ENERGY, ECOSYSTEMS AND LIVELIHOODS IN EASTERN AND SOUTHERN AFRICA

CLIMATE CHANGE/VARIABILITY IMPLICATIONS ON HYDROELECTRICITY GENERATION IN THE ZAMBEZI RIVER BASIN

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PRESENTATION OUTLINES

- BACKGROUND AND OBJECTIVES
- METHODOLOGY
- RESULTS
- MITIGATION/ADAPTATION MEASURES
- CONCLUSIONS

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BACKGROUND

- Recent historical data show persistent occurrences of droughts in the SADC region
  - ✓Possible effects of climate change on river flows,
  - ✓Implications of river flow variability on hydro-electric generation.
- The study aimed to assess the impacts on climate change on run-off and consequently hydro-electric generation in the Zambezi river basin.
- Effects of climate change on river flows are uncertain, but any significant changes would have implications for hydroelectric generation.
- Climate change could affect amount and seasonality in rivers
- This could affect the amount of electricity produced annually by hydro electric and timing of power production.
- Hydroelectric generation may be more sensitive to changes in river flows than other types of water systems

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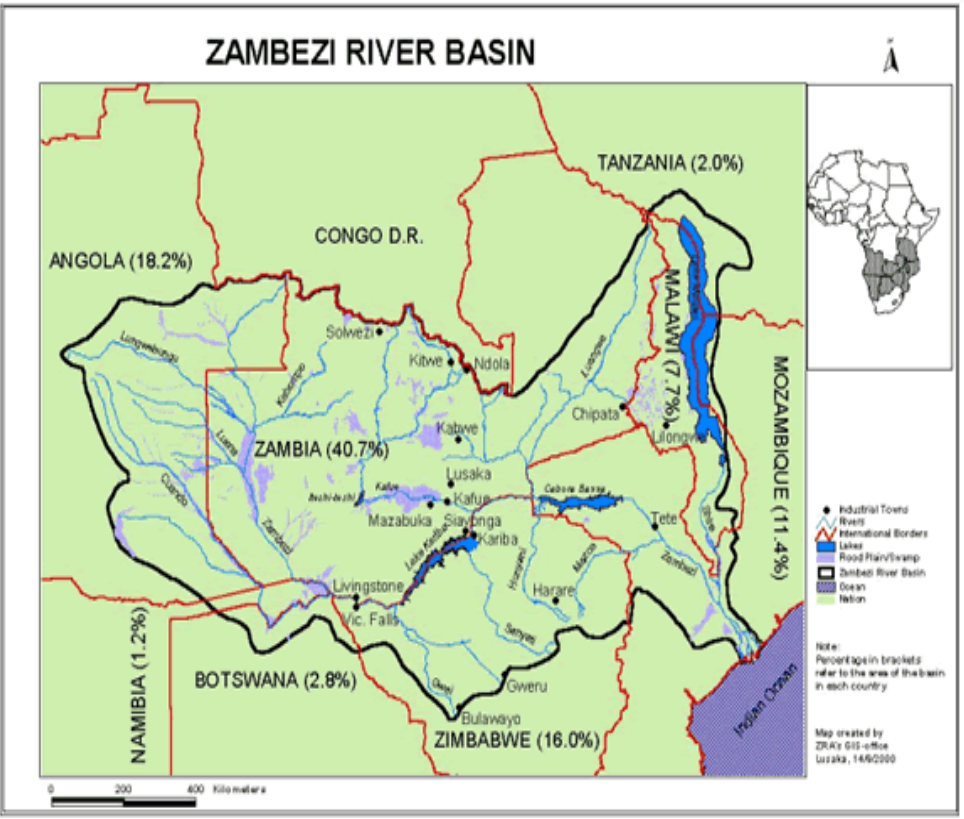

The main objectives of the study undertaken by a multi disciplinary research team were;

- To assess the effects of climate change/variability on run-off, reservoir storage capacities and hydropower potential for both baseline (1970-2000) and projected (2010-2070) situation.
- Suggest corresponding adaptation/mitigation measures.

INSTITUTIONS INVOLVED

Centre for Energy Environment and Engineering Zambia; Mondlane University, Mozambique; Energy Environment and Computer Geophysics, Botswana; C. Mzezewa; L. Nyahuma; MATAMA, Malawi

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METHODLOGY

To assess Zambezi River basin existing and projected hydropower potential variations against climate change/variability required;

- Definition of the Zambezi river basin,
- Modelling and network formulation based on the water balance model
- Assessment of water demand under baseline and projected conditions,
- Use of GCM models for precipitation projections, and water balance model to determine run-off.
- These processes were followed by assessment of effects of run-off on storage capacity and hydroelectric power potential.

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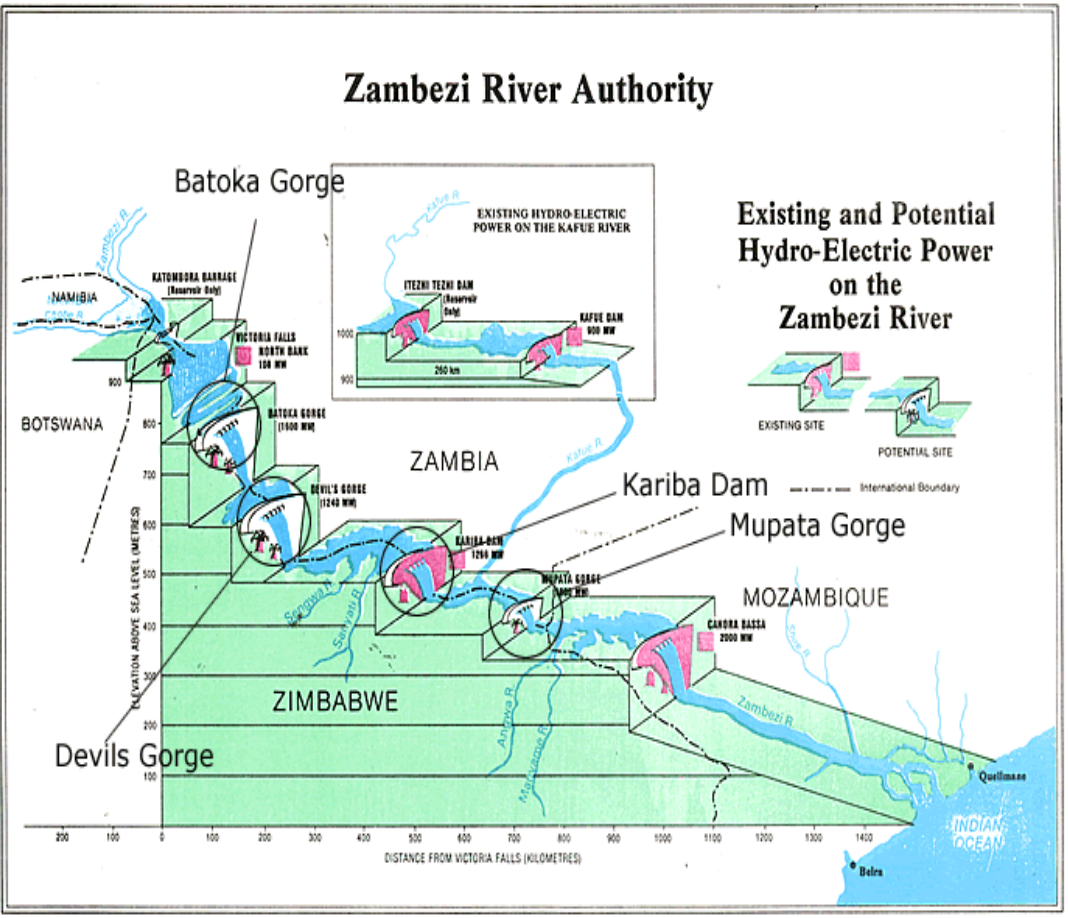
METHODOLOGY



- ✓Major existing hydropower facility Kafue Gorge, Victoria Falls, Lake Kariba and Cahora Bassa in Zambia.
- ✓Proposed hydroelectric scheme include Batoka and Mupata Gorges on the Zambia/Zimbabwe Zambezi river boundaries, and Mpanda Nkuwa in Mozambique, Itezhi-tezhi and Kafue Lower in the Kafue tributary in Zambia.

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RESULTS-BASELINE

- In the 1991/92 rainy season, a devastating drought crippled many sectors of the economies in SADC.
- Amongst the sectors worst affected were agriculture and hydroelectricity power generation.
- Over the baseline period of 30 years, the Zambezi basin has experienced some severe droughts.
- But the most striking dry episodes were in the years 1972/73, 1981/82, 1991/92 and 1994/95.
- On the other hand during the same baseline period the basin has also experienced wet rainy seasons, these seasons include, 1977/78, 1980/81, 1988/89 and 1998/99.

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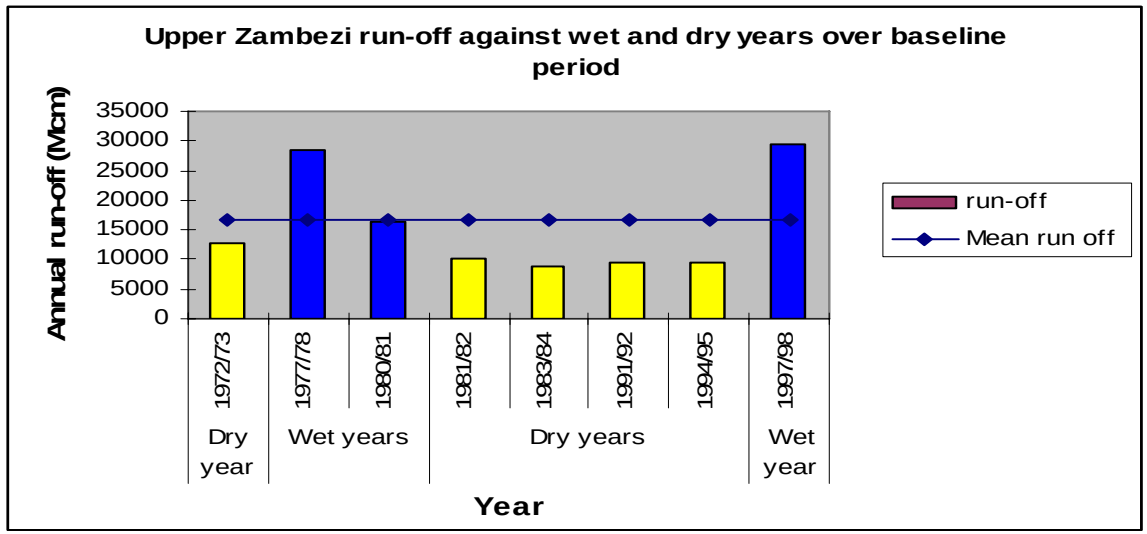
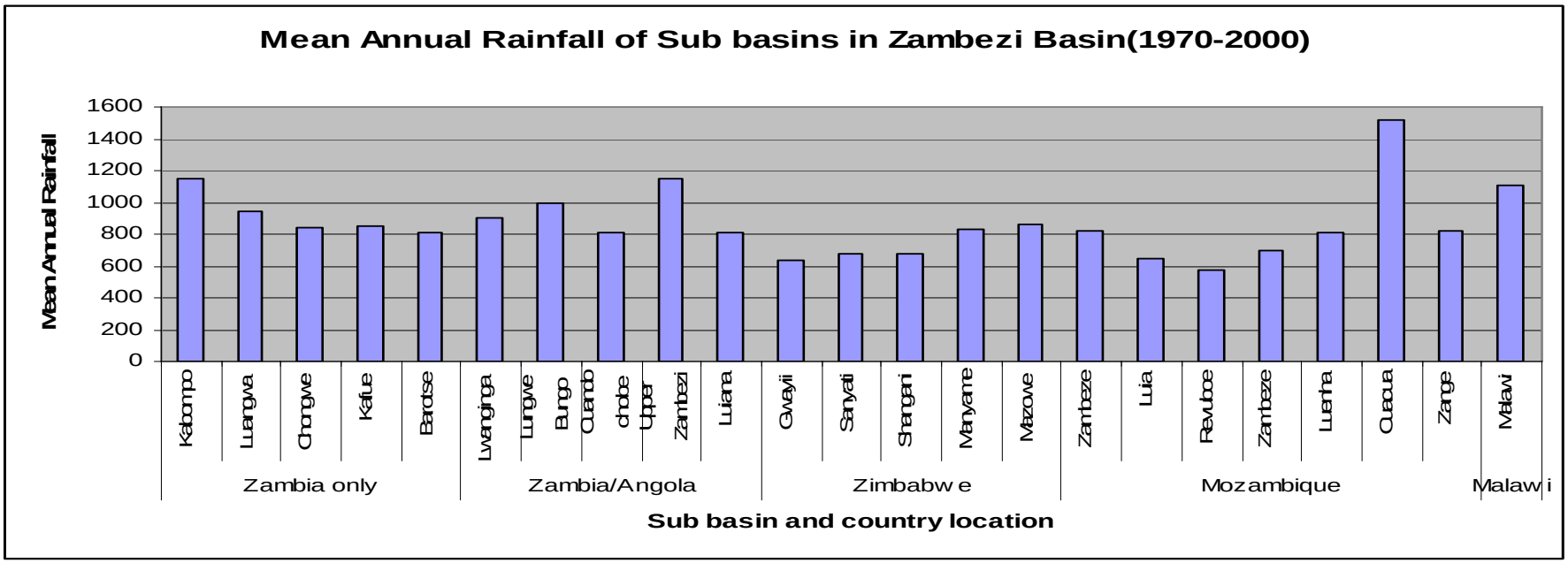
RESULTS-BASELINE





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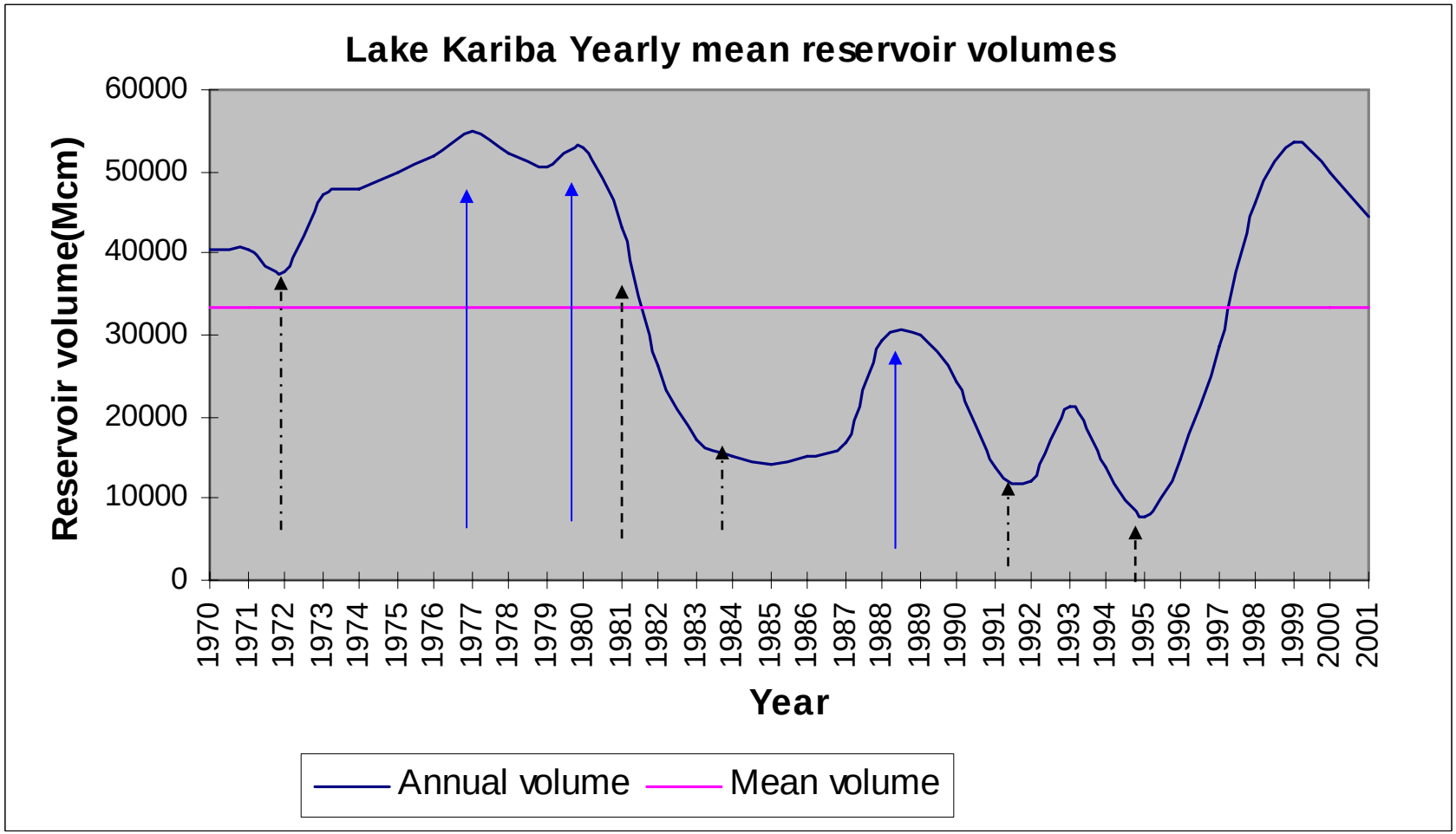
RESULTS-BASELINE



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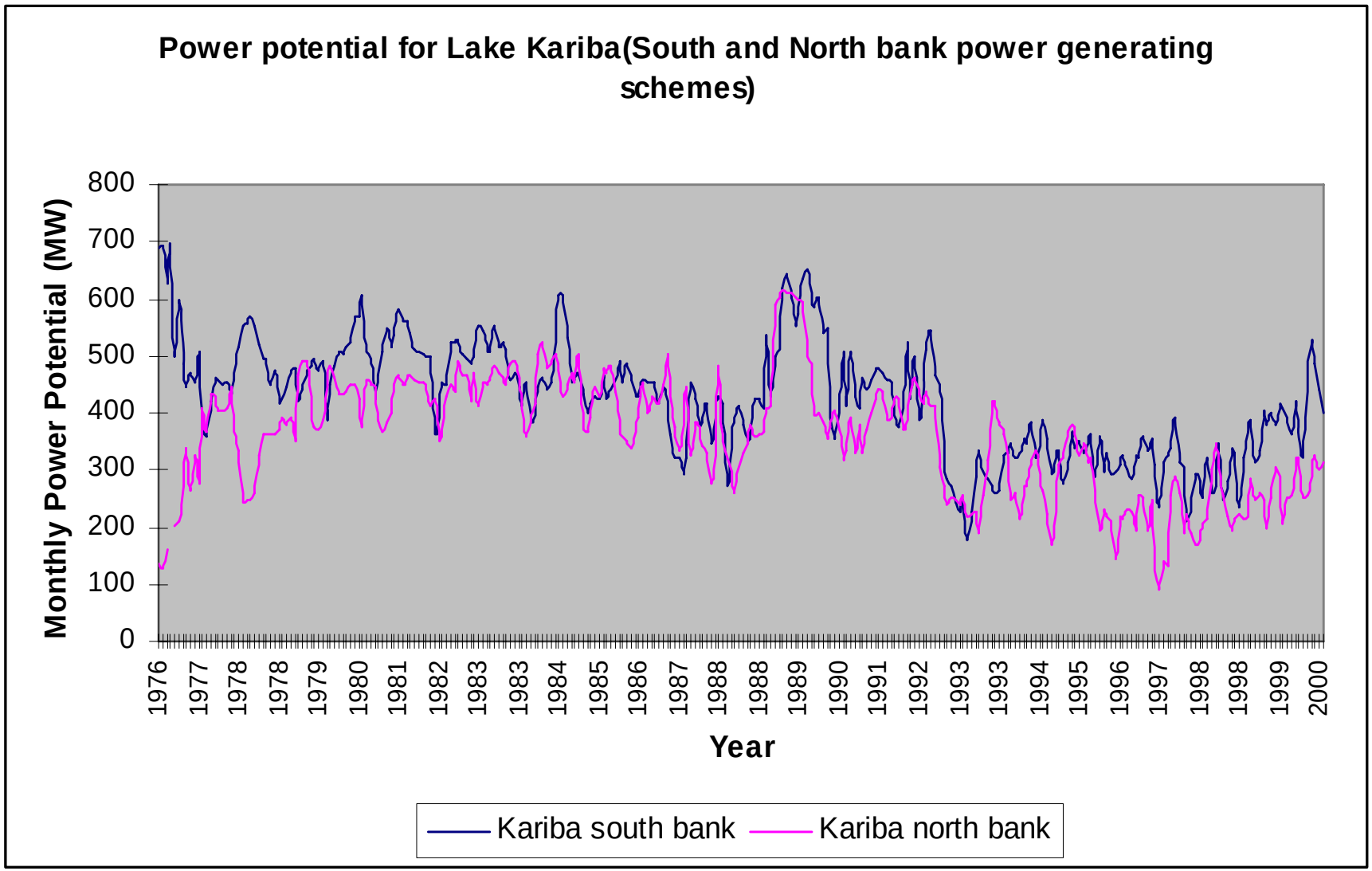
RESULTS-BASELINE



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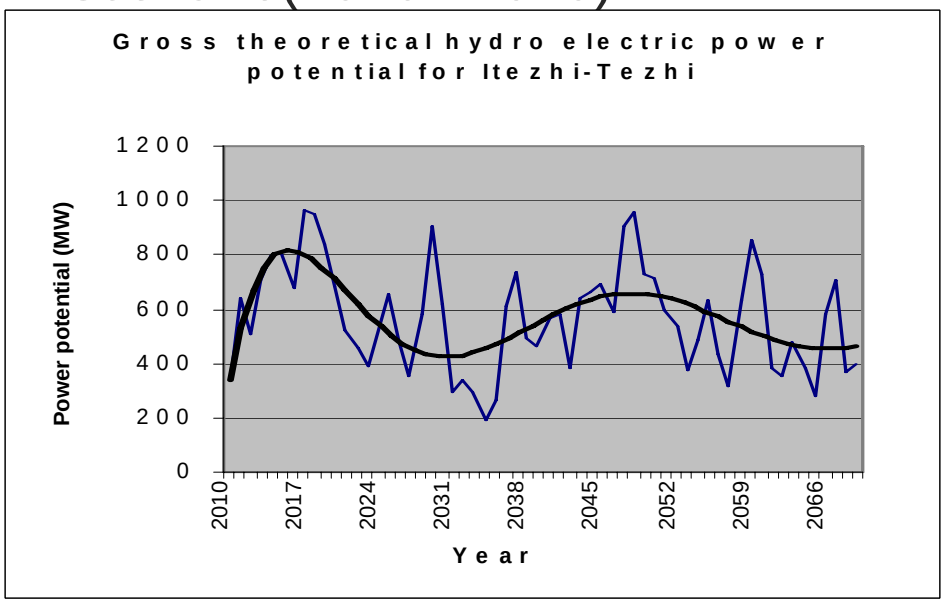
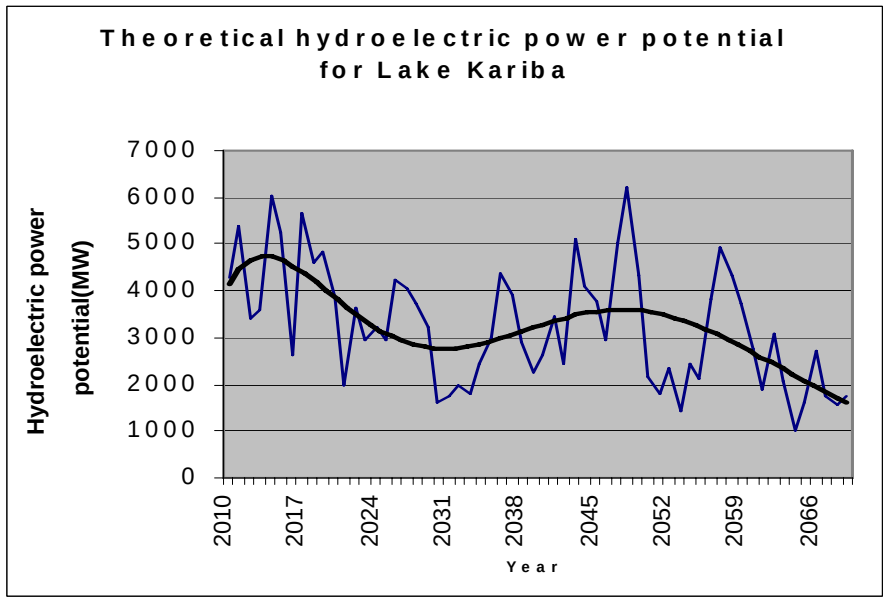
RESULTS -PROJECTED

- To determine projected hydroelectric power potential on the major hydroelectric power schemes namely, Itezhi-Tezhi, Lake Kariba, Cabora Bassa required consideration of the effects of run-off and water demand.
- Run-off on the other hand was determined with the help of GCM models which generated monthly precipitation under the projected scenario(2010 –2070).





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RESULTS- PROJECTED

- It is evident from results obtained that hydroelectric power potential has tendency towards gradual reduction in its potential in all the hydroelectric power schemes for both existing and proposed.
- Generally, it is projected that there will be extreme occurrences either higher rainfall or droughts in all the hydro electric schemes considered.

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ADAPTATION/MITIGATION OPTION

To mitigate against such risks, the following are being suggested are being suggested;

- inter-basin water transfers,
- Regional integration of electricity infrastructure from hydro and biomass sources
- Use of alternative energy sources and effective water management. During dry episodes,
- Regional integration of electricity infrastructure from hydro, natural gas and biomass sources has also greatest potential in providing electricity to the SAPP region.
  - ✓With the existence of SAPP, this development is possible.
  - ✓For hydro sources, it is important that regional projects such as Kafue Lower and Itezhi-Tezhi in Zambia, rehabilitation of existing Inga in the Congo DR, and development of natural gas power stations in Mozambique, Namibia and South Africa are considered as part of the adaptation strategy.

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ADAPTATION/MITIGATION

- ✓ In the long term, the grand Inga scheme, should be considered as a vision for the future, since it lies in a different basin (Congo River basin) which is termed to be rich in water resources.

- Apart from considering hydro based power stations on a regional basis, which can be regarded as renewable, other alternative energy resources include the following;
  - ✓ pumped storage electricity generation, which involves use of pumped storage schemes to generate electricity on a continuous basis at selected hydropower station.
  - ✓ Biomass in the form of agriculture and forest wastes is a large resource in Southern Africa which can be converted into fuels for electricity generation either as isolated schemes or feeding into the SAPP grid.
  - ✓ Other measures include effective integrated water management system
  - ✓ Energy efficiency and early warning systems.

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CONCLUSION

The study has revealed that the main climate and other risks associated with current and future hydro electric power generation include

- projected dry years which will likely result in droughts likely to reduce run-off and hence reservoir storage capacity resulting in reduced power generating capacity,
- projected wet years which are likely to result in floods-threat of damage to infrastructure,
- And projected increase in water demand (likely to reduce run-off) resulting in reduce power potential

END

- END OF PRESENTATION