NATIONAL CLIMATE CHANGE ACTION PLAN

REPUBLIC OF KENYA

Long-term National Low-carbon Climate Resilient Development Pathway

Climate Risk Assessment of Kenya's Flagship Projects:

Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas

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Climate Risk Assessment:

Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas

To achieve its long-term vision of a globally competitive and increasingly prosperous Kenya, the Government of Kenya has developed Vision 2030 and identified over 100 flagship projects to be implemented during its First Medium Term Plan (2008 to 2012). A detailed review of the vulnerability of five of these flagship projects to climate change was undertaken in 2012 to inform development of Kenya's National Climate Change Action Plan and support integration of risk reduction strategies in Kenya's Second Medium Term Plan (2013 to 2017). The review was completed as part of Subcomponent 1, "Long-term National Low Carbon Climate Resilient Development Pathway," of the action plan process.

This brief presents outcomes of the review of one of these flagship projects, the ""Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas," and the key climate risks and possible risk reduction strategies identified. It contains:

- Overview of the methodology used to identify potential climate risks and risk reduction options
- Summary of the outcomes of the risk assessment
- Detailed presentation of the risk assessment process and outcomes

Overview of Methodology

To conduct this assessment, a tailored Climate Risk Assessment methodology[1] was developed through an iterative process. This methodology was composed of two modules:

Module 1: Deconstructed climate risk assessment

To gain a better understanding of the climate change vulnerability of the selected project, the potential implications of specific climatic changes on its planned activities was assessed. Potential climate risks (e.g. higher temperatures, more frequent heavy rainfall events) to the project were deconstructed in relation to its different sub-components. The potential direct impacts of these changes were listed and quantitatively assessed with regard to (1) their likelihood of occurrence out to 2050 and (2) their potential severity or consequence. Combining the likelihood and consequence scores allowed for identification of the climatic changes likely to pose the greatest risk to the project's successful implementation and for its beneficiaries.

Module 2: Identification and assessment of illustrative resilience building and risk reduction options

Illustrative options for reducing the vulnerability of the flagship project to the listed high risk climatic changes were identified. Structural (or hardware) options, non-structural (or software) options and policy options were identified for each risk. To provide guidance regarding how to prioritize amongst

[1] A full description of this methodology is provided in "Kenya's Climate Change Action Plan - Subcomponent 1: Long-term National Low-carbon Climate Resilient Development Pathway. Climate Risk Assessment of Kenya's Flagship Project." October 2012. The report is available at: http://www.info.kccap.info.

the myriad of potential vulnerability reduction actions identified, these illustrative options in turn are assessed with respect to their:

- Feasibility of implementation and
- Potential to contribute to Kenya's sustainable development.

The outcome of this process was a shortlist of examples of potential strategies that could be used to reduce the vulnerability of the "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas" to the impacts of climate change. More information on the methodology used is provided in the annex of this brief. The full report from the assessment of vulnerability of Kenya's flagship projects to the impacts of climate change may be found at: http://www.info.kccap.info.

Summary of Results: "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas"

<table>
<tr><th colspan="4">About the project</th></tr>
<tr><td>Goals and objectives</td><td colspan="3">The flagship project seeks to improve living conditions for the poor by formalizing some slums and informal settlements, constructing permanent housing and improving physical infrastructure. Efforts by the Ministry of Housing towards this goal include:
• Delivery of the Kenya Slum Upgrading Programme, which includes the building and upgrading of housing infrastructure and the formation of housing cooperatives
• Construction of low mortgage flats by the National Housing Corporation
• Increasing the number of paved all-weather roads
• Design and construction of water and sewer lines</td></tr>
<tr><td>Progress to date</td><td colspan="3">Completed the construction of 600 housing units in the Kibera-Lang'ata Decanting site; construction of 450 housing units (about 67 percent of target) in Mavoko; formation of 14 housing cooperatives in Kisumu, Mombasa, Nairobi and Mavoko; construction of roads of various lengths (no greater than 4.5 kilometers) in the slums of Kibera and Lang'ata; and construction of water and sewer lines in Kiandutu, Mavoko and Thika, and in Langas in Eldoret.</td></tr>
<tr><th colspan="4">Climate risks of greatest concern due to their potential likelihood and severity/consequence</th></tr>
<tr><td rowspan="3">Climate Risk</td><td>More frequent drought</td><td>• Less water available to maintain sewage systems and ensure adequate provision of water to households
• Potential for people to switch to unsafe water sources, increasing the risk of disease</td><td rowspan="3">Potential Impacts</td></tr>
<tr><td>Unpredictable rainfall patterns during both the short and long rains</td><td>• Water management and planning (for housing and sewage systems) could become more challenging</td></tr>
<tr><td>Flooding, flash floods or flooding during seasonal periods</td><td>• Greater potential for loss of life and displacement of people
• Potential damage to road infrastructure, making access to slums and informal settlements more challenging
• Greater risk of water borne diseases due to contamination</td></tr>
</table>

	Increase in average annual temperature, and peaks of high temperatures	• Potential for increased damage to roads • Increased demand for water during high temperature periods, with implications for water supply and sewage systems	
Illustrative vulnerability reduction options assessed to be most feasibility and have the greatest potential to contribute to Kenya's sustainable development			
Vulnerable Project Components	Housing	• Update building codes to promote more efficient use of water • Build rainwater catchment infrastructure, particularly upstream dams that can act store water for the dry seasons, and within the targeted slum areas.	Vulnerability Reduction Options
	Road building	• Adjust construction requirements to ensure that roads are better able to withstand future climate hazards, particularly heavy rainfall events, and contract builders to repair road networks quickly over time. • Ensure there is emergency access routes or plans for all urban areas	
	Sewage and water provision	• Design in flood risks and resilience to water and sewerage provision systems	

Detailed Project Description and Risk Assessment Results:

1. Project Description

This program aims to gradually formalise slums by permitting the construction of permanent houses and attracting private investment. It includes:

- Production of 200,000 housing units annually by 2012 through a mixture of initiatives in order to fill the huge housing gap in the country (e.g. build/enhance capacity in local authorities to provide serviced land; and/or to produce low-cost housing);
- Establishment of housing technology centres in each constituency to increase access to decent housing by promoting location specific building materials and low-cost housing;
- Establishing a secondary mortgage finance corporation to increase access to housing finance; and
- Enact the Housing Bill, 2006, to legislate for a one-stop housing development approvals mechanism to fast-track approval of housing plans and reduce the time cost of construction

<table>
<tr><td rowspan="4">Overview of project goals and components</td><td colspan="3">Vision: To formalize slums and informal settlements through integrated infrastructure improvement, construction of permanent houses and attraction of private investment.
MTP1: Better living conditions, decent housing and access to social and physical infrastructure</td></tr>
<tr><td rowspan="3">Project Components</td><td>1. Housing</td><td>• Building and upgrading of housing infrastructure through the Kenya Slum Upgrading Programme (KENSUP)
• Formation of housing cooperatives under KENSUP to mobilise funds and define ownership and general tenure arrangements
• Construction of low mortgage flats by the National Housing Corporation, especially in Nairobi</td></tr>
<tr><td>2. Roads</td><td>• Design and construction or conversion of urban roads to bitumen or other forms of paved, all-weather roads</td></tr>
<tr><td>3. Other</td><td>• The design and construction of water and sewer lines</td></tr>
<tr><td>Location(s)</td><td colspan="3">Vision: National, with most large conurbations covered, including Nairobi, Kisumu Kakamega, Nakuru, Nyeri and Mombasa
MTP1: Kakamega, Kisumu, Mavoko, Mombasa, Nairobi, Nakuru, Nyeri and others</td></tr>
<tr><td rowspan="3">Status</td><td>Housing</td><td>• Kibera-Lang'ata Decanting site: Comprised of 600 units that are complete; 1,800 households from Soweto East A were relocated to the site.
• Mavoko project: Comprises construction of 450 housing units under the Sustainable Neighbourhood Programme. A total 302 units have been completed, representing about 67 percent of planned units.
• Housing Cooperatives: 14 housing cooperatives have been formed in slums and informal settlements in Kisumu, Mombasa, Nairobi and Mavoko.
• Nairobi to open up mortgage flats constructed by the National Housing Corporation.</td></tr>
<tr><td>Roads</td><td>• Design and construction of access roads to bitumen standards: 15 kilometers have been completed in Nairobi Metropolitan Area; 0.5 kilometers in Kibera slums in 2009; and 1.35 kilometers in Lang'ata in 2009. Also in Lang'ata, 1.3 kilometers of paving blocks road have been completed; and in Kibera, 4.5 kms access road upgraded to all-weather roads.</td></tr>
<tr><td>Other</td><td>• Design and construction of water and sewer lines: In Kiandutu and Thika, a 2 kilometer trunk sewer line and a 2 km main water line have been completed. In Mavoko, a 5 kilometer water line has been completed. In Langas in Eldoret, a 6.5 km trunk sewer line is complete.
• Other physical and social infrastructure: Developments are on-going in main provincial towns and key urban centres such as Kisumu Kakamega, Nakuru, Nyeri and Mombasa.</td></tr>
<tr><td>Expected Benefits</td><td colspan="3">• Greater access to social and physical infrastructure
• Improved health and other social benefits derived from overcoming the current lack of water and sewerage infrastructure in the informal settlements (e.g. alleviating the problem of water-borne diseases).</td></tr>
</table>

2. General Description of Project Context and Rationale

Urbanisation rates in Africa, and especially Kenya, are some of the highest in the world. According to the UN-HABITAT, 60 percent of Africans will live in urban areas by 2020 (UN-HABITAT, 2010). According to the report, Nairobi's population is projected to grow by between 47 percent and 50 percent in the next decade, adding millions more people to the city by 2020. This kind of growth is mirrored across Kenya's major urban centres, where "at least 2.5 million people live and working in slums and informal settlements" (Repcon Associates, 2010). Rapidly growing urban populations are creating social, health, infrastructural and management challenges for cities, which by and large have inadequate plans and infrastructure to cope. Conditions in Kenya informal settlements are characterised by limited access to electricity, water, sewage, sanitation and decent housing. As noted in a study for the Kenya Ministry of Housing: "the urban infrastructure in Kenya has not maintained pace with rapid population growth and the problem is manifested by the current environmental and socio-economic challenges such as soaring unemployment rates, inadequate housing, infrastructure, water and food supplies, rising insecurity, energy shortages, mushrooming of slums and general environmental degradation so common in all urban centres" (Repcon Associates, 2010, p.1).

Kenya Vision 2030 calls for infrastructure development in informal settlements to provide better living conditions, decent housing and access to social and physical infrastructure and to formalize some slums and informal settlements through integrated infrastructure improvement, construction of permanent houses. The infrastructure sector aspires for a country with modern metropolitan cities, municipalities and towns with infrastructural facilities that meet international standards and help make Kenya a "globally competitive and prosperous country" (GOK, 2007). The Government continues to commit more financial resources for infrastructural development (GOK, 2011). Examples of ongoing initiatives include:

- *"Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas."* This program aims to gradually formalise slums by permitting the construction of permanent houses and attracting private investment. It includes:
    - Production of 200,000 housing units annually by 2012 through a mixture of initiatives in order to fill the huge housing gap in the country (e.g. build/enhance capacity in local authorities to provide serviced land; and/or to produce low-cost housing);
    - Establishment of housing technology centres in each constituency to increase access to decent housing by promoting location specific building materials and low-cost housing;
    - Establishing a secondary mortgage finance corporation to increase access to housing finance; and
    - Enact the Housing Bill, 2006, to legislate for a one-stop housing development approvals mechanism to fast-track approval of housing plans and reduce the time cost of construction
- *"Nairobi Metropolitan Development Sub Sectors in 20 Urban Areas."* This programme is mandated to "plan the development of integrated roads, bus and rail infrastructure, efficient mass transport system, replacement of slums with affordable low-cost/rental housing, efficient water supply and waste management for Metropolitan area among

others" (GOK, 2011, p.18). The "Metropolitan Development Sub Sectors in 20 Urban Areas" programme consists of three broad components:

  - Construction of modern, low cost housing units;
  - construction of all-weather including bitumen-surfaced roads; and
  - Installation of water and sewerage infrastructure in the informal settlements being upgraded.

- *Kenya Slum Upgrading Programme*. KENSUP is aimed at addressing housing problems in slums and informal settlements, as well as the development of other infrastructure such as roads and water and sewer lines.
- *The Kenya Informal Settlements Improvement Programme (KISIP).* This program is being implemented by the Ministry of Housing in two phases from 2010 to 2015, at a total cost of US$155 to 160 million (Repcon Associates, 2010). Programme activities will be rolled out in four components namely Repcon Associates, 2010, p.ii):
  - "Institutional strengthening/development and program management to the Ministry of Housing, Ministry of Lands and participating municipalities;
  - Enhance tenure security to support scale up and process systemisation of on-going efforts to regularise tenure in urban slums;
  - Invest in settlement restructuring and infrastructure which shall entail unpaved and paved footpaths, bike paths, roads and vending platforms, street lighting, storm water drainage infrastructure, solid waste management and collection, water supply and sanitation infrastructure, electrification, open spaces and public parks, and, potentially, community halls
  - Planning for growth by supporting delivery of affordable housing and serviced land."

  Investment is planned in 15 municipalities through the program, with each initiative under the KISIP to be screened for social, environmental and displacement impacts by the World Bank.

3. Climate Context

A. Historic/current climate

- The two elements of weather/climate that impact on human settlements (including the social aspects such as health and education) are rainfall and temperature. Recurrent and intensified rainfall events/floods have in the recent past caused damage to human settlements and the road infrastructure, especially in the informal settlements where the housing structures are too weak to withstand the force of the torrential rainfall (GOK, 2010).
- Flooding in informal settlements has led to cases of water borne diseases such as cholera, typhoid and dysentery (Kimani-Murage and Ngindu, 2007). Frequent outbreaks of water-borne diseases in informal settlements during periods of excessive rainfall have been attributed to a lack of water and sewerage infrastructure (Kimani-Murage and Ngindu, 2007).

B. Projected climatic changes

- Rainfall is projected to increase in East Africa with climate change, but the change in rainfall patterns will vary regionally and seasonally (AEA Group, 2008). Increased rainfall, particularly a greater occurrence of heavy rainfall events, could cause greater damage to housing and road infrastructure.
- Rising temperatures (AEA Group, 2008) will likely cause thermal expansion of roads making them more prone to being washed away by floods.
- Greater population displacement and migration from climate disaster-prone rural areas (e.g. from drought prone northern Kenya and coastal areas affected by sea level rise) is expected to result in a larger number of people heading towards urban agglomerations where assistance, income opportunities and infrastructure are perceived to be more accessible (GOK, 2010).

4. Climate Risk Assessment

To gain an understanding of the potential vulnerability of the "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas" project to projected climate change, a general climate risk assessment was completed. Drawing upon existing literature, potential changes in climatic conditions in location where the flagship project is being implemented were identified. The potential *direct* impact of these changes was then identified. Each of these potential impacts was then quantitatively assessed on a scale of 1 to 5 with respect to their likelihood of occurrence per year in the 2050s and their potential severity to generate an overall climate risk assessment score. Climate risks with high scores were flagged for further analysis.

Sub Sector	Key Climate Risks	Potential Direct Impacts	Future Likelihood (1-5)[2]	Potential Future Severity / Consequence (1-5)[3]	Overall Risk Assessment (Low/Moderate/ High)	Flagged for Deeper Assessment
Housing	Increase in average annual temperature, and peaks of high temperatures	Increased indoor air temperatures leading to cooling /water demand in urban areas	5	2	Moderate	
	Decrease in mean annual precipitation	Less water available	4	2	Moderate	
	More frequent drought	Less water available	4	4	High	✓
	Unpredictable rainfall patterns during short and long rains	Water management and planning challenges	4	4	High	✓
	Flooding, flash floods or flooding during seasonal periods	Damage to infrastructure	3	3	Moderate	
		Water borne disease risk	3	5	High	✓

[2] Likelihood: 1 = Rare – Event not expected to occur, but possible (<5 percent probability of occurrence per year in 2050s); 2 = Unlikely – Event unlikely to occur, but not negligible (5-33 percent probability of occurrence per year in 2050s); 3 = Possible – Event less likely than not, but still appreciable change of occurring (33 – 66 percent probability of occurrence per year in 2050s); 4 = Likely – Event more likely to occur than not (66 – 95 percent probability of occurrence per year in 2050s); 5 = Almost certain –Event highly likely to occur (>95 percent probability of occurrence per year in 2050s)

[3] Consequence: 1 = insignificant; 2 = minor; 3 = reasonable/moderate; 4 = major; 5 = severe

Roads	Increase in average annual temperature, and peaks of high temperatures	Damage to roads	5	3	High	
	Decrease in mean annual precipitation	Damage to road surfaces and flooding risks	4	3	Moderate	
	More frequent drought	Damage to road surfaces	4	2	Moderate	
	Seasonal flooding or flash floods	Access challenges	4	5	High	✓
		Loss or damage to lives, road infrastructure	4	5	High	✓
		Water borne diseases	4	5	High	✓
		Displacement of people	4	5	High	✓
Sewage and water provision	Increase in average annual temperature, and peaks of high temperatures	Increased water demand during hot periods	5	3	High	
	More frequent drought	Water resource availability and severe shortages	4	4	High	
		People switching to unsafe water sources (diseases risk)	4	5	High	
	Unpredictable precipitation during both the short and long rains	Water management and planning challenges	4	4	High	
	More frequent drought	Water resource availability and Water management and planning challenges	3	4	Moderate	
		Water demand and supply challenges	4	4	High	
	Flooding, flash floods or flooding during seasonal periods	Infrastructures damage	4	3	Moderate	
		Water resource availability and contamination	4	5	High	✓

5. Options for Reducing Selected Risks

In the next phase of the climate risk assessment process, possible measures for reducing the vulnerability of the "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas" project to the high ranking climate risks were identified. For each risk, illustrative options were identified that fit within the following categories:

- Structural options – defined as physical or landscape level interventions that serve to modify or prevent the threat, or that involve a change in use or change in location;
- Non-structural options – defined as interventions that build human capacity through actions such as research, education, institutional strengthening and social change; or
- Policy options – defined as the introduction or modification of existing government policies, strategies and/or measures.

The possible benefits of these intervention options were noted. The resulting list presented in the table below is not exhaustive; a range of other vulnerability reduction options could be considered.

Sub component	Key Climate Risk	Potential Direct Impacts	Intervention Description	Expected Key Impacts of Intervention Option
Housing	Unpredictable rainfall patterns during both the short and long rains	Water management and planning challenges	**Structural:**	
			Greater use of rain water catchments/reservoirs, storage and treatment for drinking at the community and city planning level (particularly in the Aberdares and other Nairobi water catchments)	More water resources available and more resilience to prolonged drought or damage to infrastructure
			Ensure coordinated actions for all relevant agencies, possibly within the Kenya Informal Settlement Improvement Project assessment framework for safe water provision and water management, including installation and maintenance of supply systems, whereby leaks and water losses are identified and fixed quickly and durably	
			Provide improved water supply systems for all upgraded housing and access points for remaining surrounding informal settlements	
			Non-structural:	
			Information provision before, during and after water stress periods and well managed water conservation campaigns well before, during and after water stress periods	
			Policy:	
			Regulatory: Update building codes to promote more efficient use of water.	
			Regulatory: Water delivery infrastructure management plans by water companies, local authorities and communities, defining monitoring procedures, maintenance and ensuring adequate resources for identifying and fixing damaged or leaking piping and prosecution of agents that damage water delivery systems (intentional or unintentional)	
	More frequent drought	Less water available	**Structural:**	More water resources available and increased resilience to prolonged drought
			Build rainwater catchment infrastructure, particularly upstream dams that can store water for the dry seasons, and within the targeted slum areas.	
			Non-structural:	
			City wide water conservation campaigns before, during and after drought periods.	
			Policy options:	
			Regulatory: Clear quantitative and temporal limits on metered "heavy" water use activities during drought periods, either through punitive tariffs or fines for non-compliance or automatic metering.	
	Flash Floods	Infrastructure damage (upstream and downstream)	**Structural:**	
			Design in flood mitigation and management to building and infrastructure plans.	Reduce impact of flood to houses and supporting infrastructures
			Non-structural:	
			Provide information on flood warning and human impact solutions/mitigation measures.	Reduce human impacts
			Policy:	
			Regulatory: DRR plans for water infrastructure in all urban areas to identify, manage immediate and short term access and health consequences and quickly repair critical infrastructure after flood events.	Reduce severity of flash flood events
Road Building	Seasonal flooding or flash	Access challenges	**Structural:**	Improve access to people during emergency
			Ensure there is emergency access routes or plans for all urban areas	

	floods		Improved drainage systems	situations
			Adjust construction requirements to ensure that roads are better able to withstand future climate hazards, particularly heavy rainfall events, and contract builder to repair road networks quickly over time.	
		Displacement of people	**Non-structural:**	
			Awareness campaign for flood emergencies in line with DRR best practice	
			Policy:	
			Institution based: Pooling emergency response capability	
		Damage to roads	Regulatory: mandatory DRR and emergency services plans for all counties, cities and major planned and informal settlement areas	
Sewage (and water) provision	Flooding, flash floods or flooding during seasonal periods	Water resource availability and contamination	**Structural:**	
			Design in flood risks and resilience to water and sewerage provision systems	Risk reduction
			Non-structural:	
			Information provision of practical guidance on contamination and disease risk during and after floods	Risk reduction
			Policy:	
			Regulatory: Master plan for all upgraded infrastructure to include flooding risk and impact mitigation plans for example the provisioning of basic services during and after flooding events	Risk reduction

6. Outcomes of the Analysis

Using expert judgement, each of the illustrative vulnerability reduction options identified were then assessed on a quantitative basis in terms of their:

- Potential feasibility, taking into consideration factors such as consistency with existing risk management activities, potential negative spin-offs, and attractiveness to donors and partners
- Potential contribution to Kenya's sustainable development, looking at factors such as employment generation potential, establishment of (grey and green) infrastructure, possible number of direct beneficiaries, and advancement of equity.

By combining the scores from this assessment, an overall assessment of an option's potential value as a risk reduction strategy was identified. Options receiving the highest scores (as indicated by check marks in the table below) were judged to be worth considering as possible ways in which to reduce the vulnerability of the "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas" flagship project to the impacts of climate change.

Sub component	Key Climate Risk	Potential Direct Impacts	Intervention Description	Feasibility Subtotal	Sustainable Development Subtotal	Outcome score	Priority Options
Housing	Unpredictable rainfall patterns during both the short and long rains	Water management and planning challenges	**Structural:**				
			Greater use of rain water catchments/ reservoirs, storage and treatment for drinking at the community and city planning level (particularly in the Aberdares and other Nairobi water catchments)	9	16	83%	
			Ensure coordinated actions for all relevant agencies, possibly	10	14	83%	

Sub component	Key Climate Risk	Potential Direct Impacts	Intervention Description	Feasibility Subtotal	Sustainable Development Subtotal	Outcome score	Priority Options
			within the Kenya Informal Settlement Improvement Project assessment framework for safe water provision and water management, including installation and maintenance of supply systems, whereby leaks and water losses are identified and fixed quickly and durably				
			Provide improved water supply systems for all upgraded housing and access points for remaining surrounding informal settlements	10	13	81%	
			Non-structural:				
			Information provision before, during and after water stress periods and well managed water conservation campaigns well before, during and after water stress periods	10	14	83%	
			Policy:				
			Regulatory: Update building codes to promote more efficient use of water.	10	15	86%	✓
			Regulatory: Water delivery infrastructure management plans by water companies, local authorities and communities, defining monitoring procedures, maintenance and ensuring adequate resources for identifying and fixing damaged or leaking piping and prosecution of agents that damage water delivery systems (intentional or unintentional)	10	14	83%	
	More frequent drought	Less water available	**Structural:**				
			Build rainwater catchment infrastructure, particularly upstream dams that can store water for the dry seasons, and within the targeted slum areas.	10	17	90%	✓
			Non-structural:				
			City wide water conservation campaigns before, during and after drought periods.	10	13	81%	
			Policy options:				
			Regulatory: Clear quantitative and temporal limits on metered "heavy" water use activities during drought periods, either through punitive tariffs or fines for non-compliance or automatic metering.	8	10	64%	
	Flash Floods	Infrastructure damage (upstream and downstream)	**Structural:**				
			Design in flood mitigation and management to building and infrastructure plans.	10	12	79%	

Sub component	Key Climate Risk	Potential Direct Impacts	Intervention Description	Feasibility Subtotal	Sustainable Development Subtotal	Outcome score	Priority Options
			Non-structural:				
			Provide information on flood warning and human impact solutions/mitigation measures.	9	13	76%	
			Policy:				
			Regulatory: DRR plans for water infrastructure in all urban areas to identify, manage immediate and short term access and health consequences and quickly repair critical infrastructure after flood events.	10	14	83%	
Road Building	Seasonal flooding or flash floods	Access challenges	**Structural:**				
			Ensure there is emergency access routes or plans for all urban areas	8	17	80%	
			Improved drainage systems	9	14	78%	
			Adjust construction requirements to ensure that roads are better able to withstand future climate hazards, particularly heavy rainfall events, and contract builder to repair road networks quickly over time.	9	16	83%	
		Displacement of people	**Non-structural:**				
			Awareness campaign for flood emergencies in line with DRR best practice	8	11	66%	
			Policy:				
			Institution based: Pooling emergency response capability	9	9	66%	
		Damage to roads	Regulatory: mandatory DRR and emergency services plans for all counties, cities and major planned and informal settlement areas	8	15	76%	
Sewage (and water) provision	Flooding, flash floods or flooding during seasonal periods	Water resource availability and contamination	**Structural:**				
			Design in flood risks and resilience to water and sewerage provision systems	10	17	90%	✓
			Non-structural:				
			Information provision of practical guidance on contamination and disease risk during and after floods	10	12	79%	
			Policy:				
			Regulatory: Master plan for all upgraded infrastructure to include flooding risk and impact mitigation plans for example the provisioning of basic services during and after flooding events	9	14	78%	

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Annex: Detailed Methodology

The climate risk assessment of Kenya's flagship projects was undertaken by completing the following steps:

1. Identification of Vulnerable Flagship Projects

The first step in the risk assessment process was to determine which, if any, of Kenya's flagship projects are particularly vulnerable to the impacts of climate change. A list of 71 flagship projects identified for execution within Kenya's first Medium Term Plan was therefore complied, drawing upon information provided by the Ministry of State for Planning, National Development and Vision 2030. Basic information about the objectives and accomplishments to date of each of these flagship projects were obtained by reviewing the Kenya Vision 2030 web page (http://www.vision2030.go.ke/index.php).

An initial screening of each of these flagship projects was then completing using a draft climate risk screening tool developed by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The draft GIZ screening tool assesses a project's vulnerability to climate change against the following four questions:

1. Is the project active in one of the following sectors: agriculture and rural development; forests/forestry; natural resources management and biodiversity; water; disaster management; urban, municipal or regional development; health; or energy? (Yes or No)
2. Is the project situation in one of following geographic regions: coastal zones; floodplains; areas affected by hurricanes or typhoons; arid areas; or mountain regions? (Yes or No)
3. Does the impact of the project depend on important climate parameters such as temperature, precipitation or wind? (Yes or No)
4. Does the project provide opportunities to significantly increase the adaptive capacity of the target group(s) or ecosystem(s)? (Yes or No)

If the response to any one of the above questions was "yes," the flagship project was tagged for further assessment. A total of 41 projects were thereby tagged for further examination. To further refine this list, a secondary screening was applied. Specifically, projects were prioritized for deeper screening if, in the expert opinion of the evaluators:

- The activities to be undertaken as part of the flagship project are likely to be significantly affected by either current climate variability and/or long-term climate change; and
- Implementation of the project could be expected to increase Kenyans adaptive capacity.

Based on completion of this deeper screening process, 13 projects were identified as being particularly vulnerable to the impacts of climate change and having potential capacity to contribute to building adaptive capacity in Kenya.

2. Selection of Priority Projects for Detailed Analysis

Each of the 13 projects identified through the initial screening process could have been assessed for their vulnerability to the impacts of climate change and options for reducing this vulnerability.

However, in light of the scope and mandate of SC1, a further screen was applied in an effort to narrow down the list of particularly vulnerable projects to a maximum of five. To accomplish this goal, the identified projects were assessed with respect to their potential to provide benefits to a significant number of Kenyans. Each project was therefore screened against the following questions:

1. What is the expected number of direct beneficiaries of the flagship project? Responses to this question were ranked as follows:
    - Low if less than 500,000 Kenyans are expected to directly benefit from the project. (Allocated 1 point)
    - Moderate if 500,000 to 1 million Kenyans are expected to directly benefit from the project. (Allocated 2 points)
    - High if more than 1 million Kenyans are expected to directly benefit from the project. (Allocated 3 points)
2. Are the expected beneficiaries of the project members of vulnerable groups (e.g. women and children, indigenous peoples, pastoralists, individuals living in arid and semi-arid lands)? Responses to this question were ranked as follows:
    - If "no," then assigned zero points.
    - If "some," then assigned 1 point.
    - If the expected primary beneficiaries of the flagship project, then it was assigned 2 points.
3. Is the flagship project likely to be carried over into Kenya's second MTP? Responses to this question were ranked as follow:
    - If "no," then assigned zero points.
    - If "yes," then assigned 1 point.

Based on use of these assessment questions, projects that received a total number of points equal to or greater than 4 were identified as priority projects for deeper assessment. Seven priority projects were identified following application of this secondary screening process. From this list, the reviewers identified five priority projects for in-depth assessment, taking into consideration a desire to achieve a balance between "Economic," "Social" and "Enablers and Macro Projects," and to examine projects from different sectors and/or to be implemented in different regions of the country. Based on these considerations, the following five projects were selected:

- "ASAL Development Projects"
- "Setting up of Five Livestock Disease-free Zones in the ASAL Regions"
- "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas"
- "Rehabilitation and Protection of Indigenous Forests in Five Water Towers"
- "Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices."

3. Climate Risk Assessment

A general climate risk assessment was completed for each of the flagship projects by completing the following steps:

1. Identification of potential changes in climatic conditions. Drawing upon existing literature sources as well as draft reports produced as part of Sub-component 3 (SC3) of the Kenya

Climate Change Action Plan process (development of a National Adaptation Plan), potential changes in climatic conditions (or climate risk factors) were identified. These climate risks included: an increase mean annual temperatures; an increase in the frequency of drought conditions; more frequent heavy rainfall events; a decline in mean annual precipitation; and changes in the timing of the short and long rains.

2. Identification of how the anticipated change in climatic conditions might directly impact the flagship project. For example, the reviewers asked the question "how might a decline in mean annual precipitation directly impact the activities planned as part of the ASAL Development Projects?" Potential impacts were then listed in the appropriate table. In order to limit the scope of the analysis, care was taken during this process to explicitly focus on the direct impact of the anticipated climate risk on the flagship project. For example, a decline in mean annual precipitation was identified as having the potential to make less water available for irrigation. The potential secondary impacts of this anticipated direct impact, such as a decline in crop production, were not considered in the analysis.

3. Assessment of the likelihood of the anticipated direct impact occurring. Based on the background information gathered and expert judgement, the likelihood (or probability of occurrence) of an anticipated event taking place was assessed. For consistency, the likelihood scale used within the analysis was the same as applied in the draft documents prepared as part of SC3, namely:

    1 = Rare – Event not expected to occur, but possible (<5 percent probability of occurrence per year in 2050s);

    2 = Unlikely – Event unlikely to occur, but not negligible (5-33 percent probability of occurrence per year in 2050s);

    3 = Possible – Event less likely than not, but still appreciable chance of occurring (33 – 66 percent probability of occurrence per year in 2050s);

    4 = Likely – Event more likely to occur than not (66 – 95 percent probability of occurrence per year in 2050s); or

    5 = Almost certain –Event highly likely to occur (>95 percent probability of occurrence per year in 2050s).

4. Assessment of the consequence of the anticipated direct impact. For each of the anticipated direct impacts on the assessed flagship project, the potential outcome was assessed using expert judgement as to being either:

    1 = insignificant;

    2 = minor;

    3 = reasonable/moderate;

    4 = major; or

    5 = severe.

5. Overall climate risk assessment. The degree of vulnerability of the flagship project to the climate risk factors identified was determined by adding together the likelihood and consequence scores, for a potential scoring range of 2 to 10. Based on this analysis, the risk

posed by the projected change in climate for the examined flagship project was deemed to be:

- *Low,* if the total score was between 2 and 4;
- *Moderate,* if the total score was between 5 and 7; and
- *High,* if the total score was between 8 and 10.

Climate risk factors ranked as "high" were flagged for more detailed consideration with respect to how the flagship project's vulnerability to their projected occurrence might be reduced. Using the above steps, a number of high risk climate events are identified for each projects (and/or sub-component). When necessary, the number of priority climate risks flagged is limited to two risks per project sub-component and a total of six risks per flagship project.

4. Identification of Illustrative Options for Reducing Climate Risks

The next phase of the climate risk assessment process involved the identification of possible measures that could be taken to reduce the vulnerability of the individual flagship projects to the highest ranking climate risks. Illustrative examples of possible vulnerability reduction options were identified and assessed. In all cases, a wide range of additional risk reduction strategies could have been considered. The options identified therefore are not necessarily the best strategies available, or ones that might be considered for implementation by Kenya.

In seeking measures to reduce vulnerability to climate change, a wide variety of possible actions may be considered. Some of these actions may involve changes to natural or human-generated physical structures. Others might focus on building the human, social, financial and/or political capacity of individuals, communities and businesses to prepare for and respond to the impacts of climate change. Additional options may focus on government-led policy initiatives that serve to strengthen adaptive capacity. Based upon this understanding, options for reducing vulnerability to priority climate risks were identified that fit within each of the following categories:

- *Structural options* – defined as physical or landscape level interventions that serve to modify or prevent the threat, or that involve a change in use or change in location;
- *Non-structural options* – defined as interventions that build human capacity through actions such as research, education, institutional strengthening and social change; or
- *Policy options* – defined as the introduction or modification of existing government policies, strategies and/or measures. To further convey the types of policy instruments that could be used to reduce vulnerability to identified climate risks, drawing on UNEP (2011), potential options were identified as being either market-based, regulatory, public investment, information based, international cooperation, or institution based instruments.

To further define the identified climate risk management options, the expected key impact of the proposed intervention was named. In essence, this description outlines how the proposed risk management option is anticipated to reduce the flagship project's vulnerability to one of the key climate risks to which it is projected to be exposed.

The proposed options' characteristics with respect to two time bound measures were also described:

- When the identified option likely would need to be implemented given projected changes in Kenya's climate, with the parameters for consideration being either:
    - Immediately, defined as being during the next Medium Term Plan (2013 to 2016); or
    - Longer term, defined as needing to occur after 2016.
- The estimated length of time to implement the illustrative option, with the parameters for consideration being either:
    - A short amount of time, defined as the option potentially be implemented in less than 3 years;
    - A middle length of time, defined as the option potentially be implemented in 3 to 5 years; or
    - A long length of time, defined as the option potentially requiring more than 5 years to implement, and including those action that may be viewed as needing to take place indefinitely.

5. Assessment of Climate Risk Options

The selected, illustrative options were then assessed with respect to their suitability and viability from two different perspectives: the feasibility of their implementation and their potential contribution to Kenya's sustainable development. To assess the feasibility of the proposed option, a slightly modified version of the assessment criteria and indicators used within the climate risk screening tool ORCHID (Opportunities and Risks of Climate Change and Disasters) was applied (Tanner et al., 2007, p.118). Using this approach, each proposed option was assessed against the following five questions:

1. Does the proposed risk management option support win-win or no regrets actions by:
    - Increasing capacity to address current or future climate risks? If so, then 1 point scored.
    - Increasing capacity to address current and future climate risk? If so, then 2 points scored.
2. Is the proposed risk management option consistent with existing risk management activities?
    - If no, then 1 point scored.
    - If yes, then 2 points scored.
3. Can the cost effectiveness of the proposed risk management option be easily determined?
    - If no, then 1 point scored.
    - If yes, then 2 points scored.
4. Are their potential negative spin-off impacts associated with the proposed risk management option?
    - If a high likelihood for negative spin-off impacts exists, then 1 point scored.
    - If a low likelihood of negative spin-off impacts exists, then 2 points scored.
5. Is the proposed risk management option practical and feasible for a donor, partners and project implementer?
    - If no, which was defined as the option being impractical and not attractive to donors, then zero points scored.

- If difficult, defined as being practical (i.e. there is experience with its implementation and the cost is not exorbitant) but not attractive to donors, or not practical but potentially attractive to donors, then 1 point scored.
- If yes, defined as being practical and likely to be attractive to donors, then 2 points scored.

The points assigned in response to these questions were then totaled to determine the assessed feasibility of the examined climate risk management option. The total points earned ranged from four to 10.

In the second stage of this analysis, the potential contribution of the proposed climate risk management option to sustainable development was assessed using expert judgement. The following questions were used within this assessment:

1. Does the option promote employment opportunities?
2. Does the option promote access to appropriate information, skills/capacity, technology or practices?
3. Does the option build, or help to build, relevant (physical) infrastructure (green or grey) that facilitates the movement of goods, people and/or (ecosystem) services?
4. Does the option build, or remove barriers to, relevant policy/information infrastructure?
5. Does the option have the potential to promote equity (e.g., gender, age or socio-economic)?
6. What is the expected number of direct beneficiaries of the project?:
    - Low, defined as being less than 500,000 people? If yes, scored as 1 point.
    - Moderate, defined as being between 500,000 and 1 million people? If yes, scored as 2 points.
    - High, defined as more than 1 million people? If, yes, scored as 3 points.
7. Does the option have benefits for water quality, air quality and/or biodiversity?

With the exception of question 6, each of these questions was ranked against the following scale:

- If expected to have a negative impact, scored as -1 point.
- If expected to have a neutral impact, scored as zero points.
- If expected to have a low positive impact, scored as 1 point.
- If expected to have medium positive impact, scored as 2 points.
- If expected to have a high positive impact, scored as 3 points.

The scores for each question were then totaled to estimate to proposed risk management option's contribution to sustainable development (a range of -6 to 21 points).

The overall assessed feasibility and appropriateness of the proposed options was determined by averaging of the percentage scores received for the assessed feasibility of the option (that is, X out of a total possible score of 10, expressed as a percentage) and its potential contribution to Kenya's sustainable development (X out of a total possible score of 21, expressed as a percentage). The options which received the highest scores were judged as being worth being considered for implementation by the Government of Kenya as it strives to integrate climate change considerations into its next MTP.