The Economics of Climate Change in Rwanda

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DEW Point DEVELOPMENT RESOURCE CENTRE ENVIRONMENT – WATER – SANITATION

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Why Climate Change and Why Economics?

- Rwanda is changing – high economic growth - but vulnerability is increasing
- The climate is changing - higher temperatures, changes in seasonal patterns, recent floods and droughts
- Global climate policy is changing and opportunities are emerging – new markets, new mechanisms, new funds
- Climate change is becoming an economic, planning and finance issue, not (just) an environmental one
- Against this background – outline potential risks, strengthen the case for adaptation, demonstrate entitlement to adaptation funds

Economics of Climate Change

DFID funded study. Aims were

1. Assess potential impacts and economic costs of climate change
2. Scope the cost and benefits of adapting to these effects over time
3. Assess the opportunities and potential for low carbon growth

- Initial study to investigate all three areas
- Working with local partners (CGIS-NUR, Vi-LIFE Programme, RWASEF), reporting to national advisory group (chaired REMA/Minecofin), aim to...
  - Inform decision making in Rwanda, for different end-users
  - Input to international negotiations, information for national priority setting

Method – a mix of top down, sector and case studies

Local case studies

Bottom-up case studies (local or sub-national)

Synthesis of existing local case study work. Local adaptation signatures to inform local adaptation and capture vulnerability.

Case studies:
- Wildlife and tourism
- Flooding
- Agro-forestry and carbon

These local stories ground-truth the more aggregated sector analysis

National sectoral studies

National sectoral studies (bottom-up)

Modelling of impacts and economic costs plus costs of adaptation

Impact and Adaptation :
- Health;
- Agriculture
- Water resources
- Infrastructure
- Energy
- Biodiversity and ecosystem services

Low Carbon Growth
Detailed analysis of baseline and low carbon options, including potential and costs

National level analysis

Aggregate economic costs (top down)

Integrated Assessment Modelling (IAM)
- Aggregate economic costs of climate change
- Aggregate costs and benefits of adaptation

Aggregated Adaptation Costs
- Analysis of Investment and financial flow analysis
- Scaling to East Africa and Rwanda

These provide economy wide assessments and headline values

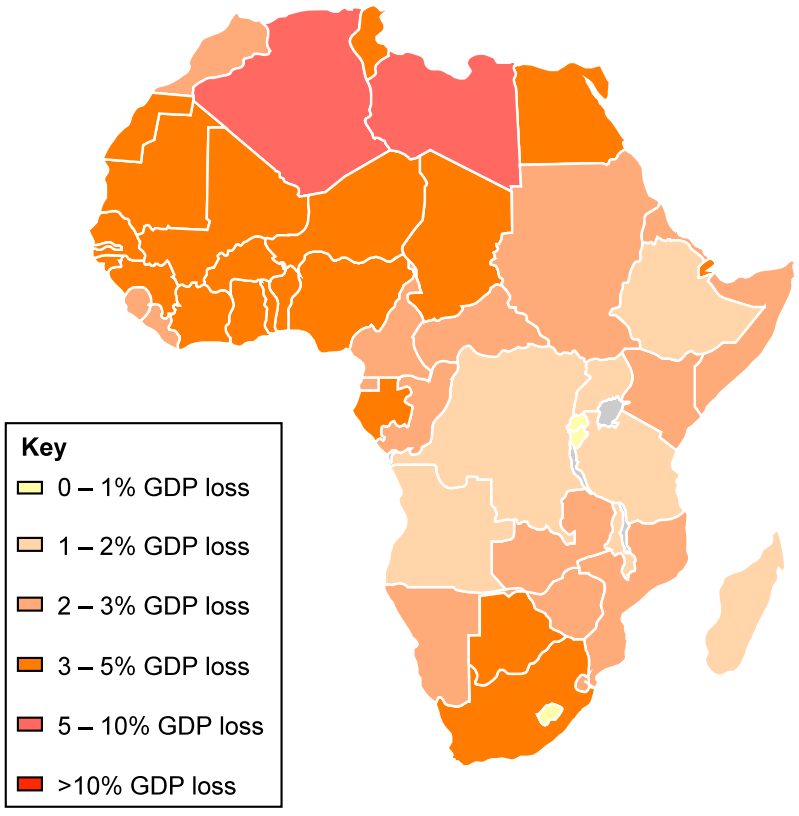
Overall provides a way to test results, provide information at various levels, for different aims

Existing climate variability already has significant economic costs in Rwanda

- Periodic floods and droughts (extreme events) already cause major economic impacts and reduce growth in Rwanda
- CGIS-NUR undertook case studies to investigate recent flood events.
- The study estimates that direct measurable economic costs of 2007 flood event were $4 to $22 million (around 0.1 – 0.6% of GDP) for two districts alone.
- Total costs higher, as infrastructure damage (transport) and repair, water system damage and contamination, soil erosion and effects to individuals
- Significant as continued pattern over time, reduce GDP, affect livelihoods

Future climate change will lead to additional economic costs, on top of current impacts

- Africa is predicted to have greater impacts than other world regions, even in short term
- Economic costs are uncertain, but scale of change from aggregated models
- Net economic costs to Rwanda (on top of existing climate impacts) minimum of 1% of GDP by 2030 (equiv)
- Noting this excludes future extremes such as floods, ecosystem effects
- Without global mitigation, impacts in later years will be very severe

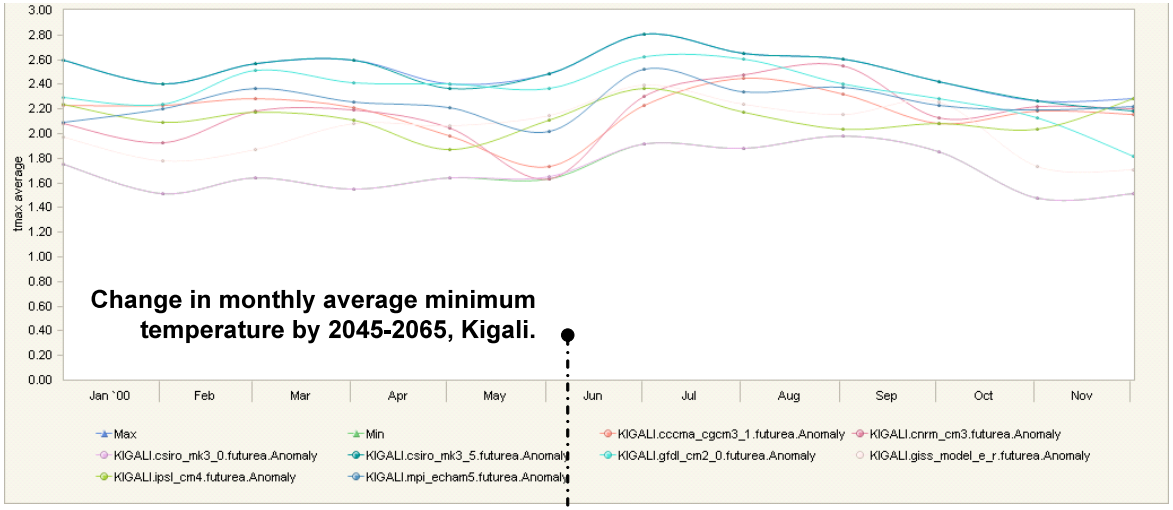


2030

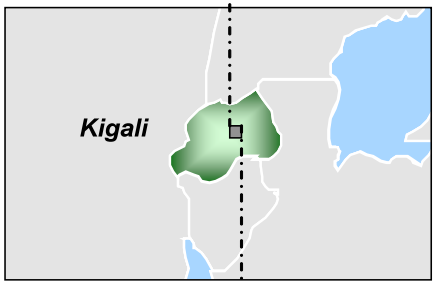
Source FUND National model

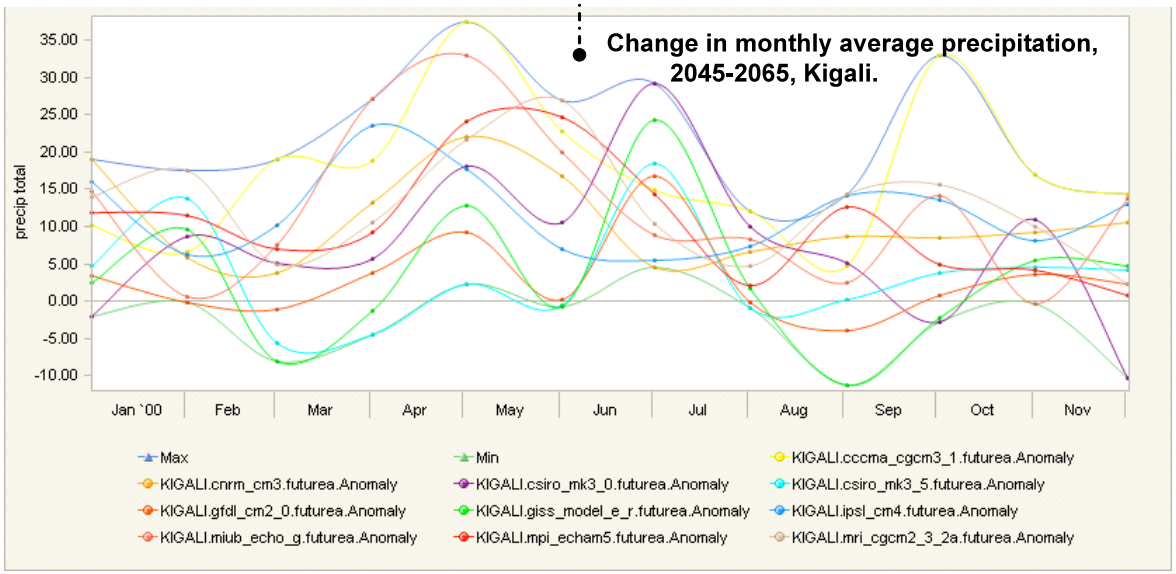
Climate projections

- Rising temperatures, 1.5 – 3C by 2050s
- Rainfall trends more uncertain, likely increase (on average)
- Changes in extremes – possible increase in intensity of heavy rain (flood risk)
- Noting socio-economic change also affect future impacts
- **Uncertainty is not a reason for inaction**



Change in monthly average minimum temperature by 2045-2065, Kigali.



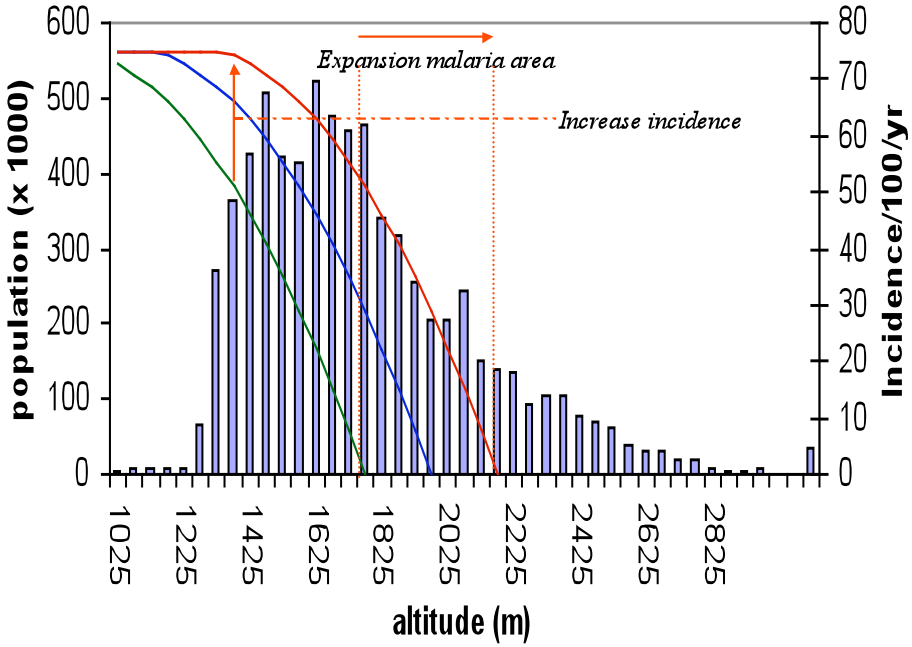


Change in monthly average precipitation, 2045-2065, Kigali.

Source University of Cape Town

Health

- Potentially large increase in the health burden of malaria in Rwanda.
- This arises because a large part of the rural population lives at higher elevations, where the disease is currently restricted by temperature.
- Study work undertaken by LSHTM with CGIS-NUR, with altitude risk model
- Whilst uncertain, climate change indicates potential increase in rural population at risk of malaria
- Economic costs over $50 milllion/year
- Other climate sensitive



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Floods

- Even without climate change, costs of floods will increase due to socio-economic change (population and growth) possibly by factor of five by 2030

- A key priority therefore is to increase the resilience of Rwanda to cope with these extreme events.

- Climate change is likely to further increase the economic costs of these events.

- Many of the projections indicate a change in heavy precipitation events for Rwanda.

  A number of models suggest a 10% - 50% increase in intensity for 1 in 10 year and 1 in 100 year rainfall events

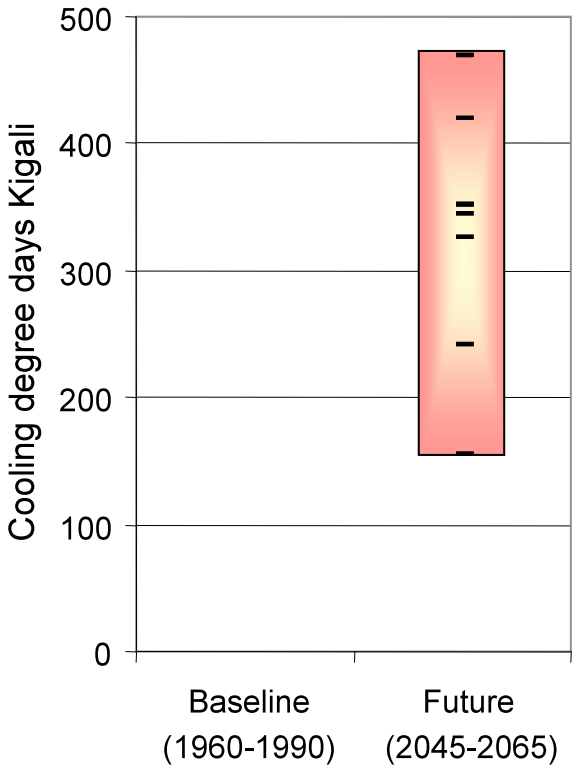
Source Shongwe et al (2009)

Agriculture

- Agriculture affected by wide variety of climate parameters, socio-economic change and regional issues
- Predicted effects depend on projections model used and crop type
- Some models predict yield reduction and economic costs
- Others predict more modest effects, even potential benefits (medium term)
- However, do not adequately take into account extremes, pests and disease, etc – remains a key priority sector because of importance to GDP and livelihoods

Energy – supply and demand

- Key concern for energy supply are extreme events and hydro
- Key concern for energy demand is from higher temperatures and cooling demand
- The study has assessed the potential cooling burden from climate change
- Relation to building comfort levels and equipment (IT)
- Projections shows modest effects by the 2050s (as existing temperate climate) but issue for future building design



Ecosystem services

- Ecosystems provide multiple benefits to society,
  which in turn have economic benefits

- These are known as ‘ecosystem services’

- include provision of food, supporting services, regulatory services including flood protection and recreational and cultural services.

- Ecosystem services are integral to the Rwandan economy and underpin over 50% of Rwandan GDP, as well as sustaining a very large proportion of the population.

- There are many stresses on these systems already and climate change will add to these pressures.

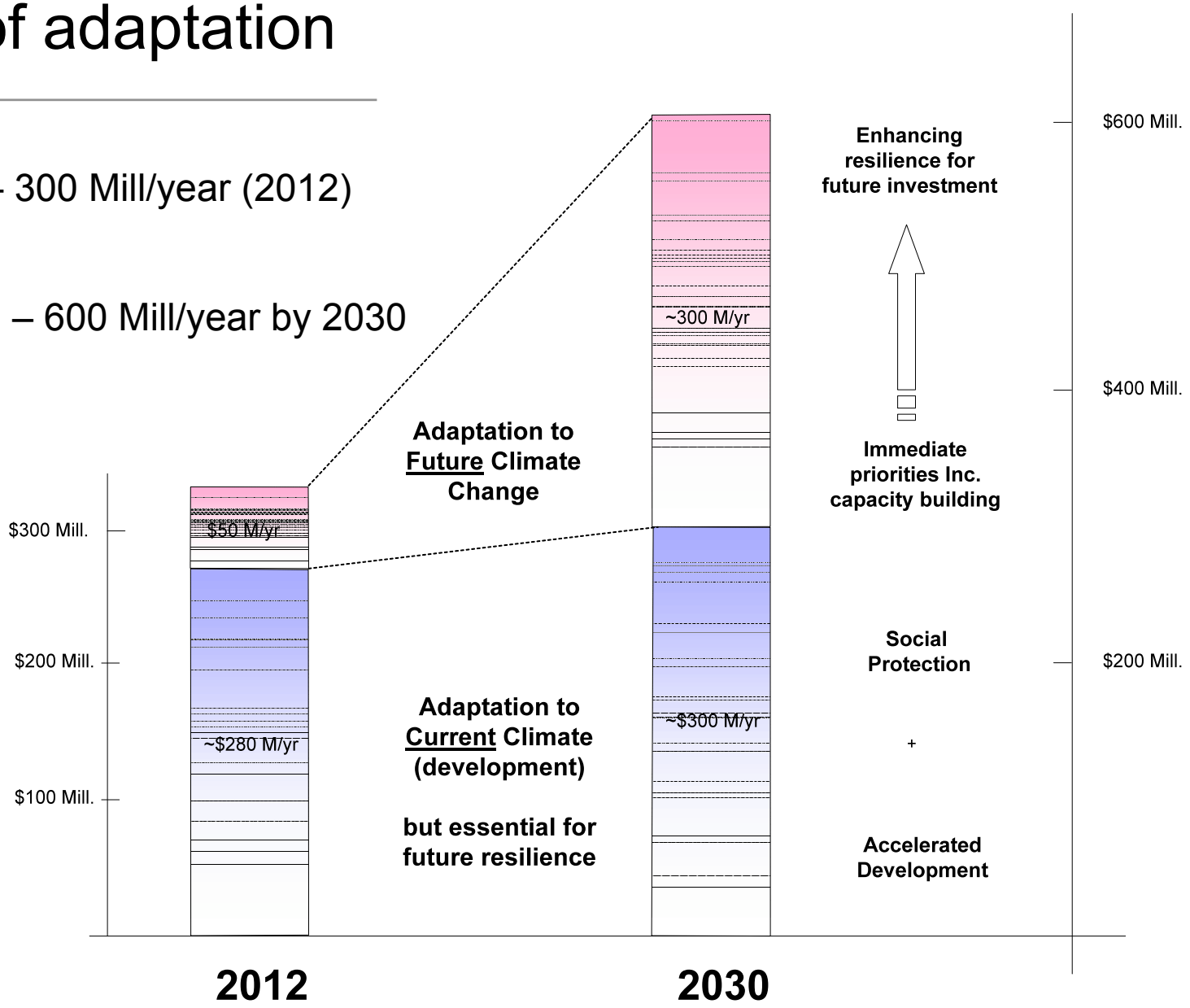
Adaptation

- Adaptation can reduce the economic costs of climate change but it has a cost
- Interest in how large these costs will be……
- Top-down aggregated estimates of the costs of adaptation. Four categories of adaptation have been identified.
- *Two of these are development activities and are targeted towards the large economic costs of current climate variability*.
- 1) addressing the current adaptation deficit and 2) increasing social protection.
- *The second two are associated with tackling future climate risks*
- 3) building adaptive capacity and 4) enhancing climate resilience.

Costs of adaptation

Costs of $50 – 300 Mill/year (2012)

Rising to $300 – 600 Mill/year by 2030



Potential Costs of Adaptation to Current and Future Climate in Rwanda $Million per year

Adaptation signatures

Study also assessed bottom-up costs of adaptation by sector, with case studies

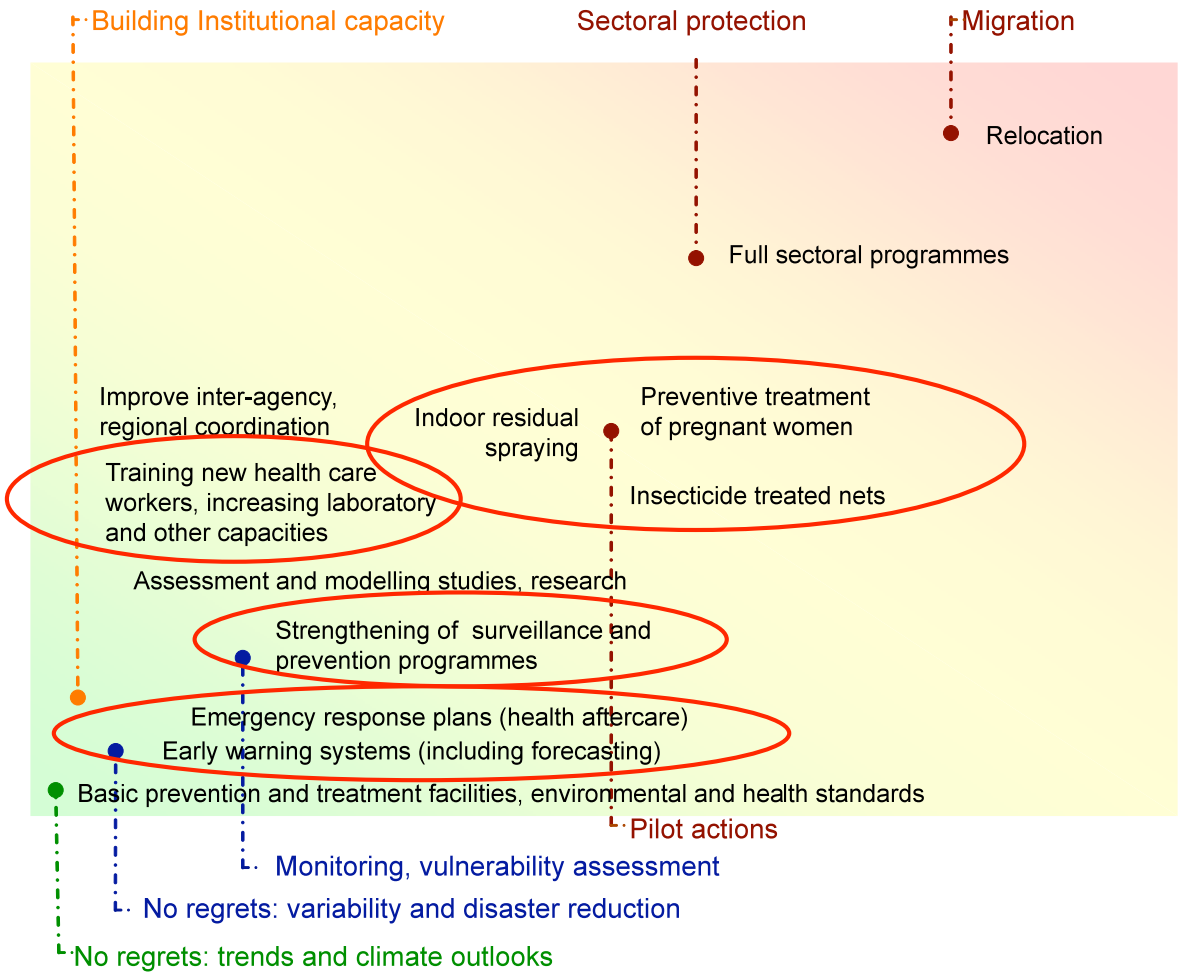
Focus on early priorities that make economic sense, given uncertainty

- Building adaptive capacity;
- Focusing on win-win, no regret or low cost measures
  (justified by current climate conditions or involving minimal cost);
- Encouraging pilot actions to test promising responses; and
- Identifying those long-term issues that require early pro-active investigation (though not necessarily firm action).

Used adaptation signatures – provide an economically rationale order of priority

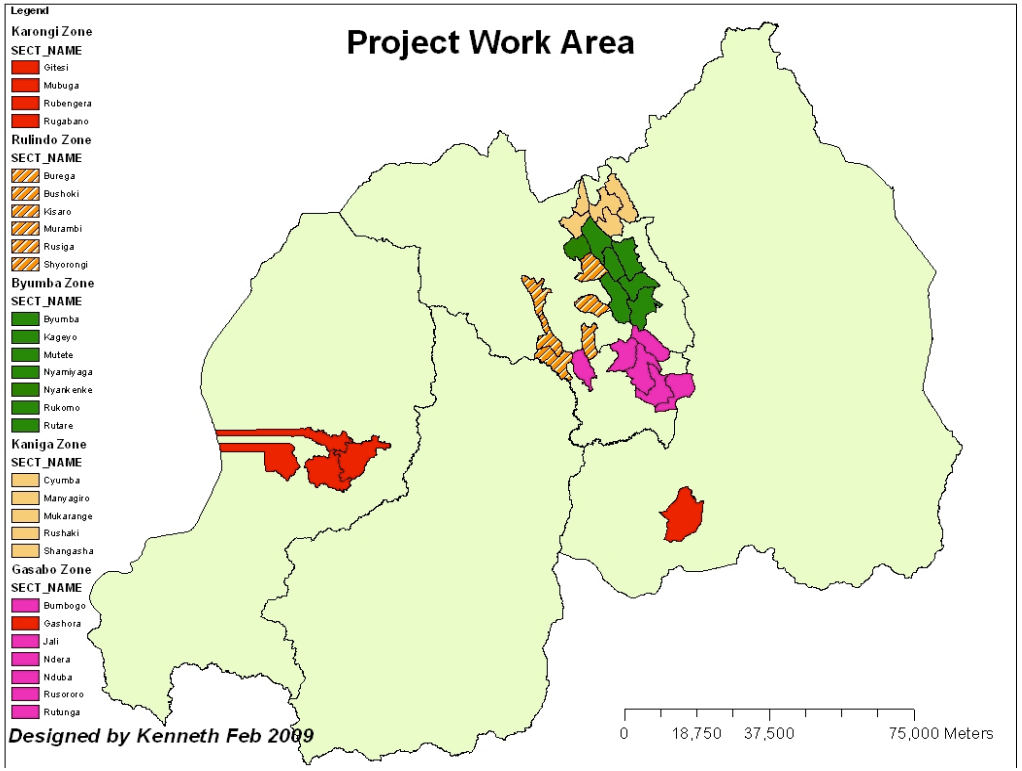
Health

- In the health sector, the potential costs of adaptation to address the potential increasing burden were considered based on treatment and prevention costs.



Flooding, agriculture, water

- For floods, analysis of potential options and case studies
- In the water sector, water resource investments were assessed to identify areas for climate resilient development and adaptation mainstreaming, based on integrated water resource management (IWRM).
- In the agricultural sector, estimates are provided to illustrate the scale of effort that may be required and some of the urgent priorities.
- Case study on agro-forestry, ecosystem services



Case study VI agroforestry

Radical Terracing

supporting livelihood resilience to climate change

Addressing soil erosion, costs of projects, costs of scaling up

Activities / Inputs	Cost RWF	Cost USD
Terracing	500,000	892
Liming & manuring	100,000	179
Preparation seedlings	50,000	89,3
Planting reeds	10,000	17,9
TOTAL	660,000	1,179

Overall

- Sectoral costs re-enforce top down estimates, show high benefits of adaptation, need to address current climate and future effects
- Large number of immediate priorities areas and no regrets options identified
- E.g. strengthening of effective surveillance and prevention programmes for health
- E.g. capacity building to strengthen meteorological data, analysis and forecasting for seasonal outlooks (agriculture) and extreme events (flood risk)
- E.g. early warning and disaster risk reduction, risk mapping and screening.
- Pilot actions identified across all sectors plus promising options (e.g. terracing) for sectoral scaling

Low Carbon Growth

- Following a low carbon development pathway could provide significant economic opportunities for Rwanda, and is strongly in its own self-interest.

- Important because of drive for Rwanda to be a middle income country

  - future economic growth could ‘lock-in’ Rwanda into high emissions path, reduce opportunities for capturing finance in the future and also leading to economic, environmental impacts

- Potential to implement no regret (win-win) low C measures which further enhanced by potential for carbon credits

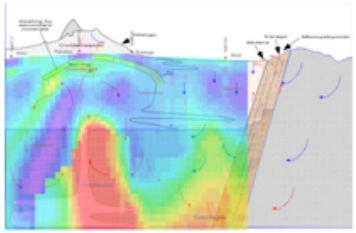
- Co-benefits from reducing energy imports, enhancing energy security, improving air quality and health, reducing pressures on natural resources, and could help achieve poverty reduction and economic development. Potential adaptation funding synergies.

Rwanda is already introducing low carbon options

Biomass Energy Strategy, including Efficient Cooking Stoves and Biogas
Improved cook stoves and charcoal production, improving efficiency and reducing air pollution. Large-scale biogas plants in prisons in Rwanda

Micro hydro potential
Large potential for off grid micro hydro and decentralised generation

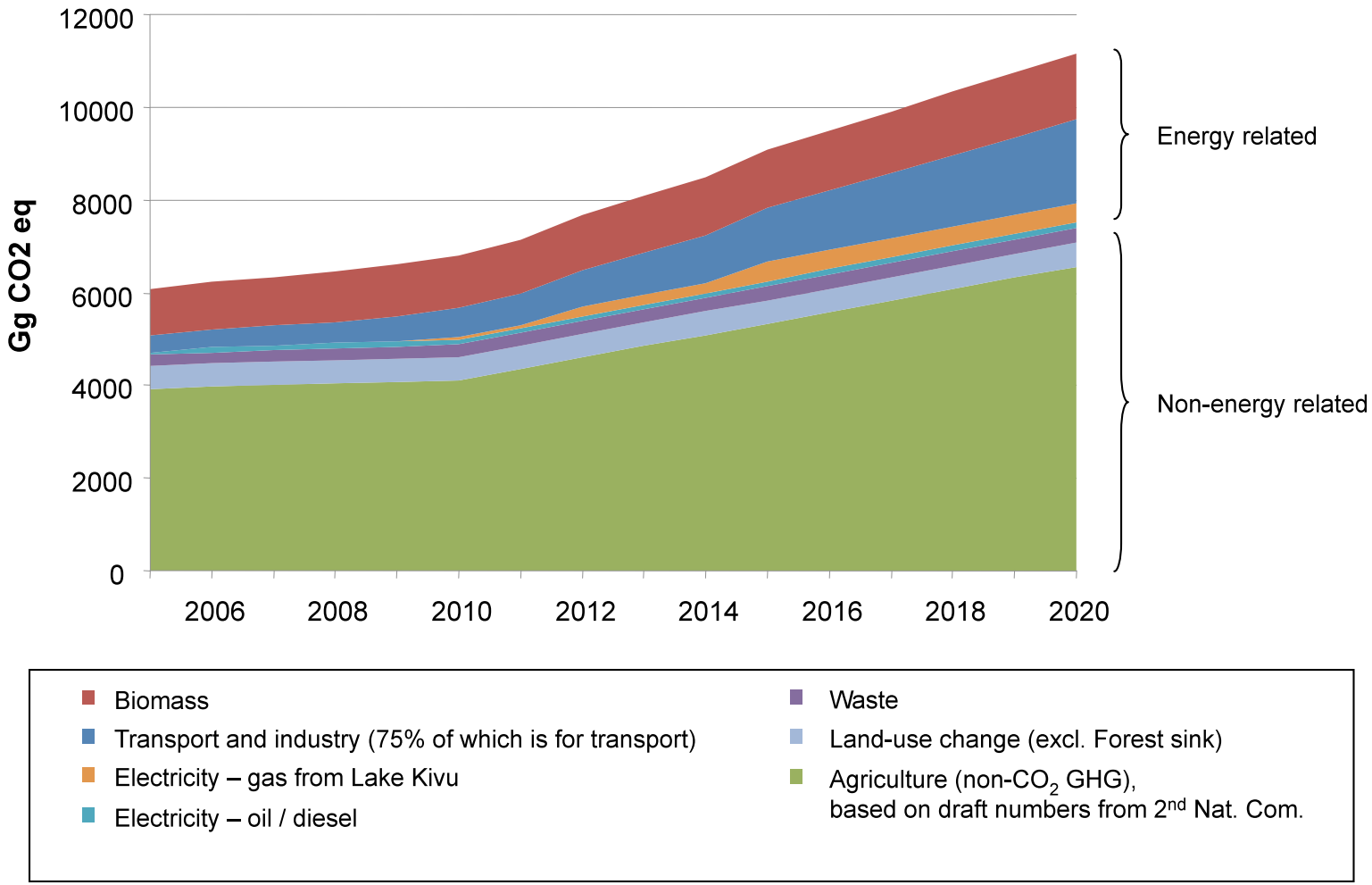
Methane recovery and fuel switching
Lake Kivu. 100 MW due on stream, reducing fugitive emissions from the lake and displacing high cost diesel generation and CO_2 emissions



Solar Power Plant (Jali Hill)
Africa largest solar power plant (250kW) reduce reducing dependency on diesel-generated electricity

Large scale hydro
5 hydropower plants in use in Rwanda
Large potential for large-scale hydro
New regional plants at Rusumo / Rusizir.

But development will double emissions by 2020

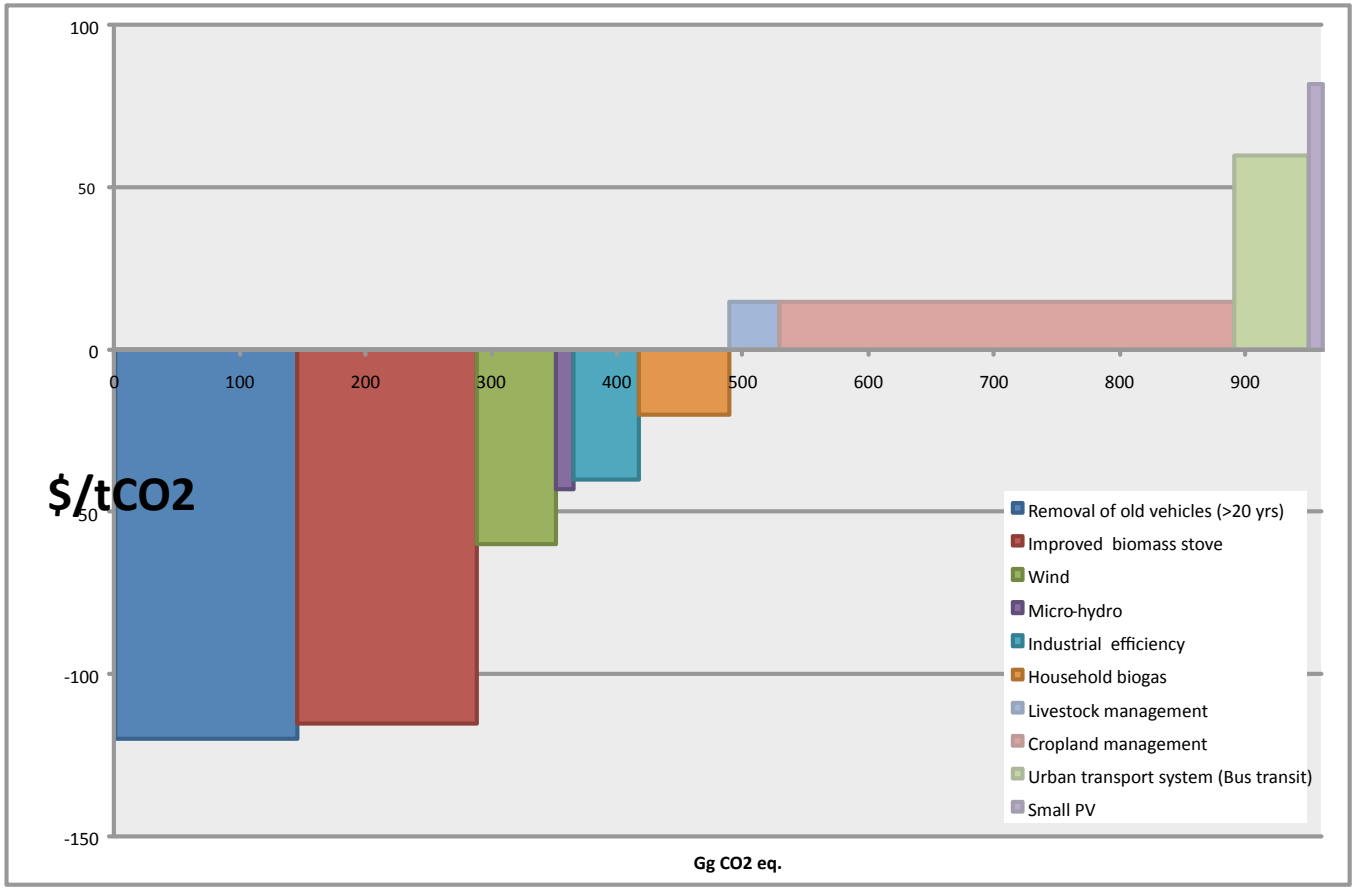


Emission projections for Rwanda

Examples

- Electricity sector
  - looked at future development, low carbon options, costs and wider effects
- Transport - fastest growth in energy emissions, urbanization trends
  - Looked at low carbon options
  - Noting alternative futures for Kigali : European high density, low private car use vs. another Nairobi – congestion, fuel imports, poor air quality
- Agiculture - plans for agricultural intensification will increase emissions
  - Lower carbon options include cropland management, grazing land management and pasture improvement, livestock management.

Rwanda can reduce GHG at negative cost



Indicative marginal abatement cost curve for Rwanda

- Low carbon options actually save money and have wider co-benefits (fuel imports, air quality) – win win (no regrets) - example fuel efficiency

Conclusions

- Existing climate variability has significant economic costs in Rwanda
- Future climate change will lead to additional economic costs
  - High economic costs projected, on top of existing impact
  - Significant in terms of GDP
- Access to significant adaptation funds is justified, though also requires tackling existing climate variability.
  - Access to funds requires the development of new institutions
- Low carbon growth offers economics, social and environmental benefits

Recommendations

- Follow on phase to provide wider analysis and more detail for emerging priorities
- Includes costing for adaptation and low carbon – identify priorities – provide a firm basis for future funding (markets and adaptation funds)
- Progress towards a national strategy
- Priorities to advance early priority areas (e.g. met systems) but also to build capacity institutionally to handle potential flows and finances
- Consideration of climate resilient growth and low carbon development in sectoral plans, national plans and even future vision
- Potential for more radical vision and to become a new African model – consistent with Presidential statements on international trading and green technology

Adaptation Strategies	Priority Actions
Immediate needs & capacity building	• Expanded research assessment into effects, adaptation and economics. Early capacity building, e.g. meteorological data/systems and early warning systems • Develop national climate change strategy including knowledge management and screening of sectoral and regional plans for climate risks and adaptation opportunities. Include in EDPRS revision. Build into long-term vision (e.g. next Vision 2020) • Prepare national level adaptation capacity to improve sectoral coordination, link to international finance, and support private sector. Enhance links between adaptation and low carbon.
Climate resilience	• Develop climate resilience strategies for immediate concerns (e.g. cross sectoral meteorological systems, information and forecasting, health and malaria monitoring and actions, flood risk screening) • Develop prototypes of sectoral actions (pilots) and pathways for scaling up to cover all vulnerable regions and populations
Social protection	• Protect vulnerable livelihoods and strengthen existing social protection programmes, expanding the coverage to consider climate change.
Accelerated development	• Adapt existing development projects to include ‘no regret’ measures to reduce climate risks and opportunities to develop adaptive capacity • Scale up successful prototypes to sectoral development plans

Mitigation Strategies	Recommended Actions
Low-Carbon Growth (LCG)	• Full analysis of low carbon options, costs and potential for prioritisation and development of strategy for mechanisms. • Develop national strategies to mainstream LCG in planning, including a revised EDPRS and possibly new Vision. • Facilitate carbon finance opportunities in voluntary and compliance carbon markets (VCM, CDM) • Prioritize agriculture, transport and electricity generation low carbon measures, considering short-term opportunities but also longer-term areas where potential 'lock-in' and identify alternatives. Improve sectoral co-ordination. • Look for synergistic adaptation – low carbon project opportunities, e.g. agro-forestry and sustainable land-use
Climate resilience & co-benefits	• Climate risk screening of low carbon growth pathways • Consider opportunities to achieve robust development, e.g. in planning hydropower (large reservoirs, small in-stream turbines), biofuels, on-farm carbon management (e.g. zero grazing, woodlots)