



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

-
-
-

Rarotonga water supply

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



-
-
-

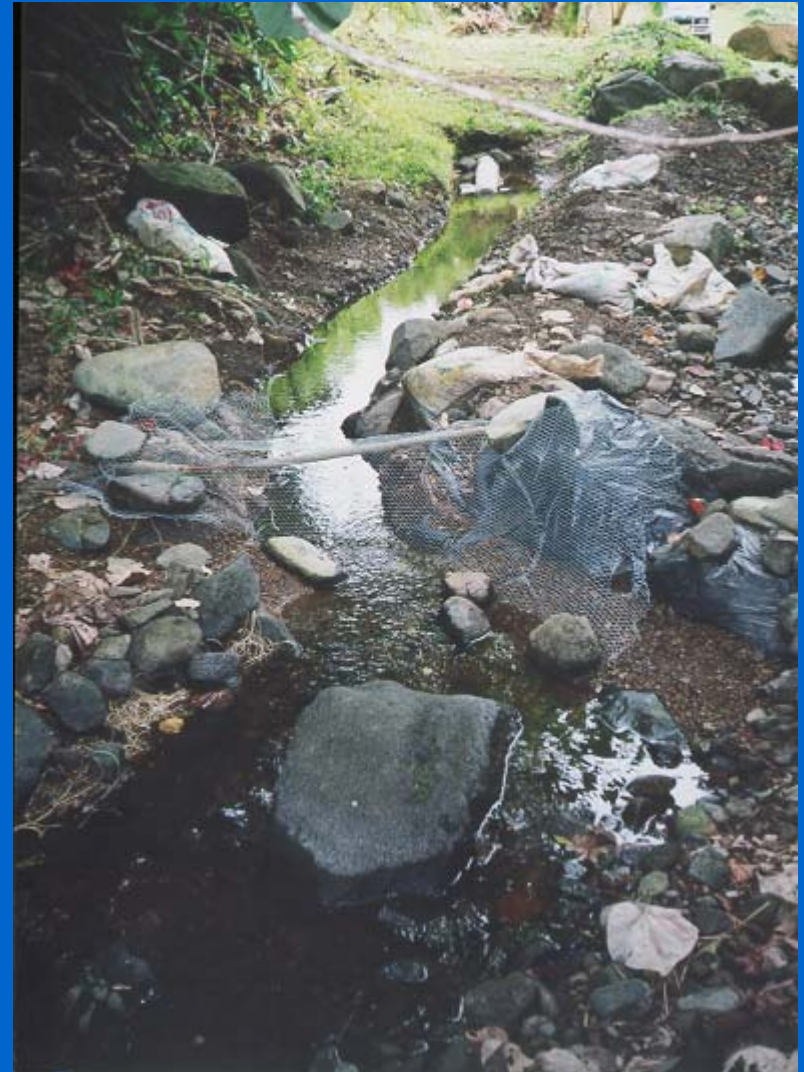
Impact of recent drought on Rarotonga water supply

Instream filterbeds dry



- 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

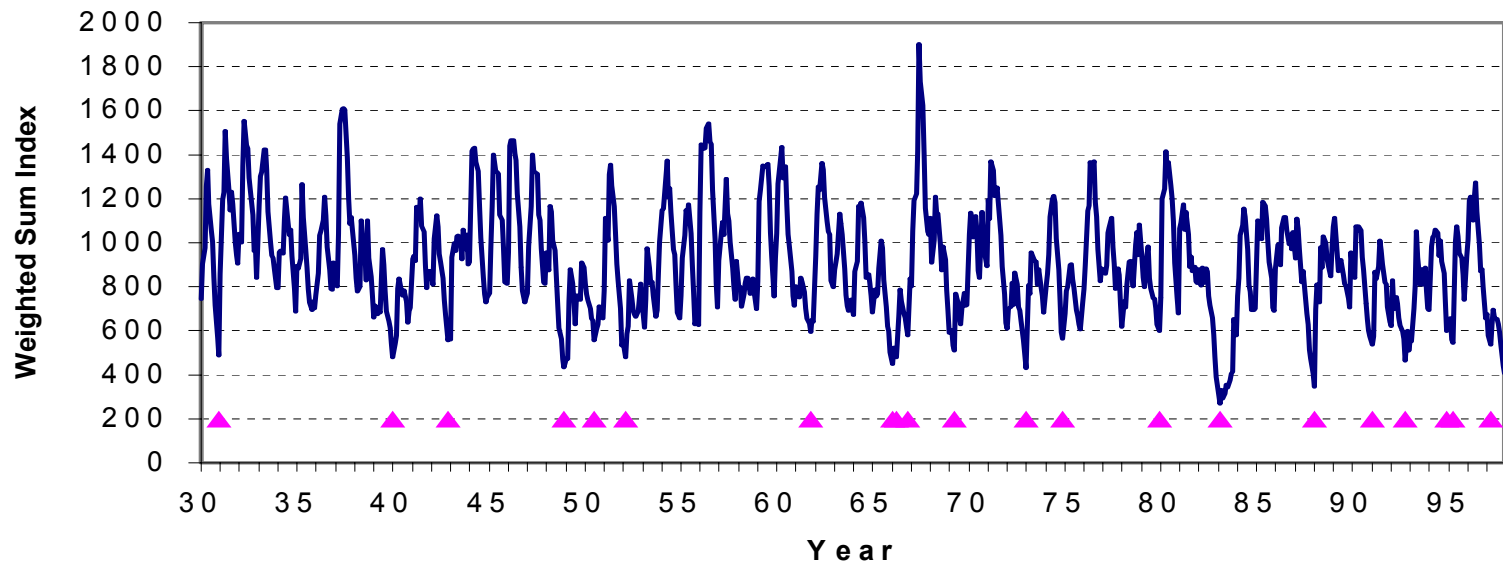
Water Supply Management requires methods for:

- 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

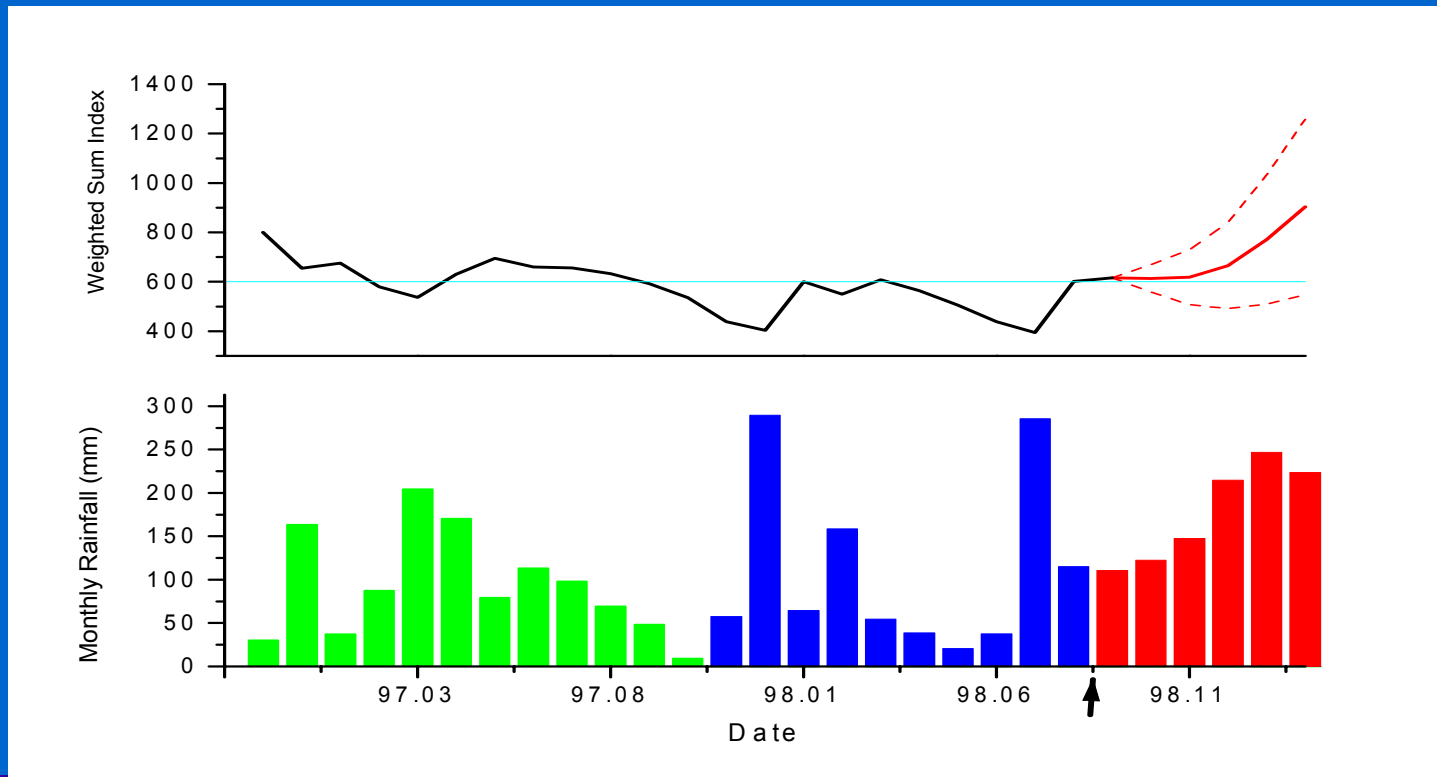
Weighted Sum Index

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.