KADI

Pilot city plans co-developed with local stakeholders,with summary of the linkages between the report

Deliverable 2.3. HORIZON-INFRA-2021-DEV-01-02

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LIST OF AUTHORS

NAME	INSTITUTION
Niina Käyhkö	University of Turku
Venla Aaltonen	University of Turku
Patricia Nying'uro	Kenya Meteorological Department
Véronique Yoboué	Universite Felix Houphouet-Boigny
Alima Dajuma	Universite Felix Houphouet Boigny
Money Ossohou	Universite Felix Houphouet Boigny

Executive Summary

This deliverable showcases the progress of and approaches taken in the KADI WP2 Task 2.3. All the city pilots in the three cities - Nairobi, Abidjan and Dar es Salaam - are in their planning or early execution stage of co-development. This is an update of the previously submitted deliverable. This update summarises the pilot experiences in more detail as they have proceeded towards execution or finalising stage. The key messages from this deliverable are summarised below:

- Academic literature on climate services in urban Africa highlight the importance of co-production and stakeholder engagement, as well as considering the complex and interconnected nature of the urban socio-ecological system when planning, developing, maintaining and using the services.

- Task 2.3 takes a holistic and community-based approach to the city pilots. So far, the approach has been implemented via stakeholder and resource assessment guideline that aids the city pilots in defining their climate service ideas and theory of change, geographical context where the service operates, most important stakeholders who have relationship to the service, and other data and resources that are needed to deliver the service.

- Task 2.3 works in close collaboration with WP1, and takes advice on their definition for climate service research infrastructure elements. In turn, the city pilot experiences inform WP1 of the elements that are crucial for city-scale climate services in Africa.

- As an update to Deliverable 2.3, this report now also describes the stakeholder identification methodology that was used to kick-start systematic and comparable stakeholder processes in each city pilot. Results that are given under the city pilot chapters show the identified existing and potential stakeholders, and their relationships to the pilot projects.

KADI

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Introduction

Task 2.3 "City pilots" aims at co-designing local climate service infrastructures and solutions with the help of three pilot cities in Africa – Nairobi (Kenya), Abidjan (Côte d'Ivoire) and Dar es Salaam (Tanzania). The task explores how climate related observations such as greenhouse gas emissions, air quality, and heat can be combined with other critical data of human and natural assets for integrated urban climate services.

The goal of Task 2.3 is to develop data and research driven infrastructures and partnerships, which are able to combine high-precision observations, low-cost sensors and citizen science approaches with other digital data sets of urban environments and assets. The aim in each pilot is to test and validate integrated local climate service models particularly from their capacity to support informed decision-making and impact quality of life in the cities. The context is complex as city infrastructures are rapidly changing and conditions of cities are dynamic in space and time.

City pilots inform the KADI project about some of the critical elements for climate service research infrastructures at the scale of urban Africa. So far, citizen engagement has become one of most important aspects when co-producing climate services that are sustainable and have a true impact on the citizens' daily life while tackling climate risks. Co-creation aspects and stakeholder engagement are well known also in literature to lay grounds for successful climate services.

This deliverable summarises work in progress on reviewing research literature related to climate services in urban Africa – what are the most common challenges and lessons learned, and how they can be overcome. Task 2.3 addressed existing state-of-the-art knowledge by creating a guideline that aids the pilot teams to plan their work with a holistic and community-based approach in mind. The report presents the current state of the ongoing research and co-design process, presenting city pilots and mirroring them against guideline's elements. By M12 (end of the reporting period 1) of the KADI project, the city pilots are all in their planning or early execution stage of co-design and co-development.

An update to this deliverable is given to systematically assess the stakeholder identification and communication processes between all the three pilots. As the pilot projects have progressed, cooperation with existing and new stakeholders have been continued and initiated. The stakeholder assessments of the pilots were conducted following the stakeholder methodology developed by the Task 2.3 team, relying on existing scientific methodologies and modifying them for the needs of the KADI city pilots.

Climate services in urban Africa

Literature review

At the beginning of the work for WP2 Task 2.3, the team familiarized themselves with scientific literature related to climate services in Africa, and concentrated especially on the urban context. In many instances, the literature examines the best practices of climate services, evaluates the barriers of implementation, acknowledges the importance of co-creation, highlights lessons learned from other disciplines, and advises on how climate services should be created to maximize impact. However, the literature also notes that it is not on every occasion that these recommendations are considered when planning climate service related projects in Africa. Let us take a look on some of the key findings.

There is a shift in the future risk profile of African development from predominantly rural flood and drought to increasingly urban risks due to rapid growth of cities (IPCC 2022). Fast-paced growth will make cities susceptible to risks associated with climate change. Sub-Saharan African cities are growing in a largely unplanned manner and hence developing in hazardous lands, with limited development controls and weak

risk information. Research has shown that climate risks are complex and vulnerability is multidimensional in African cities, with insufficient baseline knowledge and digital data to make informed decisions. The needs for climate risk information in the rapid urbanisation context demand greater resolution, timeliness, and update frequency as well as capturing the interaction of socioeconomic, environmental and physical infrastructure.

The urban setting in Africa is socio-economically and geographically complex and dynamic. This context needs to be taken into account when developing climate services with urban resilience impacts. Internal stressors in the cities, such as unplanned development, insufficient infrastructure, socio-economic status of inhabitants, and health issues engage officials every day. Climate change as a stressor interacts and usually exacerbates the internal stressors, but in some cases, it might be unmotivating for local decision makers to allocate human and financial resources concentrating on the (future) climate risks (Steynor et al. 2016). Thus, it is most efficient to connect the climate and internal stressors in a meaningful way when seeking solutions, and to acknowledge that in urban settings climate information alone is rarely enough.

As each city is different, this means that climate services at the urban scale need to be context specific and tailor made to support the planning of adaptation in the best possible way (Cortekar et al. 2016, Giordano et al. 2020). People in African cities have already faced climate change effects, and thus have adaptation strategies based on their local knowledge. Some African cities, like Durban, have active climate change adaptation strategies but many do not have. Thus, pushing climate services to existing decision-making processes that are not (yet) built to adopt such activities is challenging.

Many climate services in Africa have not obtained the desired outcomes, as they have overlooked local needs, and established services are too strongly relying on scientific, expert-driven data and knowledge, which have failed to operate in local decision-making systems (e.g. Vogel et al 2019). Top-down scientific information "pushed" to local decision making has not been sustainable (Vincent et al. 2018). Successful user identification, user engagement, mapping user needs and sustainable service uptake has been especially challenging (Vincent et al. 2018; Daly & Dilling 2019). The inability to close the "usability gap" – information is increasingly being produced, but it does not end up in use on the ground (Dilling & Lemos 2011). Many climate service project reports state these issues in their "lessons learned" section, which indicates that the challenges are already well known also in the application field, not just in scientific literature. However, due to the complexity of the context and resource-intensity of best practices, among others, climate service projects have repeated the same lessons.

There is also a huge knowledge gap in understanding whether or how the developed climate services are being used, not only in Africa, but globally (see e.g. Swart et al. 2017). Projects with limited time frame and funding are often unable to monitor services' usage, and sufficient monitoring activities have only started to become mainstream in projects' design. Institutional arrangements at the national/regional level might not support climate actions as much as climate service projects would require to be successful, and thus proper institutional support might be needed. Local and indigenous knowledge is also often overlooked as "non-scientific", even though it can be crucial for the local citizens in their adaptation actions (Daly & Dilling 2019).

Tackling the challenges in designing, testing, implementing and sustaining climate services in Africa requires stronger concentration on stakeholder engagement and participatory, bottom-up and co-approaches: *"[Our article] finds … that nearly every case of successful use of climate knowledge involved some kind of iteration between knowledge producers and users"* (Dilling & Lemos 2011). When communities, policy makers, knowledge brokers, NGOs, citizens, private businesses and other sectors are engaged in the process, true needs can be revealed and the solutions can be developed to ensure sustainable (institutional) uptake, local knowledge can be acknowledged, and trust is built.

In addition to stakeholder engagement, tailoring the climate services to the local context and understanding and embracing the local culture and its opportunities (that might be different than perceived by project designers) is of utmost importance, especially in internationally funded and/or led projects. Translating and

communicating between scientists and practitioners - and between disciplines - must be fluent. The same terms might be understood differently, the reality on the ground might not be clear for the non-locals, and delivering information in a "scientific" way might not be relevant for those utilizing the information in the "end users" daily activities.

Holistic and community-based approach to city pilots

Based on the understanding the WP2 Task 2.3 team gathered from scientific literature, a revision of the approach of the climate service city pilots was necessary. The approach is holistic in nature and acknowledges the importance of community-based approaches. Thus, a stakeholder and resource assessment was created to guide the city pilots in crystallizing and refining their approaches when planning the pilot execution. The assessment guides to think about the theory of change of the pilot climate service, scope the stakeholder and community landscape, understand the complex geographical context in a holistic way, and identify needs for additional data resources that are most likely needed in a city-context when producing useable, useful and eventually used climate services (**Figure 1**). The stakeholder and resource assessment guide was provided for use by the city pilots in May 2023. The preliminary results were discussed in June 2023, but the assessment continues to guide the pilots throughout the project and it can be updated as needed.
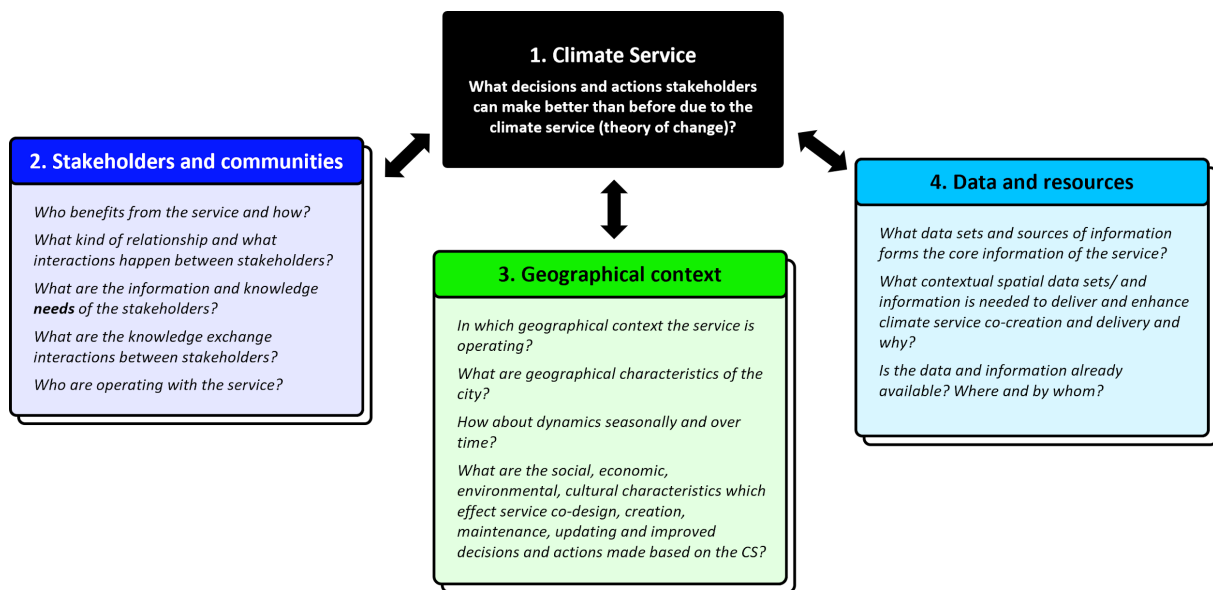
1. Climate Service

What decisions and actions stakeholders can make better than before due to the climate service (theory of change)?

2. Stakeholders and communities

Who benefits from the service and how?

What kind of relationship and what interactions happen between stakeholders?

What are the information and knowledge needs of the stakeholders?

What are the knowledge exchange interactions between stakeholders?

Who are operating with the service?

3. Geographical context

In which geographical context the service is operating?

What are geographical characteristics of the city?

How about dynamics seasonally and over time?

What are the social, economic, environmental, cultural characteristics which effect service co-design, creation, maintenance, updating and improved decisions and actions made based on the CS?

4. Data and resources

What data sets and sources of information forms the core information of the service?

What contextual spatial data sets/ and information is needed to deliver and enhance climate service co-creation and delivery and why?

Is the data and information already available? Where and by whom?

Figure 1. Four elements and guiding questions that assist in refining the climate service city pilots.

Stakeholder assessment methodology

The stakeholder and resource assessment guide aims not only to identify current and potential stakeholders for the pilots but also to clarify their roles in the climate service pilot and to develop appropriate engagement strategies. The WP 2.3 team generated documentation by drawing on scientific literature and practical experiences. This documentation serves the purpose of systematically conducting stakeholder mapping methodology across the pilots, enabling cross-comparison and synthesis. Documentation consists of: 1) Stakeholder and resource assessment guide (**Appendix 1**) and 2) Stakeholder mapping template (**Appendix 2**).

The initial document provides specific instructions on how to conduct stakeholder mapping. Stakeholder mapping is based on commonly used stakeholder mapping methodology (see Durham et al. 2014; Göbel 2019; Skarlatidou et al. 2019), and it consists four steps (**Figure 2**). The first round is for initial stakeholder identification which can be done with pilot project members in a brainstorming atmosphere. The guide provides guiding questions that help identifying existing and potential stakeholders, and articulating their possible role in the pilot, and motivation to participate.

Figure 2. The stakeholder mapping methodology for KADI city pilots consist of four rounds, which are iterative in nature.

The second step involves categorizing stakeholders according to their level of interest and influence in the pilot, determining whether they should be actively involved, closely collaborated with, informed about activities, or consulted. Based on the categorisation, an influence-interest axis figure (**Figure 3**) can be done. This classification plays a pivotal role in the third step, which focuses on formulating a stakeholder engagement plan. For instance, stakeholders earmarked for closer collaboration might be invited to participate in in-depth discussions, while those designated to be informed about pilot activities could be reached out to through email. Finally, fourth step is for executing the communication/engagement plan.
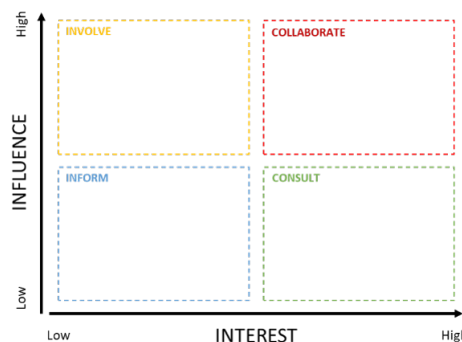

Figure 3. Commonly used way to create stakeholder engagement strategies is to categorize the stakeholders based on their interest and influende to the project.

The stakeholder mapping methodology is inherently iterative, recognizing the possibility of new stakeholders emerging during pilot activities. Concurrently, initially identified potential stakeholders and their roles may undergo changes. All city pilot teams applied the stakeholder mapping methodology to their respective KADI climate service projects, resulting in the creation of three comparable stakeholder mapping tables. The pilots then implement stakeholder engagement plans to foster climate service co-production in collaboration with stakeholders as the projects progress.

City pilots – stakeholder assessment and validation

Nairobi

Pilot overview

The climate service pilot in Nairobi builds on prior initiatives carried out in the city under the UK-funded WISER project within a program called DARAJA, meaning "Bridges" in Swahili. DARAJA aimed to assess and address climate service needs related to precipitation and its scarcity, with a brief exploration into temperature forecasts considering high and low-temperature impacts. In the KADI city pilot, similar methodologies are employed, but the emphasis shifts to temperature, specifically focusing on heat stress and the actual experiences of heat.

Nairobi, the metropolitan capital of Kenya, houses approximately 5 million people distributed across the city's suburbs and informal settlements. Almost half of Nairobi's population resides in these informal settlements, comprising just about 1% of the city's total land area. This results in densely populated living conditions with limited access to essential services. The city is susceptible to urban flooding and flash floods during the rainy seasons. Additionally, the informal settlements become literal hotspots for heat stress, especially in the hotter months, which persist for about 4-5 months each year.

The residents of diverse informal settlements face limited access to essential services crucial for their well-being. This includes challenges such as inadequate healthcare services, overcrowded schools, deficient governance structures, limited electricity availability, and high unemployment rates. The population in these settlements is growing rapidly due to heightened rural-to-urban migration driven by employment opportunities. Stakeholders involved in addressing these issues include various research organizations conducting work in the settlements, social enterprises dedicated to enhancing well-being, and diverse government agencies striving to provide and enhance public services.

The pilot will incorporate citizen science and administered questionnaires, with the exploration of using low-cost sensors. Meteorological data, including historical records, threshold analyses, and regular co-determined interval forecasts, will be used in implementing the pilot. Funding will be needed for supporting the distribution and filling of the questionnaires.

Stakeholder assessment

Table 1. Basic information of the identified stakeholders relevant to the Nairobi climate service pilot

Name	Organisation type	Application field
Forecasting Branch of the Kenya Meteorological Department.	Government Agency	Climate Services
Kounkuey Design Inittiative (KDI)	NGO	Working in codesigning services for dwellers of Informal settlements
Community members	N/A	N/A
Resurgence	NGO	
The University of Nairobi	Institute of higher education	Research
SEI - Nairobi	International Research non-profit	Research
Pamoja FM	Media	Information dissemination
Ghetto Radio	Media	Information dissemination
Kenya RedCross	NGO	Humanitarian services

Ministry of Health	Government Ministry	Regulation, Provision of services

Table 2. Roles and ways of contribution of the Nairobi climate service city pilot.

Name	Contribution/role
Forecasting branch KMD	Developing the initial forecasts, interacting with users to determine needs, co-designing services When: Throughout the project period
Konkuey Design Initiative & Resurgence	By virtue of their work with dwellers of informal settlements they would provide a link to the communities and support co-designing of products When: at the beginning and partway through the project
The University of Nairobi	The university would support research into thresholds for heat and towards the end of the project support resaerch into identified gaps When: throughout the project period
SEI Nairobi	Research activity support
Pamoja FM & Ghetto	Support dissemination of forecasts When: Throughout the project period
Kenya RedCross	Support determination of thresholds for action and co-production of heat warnings and forecasts When: throughout the project period
Ministry of Health	The ministry will be informed of our work since they may be intrested in setting inplace anticipatory action for when high temperatures are expecte

Figure 4. Communication plan for the stakeholders, based on their roles and interest in, as well as influence on the climate service pilot.

Abidjan

Pilot overview

The climate service pilot project in Abidjan builds upon the research conducted by the UFHB "Aerosol and Pollution" team in various projects focusing on local and regional atmospheric composition. Their findings underscored that air pollution, especially particulate pollution, poses a significant threat to public health in Côte d'Ivoire and Sub-Saharan Africa, consistently exceeding WHO regulatory thresholds. This has generated a demand for information from Abidjan's population and a necessity for decision-making support from public authorities. The motivation behind this demand lies in the need to anticipate the strain on health services during such pollution episodes and for political decision-makers to enforce air pollution regulations, demonstrating their commitment to safeguarding the population. The Abidjan climate service pilot project involves conceptualizing and sizing a monitoring and warning system for particulate pollution. This initiative relies on an experimental approach, integrating both reference and low-cost equipment for real-time or integrated measurements of particulate concentration (PM2.5: particulate matter <2.5 mm). Additionally, a modeling approach is employed to create maps depicting pollutant dispersion in Abidjan and identify gaps in the measurement system.

Abidjan, the economic capital of Côte d'Ivoire, boasting a population of around 6 million, is grappling with elevated levels of anthropogenic activity driven by urban population growth. Pollutants, notably PM2.5, known to have adverse health effects, register concentrations surpassing those observed in major European cities. The primary sources of these pollutants are combustion activities, encompassing the burning of fossil fuels, biomass, waste, and industrial processes. Research indicates that over 50% of PM2.5 emissions can be attributed to residential sources. The escalation of this particulate pollution source is linked to the rising demand for domestic energy, a trend closely tied to demographic factors. In Abidjan, despite the well-recognized effects of air pollution and the direct awareness of the population, there is currently no comprehensive air quality measurement network or a real-time forecasting system to handle pollution episodes. Additionally, the service needs the capability to pinpoint the sources of pollution to effectively aid decision-making in implementing emission reduction strategies.

The primary aim of this pilot project is to generate maps of air quality indicators, employing severity scales that are collaboratively defined and universally understood. These maps are intended to be accessible to all stakeholders, ranging from decision-makers and hospital departments to the general public. Agreements have already been established with key stakeholders such as the Côte d'Ivoire Anti-Pollution Centre (CIAPOL) and the District of Abidjan, which are poised to support the acquisition and deployment of low-cost sensors. In terms of information dissemination to the public, media outlets have been identified for this purpose. Beyond providing valuable data, the implementation of this climate service will also serve as an advocacy tool for enforcing air pollution decrees and promoting awareness regarding the necessity to adopt practices and technologies with low particle emissions in Côte d'Ivoire.

For the climate service data to be valuable to end users, it must be reliable, easily accessible, pertinent, and current. A partnership agreement has been formalized with the société d'exploitation et de développement aéroportuaire, aéronautique et météorologique (SODEXAM) to acquire meteorological parameter data (including air temperature, relative humidity, precipitation, wind direction, and speed) necessary for monitoring PM2.5 dispersion. The monitoring system's design will hinge on continuous PM2.5 measurements conducted by low-cost sensors, prioritizing extensive spatial coverage and community involvement. If project funding and duration permit, there is potential to enhance the deployment of low-cost equipment for fine particle measurement in critical areas of Abidjan concerning emissions or exposure.

Stakeholder assessment

Table 3 constitutes a segment of the stakeholder mapping phase within our climate service pilot project in Abidjan, specifically concentrating on PM2.5 measurement. It compiles the names of diverse stakeholders, encompassing government entities at various levels, non-governmental organizations (NGOs), and international organizations.

Over the course of the project, a total of 23 stakeholders have been identified. The stakeholder identification process is iterative, adjusting as new pertinent parties emerge, and some initially planned collaborators may choose not to participate. This table serves as a crucial tool for overseeing and recording stakeholder engagement across the entire lifecycle of the project.

Table 3. Basic information of the identified stakeholders relevant for the Abidjan climate service pilot.

Name	Organisation type	Application field
Société d'Exploitation et de Développement Aéroportuaire, Aéronautique et Météorologique (SODEXAM)	Governmental organisation	Weather forecast
Department in charge of combatting Climate change (Ministry of Environment and sustainable development)	Governmental organisation	Climate change, Disaster risk management
West Africa Coastal Areas Program (WACA) Cote d'Ivoire (Ministry of Environment and sustainable development).	Regional program	Coastal erosion, flooding,
Centre ivoirien Anti-pollution (CIAPOL) (Ministry of Environment and sustainable development).	Governmental organisation	Collecting and capitalizing on environmental data, assessment of pollution and nuisances, National Observation Network of Cote d'Ivoire (RNO-CI), Continuous monitoring of the marine and lagoon environment.
Research and Scientific innovation (Ministry of high education and scientific research).	Governmental organisation	Management of the research and teaching
Centre Universitaire de Recherche et d'application en télédétection (CURAT) at Felix Houphouët Boigny University (UFHB)	Public university organisation	Remote sensing, mapping, spatial distribution, air quality analysis using spectral parameters
Institut de Géographie Tropicale (IGT) at Felix Houphouët Boigny University	Public institution	Urban geography and planning Urban dynamic
Abidjan District and its city Halls Treichville City Hall	Public organization	Water management, urban planning, disaster risk management, healthcare
Agence Nationale de Gestion des Déchets (ANAGED) (Ministry of Sanitation and Salubrity)	Public organization	Elaborating and implementing management programs and promoting solid waste; regulating the management of all types of solid waste; implementing programs of sensitization of solid waste management and mobilising neccessary funding for managing all type of solid waste.
Agence Nationale De l'Environnement (ANDE) (Ministry of Environment and sustainable development).	Public organization	Educate, inform and raise awareness of environmental protection
Institut National de l'Hygiène	Public service	Public health, health crisis management

Publique (INHP) (Ministry of Health)\n\nDirection of Hygiène Publique, sante et environnement		Ensure that general policy of prevention are taken into account through vaccination, general health, medical and epidemiological monitoring, study, training and research
Institut Pasteur de Cote d'Ivoire (IPCI)	Public research, training and service establishment	Public health, health crisis management, Medical testing and analysis
Radiodiffusion Télévision Ivoirienne 1 (RTI1)\n\nJournalist at 7 info	Public administration	Communication, Sensitization, Promotion
Radio in charge of sustainable development (Radio CI)	Public and private administration	Communication, Sensitization, promotion
Internet press (Abidjan.net)	Public administration	Communication, sensitization, promotion
Institut National de la Statistique (INS) (Ministry of planning and development)	Public Administration	Implementing and monitoring government policy on development planning and programming
Ministry of Hydraulic, Sanitation and Salubrity	Governmental Organisation	Domestic, urban and industrial waste management
Conseil Supérieur des Imams (COSIM) Local authorities	Governmental Organisation	Religious guides
Autorité de la Mobilité Urbaine du Grand Abidjan (AMUGA)	Governmental Organisation	Ensure the organisation and coordination of different transportation regimes in Abidjan city.
Ministry of mining, oil and energy	Governmental Organisation	Energy
Ministry of Transport	Governmental Organisation	Transport data
Police rescue	Civil society	Disaster risk, emergency services

In the Climate Service pilot project for PM2.5 measurement in Abidjan, each stakeholder plays a specific role, contributing data, expertise, and support crucial for the project's success (**Table 4**). These stakeholders are integral throughout the project, ensuring a comprehensive approach to monitoring, managing, and communicating about air quality and public health in Abidjan.

Table 4. Ways of contributing and roles of the identified stakeholders, as well as when their contribution takes place in the pilot work.

Name	Contribution / Role
Société d'Exploitation et de Développement Aéroportuaire, Aéronautique et Météorologique (SODEXAM)	How: Provide meteorological data, newsletter and warning bulletin, bushfire warning.\n\nWhen: During the project
Department in charge of combatting Climate change (Ministry of Environment and sustainable development)	How: Provide data on climate change policy at national level. When: During the project
West Africa Coastal areas Program (WACA) Cote d'Ivoire (Ministry of Environment and sustainable development).	How: supporting the management of activities for tackling pollution and climate change adaptation\n\nWhen: During the project

Centre Ivoirien Anti-pollution (CIAPOL) (Ministry of Environment and sustainable development).	How: Participating in the validation of pollution data and the drafting of information and warning notes. Provide pollution data from their available equipment. When: During the project
Research and Scientific innovation (Ministry of high education and scientific research).	How: support the project by facilitating the collaboration and partnership between different institutions. Share the project results during workshops When: During the project
Centre Universitaire de Recherche et d'application en télédétection (CURAT) at Felix Houphouët Boigny University (UFHB)	How: helps to account for urban architecture in the spatialization of environmental parameters When: During the project implementation and all along the project
Institut de Géographie Tropicale (IGT) at Felix Houphouët Boigny University	How: Design maps provide geographic information systems When: During the project
Abidjan District and its city Halls Treichville City Hall	How: support the project by facilitating the collaboration and partnership between different institutions Share the project results during workshops When: During the project
Agence Nationale de Gestion des Déchets (ANAGED) (Ministry of Sanitation and Salubrity)	How: Provide waste collection informations (quantity, waste type, waste management system When: During the project
Agence Nationale De l'Environnement (ANDE) (Ministry of Environment and sustainable development).	How: ensure that climate change concerns are considered. When: During the project
Institut National de l'Hygiène Publique (INHP) (Ministry of Health) Direction of Hygiène Publique, sante et environnement	How: Extension of the warning system to the medical community, Definition and implementation of sanitary measures, When: During the project
Institut Pasteur de Cote d'Ivoire (IPCI)	How: Use its reputation to help spread warning messages When: During the project
Radiodiffusion Télévision Ivoirienne 1 (RTI1) Journalist at 7 Info	How: Sensitization on the atmospheric pollutant through flash emissions, Dissemination of the results obtained in real time (peak of pollutants and action to be taken); and the ongoing measurement campaigns, and eventually some forecasts. When: During the project
Radio in charge of sustainable development (Radio CI)	How: sensitization on the atmospheric pollutant Disclosing pollutant warnings Radio broadcast to show the results When: mainly at the end of the project to sensitize on the results. However, if necessary, it could be consulted for some intermediate sensitization program.
Internet press (Abidjan.net)	How: sensitization on the atmospheric pollutant; Disclosing pollutant warnings; Radio broadcast to show the results When: During all the project
Institut National de la Statistique (INS) (Ministry of planning and development)	How: Provide national statistics, socio-economic and demographic projections for the country When: During the project

Ministry of Hydraulic, Sanitation and Salubrity	How: Could be involved in sensitization against atmospheric pollution including waste burning; Could be consulted when collecting data and during some investigations. When: During the project
Conseil Supérieur des Imams (COSIM) Local authorities	How: Assist in communicating with some specific group including Muslim community When: During the project
Autorité de la Mobilité Urbaine du Grand Abidjan (AMUGA)	How: Ensure the application of legislation and regulations to urban mobility; Control, promote and regulate urban transport services When: During the project
Ministry of mining, oil and energy	How: Provide data on energy consumption, production and sources. They also provide emissions data of the energy sector. When: During the project
Ministry of Transport	How: Provide data on road, air and sea transport. They also provide data for future transport plans. When: During the project
Police rescue	How: Handling emergencies and reporting information; Raising awareness on social networks to help people stay safe When: During the project

The identified stakeholders are classified to communication axis figure for a systematic communication planning (**Figure 5**). Most of the identified stakeholders are existing ones from previous work of the pilot team, and are closely collaborated during the project.
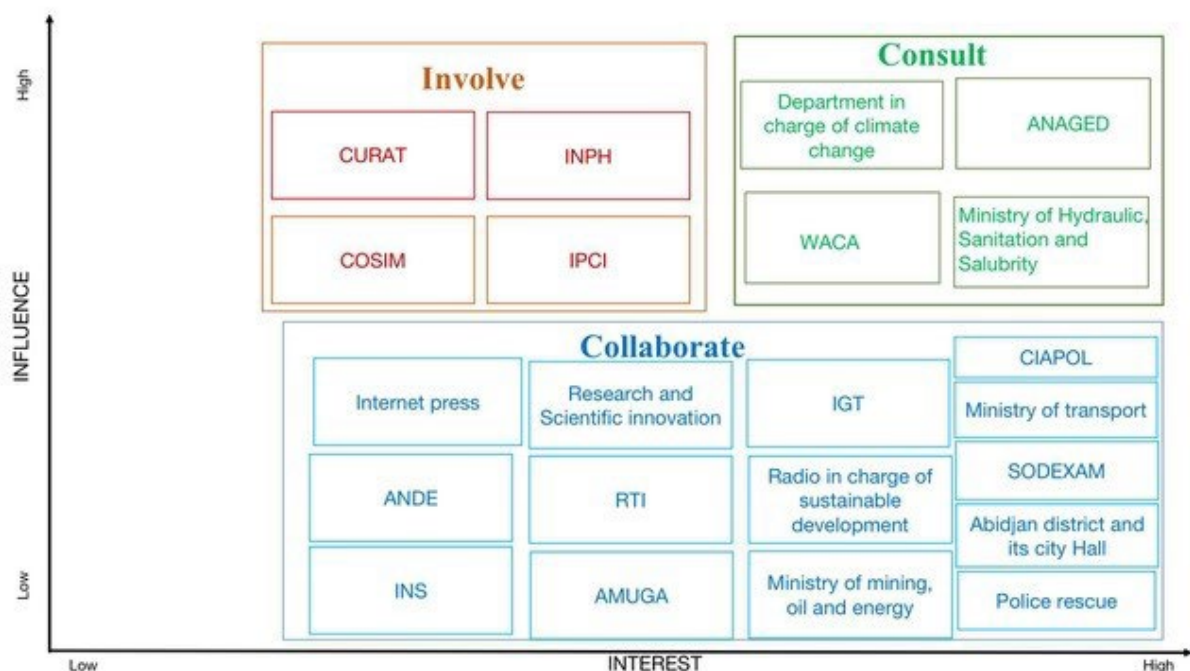
Figure 5. Axis figure where the most relevant existing and potential stakeholders of KADI Abidjan city pilot have been classified based on their influence to and interest on the project.

Dar es Salaam

Pilot overview

The climate service pilot in Dar es Salaam builds upon the prior efforts of the World Bank-funded Tanzanian Resilience Academy (RA) project (2019-2023), which has now evolved into an institutionalized program involving four Tanzanian universities, the Commission of ICT of the Government of Tanzania, and the University of Turku. The Resilience Academy follows a core approach wherein university-level students employ low-cost digital and mobile tools to conduct community mapping, gathering crucial geospatial climate risk data and other relevant geospatial information for climate services and local community environments.

The Dar es Salaam city pilot aims to conceptualize a climate service model based on the specific climate service needs of local communities. This involves integrating community co-creation of climate services to facilitate local action and adaptation to climate change. If funding and project duration permit, the climate service concept will be implemented on a practical scale. For instance, based on the needs of local communities, testing could involve the use of low-cost tools, citizen science methods, and community-based approaches to collect air temperature data. This data would provide evidence regarding day- and night-time heat stress, complemented by insights from citizens about their experiences and perspectives on the issue.

Dar es Salaam, with a population of roughly 7 million faces heightened vulnerability to climate risks, primarily attributed to rapid and largely uncontrolled urban growth coupled with inadequate land use planning, limited information for vulnerability and risk assessment, and a widening infrastructure gap. Estimates suggest that a substantial proportion, ranging from 50-80% (Dar es Salaam and Mwanza Land Nexus Research Team 2020; Magembe-Mushi & Lupala 2015), of the city's residents inhabit unplanned and poorly constructed areas in terms of urban infrastructure, including housing, transportation, and urban vegetation.

The most urgent climate risks impacting Dar es Salaam include recurrent flash floods, heat stress, and air and water pollution. While the causes, effects, and vulnerability patterns of flash floods are well understood, and both national and city governments implement measures to safeguard lives and livelihoods affected by floods, heat stress and air pollution receive less attention in research and policy-making. There is a notable absence or scarcity of data on these climate risks, impeding informed decision-making regarding these specific challenges.

The lack of knowledge about heat stress, air pollution, and their interconnected impacts, along with flash floods, on both individual citizens and larger communities, has resulted in a dearth of recorded information on the climate service needs of these communities for effective adaptation to these challenges. In response, this city pilot initiates a comprehensive assessment of these needs through participatory mapping and interviews in selected vulnerable communities within the city. These communities actively contribute to co-creating the framework for a local-scale climate service, wherein missing digital climate data is gathered through citizen science methods and community-based approaches.

Key stakeholders in this endeavor include local academic institutions with expertise in community and urban development, officials from various governmental levels within the city, and potentially other organizations already familiar to the Dar es Salaam city pilot team from their prior experiences during the Resilience Academy project.

Given the urban context of the climate service, integrating various data sources is essential to connect climate information meaningfully to the local environment. Geospatial and Earth Observation data related to urban infrastructure, building and pavement materials, vegetation, land use, and demographic patterns are actively sought from openly available databases. This is done to illustrate the spatio-temporal nature of climate risks and their impacts on the intricate and interconnected urban socio-ecological system. Detailed specifications for the required additional datasets and other resources will be provided as the pilot work advances.

Stakeholder assessment

The current and potential stakeholders for the KADI Dar es Salaam climate service city pilot have roots primarily in the prior initiatives of the Tanzanian Resilience Academy, along with various research projects, particularly those conducted at Ardhi University (ARU), Dar es Salaam. The Tanzanian Resilience Academy project orchestrated multiple mapping campaigns in Dar es Salaam, where university students from ARU and the University of Dar es Salaam (UDSM) collected essential geospatial data in the field, often in collaboration with local citizens. Numerous stakeholders, including various governmental organizations at different levels, NGOs, and international organizations, were actively engaged in these Resilience Academy activities.

Leveraging these pre-existing relationships and knowledge about stakeholders' expertise significantly facilitated the identification of both existing and potential stakeholders relevant to this pilot. A total of twenty-one (21) stakeholders were identified during the stakeholder mapping phase (**Table 5**). It's crucial to note that identifying stakeholders is an iterative process, as new and relevant stakeholders may emerge during the project, and some initially planned collaborators might choose not to participate.

Table 5. Basic information of the stakeholders most relevant to Dar es Salaam climate service pilot. Most of the organisations for on multiple application fields, but for simplification purposes the most relevant fields are displayed in this table.

Name	Organisation type	Application field
Community activity groups	Civil society	-
Individual citizens	Civil society	-
Ardhi University - Department of Spatial Planning and Social Studies	Academic institution	Research
University of Dar es Salaam - Department of Geography & Environment Studies	Academic institution	Research
Town Planner Ubungo Municipal Council	Government	Urban planning
Town Planner Kinondoni Municipal Council	Government	Urban planning
Town Planner Kigamboni Municipal Council	Government	Urban planning
Town Planner Temeke Municipal Council	Government	Urban planning
Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT)	Government	Disaster risk management
Dar City Council (DCC)	Government	Urban planning
Dar es Salaam Regional Commissioner's Office	Government	Urban planning
Environmental Officers (Temeke, Ilala, Kinondoni, Kigamboni and Ubungo)	Government	Urban planning
PMO-Disaster Management Department (DMD)	Government	Disaster risk management
Disaster Risk VPO	Government	Disaster risk management
Ministry of Water	Government	Water management
National Environment Management Council (NEMC)	Government	Urban planning
Tanzania Meteorological Authority (TMA)	Government	Meteorology, climatology
Tanzania Red Cross Society	NGO	Health, disaster risk management
OpenMap Development Tanzania	NGO	Geospatial data collection specialist
Nipe Fagio	Private business	Waste management
DFID/FCDO	International organisation	Funding

The objective of the climate service pilot in Dar es Salaam is to offer services that ultimately assist citizens in adapting to the impacts of climate change. Consequently, local communities play a pivotal role as the primary stakeholders in determining climate service needs, engaging in discussions about existing adaptation and coping strategies, and actively participating in the co-creation of the climate service design. Although various civil society activity groups, including neighborhood flood aid groups, and individual citizens are collectively categorized as a single stakeholder in **Table 6** below, it is important to note that the pilot work involves collaboration with multiple groups and individuals throughout the project.

Since sustainable climate services frequently rely on backing from local government entities, a substantial number of the recognized stakeholders are governmental organizations at various levels. These entities operate at the intersection of urban planning, risk management, and reduction, making decisions that directly impact the everyday lives of citizens. At the national level, governmental organizations in this pilot aim to establish connections with existing and planned projects related to climate mitigation and adaptation. In addition, their role involves identifying opportunities for the sustainability and scalability of the piloted climate service design.

While the Tanzania Meteorological Authority (TMA) operates at the national level of government, its significance to this pilot is substantial. This is attributed to its ongoing initiatives, including climate predictions and planned projects aimed at improving climate observation networks nationwide. Engaging in collaborative discussions with TMA officials and local community members proves to be an effective approach for facilitating bottom-up communication of climate service needs. These discussions provide an opportunity to explore the most optimal methods for disseminating such information and allow for closer dialogue regarding TMA's existing climate services, as well as strategies to enhance the provision of climate information that is most beneficial for the communities.

Table 6. Ways of contributing are rather clear for those stakeholders who have already been communicated with, but especially the roles of potential stakeholders might evolve during the pilot work.

| Name	Contribution / Role
Community activity groups	Local knowledge of climate stressors and their effects in neighborhood-scale. Important stakeholder to identify climate service needs that would aid the communities in adapting to heat stress, air pollution and flooding. Community groups are the main co-production stakeholder, and also information disseminator to other community members in their activity area. The groups are also an important link between the citizens and governmental organisations.
Individual citizens	Local knowledge of climate stressors and their effects in individual-, household- and neighborhood-scale. Individual citizens are also the main co-production stakeholder when designing the climate service concept that would best fit their climate service needs. Citizens are also climate information and data providers of their own surroundings, and eventually climate service users.
Ardhi University - Department of Spatial Planning and Social Studies	Tanzanian Resilience Academy (RA) university party. Co-executor of the KADI Dar es Salaam climate service pilot project. Local academic institution with research expertise in climate risks in Dar es Salaam, as well as experience from previous projects related to characteristics of heat stress, air pollution and floods in the city. Experience on Tanzanian Resilience Academy activities, such as participatory mapping campaigns with students. Mapping campaign(s) of this KADI climate service pilot is coordinated locally by ARU, and the campaign(s) employ ARU students who have previously participated in RA activities. Extensive existing relationships to different stakeholders that are relevant for this climate service pilot.
University of Dar es Salaam - Department of Geography &	Tanzanian Resilience Academy university party. Local academic institution with research expertise in climate risks in Dar es Salaam, as well as experience from previous projects related to characteristics of heat stress, air pollution and floods in

Environment Studies	the city. Experience on Tanzanian Resilience Academy activities, such as participatory mapping campaigns with students. Extensive existing relationships to different stakeholders that are relevant for this climate service pilot.
Town Planner Ubungo Municipal Council	District-level governmental decision-making organisation in Dar es Salaam. Promotes and administers urban planning activities in the respected district. Important stakeholder to identify and contact other organisations and more local level governmental offices. Expert information provider, and potential climate service disseminator. The piloted local level climate service design may be beneficial for district-level offices.
Town Planner Kinondoni Municipal Council	
Town Planner Kigamboni Municipal Council	
Town Planner Temeke Municipal Council	
Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT)	Committee that brings together emergency response stakeholders in Dar es Salaam. Initiative for DarMAERT was done during the World Bank funded project Tanzania Urban Resilience Program, of which the Tanzanian Resilience Academy was part of. Existing relationships to emergency response stakeholders who obtain local and expert knowledge of climate risks in Dar es Salaam. Important information provider, as well as possibly a benefiting stakeholder to climate services. Critically needed geospatial data of the urban fabric has been collected for the use of DarMAERT, which will continue to be useful for this climate service pilot.
Dar City Council (DCC)	City-level governmental decision-making organisation in Dar es Salaam. Conducts zoning decisions and other plans for the urban structure. Important stakeholder to identify and contact other organisations, both more local-level and national level governmental offices. Expert information provider.
Dar es Salaam Regional Commissioner's Office	City-level governmental decision-making organisation in Dar es Salaam. Conducts zoning decisions and other plans for the urban structure. Important stakeholder to identify and contact other organisations, both more local-level and national level governmental offices. Expert information provider.
Environmental Officers (Temeke, Ilala, Kinondoni, Kigamboni and Ubungo)	District-level governmental decision-making organisation in Dar es Salaam. Promotes and administers environmental management related activities in the respected district. Expert information provider, and potential climate service disseminator. The piloted local level climate service design may be beneficial for the Environmental Officers and their on-going and future projects related to heat, air pollution and flood management.
Prime Minister's Office - Disaster Management Department (DMD)	National-level governmental decision-making organisation whose activities are related to disaster risk, water, and environmental management around the country. Administers also more local-level projects. Important stakeholders to keep in the loop and discuss cross-connections between national-level projects related to climate risk management and adaptation, and establish relevant connections to other organisations. Possible avenue for funding opportunities.
Vice President's Office - Disaster Risk	
Ministry of Water	
National Environment Management Council (NEMC)	
Tanzania Meteorological Authority (TMA)	Important expert knowledge provider, and climate service co-creation stakeholder. Climate service needs of the citizens are communicated to the TMA, and shared co-creation workshops and discussions with local communities and TMA officials efficiently provides opportunities for informed climate service creation and dissemination by the national level meteorological organisation so that the service products are truly useful for the communities.
Tanzania Red Cross	Stakeholder that aids when climate risks materialize. Activities require up-to-date information of the climate risks, their extents, and impacts on the citizens. potential

Society	climate service co-creation stakeholder, as well as an organisation that benefits from the climate service.
OpenMap Development Tanzania	Stakeholder with extensive experience on organizing geospatial mapping campaigns with various themes and volumes. Intensive collaboration during the Tanzanian Resilience Academy project. Important stakeholder to collect and provide geospatial data for climate services.
Nipe Fagio	Company dedicated to sustainable waste management, with data collection and dissemination activities, awareness raising campaigns, and localized solutions for effective waste management together with local communities. Important data provider stakeholder, as well as potential climate service co-creation partner.
DFID/FCDO	

The KADI Dar es Salaam climate service pilot maintains close collaboration with citizens, community groups, partner universities, and local-level governmental offices across various sectors (see **Figure 5**). This collaboration involves participatory mapping campaigns, interviews, focus group discussions, as well as informal one-on-one or one-on-many dialogues. The pilot activities primarily unfold in wards situated within Kigamboni and Kinondoni municipal councils. However, the engagement of other municipal councils and their officials is possible, particularly if co-creation activities involve citizens from those areas. NGOs and private businesses, such as the Red Cross and Nipe Fagio, respectively, play crucial roles in shaping the climate service concept. Their participation provides valuable insights into the design, ensuring its relevance beyond citizens and government sectors. Private businesses, in particular, can leverage existing climate services to enhance their value, while NGOs can incorporate them into their essential work. These entities participate by organizing joint discussions and workshops with citizens to explore best practices in developing sustainable, useful, user-friendly, and utilized local-level climate services.

National-level governmental organizations are kept abreast of the pilot's progress, considering their governance over various initiatives and climate strategies. There is a reciprocal potential for both the pilot and these organizations to benefit from shared experiences. Ensuring the involvement of higher-level governmental bodies is crucial for long-term sustainability. Information dissemination occurs through emails and personal connections facilitated by the research personnel from Ardhi University (ARU).

Expert organizations specializing in environmental management, geospatial data collection, and academic knowledge of climate stressors in urban structures and society are consulted as needed. These organizations, already familiar from previous Tanzanian Resilience Academy project activities, can be easily reached due to existing connections. There is an open invitation for these stakeholders to participate more actively in the pilot activities beyond mere consultation requests, and the pilot team welcomes their involvement at any stage for further discussions.
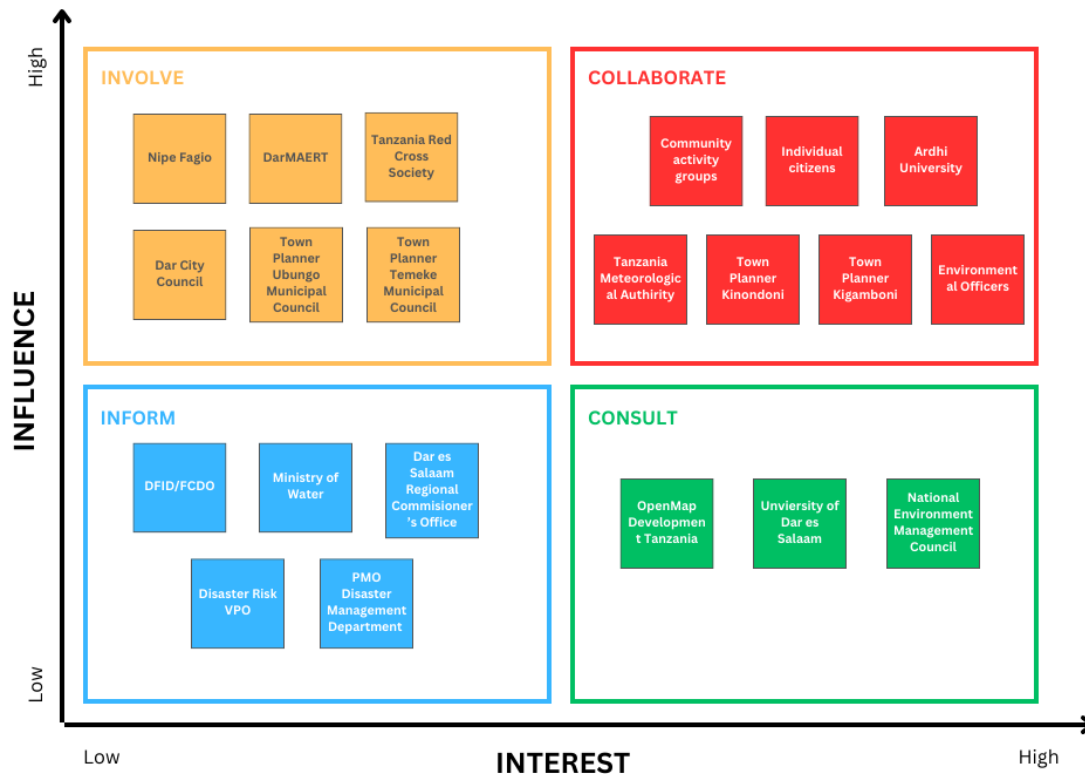
Figure 6. Axis figure where the most relevant existing and potential stakeholders of KADI Dar es Salaam city pilot have been classified based on their influence to and interest on the project.

Climate service RI elements – conceptual approach

WP1 of the KADI project has conducted preliminary literature review and stakeholder discussions which has acted as a basis for the approach to the definition of climate service research infrastructures, and their key elements (**Table 1**). This process informs the city pilots by providing a conceptual approach, which is then tested and piloted in the three cities. In turn, the WP2 Task 2.3 informs WP1 to highlight which elements are critical for city-scale climate service research infrastructures, and possibly proposes new or more defined elements to be included in the concept.

The approach expands the "traditional" definition of research infrastructures to cover a broader set of elements and also putting emphasis on the "soft infrastructures", such as monitoring impact, ensuring sustainability, dissemination and accessibility, training and knowledge exchange, policies, stakeholder engagement, co-concepts, and roles of the users. To take an example of the latter, the development of research infrastructures is often started top-down and product-first, where the users are considered solely as "end users". However, the users can be an integral part of the whole climate service research infrastructure - as part of the development, data production process, dissemination, and impact monitoring. These numerous roles of the "end users" are relevant to consider especially in the KADI city pilots which use co-creation and co-production approaches, utilize citizen science methods, and underline the importance of stakeholder engagement in defining climate service needs, and suggesting sustainable ways of dissemination and eventually service uptake. As the work of WP1 is on-going (as of M12), the climate service research infrastructure elements and their definitions listed in the table below are still evolving.

Table 1. List of climate service research infrastructure elements and their descriptions that are identified in WP1 thus far.

Climate service RI element	Description
Theory of Change	Successful climate services have a basis for sustainable usage and potential to make impact, i.e. improve climate-related decision-making processes of public and private organisations, communities and individuals. Theory of change articulates what decisions and actions they can make better than before due to the climate service.
Impact pathways	Impact pathways articulate how the climate services are able to achieve impacts that they have anticipated. They help to simplify the causal chain of events and interrelated activities that must take place for identifiable effects in the society or target sector.
Climate observations and data	Climate related observations are collected from the atmosphere, oceans, or land-systems via observation networks and systems or particular instruments, including citizen sensing, Climate service research infrastructures can collect their own climate observations or further refine existing climate related data from other providers.
Contextual data	Contextual data are combined with climate data to form meaningful climate service solutions for a specific context, such as demographic, infrastructural and environmental data, and data about distribution of vulnerabilities against a particular climate risk. Such data is usually geospatial data to enable location-specific climate service designs. Increasingly, contextual data is collected/extracted from Earth Observation data. Contextual data is particularly critical when services operate at local scales and in rapidly changing conditions.
Instruments and sensors	Instruments are the technical devices to observe climate conditions. The concept of "citizen sensors" is also an emerging methodology to record observations of the environment. See for example: Grêt-Regamey et al. (2021).
Modeling	Climate data is modelled to a meaningful format to produce climate information that is more useable than raw data. Climate service research infrastructures may, for example provide climate models as such to support decision-making, or provide modeling services for data providers.
Products and solutions	These are the key services that are provided in the climate service research infrastructures. They may take the form of a climate information dashboard, climate projection, information kit, training package, early warning system, and more.
Stakeholders, actors and community	Climate service research infrastructures can define their most important existing and potential stakeholders, actors and community members who have different roles in the infrastructure, such as giving the need and demand for the service, producing and maintaining some of the

	infrastructure elements, and/or benefiting from the products and solutions ("end-user").
Co-concepts	Co-design, co-production, co-creation, or other co-concepts may be part of climate service research infrastructures' planning, development, execution, maintenance and dissemination. Co-concepts bring relevant stakeholders into these processes to provide their expertise and knowledge. Co-concepts are usually integral parts of successful climate services and foster sustainable uptake of the services.
Networking	Networking elements aim to broaden or diversify the stakeholder community. These may be public events, collaborations between organisations, usage of personal connections, surveys, and more.
Dissemination and accessibility	Dissemination aims to reach stakeholders who could benefit from the products and solutions in their decision-making for informed climate actions. Accessibility (mode of delivery, language, possible instructions for usage etc.) of the climate services must be taken into consideration to succeed in dissemination efforts. Dissemination may be an active activity from the side of the climate service research infrastructure, or happen passively "on the ground".
Skill development and knowledge exchange	Climate service research infrastructures may provide training events for different stakeholders, and in different stages of the infrastructure design to for example use the services in a meaningful way or to provide information for the infrastructure. The climate service RI may also provide climate-related skill development materials for the public as one of the service products.
Standards and policies	Common standards or policies can be associated with many of the above-mentioned elements, such as observations and data, instruments, and accessibility. There may also be country- or organisation-specific policies that climate service research infrastructures should acknowledge and follow.

WCRP (World Climate Research Programme) Conference 2023

Abstract submission

WP2 Task 2.3 city pilots team submitted an abstract to the WCRP Open science conference 2023, with the support of WP1 lead organizations. The abstract below was accepted as a poster presentation.

Co-production of climate services for cities in Africa - combining local knowledge, digital data and low-cost tools for new opportunities of action

By 2050, over 60% of the African population will be living in the cities, which are increasingly vulnerable to risks posed by climate change. Rapid and uncontrolled urbanization, scarcity of up-to-date digital information on climate risks, and overcomplicated expert-driven solutions are some of the additional barriers to transformation. At the same time, the digital revolution and the skills and motivations of youth in African cities are key opportunities that could accelerate deployment of climate services for improved resilience.

Steering the development of African cities towards sustainability requires appreciation of the complex interconnectedness of natural and human systems and key drivers that cause and exacerbate vulnerabilities to climate change. Urban climate services operate in these socio-ecological, economic and cultural systems, where improved management of climate risks is not detached from the management of multitude of other risks in a rapidly changing urban environment. It is necessary to tie other stressors and characteristics of urban living environments to local contexts and co-create knowledge and action, which is need-driven and impactful for the local communities and actors in the cities.

In this presentation, we examine the local climate service infrastructures and solutions for rapidly growing cities of Africa. We explore how observations of climate-sensitive parameters, for example, greenhouse gas concentrations, air quality and heat can be combined with other critical spatial data of human and natural assets and risk for integrated urban climate solutions in three African cities: Abidjan, Nairobi and Dar es Salaam. The goal is to develop infrastructures driven by digital data and research plus partnerships that can be combined with high-precision observations, low-cost sensors and citizen science opportunities into solutions thereby enhancing urban climate resilience. Our use-cases stem from cooperation enabled by the European Union funded project "Knowledge and Climate Services from an African Observation and Data Infrastructure" (KADI, 2022-2025). During our session, we present our work-in-progress and share our experiences from the climate solution co-creation processes in complex urban settings.

We welcome discussion and more thoughts on what are the barriers, critical enablers and key opportunities for future climate services in African cities, highlighting particularly emerging opportunities from digital technologies and engagement of the communities. We also call for thoughts on the importance of local socio-economic and socio-ecological urban contexts, opportunities of engaging youth and ethics and safety related to urban climate services.

Keywords: urban resilience, co-creation, local, engagement, transformative

Poster Presentation at the WCRP Open Science Conference

The KADI WP2 Task 2.3 city pilots team presented a poster in the WCRP 2023 conference. The poster illustrates the current opportunities for climate service co-production in Africa, and how the KADI city pilots are an avenue to test the opportunities in urban contexts. The experiences drawn from the pilots inform the whole KADI project about what kinds of research infrastructure elements are crucial for successful urban climate services in Africa.

Figure 7. KADI WP2 Task 2.3 city pilots poster for the WCRP 2023 congress.

Discussion and feedback

On October 9th, Niina Käyhkö led the presentation during the online poster session for the World Climate Research Programme's Open Science Conference. The KADI city pilots' approach captured attention and generated excitement by emphasizing the bottom-up co-production of climate services. Notably, the audience actively engaged, posing questions and spotlighting key elements like youth and community involvement, as well as the use of open-source tools. The comments received further fueled interest in adopting similar approaches in different locations.

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Knowledge and climate services from an African observation Data research Infrastructure (KADI)
WP2, Task 2.3 City pilots

Last updated: 17.5.2023 (UTU)

Appendix 1: Holistic climate service identification, stakeholder mapping and resource assessment – guide for KADI pilots

This document provides background guidance for the identification of potential climate service (1) pilots in KADI project, with a focus on identification of stakeholders (2), geographical context (3) and data and resources needs and gaps (4) (see figure below, step 1), and then supports the actual stakeholder mapping and engagement process (see step 2).

The approach is particularly designed for the city pilots (T2.3), but can be applied in other pilots of the project. For the city pilots (Abidjan, Nairobi, Dar es Salaam), we will work through these steps and meet on June 19th (exact time tbc) in a 2-3 h webinar to share our findings from each city.
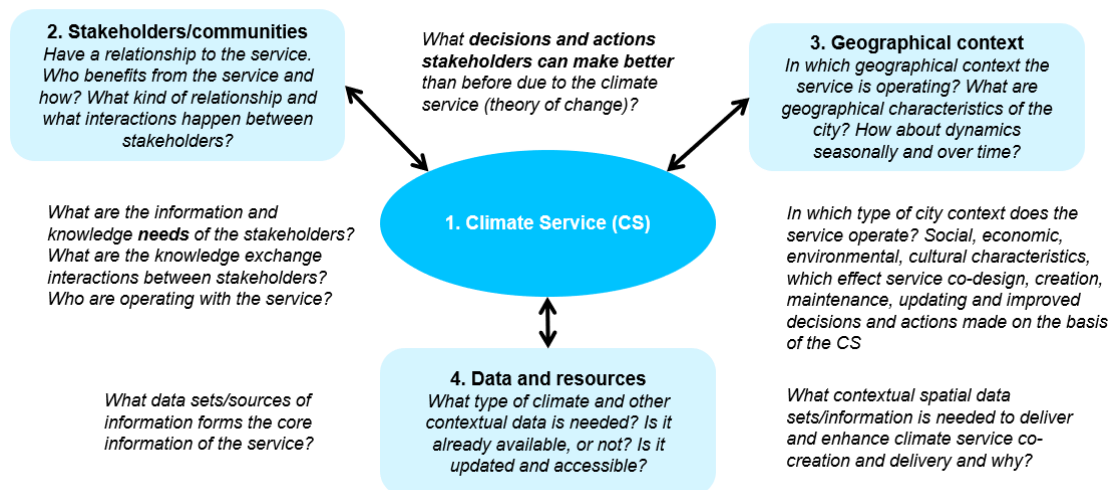
Mirror your KADI pilot identification against the definitions of climate services (CS):

- *"The transformation of climate-related data – together with other relevant information – into customized products such as projections, forecasts, information, trends, economic analyses, assessments (including technology assessments), counselling on best practices, development and evaluation of solutions and any other service in relation to climate that may be of use for the society at large."* (Street 2016)

- *"Climate services generally try to enable countries and various users and actors, through informal and formal institutions and networks, to better manage the risks of climate variability and change at all levels. Through these interactions the development and incorporation of science-based climate information and prediction services into planning, policy and practice are fostered."* (Vogel et al. 2019)

- In an urban context, the complexity and dynamics of urban system and the decision-making context must be taken into consideration. The climate measurements, data and information are tied to other data sources and the local context to successfully foster informed decision-making processes in different scales in time and space.

Knowledge and climate services from an African observation Data research Infrastructure (KADI)
WP2, Task 2.3 City pilots

Last updated: 17.5.2023 (UTU)

Step 1: Identification of potential climate service(s), including a theory of change, stakeholders, context and data

Questions in the tables provide assistance. If you have several CS candidates, then fill in the tables for each service. After the meeting on June 19th, we can select which of the candidate climate services serves best as a pilot for KADI.

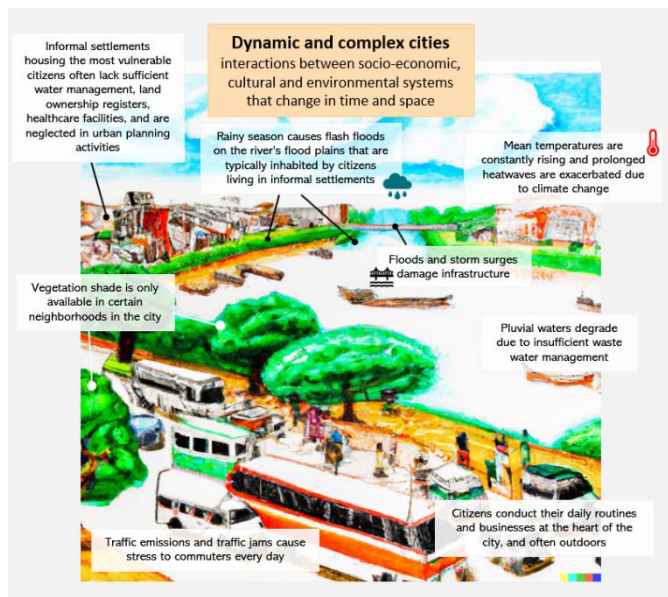| 1. Identification of pilot climate service(s) in each city	
Briefly describe the core idea/content of your climate service(s) and its theory of change, i.e. what is desired to happen when your climate service is brought into concrete actions by engaged stakeholders, using data in a specific geographical context. This articulation fosters identification of existing and possible stakeholders to collaborate with.	
What is your KADI pilot climate service about? What information does it contain and what anticipated actions CS triggers in the society?	
What climate data/information forms the core data of the service and how will this data become a *service created and used by people in a real-world context* (i.e. service that is useable and support decisions)?	
What decisions and action stakeholders can make better than before due to using and producing the climate service (i.e. what is the theory of change behind your service)?	

2. Stakeholders and communities	
Identify most important stakeholders/actors related to your climate service	
Who benefits from the climate service and how? Describe.	
What are specific climate service and knowledge needs and knowledge provision of different stakeholders?	
What kind of relationship, interactions and knowledge exchanges may happen between stakeholders during climate service co-production, and operational use? Describe key dependencies.	
Who are key actors to make service operational and sustainable in the long-run?	

3. Geographical context	
Describe the characteristics of the real-world, where the service should be operational. Think of biophysical characteristics of the operational environment and also social and cultural practices of human societies. How do these characteristics very in space and time? These descriptions support identification of possible sectors and the scale of decision-making bodies relevant for your Cs and stakeholder mapping process (Step 2).	
At which scale(s) will your pilot climate service operate?	*Such as neighborhood, city, country, region, continent…*
What are the non-climatic stressors characteristic for the context?	*Such as unplanned urban encroachment, insufficient waste management, water and soil degradation, corruption in decision-making…*

Knowledge and climate services from an African observation Data research Infrastructure (KADI)
WP2, Task 2.3 City pilots

Last updated: 17.5.2023 (UTU)

What are the climatic stressors characteristic for the context?	*Such as prolonged drought events, extreme heat, storm surges, heavy precipitation…*
What are the opportunity spaces characteristic for the context?	*Such as mainstreaming of low-cost digital tools, innovation hubs, climate adaptation strategies, local knowledge, academic collaboration…*
For what sectors your pilot climate service is useful for?	*Such as disaster risk management, water and waste management, urban planning, healthcare, biodiversity protection…*

Think which social, economic, environmental, and cultural characteristics of the city affect climate service co-creation, implementation, maintenance, and updating as a whole.
For creating a successful climate service, the operative real-world context is holistic and interconnected system of natural and human processes.

4. Data and resources

Climate data is often most useable in the local contexts' decision-making processes when it is tied to other data sources, such as demographic, socio-economic, or infrastructure data. Sustainable usage of the developed climate services might also require other resources, such as capacity building and institutional support.

What data forms the core climate information of your climate service pilot? How is/will this data be produced (source/method/tools/devices)?	
What type of additional geospatial contextual data is needed to turn climate data into a climate service co-created and used by different stakeholders?	
What are key challenges related to data production, availability, access and maintenance?	

A commonly used way to scope and store information about the availability of additional data sources is a data-metadata table, which can be a useful method also during KADI pilot service projects:

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Step 2: Stakeholder mapping

Stakeholder mapping is started as an internal process within your pilot project team and continues iteratively throughout the project duration. New stakeholders can be added to your stakeholder map whenever needed (snowballing method).

When mapping the already existing and potential stakeholders, keep in mind the relevant sectors, and the scale in which your pilot climate service is operational. Think about who are the stakeholders that transform your pilot climate service into actions, who are the ones providing possibly needed resources, and who you are collaborating with when developing the services.

Methodology references for this guide can be found from: Skarlatidou et al. (2019); Göbel (2019); and Stakeholder Engagement Handbook from Biodiversa (2014).

You may utilize the ***KADI_Task2_3_CityPilot_StakeholderTable*** files as a fillable template.

Stakeholder mapping
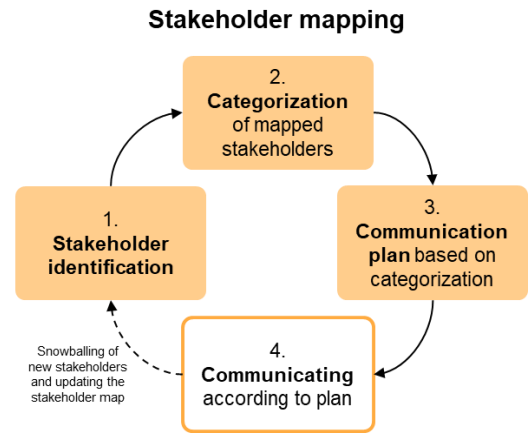
Round 1 – Initial stakeholder identification

*An initial stakeholder identification can be done with your project members in a brainstorming atmosphere. The **Stakeholder table** is a template, which can be modified according to your project's needs. Questions below are assistive and can help you get creative. Fill in the initial mapping results from **Round 1** to the table's blue columns.*

- Who is involved in making the climate service project happen, i.e. initiating project, organizing day-to-day activities?
- Who are transforming the climate service to use?
- Who are key actors for developing the service?
- Are there stakeholders providing data, information, equipment or capacity resources?
- Who are crucial for creating networks and/or conducting dissemination?
- Are there stakeholders that have been involved in similar activities on previous occasions?

- What do the stakeholders contribute to the activity?
- How frequently are they involved with the activity?
- Why are they involved?
- What do they get out of the activity?

- Which individuals/or stakeholder groups are likely to be affected by the outputs of the activity?
- Who, although not directly affected, may be interested in the results of the activity?
- Are there policies emerging or in existence that will benefit from or be affected by the activity?

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Consider different sectors and organisation types:

- Local communities
- Non-governmental organisations
- Government departments, policy makers and advisers (local, national, international)
- Business and industry
- Landowners and managers
- Professional groups
- Researchers working in relevant disciplines
- Researchers working across different disciplines
- Students, educators, schools
- The media
- The general public

Think also different roles the stakeholders could have in your project:

- Climate service implementors
- Co-production facilitators
- Network creators
- Data and resource providers
- Local consultants
- Knowledge brokers
- Information disseminators

Round 2 – Categorize the stakeholders

Categorize the stakeholders in relation to their interest in and influence/importance to your project.

- Who should be **involved** in the project?
- Who should be **collaborated** more closely with?
- Who should be **informed** about the project activities?
- Who should be **consulted**?

Fill in the categories to the table's red column. If desired, you can also utilize a commonly used axis figure for conducting the Round 2 (Figure 1).

💡 *HINT! If you work online with your team members, you may use interactive online tools to fill in the figure, such as Canva (Figure 2). Here is a link to a Canva template for stakeholder categorization. Sign in to Canva is required.*
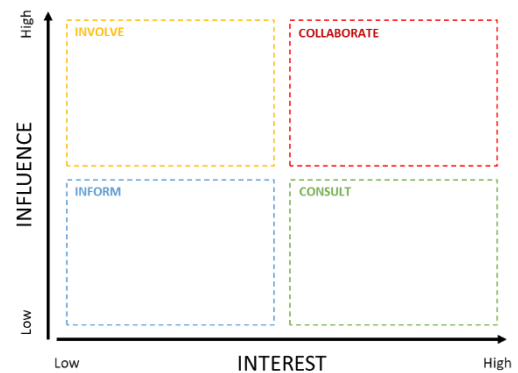
Figure 1. Axis-figure for stakeholder categorization.
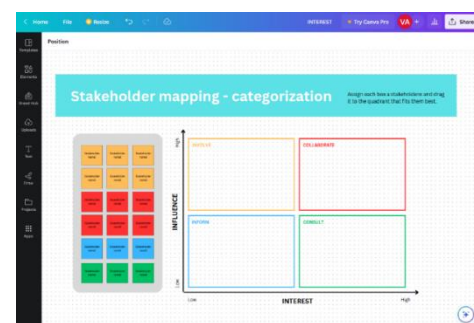
Figure 2. Screen capture from Canva-template.

Round 3 – Create a communication plan

Create a stakeholder communication plan based on the categorization. Those who should be collaborated more closely could be for example invited to a more in-depth discussion, whereas those who should be informed about the project activities could be contacted via e-mail. Create your own communication plan based on your project activities. You may utilize the table's purple column.

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- Mapping stakeholders' interest in participating in the project via surveys
- Conducting online or live workshops where stakeholders are invited to
- Keeping stakeholders regularly in the loop via e-mails
- Discussing with potential stakeholders via personal connections

Round 4 – Snowballing

Update your stakeholder map regularly. New potential stakeholders might emerge via discussions while the project evolves. You may even systematically ask from the initially identified stakeholders who they think should be brought on board to the project.

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Appendix 2: Stakeholder Mapping Template

[Your KADI pilot climate service]							Categorization	Communication
Stakeholder name	Contact information	Organisation type	Application field	Contribution	Motivation	Existing/potential	Categorization	Communication
If specific organisations or individuals can not yet be identified, you may write down the type or sector that contains potential stakeholders.		*Governmental organisation / NGO / private business / civil society member / academic institution…*	*Does the stakeholder work in a specific field (e.g. water management, urban planning, disaster risk management, healthcare…)?*	*What the stakeholder is contributing to the project, when and how?*	*Why does the stakeholder contribute to the project?*	*Is the stakeholder already part of the project activities, or is it a potential partner?*	*Categorize the stakeholders in relation to their levels of interest and influence to the project. Should the stakeholder be **involved, collaborated, informed** or **consulted**?*	*How the stakeholder should be contacted? Create a communication plan based on the categorization.*

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This additional and modifiable table can be utilized when discussing with the stakeholders:

	Stakeholder	Existing relationship	Relationship with other stakeholders	Knowledge on the project	Views on the project	Willingness to engage	Capacity to engage
Collaborate							
Involve							
Consult							
Inform							