Report from the Future Climate for Africa Pilot Country Case Study project

CSAG, START, SEI and University of Ghana

Climate System Analysis Group

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INTEGRI PROCEDAMUS

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1. Introduction

As a precursor to the Future Climate for Africa (FCFA) research activities, CDKN, on behalf of DFID commissioned a series of case study activities with the purposes of exploring the climate science needs of decision makers in Africa. The intention was for the learning gained through these pilot case studies to inform the design and implementation of the broader FCFA research activities over the coming years. The overarching aim of the case studies was to:

- Provide users with the state of the art scientific information and build their capacity to use such information to support long term adaptation
- Contribute to the identification of climate information needs for real decision-making, with a view to informing the design of the FCFA

The Climate System Analysis Group (CSAG), in collaboration with START, and SEI-Oxford proposed a dual city case study covering Maputo and Accra based on the following rationale:

- Africa is one of the fastest urbanizing areas of the world and cities are areas of both high climate vulnerability and high exposure to other stressors such as poverty, lack of infrastructure, informal development, etc.
- Studying two cities allows for co-learning by participants from both cities which have some common and some unique characteristics (highlighted later)
- Coastal cities are particularly vulnerable to risks such as sea-level rise and flooding.
- Good previous collaboration and linkages with both cities

The proposed case study rested strongly on the "co-exploration" model of engagement. The primary concept of co-exploration is that the decision-making process is complex and progresses through different stages. Different climate information is required at different stages and the nature of this information is not known beforehand, rather it emerges through the decision process. The process therefore requires the continual engagement of climate scientists and decision makers as the decision is explored, hence the term "co-exploration". As will emerge through the results of the case study below, the co-exploration approach is diametrically opposite to the dominant approach practised in most real world decision-making contexts.

This report describes the outcomes and activities of the case study, including the desktop study, the initial participant engagements, and the workshop activities itself. It draws out key learning messages that address the guiding questions posed by DFID and CDKN as well as identifying discrete learning points gained from implementation.

2. Addressing the FCFA case study guiding questions

The FCFA pilot study programme has specific learning objectives within these case study projects. These were communicated via a set of guiding questions. The questions are

structured around the themes of decision process, use of science in decision-making, barriers to climate science uptake and opportunities to support the uptake of climate science. Through completion of this project, we have found the answers to these questions are often nuanced and not perhaps as straight-forward as one might expect. These nuances are explored under the themes below.

2.1. Understanding the decision-making environment:

2.1.1 The case study cities

The two cities of Maputo and Accra were identified due to their complexity (large, rapidly growing, mixture of formal and informal), their coastal location (exposure to sea-level rise and dependence on coastal activities), and prior engagement with key people within each city. The information used to inform this section was attained through a desktop study, a survey and a workshop. All of these activities are described further in section 3 of this report.

2.1.2. City Profile | Maputo

The city of Maputo has a population of around 2 million if combined with neighbouring Matola. Like many developing cities Maputo faces critical development and planning challenges. In common with other African cities it is experiencing a rapid population growth equal to 1.2% causing an increasing demand for housing and infrastructure, especially in the semi-urban and non-urbanised areas. It is densely populated with a growing urban population of about 1.1 million people. The city is divided into two areas, the 'cement city' that is part of the old colonial centre with paved roads and high-rise buildings and the *bairros* which is a congested and underserved area housing the majority of the city's population. This growing urban population has created a huge strain on urban infrastructure development and planning. Low-lying and situated on the Indian Ocean, the city is highly vulnerable to climate change impacts such as cyclones, flooding and sea-level rise. Poverty and inequality, which are concentrated in the bairros, further exacerbate climate change vulnerabilities in the city, particularly to increasing frequency and intense flood events.

A large number of unplanned settlements, which are characterised by unregulated growth, lack of common infrastructure services (water, electricity); poor building material and located on unsuitable land have gradually increased in size, constraining social services in the city leading to effects such as blocked water and storm drainage and solid waste disposal facilities. With a growing human population and increase in the number of buildings and infrastructure, Maputo is faced with development challenges including urban infrastructure planning, housing, sanitation, health and ecosystem management. Around 50% of Mozambique's annual budget comes from foreign aid.

The Maputo area comprises the coastal plain (with its small coastal dunes and river sediment deposit) and higher consolidated dune areas. Both are soft, low-density substrata and thus are highly conducive to erosion. As the human population has rapidly expanded in the last 20 years,

development and the need for land have been extensive. This may continue as more migrants are attracted to coastal regions. As a consequence there are few natural habitats left; just a little natural vegetation on the coastal zone to the north of the municipality on the Inkomati coastal plain; dune vegetation, wetlands and estuaries, and relatively well-conserved mangroves in some areas. Most of the trees in and around Maputo are ones that provide food and resources; cash-crop bearing trees such as cashew, coconut, and mango, and wood-providing trees such as casuarinas and jacarandas.

Historical climate impacts

Maputo has suffered a number of climate related disasters over the past years. These include:

- Severe floods in 1977-1978, 1985, 1988, 1999-2000 (tropical cyclone), 2007-2008 (tropical cyclone) and 2009
- Severe droughts in 1981-1984, 1991-1992, 1994-1995
- Strong winds (various events)

In particular, the floods of 2000 resulted in the following key impacts:

- 700 people killed
- US$ 600M in damages
- City was flooded – affected roads, drainage systems clogged
- Damaged houses, diseases due to flooding

The impacts of flooding are seldom restricted to Maputo and one of the most critical impacts is often the damage to roads and bridges connecting Maputo with neighbouring areas and countries such as South Africa. This has often, particularly in the floods of 2000, severely limited disaster relief efforts. The floods of 2000 did however result in some significant responses by government and international partners to begin to improve Maputo's resilience to such events as well as increase disaster preparedness and responses. In particular the following activities to some extent resulted from the experiences of the floods:

- Development of NAPA provided framework for urgent action (*Government*)
- Development of NAPA provide framework for urgent action (*UNDP and UN-Habitat*)
- UN programme on Mainstreaming and Adapting to climate change – cities and climate change initiative (*FAO and UN-Habitat*)
- Urban Master Plan of Maputo Municipality – Plano de Estrutura Urbana do Municipio de Maputo (PEUMM) (*World Bank funding for Cities and climate change initiative)*

Besides large scale disasters such as the flooding events mentioned, and droughts, the participant surveys identified more systematic exposures and vulnerabilities such as strong winds limiting or placing harbour activities at risk, high river flows causing build-up of sand banks risking navigation, high temperatures and winds associated with increased fire risk, and intrusion of salt water into fresh water resources. Risk can be categorized into intensive (high impact, infrequent) and extensive (relatively low impact, but frequent). There is growing

evidence that the impact of exposure to extensive risk could far outweigh the impact of exposure to intensive risk. There is underreporting of the impacts of extensive risk and a related lack of research.

Existing support for climate-related decision-making in Maputo

There have been a number of activities aiming to support Maputo in various aspects of climate resilience. Many projects have focussed on increasing resilience to flooding as well disaster risk reduction. Early warning systems, flood protection schemes (hard and soft), and disaster response strategies have featured strongly. CDKN in particular have focussed on health issues. Malaria is prevalent in peri-urban Maputo (approximately 238,000 cases a year) and is projected to rise at a rate of 900 cases/annum per degree of temperature increase.

The INGC (National Institute for Disaster Management) commissioned two key reports (INGC phase 1 and INGC phase 2). These form the basis for ongoing strategic decision-making and implementation of disaster risk reduction activities in Maputo and Beira.

2.1.3 City Profile | Accra

With a metropolitan population of about 4 million people (and growing at about 3.36% annually), Accra Metropolitan Assembly (hereafter Accra) is a rapidly developing coastal city on the coast of the Gulf of Guinea. Like other fast growing urban conglomerates in Africa, Accra grapples with a multitude of development challenges such as poor infrastructure, sub-standard housing, inadequate solid waste management and sanitation and decay of the city's Korle Lagoon. Provision of water in the fast growing Accra has proved to be a daunting challenge. Migration from rural areas has also created severe problems of congestion in the city.

Most coastal cities in sub-Saharan Africa will be affected by flooding and sea-level rise, which leads to the inundation of lagoons and seaside wetlands, increased storm surges and consequent flooding, changes in disease vectors and drought. Additionally, the IPCC 5th Assessment report notes that sea level rise along Africa's coastal zones could disrupt economic activities such as tourism and fisheries. Accra is similarly vulnerable to flooding and sea level rise. Rain-fed floods have damaged property, caused loss of life, and a slow-down of transportation and economic activity. Sea Level Rise, combined with other non-climatic stressors such as poor drainage infrastructure, could worsen future incidents of flooding in the city.

Historical climate impacts

Accra has suffered a number of climate related disasters over the past years. These include:

- Severe floods in 1995, 2001, 2006, 2007, 2009, 2010, 2011 (tidal wave) and 2014 with some form of flooding now an annual event
- Droughts
- Strong winds

The July 1995 flood event is recorded as a particularly extreme event with 2, 493 mm of precipitation recorded. These floods destroyed major roads and infrastructure, thousands of homes and businesses and claimed 13 lives. Today, flooding in Accra has become an annual event with severe consequences mostly felt by the urban poor. Although, flooding is a constant challenge in Accra, there is no evidence to suggest the city has been subjected to unusual rainfall in the last few years that could explain the increased incidences of flooding. Governance failures thus seem to play a significant role in worsening the impacts of flooding in Accra.

Existing support for climate-related decision-making in Accra

Support for climate related decision-making in Ghana mostly takes the form of reports or policy documents such as the EPA National Climate Change Adaptation Strategy (UNEP/UNDP), the NADMO Disaster Risk Reduction and Climate Change Adaptation (DRR&CCA) plan (UNDP/UNISAR) and the UNDP country profiles. CDKN have also recently contributed to funding a project on developing a high-level statement of Ghana's current position on climate change. This statement, the National Climate Change Policy Framework (NCCPF), was a fore-runner to the National Climate Change Policy (NCCP) for Ghana.

2.1.4 Common challenges facing both cities

From a non-climate perspective both cities are experiencing significant governance issues which are believed to exacerbate the vulnerability of exposed communities. Key among these governance issues are insinuations of corruption in government processes, lack of law enforcement (particularly in the informal areas), lack of communication across government departments, key political figures not acting as champions for climate change action and lack of concern or government coordination with respect to building codes. These governance issues are seen as major impediments to moving forward with planning processes for both cities, let alone planning for climate change related issues.

Also high on the list of current stressors for both cities are vulnerabilities around drainage and transport infrastructure. These have significant ramifications for livelihoods and services with an amplified impact in the informal areas. Very strong economic drivers are often at odds with climate resilient development (eg. building a bridge to connect Maputo with the low lying Catembe to promote development is placing large new development areas at high risk to flooding).

Both cities are coastal and have similar risks from climate change. They are vulnerable to the gradual impacts of sea level rise, particularly due to population growth which is putting increasing pressure on the coastal areas. Changes in rainfall leading to increased flooding will also have severe impacts on both cities, especially given concerns around current drainage infrastructure.

2.1.5 Identifying adaptation options in the workshop environment

The project workshop aimed to distil these common challenges into a multi-stressor decision-making process through a case study approach that was theoretical in its precept but grounded in a real-life climate-sensitive development challenge facing both cities. The workshop process was designed to instill cross-disciplinary learning around integrating climate and non-climate information streams and around critically evaluating the potential and limits of medium-term climate projections data for decision-making.

During the workshop, adaptation options were identified for each of the two cities that corresponded with the case study areas. For Maputo these included improving urban planning, incorporating new building codes that take into account climate change, designing and implementing communication strategies among stakeholders and upgrading the drainage system. Accra identified somewhat similar adaptation options. These included redesigning and reconstructing the drainage and infrastructure systems, desilting the drains all year round, promotion of waste management through education, stronger leadership and law enforcement. In practice, each of these adaptation options would be implemented on varying timescales. Implementation of communication/education strategies, for instance, could be implemented within a fairly short time period (1-5 years) whereas upgrading the drainage system would be a long term project (5-40 years) entailing significant financial investment.

In the context of this workshop, no actual decisions were being made; rather the workshop provided a learning opportunity for identifying potential adaptation options one would actually implement on a 5-40 year time horizon. In real-life situations, decisions only get made when there are budgets to allocate and specific objectives to be met so these are almost impossible to elicit in a workshop environment. It is once options and strategies have been narrowed in this multidisciplinary setting, and finance and political will is on the table, that a more detailed examination of available climate information, and what it means for the adaptation options, becomes truly consequential.

2.2 Exploring the use of climate science in decision-making and data needs

The participant surveys revealed that for many activities, historical observations are used to inform risk management while short term weather forecasts are used for disaster early warning. Climate information currently being used in-country comes from the meteorological agencies, water authorities, remote sensing data, the Co-ordinated Regional Downscaling Experiment (CORDEX) and, in Accra, the African Centre of Meteorological Application for Development (ACMAD). While the scope of the desktop study and surveys is small it does appear that climate information is largely fed into decision-making in the form of either internally produced or (more frequently) consultant produced reports. For instance, the INGC commissioned reports (mentioned above) utilised observations and GCM projections from three CMIP3 GCMs. These reports then form the basis for ongoing decision-making in the city.

Universally the participants responded that the observed climate information they currently use is inadequate for their needs. Both cities reported sparse data coverage and several temporal gaps in data. Much of the observed data is not verified and the data inconsistency that results presents an issue for robust scientific research. There was a call for more a comprehensive, standardized observation network. This is not an appeal unique to these two cities but is a problem faced Africa-wide. There were also reported problems with other data sets required for decision-making such as the socio-economic information that is available. One respondent stated; *"In most cases information for this kind of information may only represent part of the population. In other cases, data is too coarse for the purposes of the study".*

In order to better manage risks in their cities, the participants reported the need for better observed data (as mentioned above), a risk assessment that could inform decision-makers and stakeholders, hazard data including early warnings for extreme weather events and flooding risk maps.

2.3 Climate Science Uptake

Barriers to climate science uptake

Currently there is very little decision-making in either city that seems to directly consider climate information. Climate information that is used is largely restricted to historical data informing current vulnerabilities, and short term forecasts informing disaster early warning. Climate projections on the 5-40 year time frame are also not routinely used in decision-making and, where used, the mode of delivery is through consultancy reports such as the INGC reports.

As stated previously, the survey participants indicated that the available climate information is not adequate for their decision-making needs. Perhaps addressing some of these concerns may aid the more mainstream uptake of climate information into decision-making. Both cities reported sparse data coverage and several temporal gaps in observational data. Much of the observed data is not verified and the data inconsistency that results presents an issue for robust scientific research into future projections modelling. The vulnerabilities that have been identified through numerous reports indicate that there is a strong need for more decision-relevant climate information on the 5 to 40 year time frame. The climate information required includes projections of changing rainfall intensity, frequency of tropical cyclones, frequency of large scale heavy rainfall in upstream catchments, and sea level rise. But beyond climate and ocean variables, there is a need for impacts modelling outputs such as hydrology modelling, disease modelling, and possibly even coastal dynamics modelling.

Limitations of the use of climate information in decision-making

During the workshop, the participants were challenged to study a case study area under development in their respective cities. The area includes informal and formal housing and is at risk from climate impacts as well as multiple other socio-economic stressors. Although the area of study is real, the exercise undertaken in the workshop was a theoretical one.

In order to elicit the multi-stressor nature of these case study areas, climate information was not introduced until mid-stream in the process. This approach was appreciated by the participants because it allowed for the socio-economic vulnerability perspective to essentially guide where climate information would be most appropriately applied. Using this approach, layering and building up information gradually was a key feature throughout the workshop. This aimed to reduce the perceived complexity of information being shared each day thus allowing the exercises to be modified in response to new insights from different sectors, stakeholders or city contexts.

By using this approach, the overriding observation during the workshop concerned the extent to which climate risks and impacts in both case study areas were so strongly shaped by underlying socio-economic vulnerabilities. The myriad of socio-economic concerns outweigh those of climate change in the current context. Also, by introducing the identification of adaptation options earlier in the workshop than in the traditional decision-making cycle, it resulted in the responses not being overly climate-specific but rather encompassing the realm of interacting non-climatic and climatic stresses. However, when the climate variables were introduced, none of the adaptation options were taken out of consideration indicating the 'no regrets' nature of the identified options.

The traditional decision-making process would have taken a climate data-led approach, introducing climate information as the pivot around which decisions are made. This, arguably, ascribes too high an importance to the climate aspect of decision-making. Allowing the participants to contextualize the vulnerabilities using their place-based knowledge resulted in the highlighting of more pressing socio-economic issues such as weak law enforcement for building codes, inefficient or non-existent waste disposal, pressures facing land from lateral development, and, in the case of Dansoman in Accra, tensions between the local communities and the nearby salt production company. It became immediately apparent that only by acknowledging these issues upfront can suitable climate change adaptation strategies and interventions be identified.

This is a lesson that should be heeded in future attempts to integrate climate information into decision-making. Vulnerability is not static – it is constructed simultaneously on more than one scale (e.g. socio-economic, institutional or political dynamics at the national or international scale can have cascading and sometimes unpredictable impacts at the local scale, often compounding the impacts of climate events, which themselves have varying durations ranging from sudden shocks to gradual trends). Placing climate information (both historical and future) in context will aid in designing appropriate adaptation measures and will allow for greater acceptance of those measures by the recipient community.

This workshop helped to demonstrate the contemporary (as opposed to future focused) context of climate change considerations in decision-making processes and also indicated the limits that climate projections data have on effectively informing decisions on near to medium term

planning horizons. This situation underscores the importance of the larger FCFA initiative in bringing both a greater future focus to climate related decision-making and improving the science of climate projections in Africa.

2.4 Co-exploration: an opportunity to support uptake of the science

Apart from addressing some of the data requirements, as reflected upon above, an ongoing collaboration is also required in order to enable the robust use of climate information in decision-making. A persistent reflection on any process like this is how to sustain engagement with the participants post-workshop. Inevitably, once the funding ceases, the project team moves on to other priorities and any trust and sense of community established as a result of this type of project dissolves. The concern is that this kind of "drop in and out" type of relationship with users will generate user apathy over time and create a negative working relationship. However, the organizers recognize that the pilot nature of this project only allowed for a single workshop with limitations as to how much of the actual in-city decision-making context could be explored. The full Future Climate for Africa programme has potential to begin to at least partly address the continuity issue, allowing for real change to be effected.

A sustained engagement between the "producer" and "user" community will go a long way towards generating a more effective and meaningful dialogue. Fundamentally, the role of climate services should be to facilitate these kinds of ongoing interactions, rather than as a mechanism for data delivery to users. The delivery of data does not translate into actionable information. Only with significant investment into co-development of information between the users and the providers will the science be effectively applied in informing the design and delivery of development policy, planning and implementation.

The approach undertaken in this project is proving an effective technique for facilitating a co-exploration and co-development process. It is still in its proof of concept phase to the extent that it has been tested through two distinct workshops but not tested in the context envisaged by CSAG, START and SEI. That context would necessarily involve early and continuous collaboration with local actors, iterative engagement of city teams, "deeper diving" into the climate projections data, anchoring of the case study in an actual and active policy context, and a strong focus on capacity building outcomes that would ultimately enable this approach to be replicated by locally based teams rather than by outside organizers. While these goals have not yet been realized, the two workshops to date (Accra (2014) and Dar Es Salaam (2013)) have produced rich insight into the process that will allow for appropriate scaling up when the opportunity arises. The organizers are grateful to CDKN for supporting this pair of workshops.

The co-exploration approach is quite complementary to the FCFA 3-pillar design in that it prioritizes close engagement between the climate community and the various decision-making constituencies who rely on climate information, and it examines limits of climate model data in a place-based context that recognizes the "messiness" of real life decision-making related to risk management and future planning. Moreover, this approach values multi-focal learning across

the decision-making space that goes well beyond the simplistic dichotomy of “climate services” and “end users”.

A co-exploration approach seems, therefore, to be a valuable way of beginning the dialogue between climate scientists, climate service providers and relevant experts from different disciplines and arenas that have a stake in policy outcomes. This approach also provides a means to strengthen climate data “literacy” of those who depend on climate information for decision-making but who lack the requisite skills to critically evaluate the potential and the limitations of this information. Such strengthened capacity and understanding is critical for promoting effective adaptation planning and avoiding maladaptation.

3. Description of how the FCFA guiding questions were addressed through the project approach

3.1 Pre-workshop preparation:

3.1.1 Desktop study

The project team undertook an initial desktop study of Accra and Maputo in order to better understand climate challenges faced by the two cities and to assess the state of project-based interventions and investments that sought to address vulnerability and adaptation concerns. This desktop study involved a wide ranging literature review including vulnerability and climate change disaster risk related reports, government policies/strategies, sources for sharing climate related information, media reports and academic publications. The observed and future climate data for each city was also assessed to gain an understanding of the climate system dynamics in each city. The full desktop study reports for each city are available in a separate document and have been utilized in addressing the guiding questions in section 2.

3.1.2 Pre-workshop survey

In addition to the desktop study, the project team undertook a pre-workshop survey of the participants. The survey sought to better understand the expertise and perspectives of the participants and the decision-making context in which they work. Questions centred around why and how they use climate information, limitations of access to adequate climate information, other types of information they view as important in their workplace, and what they view as critical climate challenges facing their respective cities, drawing from recent extreme events. The answers to this question mapped closely with the main findings of the desktop reviews. (The survey questions can be found in Appendix 3.)

3.1.3 Pre-workshop webinar

As final preparation for the workshop, the CSAG team hosted a webinar event two weeks prior to the workshop. The purpose of the webinar was to both prepare the participants for the workshop and to receive feedback on the proposed agenda. The recording of this webinar can be viewed at http://meeting.uct.ac.za/p2j3k6z4jgm/.

Although attendance at the webinar was not as high as hoped (8 of the 24 invited to participate in the webinar), it was successful in achieving its objectives. Feedback was attained from the participants on the selection of sites for the workshop case study, some preparatory information was relayed to the participants and final logistical details were announced.

Although a webinar is an effective means of engaging a large group of geographically disparate people, the attendance at a webinar continues to be disappointing within this kind of activity. It is hard to ascertain why attendance on the webinar was low. There were bandwidth issues, particularly amongst the Accra participants, that limited participation but more likely work responsibilities took precedence over attending a webinar. Although a webinar does allow for virtual, real-time interaction across a large group of people, the ease in which a participant can opt out of the event does tend to be a hindrance to their success. Pre-workshop interaction is essential. Thus, a webinar should always be supplemented with other forms of interaction in order to provide ample opportunity for all delegates to participate. In this case, the surveys helped to augment the webinars.

3.2 Workshop Accra: 16-19 June 2014:

The activities of the project centred around the implementation of a place-based climate vulnerability analysis workshop which was held in Accra, Ghana on 16-19 June 2014. The workshop involved participants from the cities of Accra, Ghana and Maputo, Mozambique. It built on a co-exploration approach of place-based vulnerabilities that was tested in a proof-of-concept CDKN-funded workshop held in Dar Es Salaam in 2013. The methodology framing the workshop featured a step-wise process that involved first identifying key elements related to urban livelihoods, infrastructure and services, next identifying important non-climate stressors of these elements that are exacerbated by climatic stressors, followed by a layered application of climate projections information beginning with coarse (GCM) data and proceeding through to finer scale RCMs with a corresponding increase in the number and complexity of climate parameters. Adaptation options were identified at key junctures in the process and evaluated against the messages of future change contained in the climate projections.

This step-wise process allowed for identification of critical vulnerabilities in livelihoods, infrastructure and services that then provided a targeted, contextual basis for identifying climate sensitivities to which users could appropriately integrate climate information and develop response strategies. Thus, rather than beginning with the climate and sector focus, the co-exploration approach began with a place-based, multi-stressor situation which was embedded in a learning process for integrating climate data into decision-making. Using a bottom-up vulnerability first approach, and co-exploring the decision-making needs and priorities of key constituencies in an interdisciplinary setting, provided a constructive way to interrogate assumptions about adaptation solutions, and to instill foundational learning related to the quality and robustness of climate information and of the physical limits of climate information.

The integrative and user-led nature of the activity is transformative to the way climate change at local scales is typically approached, and engenders a new experiential growth of capacity among the participants. Of note, in this project, was the growth in awareness of issues and nuances from beyond each participant's normal sphere of exposure, and the integration of end users' perspective and knowledge so that climate information can be tailored to decision-making needs and priorities.

3.2.1 Workshop approach

DAY 1

The workshop began with a welcome from Dr Benjamin Ofuri from the University of Ghana, which served as the host institution for the workshop. Dr. Ofuri stressed the relevance of the workshop topic through a presentation that depicted how Accra is currently being impacted by extreme events and climatic variability. His presentation not only highlighted climatic impacts on Accra but also the current socio-economic vulnerability of the city. The introduction helped to underscore an important emphasis of this workshop, which was to articulate and describe the development context of vulnerability as a pre-cursor to examining future climate change and its relationship to vulnerability.

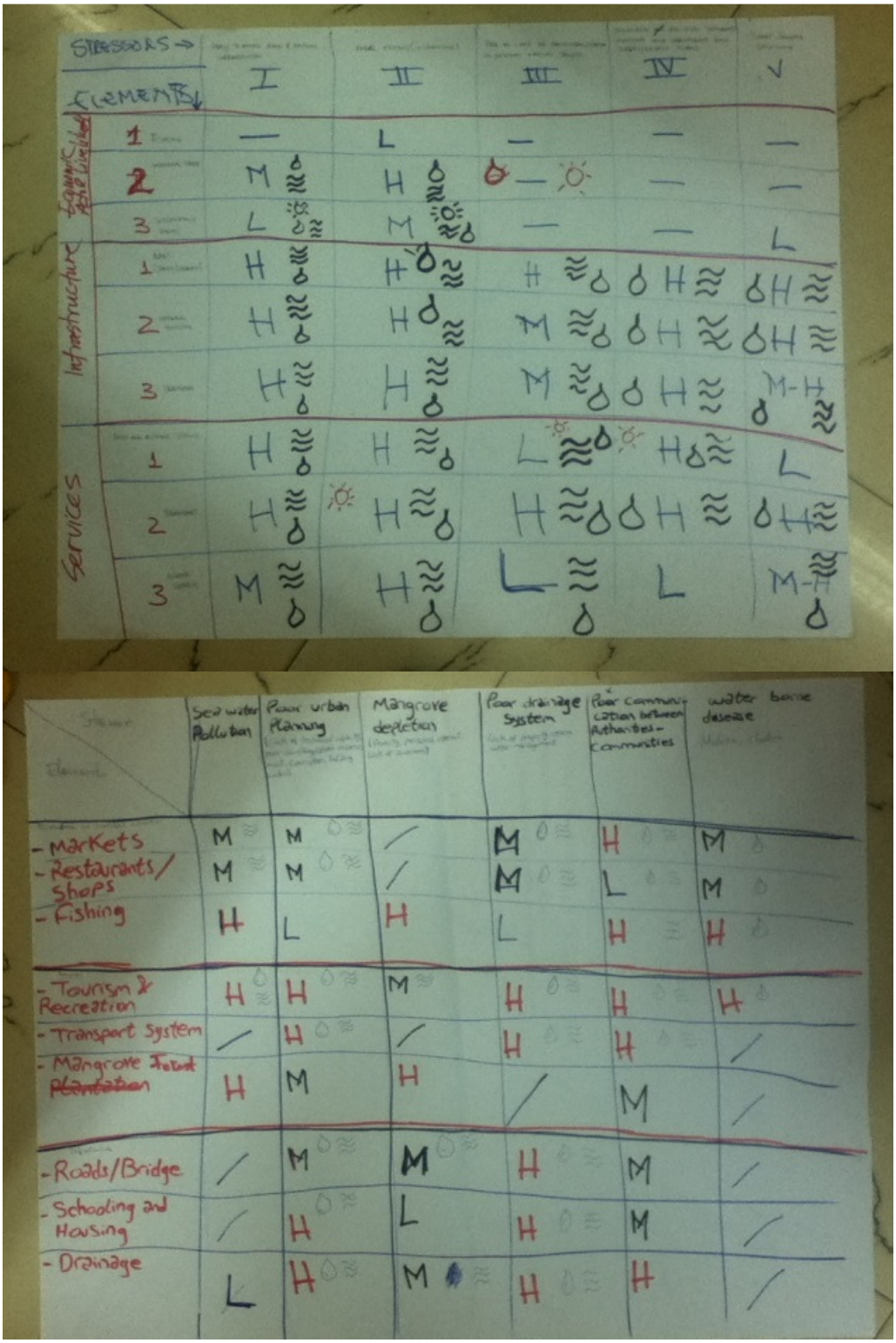
The workshop activities revolved around a case study area identified in each city. As an initial activity in Day 1, each city group was tasked with selecting a real-world case study within a defined set of parameters, which stipulated that 1) the area must be one that is under development, 2) there must be formal housing co-located (in reasonably close proximity) to informal housing, and 3) it must be an area that is vulnerable to climate hazards. Within these parameters, the Maputo group chose Costa do Sol on a coastal area of Maputo and the Accra group chose Dansoman on the coast of Accra.

The first formal exercise was to map key elements of livelihoods, services and infrastructure within the case study area against stressors that impact on those elements. In order to do this, each city group was divided into an "informal settlement" group and a "formal settlement" group. By dividing the cities into two groups, it was possible to assess the similarities and differences in vulnerability experienced by different sectors of society, while recognizing that adaptation measures should be designed to encompass unique vulnerabilities experienced in both communities.

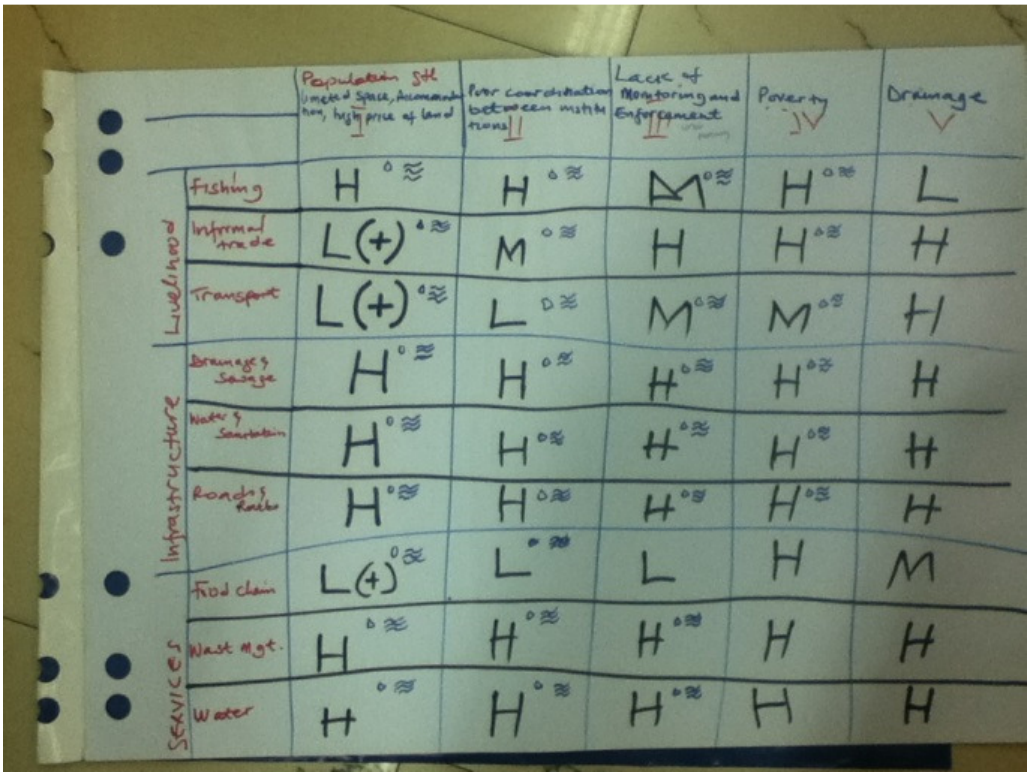
Each of the (now) four groups were asked to identify three livelihoods, three services and three infrastructure elements that are important to their case study area. These formed the rows in a matrix. Against those rows, each group identified five non-climate stressors that potentially act on these elements. These stressors made up the columns. They were then asked to examine each cell of the matrix and rank them with a high, medium or low ranking depending on the degree to which each stressor impacted each element. There were a few occasions when the impact of the stressor was actually positive, for instance population growth may actually have a

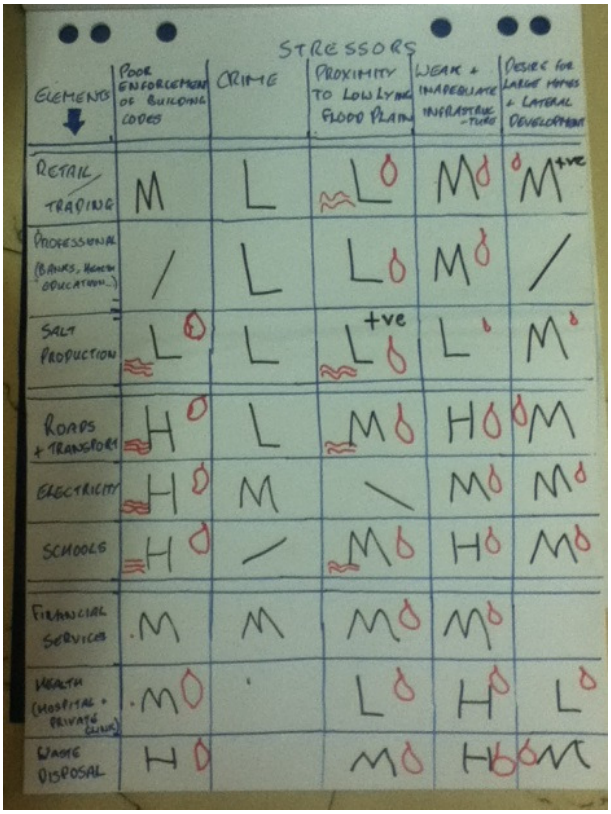
positive impact on informal trading activities. In those cases the impact was marked as low but a "+" sign was added to the cell to indicate the positive impact.

The final stage in the development of the matrix was to consider the exacerbating effects of current climate vulnerabilities. The participants were asked to mark in each cell where the impact may be exacerbated by flooding, storm surge or, in the case of Maputo, heatwaves. These climate variables were marked in each cell as symbols, as depicted in the figures below.



MAPUTO INFORMAL SETTLEMENT MATRIX (ABOVE) AND THE MAPUTO FORMAL SETTLEMENT MATRIX (BELOW)





ACCRA INFORMAL SETTLEMENT MATRIX (ABOVE) AND THE ACCRA FORMAL SETTLEMENT MATRIX (BELOW)

The completed matrices provided the groups with a visual representation of where non-climate stressors significantly act on elements and where climate stressors interact to exacerbate these vulnerabilities. The cells that indicated high vulnerability, as a function of both climatic and non-climatic stressors, were viewed as priority cells for further examination using climate projections data. In addition to providing a means to prioritize and direct the climate projections analysis, this matrix activity also highlighted the heightened vulnerability of the informal settlement areas of both cities, which contained many more cells of high impact and additional climate influence in comparison to the formal settlement areas.

DAY 2

At the start of Day two, the informal and formal groups within each city were merged back into one city group in order to enable that day's activities. Within the merged groups, each participant took on the role of a stakeholder which they themselves had identified as part of the exercise) within the informal and formal settlement communities. They were asked to compare the two settlement matrices and pull out three mutually high priority cells for further investigation.

From these high priority cells they brainstormed adaptation options that may help to minimize the impacts. These adaptation options (both 'hard' and 'soft' options) were not meant to be considered for robustness under future climate (as climate factors had not yet been introduced) but rather focused on better managing risks in order to mitigate the impact of current stressors on the community. On immediate reflection of this session, the facilitators recognised that the adaptation options being identified, in many cases, needed further refinement in order to be constructively discussed. However later exercises helped to refine the adaptations options to be more specific.

At this point (mid-day on Day 2), the workshop participants had gone as far as possible with current information and it was thus time to introduce future climate change into the case study analysis. This section began with a brief game called "*crossing the river*" to introduce the concept of uncertainty and why making uncertainty explicit is an important aspect of communicating future climate change. Following this game, a presentation was provided on the concepts of uncertainty and how to incorporate uncertainty into robust decision-making. This presentation had a strong emphasis on the reasons behind the greater uncertainty that is introduced as one seeks to provide a higher resolution projection.

Once the concept of uncertainty was established the participants were given the first of three layers of climate information. After the provision of each layer of climate information there was discussion around the quality and suitability of the information provided for their purposes. Very little background context was provided with each of these climate information layers, out of a deliberate attempt to simulate the decision-making environment that everyday decision-makers find themselves in.

The first set of information came from the UNDP country profiles. They were tasked with reading the summary text of the profiles and then asked to reevaluate their adaptation options to assess whether or not they were still applicable under future climate and whether additional options or adjustments to the existing options were required.

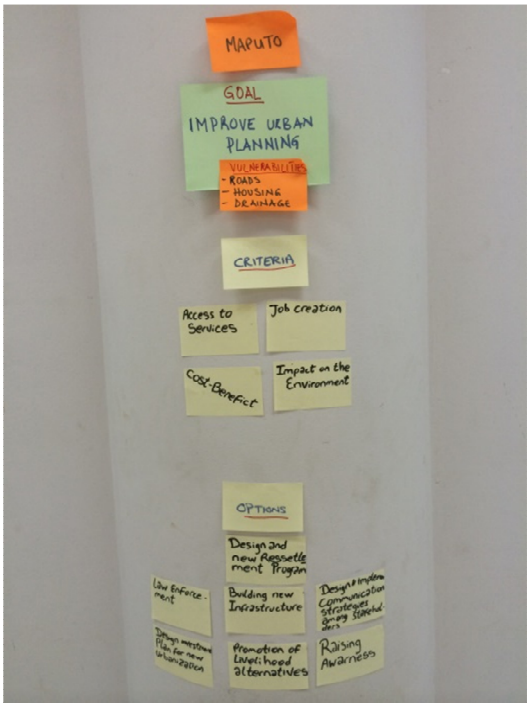
DAY 3

On the morning of Day three, the second layer of climate information was introduced; the Intergovernmental Panel on Climate Change (IPCC) Global Climate Model maps from the Fifth Assessment Report regional Atlas for the 2050s. Again the participants were asked to reevaluate their adaptation options in light of this new information. The participants were now faced with a set of models that, in some cases, disagreed on the sign of the projected change. Although the discussion concluded that the results were from a veritable source, they found it hard to draw relevant conclusions from the information presented to them given the uncertainties and the coarse scale resolution.

Finally, a third layer of climate information, station-scale graphs taken from the CSAG Climate Information Platform, was presented to the participants. It may be a function of the perceived certainty that these station scale plots convey but the participants (rightly or wrongly) gave a lot of weight to these station scale plots as providing the scale of "answer" that they require to make a decision. This is an interesting, though perhaps not entirely surprising, observation. It may have been due to the fact that it was the last piece of climate information provided or due to the spatial scale of the climate information and the apparent value that high spatial resolution information implies. Either way, the participants all but ignored the previous information given to them in favour of what the station scale plots conveyed.

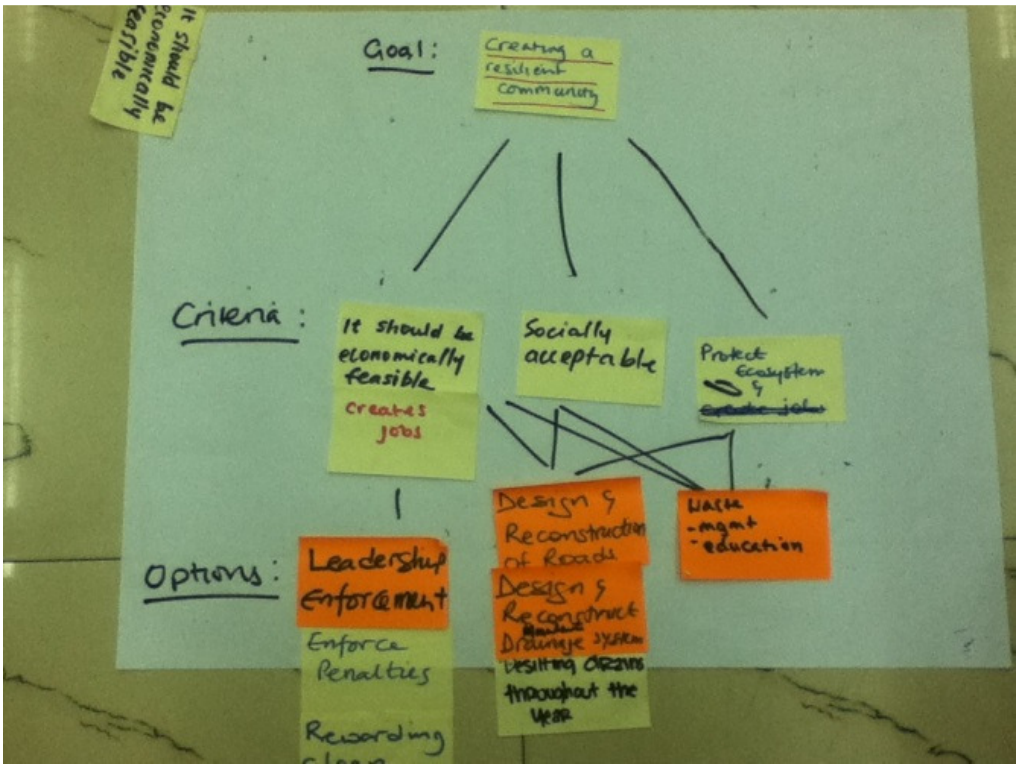
At this stage, the participants reevaluated the adaptation options that they had developed in response to current climate risks, making minor adjustments to some and adding a few more. The adjustments were mostly around the spatial or temporal scale at which to implement an option such as "desilting all year round as opposed to just in the rainy season", though it was interesting to note that many of the adaptation options identified in response to current climate were still quite applicable under future climate projections.

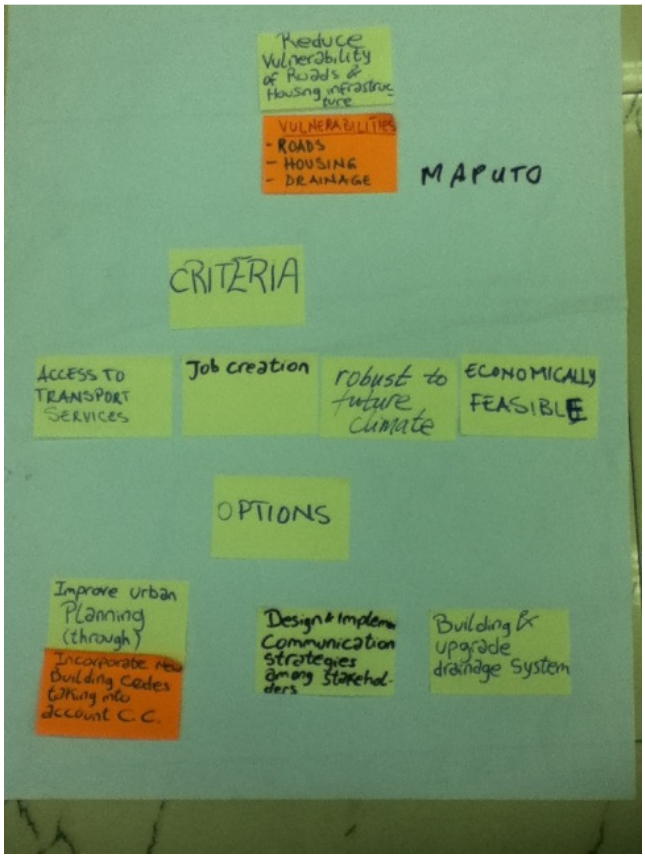
As an addition to thinking about future climate, participants were also tasked with thinking about potential changes in socio-economic futures such as population growth, economic growth and political change. At this stage, very few changes to the identified adaptation options were made due to the introduction of socio-economic futures. However, the participants noted the dearth of robust projections about future socio-economic projections.



ACCRA GOAL, CRITERIA AND OPTIONS (ABOVE) AND MAPUTO GOAL, CRITERIA AND OPTIONS (LEFT) FURTHER REFINED OR EXPANDED BASED ON CLIMATE AND SOCIO-ECONOMIC FUTURES PROVIDED IN DAY 2.

Following the exercise on identifying and refining adaptation options, the participants were taken through a formal process of ranking these options against each other through a tool called the Analytical Hierarchical Process (AHP), developed by SEI. In introducing the tool, the workshop organisers emphasized the fact that there is no one tool that should be solely relied on but rather that multiple methods for screening adaptation options should ideally be applied. In order to use this tool, the groups needed to select specific goals, three criteria and three options to assess. This selection had already been made and refined throughout the first 2 days. A further criteria "robust to future climate" was imposed upon them.





ACCRA GOAL, REFINED CRITERIA AND REFINED OPTIONS (PG. 14 ABOVE) AND MAPUTO GOAL, REFINED CRITERIA AND REFINED OPTIONS (ABOVE)

The AHP tool took the participants through a step-by-step process of assessing, while still maintaining their 'role', each option against each criteria and assigning a weight to the degree that each option met the criteria, given a particular scale. Then the criteria were compared against each other and their ability to meet the goal, and also assigned a weight. Each of these weights were added to the AHP spreadsheet and, at the end of the task, a ranking of adaptation options was automatically generated through the AHP program. The tool's ranking of the adaptation options was presented back the groups by the facilitators and a discussion took place around the appropriateness and sensitivity of the results.

Somewhat inevitably, the "ideal" adaptation option identified by the AHP tool was at odds with what the groups considered to be the best adaptation option. This was a function of two aspects; the first was the high ranking assigned to the cost and the "climate robust" criteria in the exercise; in reality the latter may not receive such a high ranking. The second was the low weighting assigned the "social acceptability" criteria by the group, which in many situations would receive a high weighting from policy-makers. In essence, a theoretical example assigns weighting based on a scenario of what the participants think the weighting *should* be rather

than what the weighting *is* in reality. This was a lesson to both the participants and the facilitators.

DAY 4

Throughout the week, each city group presented results from their exercises back to each other and this was valuable both to support processes of learning from each other, but also for both cities to understand each other's experiences and explore similarities and differences. On day four, the participants were given time to distill the lessons they had learnt during the week to create a final seven minute presentation targeted at policy-makers in their country to gain funding support for their respective communities. The instructions were to keep to time, keep the message concise and decision-relevant and to use images rather than words where possible. For the presentation session we were joined by the Ghana DFID country officer, Vincent Langdon-Morris. He ably represented the policy-maker perspective and asked the participants probing questions in response to their presentations.

The Accra participants drew on the knowledge they had gained during the week to present a compelling case for funding support, not only in response to climate challenges but also the socio-economic stresses faced by the community. The Maputo participants also presented a compelling case but notably drew on material that had resulted not from the workshop but rather from previous research work that had taken place in the case study area. This meant that the presentation was biased towards the impacts of climate in their case study region and did not take adequate account of the socio-economic stressors that had been explored in depth during the week. On reflection, this may not have been due to a lack of learning during the workshop but rather a desire to present a well-researched case to a "real" policy maker. The follow-up evaluation and the level of participation from the Maputo group during the week suggested that they gained a lot of learning from the week so it was rather disappointing that they decided not to reflect much of that learning in their final presentation.

PRESENTATIONS BY GROUPS FROM EACH CITY

The final session centered around the continuity of engagement. Participants were legitimately concerned about workshop fatigue and noted the constant demands on them to participate in workshops that have no or very insubstantial follow through. A constant barrier against sustained engagement is the support required to continue engagements with mixed groups such as those represented at the workshop. This limitation was made explicit to the group and suggestions were solicited for means by which to continue engagement with limited funding. A second workshop was high on the priority list but it was acknowledged that this would require further funding. Another suggestion was a cell SMS service amongst the group or exploration of potential calls for project proposals that would provide opportunities for collaboration. However, no satisfactory means for continuing engagement were made within the limited time allowed for the discussion. This is a concern because continued engagement is a very important aspect of these types of projects and a suitable way forward needs to be considered in order to avoid user apathy in these kinds of events.

The final activity of the workshop was a fieldtrip to the Accra case study site – the Dansoman informal settlement. This was an enlightening experience for all the participants and facilitators (including many of the Accra participants who had not visited Dansoman before) and provided concrete insights into the climate and non-climate stressors the group had been studying all week.


DANSOMAN (WITH PARTICIPANT ANTONIO QUEFACE)

4. Discrete learning points from the project

- The non-climatic challenges facing both the cities of Maputo and Accra are profound, lending further evidence of the need to pursue development-led planning that appropriately accommodates adaptation as opposed to impacts-led adaptation planning that over emphasizes the climate influence on development challenges. This situation mirrors that of other African cities where multiple drivers and stressors act alongside the risks from a variable and changing climate.

- The approach of layering climate information on top of non-climate stressors was successful in this context and allowed for a more holistic investigation of the multi-stressor nature of climate change.

- Regular presentations and feedback about the two different urban contexts, Accra and Maputo, throughout the week facilitated unique learning opportunities; this aspect was highly valued by the participants.

- The workshop allowed an opportunity to test the Analytical Hierarchical Process tool in a participatory way. Though a necessarily simplified approach was used, given time constraints, it allowed participants playing 'roles' with differing perspectives and priorities to appreciate the difficulty of reaching a consensus about which adaptation options were the preferred. The resulting discussion was extremely rich, uncovering further insights and complexity about the situation at risk.

  A challenge that remains is how to include climate information in this type of approach. The inclusion of 'hard' and 'soft' adaptation options, while important, complicated the consideration of 'climate resilience' as a criterion as it skewed the weightings against one or the other, depending on the framing used. This is an interesting point, which needs to be further tested in this type of setting.

- While the structure of the workshop highlighted the strong influence of non-climate stressors in the decision-making context, the participants still displayed a deep-routed preference for framing climate risk analysis and adaptation in the context of climate model projections, using a data-led approach. This included an obvious inclination towards using high resolution data despite the communicated increase in uncertainties that comes with that data. The mind-set of top down integration of climate information into decision-making is already deeply ingrained in the user community. The co-exploration approach is intended to change that mind-set but this can only be attained through sustained engagement.

- One-off workshops such as this provide a useful mechanism for investigating initial vulnerabilities and testing potential approaches to addressing these. However, real decision-making happens in a much more complex institutional context. It is within these institutional contexts that real changes in the way climate information is incorporated into decision-making needs to take place. This requires a more sustained interaction with the relevant institutions.

Appendix 1

Agenda

Future Climate for Africa case study workshop

16 – 19 June 2014

Mensvic Hotel, Accra Ghana

Organized by the Climate System Analysis Group-University of Cape Town, START, the Stockholm Environment Institute (UK) and the Institute for Environment and Sanitation Studies-Univ. Ghana with support from CDKN

DAY 1: Identifying key stressors	
Time	**Activity**
09.00 – 10.00	***Opening session*** • Welcome statement – Prof E.O. Owusu, Vice-Dean, Faculty of Science-UG • Introductions • Expectations and outputs • Overview of the agenda for the 4 days briefly explaining the purpose and how the sessions contribute to building toward the outcomes.
10.00 – 10.30	*Tea/coffee break and group photograph*
	Session 1: Mapping non-climate stressors
10.30 – 11.00	Establishing case studies – place-based juxtaposition of a formal development with informal settlements
11.00 – 12.45	Split into 4 groups: Generating material for the matrix. Identifying livelihoods, infrastructure and services and identifying non-climate stressors
12.45 – 13.45	*Lunch*
13.45 – 14.45	Ranking key stressors vs activities in a matrix
14.45 – 15.30	Investigate climate impact on matrix
15.30 – 16.00	*Tea/coffee break*
16.00 – 16.55	Developing story lines from the matrix
16.55 – 17.00	Reflections on the day
18.30	*Workshop reception*

DAY 2: Identifying climate stressors	
Time	**Activity**
	Session 2: Mapping climate stressors
09.00 – 09.15	Overview of the day
09.15 – 9.45	City groups merge: Pull out mutually high priority cells

	Identify a range of suitable options to address development challenges linked to the priority cells and any potential barriers to implementing options
9.45 – 10.30	*Tea/Coffee*
10.30 – 11.45	*Cont…..*
11.45 – 12.30	Present narrative about options to the group
12.30 – 13.45	*Lunch*
	***Session 3*: Climate projections and uncertainty**
13.45 – 14.15	Crossing the river: uncertainty game
14.15 – 15.15	Uncertainty and limitations within a robust decision-making context
15.15 – 15.45	*Tea*
15.45 – 16.55	Assessing response options in relation to layers of future climate projections
16.55 – 17.00	Reflections on the day

DAY 3: Adaptation to future change

Time	Activity
	Session 4: Integrating climate change information
09.00 – 09.15	Overview of the day
09.00 – 10.15	Assessing response options in relation to layers of future climate projections
10.15 – 10.45	*Tea/coffee break*
10.45 – 12.30	Assessing response options in relation to a future world
12.30 – 13.45	*Lunch*
	Session 5: Adaptation decision-making
13.45 – 16.55	Choosing between adaptation options using multiple criteria and discussion of robust decision-making
16.55 – 17.00	Reflections on the day

DAY 4: Development of policy messages

Time	Activity
	***Session 6:* Development of policy messages**
09.00 – 09.15	Overview of the day
09.15 – 12.00	Developing a storyline based on climate information—what does climate change mean for your city. Developing a policy message to take back.

12.00 – 12.30	*Wrap up and evaluation + input on sustaining learning*
12.30 – 13.45	*Lunch*

Appendix 2

List of Participants

NAME	INSTITUTION	POSITION
Ghana Participants		
Dr. Benjamin Denkyira Ofori	IESS, UG	Research fellow
Mr. Kofi Asare	Ghana Meteorological Agency	Assistant Meteorologist
Lucky Worgbah	Accra Metropolitan Assembly	Engineer
Mrs Charlotte Nana Norman	NADMO	Director for Climate Change
Mr. Winfred Nelson	National Dev't Planning Commision	Deputy Director
Dr. Kwadwo Owusu	Dept. of Geography, University of Ghana	Senior Lecturer
Mozambique Participants		
Mr. Izidine Pinto	University of Cape Town	PhD Student
Mr. Fernando Tavares Caniua	Ministry of Env't Mozambique	Project Manager
Dr. Antonio Joaquin Queface	Eduado Mondlane University	Professor
Mr. Igor Bernardo Honwana	Disaster Management Institute (INGC)	GIS Technician
Mr. Jose Jaime Simbine	INAHINA	Nautical Carthographer
Dr. Genito Amos Maure	Eduado Mondlane University	Snr. Lecturer and Researcher
Mr. Antonio Jose Beleza	National Institute for Disaster Management	Information Officer
Mr. Isaias G. Antonio Raiva	National Institute of Meteorology of Mozambique	Research
Facilitators and Observers		
Dr. Thomas Matthew Tanner	Overseas Development Institute	Senior Research Fellow
Dr. Joseph David Daron	University of Cape Town	Postdoctoral Research fellow
Dr Sukaina Bharwani	Stockholm Environment Institute	Senior Research Fellow
Ms. Anna Steynor	University of Cape Town	Researcher
Mr Vincent Langdon-Morris	DFID	DFID country officer to Ghana

Appendix 3:

Survey questions

Questionnaire for workshop participants

Could you please provide brief answers to the following questions? Your answers will help the organizers to design the workshop to best fit your needs. *Thank you.*

1. What is your job title? Briefly describe your job position.

2. Do you (or your work place) use climate information?

    a. If yes, what kinds of information do you use and for what purpose?

    b. What are the sources of climate information that you use? How often do you use it?

    c. Is the information adequate or are there gaps? If gaps, what kind?

3. What other (non-climate) kinds of information do you use in carrying out your job that are related to planning and risk management?

    a. What are the sources of information that you use?

    b. Is the information adequate or are there gaps? If gaps, what kind?

4. What are examples of important climatic events that have impacted your city in the recent past (such as floods, drought, heatwaves, high winds and heavy storms)? How did they impact your city?

5. Based on question 4, what information do you view as critical for better managing risks and reducing climate impacts and vulnerabilities?

    a. What kinds of climate information are important?

    b. What kinds of other information are important?