Deliverable D2.6
Innovation Policy for the African Water Sector
Deliverable Title | Innovation Policy for the African Water Sector
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Status | Final
Related Work Package | WP2 Identifying and matching social innovation and research needs
Deliverable lead | IHE Delft
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Dissemination level | Public
Due submission date | M36 (28 February 2019)
Actual submission | M46 (13 December 2019)
Project acronym | AfriAlliance
Grant agreement number | 689162

Abstract of deliverable
This report presents policy guidelines for fostering the innovation process in the water sector in Africa in the context of climate change. It provides recommendations on how to support and boost water innovation in Africa by reducing the existing barriers and bottlenecks. The report brings together insights across various AfriAlliance outputs while also drawing on insights from research on determinants of water innovation in African cities, jointly conducted by IHE Delft and the Centre for Frugal Innovation in Africa (2017-2019).

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<th>Version</th>
<th>Date</th>
<th>Modified by</th>
<th>Modification details</th>
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<tbody>
<tr>
<td>v.01</td>
<td>27.03.2019</td>
<td>Silas Mvulirwenande</td>
<td>Draft Table of content based on discussion with Uta Wehn</td>
</tr>
<tr>
<td>v.02</td>
<td>15.04.2019</td>
<td>Silas Mvulirwenande</td>
<td>Initial draft based on exchanges with Uta Wehn</td>
</tr>
<tr>
<td>v.03</td>
<td>12.5.2019</td>
<td>Uta Wehn</td>
<td>Revisions and additions throughout; added executive summary.</td>
</tr>
<tr>
<td>v.04</td>
<td>27.05.2019</td>
<td>Tarryn Quayle</td>
<td>D2.6 Review</td>
</tr>
<tr>
<td>v.05</td>
<td>29.05.2019</td>
<td>Bettina Genthe</td>
<td>D2.6 Review</td>
</tr>
<tr>
<td>v.06</td>
<td>26.11.2019</td>
<td>Silas Mvulirwenande</td>
<td>Revisions throughout based on reviewers’ feedback</td>
</tr>
<tr>
<td>v.07</td>
<td>08.12.2019</td>
<td>Uta Wehn</td>
<td>Final edits throughout</td>
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Executive Summary

Water and climate change challenges are stark realities in many African countries, and it has become clear that, due to their complex nature, these challenges cannot be solved by conventional approaches. The continent is in urgent need of funding, creating visibility and bringing to scale of existing and new innovations to address water and climate change issues. Yet, at the same time, the continent is characterized by numerous organisational and institutional conditions that constrain efforts to apply appropriate innovations for addressing water and climate change issues. In particular, the financial resources needed for developing and sustaining these innovations are not effectively mobilised. The other main challenge is that the innovation systems for water (and climate change) in many African countries are poorly constructed, very fragmented, and overwhelmed by weak country business environments, insufficient researchers and research infrastructure and poor governance mechanisms.

This report argues that the role of innovation policy is crucial to provide direction and to mobilise the necessary resources for effective identification and implementation of water and climate change innovations in Africa. Existing water and climate policies are an obvious starting point for leveraging innovation to help address water and climate-related challenges. Mainstreaming innovation into water and climate policy requires an understanding of and agreement on what innovation is, how it relates to water and climate challenges, and how the innovation process can be strengthened via legislative and regulatory frameworks. This is what innovation policy consists of and contributes.

The guidelines for policy makers proposed in this document draw on four distinct studies, each of which focused on particular aspects of water (and climate) innovation in Africa. Of note is that these studies made efforts to obtain “an African perspective” on water innovation, notably by giving priority to obtaining insights from policy makers, innovators, experts and professionals living on the African continent. The first three studies were conducted within the framework of the AfriAlliance project, while the fourth study was a joint effort by the IHE Delft Institute for Water Education and the Centre for Frugal Innovation in Africa (CFIA), both based in the Netherlands.

Drawing on available best practices and taking into account the local conditions of African countries, this report proposes a set of 12 guiding principles for how innovation policy for the water sector in Africa can be composed:

- Open up the innovation policy process, ensuring active participation of all relevant actors
- Create an enabling environment for water and climate change innovation
- Widen the scope of water and climate change innovation, e.g., by considering technological and non-technological innovations, science-based innovations and those that are not
- Embrace the innovation system approach
- Tap into globally available knowledge and innovative water and climate solutions
- Strengthen absorptive capacity for water and climate innovations; i.e., the ability of African innovators and countries to identify, attract and use existing knowledge and innovations
- Promote and support open innovation
- Expand the role of government beyond facilitation, particularly by taking the lead and making actual investments across the entire innovation chain (ideation, development and diffusion)
- Promote locally-embedded innovation processes
- Conceive policy implementation as a gradual learning process
- Consider country and water sector specificities
- Develop a vision and long term strategy for water and climate innovation
This report also formulates a set of recommended actions that policy makers can undertake to embed innovation policy in water and climate policy in their respective countries.

- Enhance the innovation capacity of water innovators (e.g., providing them with technical, financial and business services through incubators and accelerators)
- Strengthen the regulatory framework for water and climate innovation (e.g., reforming laws and rules to allow easy development and/or uptake of innovation)
- Strengthen the water and climate research and development base (notably through increased investment in education, science, and innovation related to water and climate change)
- Stimulate (interactive) learning
- Raise awareness about water and climate change
- Promote context-sensitive water innovation (e.g., frugal innovations or innovations that use resources economically across the whole innovation value chain, are environmentally sound, of high quality and affordable to resource-constrained customers)
- Establish financial systems for water and climate innovation
- Foster entrepreneurship (mentality) in the water sector
- Create water and climate innovation milieus
- Encourage innovation partnerships
- Promote and support grassroots water innovation
- Set up mechanisms to monitor and evaluate innovation policy

Given the urgency to address the societal water-related challenges arising from climate change - water security, food security, energy security, public health, ecosystem management, and water energy-food nexus - it is now time for African policy makers to tap into the potential of innovation. They must aggressively mobilise local and foreign innovative ideas, entrepreneurs, and both public and private investments through innovation policy to meet the water and climate change related challenges. The advice provided in this document is not a blueprint that policy makers must follow to the letter. It is up to the policy making community in each African country to decide what best fits their specific conditions, undertake carefully selected initiatives and continuously adapt their innovation policies to the changing environment. The Afri-Alliance project, as the Africa-EU Innovation Alliance for Water and Climate, proposes this advice as guidance for this collective process.
1 Introduction

1.1 Background

Africa is one of the regions most in need of innovative solutions for tackling water and climate change-related challenges. Acknowledging regional differences in terms of rainfall, the continent is generally expected to experience an increase in sea level above the world average and a decrease in precipitation and groundwater recharge levels, with a wide range of direct and indirect impacts on human societies and ecosystems. However, lack of information on climate for different regions of Africa still makes it difficult to predict what the future climate conditions may be, particularly regarding the availability of water resources. This affects the capacity of countries to plan how to adapt and reduce the likely impacts of climate change. The situation is further complicated by the fact that many African countries face a variety of capacity and governance issues (e.g., insufficient water-related skills, poor synergies between policy and research, and institutional fragmentation) which make current mechanisms to deal with water and climate change challenges ineffective. This is notably the case of efforts that aim at promoting water and climate-related innovation (e.g., transferring applicable EU knowledge and technologies to African countries and vice versa) as a means to solve these challenges and ensure a resilient and sustainable society. The Africa-EU Innovation Alliance for Water and Climate project (or AfriAlliance) aims to prepare Africa for future climate change challenges by creating a framework for African and European stakeholders to work together in the areas of climate and water innovation, research, policy, and capacity development. The project builds on (and consolidates) the existing initiatives and networks (in both the EU and Africa) of scientists, decision makers, practitioners, citizens and other key stakeholders into an effective, problem-focused knowledge sharing mechanism via an overall coordination platform.

Within the project activities, Work Package 2 addresses the nature of the knowledge gap of African stakeholders, hampering their preparedness for the impacts of climate change on water resources. It aims to identify the knowledge and innovation needs of the African stakeholders in order to become better prepared for Climate Change in the short, medium and long term; to identify the barriers and bottlenecks that could hamper their capacity to implement appropriate solutions; and to propose solutions by targeting various audiences and levels. A specific part of this work has focused on producing recommendations for fostering the innovation process in the water sector in Africa, how to support and boost it by reducing the existing barriers and bottlenecks.

1.2 Purpose

The purpose of this document is to provide recommendations for fostering the innovation process in the water sector in Africa in the context of climate change, presenting practical guidelines and inspiration to the policy making community in Africa about how to foster water innovation activities and to prepare for climate change effects on water resources. It is therefore not a blueprint; since Africa is diverse, it is up to the policy makers and relevant stakeholders in each country to decide what they can do to leverage the potential of innovation for addressing water and climate change related challenges. The AfriAlliance projects hopes that the guidelines provided in this document can support that process.
1.3 Approach

The guidelines proposed in this document draw on four distinct studies, each of which focused on particular aspects of water (and climate) innovation in Africa. The first three studies are interrelated and complementary and were conducted within the framework of the AfriAlliance project, namely deliverable D2.2 Initial Demand-Driven Research & Innovation Outlook (Wehn et al., 2018), D2.3 Report on matching needs and knowledge (Amorsi et al., 2018) and D2.4 Draft Research & Innovation Agenda “Strategic Knowledge and Innovation Advice” (Seijger and Wehn, 2019). The fourth study was conducted within the framework of postdoctoral research on the determinants of water innovation in African cities, undertaken jointly by the IHE Delft Institute for Water Education and the Centre for Frugal Innovation in Africa (CFIA), both based in the Netherlands. These studies had different aims and followed different methodologies, as described in Table 1. It needs to be emphasized that due to the focus on the water sector in Africa, all four studies made efforts to obtain “an African perspective” on water innovation. For example, the AfriAlliance studies gave priority to obtaining insights from policy makers, experts and professionals living on the African continent. Similarly, the IHE Delft-CFIA study interviewed innovators and policy makers operating in African cities.

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<th>Study</th>
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<tr>
<td>1. AfriAlliance Demand-Driven Research and Innovation Outlook</td>
<td>Analysed the water-related needs of the African water sector organisations (demand side of innovation) in view of Climate Change. Investigated barriers and bottlenecks for the adoption of existing solutions by African stakeholders</td>
<td>Used a dual approach of top-down desk research and bottom-up empirical investigation. The former identifies national and sectoral needs via a review of societal challenges expressed in strategic agendas and policy documents. The latter identified innovation needs via empirical research at local or micro level, with water sector organizations as the unit of analysis, and used and adapted the Value Proposition Canvas, a proven business approach for identifying demand (customer) side needs.</td>
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<td>2. AfriAlliance Report on Matching knowledge needs and innovation solutions</td>
<td>Built on the previous study (D2.2) and explored the match between the identified needs (of water utilities, civil society organisation and river basin organisations) and innovation solutions identified.</td>
<td>Used the method developed in D2.2, namely that adapted from the Value Proposition Canvas to match identified needs for distinct types of organisations with existing solutions. Matching solutions were identified by AfriAlliance partners, relying on their expertise and networks.</td>
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<tr>
<td>3. AfriAlliance “Strategic Knowledge and Innovation Advice”</td>
<td>Proposed Strategic Knowledge and Innovation Advice for African policy makers on how to strengthen the capacity of the water sector in Africa and prepare for climate change impacts</td>
<td>Based on the results of the previous two studies by AfriAlliance (D2.2 and D2.3) as well as empirical evidence solicited from a diverse range of stakeholders (predominantly African), all insights were combined into one advice on how to strengthen the long term knowledge base of the water sector in Africa for tackling the impacts of climate change.</td>
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<tr>
<td>4. IHE Delft &amp; CFIA Research on determinants of water innovation in African cities</td>
<td>Aimed at studying and defining key factors of success and failure for water innovations in African cities, using VIA Water as a case study. VIA Water is a Dutch Government</td>
<td>Followed a qualitative case study approach. The study drew on the empirical experience of water innovators supported by VIA Water and policy makers in African countries. It implemented a multi-level method, combining surveys and in-</td>
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The guidelines presented in this document draw also from insights obtained from other sources, including existing scientific and policy publications on promoting innovation in Africa and developing countries at large.

The reviewed materials were analysed to address two main questions related to fostering the innovation process in the water sector in Africa by reducing the existing barriers and bottlenecks:

1) how should innovation policy for the water sector in Africa be devised? and
2) what concrete activities should innovation policy for the water sector in Africa consist of?

The responses to these questions were processed to distil a) guiding principles for innovation policy for the water sector in Africa as well as b) concrete actions that can be proposed to the policy making community in African contexts.

1.4 Structure

The remainder of this document is divided into four sections. Section 2 distils the key concepts used in this document, notably innovation policy and relevant aspects in the context of climate change. Section 3 provides the rationale for innovation policy for the African water sector and for the proposed recommendations. More specifically, the section explains how the societal challenges arising from water and climate change issues in Africa and the gaps in knowledge and innovation base of the continent (to deal with these issues) have made innovation and innovation policy imperative.

Section 4 describes a set of principles relating to how policy makers in Africa can foster innovation processes in the water sector in the context of climate change. Section 5 proposes recommendations for concrete actions that can be undertaken by the wider policy making community in Africa (e.g., government leadership, innovators and entrepreneurs, water sector financiers and donors) to promote water and climate related innovation, notably by reducing the existing barriers and bottlenecks. Section 6 concludes the document, including indication of the next steps for AfriAlliance.
2 Concepts

2.1 Innovation

Innovation is nowadays accepted as a major driver of change and the basis of economic development. Contemporary innovation scholars describe the concept of innovation in broad terms, as any attempt to try out new or improved products, processes or ways to do things (Bell and Pavitt, 1993) or the introduction of new solutions in response to challenges and opportunities that arise in the environment (Fagerberg et al., 2004). Following this broad perspective on innovation, innovations can be distinguished in terms of their degree of novelty (radical vs. incremental), their types (e.g. product, process or service), whether they are of a technological or non-technological nature, and whether they follow a closed or open approach (Chesbrough, 2006; Damanpour et al., 2009). Modern innovation theory emphasizes that what adds value economically and at societal level is not the innovation idea itself but whether it is exploited to solve the challenges facing societies at a particular time. It also acknowledges that innovations do not take place in a vacuum: they involve locally embedded and collaborative processes whereby innovating organisations interact and learn from other entities and whose behaviours are shaped by the local environments (Lundvall, 1992). In line with these views, innovation policy for water and climate change needs to take a broad view and focus both on the creation of new solutions as well as their uptake, exploitation and diffusion.

2.2 Social innovation to address water and climate change

The cross-cutting and complex nature of water and climate issues is increasingly encouraging social innovation as an effective approach to deal with these issues (Wehn and Montalvo, 2018). According to the European Commission (2011) the social innovation approach highlights the development of new solutions to respond to societal challenges; i.e., challenges facing society as a whole and that are both economic and social in nature (e.g., climate change, gender mainstreaming). Societal challenges are complex and solving them through innovation requires attention to the interactions between socio-economic, political and technological realities, as well as to the feedback loops that take place across the entire innovation chain. It also requires solutions that are achieved through an inclusive and joint problem solving approach, implying that end-users as well as other relevant stakeholders are an integral part of the innovation process (Mazzucato and Semieniuk, 2017). For AfriAlliance, the discussion on water and climate related innovations for Africa is framed around the concept of social innovation. AfriAlliance has defined social innovation as “tackling societal, water-related challenges arising from climate change by combining the technological and non-technological aspects of innovation. The concept refers to the processes and outcomes focussed on addressing societal goals, unsatisfied collective needs (or societal) as opposed to mere economic returns. Social innovation therefore consists of new combinations or hybrids of existing and new products, processes and services. To succeed, social innovation processes need to consider the following four dimensions: (1) technology, (2) capacity development, (3) governance structures, and (4) multi-stakeholder co-creation of solutions. These dimensions cut across organisational, sectoral and disciplinary boundaries, imply new patterns of stakeholder involvement and learning, and are critical to ensure social acceptance and success of innovations that address the challenges of climate change”. (D2.2, p.19).
2.3 Innovation policy

The past decades have seen the emergence of the widespread view that innovation policy has an important role in fostering innovative solutions to the complex and cross-cutting challenges relating to water and climate change. According innovation scholars such as Edquist (2011), the concept of innovation policy\(^1\) refers to policies that have a significant impact on innovation. These policies can have different motivations and there are, thus, different types of innovation policies. For instance, Edler and Fagerberg (2017) describe three main typologies. Mission-oriented policies aim at providing new solutions to specific challenges that are on the political agenda (i.e., solutions that work in practice) and, as such, take all phases of the innovation process into account. Invention-oriented policies have a narrower focus, as they concentrate on the research and development (R&D) or the invention phase, and leave the possible exploitation and diffusion of the invention to the market. System-oriented policies focus on system-level features, such as the degree of interaction between innovation system actors, the institutional gaps in the system that need to be bridged, and the capabilities of individual actors. The development of such policies relates to the emergence of the so-called ‘innovation system’ approach to innovation that emerged in the 1990s (Freeman, 1987; Lundvall, 1992). Innovation policy relies on a variety of policy instruments which can have different goals and focus either on innovation providers or innovation users. For example, there are instruments that promote the creation of new knowledge and innovation (e.g., fiscal incentives for R&D activities). Others may focus on strengthening the capabilities to diffuse innovation, promoting interaction and interactive learning, or on influencing demand for innovation (e.g., regulation and standardization instruments influence both supply and demand conditions and incentives) (Edler et al., 2016).

2.4 Systems approach to innovation policy

The systems approach to innovation\(^2\) (and innovation policy) became popular among policy-makers in the 1990s. It conceives innovation as a systemic phenomenon and acknowledges the determining role of innovation players other than research and science institutions in the innovation process (Lundvall, 1992). This approach emphasizes that innovation is accomplished through a collaborative process that involves a variety of individual actors and organisations and facilitated by appropriate ‘rules of the game’. The innovation systems literature associates innovation systems with many functions, notably fostering interactive learning and partnerships between actors, ensuring supply of resources exchange, facilitating the creation of markets, and so on (Hekkert et al., 2007). Innovation policy must therefore be designed and implemented in a way that it enables the system to effectively play these roles and remove all kinds of barriers that can hamper innovation activity. The systems of innovation approach is nowadays widely accepted as a useful framework to study and foster innovation at different levels (e.g., national, regional, sectoral). For example, building strong national innovation systems is recognized in many countries as the best way to promote innovation activity. Thus, the systems approach appears salient for fostering innovation to address water and climate change challenges in Africa – since solving these challenges requires the involvement of a variety of actors at different levels and the development of relevant institutions, structures and incentives that shape the actors’ interactions.

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\(^1\) Note that notions such as industrial policy, science policy, research policy, or technology policy have been previously used to refer to what is called innovation policy today (Steinmueller, 2010).

\(^2\) This approach is opposed to the linear approach which assumes that research is the basis of innovation and therefore gives to science (and technology) a fundamental role in innovation. According to this thinking, once scientific knowledge is produced, it is assumed to become an input to innovation activities which turn it into innovation outputs and diffuse them (Godin, 2007).
2.5 Current European perspective on water innovation policy

The idea to structure research and policy programmes around societal challenges emerged in the last decades and is nowadays widespread among European policy makers. In that regard, the EU research and innovation programme (Horizon 2020) moved in this direction with the introduction of societal challenges and innovation partnerships to increase the transformative impact of this programme on Europe and beyond. In the context of the European water sector, most research and policy instruments are nowadays structured along the same lines. This is notably the case of the Water Framework Directive, which was adopted in 2000 to address all grand challenges that are related to water in the EU (European Commission, 2012). The framework acknowledges the crucial role of water innovation (and innovation policy) as evidenced by the European Innovation Partnership (EIP) Water which was launched in 2012 (European Water Platform, 2014). This innovation policy instrument aims to stimulate creative and innovative solutions (technological and non-technological) that contribute significantly to tackling water challenges at the European and global level, while stimulating sustainable economic growth and job creation (European Commission, 2012). It intends to foster collaboration in the water sector across the public and private sector, non-governmental organisations and the general public.

The current debate on innovation at the European Union level emphasises the critical role of setting mission-oriented policies to address global challenges, including those relating to water and climate change. Drawing on the work of some influential innovation scholars such as Mariana Mazzucato (2018), these policies are expected to recognize the central role of the market creation perspective, as opposed to one of addressing market failures. In sum, current innovation policies (including on water) at the European union level are mission-based (aimed to achieve results) and have the following three characteristics (1) involve a challenge-based approach, (2) create markets, and (3) integrate supply and demand-side policies (European Commission, 2018). Mazzucato (2018) argues that to engage research and innovation in meeting societal challenges, a clear direction must be shaped (with the involvement of a wide array of stakeholders), while also enabling bottom-up solutions.
3 Innovation – key to addressing water and climate challenges in Africa

This section highlights that the African water sector is highly vulnerable to the impacts of climate change and provides the rationale for fostering innovation (and innovation policy) to address water and climate challenge impacts.

3.1 Societal water-related challenges arising from climate change in Africa

Current scientific predictions and field experiences suggest that in the decades to come water systems around the world will be unprecedentedly stressed due to climate change and its effects such as floods and droughts. These phenomena are expected to have negative impacts on the quality and quantity of water resources, the capacity of water infrastructure and the cost of water services, therefore threatening water security across the world, particularly in developing countries (UNESCO, 2012). In view of its current level of economic development, Africa is highly vulnerable to climate change impacts. The continent is expected to be significantly affected by increase in temperature extremes and changes in the distribution and timing of rainfall. There is generally more certainty about the increase in temperature for the different regions of the African continent and some certainty about sea-level rise, but less certainty exists about the change in rainfall patterns because of limited data. Notwithstanding the uncertainty of climate change, there is high confidence in the predictions that by the end of the 21st century, Africa will experience higher temperatures and raising sea-levels (Potsdam Institute, 2013; Niang et al., 2014). The impacts of climate change represent the most important societal challenges facing the African continent today. The study conducted by AfriAlliance (Wehn et al., 2018) identified 5 major societal challenges arising from climate change in Africa: they relate to the themes of water security, food security, energy security, public health, ecosystem management, and water energy-food nexus. These challenges are acknowledged by most African countries as issues that must be urgently and systematically addressed.

3.2 African needs to address water and climate change challenges

Africa has a wide range of resource and capacity challenges that need to be addressed in order to tackle water and climate change challenges. The review of 31 national water policy documents and strategic agendas undertaken by AfriAlliance (Wehn et al., 2018) identified three major categories of needs faced by African countries in view of climate change. These are (1) pressing needs for human well-being and their livelihoods as well as ecosystem health (e.g., water security, food security, ecosystem protection, public health, security and risk prevention); (2) transition needs that provide individuals and organizations the means to mitigate or adapt to climate change (e.g., knowledge and capacity, technology and infrastructure); and (3) cross-cutting needs referring to multi-sector, multi-disciplinary needs (e.g., policy improvement, financing, monitoring, research, water governance). At the micro level, the AfriAlliance study (Wehn et al., 2018) and other studies (e.g., Mvulirwenande and Wehn, 2019) have shown that the needs of water sector organisations in Africa are generally consistent with the needs identified in national policy documents. However, the specific needs of organisations differ, which is a reflection of their varying roles in water management. The analysis of the needs of the three specific water stakeholder groups (i.e., water utilities, river basin organisations and civil society organisations) showed that their urgent concern relates to addressing current water management issues whereas the (perceived longer term) effects of climate change do not feature strongly. They seem to be primarily concerned with pressing needs and to a lesser extent with transition and cross-cutting needs. An overarching need appears to be to strengthen the knowledge and capacity base to conceive the implications of climate change for specific organisational activities and their related solutions.
3.3 Mismatch between water and climate needs and existing innovative solutions

To overcome the water management issues and adapt to or mitigate climate change impacts, the African water sector needs to move away from business as usual approaches: it needs not only innovative solutions but also an environment that enables their application (e.g., appropriate policies and funding instruments). The truth of the matter is that, for many of the needs faced by the continent, solutions are available either locally or globally, but these cannot instantly be applied in Africa. There are still many gaps in the long term knowledge base (5-15 years) for water and climate in Africa which create a mismatch between the identified needs and existing solutions (Amorsi et al., 2018). In particular, many countries still lack the expertise and competencies needed to address water and climate change problems through co-creation between innovation providers and end users. In fact, the particularity of water and climate change issues in Africa requires a mix of home-grown and/or foreign-based innovations adapted to the local context where the needs are expressed. This reality suggests that the exchange of solutions remains a key issue in dealing with water and climate change related issues in Africa. On the other hand, some needs faced by African countries remain a challenge, thus commanding search for novel solutions. According to AfriAlliance (Amorsi et al., 2018), the needs that still require additional attention and efforts include those relating to the cross cutting themes of biodiversity (e.g., awareness of wildlife issues and conservation, protection of water resources) and water and food security. Furthermore, with regard to the four dimensions of social innovation identified by AfriAlliance, the evidence gathered by the AfriAlliance project suggests that existing knowledge and innovation solutions for water and climate change issues are biased. They tend to focus on water-related problems (water security) and lay an emphasis on technological aspects, with little attention being paid to fostering stakeholder interactions, for example. Missing is also the attention for creating an enabling business environment for innovation to flourish (see also Mvulirwenande and Wehn, 2019).

3.4 Barriers and bottlenecks to water and climate change innovation

Despite the acknowledged role of innovation to solve water and climate change problems in Africa, the levels of innovation activity in the water sector are still low due to a variety of factors. On the one hand, many water sector organisations have a whole range of capacity challenges preventing them from innovating; that is, adopting or adapting existing innovations or developing new ones. These innovation barriers and bottlenecks include a lack of environmental education and awareness of climate and water issues, limited personnel and technical expertise, lack of access to existing innovation and knowledge; hampering governance schemes; and lack of financial support. On the other hand, there are many institutional, sectoral and contextual (macro-economic, social and technological) conditions hampering water and climate innovation processes in Africa. These include absence of interaction processes at sector/country level, limited research on climate change, predominance of top down approaches, poverty, lack of transparency, corruption and poor coordination among sectoral policies and among donors. Aspects such as lack of policy guidance, institutional setups not allowing collaboration as well as lack of long-term innovation funds and partnerships are also perceived to stand in the way of water and climate change innovation (e.g., AfriAlliance (Seijger and Wehn, 2019); Mvulirwenande and Wehn, 2019).

3.5 Rationale for water innovation policy for the African water sector

In view of the challenges highlighted above, policy makers in Africa are increasingly recognizing that innovation is imperative to find sustainable solutions to water and climate related problems. This recognition implies that water and climate innovation policy is an essential issue that needs to be addressed in Africa. In fact, there is today an increasing number of initiatives aimed to foster water (and climate) change related innovation in Africa (e.g., the AfriAlliance project, the Dutch VIA Water programme), but these efforts have
not yet achieved the level of coordination or created the sense of purpose needed to have the expected transformative impact of innovation on the African continent. Moreover, the AfriAlliance review of existing water and climate research agendas (Seijger and When, 2019) in African contexts showed that innovation is insufficiently embedded in existing water and climate policies. Innovation policy for the African water sector seems to be the missing link for current and future efforts to have greater impact. We argue that carefully designed and implemented innovation policies can not only help water sector organisations to deal with current water management problems but also help to prepare for climate change impacts. Notably, innovation policy has the potential to help mobilise the necessary resources (e.g., advocating the establishment of credit guarantee schemes for small scale innovators such as SMEs), strengthen the capabilities of innovators and other key players, and to facilitate the development or uptake of the right technological and non-technological innovations that will allow the continent to achieve broadly inclusive growth while fighting climate change effects. Overall, these efforts should be linked to and embedded in existing water and climate policies in order not to create new policy silos.
Innovation policy for the African water sector: guiding principles

This section addresses the question of how the policy making community in Africa should promote innovation to address water and climate change challenges, taking into account available best practices and specific conditions of African countries (policy principles). The policy-making community in this document is understood to include not only those who have political mandates or government leadership (e.g., ministers, policy makers, traditional leadership) but also those who are directly or indirectly involved with science and education, industry, those in charge of water and innovation financing, donors and development partners. All these actors have a crucial role to play in ensuring successful design and implementation of water and climate change innovation policies in Africa.

Specifically, we propose 12 guiding principles for how innovation policy for the water sector in Africa should be composed, each of which is elaborated in the sub-sections below:

- Open the innovation policy process
- Create an enabling environment for water and climate change innovation
- Widen the scope of water and climate change innovation
- Embrace the innovation system approach
- Tap into globally available knowledge and innovative water and climate solutions
- Strengthen absorptive capacity for water and climate innovations
- Promote open innovation
- Expand the role of government beyond facilitation
- Promote locally-embedded innovation processes
- Conceive policy implementation as a gradual learning process
- Consider country and water sector specificities
- Develop a vision and long term strategy for water and climate innovation

4.1 Open up the innovation policy process

The recognition that addressing societal challenges requires a broad-based mobilisation and active participation has led to an increased involvement of non-state actors in innovation policy processes. Thus, in the context of water and climate change innovation in Africa, not only the innovation process but also the innovation policy process must be open up, ensuring that all those concerned have a chance to participate both in the design and implementation of innovation policies. This is particularly crucial, given that African countries need to set up policy targets and priorities that are based on the specific challenges and opportunities as perceived by their populations. No matter the level of policy making (national, regional), it is important to involve government leadership, entrepreneurs, scientists, Civil Society Organisations, the youth, local and indigenous communities, financiers, and so on. All of these societal actors are beneficiaries of water and climate change innovations and at the same time agents of the changes needed in the innovation system and the country system as a whole for innovations to work. They need to be actively involved in the design, co-financing and implementation of innovation policy instruments. The policy making community in Africa should acknowledge that central level actors cannot do it alone: their efforts can only lead to expected impacts if, and only if, local actors and governments are mobilised and involved. This implies the creation of adequate incentives (e.g., delegating of power and financial resources), especially for these local actors to feel that the process is really transparent, interactive and empowering. Only then can central and local level actors become mutually responsive and accountable during policy design and implementation. The bottom line is that innovation policy instruments become locally embedded and are easily accepted and used when they result from participatory and democratic processes.
4.2 Create an enabling environment for water and climate change innovation

The success of water and climate change innovations in Africa is dependent not only on the capabilities of innovating organisations, but also on the broader environment into which innovation processes take place. For example, Mvulirwenande and Wehn (2019) found that many of the water innovations supported by the VIA Water programme in African cities will face diffusion challenges as long as governments in the respective countries do not enforce the current environmental protection and water quality laws. Thus, innovation policy efforts to foster water and climate change innovation in Africa should consider the innovation environment as an important resource (and an enabler) and aim to create and or strengthen an environment that is enabling for innovation activities. This could be done notably by identifying and filling the gaps in the innovation systems for water so that they do not only provide frameworks for interaction, but also various resources and capacities needed by innovating organisations. Moreover, taking institutional measures (such as regulations) is important to encourage public-private investment in water and climate innovations and eventual uptake of these innovations by users. The policy making community in Africa should also promote institutions that protect the rights of innovators, thus providing a solution to the problem of appropriation of innovation benefits. Finally, since the responsibility for water and climate change-related innovation is distributed across the different components of the innovation system, it is important to create institutional mechanisms that allow effective coordination and collaboration across institutional and disciplinary silos.

4.3 Widen the scope of water and climate change innovation

Solving “wicked problems” such as those arising from water and climate change in Africa requires broad innovation approaches and a wide range of innovation outputs. Innovation policy in Africa must therefore widen the scope (of innovation) while promoting the search for potential innovations to address water and climate change challenges. This implies, on the one hand, considering the different dimensions of social innovation (i.e., technological and non-technological), science-based or not, as well as the entire innovation cycle from the creation of novel ideas to their implementation and diffusion. On the other hand, innovation policy needs to promote both the exploration approach (creation of new knowledge and innovative solutions) and the exploitation approach (identification and valorisation of existing knowledge and solutions). Furthermore, innovation policy should acknowledge that relevant, innovative water and climate solutions can also be introduced by non-conventional innovators (e.g., small scale organisations, CSOs, and consulting firms, few of whom have R&D departments and activities) and establish support mechanisms to these “unusual” players in the public as well as the private sector.

4.4 Embrace the innovation system approach

This principle is a prerequisite for many of the policy guidelines discussed later in this document. Taking the systems approach allows water and climate change innovation policy to effectively consider all potential types and sources of innovation and to create the much needed synergies among the very high diversity of the innovation stakeholders in Africa. In particular, the systems approach enables innovation policy to acknowledge explicitly that not only science and research-driven innovation activities must be supported. In fact, while it is true that many societal challenges arising from climate change impacts in Africa can and will be addressed through research and development oriented efforts, innovations derived from other learning processes (or from other sources of knowledge such as experiential learning and direct contacts with customers) will have a considerable impact as well, and innovation policies must foster them equally. At the same time, it is acknowledged however, that implementing system-thinking based innovation poli-
cies is complicated in African countries because of their wide variety of institutional voids, the many unconventional innovators involved, and unpredictable governance and regulatory frameworks. Under these circumstances, the main challenge that innovation policy must help to address is how to meet the needs of both formal and informal sector innovators.

4.5 **Tap into globally available knowledge and innovative water and climate solutions**

Water and climate innovation policy in Africa should, in principle, aim to foster the adoption of existing innovations and to adapt and disseminate them in local contexts. Put differently, the African water sector does not have to reinvent the wheel: it can tap into available knowledge and innovative water and climate solutions, in Africa and beyond. In fact, experience has shown that the innovations being introduced in the water sector of African countries are generally incremental innovations, mostly based on already existing (and mostly foreign) systems. Promoting the adoption of existing water and climate innovations seem to be a more realistic and attainable ambition for African countries than aiming for breakthrough innovations. This is understandable given the current economic development level of the African continent and associated with the fact that potential innovators do not necessarily have enough resources (human, financial) to venture into radical innovations. Innovation experiences from other developing countries also suggest that in their earlier stages of development, countries rely on the adoption of foreign innovations rather than developing their own innovations. For example, the development of China that we see today has heavily relied on foreign innovations; only during the last decades has it started investing aggressively in radical and disruptive innovations (Lundvall, 2016).

4.6 **Strengthen absorptive capacity for water and climate innovations**

This principle is a direct corollary of the previous one in the sense that African innovators and countries must develop the necessary ability (in terms of hard and soft infrastructure) to support the identification, attraction and use of existing knowledge and innovations to address water and climate change-related challenges. Cohen and Levinthal (1990) refer to this ability as absorptive capacity and emphasize the importance to consider aspects of absorptive capacity that are distinctly organizational and absorptive capacities of individual members as well as of societies. Thus, policy efforts to promote water and climate–related innovations in Africa must consider the strengthening of absorptive capacity at multiple levels. This implies, among other things, increasing the basic technological infrastructure, educated labour, research and development activities, and improving the business environment. It also involves improvements in the decision making arrangements and structures governing innovation in the water sector.

4.7 **Promote and support open innovation**

The term open innovation describes processes in which innovating organisations do not rely only on their own internal resources (e.g., their own staff or R&D) but also uses multiple external sources of inputs and paths (e.g., customer feedback, published patents, competitors) to drive and diffuse their innovation products, be it through market or non-market based mechanisms (Chesbrough, 2006). In the context of innovating for water and climate change challenges in Africa, it seems that no single African organisation or country, no matter how rich it may be, can afford to do it alone. Innovation policy in Africa should thus encourage approaches that enable water sector innovators and those who support their innovation processes to team up with others (including foreign innovators). Only then can innovations to address water and climate change issues in Africa be realistically developed and diffused.
4.8 Expand the role of government beyond facilitation

There are two dominant schools of thought among policy makers in Africa (and globally) on the role of government in innovation. The first argues that governments should invest directly or indirectly in innovation activities such as fundamental research (e.g., through the support provided to public universities) and research and development (e.g., through R&D subsidies to private sector firms). The second school (which tends to dominate the innovation discourse at the moment) posits that the role of government in promoting innovation should be limited to facilitation; that is, creating the right conditions for innovation to flourish and leave the rest to market forces. In the context of innovation policy for water and climate change in Africa, it seems more realistic to promote both approaches, given that the social innovations needed to address related challenges are not easily brought about by market mechanisms alone. Thus, innovation policy must maintain the active role of governments as crucial and indeed expand it beyond facilitation. Climate change involves many of uncertainties and related innovation activities are so risky that private firms lack incentives to invest in them. Under these circumstances, rather than waiting for the private sector, governments should take the lead and make actual investments across the entire innovation chain (ideation, development and diffusion). As argued by Mazzucato (2018), the entrepreneurial and lead investor role of public actors, willing and able to take on extreme risks (independent of the business cycle) is crucial for addressing societal challenges of our time, including those arising from climate change.

4.9 Promote locally embedded innovation processes

For any innovations to be successful, they must be socially desirable, technically appropriate and financially affordable for targeted customers. One way to produce such innovations is through locally embedded processes, whereby innovators consider knowledge of local specificities (e.g., lifestyle and cultural values of customers). Such innovation processes are particularly salient in the context of water and climate change in Africa where geographical regions have different vulnerabilities that must be taken into account by innovators. Thus, policy for water and climate change innovation must encourage strategies that enable innovators to consider African realities and, as such, increase the relevance of their innovations. This also aligns with the fourth dimension of AfriAlliance’s definition of social innovation, i.e. roadmap for multi-stakeholder interactions in co-designing locally relevant solutions. The Future Resilience for African Cities and Lands [FRACTAL] project provides useful insights on how to operationalise this concept (FRACTAL, 2017). Locally embedded innovation processes can result in sound adaptations of Western innovations or innovations that are developed with a completely different innovation approach (e.g., the frugal innovation approach). The innovation policy ought to also acknowledge that locally-embedded innovations that address water and climate change issues can be achieved by identifying and empowering local and indigenous innovators.

4.10 Conceive policy implementation as a gradual learning process

Policy making and implementation experience suggests that policy makers should not assume that they will get things right from the very first attempts. Innovation policy for water and climate change must be conceived and implemented as a gradual learning process. This allows the policy making community to pay attention to and learn from intended and unintended outcomes of their policy efforts. For instance, as described by Lundvall (2016), the original intentions of the Chinese reforms to create ‘markets for knowledge’ were not successful due to the fact that the enterprises were not ready to use knowledge produced by universities and other knowledge providers. Instead, knowledge providers moved ahead and established their own enterprises in order to translate knowledge into innovations. This unintended process proved to be an important step in China’s catch-up process, and policymakers accepted it as such. In
the context of Africa, the gradual and learning approach to innovation policy is particularly relevant due to the fact many African countries are still overwhelmed by issues relating to institutional voids and unpredictable governance systems. Taking this approach implies that policies should encourage policy makers to start with the implementation of small and specific innovation initiatives, systematically monitor and evaluate these initiatives, and then build on the lessons learnt to craft the next wave of initiatives.

4.11 Consider country and water specificities

As described before, African countries and regions differ considerably in terms of their vulnerability vis-à-vis climate change impacts as well as their capabilities to deal with these impacts. Thus, the innovation policy for water and climate change must set targets and priorities that reflect the specific challenges and opportunities faced in each country. For example, innovation policies of African countries that are well equipped with R&D competencies and infrastructure and with a good business climate (e.g., South Africa) could emphasize the pursuit of advanced water and climate change research, while those of poor countries with limited knowledge base and weak business and governance environment (e.g., Mozambique) could draw attention to the exploitation of existing innovative solutions and provision of support to promising entrepreneurs (e.g., through accelerators, incubators). At sector level, policies for water and climate innovation must acknowledge that the water sub-sectors (e.g., water supply, water resources management) are not necessarily equally equipped (e.g., in terms of human resources) and, where relevant, devise specific policy instruments targeting innovation in less privileged sub-sectors.

4.12 Develop a vision and long term strategy for water and climate innovation

Addressing societal challenges arising from water and climate change issues through innovation requires long-term vision. Such a vision must be collectively developed, involving multitudes of relevant stakeholders and be bold enough to awaken passion for water and climate change innovation. It is only when a shared vision for innovation exists that the policy making community can have the courage to take the risks needed, to commit essential investments, remove obstacles in the institutional environment, and launch innovation initiatives that are likely to lead to sustainable impacts. At the same time, implementing a water and climate change innovation policy requires a long term strategic approach, based on the established vision. A well-defined strategy should be articulated to move gradually from small scale initiatives and, as such, create the base for major innovation programmes. The bottom line is that innovation vision and strategy allow multi-year efforts and budgeting, which is key for water and climate change–related innovations.
5 Recommendations for actions by African policy makers

Existing water and climate policies are an obvious starting point for leveraging innovation to help address water and climate-related challenges. Mainstreaming innovation into water and climate policy requires an understanding of and agreement on what innovation is, how it relates to water and climate challenges, and how the innovation process can be strengthened via legislative and regulatory frameworks. This is what innovation policy consists of and contributes.

In line with the policy principles introduced in section 5, this section presents the following practical activities that African policy makers can undertake to promote innovation to address water and climate change impacts in their respective countries (policy formulation, implementation and monitoring):

- **Enhance the innovation capacity of water innovators**
- **Strengthen the regulatory framework for water and climate innovation**
- **Strengthen water and climate research and development base**
- **Stimulate (interactive) learning**
- **Raise awareness about water and climate change**
- **Promote context sensitive water innovation**
- **Establish financial systems for water and climate innovation**
- **Foster entrepreneurship (mentality) in the water sector**
- **Create water and climate innovation milieus**
- **Encourage innovation partnerships**
- **Promote grassroots water innovation**
- **Set up mechanisms to monitor and evaluate innovation policy**

Each proposed activity that African policy makers can undertake to promote innovation to address water and climate change impacts in their respective countries is discussed in detail in the subsections below.

### 5.1 Enhance the innovation capacity of water innovators

Similar to innovations in other development sectors, water innovations (including those that address climate change impacts) in Africa are very often introduced by small scale organisations (such as Small and Medium Enterprises, Civil Society Organisations, and consulting companies). This category of innovators generally faces the challenge of weak innovation competency; they notably require investment, more creative people, and partnerships with relevant institutions in order to successfully conceive and implement their water innovation projects. Thus, an important and pragmatic activity to foster water and climate change innovation in Africa should be to provide support to these innovators and enhance their innovation capabilities. This implies identifying them and availing for them the necessary technical, commercial and financial services, among others. The support to water and climate change innovators can be ensured through a variety of instruments, including innovation incubators and accelerators. In countries such as such as Kenya and Ghana, there are already a number of programmes that aim specifically to support innovators addressing water and climate change issues and which other African countries could learn from. These programmes include the Dutch VIA Water programme (hosted by Aqua for All) which operates in seven African countries, the Climate Technology Program (initiated by InfoDev and the World Bank) which initiated the Climate Innovation Centres in countries such as Ghana and Kenya, and the Kenyan NETFUND Incubation programme, promoting “green” innovations (in energy, water and agree business sectors).
5.2 Strengthen the regulatory framework for water and climate innovation

Creating an enabling environment for water and climate innovation implies changing the conditions that may potentially block foreign and local innovation initiatives and investments. An important policy task in this perspective consists of strengthening the regulatory framework for water and climate innovation; that is, implementing practical reforms in the laws, rules and regulations that allow easy development and or uptake of innovations. Such reforms could include the following: introduction of legal instruments that prohibit monopolistic markets for innovation and reduce bureaucratic hurdles for innovators (e.g., relating to acquiring Intellectual Property Rights), creating incentives for the innovation demand and supply side to invest in climate change innovation (e.g., easy procurement procedures for relevant technological innovations), and so on. For example, the diffusion of new membrane technologies to solve the wastewater treatment challenge in Africa requires regulatory measures (or incentives) such as procurement initiatives to accelerate take-up beyond the normal slow replacement rate for existing infrastructure.

5.3 Strengthen water and climate research and development base

As seen previously, many African countries have a knowledge base deficit to address water and climate change problems. This is notably due to the fact that most of these countries do not allocate sufficient investments in research and development activities. There is therefore an urgent call for action to strengthen the water and climate R&D base in Africa. This involves, among other things, increasing investment in education, science, and innovation related to water and climate change. The outputs would be an increased scientific personnel and upgraded research infrastructure (e.g., laboratories) which are prerequisites not only for doing original research and innovation but also for acquiring and acting upon existing knowledge and technology relevant for dealing with water and climate change issues. African scientists should focus their research efforts on finding solutions that work in practice and on topics that are not sufficiently covered by existing efforts elsewhere. In other words, African countries must strengthen their knowledge base for water and climate change by striking the right balance between adapting existing knowledge and innovation to local contexts and pursuing focused research. An important prerequisite for this to happen is to break down the silos, i.e., connecting researchers, government and other key stakeholders at all levels and to promote demand-driven and needs-based research.

5.4 Stimulate (interactive) learning

Interactive learning as competence building among individuals and within organizations is generally acknowledged as a factor that decisively determines innovation. Thus, the policy making community in African countries ought to implement initiatives that stimulate learning among the many actors that are likely to be involved in the development, implementation and use of water and climate change innovations. Interactive learning can be stimulated by creating innovation bridging institutions at the water sector level, such as innovation alliances that bring together innovation providers and users and enable them to reflect on their innovation experiences and to improve what they do. Linkages between locally-based innovators and multinationals can easily facilitate knowledge transfer, while those between industry and local universities can facilitate the acquisition of human resources. Innovation intermediaries (such as incubators) that are carefully designed can also serve interactive learning purposes. In the context of water and climate change innovation, a particular attention should be laid on interventions that aim at strengthening the capacity of weak and or less privileged learners (e.g., users of conventional technologies who have vested interests in keeping them) and offering them better access to learning opportunities related to climate change innovations.
5.5 Raise awareness about water and climate change

The impacts of climate change at local level have increasingly become evident in most African countries, especially for communities such as those in Southern African that were hit by the Tropical Cyclones Idai and Kenneth in early 2019. Notwithstanding, there is still need for more awareness raising about water and climate change across different segments of society: from policy makers themselves to citizens, civil society organisations, students, the youth, farmers and so on. Only then will there be a collective understanding of the urgency to address water and climate change related problems and an increased social readiness to invest in relevant innovative solutions. Policy makers need to initiate education and training programmes that improve the knowledge, skills and attitudes of people vis-à-vis water and climate change issues and redesign national curricula. This requires establishing collaboration with universities and other learning institutions so that they can upgrade their teaching curricula and include topics related to water and climate change. Other possible actions to generate a greater degree of awareness on the strategic importance of dealing with water and climate change issues include strengthening the capacities of relevant networks of water and environmental NGOs and those of relevant mass media and independent journalists to improve information coverage, advocacy and campaigning on water and climate change issues.

5.6 Promote context sensitive water innovation

Many African countries can hardly uptake water and climate change innovations developed in the global North. They are generally expensive (for African users) and so complex that their application in Africa is difficult due to the lack of relevant expertise and financial means to maintain and operate them. Therefore, it makes sense for policy makers to promote innovations that take into account the sensitivities of the African contexts. One pragmatic way to do this is to encourage frugal innovations; that is, innovations that use resources economically across the whole innovation value chain, are environmentally sound, of high quality and affordable to resource-constrained customers (Bhatti, 2012; Radjou and Prabhu, 2015). The policy making community in Africa should, for example, encourage the use of “frugal” decentralized water and wastewater treatment technologies which not only offer opportunities for resource recovery and reuse, but also are less capital intensive, more affordable to both individual and collective customers, cheaper and easy to operate and maintain (compared to conventional centralised technologies). It should be mentioned that some large scale initiatives are being undertaken to explore the potential of frugal innovation in Africa, including for the water and climate sector, and policy makers in Africa should liaise with them. The Centre for Frugal Innovation in Africa (jointly created by Leiden University, TU Delft, and Erasmus University Rotterdam, all based in the Netherlands) is one of such initiatives. In the field of weather forecasting, the Trans-African Hydro-Meteorological Observatory (TAHMO) project is developing and testing inexpensive and robust weather stations for Africa.

5.7 Establish financial systems for water and climate innovation

The financial systems in many African countries are so weak that African water innovators have difficulties to obtain finance for innovation activities, especially for the scale-up phase of their innovation processes. Thus, given the high risks involved in water and climate change innovations, policy makers must establish appropriate and focused financial systems. That is, systems that are willing to bear high risks and are patient, taking into account the long-run and cumulative nature of water and climate innovation. The financial systems needed can be established at country or continental levels, and should involve finances from both public and private sources. Since each stage of the water innovation process has its own financing challenges, the financial systems for water and climate innovation should be designed in way that they provide support in line with the maturity level of innovation projects. Finally, the financial instruments for water
and climate change innovation in Africa need to take into account the fact that, in many cases, the funds available are too huge to be absorbed by small scale innovators, which calls for strong water innovation intermediaries such as incubators to ensure that available support is also accessible to all categories of innovators.

5.8 Foster entrepreneurship (mentality) in the water sector
Innovation and entrepreneurship often go hand in hand and they are generally associated with profitability and superior performance. Thus, in order to effectively foster water and climate change innovations, the African water sector must at the same time promote entrepreneurship. On the one hand, the sector itself must be entrepreneurial, which can be achieved notably by putting in place mechanisms that enable the sector workforce (both top leaders and professionals) to embrace experimental approaches in solving problems, as well as adaptive management practices to fit the changing environment in which they work. These mechanisms can include the delegation of autonomy (to think and act) to frontline staff, introduction of more flexible funding arrangements (e.g., to be adopted by national governments or members of the donor community) and so on. It is only by introducing such practices that relevant solutions to climate change can be tried, tested and continuously adjusted until sustainable solutions are achieved. On the other hand, since innovation relies fundamentally on entrepreneurs, these must be promoted in the water sector. Appropriate incentives should therefore be developed for potential entrepreneurs in the public and private sectors to be interested in bringing water and climate change innovation ideas to the market. It should be indicated that interest in market-based approaches to solving water and climate change challenges has started growing in Africa. The water and sanitation sector has so many examples of successful public-private partnerships (Marin, 2009) which the whole sector can learn from. Across Africa, there is also a growing community of SMEs who could act as a vector of water and climate change innovations. Policy makers need to craft robust models on how to engage more with and involve these entrepreneurs.

5.9 Create water and climate ‘innovation milieus’
Experience has shown that interesting innovative projects tend to emerge through networks of organisations, concentrated in the same geographic areas, or so called ‘innovation milieus’ (e.g., the Silicon Valley in the USA). Policy makers in Africa need to support the creation of such spaces (e.g., technology parks, industrial zones) specifically targeting the development of water and climate change innovations. These milieus will provide essential tangible and intangible inputs for innovation processes, and facilitate networking and learning for innovation. Worth noting is the fact that many African countries have started introducing such innovation milieus (e.g., the Silicon SavannahGovern in Kenya, the Kigali Innovation City in Rwanda) (Bright and Hruby, 2015; USAID, 2016), but these are still generic. Notwithstanding, the policy making community in Africa can learn from the experience of these initiatives and develop strong innovation milieus for the water and climate change sector. To be successful, these milieus should benefit from good financing packages, adequate integration in other national development programmes, and focus on clearly defined visions and missions.

5.10 Encourage innovation partnerships
Innovation partnerships are nowadays acknowledged as an excellent way to innovate cost-effectively and time efficiently. They allow innovating organisations and other relevant stakeholders to exchange complementary resources that are necessary to successfully conduct innovation activities. Because of resource constraints facing many African countries and innovators, policy makers should encourage innovation partnerships, especially between small and large water and climate change innovators. However, innovation
partnerships to deal with water and climate change issues must expand to partnerships between African countries and or between Africa and other continents. Programmes such as VIA Water could inspire future initiatives on how to foster partnerships for water and climate change innovation projects in Africa. Most of the innovations supported by VIA Water are produced through partnerships that bring together foreign and/or African innovating organisations as well as other relevant stakeholders (including policy makers, potential customers and/or users, financiers, and so on). The partnership approach to innovation allows VIA Water supported innovators to leverage the local knowledge possessed by domestic partners as well as their networks. As such, they are able to produce water innovations that are relevant for African cities and thus likely to be collectively endorsed and easily diffused.

5.11 Promote grassroots water innovation

Grassroots innovators are described as "...individual innovators, who often undertake innovative efforts to solve localised problems, and generally work outside the realm of formal organisations like business firms" (Bhaduri and Kumar, 2010, p. 29). The innovation systems of African countries are dominated by many such innovators, generally operating informal sectors. These have considerable innovation potential to address some of the water and climate change challenges. Grassroots innovations are generally based on traditional and indigenous knowledge, local needs and practices, and they are simple and cost-effective. Thus, policy makers in Africa must set up mechanisms that allow to systematically exploit this potential. For example, innovation from grassroots innovators can be encouraged and promoted through the creation of formal links between informal innovators and universities and industry, or through identification and further exploitation of the specific knowledge possessed by informal innovators. The Honeybee Network in India (Gupta 2012) is one of such mechanisms that could inspire policy makers in Africa: it aims to identify, document and disseminate grassroots innovations. The network also provides grassroots innovators with capacity development technical assistance services (Gupta 2012).

5.12 Set up mechanisms to monitor and evaluate innovation policy

The need to conceive water and climate change innovation policies as gradual and learning processes implies that policies should properly monitored and evaluated. The policy making community should therefore set up appropriate institutions with adequate human capacity to carry out the mission of monitoring and evaluation of water and climate change innovation policies. Similar to other countries, innovation policy responsibilities in Africa traditionally lie within ministries such as that of industry, education, or economic development. However, these functions are increasingly delegated to specialized public-sector organizations to ensure efficiency and effectiveness in innovation policy implementation. In that regard, policy makers in Africa could establish national and or regional bodies that deal with monitoring and evaluation of water and climate change innovation policy. The establishment of these new institutions must be done with care to avoid conflicts of interests with the already existing ones (e.g., the ministries in charge of science, technology and innovation, common in many African countries). The key issue to consider is proper division of labour between the old and new innovation bodies, ensuring that the latter are not mere implementers of policy but have some level of autonomy to think and act. Policy makers in Africa could learn lessons from the “innovation councils” existing in many developed countries (e.g., in the United Kingdom Innovation Council) and whose functions include that of monitoring and evaluation of innovation policy.
6 Conclusions

Water and climate change challenges are stark realities in many African countries, and it has become clear that, due to their “wicked” nature, these challenges cannot be solved by conventional approaches. The continent is urgently in need of social innovations (technological and non-technological) to address water and climate change issues. Yet, at the same time, the continent is characterized by numerous organisational and institutional conditions that constrain efforts to introduce appropriate innovations for addressing water and climate change issues. In particular, the financial and intellectual capital needed for developing and sustaining these innovations are not readily available. The other main challenge is that the innovation systems for water (and climate change) in many African countries are poorly constructed, very fragmented, and overwhelmed by weak country business environments, insufficient researchers and research infrastructure and poor governance mechanisms.

This report has argued that the role of innovation policy is crucial to provide direction and mobilise the necessary resources for effective search and implementation of water and climate change innovations in Africa. Drawing on available best practices and taking into account the local specificities of African countries, this report proposed a set of policy guidelines (or recommendations) for the African policy makers to promote water and climate change innovation. It also formulated a set of recommendations with regard to concrete actions that policy makers can undertake to implement a water and climate change innovation policy in their respective countries. Given the urgency to address the societal water-related challenges arising from climate change - water security, food security, energy security, public health, ecosystem management, and water energy-food nexus - it is now time for African policy makers to tap into the potential of innovation. They must aggressively mobilise local and foreign innovative ideas, entrepreneurs, and both public and private investments through innovation policy to meet the water and climate change related challenges. The advice provided in this document is not a blueprint that policy makers must follow to the letter. It is up to the policy making community in each African country to decide what best fits their specific conditions, undertaken carefully selected initiatives and continuously adapt their innovation policies to the changing environment. AfriAlliance hopes that this advice will guide this collective process.

AfriAlliance can take the promotion of the insights created in this report forward in a number of concrete ways:

- Production of a ‘digestible’ version of this report as an AfriAlliance Policy Brief
- Promotion of the resulting AA Policy Brief and the full report via the AfriAlliance online platform, social media and in discussions with policy makers
- Support the discussions and interactions facilitated during upcoming AfriAlliance knowledge brokerage events (2 more Innovation Bridge Events, 7 more Brokerage Roadshow events).
7 References


