2023 ENGINEERING INSTITUTION OF ZAMBIA SYMPOSIUM

ESTIMATION OF WATER YIELD POTENTIAL OF MULUNGUSHI CATCHMENT AREA USING ARC GIS.

PRESENTER : Precious. M. I. Uzamutuma

AUTHOURS : P. Uzamutuma, M. Lweendo, C. Chanda, M. Himwinga.

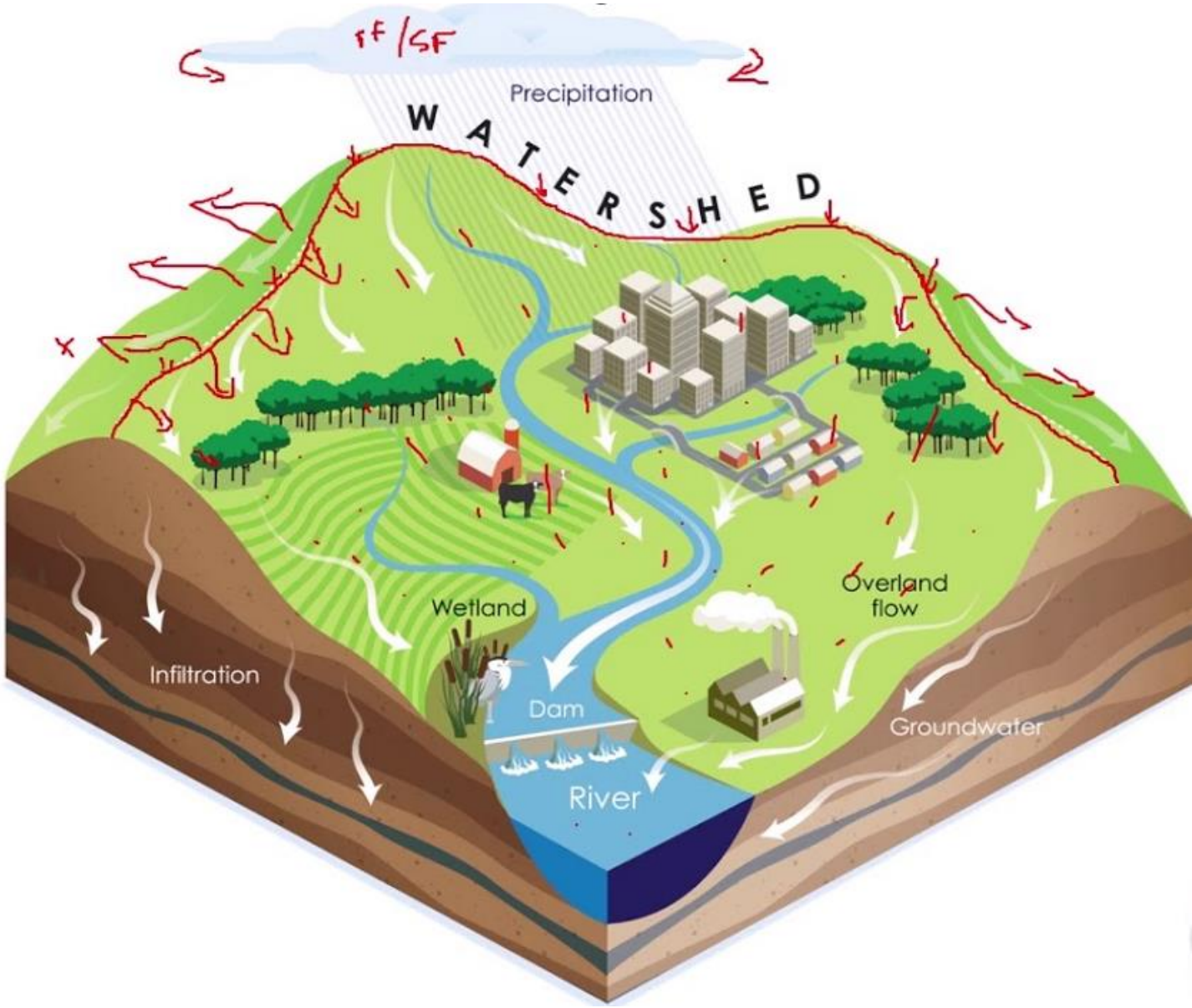
DATE : Friday 19th April 2024

Avani Victoria Falls Resort, Livingstone, Zambia

TABLE OF CONTENTS

INTRODUCTION

- A catchment area is an area of land that drains water in a water body.
- When it rains, the total amount of water available for storage in a catchment after all losses from infiltration, evapotranspiration and ground water recharge is called water yield potential.
- Climatic conditions of an area play a major role in the yield of a catchment .
- Catchment Yield depends on rainfall, drainage density, topography, soil type and land use.

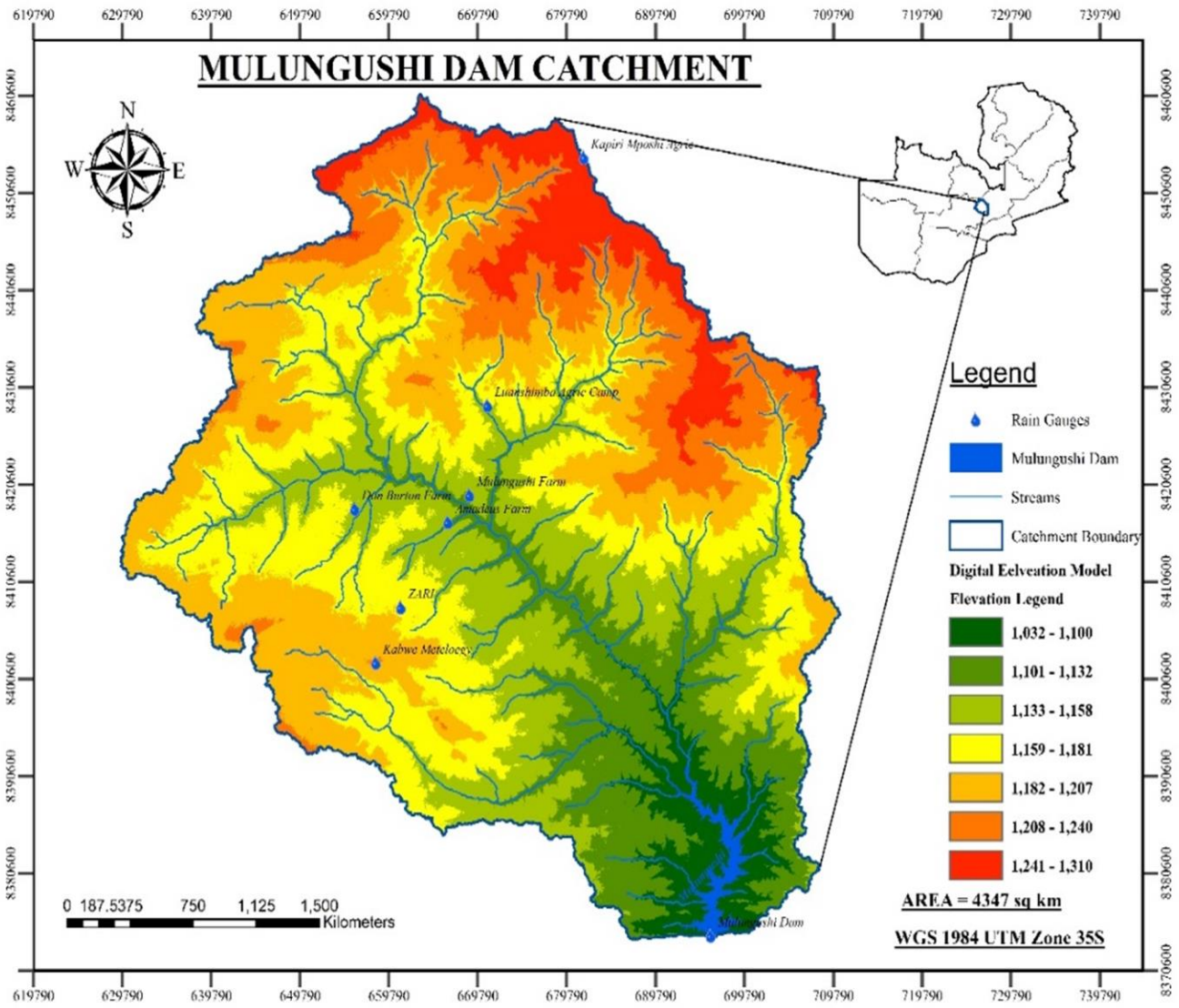


PROBLEM STATEMENT

- The Mulungushi catchment faces challenges due to escalating water demand.
- It is used for domestic water supply, irrigation and hydropower generation
- To promote prudent management of water resources, it is important to determine the catchment's maximum water capacity to enable optimized water allocation plans

STUDY AREA

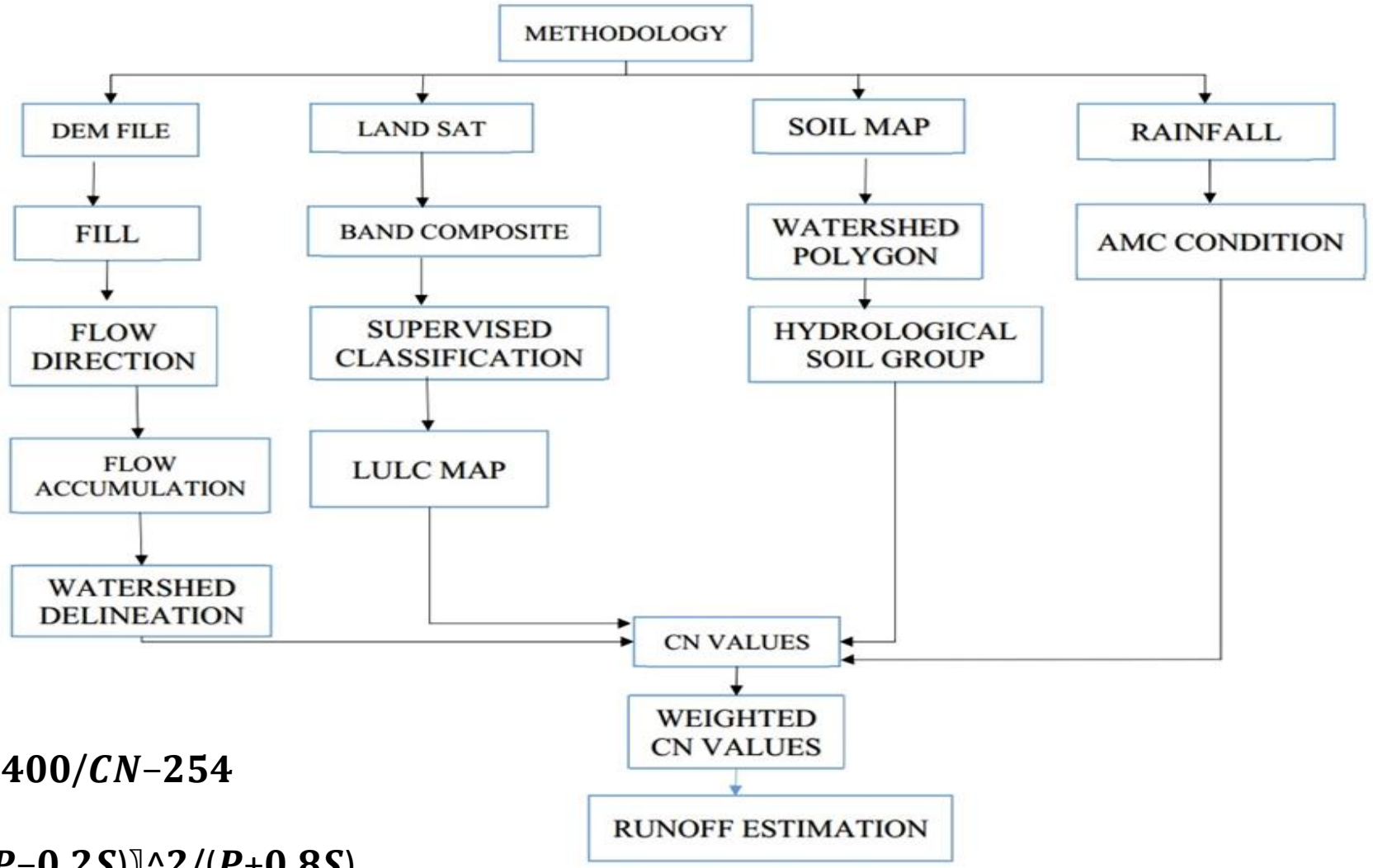
- Mulungushi catchment area is a sub catchment of the Lunsemfwa river basin.
- It houses Kapiri and Kabwe town.
- Predominantly covered by open forest and suitable for agricultural practices as it is covered with loamy soil, hydrological soil group D.
- The catchment receives a mean rainfall of 925mm per annum.



OBJECTIVES

- To determine the water yield potential of Mulungushi catchment area using ARCGIS (SCS-CN model).
- To assess the relationship between rainfall and the water yield of a catchment area.
- To evaluate the relationship between land use and the water yield potential of a catchment area.

METHODOLOGY



$$S=25400/CN-254$$

$$Q=[(P-0.2S)]^2/(P+0.8S)$$

RESULTS

- According to the rainfall data obtained from the meteorological centre in Kabwe there has been a 4.2% decrease in annual rainfall from 1951 to 2023.
- 1990 was used as a year of comparison in order to monitor significant changes in the land use of the catchment.
- After the generation of land use map, the CN value of the catchment was estimated as 86, showing that it has a high chance of generating surface runoff.

land use	% in 1990	% in 2023	% change
water	9.68	0.49	94.90
Built-up	4.83	5.94	18.64
vegetation	75.78	90.03	15.83
Bare/ shrubs	9.71	3.54	63.52

ANALYSIS

- The water yield of the catchment was calculated in excel as 31.94 m^3/sec and the potential maximum retention as 41.35mm.
- The year of comparison (1990) had a discharge of 45.9m^3/sec.
- Though the catchment had a CN value that supported high runoff and yield potential the catchment had a reduction in the yield through the years due to the reduction in the amount of precipitation received.

CONCLUSION AND RECCOMENDATIONS

- The study estimated Mulungushi catchment's water yield at 31.94m³/sec with the SCS-CN model.
- Rainfall reduction which is due to climate change and land use variations affected the yield.
- Indicating that rainfall is directly proportional to the yield of a catchment while vegetation cover is inversely proportional to the yield of the catchment.

CONCLUSION AND RECCOMENDATIONS – Cont'd

- Future research on Mulungushi Catchment should explore alternative yield estimation methods, addressing limitations like single-point rainfall data by incorporating multiple points for validation.
- Future research should conduct a feasibility study on Mulungushi catchment's water management system, assessing its performance and proposing improved water allocation strategies based on the climatic changes experienced by the catchment.

The End

THANK YOU FOR YOUR ATTENTION.