Presentation given the TransLinks workshop:

Modeling and Managing Watersheds

September 13-16, 2011

Kigali, Rwanda
Umubano Hotel, Boulevard de l'umuganda

This workshop was hosted by the Wildlife Conservation Society, the United States Department of Agriculture (USDA) Forest Service and the United States Agency for International Development (USAID)

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National Decision Support System Unit- Rwanda

National pilot case study for NB DSS testing:

Understanding the water use in the Nyabarongo River basin development

Antoine Niragire
September 2011

Structure of Presentation

a. Nile Basin Initiative & NB DSS
b. NB DSS Implementation at National level
c. Rwanda political and basin boundaries
d. RWANDA & ITS Environment
e. Case study: Use of water resources in Nyabarongo river basin
f. Data collection in the nyabarongo basin
g. Modeling and simulation results for baseline scenario
h. Conclusion for baseline scenario
i. Results for scenario1 (Yr 2030)
j. Description of scenario 2 (HPP)
k. Analysis for Rukarara hydropower plant
l. Key messages and conclusion

The Nile Basin Initiative

•Launched Feb 1999

N

•*to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, th common Nile Basin Water Resources*

B

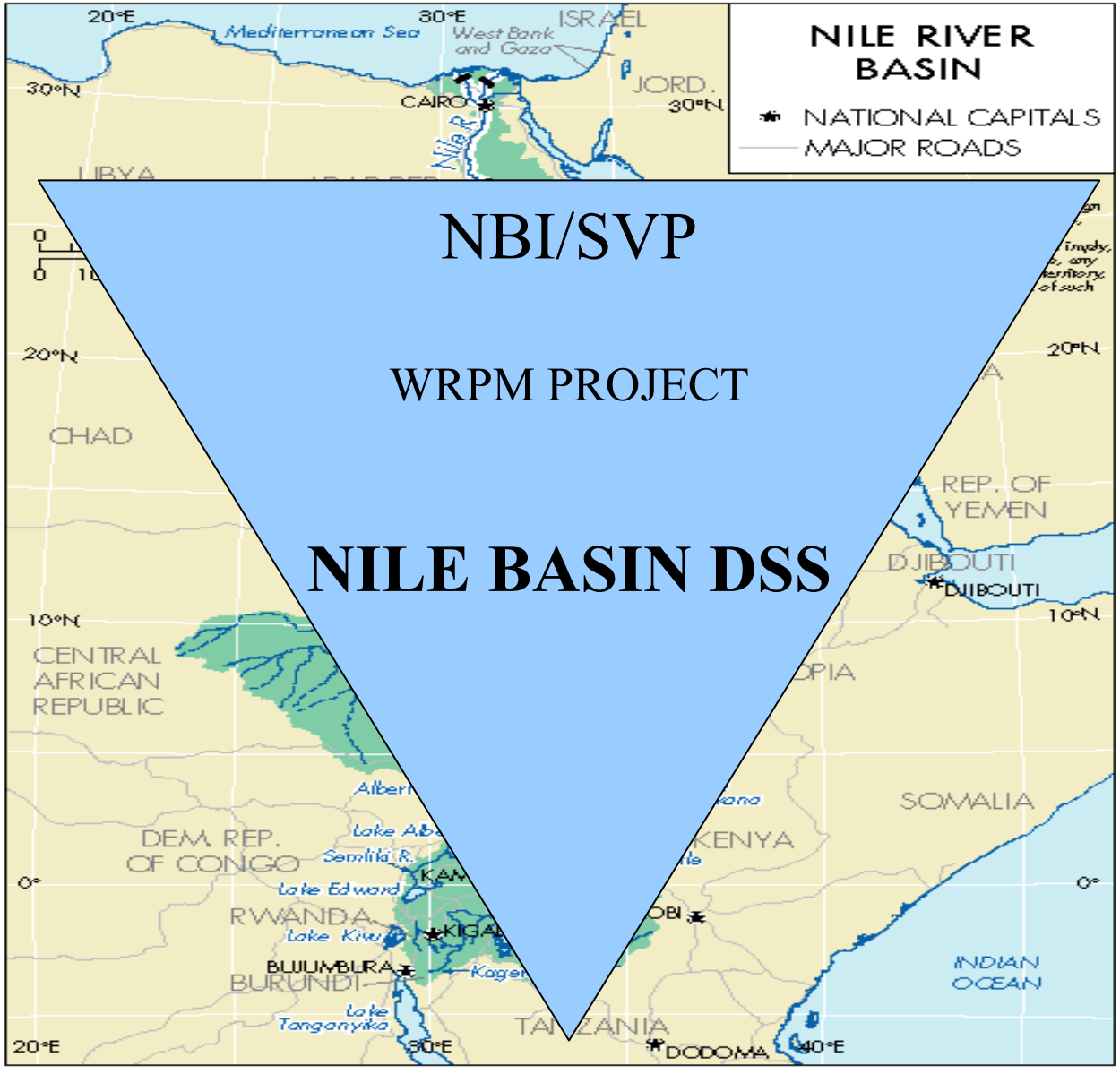
→***Shared Vision Program (SVP)****: to build trust, capacity and an enabling environment for investment in Nile Basin countries*

I

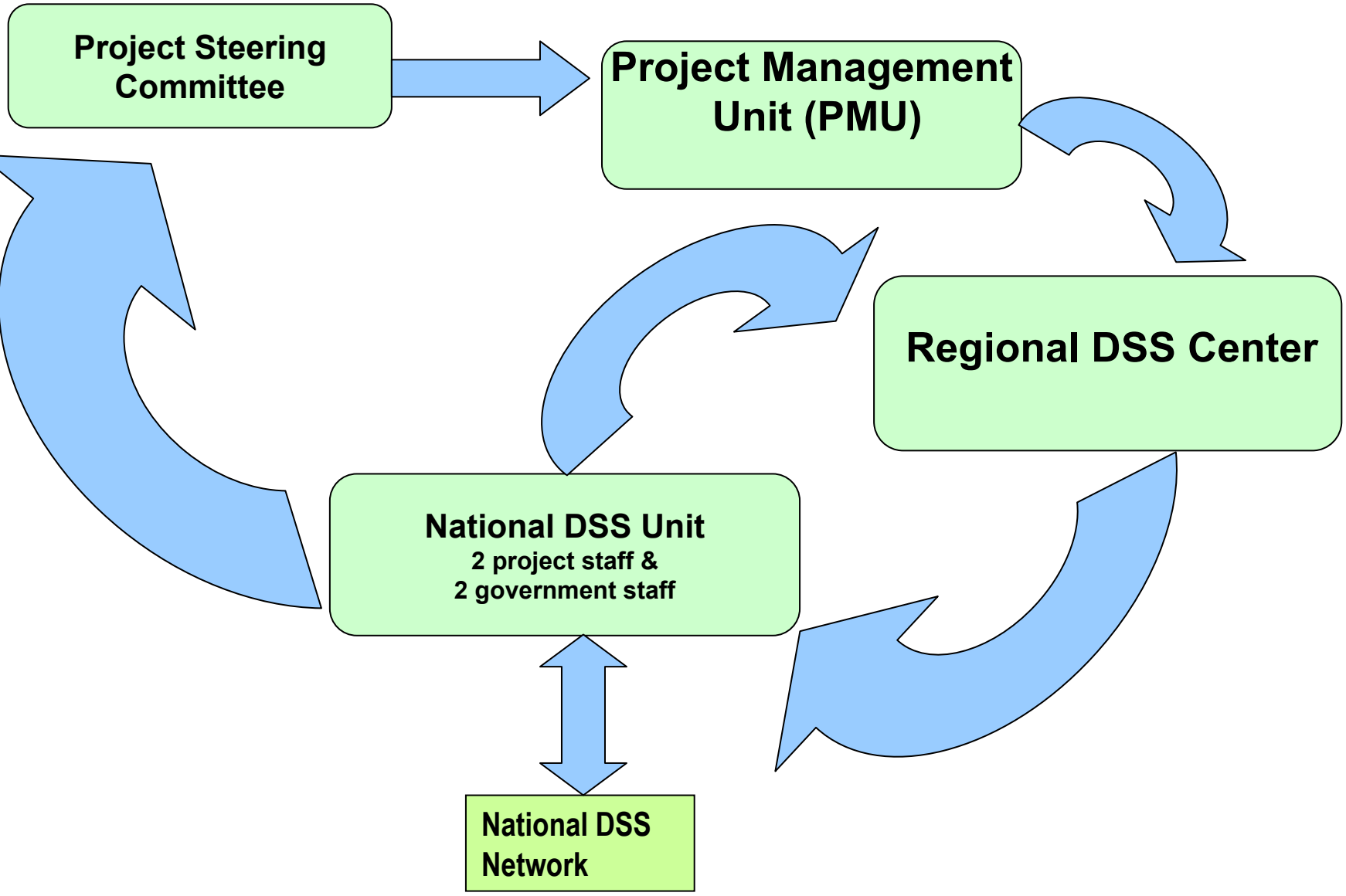
→ ***Subsidiary Action Program (SAP)****: to promote action on the ground:*

- *the **Eastern Nile Subsidiary Action Program (ENSAP)**: Egypt, Ethiopia, Sudan, (Eritrea)*
- o *The **Nile Equatorial Lakes Subsidiary Action Program (NELSAP)***

NBI and NB DSS Implementation

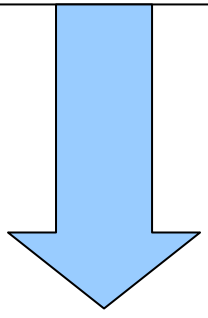


NB DSS Implementation Arrangement



DSS –Conceptual Framework and Strength

Exist
MOU between Project and Nile Members

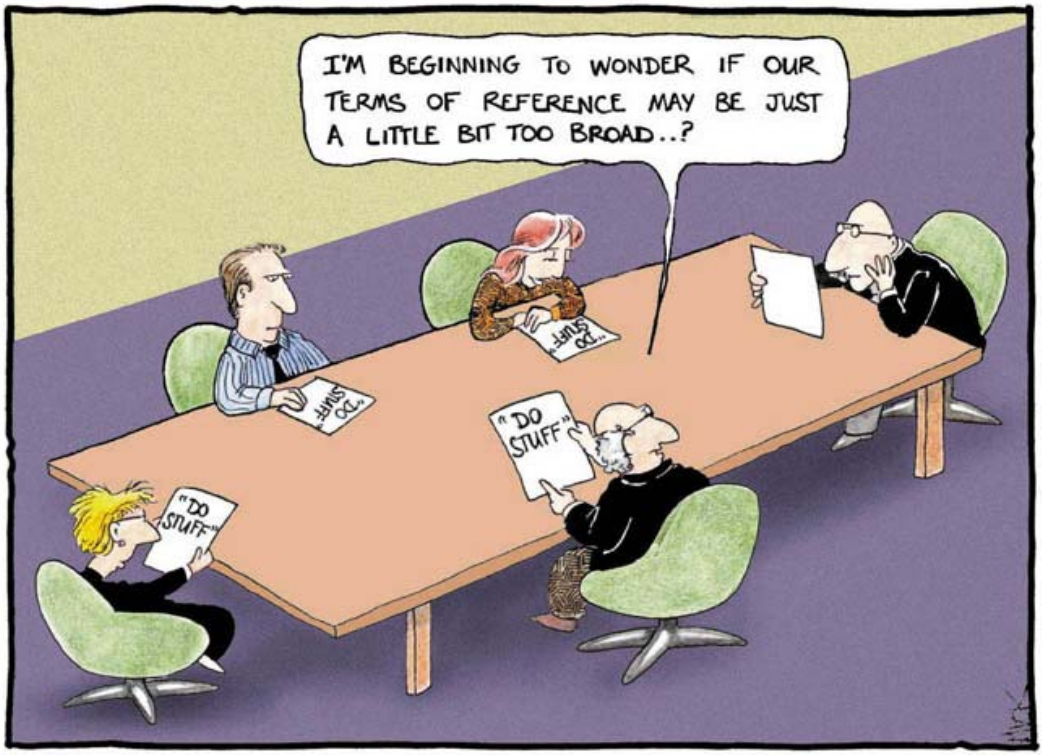


In Rwanda the National DSS Unit is hosted by the MINIRENA

National DSS Network

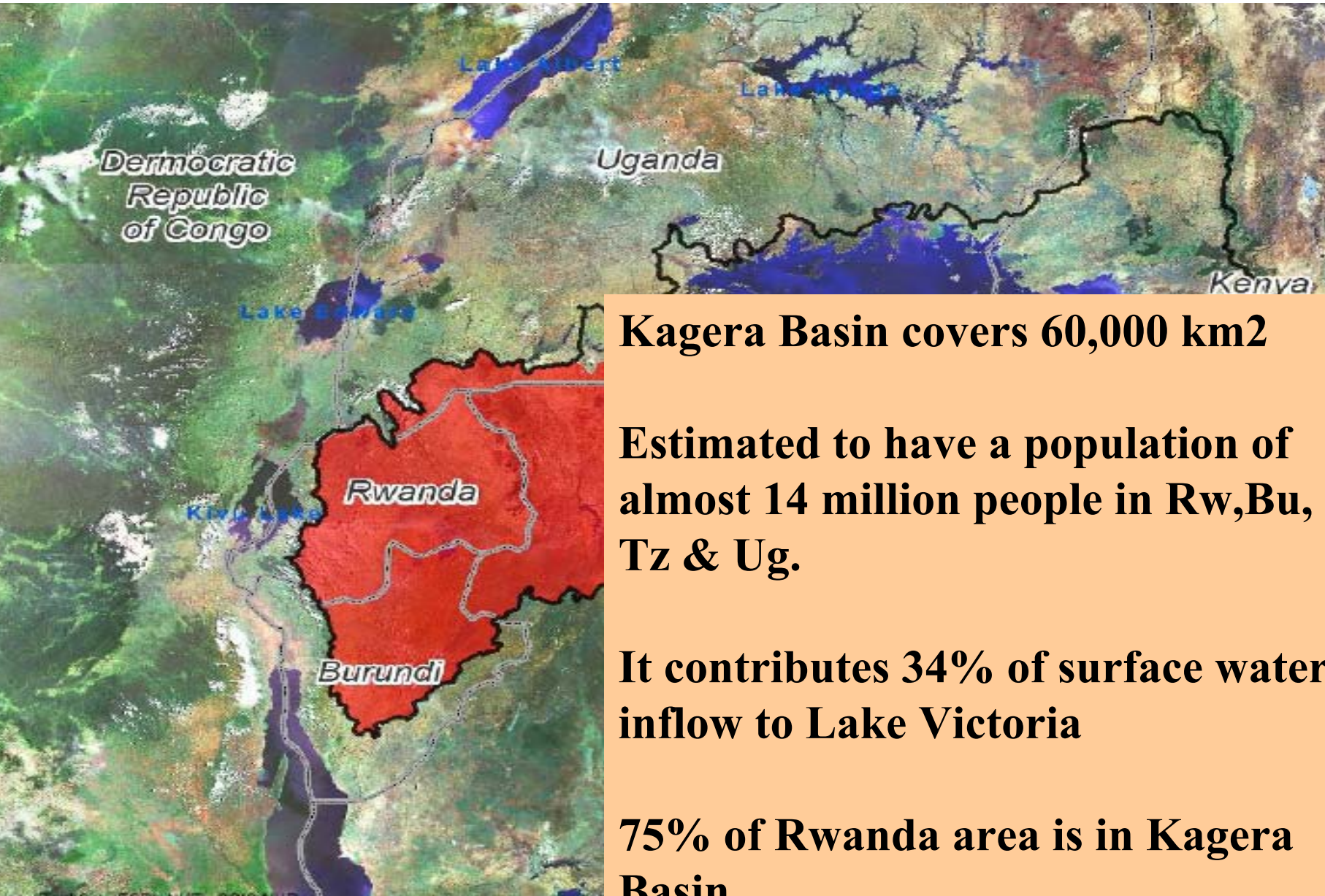
Major stakeholders

- MINIRENA
- MINAGRI
- IRRIGATION
- MININFRA
- METEOROLOGY
- EWSA
- UNIVERSITIES
- MINISANTE
- OTHERS



Objectives: Assess DSS Needs, trainings, prepare design specifications, Development Plans and Use NB DSS

Rwanda & Kagera basin boundaries



Kagera Basin covers 60,000 km2

Estimated to have a population of almost 14 million people in Rw,Bu, Tz & Ug.

It contributes 34% of surface water inflow to Lake Victoria

75% of Rwanda area is in Kagera Basin

Rwanda political boundaries

RWANDA & ITS WATER RESOURCES

- **Area:26,338 km²**
- **Annual rain: 1100 mm**
- **Nyabarongo River basin occupies 8 343 km² from Kigali to Congo/Nile ridge**

RWANDA & ITS Environment

Challenges:

- Demographic pressure,
- Pressure on natural resources (86% of population practice traditional agriculture)
- Concern of climate changes.
- Poverty
- Spatial and temporal distribution of water resources
- …


Irrigation in the marchlands

RWANDA &
TS
Environment

Irrigation on the hillside

RWANDA & ITS Environment

Water supply for domestic/industry

RWANDA & ITS VISION

One of Government objectives is to raise rural income, food security and access to safe water

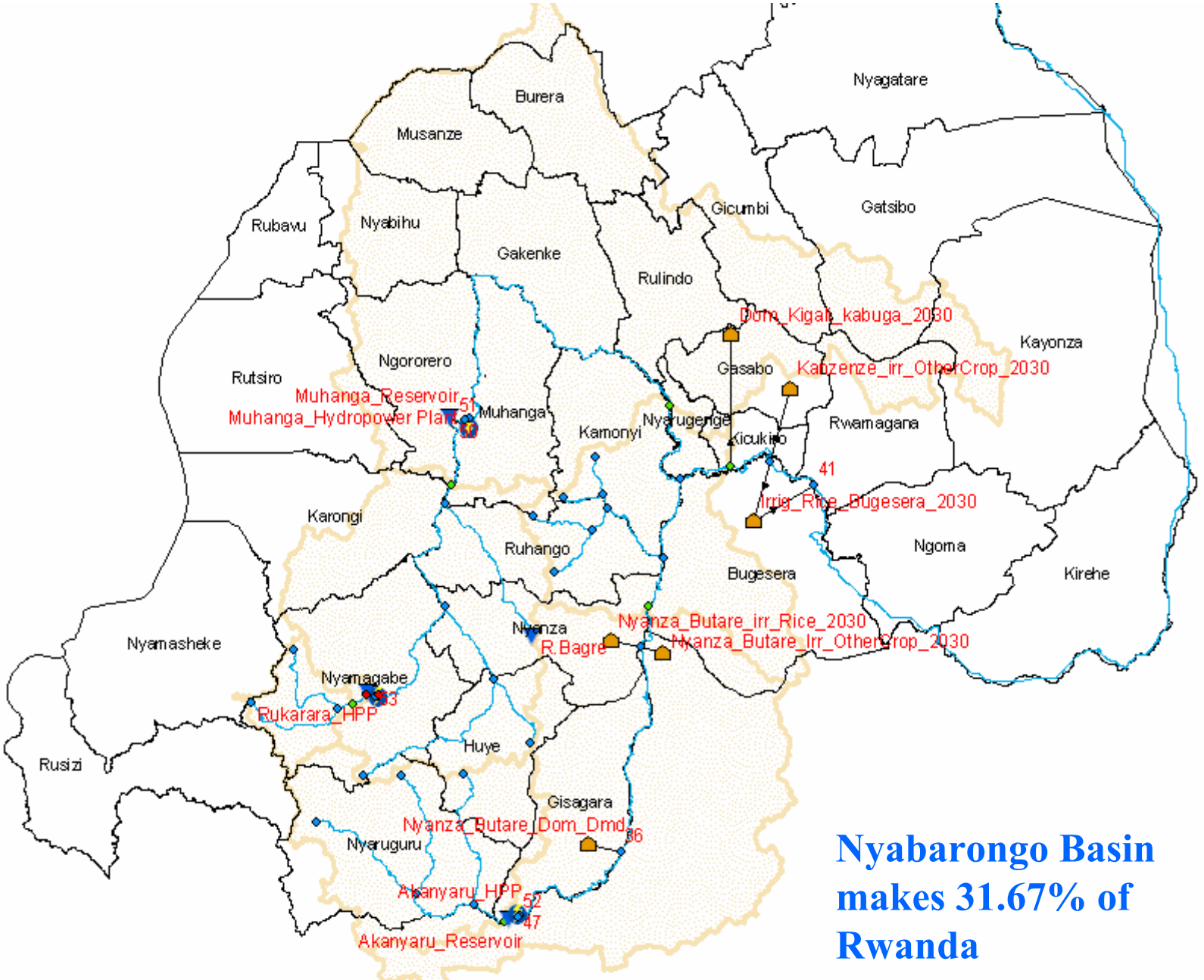
NATIONAL PILOT CASE STUDY

USE OF WATER RESOURCES IN
NYABARONGO RIVER BASIN

USE NB DSS

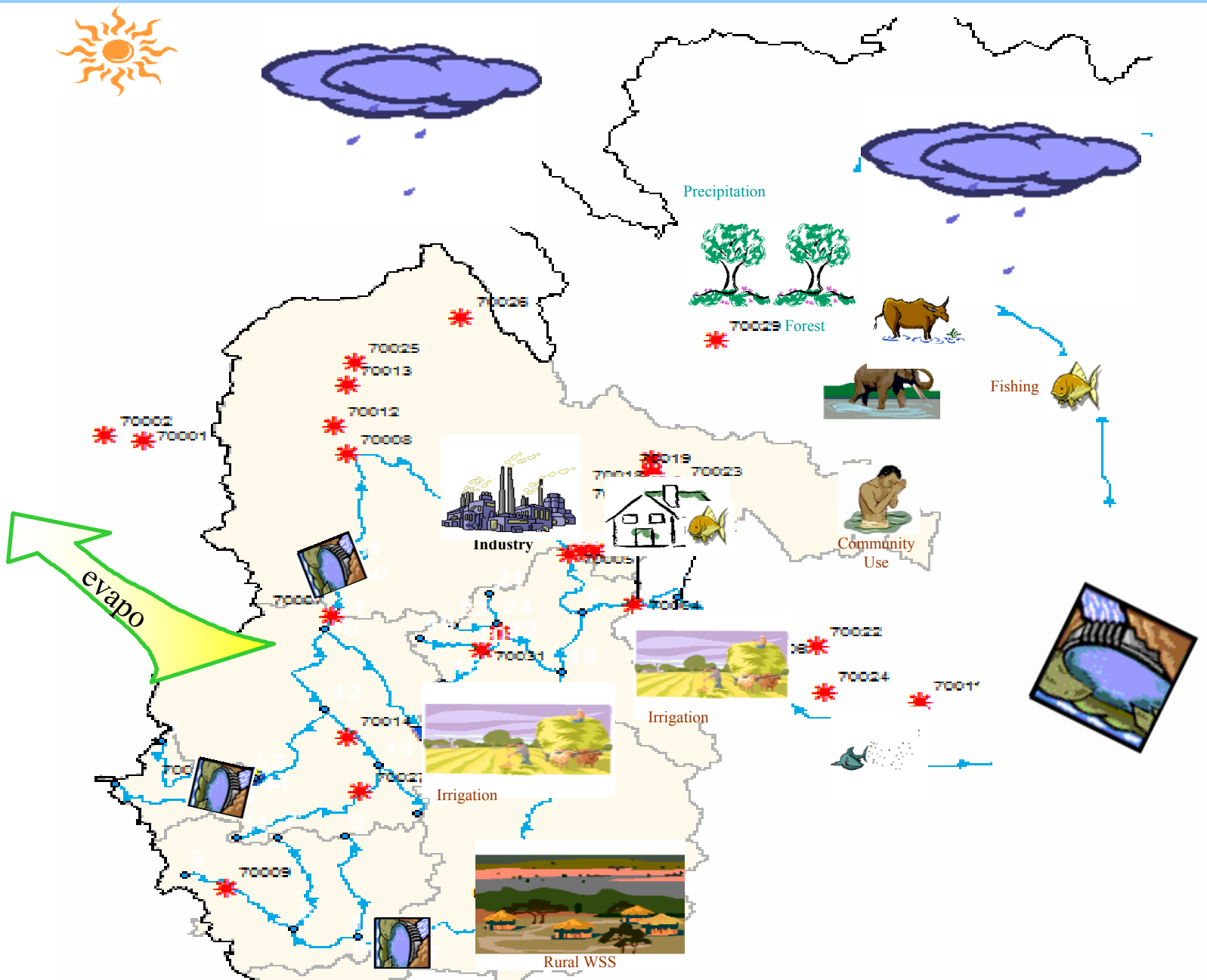
MODEL RESULT
DISCUSSION

Rwanda districts and study location



Nyabarongo Basin makes 31.67% of Rwanda

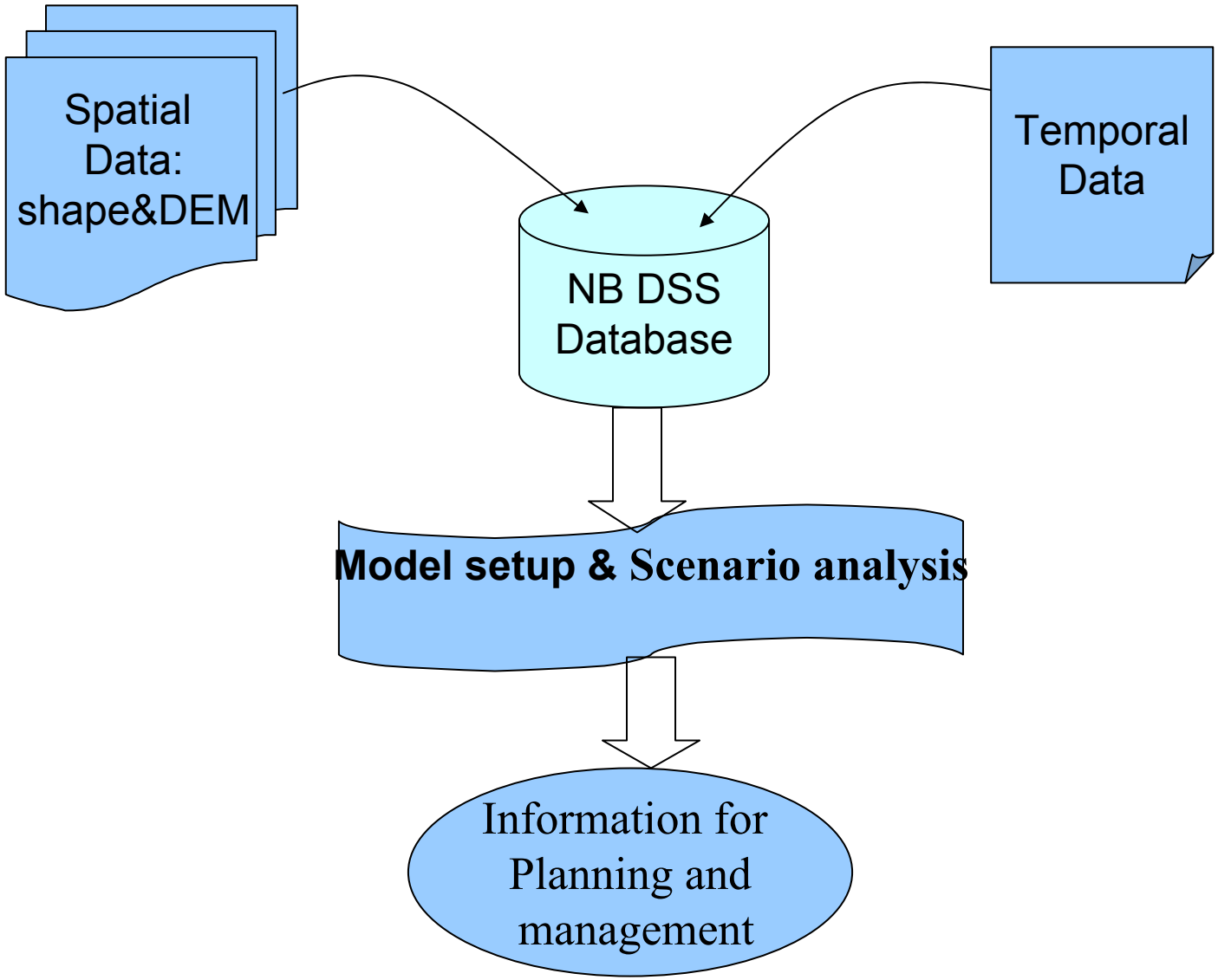
DATA COLLECTION IN THE NYABARONGO BASIN



Case study background

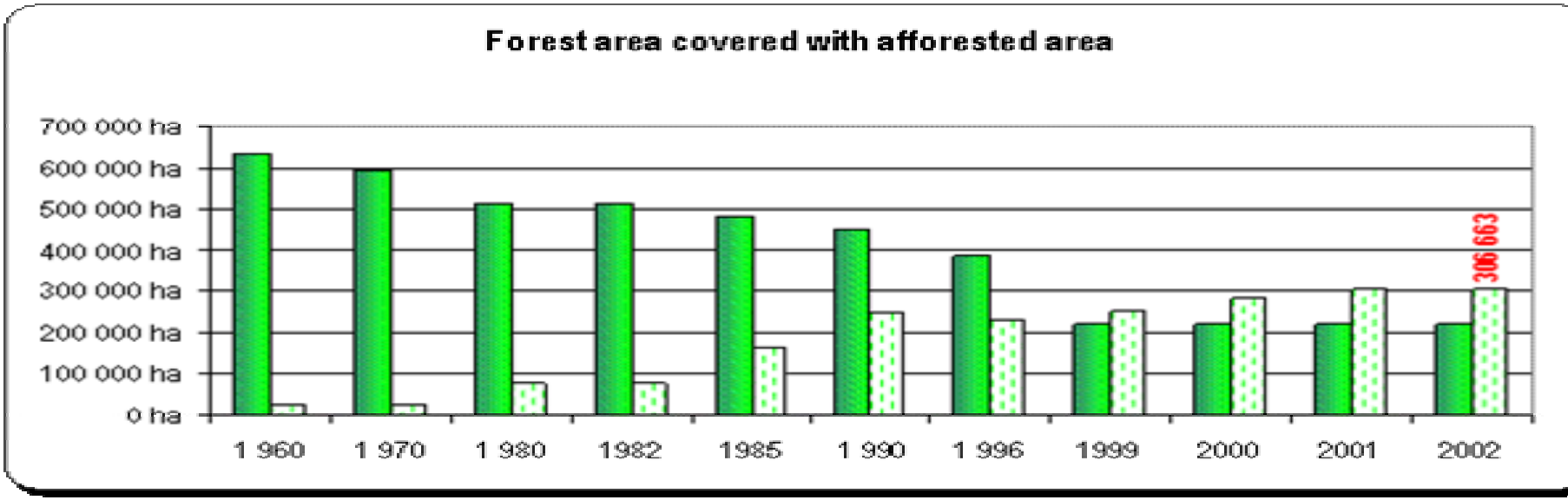
Purpose:
Evaluate Rukarara HPP in operation, Akanyaru and Muhanga planned HPP and other water uses using the Nile Basin DSS Release1.

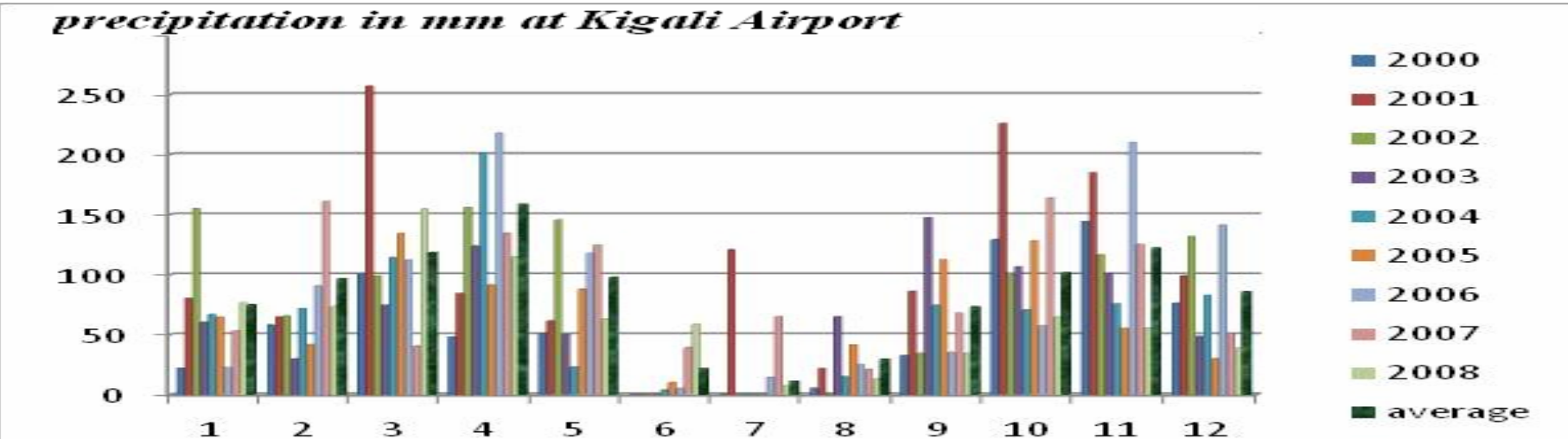
NB DSS INFORMATION MGT



Example of temporal data plot

DATA & INFORMATION: Forest

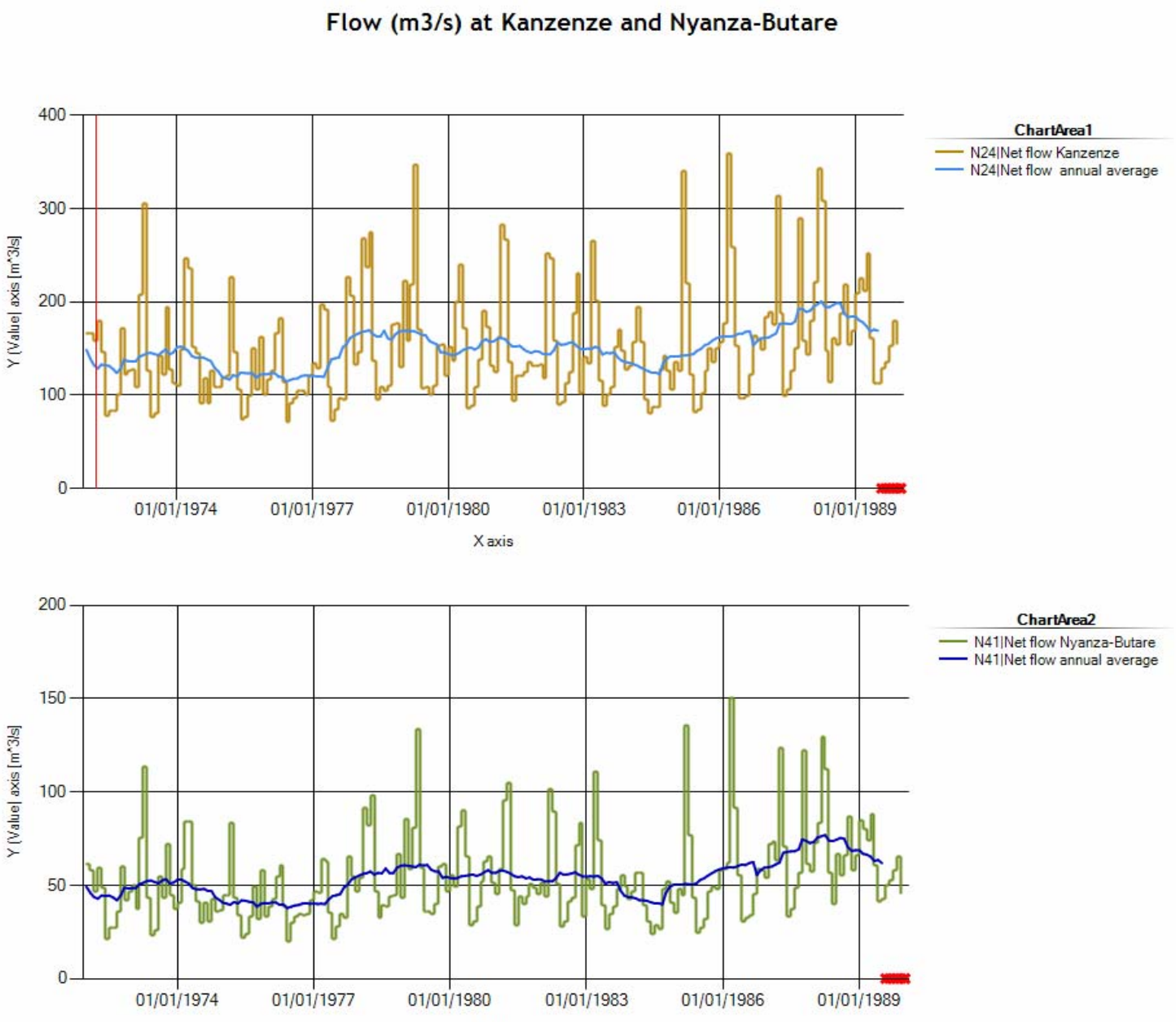




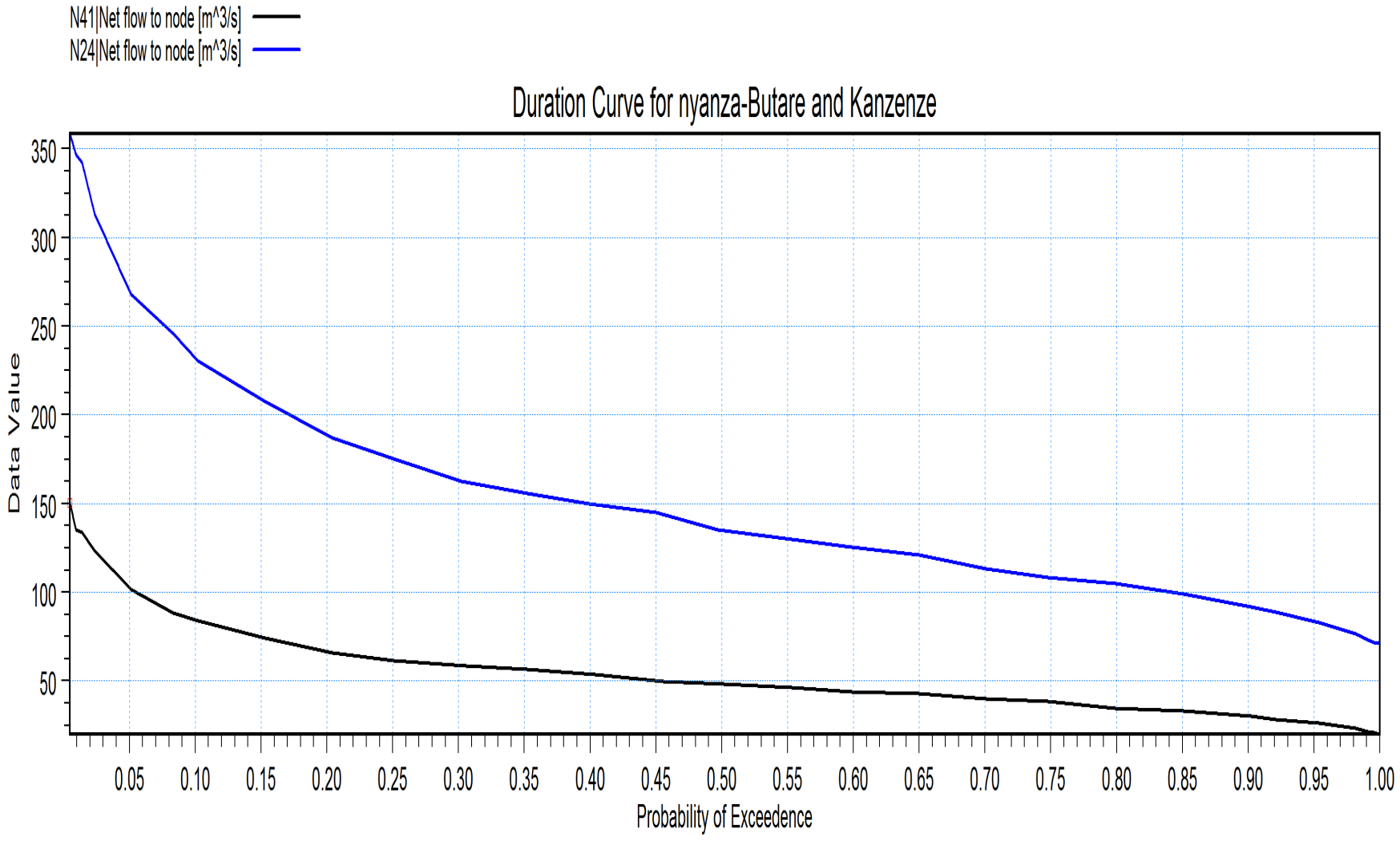
Data requirements

DATA REQUIREMENT FOR DIFFERENT SCENARIO	BASELINE SCEARIO 2009	SCENARIO FOR 2030 2030:Population will increase at the rate of 43.7%	REMARK
Kanyaru_Nyanza_Butare Domstc Dmd	0.358m3/s	0.637m3/s	
Nyabarongo_Kigali_Kabuga Domstc Dmd	1.580m3/s	2.814m3/s.	
Kanyaru_Nyanza_Butare_Rice Irrig_Dmd	10 % of PIA	40 % of PIA	TS dmd data available
Nyabarongo_Bugesera_Rice_Irr Dmd_Rice	10 % of PIA	40 % of PIA	TS dmd data available
Kanyaru_Nyanza_Butare_Other Crops Irrig_Dmd	0 % of PIA	60 % of PIA	TS dmd data available
Nyabarongo_Bugesera_Other Crops_Irr Dmd_Rice	0 % of PIA	60 % of PIA	TS dmd data available
Stream flow time series data	TS flow data available	Same TS flow data	
Rainfall and evaporation	TS flow data available	Same TS flow data	
DEM for Kagera basin	90 m	90 m	downloaded & processed

Modeling and simulation results



Simulation results for baseline scenario



Flow at Nyanza-Butare gauging station is above than 30.4 m3/s while at Kanzenze, it is above 91.7 m3/s.

Conclusion for baseline scenario

Water demand deficit at all predefined water users shows that water demand deficit is null every month.

This means that water resource available is higher enough than it is used currently (2009) in agriculture and domestic/industry sectors.

- The flow duration curves indicate opportunities for potential investment in Nyanza-Butare, in Bugesera districts or in Kigali city **without any expected negative impacts in the downstream**

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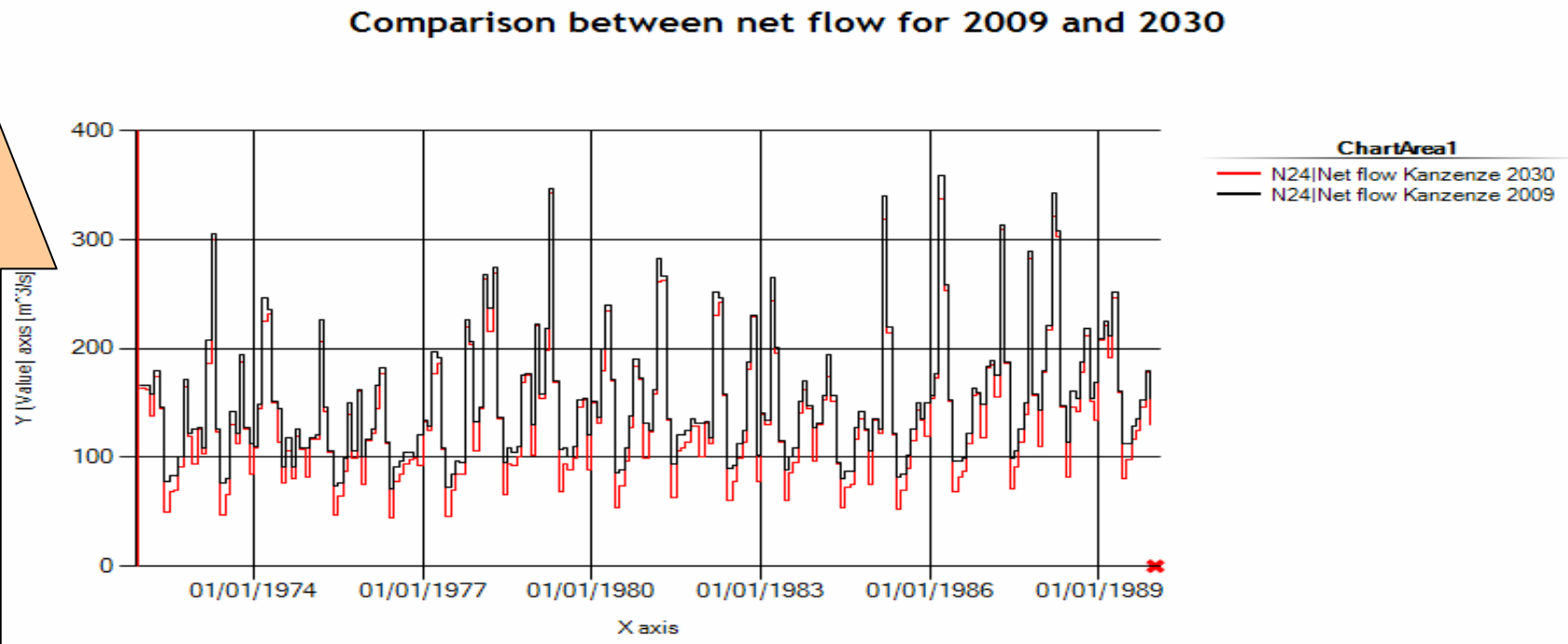
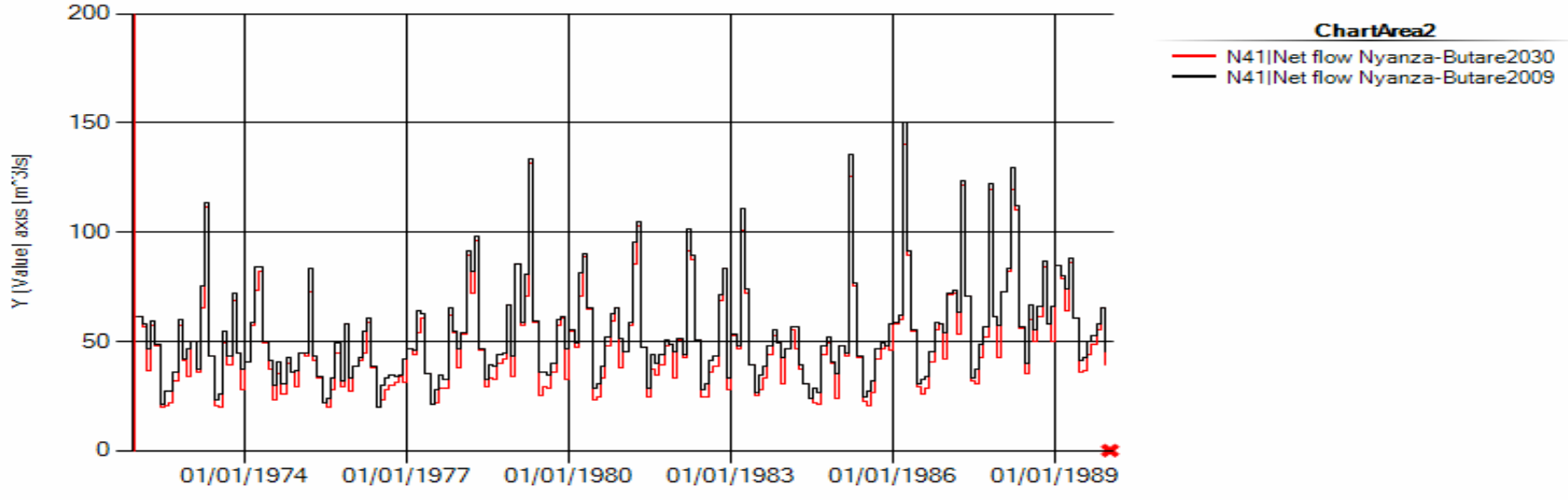
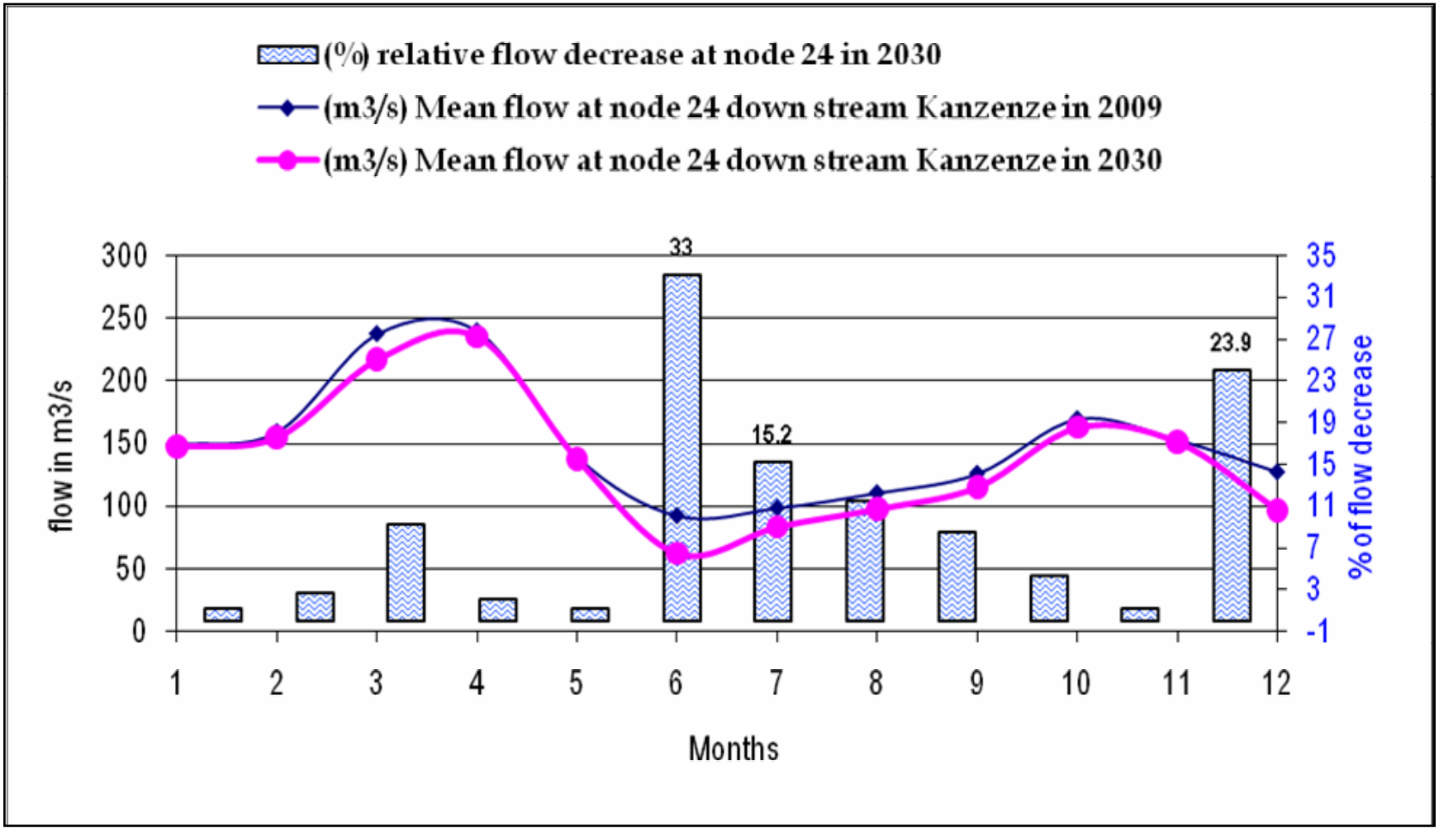
Results for scenario1 (Yr 2030)

FLOW DIRECTION





Results for scenario1 (Yr 2030)

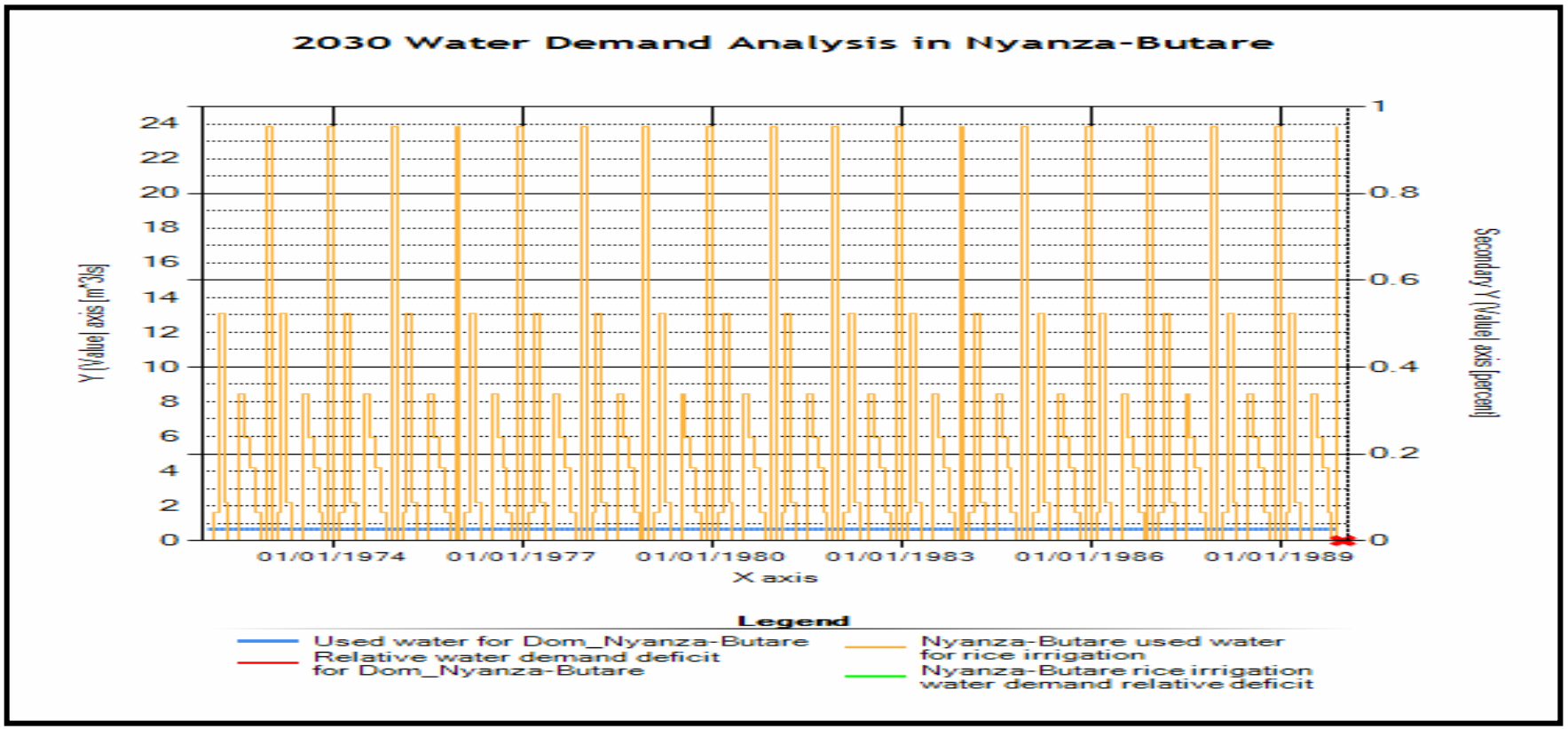


The decrease of flow during June, July and December varies between 15 and 33% at Kanzenze. This should **call water resources manager's attention to plan alleviate drought impacts especially for these three months**.

Results for scenario1 (Yr 2030)

Suggestion

Prioritise domestic use by avoiding rice irrigation in Nyanza Butare in June to improve water availability

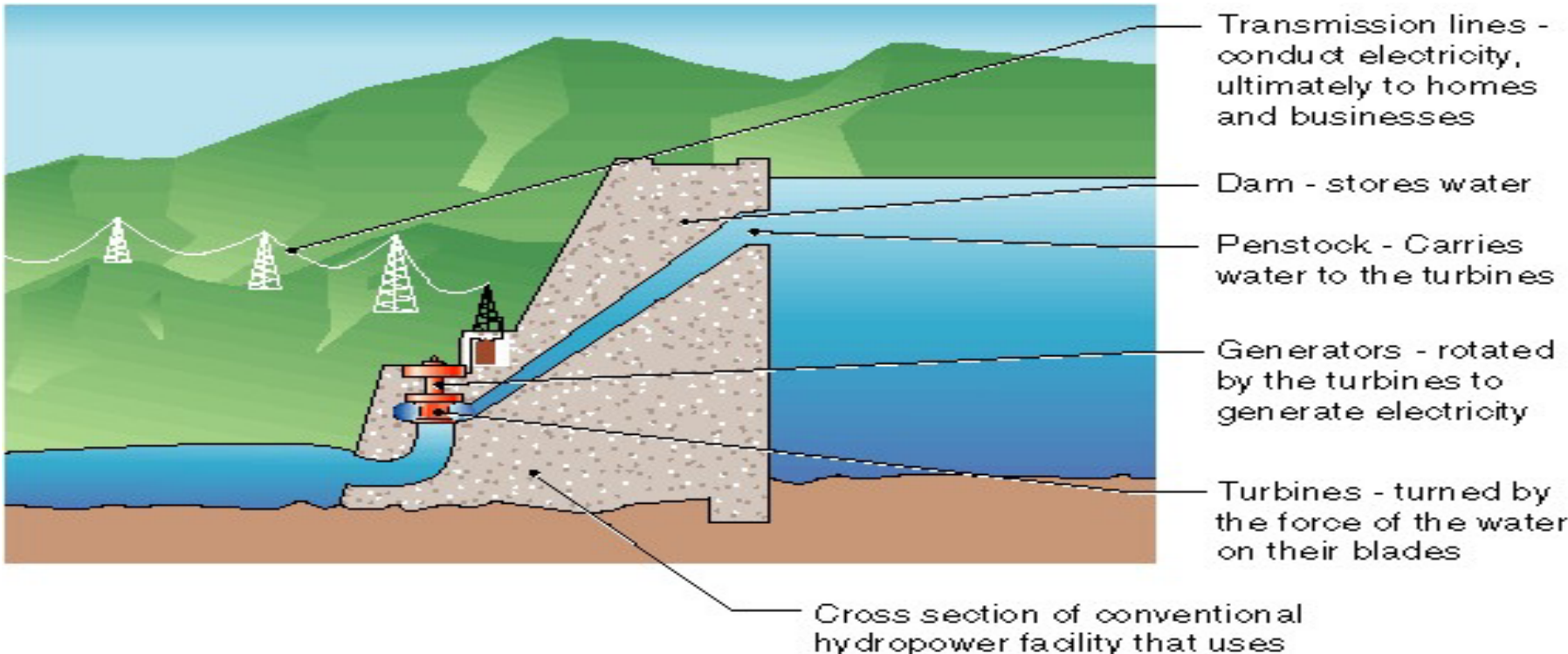


Description of scenario 2 (HPP)

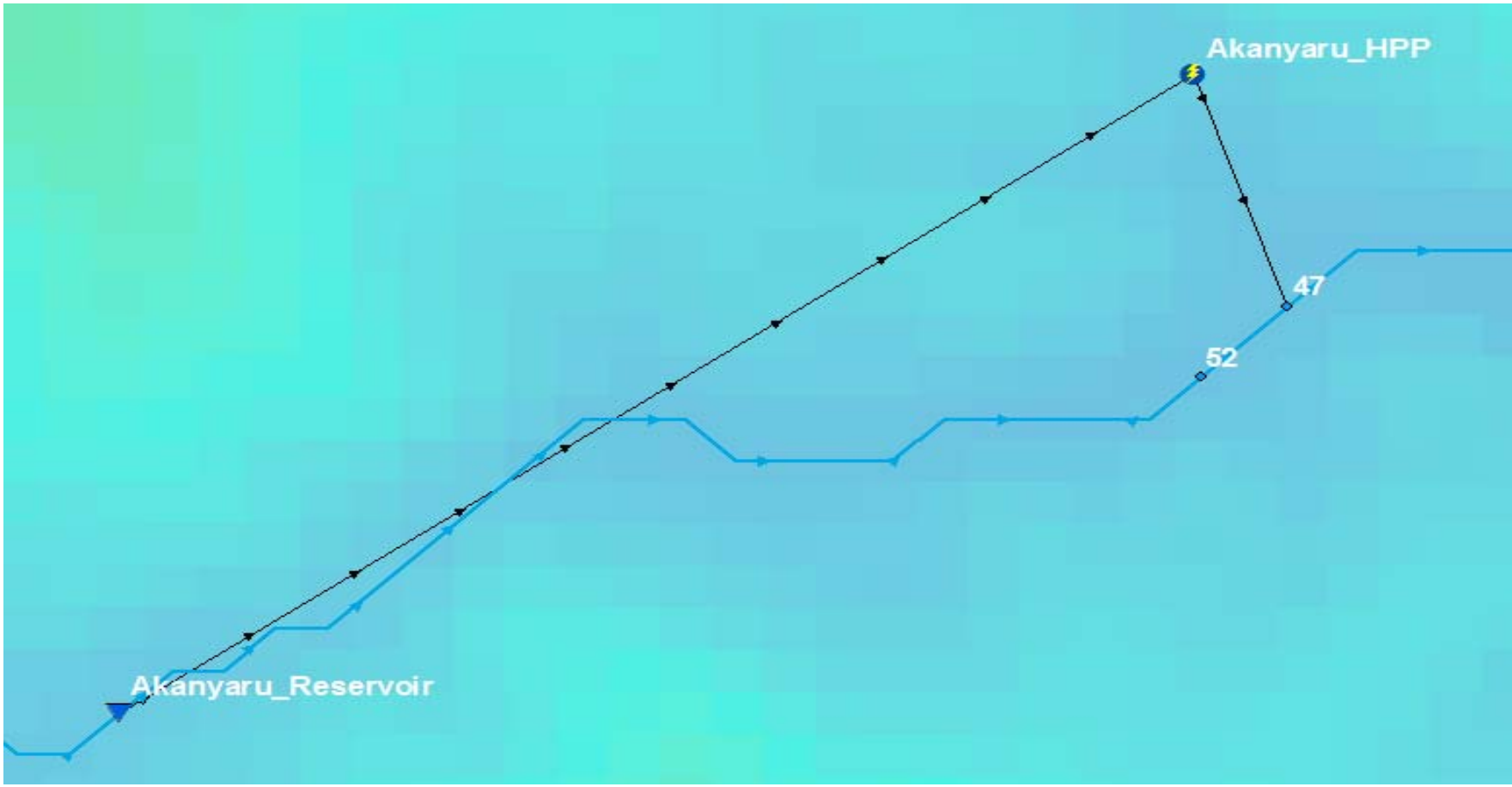
Objective is to analyze the impact of the new infrastructures at Rukarara, Akanyaru and Muhanga on:

- •generated power against annual targeted energy,
- •available water flow between reservoir and return flow from power house,
- •water users located downstream power houses then and

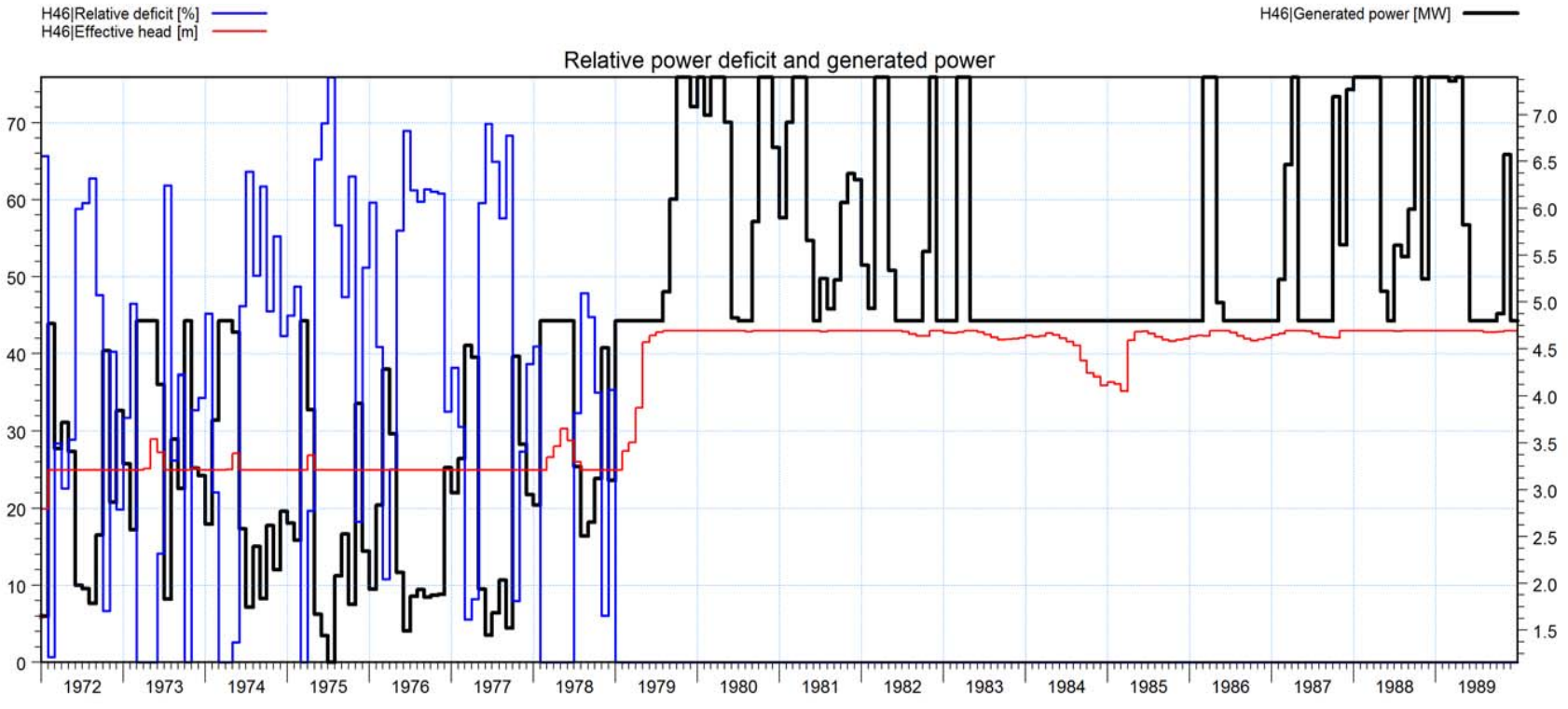
Propose the changes in reservoirs operation rules.



Result analysis for hydropower plant (HPP)

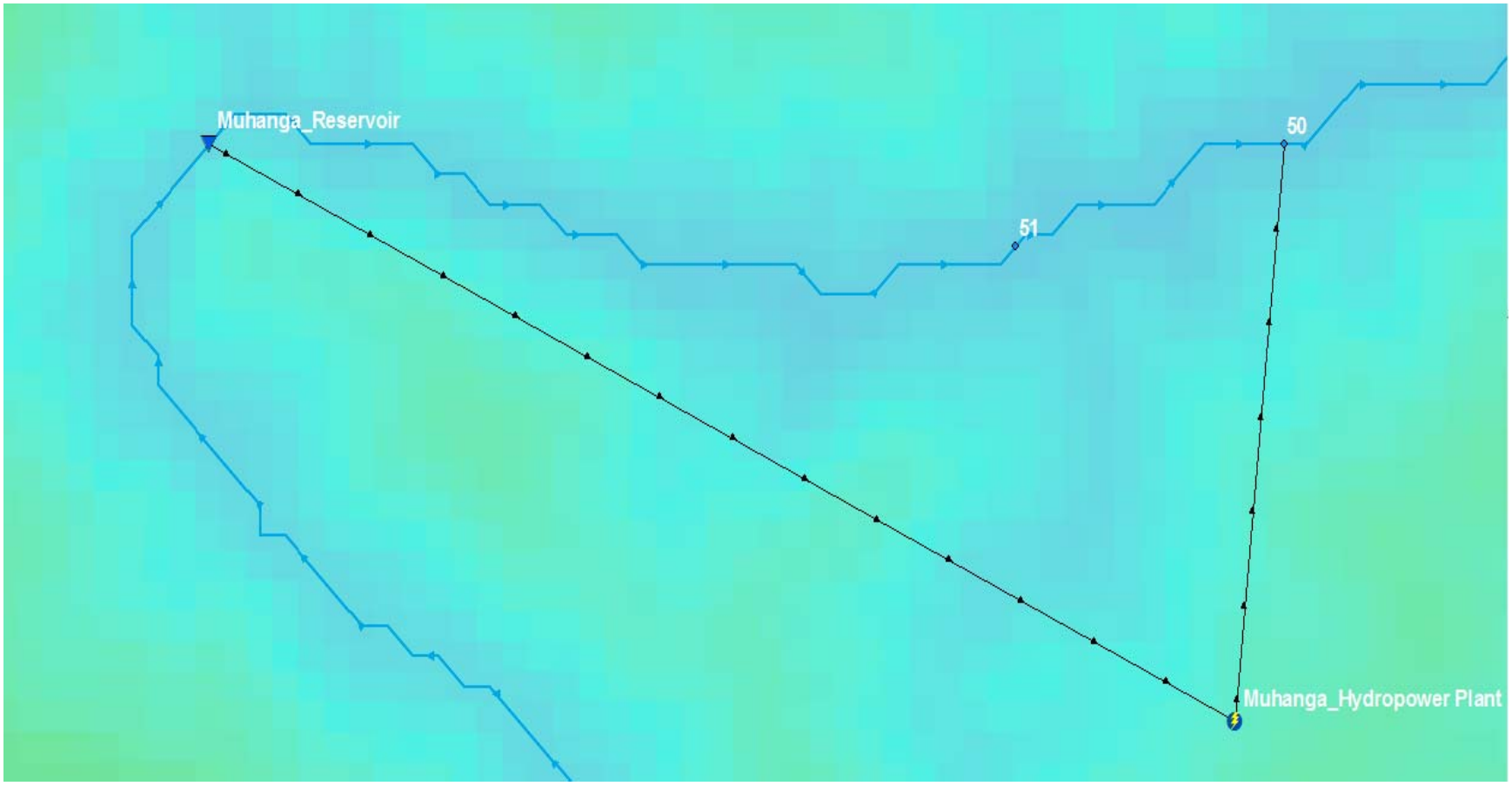


Analysis of power demand against generation at Akanyaru

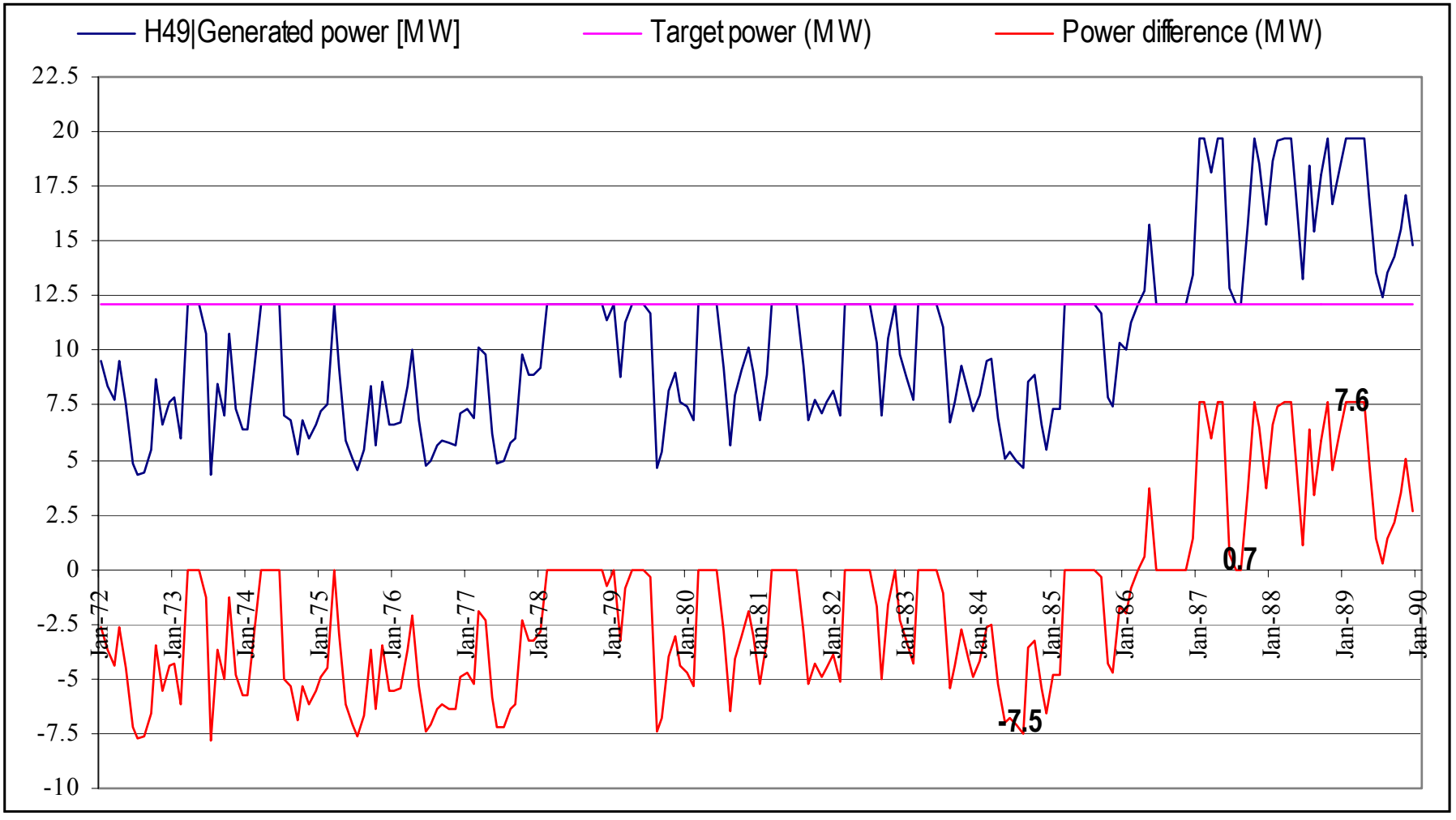


- Generated power is < required when inflow to reservoir is smaller than 20 m3/s).
- Relative power deficit varies between 45% and 65% in year
- When inflow becomes > 30m3/s, power deficit is null.

Analysis of power demand against generation at Muhanga HPP

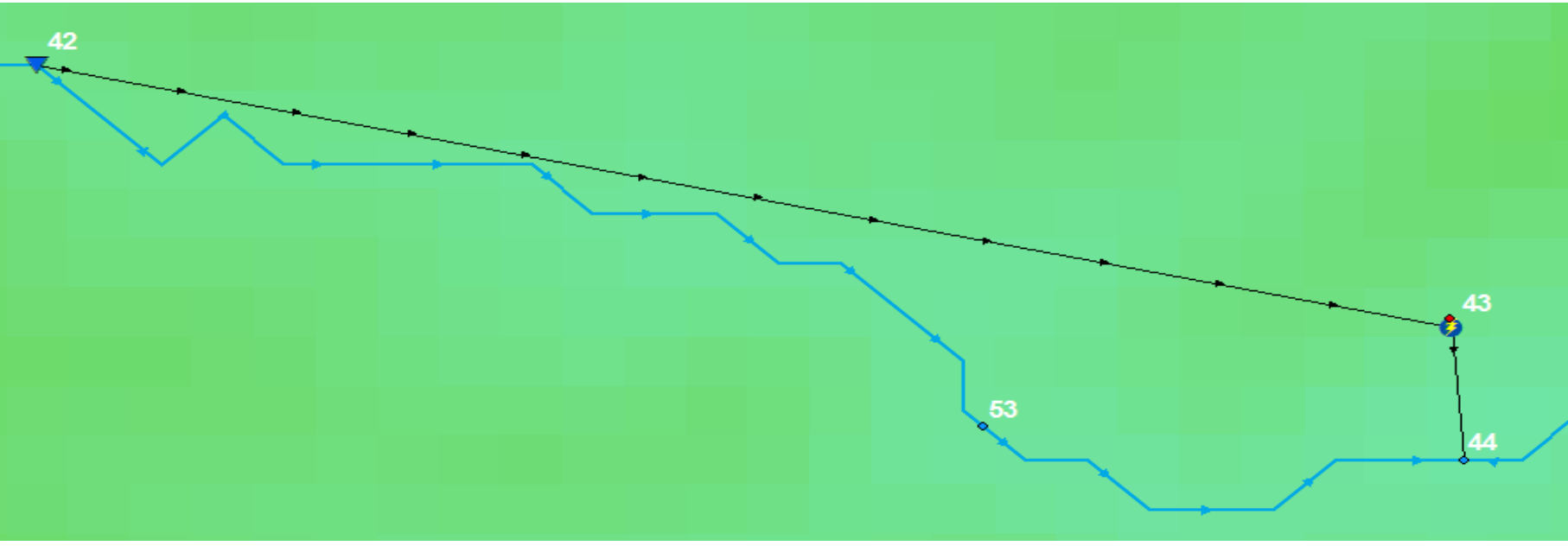


Analysis of power demand against generation at Muhanga HPP

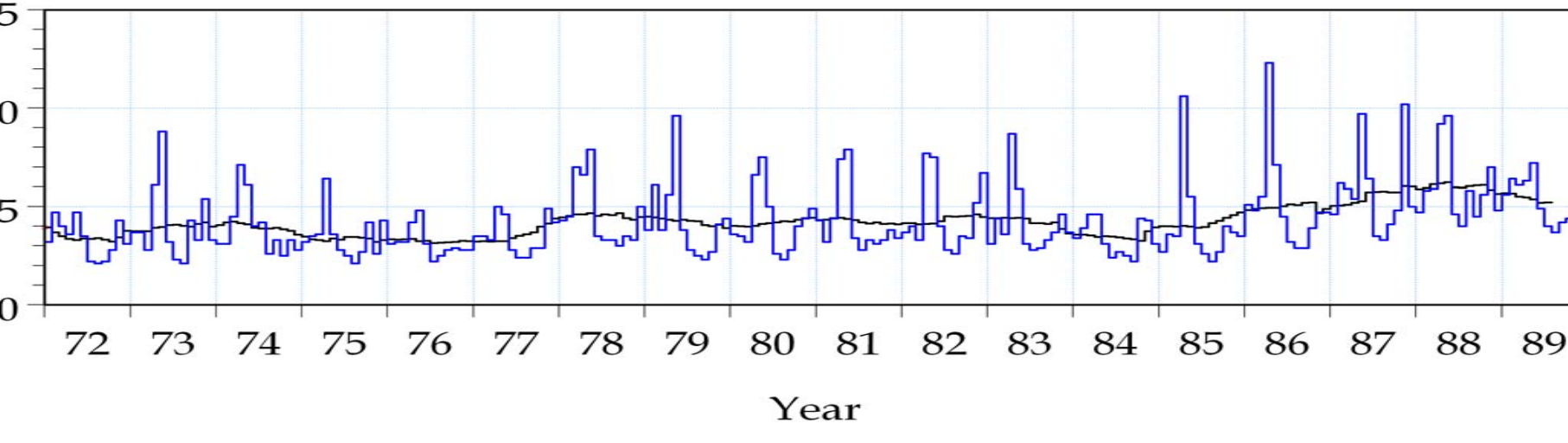


Generated power is > target power only from January 1987

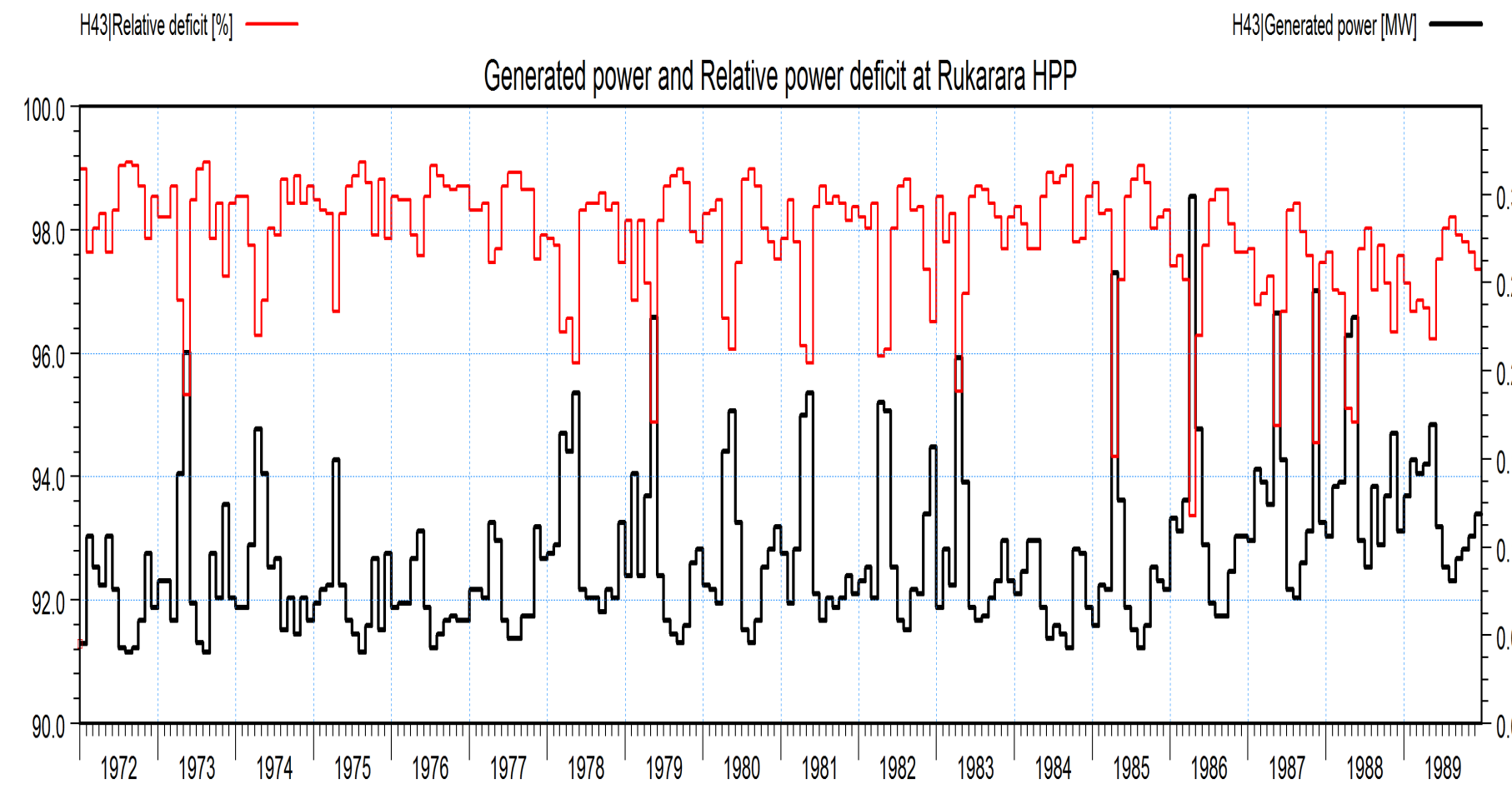
Analysis for Rukarara hydropower plant



R42 | averaged annual Inflow at Rukarara reservoir [m^3/s]
R42 | monthly Inflow at Rukarara reservoir [m^3/s]



Analysis for Rukarara hydropower plant



Analysis for Rukarara hydropower plant

Analysis of model results and actual data for Rukarara hydropower plant

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
avg FLOW (m3/s)	3.8	4.3	4.3	6.9	6.7	3.8	2.9	2.8	3.2	3.7	4.6	4.2
avg POWER (Mw) calculated by the model	0.26	0.34	0.3	0.29	0.32	0.29	0.25	0.25	0.25	0.27	0.31	0.28
Total Energy in kwh per hour(evaluated by model)	3,163	4,137	3,650	3,528	3,893	3,528	3,042	3,042	3,042	3,285	3,772	3,407
Total Energy in kwh per hour(observed on field)	3,570	3,206	4,037	3,819	3,948	2,843	3,570	3,570	3,570	3,570	3,570	3,570
Number of required machines to operate (evaluated by model)	1	2	2	2	2	2	1	1	1	1	2	2
Number of operating machines (observed on field)	2	1	2	2	2	1	2	2	2	2	2	2

Conclusion for Rukarara HPP

Installed machines (Units) at Rukarara HPP are three each having capacity of 3.287 Mw. The model result and the real field data prove that only two unit machines are sufficients.

Key messages

- Nyabarongo basin has enough surface water resources. Hence potentiel investments are welcomed
- Water use during June, July and December could be critical. Hence, attention of water resources managers when allocating water
- Investment projects for agriculture, industrial, hydropower and/or domestic in 2030 have no significant negative impact on the overall Nyabarongo environment.
- Using model in power/water project design is with very high value

Murakoze/Merci/Thanks

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