# Water use accounting in the Volta basin

## Basin Focal Project – Volta

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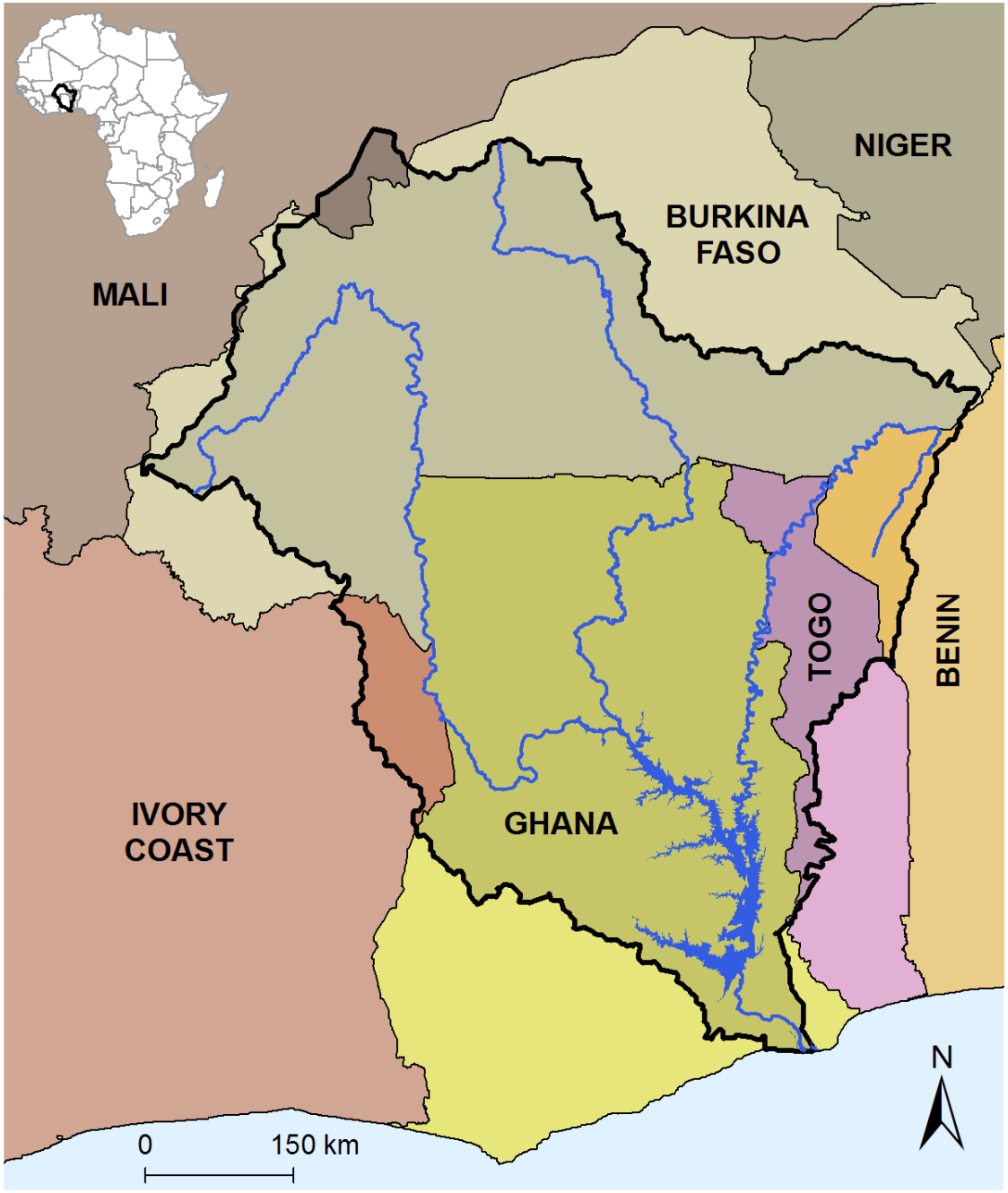
# The Volta basin – Location




- 400,000 km².
- Transboundary basin shared by 6 countries.

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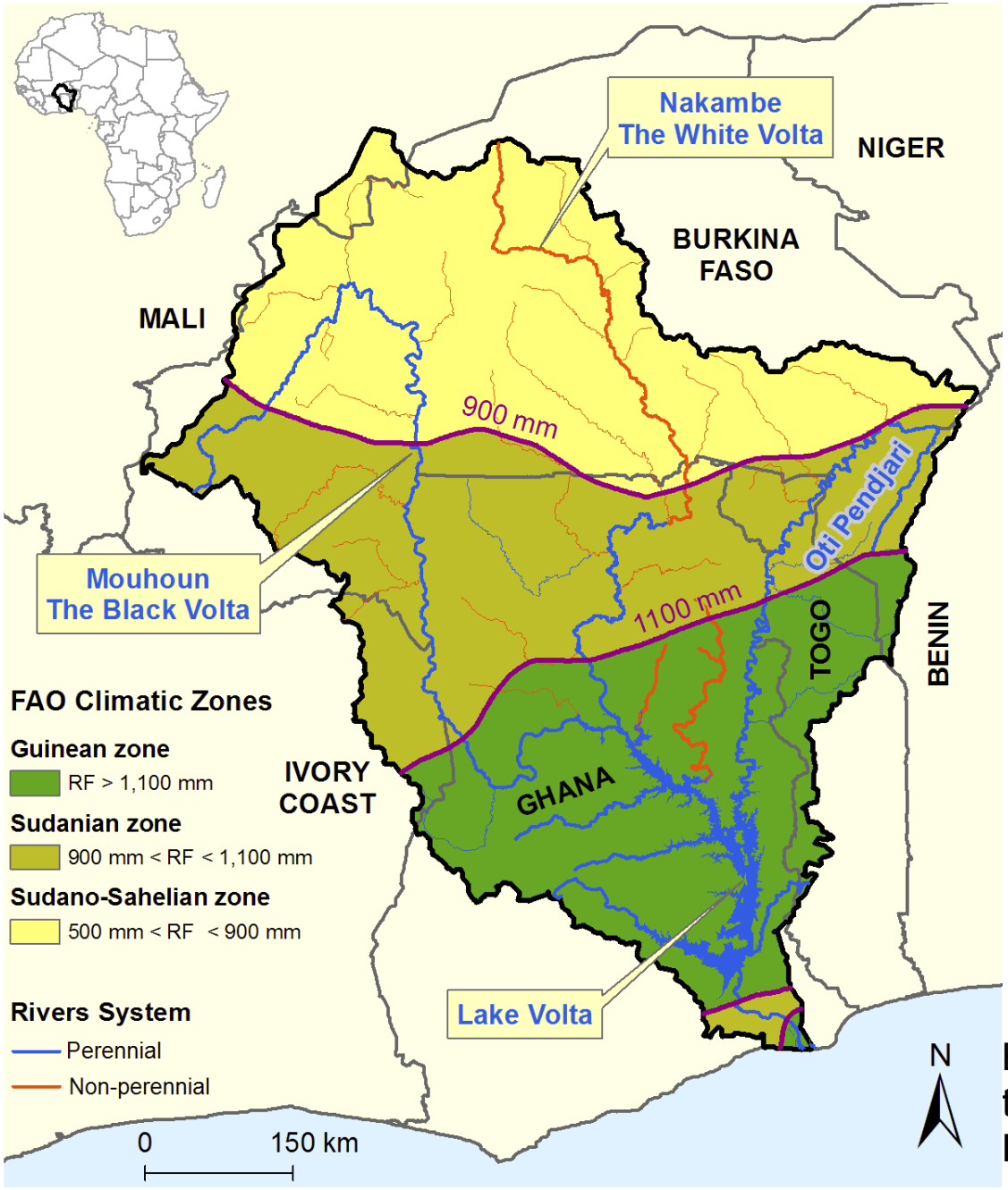
# The Volta basin – Climate & Rivers system




- Rainfall gradient:
  - drier in the North,
  - wetter in the South.
- ⇒ **upstream drier than downstream**.
- 3 main rivers system:
  - 2 perennial,
  - 1 non-perennial.
- Downstream, Lake Volta:
  - largest man made lake,
  - 8,500 km².

Based on data from the CRU
Period 1980 - 2000

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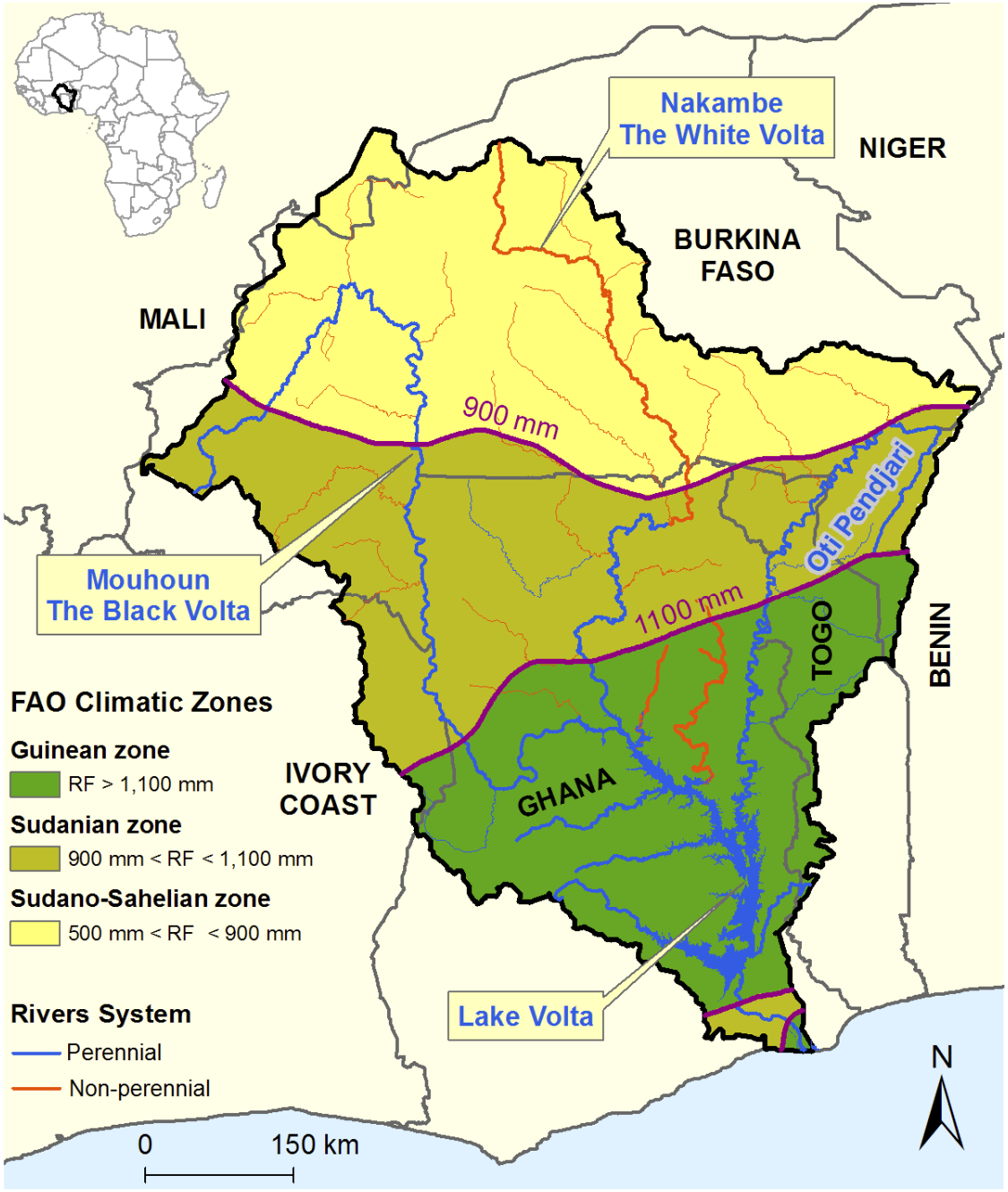
# The Volta basin – Aim of this work




- **Aim**: assess the Basin's water resource:
  - how much water is received by the Basin?
  - Basin uses?
  - distribution?

- **Tool**: the Water Use Account Spreadsheet of Kirby et al. (2006), relevant for such a large basin.

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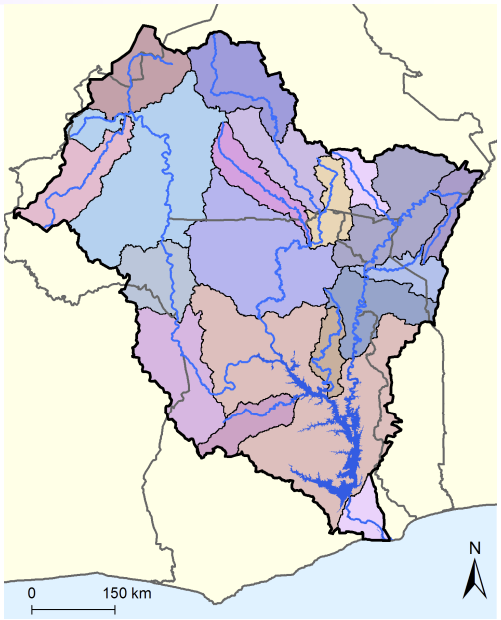
# Input data

- Digital Elevation Model:
  - 19 sub-basins,
  - modelling entities.




- Meteorological data from the Climate Research Unit:
  - precipitations,
  - temperature.
- Observed river-flows:
  - at the outlet of the 19 sub-basins,
  - data from:
    - → Volta HYCOS,
    - → Monthly Discharge Data for World Rivers dataset.

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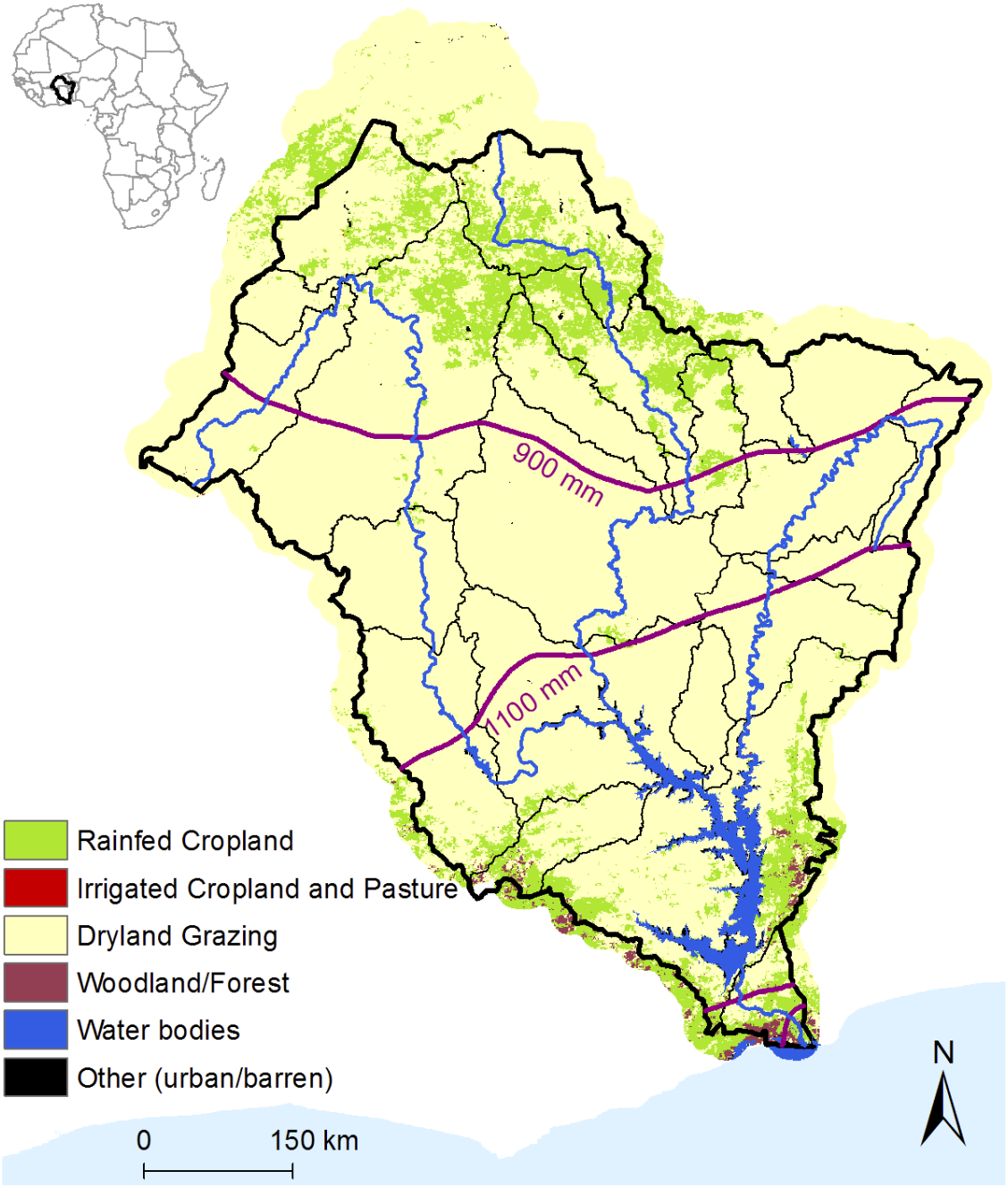
# Input data – Landuse




- Agglomerated landuse categories ⇒ 2 main classes:
  - Dryland Grazing,
  - Rainfed Cropland.
- Errors in Rainfed Cropland ⇒ correction with national agricultural statistics.

Adapted from AVHRR / USGS

# Calibration

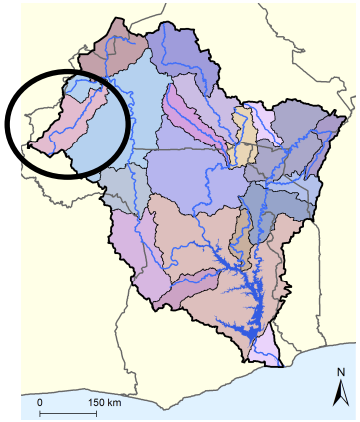
- 2 steps for calibration over a given period:
  1. Reproduce the **total flow volume**.
  2. Reproduce the **shape of the hydrogram**.
- Quality of the calibration was estimated with the Nash-Sutcliffe coefficient.

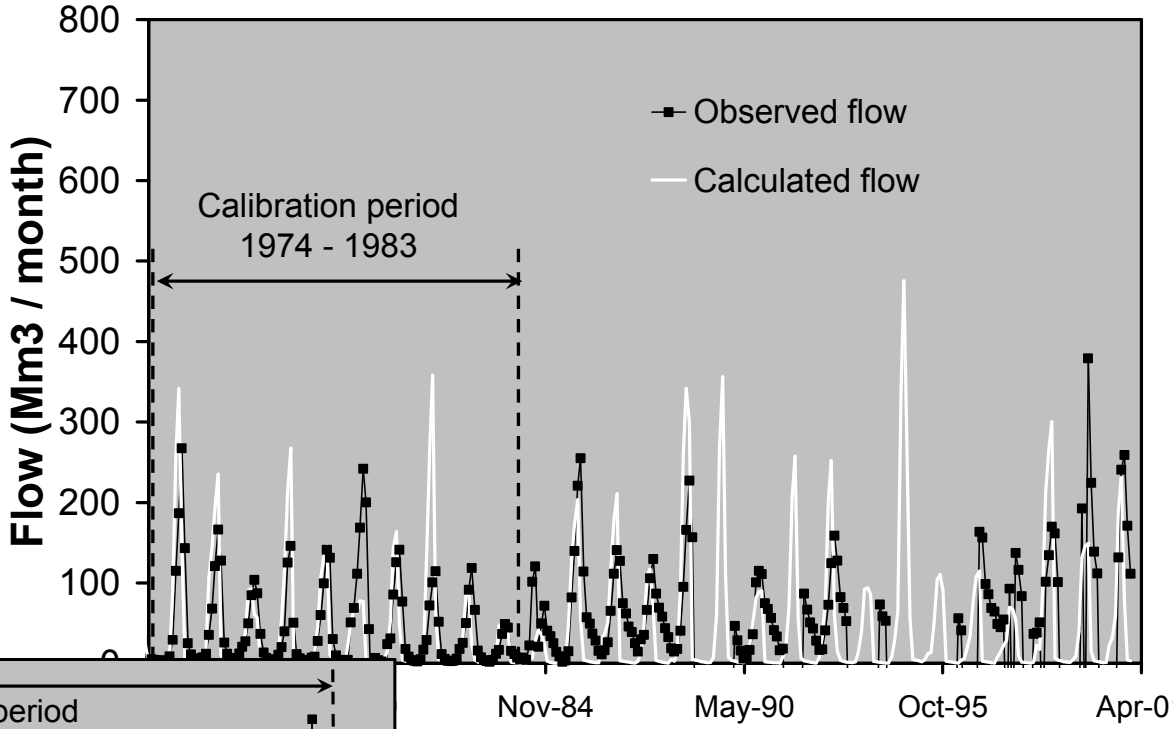
- Difficulty in the Volta basin: observed flows are more or less available.

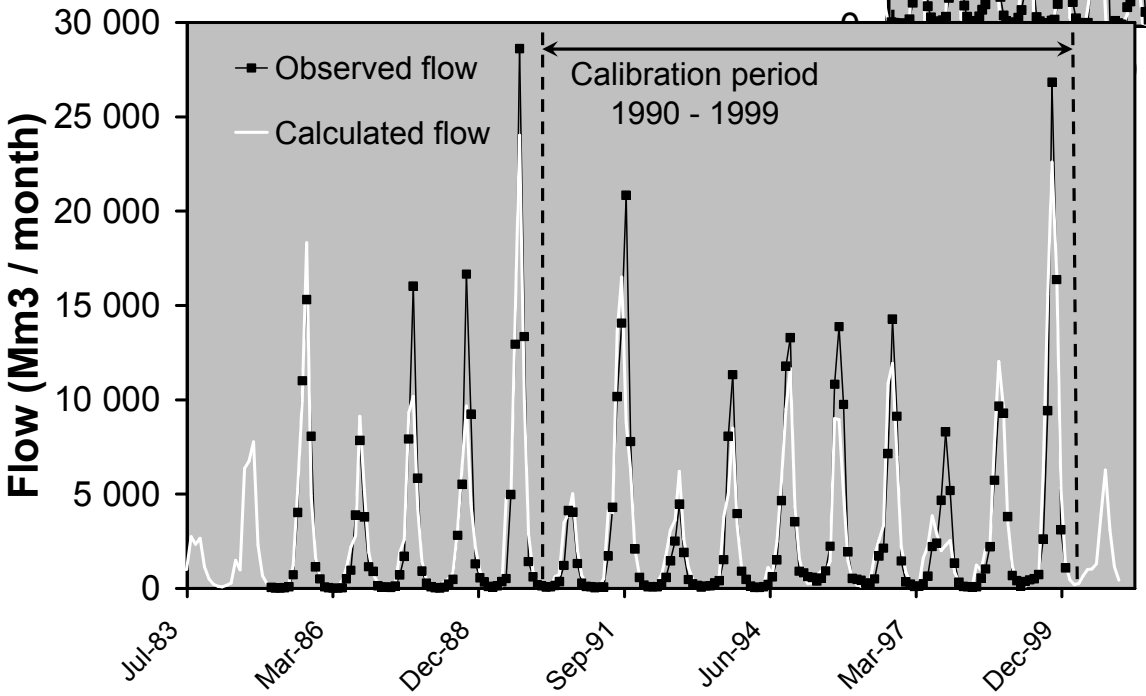
# Calibration

## Bad

Nash-Sutcliffe coefficient < 0

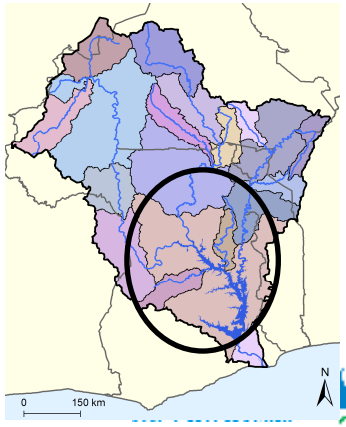



## Good

Nash-Sutcliffe coefficient = 86%

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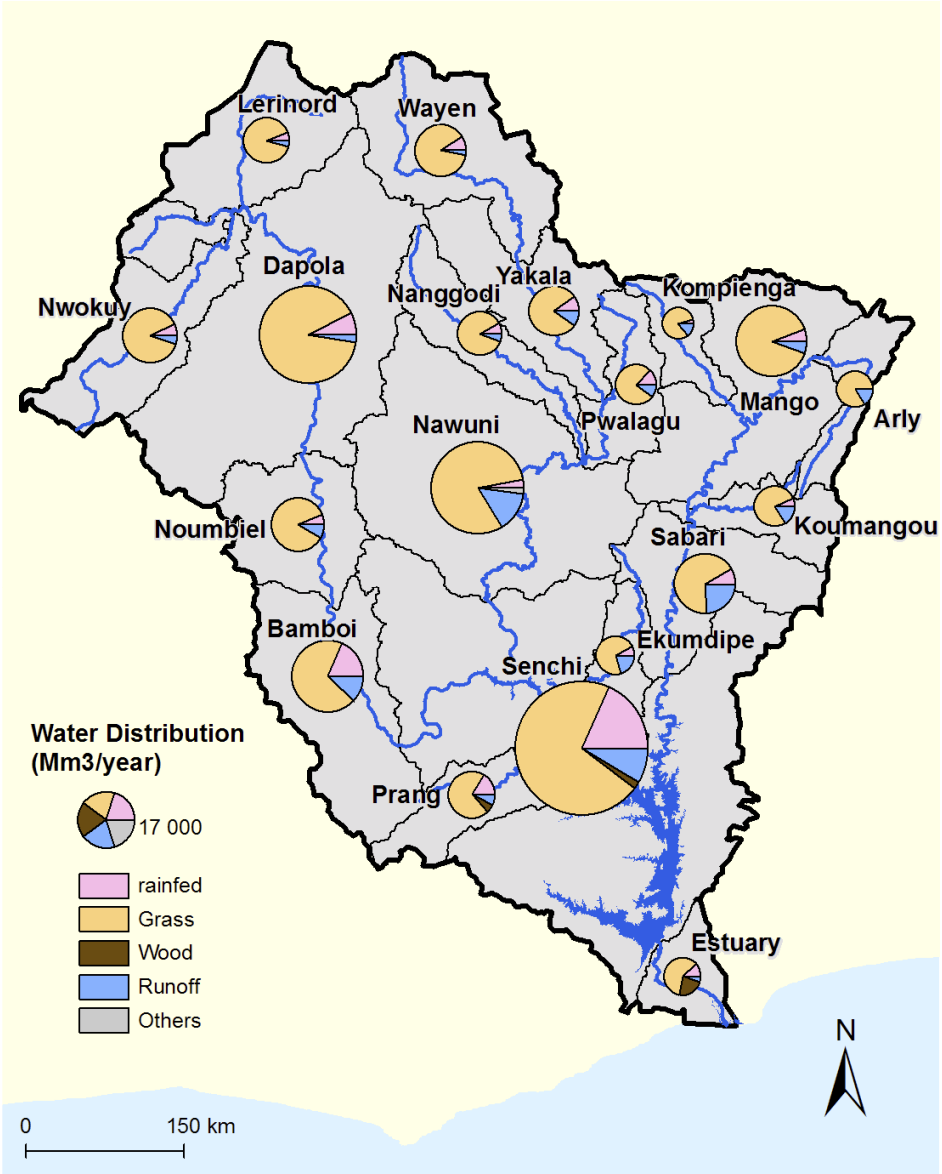
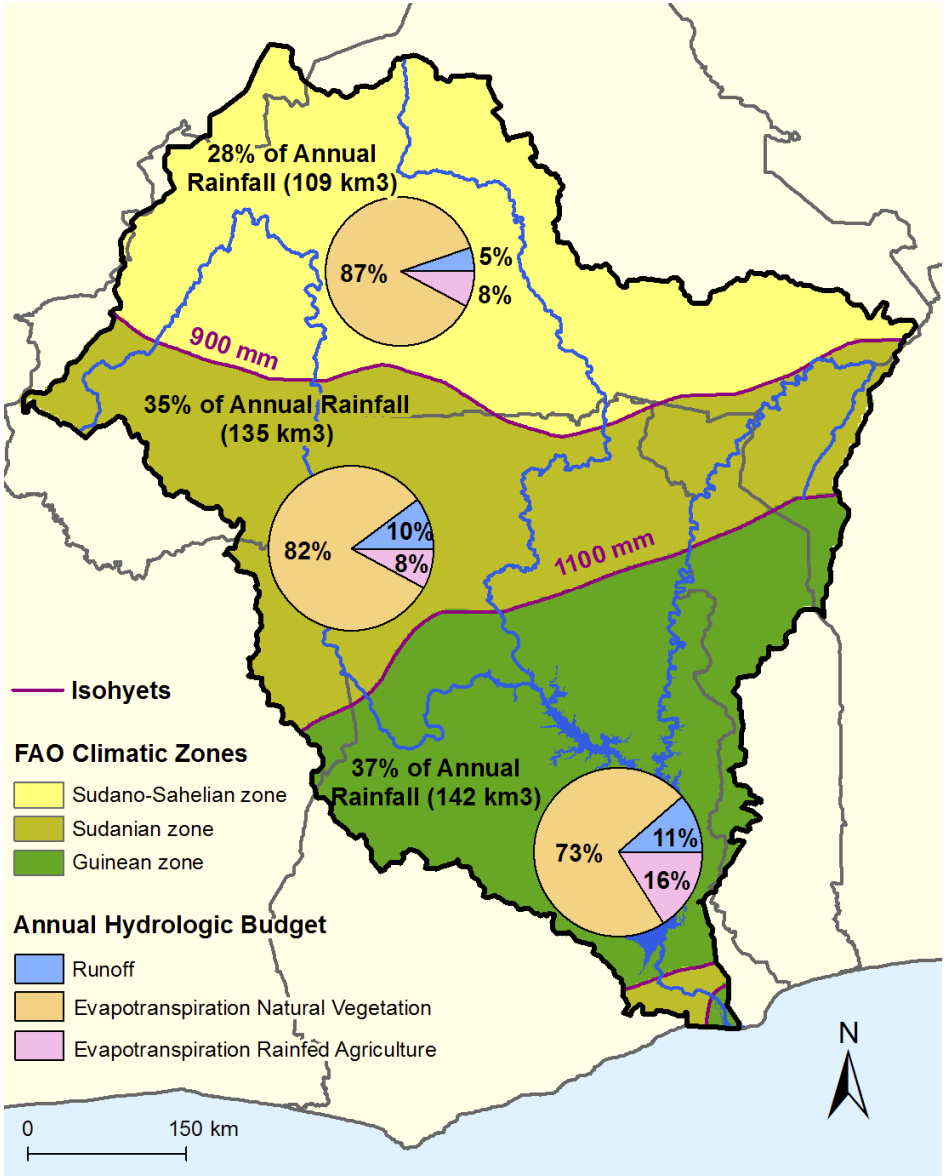
# Results – Overview of the Water Resource




Average values for the period 1990 – 2000.

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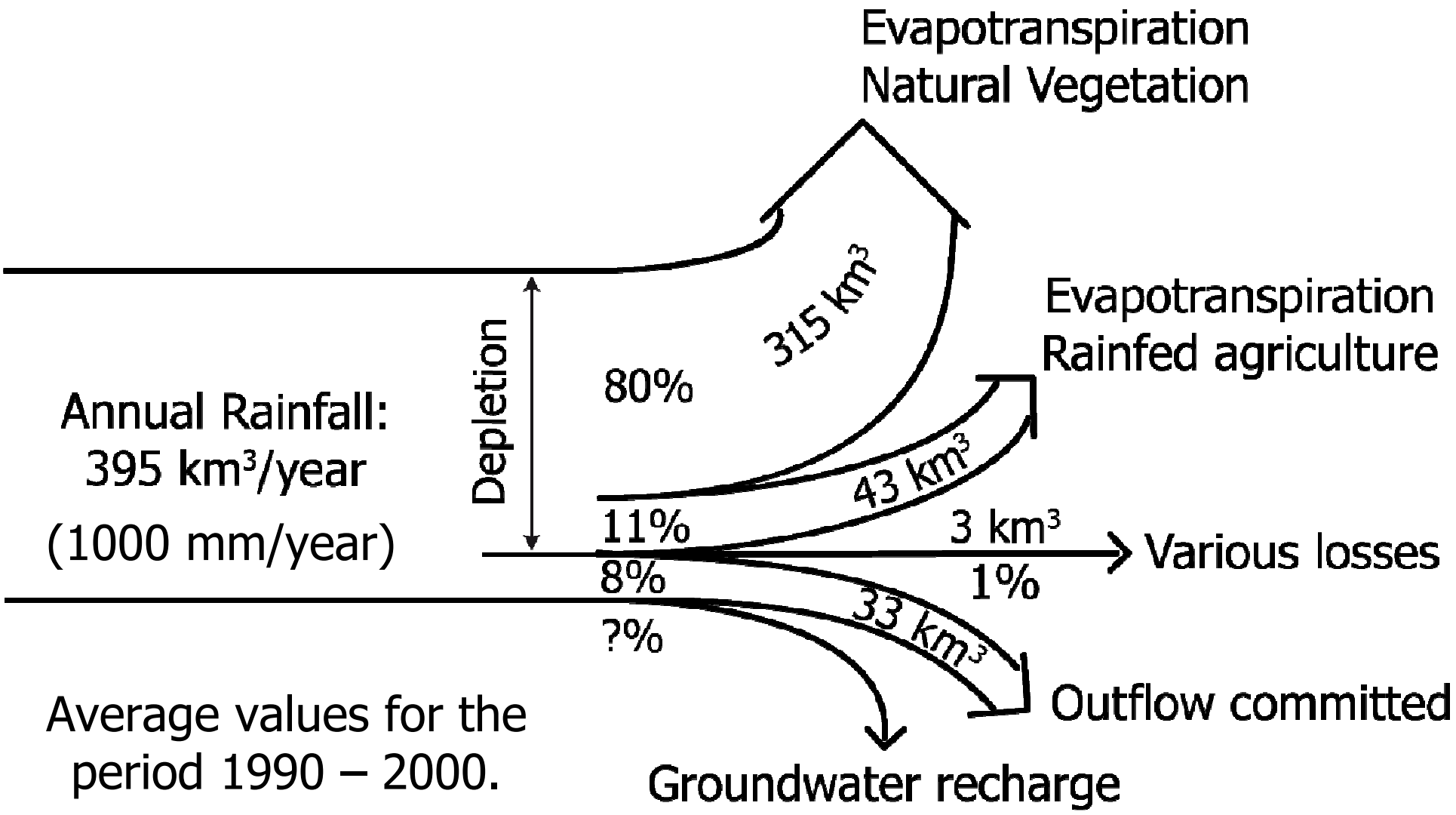
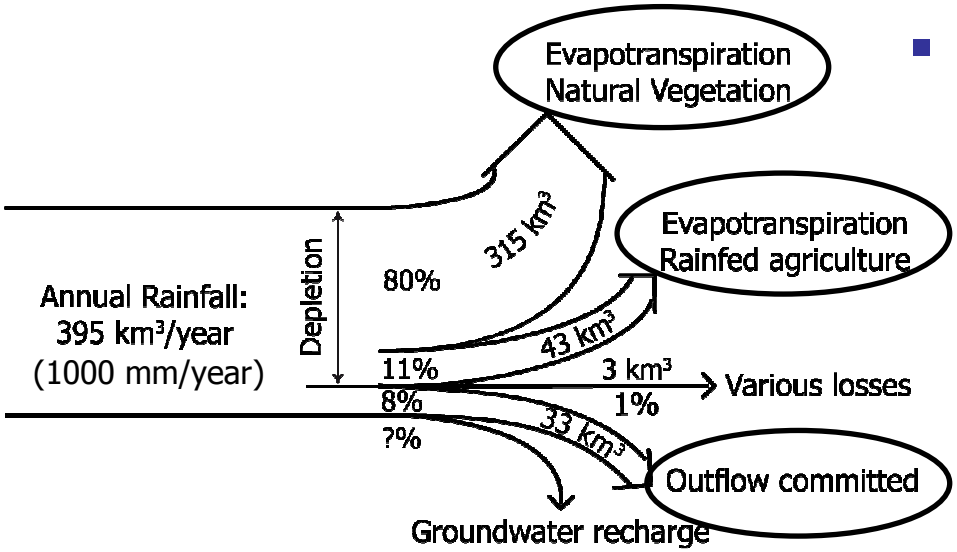
# Results – Water Accounting




Average values for the period 1990 – 2000.

# Results – Water Accounting and Water Uses

- How to increase the Water Uses?
- Outflows underused in the Basin.
- But one should keep in mind that Outflows and Evaporation from Natural Vegetation have non-economic values (natural, cultural, religious).




- Here: how to increase Agricultural Evapotranspiration?
  - Reduce Outflows:
    - → Soil and Water Conservation techniques,
    - → irrigation by development of Small Reservoirs.
  - Reduce Natural Evapotranspiration:
    - → increase agricultural lands.
  - Develop irrigation from groundwater.

# Continuation

- Uses and Allocation of outflows:
  - modelled with WEAP,
  - using river flows calculated by the Water Use Account Spreadsheet of Kirby et al. (2006),
  - e.g., trade-off between development of upstream Small Reservoirs and impacts on downstream flows,
  - presentation in the Science Topic 3 Session “Water benefits sharing for poverty alleviation and conflict management”.

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