



# Drought measurement



# Overview

- Definitions of drought
- Rarotonga case study
- Practical exercise – Excel example
  - Rainfall depreciation method (weighted sum)
  - Decile method

# Reactions to the 1997-98 El Nino

- Water supply reliability severely tested
  - Kiribati - *impact on groundwater lens*
  - Marshall Is - *interest in desalination*
  - Fiji Is - *Suva water supply, Drought Emergency*
  - Cook Islands - *need for demand management*
- Questions
  - How long is the current drought going to last?
  - How severe is it? What can be done?
  - How frequently can droughts be expected?

# Drought as a Natural Hazard

- Loss of life
- health problems
- increased risk of fire
- deterioration of water quality
- loss of agricultural production
- increased demand for water
- salt water intrusion

# Drought Definitions

- Partial or total absence of rainfall or irregular distribution during a period in which precipitation should occur
- prolonged or abnormal moisture deficiency
- “a worrisome lack of rain”
- Meteorological, Agricultural, Hydrological, Socioeconomic

# The Climate / Drought Linkage

Climatic State

Precipitation Anomaly

Water Resources Anomaly

(low stream flows, groundwater and soil moisture levels)

Drought Effects

(loss of production, health problems, etc.)

# Measuring Drought

- Climate data based
  - Palmer Drought Index (PDI)
  - Standardized Precipitation Index (SPI)
  - Decile (percentile ranking)
  - Rainfall depreciation
- Effects based
  - Remote sensing
  - Socioeconomic survey of impacts

# Reducing Drought Consequences

- Coping e.g.
  - leak detection & control
  - water conservation campaigns
  - emergency water supplies
- Adaptation e.g.
  - changes in farming patterns
  - drought tolerant species
  - irrigation
  - drought management plans



# Rarotonga, Cook Islands

- Reticulated water supply dependent on several small catchments
- No effective storage
- Limited control on water use from reticulated supply
- Need for demand management and leak control

# Rarotonga Water Supply - Overview

- 12 Water intakes sited within small catchment areas
- 4 Underground horizontal water galleries
- 120km pipeline network
- Limited storage
- Untapped groundwater

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# Rarotonga water supply

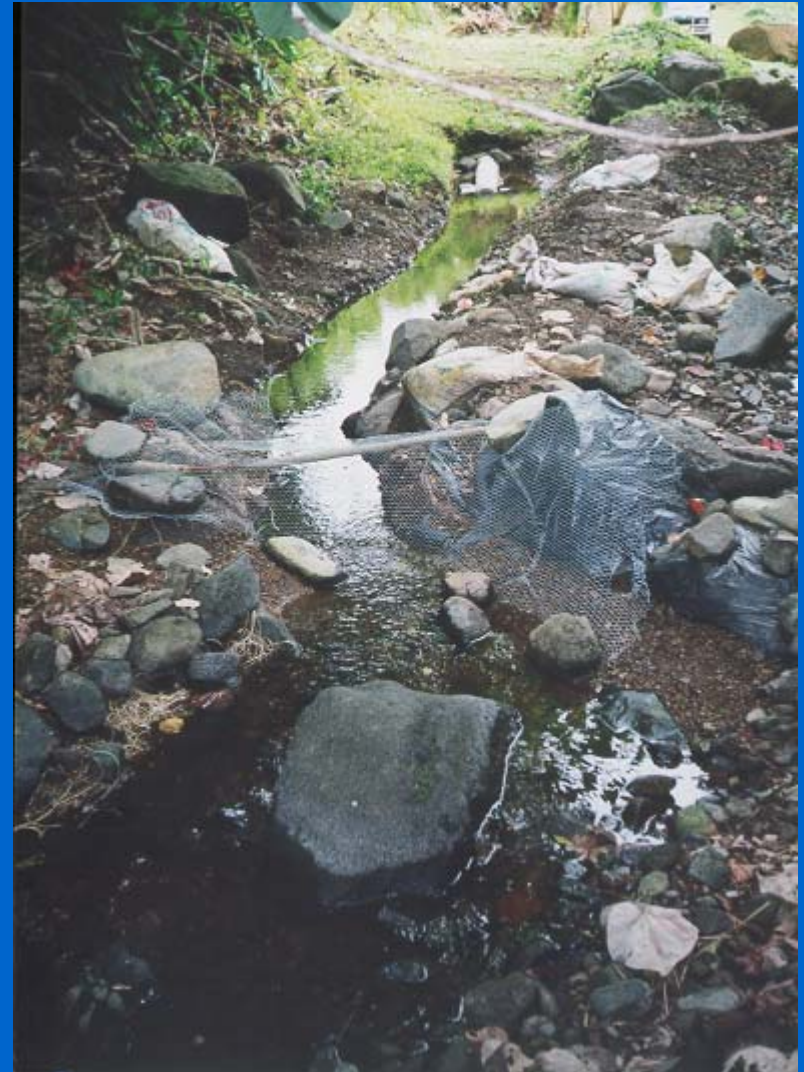
Very low water flow  
in stream/high flow loss  
in pipeline network





- Impact of drought on Rarotonga  
water supply

Stream flow diverted  
into intake by-pass  
line



# Rarotonga Water Supply

May 98



July 98



# Rarotonga Water Supply

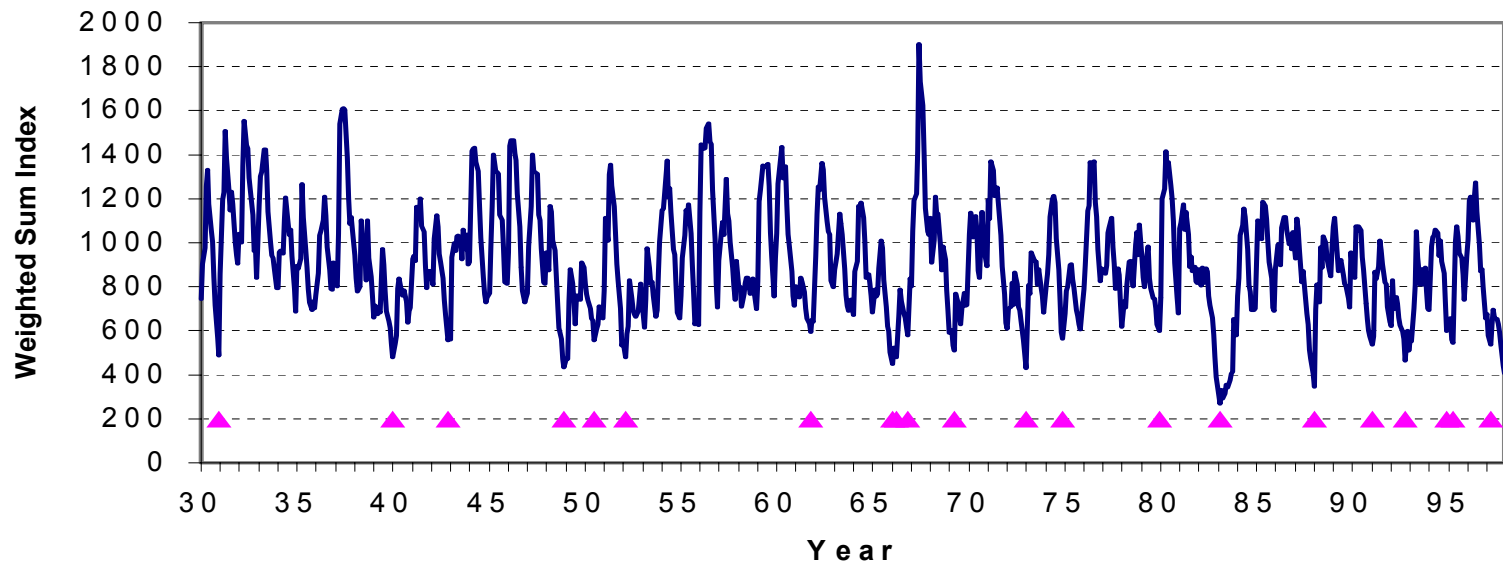
Water Supply Management requires methods for:

- Early warning of drought events
- Prediction of severity and duration
- Prediction of future drought events
- Drought severity/duration/frequency

*To manage drought we need to measure it*

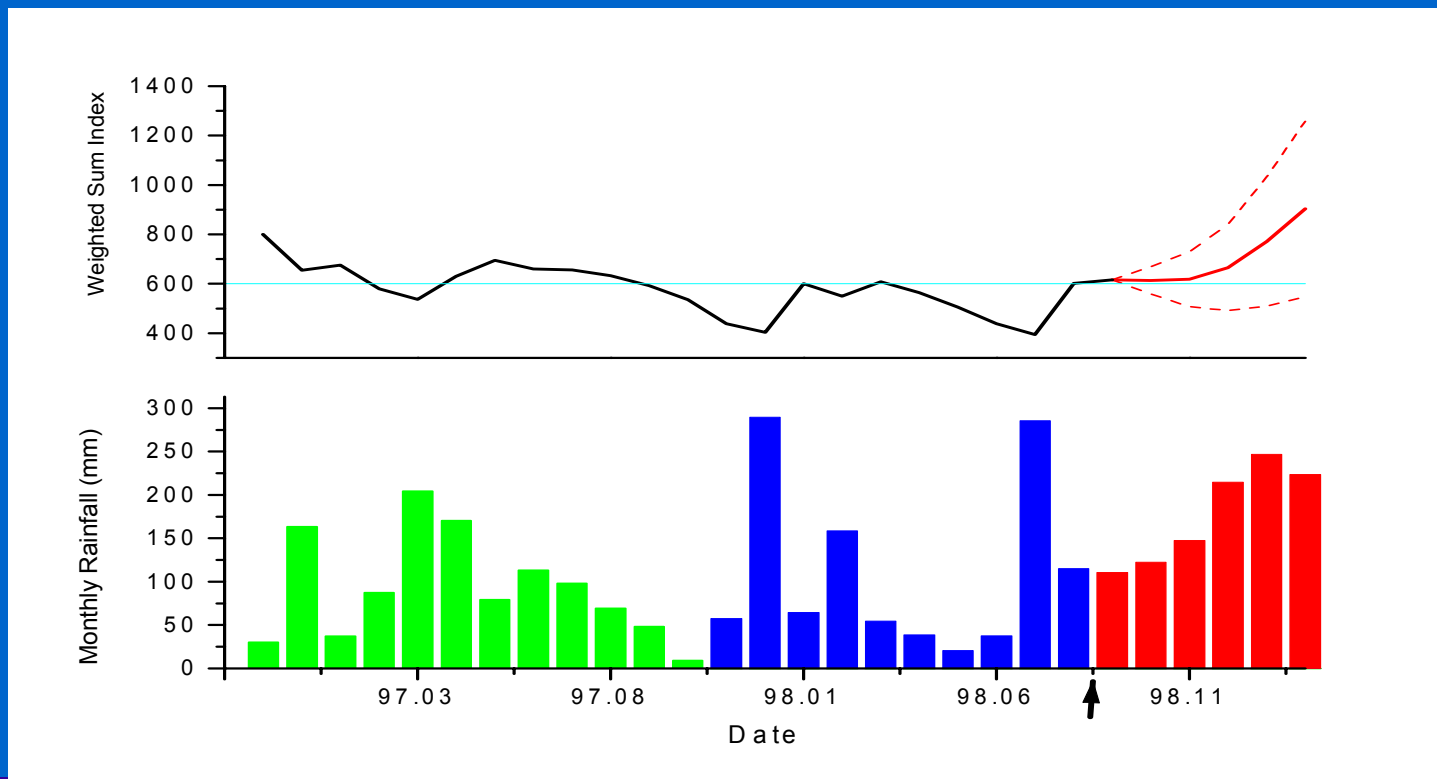
# Weighted Sum Index

Uses a time window with increasing weight given to most recent rain (a measure of catchment memory)



# Drought Forecast

Long term rainfall forecast allows a forecast of drought persistence



# Rarotonga Management Options

- Public information to increase public and political awareness
- Control of irrigation watering from the reticulated supply
- Bans on specified classes of water use during severe or extreme droughts

# Information Needs

- need for information to allow response to a particular drought
- need for information on viable strategies for coping with drought
- need information on the nature of the drought hazard -  
severity/duration/frequency

# Practical exercise

- Use Suva or Nadi monthly time series data to calculate drought indices:
  - Deciles
    - PERCENTRANK function
  - Rainfall depreciation method
    - $\text{Index} = 0.9 * R_0 + 0.8 * R_1 + 0.7 * R_2 + 0.6 * R_3$  etc.