Long-term National Low-carbon Climate Resilient Development Pathway

Climate Risk Assessment of Kenya's Flagship Projects

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National Climate Change Action Plan:

Climate Risk Assessment of Kenya's Flagship Projects

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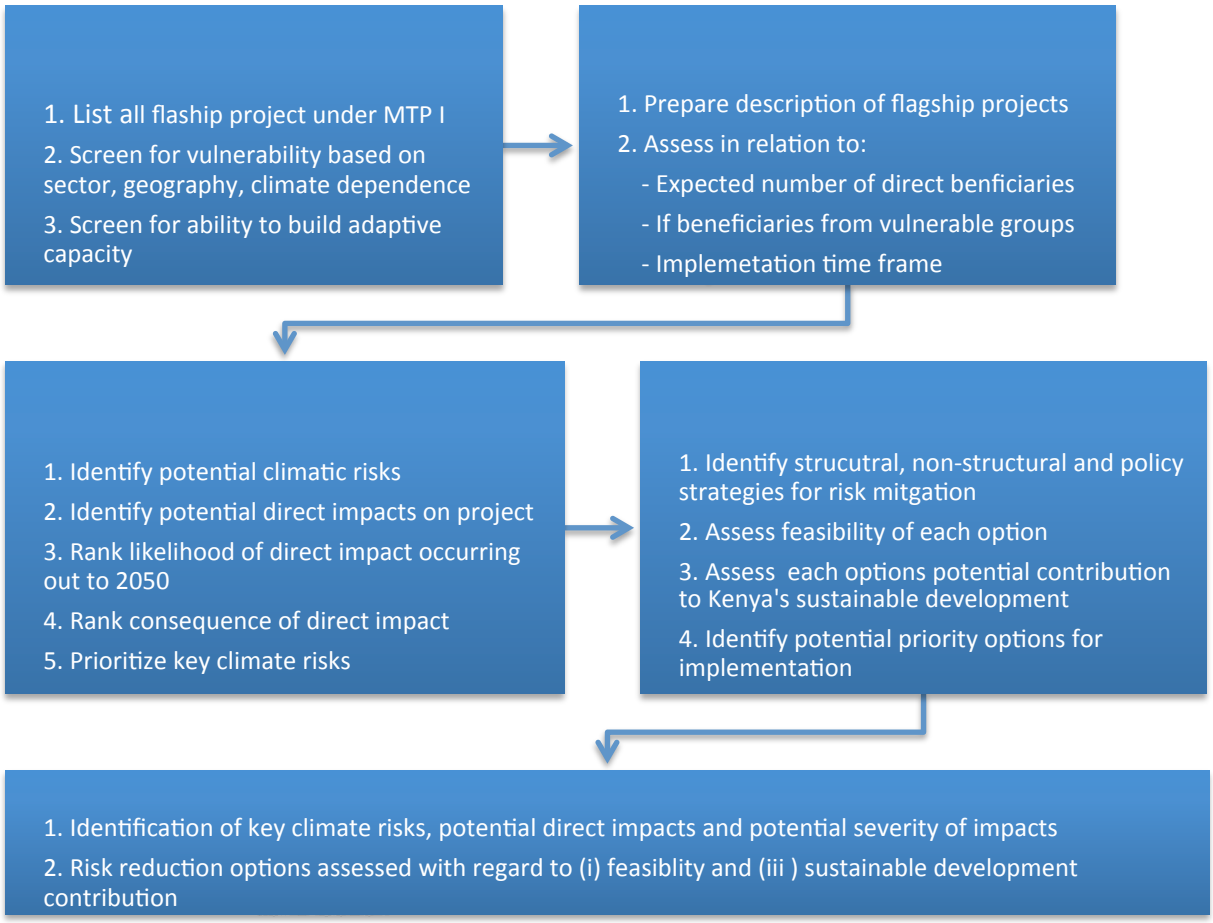
Summary

To achieve its long-term vision of a globally competitive and increasingly prosperous Kenya, the Government of Kenya has developed Vision 2030 (V2030) and identified over 100 flagship projects to be implemented during its First Medium Term Plan (2008 to 2012). A review of the vulnerability of these flagship projects and identification of possible risk reduction strategies was undertaken to strengthen the capacity of Kenya to integrate climate change considerations into its Second Medium Term Plan (2013 to 2017) and support development of Kenya's National Climate Change Action Plan (NCCAP). This review was completed as part of Subcomponent 1, "Long-term National Low Carbon Climate Resilient Development Pathway," of the action plan process.

To conduct this assessment, a Climate Risk Assessment methodology was developed. This drew upon components of a number of different pre-existing climate risk screening tools, project specific adaptations and from extensive stakeholder feedback.

A basic schematic of the tool is displayed below in Figure 1. The assessment moves sequentially through each step to comprehensively assess key risk and risk management strategies.

Figure 1: Methodology used to undertake climate risk assessment of Kenya's Flagship Projects



Overview of Methodology

Step 1: Initial screening of flagship projects

In the first step of this methodology, Kenya's Flagship Projects under V2030 were screened as to their potential vulnerability to the impacts of climate change and their potential to build adaptive capacity. Projects assessed to be potentially vulnerable and to have the potential to help build the capacity of Kenyans to adapt to

Results

Results: Shortlisted flagship projects

Completion of steps 1 and 2 of the methodology generated identification of five flagship projects judged to be highly vulnerable to climate change and have significant potential to build adaptive capacity. The five projects selected for inclusion in the deeper deconstructed climate risk assessment and feasibility of options assessment were:

1. "ASAL Development Projects" focused on irrigation infrastructure.
2. "Setting up of Five Livestock Disease-free Zones in the ASAL Regions" focused on livestock and diseases control measures.
3. "Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas" focused on roads, house and water/sewerage service provision in informal settlements.
4. "Rehabilitation and Protection of Indigenous Forests in Five Water Towers" focused on biodiversity, forestry and water security.
5. "Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices" focused on electrification and increasing and greening installed capacity.

Results: Deconstructed climate risk and impact assessment

Each shortlisted projects was assessed in terms of its potential exposure to climate risk, leading to the cross-cutting climatic changes provided below being identified as of particular concern for Kenya and achievement of V2030. (Note that vulnerability to these climate risks varies between the different flagship projects and their individual components).

More frequent drought events	• 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
Increase in mean annual temperatures	• 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
Decrease in mean annual precipitation	• ASAL Development Projects • Setting up of Five Livestock Disease-free Zones in the ASAL Regions • 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
Increased potential for flood events, including flash flooding and seasonal flooding	• ASAL Development Projects • Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas

	• Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices
Unpredictable precipitation during both the short and long rains	• ASAL Development Projects • Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas • Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices
More frequent heavy rainfall events	• ASAL Development Projects • Setting up of Five Livestock Disease-free Zones in the ASAL Regions
Changes in the timing of the short and long rains	• ASAL Development Projects
Increase in mean annual precipitation	• Rehabilitation and Protection of Indigenous Forests in Five Water Towers

Results: Identification of climate risk reduction options

Illustrative options for reducing the vulnerability of each flagship project to these climate risks were identified for each of the flagship projects. Proposed vulnerability reduction measures included structural options, non-structural options, and policy options. For example, to reduce the vulnerability of the large-scale irrigation systems being implemented as part the ASALs Development Project, the following options were identified:

	Physical or landscape level interventions that serve to modify or prevent the threat, or that involve a change in use or change in location	
	Interventions that build human capacity through actions such as research, education, institutional strengthening and social change	
	Introduction or modification of existing government policies, strategies and/or measures. Potential options were identified as being market-based, regulatory, public investment, information based, international cooperation, or institution based instruments.	

Results: Feasibility and sustainable development contribution of risk reduction and resilience options

Each of the selected climate risk reduction options was assessed with respect to its potential to have the greatest likelihood of being feasible and contributing to Kenya's sustainable development. The potential performance of each option was assessed against the 12 considerations presented below, and the highest ranking options were identified as possible risk reduction measures that might be implemented by the Government of Kenya.

Feasibility of options	1. Does the proposed risk management option support win-win or no regrets actions? 2. Is the proposed risk management option consistent with existing risk management activities? 3. Can the cost effectiveness of the proposed risk management option be easily determined? 4. Are their potential negative spin-off impacts associated with the proposed risk management option? 5. Is the proposed risk management option practical and feasible for a donor, partners and project implementer?
Potential Contribution to Sustainable Development	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? 7. Does the option have benefits for water quality, air quality and/or biodiversity?

Based on the outcomes of this assessment, the following illustrative vulnerability reduction options proposed for each of the flagship projects emerged as being more feasible and with a greater potential to contribute to sustainable development:

Large-scale irrigation systems	• Enforce requirements for the use of water efficient irrigation technology and techniques, such as drip irrigation or evening/night irrigation, where relevant. • Restore key watersheds that feed irrigation systems in the ASALs by expanding programs that promote agroforestry practices by small-scale farmers. • Provide large scale farmers with training on the techniques, costs etc. of establishing protected areas and water catchments within watersheds to ensure sustainable supplies of water for their irrigation systems.
Small scale irrigation systems	• Provide small scale farmers with training in the appropriate design and use of irrigation systems in order to promote efficient use at all times and conservation of water supplies during periods of low water availability. • Build community/farm based water catchments and boreholes/abstraction for use during dry periods. • Provision of down-scaled information to small-scale farmers, such as forecasts of heavy rain to match planting and cropping cycles, through mechanisms like radio and Internet.
Improving animal	• Improve infrastructure for disease control, animal handling and marketing,

health by controlling and eradicating trade sensitive diseases, zoonoses and pests	including quarantine stations • Strengthen early warning systems for the outbreak of diseases
Improving animal productivity through livestock-breeding programs	• Increase research into the development of drought-tolerant livestock • For small-scale production systems, improved access to shade such as through reforestation
Improve rangeland through enhanced management	• Promote rotational grazing • Construction of bunds, sand dams and other water retention structures
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.
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
For all five Water Towers	• Strengthen capacity of forest service to engage in sustainable forest management • Increase availability of locally appropriate firefighting capacity, equipment and practices, such as watch towers, rapid response units and fire-breaks • Integrate climate change risks into forest meygement planning (including RDD+)

Conclusions

Kenya's V2030 is vulnerable to climate change impacts. This vulnerability stems in part from the fact that the flagship projects developed to enable Kenya to achieve its long-term vision of a globally competitive and increasingly prosperous country have been developed without considering potential climate changes. This assessment revealed that many of these projects are at risk to projected climatic changes, particularly more frequent drought, higher temperatures and decreased precipitation. Management of these risks is key to achieving successful project outcomes, and there are ample opportunities to build resilience into flagship projects. There are however an infinite variety of options for reducing risk, so consideration must be made of different option's feasibility and alignment with Kenya's sustainable development goals.

The completed review provides an example of a flexible process that can be used to assess the vulnerability of Kenya's current and future flagship projects to the impacts of climate change. However, the outcomes of this assessment process should be viewed as illustrative of how projects may be vulnerable to the impacts of climate change and which measures could be taken to reduce this vulnerability. Certainly, a more rigorous and detailed examination of the climate risks that could impact individual components of vulnerable flagship projects, and of potential response strategies, should be undertaken prior to the selection, resourcing and implementation of appropriate adaptation strategies.

Table of Contents

Climate Risk Assessment of Kenya's Flagship Projects

1. Introduction

To help fill gaps in the Kenya Climate Change Action Plan process, screening of the climate resilience of flagship projects included in the first Medium Term Plan (MTP1) was undertaken as part of Subcomponent 1 (SC1), "Long-term National Low Carbon Climate Resilient Development Pathway." The objective of the climate screening component of SC1 was to identify flagship projects expected to be particularly vulnerable to the impacts of climate change and undertake a more in-depth, desk-based climate risk assessment of each of these selected "high-risk" projects.

To facilitate achievement of this objective, an iterative process was used to develop a methodology through which it was possible to:

- **Identify** Kenya's flagship projects expected to be particularly vulnerable to the impacts of climate change.
- **Determine the climatic changes which pose the greatest risk** for this shortlist of particularly vulnerable projects.
- **Identify illustrative risk reduction options** that could be used to reduce the vulnerability of the selected flagship projects to the climatic changes that appear to pose the greatest risk.
- **Assess the feasibility** of these illustrative vulnerability reduction options
- **Examine** the potential contribution to Kenya's sustainable development of these options.

Each of the steps within this methodology is described in the sections below. Findings from the screening process used to determine which flagship projects are likely to be particularly vulnerable to the impacts of climate change are included in Appendices 1 and 2. Assessments of each of the flagship projects deemed to be particularly vulnerable to the impacts of climate change are presented in Appendices 3 to 7 of this report.

In examining the outcomes of the climate risk screening process used to assess Kenya's flagship projects, the following caveats should be kept in mind:

- Considerable uncertainty remains regarding how Kenya's climate change will change in the future, particularly with respect to alterations to its hydrological regime.
- The screening of the flagship projects and assessment of potential vulnerability reduction options was completed over a period of three months. Within this timeframe, a detailed examination of large-scale national flagship projects could not be undertaken.
- Assessment of the vulnerability of each of the flagships was primarily undertaken through a desk-based process. To the extent possible, consultations were undertaken

with experts in key sectors and national government representatives to validate the process undertaken and outcomes of the analysis.

- The assessment team had limited access to clear, consolidated and detailed information about each of the flagship projects and the specific activities to be undertaken in support of their individual objectives. Information came from a myriad of sources that had not previously been consolidated for each of the flagship projects.

This assessment of Kenya's flagship projects therefore should be viewed as illustrative of the way in which their vulnerability to climate change may be assessed and potential adaptation options considered. A more rigorous examination of the climate risks facing particularly vulnerable flagship projects, and of potential response strategies, would need to be undertaken prior to the selection and implementation of actions that reduce their vulnerability.

2. 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 the 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. A total of 71 flagship projects were identified through this process. Basic information about each the objectives and accomplishments to date 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.[1] Through this process, a total of 41 projects were tagged for further examination. Each of these flagship projects was then described with respect to their:

- Sector of activity, selecting from either: Agriculture and Rural Development; Special Programs; Environment, Water and Sanitation; Physical Infrastructure; Human Resources and Development; or Tourism, Trade or Industry;
- Location, selecting either national or local (noting the specific location of each project occurring at the local level); and
- Status as either a policy or a project.

To further refine the list of flagship projects vulnerable to the impacts of climate change, 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.

Through application of this process, many of the policy focused flagship projects were not prioritized for deeper screening. In many cases, these policy initiatives are being applied within sectors that may be vulnerable to the impacts of climate change (such as agriculture, forestry, urban planning). However, the planned activity itself (such as the creation of a National Spatial Plan or enactment of Consolidated Agricultural Policy Reform Legislation) is not at risk due to climate change. While it might be wise to ensure that climate change considerations are mainstreamed into the development of these policies, their creation and/or modification per se is unlikely to be directly impacted by climate change.

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. As presented in Appendix 1, these projects were:

1. "ASAL Development Projects"
2. "Development of Niche Tourism Products"
3. "Setting up of Five Livestock Disease-free Zones in the ASAL Regions"
4. "Integrated growth and development strategy for six metropolitan regions: Nairobi, Mombasa, Kisumu-Kakamega, Nakuru-Eldoret, Wajir-Garissa-Mandera, and Kitui-Mwingi-Meru"

[1] During this step, expert opinion was also used to further screening out a few of the projects being implemented in vulnerable sectors (primarily the health sector) but the actions of which were clearly not vulnerable to the impacts of climate change. Examples of projects screened out of the assessment on this basis included: "Channel Funds Directly to Health Facilities," "Construction and Rehabilitation of at least one Boarding Primary School in Each Constituency in Arid and Semi Arid Lands," and Development of a Human Resources Strategy for the Health Sector.

5. “Installation of Physical and Social Infrastructure in Slums in 20 Urban Areas”
6. “Producing 200,000 Housing Units Annually by 2012 under Public Private Partnerships (PPPs) and Other Initiatives”
7. “Rehabilitation and Protection of Indigenous Forests in Five Water Towers”
8. “Secure Wildlife Corridors and Migratory Routes”
9. “600 Hydro-Meteorological Stations Rehabilitated”
10. “Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices”
11. “Twenty-Four Medium Sized Multipurpose Dams (including the 2 multipurpose)”
12. “Two Multi-Purpose Water Conservation Structures; Nzoia along Nzoia River and Koru on Nyando River”
13. “Rehabilitation of the Bura Irrigation Scheme”

3. 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, as listed in Appendix 2. 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."

The process by which each of these five projects was subject to a more in-depth assessment of their vulnerability to the impacts of climate change is presented in the remainder of this report. Appendices 3 to 7 present the outcome of this analysis for each of the projects.

4. Description of the Flagship Projects

Prior to undertaking an assessment of the potential vulnerability of the selected flagship projects to climate change, a more in-depth understanding of their objectives, scope and planned and/or ongoing activities was sought. Information regarding the individual flagship project and its associated sector was gathered through available online sources. In particular, when applicable, the major sub-components of the flagship project were identified so that each could be assessed individually. Complementary knowledge was also gathered regarding the changes in climatic conditions projected to occur within the region of Kenya where the flagship project is located. A summary description of each of the flagship projects was prepared, and the information collected used to inform the remainder of the climate risk analysis. The findings from this research are summarized in section 9 of this report, and presented in full in Appendices 3 to 7.

5. Climate Risk Assessment

To gain a deeper understanding of the potential vulnerability of the individual flagship projects to projected climate change, a general climate risk assessment was completed for each. The risk assessment process was structured in accordance with a standard definition of risk, namely (UKCIP, 2010):

Risk = (the probability of an event occurring) x (the consequences of an event occurring).

Using this definition, events with a high probability of occurring and that have the potential for significant adverse consequences are considered to be high risk events. In contrast, events with a low probability of occurring and that are anticipated to have limited adverse effects are considered to be low risk events.

The climate risk assessment was undertaken 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, as included in section 4 of each of Appendices 3 to 7. 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 were identified for each of the flagship projects. Given time and resource constraints, it therefore was sometimes necessary to limit the number of impacts flagged for more detailed consideration. When necessary, the number of priority climate risks flagged was limited to two risks per project sub-component and a total of six risks per flagship project.

6. 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:[2]

- *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

[2] The following resources were used to identify and define these categories: Burton, Smith and Lenhart (1998); UKCIP (2010); and DEW Point (2008).

- *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.[3]

7. 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:
    a. Increasing capacity to address current or future climate risks? If so, then 1 point scored.
    b. Increasing capacity to address current and future climate risk? If so, then 2 points scored.

[3] For example, monitoring activities should be undertaken on a routine basis. While a discreet amount of time will be required to establish the monitoring system, its implementation will take place over an indefinite length of time.

2. Is the proposed risk management option consistent with existing risk management activities?
    a. If no, then 1 point scored.
    b. If yes, then 2 points scored.
3. Can the cost effectiveness of the proposed risk management option be easily determined?

    a. If no, then 1 point scored.
    b. If yes, then 2 points scored.
4. Are their potential negative spin-off impacts associated with the proposed risk management option?
    a. If a high likelihood for negative spin-off impacts exists, then 1 point scored.
    b. 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?
    a. If no, which was defined as the option being impractical and not attractive to donors, then zero points scored.
    b. 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.
    c. 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:

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.

8. Outcomes of the Review of Vulnerable Flagship Projects

Completion of the previously described steps enabled identification of the climate risks most likely to affect the five flagship projects chosen for detailed assessment. A set of structural, non-structural and policy interventions that could be pursued in order to reduce vulnerability to these key climate risks were also identified. A shortlist of options judged to be potentially feasible and with greater likelihood to promote Kenya's long-term sustainable development was then created.

The tables presented below provide a summary of the findings from the assessment undertaken for each of the five flagship projects chosen. The appendices to this report present the full results from the analysis undertaken. As previously noted, these results represent an *initial* screen of the type of climate risks to which the examined flagship projects may be exposed, and provides *illustrative* examples of the type of options that could be pursued to reduce this vulnerability. More rigorous analysis should be undertaken prior to making policy and investment decisions to assess how individual components of a flagship project may be vulnerable to the impacts of climate change and which response strategies may be appropriate—taking into consideration the specific socio-economic and environmental context in which the project will be implemented.

A. ASAL Development Projects

Goals and objectives	Led by the Ministry of Agriculture, the project's objective is to increase the area of ASALs under irrigation by 100,000 hectares per year. In the MTP1 period, the ministry aims to increase the amount of irrigated land by 600,000 hectares, mainly in the Tana and Athi River Basins. This is to be achieved through: • Improving farmers' access to small-scale irrigation schemes by constructing 22 medium-sized multi-purpose dams; constructing the Rahole inter-basin water transfer channel; and rehabilitating and expanding existing major irrigation schemes in the ASALs. • The Lower Tana (Bura) project, which involves expanding the existing irrigation scheme by about 100,000 hectares. • The Tana Integrated Sugar project, covering about 33,000 hectares of land.
Progress to date	Establishment of small- and medium scale irrigation systems in Turkana (10,000 hectares) and Lower Tana (4,400 hectares); initiation of a feasibility study for the Lower Tana (Bura) project; completion of a feasibility study for the Tana Delta Integrated Sugar project, as well as obtaining an Environmental Impact Assessment licence from NEMA. Remaining activities are to be rolled over into MTP2.

Climate Risk	Potential Impacts
Increase in average annual temperatures	• Increase in the rate of evapotranspiration, affecting large- and small-scale irrigation systems • Increase in water demand from small-scale systems
Decrease in mean annual precipitation	• Reduction in the availability of water for large-scale irrigation systems
Unpredictable precipitation during both the short and long rains	• Greater water management (supply and demand) challenges for large and small-scale irrigation systems
More frequent drought	• Reduction in the availability of water for large- and small-scale irrigation systems

	systems	water supplies during periods of low water availability. • Build community/farm based water catchments and boreholes/abstraction for use during dry periods. • Provision of down-scaled information to small-scale farmers, such as forecasts of heavy rain to match planting and cropping cycles, through mechanisms like radio and Internet.	

B. Setting up of Five Livestock Disease-free Zones in the ASAL Regions

Goals and objectives	The aim of this project led by the Ministry of Livestock Development is to improve the quality of Kenya's livestock products through the establishment of disease-free zones in Coast, Laikipia, Isiolo and North Rift By enabling international marketing standards to be met, the project is expected to increase Kenya's competitiveness and improve access to high-value markets worldwide. The project involves six main components: • Improve animal health through measures to control and eradicate trade-sensitive diseases, zoonoses and pests • Infrastructure development for disease control, animal handling and marketing, such as quarantine stations • Improve animal productivity through breeding programs • Improve rangeland through dedicated management efforts • Improve livestock marketing • Institutional strengthening through training of staff and enhancing capacity of laboratories and offices		
Progress to date	A study of the feasibility of establishing a disease-free livestock area in the Laikipia-Isiolo area concluded that this project was not environmentally appropriate and the plan has been abandoned. In Coast Province, social and environmental impact assessments, a baseline survey, rehabilitation of a foot and mouth laboratory at Embakasi and designs for a veterinary fence and Level 3 BioSafety laboratory have been completed (GOK, n.d.).		
Climate Risk	Increase in average annual temperature	• Increase in the abundance, distribution or rate of development of some pathogens and parasites • Increased risk of heat stress, particularly for dairy cattle derived from temperate-breed genetic stock, with associated negative impacts on physiological processes and production • Decline in grasslands productivity, leading to declines in animal health and productivity • Greater need for refrigeration at quarantine stations and other facilities used for disease control and animal handling	Potential Impacts
	More frequent drought	• Greater migration of livestock herds could promote the spread of diseases • Decline in growth and poor reproductive performance of livestock if drought is more frequent than once every five years • Long-term degradation of grazing resources	
	Decrease in mean annual precipitation in the ASALs	• Change in the distribution or abundance of disease vectors • Less water availability or declines in grasslands productivity, leading to declines in animal health and productivity	

	More frequent heavy rainfall events	• Increased probability of wide-spread outbreaks of Rift Valley Fever	
Vulnerable Project Components	Improving animal health by controlling and eradicating trade sensitive diseases, zoonoses and pests	• Improve infrastructure for disease control, animal handling and marketing, including quarantine stations • Strengthen early warning systems for the outbreak of diseases	Vulnerability Reduction Options
	Improving animal productivity through livestock-breeding programs	• Increase research into the development of drought-tolerant livestock • For small-scale production systems, improved access to shade such as through reforestation	
	Improve rangeland through enhanced management	• Promote rotational grazing • Construction of bunds, sand dams and other water retention structures	

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

Goals and objectives	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		
Progress to date	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.		
Climate Risk	More frequent drought	• 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	Potential Impacts
	Unpredictable rainfall patterns during both the short and long rains	• Water management and planning (for housing and sewage systems) could become more challenging	
	Flooding, flash floods or flooding during seasonal periods	• 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	
	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	

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	

D. Rehabilitation and Protection of Indigenous Forests in Five Water Towers

Goals and objectives	The Ministry of Environment and Mineral Resources is working to fully rehabilitate and protect Kenya's five water towers—the Mau Escarpment, Mt. Kenya, Aberdare Ranges, Cherangany Hills and Mt. Elgon. In MTP1 it set a goal of increasing forest cover and the volume of water flowing from the water towers' catchment areas.		
Progress to date	In the Abedare Ranges, an assessment of the forest quality has been completed. Detailed forest surveys have also been completed for the Cherangany Hills and Mt. Elgon.		
Climate Risk	Increase in average annual temperature	• Shift in the location of species (move to higher elevations) • Drying of the forest, leading to greater risk of fire	Potential Impacts
	More frequent drought	• Higher risk of forest fires • Decline in the productivity of deciduous and semi-deciduous closed canopy forests	
	Increase in mean annual precipitation in the highlands	• Shift in the location of species (move to higher elevations)	
	Decrease in mean annual precipitation in the highlands	• Decline in the productivity of deciduous and semi-deciduous closed canopy forests	
Possible interventions for all five water towers	• Strengthen capacity of forest service to engage in sustainable forest management • Increase availability of locally appropriate firefighting capacity, equipment and practices, such as watch towers, rapid response units and fire-breaks • Integrate climate change risks into forest management planning (including REDD+)		Vulnerability Reduction Options

E. Energy Scale up Programme and Rural Electrification: Generation of 23,000 MW and Distributed at Competitive Prices

Goals and objectives	The Ministry of Energy is leading efforts to increase power generation capacity in Kenya by up to 23,000 MW. The electricity generated will be distributed at competitive prices to provide large segments of the Kenyan population with access to energy. Specific targets have been set for the following energy sources: • Geothermal – including expansion of the Olkaria, Menengai and Eburu geothermal power

	plants • Wind – including building or expanding the Ngong and Lake Turkana wind power stations • Hydropower – including upgrading the Tana, Kiambere and Kindaruma hydropower stations and construction of the Sangoro hydropower station • Coal – construction of the Dongo and Athi River Mining coal power stations • Rural Electrification Programme – contributes to Kenya's goal of achieving 100 percent connectivity across the country through grid extensions and off-grid systems.		
Progress to date	• Geothermal – 35 MW Olkaria II geothermal power plant completed on schedule in June 2010; work on the Menengai 1,000 MW geothermal project ongoing • Wind – completion and operationalization of the 5 MW Ngong Wind Plant in December 2009; upgrading of Kiambere Unit 1 from 72 MW to 82 MW completed and operational from October 2009; and commencement and testing of 20 MW Tana Power Station completed in November 2010 • Solar – Lake Turkana solar energy generation project began in June 2012 and is expected to be completed by June 2015 • Rural Electrification Programme – by May 2012, connected over 800,000 of the targeted 1 million new users		
Climate Risk	Decrease in mean annual precipitation	• Less water available to support power generation from large- and small-scale hydropower stations, particularly in dry season	Potential Impacts
	More frequent drought	• Critical and extended water availability challenges leading to decrease in generation from large- and small-scale hydropower installations • Decreased availability of biomass to fuel biomass-based power generation schemes	
	Flooding	• Damage to hydropower installations • Greater siltation of hydropower reservoirs, leading to lower power generation capacity • Greater potential for flooding upstream of small-scale hydropower dam infrastructure • Greater difficulty accessing biomass needed to fuel biomass-based power generation schemes • Disruption of energy transmission systems	
	Unpredictable rainfall during both the short and long rains	• Greater difficulty to ensure a steady supply of energy from hydropower sources	
Vulnerable Project Components	Climate proofing and rehabilitating large scale hydro schemes	• Set specific quantitative and temporal targets for a diversified renewable energy mix that is resilient and can provide base/peak load during prolonged periods of drought and hydropower suppression or absence • Expand ambition for energy generation from wind, solar, geothermal and biomass-based power generation, and increasing the level of feed-in tariff for renewable generation to draw in private sector operators. • Establish forest cover targets in critical water catchment areas, and provide the financing and capacity required to ensure achievement of these targets.	Vulnerability Reduction Options
	Development and climate proofing of small scale hydro schemes	• Expand of grid connection to un-connected small hydro sites as back up. • Effective local watershed protection and management that monitors, rewards and enforces where necessary tree cover along river banks and in water catchments.	
	Biomass power generation schemes	• Set specific quantitative and temporal targets for a diversified renewable energy mix that is resilient and can provide base/peak load during prolonged periods of drought and hydro power suppression or absence	

9. Observations

The review of vulnerability of Kenya's flagship projects as identified in the MTP1 using the presented methodology has demonstrated that a number are vulnerable to the impacts of climate change. Of these projects, a handful deserve closer examination because of their potential to both be adversely affected by climate change and, if successfully implemented, their potential significant contribution to building adaptive capacity among vulnerable populations. Based on the deeper analysis given to the five shortlisted, particularly vulnerable flagship projects, the following observations may be made:

- **Interconnectedness of vulnerable flagship projects and potential for cross cutting impacts.** The five priority flagship projects were selected based on their individual characteristics and exposure to climate risk, but each may be seen as being linked to the other (to varying degrees). For instance, efforts to rehabilitate Kenya's five water towers will influence the future success of the ASAL Development Project's efforts to expand irrigated agriculture in this region. In turn, expansion of irrigation infrastructure in the ASALs has the potential to influence the health of local livestock populations and support achievement of the goal of establishing disease-free livestock production zones. This inter-connectedness reflects the need for an integrated approach to adaptation planning, as actions in support one flagship project might have positive or negative ramifications for (an)other flagship project(s).
- **Multiple and cross cutting benefits can be derived from many risk reduction options.** Some risk reduction options were identified as being possible strategies of reducing the vulnerability of more than one flagship project (for example, reforestation). Solutions that deal with risks across programmes and provide multiple benefits should be drawn out and prioritized to make interventions cost effective. Further iterations of the tool could identify those options that have the potential to provide multi-benefits for different national initiatives.
- **Uncertainty in change projections and scenario modelling.** The climate change projections used in the assessment took into consideration results from available climate models and studies. However, these studies are uncertain at best (particularly with respect to precipitation regimes) and are liable to change as scientific understanding of climate change and emission reduction regimes continues to emerge. Future iterations of the tool could be designed to accommodate this level of uncertainty by, for example:
    - Assessing the vulnerability of national projects under different climate risk scenarios (e.g. performance in a world in which temperatures increase by 1^{o}C by 2050 and mean annual rainfall increases by 10 percent compared to a world in which temperatures increase by 2^{o}C by 2050 while mean annual rainfall declines by 20 percent)
    - Assessing identified risk reduction options for their viability under different climate scenarios

  Periodic reviews of the risk climate change poses for different national projects would also allow for new analysis of climate change projections to be considered. This would expand the application of the tool greatly toward scenario planning and provide policy makers with greater flexibility and capacity to identify vulnerability reduction options that are robust under a range of possible future climatic conditions.

- **Indirect impacts.** The tool explicitly looks only at potential direct impacts. There

through simplification of some components of the tool and adjustment of the questions used to assess feasibility and contribution to sustainable development. Moving forward as Kenya transitions to more decentralised governance systems, creation of such as tool would be useful for risk identification and to help local policy makers and sectoral working groups include climate change risks in their development plans.

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