

## **Project working paper evaluation report for:**

**Activity 2.1: Development of methodologies for monitoring changes in peri-urban settlements** for the project title ‘Adapting to Climate Change in Coastal Dar es Salaam’

### **Prepared by**

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**1. Object of Engagement:** Evaluation of the results of *Activity 2.1: “Development of methodologies for monitoring changes in peri-urban settlements”* for the project title ‘Adapting to Climate Change in Coastal Dar es Salaam’ referred in short as **ACC Dar project** in this report.

**2. Extent of Services:** The assignment specifies among others that the evaluator shall adequately and accurately provide the following services:

(a) Critical reading of the report on Activity 2.1: “*Development of methodologies for monitoring changes in peri-urban settlements*” on the basis of the expected outputs specified in the project proposal.

(b) Give comments and recommendations on improvement of the working paper on the results of Activity 2.1 “Development of methodologies for monitoring changes in peri-urban settlements”, based on the critical reading of the report.

**3. Entry and Duration of engagement:** The engagement become effective by signing the contract of engagement by Dr. Elifuraha Gerard Mtalo (Evaluator) and Prof. G.R. Kassenga (Project Local Coordinator) on the 30<sup>th</sup> March 2013 in Dar es Salaam and the duration of the engagement was estimated to be four (6) weeks from the date of signing the contract.

**4. Materials provided:** The following materials and facilitation was provided to accomplish the assignment:

(a) Working paper report titled Activity 2.1: “*Development of methodologies for monitoring changes in peri-urban settlements*” of 56 pages in length and dated Rome 4<sup>th</sup> April 2013.

(b) ACC Dar Project Website

(c) Invitation by the Project Local Coordinator to attend to an *International Workshop TOWARDS SCENARIOS FOR URBAN ADAPTATION PLANNING Assessing seawater intrusion under climate and land cover changes in Dar es Salaam, Tanzania held in Rome, 20-22 April, 2013.*

The objective of the workshop was *to draw together a small 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 climate change; and to provide an opportunity for sharing information and exchanging ideas among researchers, and stimulating initiatives for international networking.*

### **5. Context/background of the project**

The ACC Dar project aims at improving the effectiveness of Local Authorities in supporting peri-urban population in their efforts to adapt to climate change impacts, thus contributing to the implementation of the National Adaptation Programme of Action of the United Republic of Tanzania.

The project seeks to improve the effectiveness of municipal initiatives in Dar es Salaam that support the efforts of those coastal peri-urban dwellers, partially or totally dependant on natural resources, through:

- Enhancing the capacities of Dar's municipalities by increasing their understanding of adaptation practices and by providing them with enhanced methodologies for mainstreaming adaptation into their Urban Development and Environment Management (UDEM) strategies and plans.
- Building a better understanding of adaptation, the study conducted extensive surveys and the analysis of collected data from the household questionnaires was done to propose a framework for assessment of the adaptive capacity of people living in the peri-urban areas of coastal Dar es Salaam.

## **6. Comment on Study objective and components**

As indicated in the project proposal and in the Activity 2.1 report being evaluated, the overall objective of the study was the development of methodologies for monitoring Land Cover Changes (LCC) in the Dar es Salaam region from the perspective that LCC in the form of urban sprawl is considered a non-climatic factor that could amplify climate change impacts while reducing people's adaptive capacity in coastal peri-urban areas of Dar es Salaam, thus worsening the vulnerability of the growing population living there. In particular Activity 2.1 reviewed in this report represents the first step in the process of developing a methodology for the participatory design of institutional adaptation initiatives, which is the ultimate goal of Work Package 2 of the Project. With this broad goal Activity 2.1 has the overall objective of advancing LCC assessment methods and providing an understanding of LCC drivers in the Dar es Salaam region, with a special focus on peri-urban development within the coastal plain.

Given the broad objective of the ACC Dar Project and reading through the Activity 2.1 report it is clear that the methodologies adopted for assessing LC and LCC and the results obtained in using the observed LC and LCC to model population changes in the study region are germane to the overall project objective.

## **7. Information about the evaluation process**

In the absence of a detailed terms of reference (ToR) for the evaluating Activity 2.1 of the ACC Dar Project the following approach was adopted:

1. Initial perusal through the Activity 2.1 report to build up an initial understanding of what the project is about.
2. Desk study of previous ACC Dar Project reports downloaded from the given website link to build up an overall knowledge of the Project Objectives and to appreciate the links between the different project components in order to help the evaluator to position Activity 2.1 in the context of the overall project objectives.
3. Reading through the document to ascertain consistency and in the flow of ideas and concepts from problem specification, through methodologies, results analysis/discussion and conclusions
4. Literature review of past and current related studies by other researchers to establish the basis for a comparative critique of the Activity 2.1 project
5. Application of the knowledge gained to make general and specific recommendations on how to improve the Activity 2.1 report

The above approach was used to execute the assignment in accordance with the letter of appointment (Annex 1 to this report). In writing the evaluation report appropriate citations/references are made where germane for knowledge elicited in points 2 to 4 above.

## **8. Critical report reading**

In reviewing the Activity 2.1 the following strategy was adopted.

1. Evaluation of the approaches and data used (methodologies) in the context of the stated specific objectives or outputs of the study
2. Evaluation of methodologies and data used in the context of general scientific practices
3. Assessment of the study outputs in the context of the stated specific objectives of Activity 2.1

- and the broad goal of the ACC Dar Project
4. General comments on the quality of the study
  5. Specific comments on areas of improvement

### **8.1 Evaluation of methodologies and data in the context of stated objectives and outputs**

The specific goals pursued by the working team based at Sapienza University of Rome were as follows:

- development and validation of a methodology for monitoring Land Cover (LC) that allows for observation of the urban sprawl phenomenon and can be adapted to the needs of the Local Authorities in the Dar es Salaam region. More specifically, the monitoring technique must be: i) economical, in order to guarantee practicability for municipal services; ii) simple, in order to allow for regular updating of land use information; iii) quick to execute, in order to reveal the land cover changes in a very dynamic area;
- analysis of the urban development dynamics occurring in the Dar es Salaam region over the last decade in order to assess the change patterns which prevailed, leading to either the densification or the sprawling of peri-urban areas. This analysis will also provide the opportunity for testing LCC indicators from the literature in order to select an easy-to-use indicator of urban sprawl to be adopted by municipal services for further assessment;
- investigation of the relationships between urban sprawl and population growth, two phenomena which are usually considered misaligned but nevertheless seem to be highly correlated in the Dar es Salaam region. A deeper knowledge of the actual correlation linking them will pave the way to the development of new methods for estimating the regional population from LC classification datasets, which is crucial for the management of fast growing cities like Dar es Salaam, especially for interim years between two censuses.

Reading through the paper on Activity 2.1 there is ample evidence that these goals have been largely achieved. In particular the validation method developed for monitoring LC is indeed economical in the sense that it largely uses generally freely available satellite image data and public domain software for processing the data to extract LC and LCC information. The method is also simple because the methods used to process the data are well known and they can easily be taught to the local staff. It is therefore possible for the staff of the Dar Es Salaam Municipalities to replicate the approach used for regular monitoring of LC and LCC. The satellite data used (Landsat TM/ETM+) for the study has a revisit cycle of 16 days. This means that data for monitoring urban sprawl is available at a temporal resolution of 16 days. The use of free image processing and analysis tools such as QGIS and the availability of (free) satellite images throughout the year satisfies the requirement that the method be quick. The LC and LCC maps generated from satellite images covering a period of 10 years successfully revealed the patterns of densification and the sprawling processes of urbanisation in Dar Es Salaam. In addition the study developed an urban sprawl indicator that was successfully used to derive fairly good population estimates from the observed LC. Thus the three goals above have clearly been achieved.

### **8.2 Evaluation of methodologies and data used in the context of general scientific research practices**

During the evaluation process a number of past and recent literature on LC and LCC monitoring in conjunction with urbanisation studies were consulted to provide the basis for establishing scientific value and validity of the approaches used in the study. The study by Park and Baro (2003) attempted to apply remote sensing techniques using SPOT imagery to support socio-economic study of six arid cities, including Dodoma, in the SSA region. In their study satellite images were used to support a random spatial sampling framework for houses to be included in detailed household survey and focus group selection but there was no attempt to use the images to estimate populations or to determine the nature of land use changes in the studied cities. Studies that had objectives similar to the current study include Decker (2000), Sliuzas et al (1998, 2000), Sliuzas, Gorte and Mitalo (2000) and Kuffer (2003) which focused on determining the nature of urbanisation in Dar Es Salaam using a combination of SPOT

Imagery, ERS SAR and Small format photography. The review also looked at three recent studies on urbanisation in Dar Es Salaam, specifically the work of Vincent (2009), Young and Flacke (2010) and the masters thesis by Abebe (2011). Measured against the past studies the present study has brought in two major solutions that address two problems 1) The perpetual cloud cover over Dar Es Salaam that renders use of Optical Satellite Sensor data fairly useless 2) Assessment of housing density which is an essential parameter in remote sensing data based population estimates. The approaches used to tackle these problems coupled with the relatively good quality results obtained are a good indicator of the scientific merit of the study being evaluated.

### **8.3 Assessment of Activity 2.1 study outputs in the context of specific and broad objectives**

The study initially set out to develop methodologies for using remote sensing imagery for determining land cover (LC) and Land use change (LCC) in peri-urban settlements as indicators of urban sprawl progression. The study not only achieved these stated objectives using medium resolution satellite images but also managed to obtain fairly good estimates of the population of the city of Dar Es Salaam and its municipalities to a lesser accuracy. It is therefore evident that the outputs obtained in the study not only satisfy the specific and broad objectives of the study but also went far beyond what the objectives specified.

### **8.4 General Comments on the quality and significance of the study**

One of the broad objective of the ACC Dar Project is knowledge and skills transfer to local communities and technical personnel. This objective seems to have been achieved in respect to the non-scientific assessment of LC and LCC i.e. the involvement and ARU technician in interpreting the satellite images. However there is paucity in involvement of ARU or other local researchers at postgraduate level. This project could have generated more capacity if researchers from other departments at ARU such as the Geomatics and Geoinformatics program were involved e.g. in the form of MSc and Ph. D. level research

Not-with standing the above paucity in the development of scientific capacity for developing methodologies and solutions for LC and LCC assessment among the local partners the overall goal of developing methodologies for LC and LCC assessment in the Peri-Urban settlements has been largely achieved because:

1. The output from the application of the LCC assessment methodologies developed provide important qualitative and quantitative measures of the non-climatic factors that play an important role in determining impacts and shaping adaptive capacity.
2. Quickl and relatively accurately LC and LCC mapping provides a credible and indisputable evidence that can be used by policy makers, politicians and technocrats to develop policy and legal instruments to regulate or enforce existing regulations on uncontrolled urban sprawl.
3. The strong correlations between LCC and Population increases established in the study provide cheap means of providing critical population statistics in between major census operations.
4. Urban Geographical Databases can be built from the methods developed for efficient compilation of LC, LCC and Households Survey and used to support urban development planning, including land use and urban planning, river basin and land management, hazard-resistant building codes, and landscape design; activities that can reduce exposure and vulnerability to hazards and change.
5. The study has, therefore, succeeded in contributing to the effort of reducing exposure and vulnerability to hazards and change through the enhancement of knowledge of the relationship between LCC and climate change vulnerability in coastal Dar es Salaam.

### **8.5 Specific Comments on areas of improvements**

The study by Sliuzas et al (2000) and Gorte (2000) provides a method that allows land use classes to be indirectly obtained from multi-spectral satellite images through a two stage classification. The present study can be further improved by employing similar strategies to derive the land use information from satellite images. Given the perpetual cloud cover over Dar Es Salaam use of Small Format Photography

could come in handy in planning the households sampling tracts and establishing housing densities.

## 9 Conclusion

It is the opinion of the reviewer that the work done in this study has achieved all the broad and specific objectives stated in the terms of reference for the study. An affordable and fast validated method for the use of remote sensing methodologies in studying LC and LCC in per-urban areas of rapidly urbanising cities in Sub-Saharan Africa has been developed that offers quality information on urban sprawl and population estimates to city governors. This is especially important given the paucity of funds for urban governance in developing countries.

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