merging existing institutions, networking among diverse departments, and structural changes of budgets. At a more political level, one option might be also to consider iii) the formalization of CC adaptation related issues in existing strategies and policy frameworks alongside with the allocation of additional targeted resources and, looking in a longer perspective, iv) the reshaping of the policy frame of traditional sectors.

Given the broader project objective, the identification of initiatives for changing existing procedures (as described under i.) and organizational framework (as described under ii.) are prioritized, since they seem to be the most applicable at local government level. However, ideas for possible formalization of the issues under examination (iii.) and reframing of policy framework (iv.) will be retained as a basis for advocacy with national government authorities.

Description of the activity

The first step in the activity was to select a number of planning documents, already in force or under approval process, that have strong influence on decision-making about UDEM related issues at local government level. A variety of document types were considered, ranging over different scales of time (3 to 20 years), space (municipal to regional) and scope (one policy sector to multi-sectoral).
Consistently with the scope of the project, the selection of planning documents was made with a focus on water resources, including both conservation and access issues, and on peri-urban areas facing the problem of groundwater salinization. Accordingly, it was decided to conduct the mainstreaming exercise with Temeke Municipal Council as a study case, because the majority of Temeke territory lays within the coastal plain and is made by peri-urban and rural areas, with the latter expected to change into peri-urban in the next years.

The selection process led to choose the following planning documents:
- 2012-2032 Dar es Salaam Master Plan, under approval process to date
- 2012-2032 Strategic Water Supply Plan for Dar es Salaam, recently approved

- Temeke Municipal Council's Strategic Plan 2010/11-2012/13
- Temeke Municipal Council's Medium Term Expenditure Framework 2010/2011-2012/2013

A joint team was set-up at Sapienza and Ardhi University to carry out the assessment and the four plans and formulate recommendations of possible initiatives to be enforced by the competent local authorities in order to ensure the mainstreaming of CC adaptation into the planning document under examination. Both assessment and recommendation phases were conducted according to the guidelines developed under the activity 2.3, focusing on two measures or provisions for each of the considered documents.

The measures and provisions that were submitted to in-depth examined are listed in the following table.

PLAN ANALYSED	SELECTED MEASURES
Dar es Salaam Master Plan 2012-2032	1. Building provisions under Article 6. Consolidation process zone 2. Building provisions under Article 18. Peri-urban areas / urban agriculture zone
Strategic Water Supply Plan for Dar es Salaam 2012-2032	1. Improve surface water and groundwater sources from the current 276,000m3/d to 576,000m3/d ultimate capacity by 2032, through extension of the existing water treatment plants on Ruvu River and Kizinga River. 2. Installation of 20 deep wells with a minimum depth of 600 m in Kimbiji and Mpera for producing 260,000 m³ and 130,000 m³ per day.
Temeke Municipal Council's Strategic Plan 2010/11 – 2012/13	1. Protection of environment and reserved areas in 4 wards enhanced by 2013 2. 1,500,000 trees in 175 subwards planted by 2013
Temeke Municipal Council's Medium Term Expenditure Framework 2010/2011 - 2012/2013	1. Forest conservation increased from 2100 ha to 25,000 ha by 2013 2. Construction of demonstration toilets and sanitation facilities in 11 wards by June 2013

Figure 20 List of measures and provisions selected for the in-depth examinations

Achieved results

The main results achieved from the mainstreaming exercise consists of a list of amendment options for each measure or provision examined, accompanied by a comparative assessment of the identified options drawn on the basis of the ten criteria as defined in the guidelines. All the amendment options proposed have potential to improve the effectiveness of the measure or provision for CC adaptation. However, best amendment options were selected and further analyzed in order to provide recommendations for an effective implementation (including analysis of the major actors to be involved, threats and opportunities to be considered, and additional costs to be borne). These recommendations include: (i) develop pilot projects to adopt best available technologies (e.g. in agriculture, forestry, construction, energy, water and waste sectors, etc.); (ii) create, participatory monitoring systems for local adaptive management of natural resources; (iii) set-up of local committees for guaranteeing wise and equitable use of resources; and (iv) facilitating increased use of ecosystem services payment schemes (e.g Equitable Payment for Watershed Services (EPWS)), to finance local development while preventing environmental damages.

These results are detailed in the working paper titled "*Mainstreaming Adaptation Into Existing Urban Development and Environmental Management Plans: Guidelines and an Application to Four Plans and Programs in Dar es Salaam*".

As general conclusion the in depth examination of a few planning measures or provisions provided sufficient insights for the identification of key mainstreaming initiatives whose reach goes far beyond the improvement of a single measure or provision. In other words, what emerges from the examination of a specific measure has potential to be generalized and provide clear directions for how to proceed in order to mainstreaming adaptation into the whole plan, which is the ultimate scope of this work.

Links with other project activities

The whole process of the activity 3.4 is based on the whole results achieved under previous three year projects. In particular from the knowledge about adaptation concerns gained under work packages 1 and 2, and from the inputs provided by LGAs in the capacity-building process under work package 3.

Activity 3.5 "Third International Workshop "

Objectives

The third international workshop represented the final event of the project. Its objectives were:

- evaluating the results of the methodologies on participatory backcasting scenario and on mainstreaming, developed respectively under the activities 2.3 and 3.4;
- disseminating data with the LGAs' officers on seawater intrusion phenomena and on CC future patterns in Dar es Salaam;
- communicating ACC Dar results and sharing knowledge with the relevant stakeholder invited; and
- promoting network and stimulating further future collaborations.

Description of the activity

The workshop titled "***Mainstreaming Climate Change Adaptation Into Urban Development And Environmental Management Plans And Programs***" was held in Dar on 9th and 10th of June 2014.

Besides the two previous international workshops organized in the framework of ACC Dar. The first day was organized as a restricted session dedicated to the discussion and the evaluation of the methodologies developed. Participants were the core research team from Ardhi and Sapienza Universities, the representatives of Dar City Council, the two selected evaluators and the ad hoc invited experts. Among them:

- local NGOs dealing with issues related with CC, water management and land issues like Haki Ardhi, EEPCO and Form CC;
- authorities' representatives dealing with water management, like DAWASA, Wami Ruvu Basin
- Temeke municipality representatives participating in the capacity-building activity

The second day was organized as an open door session to present main results of the project to be discussed with relevant stakeholders invited.

Achieved results

First day: restricted session

In occasion of the international workshop three background papers have been prepared by the project team and available on the project web site: *"A Participatory Backcasting Scenario Methodology for*

Supporting Climate Change Adaptation Planning at Community Level: Access to Water in Coastal Dar es Salaam." and *"Mainstreaming Adaptation Into Existing Urban Development and Environmental Management Plans: Guidelines and an Application to Four Plans and Programs in Dar es Salaam."*.

The authors presented the main results that were then discussed by the external evaluators.

The external evaluation reports are available on the project web site:

- *Evaluation Report Activity 2.3, June 2014, Haki Ardhi*
- *Evaluation Report Activity 3.4, June 2014, University of Naples*

Two roundtables took place during the afternoon around two main topics: i) how to ensure a participatory approach in the definition of the adaptation objectives to be integrated into existing UDEM plans and programs? and ii) how to assess existing plans and programs for mainstreaming CC concerns and related adaptation objectives?

Second day: open door session

The open session hosted many interesting contributions from the project team members and from external experts. The morning was focused on dawn-scaling of future CC scenarios, especially in terms of future rainfall patterns, and on seawater intrusion and groundwater management of Dar's coastal aquifer. Contributions came from Experts and researchers from Sapienza University of Rome, Ardhi University of Dar es Salaam, State University of Zanzibar, and UN-Habitat.

Futhermore exsisting practices on water monitoring and adaptation were presented respectively by Wami Ruvu Basin Water Office representatives and by the Director of Temeke Municipality.

Also the strategy carried out and the main results of the capacity-building activity involving Dar es Salaam LGAs during the last year project was presented (*"Capacity building for Climate Change Adaptation at Local Government Level in Dar es Salaam."*)

The afternoon was dedicated to the results from the assessment of the four plans and programs in Dar es Salaam, with a focus on the ones concerning Temeke Municipality.

The workshop participants worked in roundtables on the discussion of the suitability and the feasibility of the amendment options proposed by the ACC Dar team.

All the materials related to the third International Workshop are published on the project website in the following page: http://www.planning4adaptation.eu/043_News_Information_Materials.aspx

Links with other project activities

As final project events, the workshop was a summary of all the results achieved under the project and presented the final outcomes. It was mainly based on the work done under the WP2 and WP3.

DISSEMINATION

Considerable efforts have been spent in the dissemination of the project activities and results in order to spread information about data and to share knowledge about the scientific findings under each project activity, to enlarge networking and to involve new stakeholders interested.

First of all, the **project web site** http://www.planning4adaptation.eu, set-up at the beginning of the project, was for the whole project duration the most important interface for the visibility of the project. It has been updated constantly and it hosts all the outputs, the deliverables and the products developed under ACC Dar. In the web page called "DISSEMINATION" are available for free download papers submitted to international conferences and for publication, working papers, maps, training materials, database, materials related to workshops and other events held during the project, ROM, narrative and evaluation reports.

Figure 21 Project web site "dissemination"

The whole **Borehole Monitoring Database** and the technical notes for its use have been uploaded on the web site to allow sharing and free access of those data.

A part from the website, the project activities and the results achieved during the project have been disseminated by the team members presenting **scientific papers and dissertations in several national and international events**. In particular, the ones related to the reporting period are listed here following:

AESOP Annual Congress 2014 "From control to co-evolution", 9-12 July 2014, Utrecht/Delft, The Netherlands

- "*Mainstreaming Adaptation to Climate Change into Urban Planning: Lessons from Dar es Salaam, Tanzania",* Macchi S., Ricci L.
- *"A Backcasting Scenario Methodology for Planning Adaptation to Climate Change in Coastal Dar es Salaam",* Faldi G.

International Workshop "Mainstreaming Climate Change Adaptation Into Urban Development And Environmental Management Plans And Programs", *9-10 June, 2014, Dar es Salaam, Tanzania*
Already described in details under activity 3.5 of this report.

XVII National Conference of the Italian Society of Urban Planners "Italian urban planning in the world", 15-16 May 2014, Polytechnic of Milan, Milan, Italy

- *"Pianificare l'adattamento a livello comunitario: prove di backcasting partecipativo a Dar es Salaam (Tanzania)",* Faldi G., Macchi S.

European Geosciences Union General Assembly 2014, 27 April - 02 May 2014, Vienna, Austria

- *"Projecting Changes in Tanzania Rainfall for the 21st century: Scenarios, Downscaling and Analysis",* Cioffi F., Monti A., Conticello F., Lall U

Tyndall Centre's 4th annual Ph.D. Conference "Research in Practice: Addressing Speed, Scale and Scope", 23-25 April 2014, University of Manchester, Manchester, UK

- *"Backcasting for climate change adaptation: Developing a participatory scenario methodology in coastal Dar es Salaam",* Faldi G.

I Annual Conference "Esperienze e Conoscenze. Progetti Internazionali nei Paesi Emergenti", 4 February 2014, Centro PVS, Sapienza University of Rome, Italy

- *"Rafforzare le capacità delle amministrazioni locali per l'adattamento al cambiamento climatico: il caso di Dar es Salaam, Tanzania",* Fantini L

International Conference "UICCA 2, Urban Impact of Climate Change in Africa. Planning with Scant Information", 13th of November 2013, Politecnico di Torino, Italy

- "*Adaptation to Climate Change in Dar es Salaam, Tanzania*" Shemdoe R.,
- "*Mainstreaming Adaptation into Urban Development and Environmental Management Planning: Lessons from Dar es Salaam"* Macchi S.,
- "*Analysis of the Sensitivity to Seawater Intrusion of Dar es Salaam's Coastal Aquifer with Regard to Climate Change*" Sappa G.;
- "*Capacity Building for Adaptation to Climate Change at Local Government Level: the Case of Dar es Salaam"* Fantini L., (Poster)
- *"Non climatic Factors of Vulnerability to Climate Change: an Estimation of Population in Dar es Salaam using Remote Sensing"* Congedo L., (Poster)
- "*The Use of Backcasting Scenario for Planning Adaptation to Climate Change in Dar es Salaam"* Faldi G., (Poster)
- *"Hydroclimatic Changes in Tanzania"* Monti A., (Poster)

LOCS 2013, The Local Climate Solutions for Africa 2013 Congress, 31th October 2013, Dar es Salaam, Tanzania

- "*Settlements and Population located in Flood-prone Areas of Dar es Salaam: Local Challenges and Experiences with Adaptation and Risk Management*" Rugai D.

AESOP / ACSP 5th Joint Congress 2013 "*Planning for Resilient Cities and Regions*", 15-19 of July 2013, University College Dublin, Ireland

- "*Adapting to Climate Change in Coastal Dar Es Salaam*" Macchi S., Ricci L., Congedo L., Faldi G.
- "*The Use of Backcasting Scenario for Planning Adaptation to Climate Change in Sub-Saharan Urban Areas*" Faldi G.;
- "*Using the Concept of Adaptive Capacity to Explore the "Urban Security" Approach in Kigamboni New City Project*" Ricci L.

4th UNICA - Santander Group - Compostela Workshop: "Exploring academic collaboration between European and Sub-Saharan universities", 4 June 2013, University of Kent - Brussels Campus, Brussels

- "*Europe-Africa Academic Cooperation: the ACC DAR project*", Macchi S.and Magrini D.

4th Global Forum on Urban Resilience & Adaptation, Session "*Reality Check: Adaptation on the Ground Dar es Salaam, Tanzania*", 31 May – 2 June 2013, Bonn, Germany.

XVI National Conference of the Italian Society of Urban Planners "Urbanism for a different kind of growth", 9-10 May 2013, Naples

- "*Urban Sprawl e Adattamento al Cambiamento Climatico: il caso di Dar es Salaam*", Congedo L., Macchi S., Ricci L., Faldi G.,
- "*L'analisi di scenario per l'adattamento al cambiamento climatico: definire un progetto di sostenibilità per la città sub-Sahariana*", Faldi G.

International Workshop "Towards Scenarios for Urban Adaptation Planning-Assessing seawater intrusion under climate and land cover changes in Dar es Salaam, Tanzania", 20-22 April, 2013, Sapienza University of Rome, Rome, Italy
Already described in details under activity 2.4 of this report.

Benchmark International Workshop in the *Urban Studies* Journal Seminar Series "Bearing the brunt of environmental change: understanding climate adaptation and transformation challenges in African cities", 16-17 April 2013, Royal Holloway, University of London, UK

- "*Land cover change and demographic growth: an estimation of Dar es Salaam's population using remote sensing,* Congedo L.,
- "*Building knowledge for climate change adaptation in coastal peri-urban Dar es Salaam, Tanzania",* Macchi S. and Kassenga G.,
- "*Exploring coping strategies for supporting autonomous adaptive capacity in Dar es Salaam",* Ricci L.

Tyndall Centre's 3rd annual Ph.D. Conference "Climate Transitions. Connecting People, Planet & Place", 3-5 April 2013, Sustainable Places Research Institute, Cardiff University, UK

- "*Backcasting scenarios for adaptation to climate change: the case of Dar es Salaam (Tanzania)",* Faldi G.

Conference "Il consumo di suolo: lo stato, le cause e gli impatti", 5 February 2013, ISPRA, CRA and DICEA, Sapienza University of Rome, Italy

- "*Adattamento autonomo come causa di crescita del periurbano"* Macchi S.

Working papers related to the project results 1.3, 2.1, 2.2 and 2.3 have been elaborated:

- Capacity building for Climate Change Adaptation at Local Government Level in Dar es Salaam. *Working Paper Activity 3.2*
- Mainstreaming Adaptation Into Existing Urban Development and Environmental Management Plans: Guidelines and an Application to Four Plans and Programs in Dar es Salaam. *Working Paper Activity 3.4*
- A Participatory Backcasting Scenario Methodology for Supporting Climate Change Adaptation Planning at Community Level: Access to Water in Coastal Dar es Salaam. *Working Paper Activity 2.3*
- Mainstreaming Literature Review for the Design of a Mainstreaming Strategy. *Review Paper Activity 2.3*
- Workshop on exploring CC adaptation through Participatory Theatre. *Working Paper Activity 1.3*
- Analysis of the Sensitivity to Seawater Intrusion of Dar es Salaam's Coastal Aquifer with Regard to Climate Change. *Working Paper Activity 2.2*
- Investigating the Relationship between Land Cover and Vulnerability to Climate Change in Dar es Salaam. *Working Paper Activity 2.1*
- Semi-Automatic Classification Plugin for QGIS. *Working Paper Activity 2.1.*

Three **books** collect part of the main project results:

- Macchi S. and Tiepolo M. (eds) Climate Change Vulnerability in Southern African Cities, 2014, Springer
- Macchi S. and Ricci L., (eds), Adaptation Planning in a Mutable Environment: From Observed Changes to Desired Futures, 2015, Springer
- Macchi S. and Kassenga G., (eds), Adapating to Climate Change in Coastal Dar es Salaam,2014, Aracne, ISBN 978-88-548-7738-2

A **video** about the participatory workshops held in Dar es Salaam during the second year project (activity 1.3) has been produced and uploaded on the web site: *Researching options through forum theatre*

Copies of the **project brochure** were distributed during the second International Workshop, held in Rome in April 2013.

At the state of the art two other tools are under finalization for dissemination to the wider public:

- a **toolkit** collects the materials and systematizes the methodology of the whole training with the aim to facilitate future improvements and replication of the capacity-building carried out under ACC Dar; and
- a **booklet** that summarize and systematize the main results of the whole project.

The project applied to the Expo Milano 2015 - International Call for Best Sustainable Development Practices. Results will be available on 31st of December 2014.

WORKING PACKAGE 0: PROJECT MANAGEMENT

The structure and the composition of the **internal project management and coordination** did not change during the whole project ensuring continuity of the action. The activities of the joint working groups were supported and monitored by the Project Manager; their achievements were supported evaluated by the Project Coordinator and the Local Coordinator.

Internal monitoring of the project activities has been carried out by the Project Manager on the basis of performance indicators through analysis of documentation and periodical meetings with the project staff.

Evaluation of the results achieved under the whole WP 2 have been performed by external international experts in the framework of the second international workshop held in Rome in April 2013.

The project team and the management took into consideration the recommendations held in May 2013 by the external ROM experts, Mr Benjamin Landreau. In particular, during the second semester of 2013, more efforts than foreseen have been spent working with the LGAs to ensure the successful impact of the capacity-building initiative. Furthermore the project management in Dar es Salaam has been strengthened for a period of three months.

As from the beginning of the project the internal communication flow between the two partners and among the working group members took place mainly by email, by phone and by in-person meeting several times in Dar es Salaam and in Rome in order to validate results and to agree planning for the upcoming activities.

Two financial audits have been carried out: one at the end of the second project year (February-March 2013) and one is in parallel with this report.

A request for extension of the project duration and a budget addendum was approved by EU delegation in December 2013.

Accountability to EU delegation is ensured by submitting the bi-annual ROM and the annual interim narrative and financial report.

2.3 CHANGES IN THE WORKPLAN

As regards the project work plan some changes have arisen during the reporting period. A period of 7 months of extension of the project duration was required and approved by the EU Delegation for the successful project implementation and the achievements of the results.

The extension of the project deadline is required due to two main reasons.

Firstly, significant efforts were spent during the third year project to carry out successfully the capacity-building involving five government authorities in Dar es Salaam, in total 38 local officers. The whole working package 3 required more time and efforts than foreseen. The selection of the participants required the support and the authorizations by the government authorities' Directors and the design of the capacity-building strategy required a long negotiation with them to ensure the officers' participation. After several consultations, it was decided to deliver the training in a residential modality outside Dar es Salaam, in Morogoro, to avoid participants' turnover and drop out. This decision entailed stronger efforts in terms of logistic and coordination for the organization of the whole activity.

Secondly, some delays and postponements already occurred during the project implementation of the past two years leading to reschedule all the related activities. Justifications and corrective actions were already reported in the bi-annual ROM reports and through the interim narrative reports. They are summarized here following:

- WP1, Activity 1.1: The sample size of the households' survey assessing the adaptive capacity increased from 500 to 6000 units. It required increased efforts and time allocation in administering questionnaires, entering and analyzing data;

- WP2, Activity 2.2: The groundwater monitoring boreholes campaign delayed due to bureaucratic problems in customs clearance of the chemical reagents purchased for instrument calibration and chemical analysis;

- WP3, Activity 1.3: The needs assessment targeted almost 50 officers from Dar es Salaam LGAs and other relevant stakeholders. The project team had to adjust its schedule taking into consideration officers' availabilities to interview them.

Accordingly with the above described needs and the extension of the project duration already approved, some of the project activities have been rescheduled.

In the framework of the activity 3.4 a period of internship for one of the Ardhi junior researchers was foreseen by the project to hosted in Sapienza. The activity planned did not take place because the visa issues was denied by the Italian Embassy in Dar es Salaam.

2.4 ASSESSMENT OF THE RESULTS

Project objectives and expected results planned in the logframe remained relevant during the reporting period. The results' achievements and their related outputs have been already described in details in the extensive paragraph 2.2.

The table of the results-indicators is updated and annexed to this report.
The whole development of the action did not encounter any relevant obstacles because there were no changes in the project operating context since the start of the project, unless the isolated case of visa rejection highlighted in the previous paragraph. All the assumptions described in the logframe have been fulfilled.

Achievements deserving to be mentioned

Under the activity 2.1 two important and unexpected results have been achieved.
Firstly, a **plugin for the open-source software Quantum GIS** has been developed. It relies on other open-source software (Sextante plugin, Orfeo Toolbox and SAGA) and **can replace commercial software in the Land Cover classification process**, making the methodology developed under this project more affordable.
Secondly, drawing on data from land cover classifications and the households' survey conducted under the activity 1.1, **a method to estimate the number of households** for years in-between census time has been defined and tested. The methodology used to select the households sample for questionnaire administration in 2011 provided the data for calculating an average of the households' density per pixel for each land cover class identified. Based on these household/pixel density rates, the number of household was calculated for year 2002 and 2011. The estimates thus obtained resulted largely consistent with data from 2002 and 2012 census at both Dar's region and municipal levels validating the methodology and confirming that a strong correlation exists between population density and land cover classes in Dar region. The methodology developed can provide **a valuable alternative for demographic estimation to traditional census** in fast growing African cities.

Under the activity 2.2 some final conclusion could be drew by the results achieved.
The methodologies and the tools identified in the framework of this activity are a first step to support the local institutions in identifying adaptation strategies aimed to design new water management plans as a consequence of the people vulnerability to seawater intrusion.
Furthermore, the specific tools used for systematic data collection and management as the ACC-Dar **Monitoring Boreholes Database** could be a reference for the storage of the future monitoring results in order to assure the standardization of the data collected and their preservation over time.
LGAs could be able **to update the analysis of seawater intrusion evolution** and to explore likely scenarios of aquifer sensitivity through realizing a few monitoring points for the neighborhoods identified as the highest sensitive ones, consisting of observation wells with separate screens on each aquifer levels. This would enable to register continuously the logs of some of the most important parameters characterizing the groundwater evolution, like SWL, EC, T, TDS, pH, Cl.
Moreover, the integrated use of the methodologies proposed in this study with the information provided by other project activities, related to the urban expansion (activity 2.1) and the degree of dependence of the population from groundwater resources (activity 1.1), will enable LGAs to use the mere scientific monitoring outputs in the framework of a broader assessment of population's vulnerability, aimed to assist the identification of the adaptation actions to be mainstreamed in water management plans and strategies.

A part from the LGAs' monitoring and planning activities, the results of the study conducted under activity 2.2 presents significant links with ongoing studies performed by other stakeholders in Dar es Salaam Region. In particular, the ACCDAR coordinator has been requested to authorize the use of the project's database in the framework of a comprehensive groundwater study of the Dar es Salaam aquifers that Un-Habitat (Water and Sanitation Urban Basic Services Branch) has undertaken in collaboration with DAWASA and a group of experts from Tanzanian Universities to get a better understanding of the salinity problem.

Under the Working Package 3, the active participation of the LGAs exceed expectation.

Firstly, the **capacity-building** strategy was implemented involving the four LGAs in Dar es Salaam during the whole process as showed in the following figure.

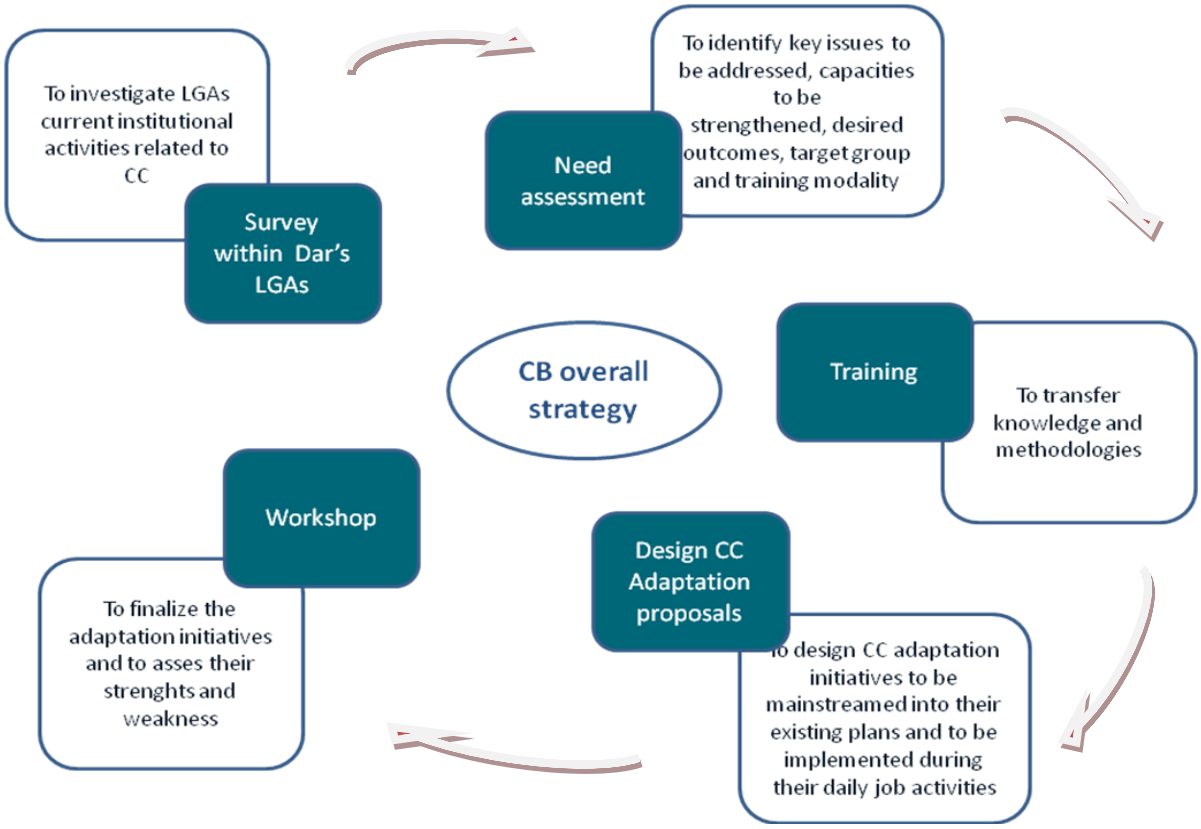


Figure 22 The capacity-building strategy

The LGAs' representatives involved showed their interest and motivation in the process. In fact, during the training course there were only two cases of turn over between the first and the second week, and the final output to design one adaptation project proposal for each LGA was achieved.

At the end of the process the 38 participants were **able to identify key areas in which adaptation to CC goes hand-in hand with other development priorities** and building resilience in natural and human systems. They were also **able to identify and develop basic elements for designing CC adaptation proposal design**.

Furthermore, the capacity-building action provided an opportunity of **cross-sectoral exchange among the departments within the same administration and among the different authorities involved**, namely the three municipalities of Temeke, Ilala and Kinondoni, the Dar City Council and the Wami Ruvu Basin Office.

Besides the improved knowledge and competences, the capacity-building had as unexpected result the **enhancement of conceptualization on CC adaptation related issues**. This means that local solutions in peri-urban areas to respond to the environmental changes supported and implemented by the LGAs in their day-to-day activities already exist without being conceptualized as CC adaptation measures.

Under the activity 3.4 it deserves to be mentioned that the **mainstreaming methodology developed provides useful insights to identify which are the best plans to mainstream CC adaptation**. The plans selected under the activity show to be suitable on the one hand because they are the ones including measures affecting the adaptive capacity and (viceversa) on the other hand because they are the ones including planning measures that could potentially be affected by CC impacts.

Cross-cutting objectives

The action pays special attention mainly to three cross-cutting objectives: environmental protection, promotion of gender equality and equal opportunities and good governance.

The whole action is based on the purpose of ensuring the environmental sustainability of adaptive measures and strategies. The target groups of the action are those living in coastal unplanned and underserviced settlements whose livelihood is strictly depending on natural resources. The protection of natural resources is one of core elements of the "vulnerability" concept.

By drawing on people's daily experience, the data collected during the household survey combined with land cover classification provided a better understanding of adaptive capacity distribution across Dar's coastal plain.
Findings in terms of autonomous adaptation strategies explored further through the participatory cycles provided a better understanding of the impact of access to land and access to water on household adaptive strategies.

Furthermore, the monitoring of coastal shallow watershed condition and the analysis of the current state of seawater intrusion phenomenon into Dar es Salaam's coastal aquifer and its relationships with climatic conditions and urbanization processes provided an in-depth knowledge about the groundwater conditions. Access to available and safe water sources for domestic and agricultural uses is one of the major concerns for the target population's vulnerability to CC mainly for those living in peri-urban areas of the city.

Women's concern about CC impacts as well as gender aspects of adaptation have been taken into account as a fundamental piece of knowledge.
Equal participation of men and women has been ensured in the surveys and in the forum theatre events (under WP 1 and 2) and in the whole training activities (under WP 3).
Furthermore, women hold prominent positions in the action management.

LGAs' involvement (mainly DCC and the three municipalities) in the project was ensured by the beginning of the project. They are the direct beneficiaries of the action.

The role played by LGAs in assessing adaptation needs and proposing adaptation initiatives is crucial as CC adaptation is a strongly context dependent issue. The action paid special attention in the active involvement of key representatives of the four LGAs governing the city of Dar es Salaam (as exhaustively described in the description of the working package 3 activities and results in the previous paragraphs). The capacity-building action enhanced their understanding of CC impacts and adaptation

related issues and improved their capacities in designing adaptation proposals and in fostering changes within their own existing sector plans to mainstream adaptation initiatives. In addition to the four LGAs, it included the Rivu Basin Authority due to its responsibility in managing both ground and surface water resources within Dar es Salaam city.

LGAs' availability, commitment and willingness to collaborate has been essential to guarantee the effectiveness of the project results and the consistency with their strategies and the local institutional framework.

Potential risks already tackled

The two major surveys within the boreholes monitoring campaign conducted within the monitoring campaign (under work package 2) required an effort for laboratory analysis greater than anticipated. In addition, it has been necessary to replace a number of boreholes previously selected because during the monitoring campaign they became not more accessible or working. This required a supplementary effort for the monitoring teams and, consequently, one minor survey and tidal effect survey were cancelled. However these changes did not jeopardize the possibility of achieving the foreseen meaningful results in data interpretation.

The involvement of the local officers from several departments in each LGA represented the main challenge of this phase of the project. The selection of the participants was negotiated by Ardhi University and the LGAs' Directors. To overcome the risk of turn over or drop out during the training activity it was decided to deliver the course in a residential modality outside the city. The active and constant participation of the 38 officers showed the effectiveness of the strategy chosen.

3 PARTNERS AND OTHER CO-OPERATION

The partnership

Sapienza University of Rome and Ardhi University of Dar es Salaam shared responsibilities in implementing all the project activities and in achieving related results. The fruitful management of the project was ensured by the project coordinator, the local coordinator and the project manager. The internal communication flow between the two partners and among the working group members has been on almost weekly basis; exchange of documents took place mainly by email and uploading them in the reserved area of the project web site. Management and coordination meetings took place in Rome and in Dar es Salaam in correspondence of the main project milestones several times each year.

In particular during the reporting period, one junior researcher from Ardhi University was hosted in Sapienza University to spend a period of internship of one month (February 2013). The researcher, already involved in the boreholes monitoring campaign performed in Dar es Salaam and in the data entry in the boreholes database, participated in the analysis of hydrochemical data collected.

In September 2013 a short course on "Seawater intrusion monitoring" was held at Ardhi University by one senior expert from Sapienza University. The course was addressed to 20 Master and PhD students.

A part from the two workshops organized in the framework of the project activities already described (namely the one titled "*Towards scenarios for urban adaptation planning. Assessing seawater intrusion under climate and land cover changes in Dar es Salaam, Tanzania*" held in Rome on April 2013 and the one titled "*Towards Mainstreaming Climate Change Adaptation in Sustainable Development of Dar es Salaam City*" held in Dar es Salaam in September 2013), the two partner Universities' representatives participated as keynote speakers in other international events on CC adaptation presenting together the results achieved by the project. The two international workshops already mentioned in the dissemination paragraph are the following:

- the International Workshop "*Bearing the brunt of environmental change: understanding climate adaptation and transformation challenges in African cities*", held at the Royal Holloway, University of London, on April 2013; and
- the International Workshop "*Urban Impact of Climate Change in Africa 2nd International Conference "Planning with Scant Information*", held at the Polytechnic of Turin, on November 2013.

The two universities contributed to the publication of a book titled "*Climate Change Vulnerability in Southern African Cities: Building Knowledge for Adaptation*" and edited by Springer Climate Series. This work came from a long-standing existing collaboration between Sapienza Univeristy of Rome and Polytechnic of Turin.

At the state of the art, as follow up of the results achieved under the project, the team members of both universities are collaborating in three future publications that are under the editing phase:

- "*Planning the adaptation to climate change for the cities off the Tropical and subtropical regions*", edited by Versita, is the result of the further step of the collaboration between Sapienza Univeristy of Rome and Polytechnic of Turin;
- "*Adapating to Climate Change in Coastal Dar es Salaam*", edited by Aracne, collects all the working papers elaborated during the whole project; and

- "*Adaptation Planning in a Mutable Environment: From Observed Changes to Desired Futures*", edited by Springer, collects all the contributions discussed during the Second International Workshop held under activity 2.4

The associate

Dar City Council, associate in the ACC Dar project, provided its endorsement to the action. Its commitment and involvement during the whole project duration remained a strong asset.

They supported the project team providing information about existing projects and programmes (expired or ongoing) linked to CC and adaptation issues.

One key person from the GIS office actively participated during the international workshop in Rome providing strategic inputs.

Furthermore, DCC representatives have been part of the capacity-building, participating actively in the training course and elaborating an adaptation project proposals.

Community involvement

Community involvement in the project activities during the reporting period was crucial to define shared adaptation objectives.

It has proven to be successful during the participatory backcasting scenario exercise carried out in several subwards in Kigamboni ward. Two events was held in Kunduchi and Somangira wards.

The residents participated actively both during the workshop and during the 10 events of forum theatre. Almost 2000 people were involved.

The results of their active involvement were the following:

- the identification of a future vision shared by the community as regards the access to safe water for domestic and agricultural purposes;
- the representation of the state of the art of the water availability and access;
- the identification of the economic, social, technological and political challenges to be addressed by the community to reach the desired future vision;
- the suggestion of possible actions to find solution in order to overcome those challenges

Other stakeholders involved

During the reporting period other stakeholders have been involved in the project activities.

Wami Ruvu Basin Authority representatives have been involved in the training course due to the strict links between their functions and competences and the problems related to water availability in Dar es Salaam tackled by the project. As arose during the workshop with the LGAs, the relationships between the Basin Authority and the municipalities on the issues related to the management and the monitoring of groundwater is still weak. Competences and responsibilities related to measures addressing community boreholes, authorizations and planning adaptive measures related to water issues are often not clear.

Other Universities and research centres demonstrated interests in the project results inviting the project team to discussed them and participating in the second and third international workshop organized respectively in Rome (April 2013) and in Dar es Salaam (June 2014). Among them:

- University of Sassari, Italy
- Bari Polytechnic, Italy
- Turin Polytechnic, Italy

- University IUAV of Venice, Italy
- ISPRA - Italian Institute for Environmental Protection and Research
- Sokoine University of Agriculture, Tanzania
- Bagamoyo University, Faculty of Science and Built Environment, Tanzania
- State University of Zanzibar
- Royal Holloway, University of London

During the reporting period a research collaboration started between Sapienza and Columbia University to collect meteorological data, in particular, for predicting future rainfall patterns under global warming scenario, and to improve models for downscaling CC impacts in Tanzania, and in particular in Dar es Salaam Region.

Representatives of Dar's civil society have been involved and participated actively during some of the project activities. More in details:

- Representatives from Haki Ardhi and Forum Climate Change participated in the last international workshop held in Dar es Salaam in June 2014 titled *"Mainstreaming Climate Change Adaptation Into Urban Development And Environmental Management Plans And Programs"* (activity 3.5);
- Representatives from Kigamboni Community Center participated actively during the workshop for preparing the backcasting scenario exercise (activity 2.3);
- The well-known local theatre and dance group Club Wazo was involved as actors during the forum theatre sessions (activity 2.3)

Furthermore, during the reporting period the project coordinator has been contacted by representatives of the Urban Basic Services Branch UN-Habitat in Nairobi and afterwards they met them in Dar es Salaam. UN-Habitat is supporting the Dar es Salaam Water and Sanitation Authority (DAWASA) with the implementation of the Community Water Supply and Sanitation Program (CWSSP) which aims at providing reliable, affordable and sustainable water supply and sanitation service in areas not served by water pipeline. In particular, CWSSP that constructed a large number of boreholes for the communities in town and peri-urban areas where results of water quality tests revealed that a significant number of the community boreholes have medium to high salinity levels, which is leading to complaints and in some cases necessitating abandonment of the wells. UN-Habitat has been requested to appraise the situation and to give recommendations to get a better understanding of the salinity problem.
To support the comprehensive groundwater study of the Dar es Salaam aquifers that they have already undertaken in collaboration with DAWASA and a group of experts from Tanzanian Universities,
UN-Habitat asked for the authorization in using the project's boreholes database.
UN-Habitat representatives were invited during the last international workshop held in Dar es Salaam.

Future collaborations

The ACC Dar project offered the opportunity to strengthen the existing collaborations and to launch new ones. The foreseen future steps to foster this network and to ensure sustainability of the project results are at the moment under exploration phase.

On the one hand, the above mentioned publications are under elaboration in order to disseminate to the scientific community the research results.

On the other hand, future project proposals as operational follow-up of the ACC Dar project are under development. In particular, among the four Dar's LGAs involved under the action Temeke municipality was the most active and the one showing the best results during the capacity-building in designing CC

adaptation proposals. During the final phase of ACC Dar they became active partners in the design of a project proposal submitted under the Global Climate Change Alliance programme.

Furthermore, the process for signing general framework agreements between Universities is ongoing, in particular involving again Ardhi University and State University of Zanzibar

4 VISIBILITY

EU visibility has been ensured for each of the dissemination activities and within all the events following the rules of the "Communication and Visibility Manual for European Union External Actions" (Europeaid, 2010).

In particular, EU flag and ACC Dar logo appear in all the communication and the dissemination materials described in the paragraph 2.2 of this report. More in details, they are visible on the web site, on the brochure, on the cover page of the working papers and of the internal technical reports, on the publications elaborated by the project staff, and in the training materials.

They appear also in all the materials and presentations held during the events organized in the framework of the action: the invitation letters, the information materials, the posters, the programmes, the template used for ppt presentation.

Furthermore, they are visible on all the papers, posters and presentations discussed in other conferences and seminars by the project team members

The European Commission may wish to publicise the results of Actions. Do you have any objection to this report being published on EuropeAid Co-operation Office website? If so, please state your objections here.

Name of the contact person for the Action: Prof.ssa Silvia Macchi

Signature:

Location: Rome, Italy

Date report sent: 22 December 2014

ANNEX 1 RESULTS-TRACKING TABLE

Result Description	Result Indicator (OVI)	Target	Performance Rating (Red, Yellow, Green)	Progress/Arising Issues	Action Required by the which implementing partner/s
1.1 Livelihoods of population dependent on natural resources and their concern for CC investigated	N. households questionnaire administered/ Households questionnaire validated in the data entry	6000/5885	Traffic Light		
	N. people involved in the Data Analysis training course	26	Traffic Light		
	N. Data Analysis Methodologies implemented	3	Traffic Light		
1.2 Dar's institutional activities related to CC investigated	N. officers participating in the kick off meeting	10	Traffic Light		
	N. officers interviewed	48	Traffic Light		
1.3 Local options of autonomous adaptation and raise awareness on CC explored	N. people involved in the feasibility study	28	Traffic Light		
	Participatory cycles realized	2	Traffic Light		
	N. people involved in the participatory cycles	At least 100 people for each cycle	Traffic Light	Almost 400 people involved in the first participatory cycle held in March 2012. Almost 500 people involved in the second cycle held in September 2012	

1.4 1st International Workshop organized	N. Background papers	2	Traffic Light		
	N. papers presented	4	Traffic Light		
	N. people attending the workshop	10 researchers from each university partner country (Tanzania and Italy); 3 seniors from EU universities; and 3 seniors from EAC/SADC universities	Traffic Light	4 senior researchers from EU universities and 2 from EAC/SADC universities	
2.1 Methodologies for monitoring changes in peri-urban settlements developed	N. methodologies developed for monitoring Land Cover changes	1	Traffic Light	2 (two similar methodologies, respectively for LANDSAT images and SPOT images)	
	N. LANDSAT images acquired/ N. LANDSAT classifications/ N. LANDSAT images processed	5 images acquired / 5 classifications/ 5 images processed (period 2002-2010)	Traffic Light	6 images acquired / 6 classifications/ 6 images processed (period 2002-2012)	
	N. Landscape Metrics Indices calculated for Land Cover change analysis	8	Traffic Light		
	N. people involved in the training short course on land cover classification and landscape metrics analysis	20	Traffic Light	The short course has been held on "Seawater intrusion monitoring"	SAPIENZA

	N. methodologies developed for Land Cover validation	1	Traffic Light		
2.2 Methodologies for exploring CC vulnerability scenarios, as regards seawater intrusion phenomenon, developed	N. methodologies for conducting groundwater monitoring campaigns in Dar's coastal plain/ N. georeferenced boreholes / N. boreholes selected for the monitoring network	1 methodology/ 133 georeferenced boreholes/ 90 boreholes selected for the monitoring network	Traffic Light		
	N. groundwater monitoring activity conducted	1	Traffic Light	2 major monitoring campaigns/surveys (long term activity) have been carried out. 3 minor monitoring campaigns/surveys (monthly activity) have been carried out.	
	N. methodologies for the analysis of seawater intrusion / N. maps produced	1 methodology / 9 maps (SWL maps, EC maps, Seawater intrusion maps for 1997, 2002, 2012)	Traffic Light	Sectors affected by seawater intrusion 2001-2012; Evolution of groundwater table 2003-2012; Evolution of EC, TDS and Cl values 2001-2005-2012; Groundwater Active Recharge evolution estimation 2002-2020; Groundwater exploitation evolution estimation 2002-2011	

	N. methodologies for exploring vulnerability scenarios under CC	1	Traffic Light		
	N. methodologies for investigating Land Cover Change correlation with Climate Change	1	Traffic Light		
2.3 Methodology for designing community based adaptation initiatives developed	N. of methodologies for designing community based adaptation initiatives	1	Traffic Light		
2.4 2nd International Workshop organized	N. Background papers	2	Traffic Light	3	
	N. papers presented	4	Traffic Light	5	
	N. people attending the workshop	10 researchers from universities of each partner country (Tanzania and Italy); 3 seniors from EU universities; and 3 seniors from EAC/SADC universities	Traffic Light	24 persons in the indoor session on 20th April 2013; Almost 100 persons in the opendoor session on 22nd April 2013	
3.1 Capacity building strategy prepared	N. Need assessment report of the training needs of municipal staff	1 need assessment	Traffic Light		
	N. Officers involved in the need assessment	At least 40	Traffic Light	50	
	N. capacity-building action plan	1	Traffic Light		

3.2 Training programme developed and implemented	N. learning curricula / N. evaluation procedures	2 learning curricula / 1 evaluation procedure	Traffic Light		
	N. Training resource book	1	Traffic Light		
	N. Officers involved in the training	20	Traffic Light	38 officers participated during the first training week; 35 officers participated during the second training week	
3.3 Mid term Conference organized	N. submitted papers	12	Traffic Light	5 adaptation proposals have been submitted by the LGAs	
	N. People attending the Conference	100	Traffic Light	60	
3.4 Dar's municipalities supported in designing adaptation initiatives	N. Adaptation initiatives designed	At least 4	Traffic Light	4 local plans has been selected and assessed.	
3.5 3rd International Workshop organized	N. Background papers	2	Traffic Light		
	N. papers presented	4	Traffic Light	6	
	N. people attending the workshop	10 researchers from universities of each partner country (Tanzania and Italy); 3 seniors from EU universities; and 3 seniors from EAC/SADC universities	Traffic Light	40	

Dissemination results	N. scientific papers submitted to academic journals	At least 5	Traffic Light	10	
	N. evaluation reports	6 (2 for each international workshop)	Traffic Light		
	N. Proceedings (international workshop and conference)	3 proceedings (1 for each international workshop)	Traffic Light	3 books	
	N. Booklets reporting on designed adaptation initiatives	100 copies	Traffic Light		
	N. Training Toolkit	100 copies	Traffic Light		
	N. Web sites	1 web site with a public and a reserved area	Traffic Light		
	N. Promotional material kit	1 brochure + 1 bag + 1 CD Rom	Traffic Light	Pen-drive has been produced instead of CD Rom for both international workshops (in Rome and in Dar) Also t-shirt and posters have been produced for dissemination and visibility during participatory cycles