RAF 7011: INTEGRATED AND SUSTAINABLE MANAGEMENT OF SHARED AQUIFER SYSTEMS AND BASINS OF THE SAHEL REGION

COUNTRY PRESENTATION- GHANA

INTRODUCTION

- The Upper Volta transboundary system consists of Upper East and West regions.
- The area covers about 27,000 km^2
- The total population is about 1,748,655.
- The climate of the area is semi-arid.

INTRODUCTION Contd.

- Average annual rainfall is1000mm.
- Temperatures varies from 18-38°C.
- Groundwater serves as a major source of potable water supply in the area.
- Therefore, sustainable groundwater resources is very important for the inhabitants.

HYDROGEOLOGY

- Groundwater occurrence and flow are mainly controlled by:
  - Secondary porosity,
  - Resulting from chemical weathering, faulting, fractures and shear zones

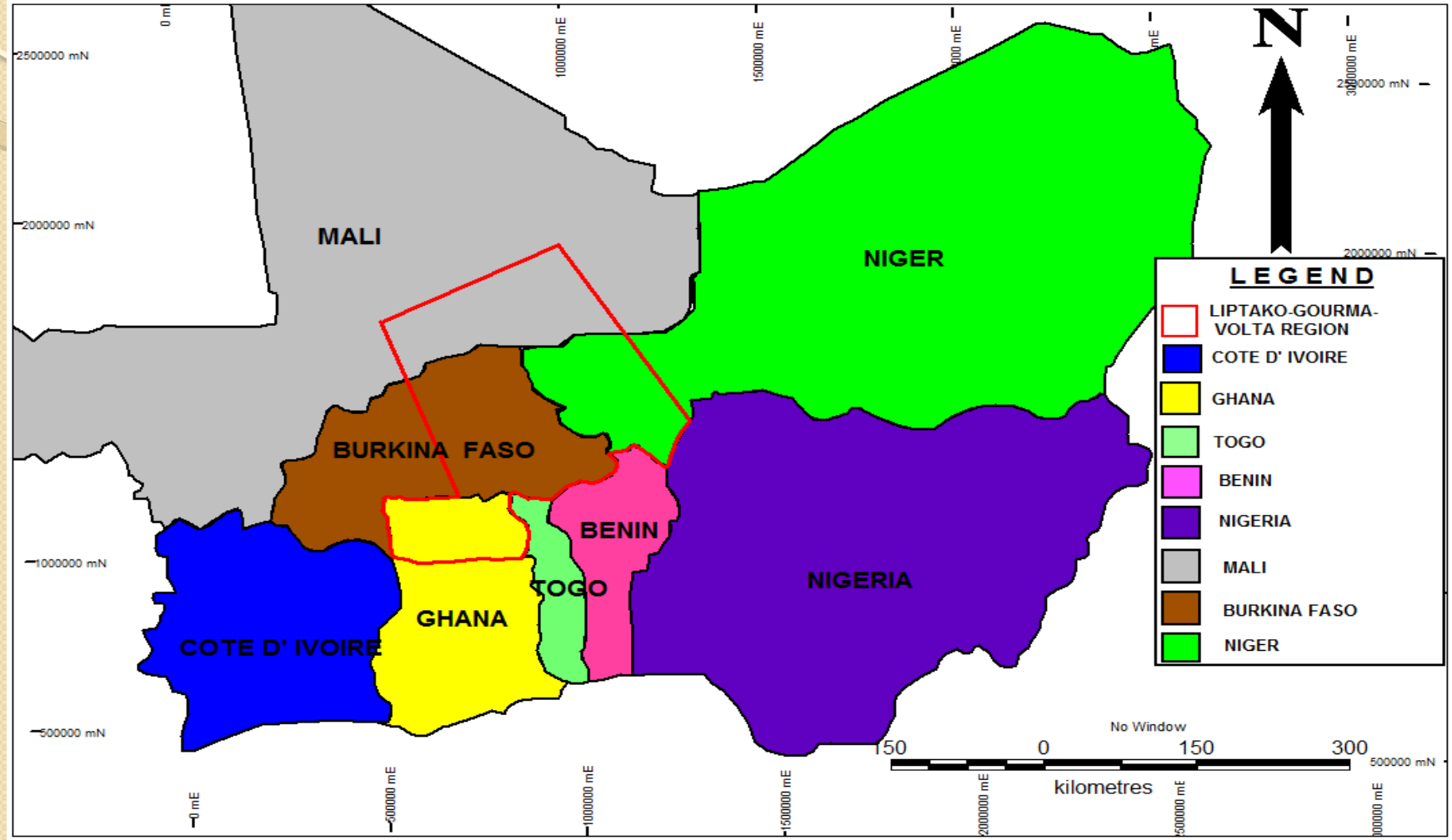
- Therefore, groundwater is located:
  - In the weathered layers of the volcanic and metavolcanic material (Birimian Supergroup)
  - And granitoids formation (intrusive rocks).

- The average depth of wells is around 80 m

PROBLEMS

- Some communities in the study area have experienced water quality problems.
- Among these are high concentrations of Fluoride, Nitrate, Arsenic and chloride.
- Low yield of aquifers in some communities
- Over exploitation of aquifers in some communities

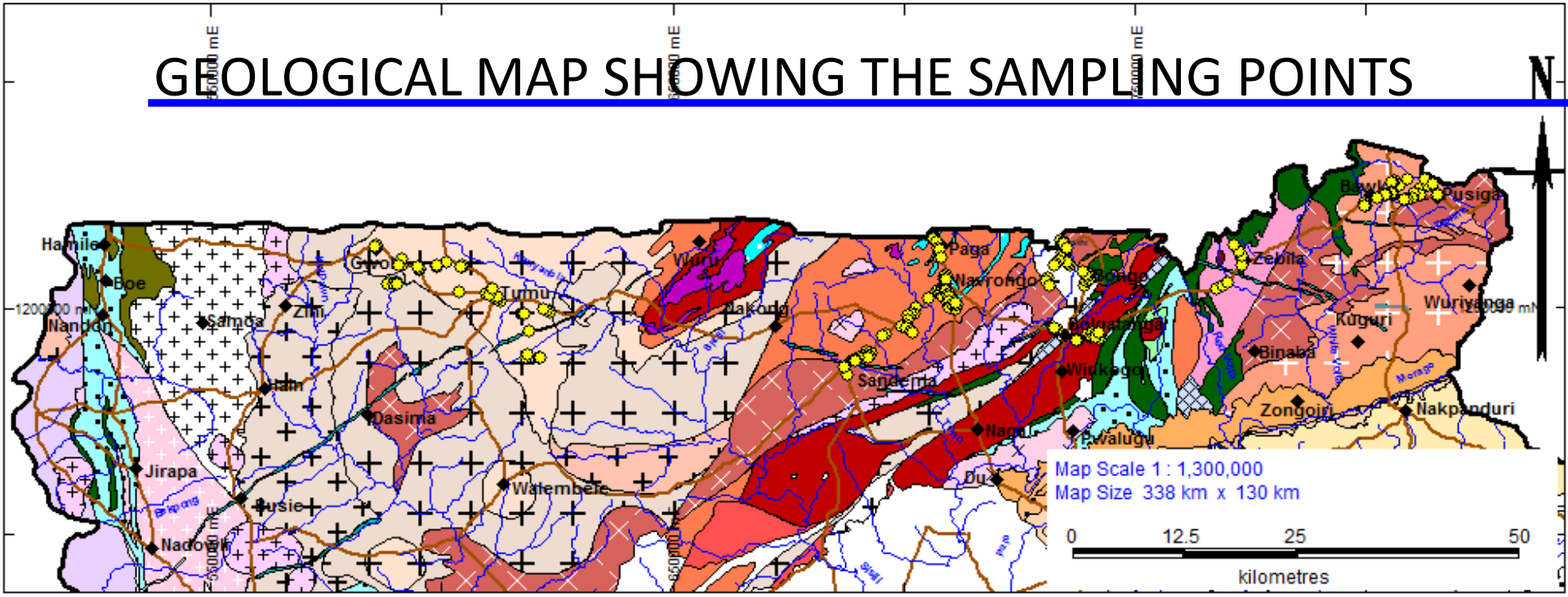
MAP OF THE STUDY AREA



CRITERIA FOR SELECTING SAMPLING POINTS

- Geology
- Area of potential over-exploitation
- Previous water quality problems

GEOLOGICAL MAP SHOWING THE SAMPLING POINTS



LEGEND

Samples

Mafic dyke, dolerite

Eburnean Plutonic Suite

- Two mica or muscovite granite and minor granodiorite
- K-feldspar - rich granitoid, mainly granite and monzonite (Banso/Bongo type)
- Biotite granodiorite
- Biotite granite and minor granodiorite, K- feldspar porphyritic
- Biotite (+/- hornblende +/- muscovite) granites undifferentiated
- Hornblende biotite tonalite, minor granodiorite, minor quartz diorite
- Hornblende - biotite diorite or quartz diorite
- Hornblende - biotite granitoid, undifferentiated
- Biotite tonalite
- Hornblende-biotite tonalite, minor granodiorite, minor quartz diorite

Tarkwaian Supergroup

- Detrital sediment, mainly sandstone and conglomerate undifferentiated
- Biotite-hornblende (monzo) granite, quartz monzodiorite and monzodiorite

Birimian Supergroup

Sedimentary basin

- Chert (Syn or epigenetic)
- Sediment/volcaniclastic sediment (undifferentiated)

Volcanic rocks

- Dacitic to rhyolitic flow/ subvolcanic rock minor interbedded volcaniclastic
- Basaltic flow/ subvolcanic rock minor interbedded volcaniclastic
- Undifferentiated volcaniclastic flow, spatially associated and interbedded with rock flow
- Volcanic flow/ subvolcanic rock and minor interbedded volcaniclastic, undifferentiated

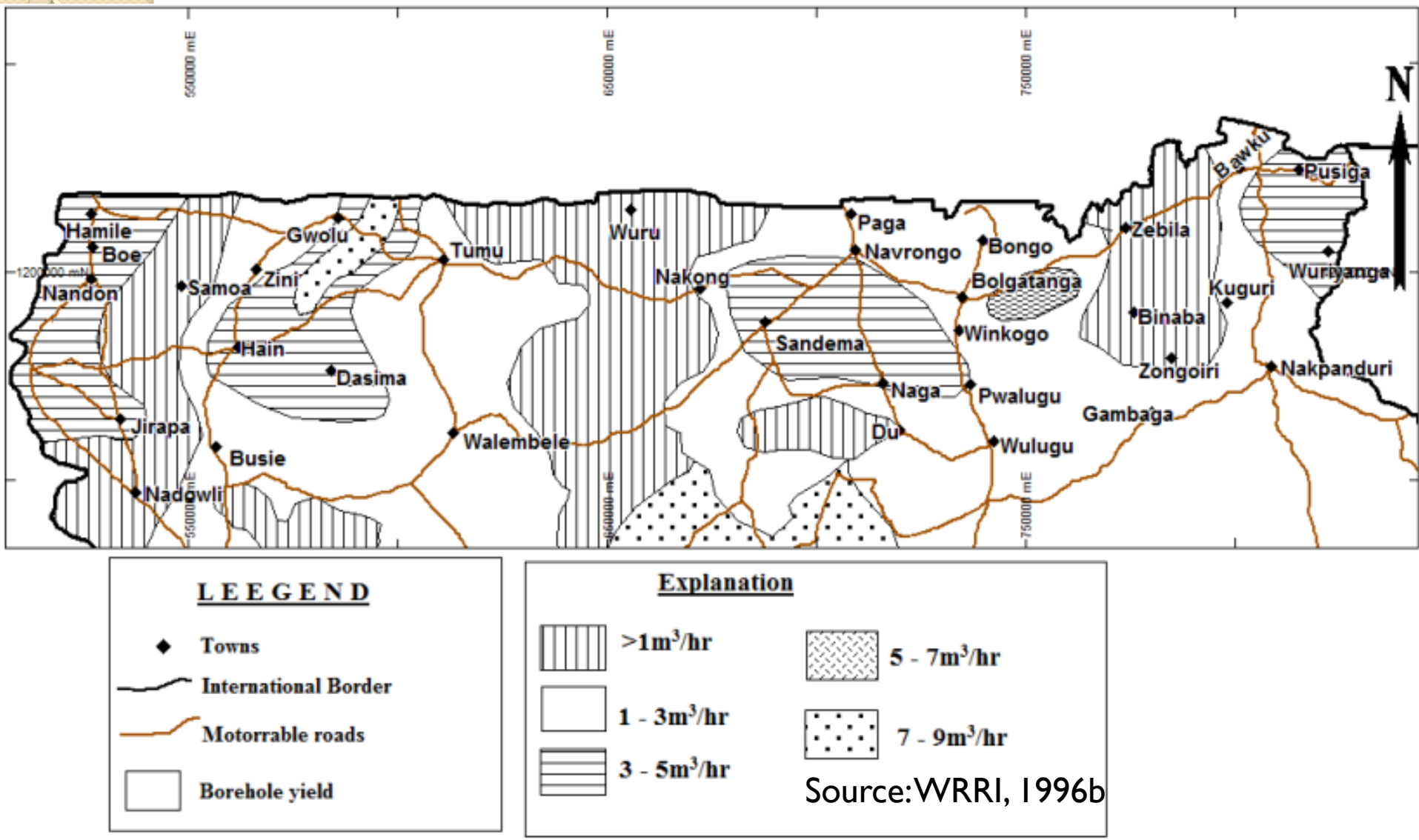
volcanic belts

- Biotite granitoid, undifferentiated, mostly granodiorite
- Hornblende - biotite granodiorite
- Horblende - biotite granitoid, undifferentiated
- Gabbro, Norite

Birimian protolith affected by Eburnean tectono - metamorphic overprint

- Biotite gneiss, locally magmatitic and minor biotite schist
- Amphibolite, partly of contact metamorphic origin

Map showing Borehole Yield distribution in the Upper Regions



Source: WRRI, 1996b

Characteristics of major Aquifer Systems of Precambrian province in Ghana

Hydrogeologic provinces and Sub-provinces	Yield (m^3/h)	Transmissivity (m^2/d)	Borehole success rate (%)	Borehole depth (m)
Buem structural units	0.7 - 24.3	0.9 - 43	87.9	30 - 45
Togo structural units	0.7 - 24.3	0.9 - 43	87.9	33 - 80
Tarkwaian Supergroup	1.0 - 23.2	0.2 - 119	83	34 - 60
Birimian metavolcanic rock suite	0.5 - 23.6	0.2 - 119	76.5	35 - 62
Birimian metasedimentary rock suite	0.4 - 29.8	0.2 - 119	75	42 - 60
Eburnean granitoid	0.3 - 36.4	0.3 - 114	68-85	35 - 55

Source: HAP, 2006

HYDROGEOLOGICAL PROBLEMS TO BE ADDRESSED IN THE PROJECT

- Regional and Intermediate flow using Isotope and Chemical data
- Surface water and groundwater interaction
- Vulnerability of aquifer and protection
- Recharge estimation

AVAILABLE RECORDS

- Geological map, hydrogeological map and estimated hydraulic properties are available.
- They are available in hard copies, digital and formats compatible with GIS.
- However, geophysical explorations that give information on the geometry of aquifers under study are not available.

SAMPLING

- 200 groundwater samples from selected bore holes and hand dug wells
- On site measurements of some physicochemical parameters such as conductivity, temperature, pH and alkalinity were carried out.
- Location of sampling points (coordinates i.e. the latitude, longitude and altitude) using a global positioning system (GPS)

SAMPLING CON'T

Samples were taken for:

- Stable isotopes ($\delta^{18}O$ and $\delta^{2}H$)
- Tritium
- Carbon-14
- Chemical analyses (Major and Minor ions).

Duplicate samples for QA/QC purposes.

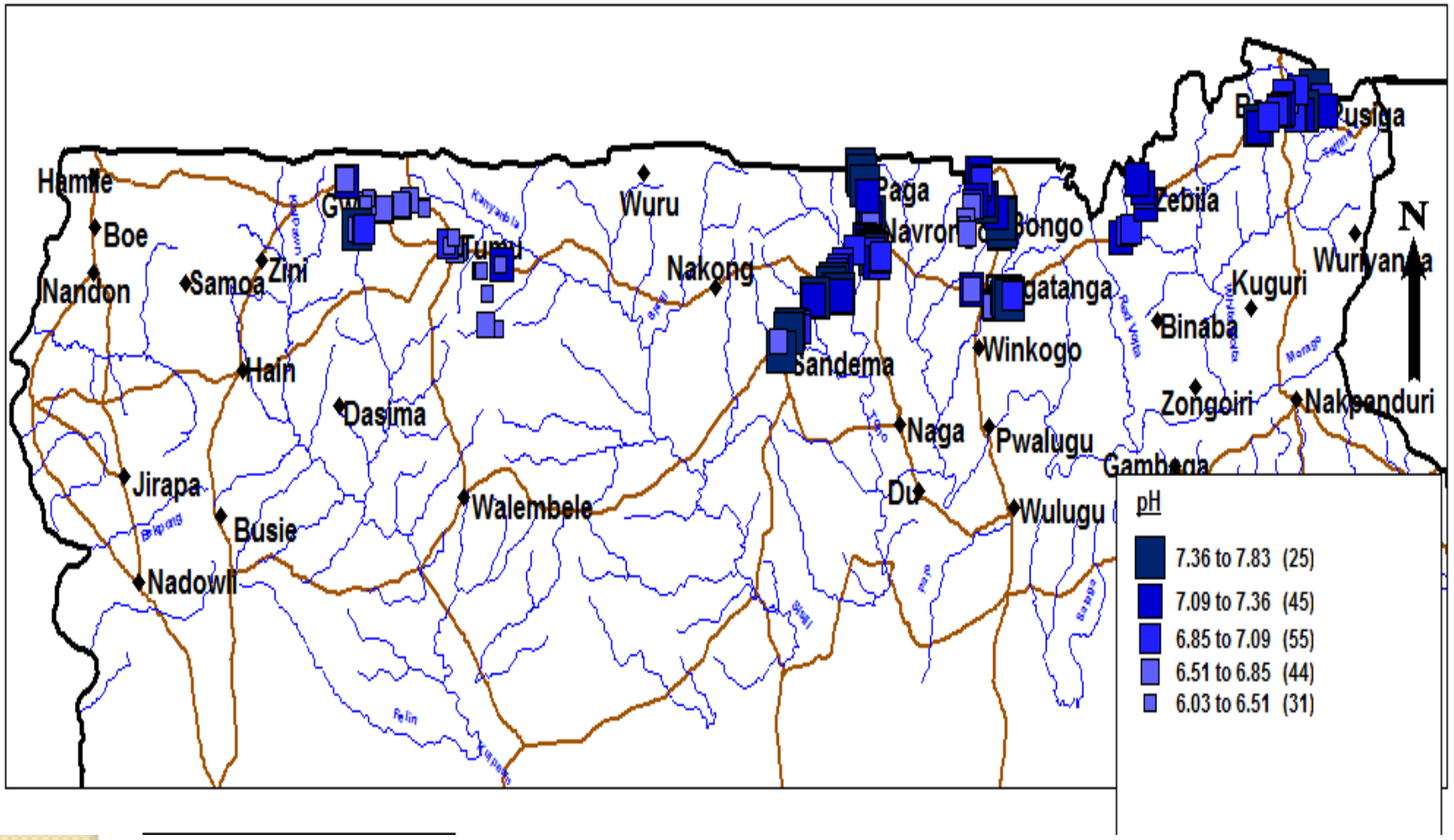
ANALYSIS AND EXPECTED RESULTS

- Radiocarbon analyses - University of Groningen, Netherlands. Results were just received.
- Stable isotopes ($\delta^{18}O$ and $\delta^{2}H$) analyses were done at GAEC and results are ready.
- Chemical analysis results - CNESTEN, Morocco. Results are not yet in.
- Duplicate samples for stable isotopes ($\delta^{18}O$ and $\delta^{2}H$) and ^{3}H analyses - CNESTEN, Morocco. Results are not yet in.

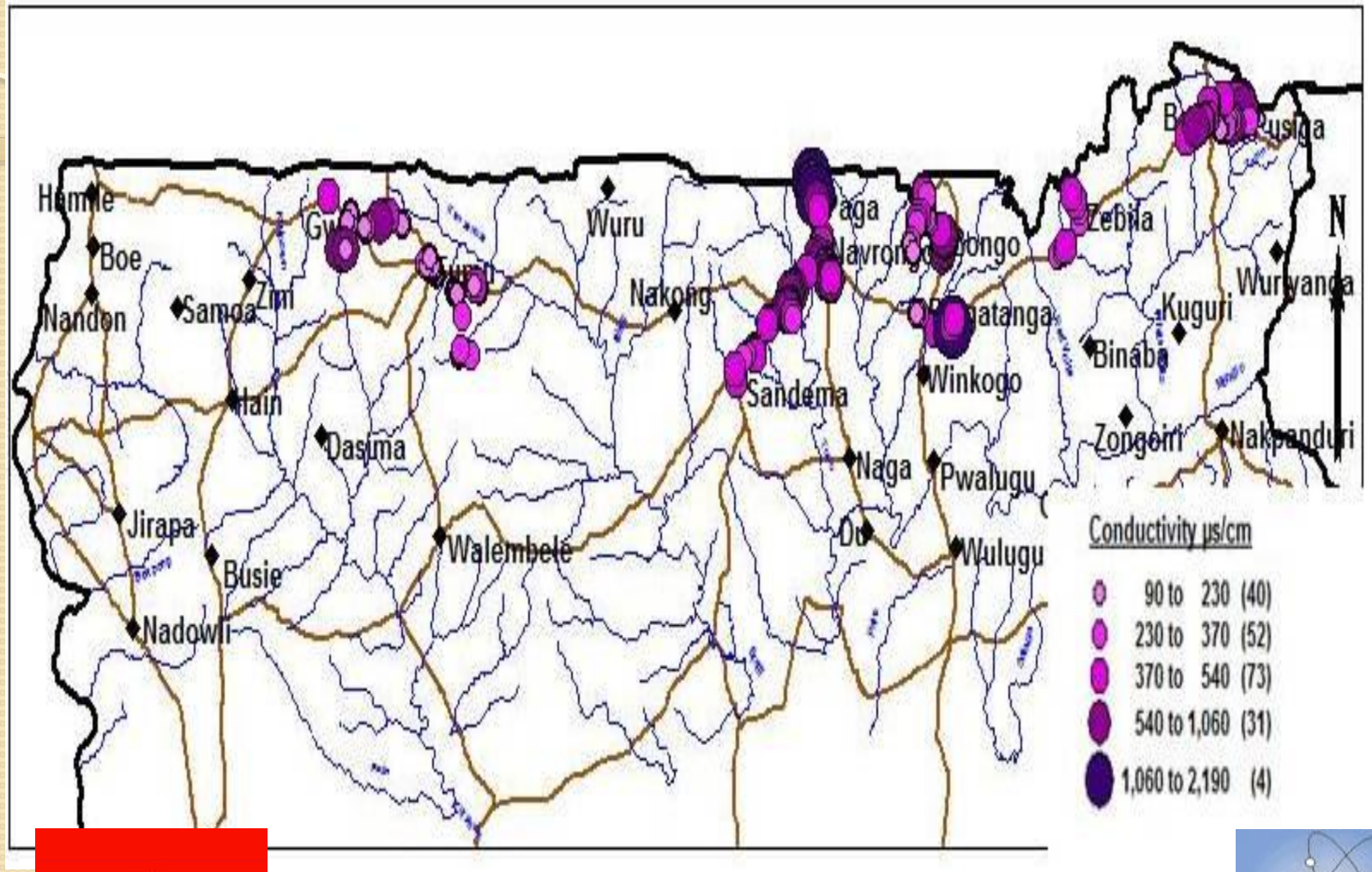
RESULTS AND DISCUSSIONS OF AVAILABLE DATA

PARAMETER	EC (µs/cm)	TDS (mg/L)	Temp (°C)	pH	HCO_3^- (mg/L)
Minimum	90.3	45.1	20.3	6.03	56.08
Maximum	2190.	1095	34.1	7.83	575.50
Mean	415.08	207.4	30.71	6.93	225.53

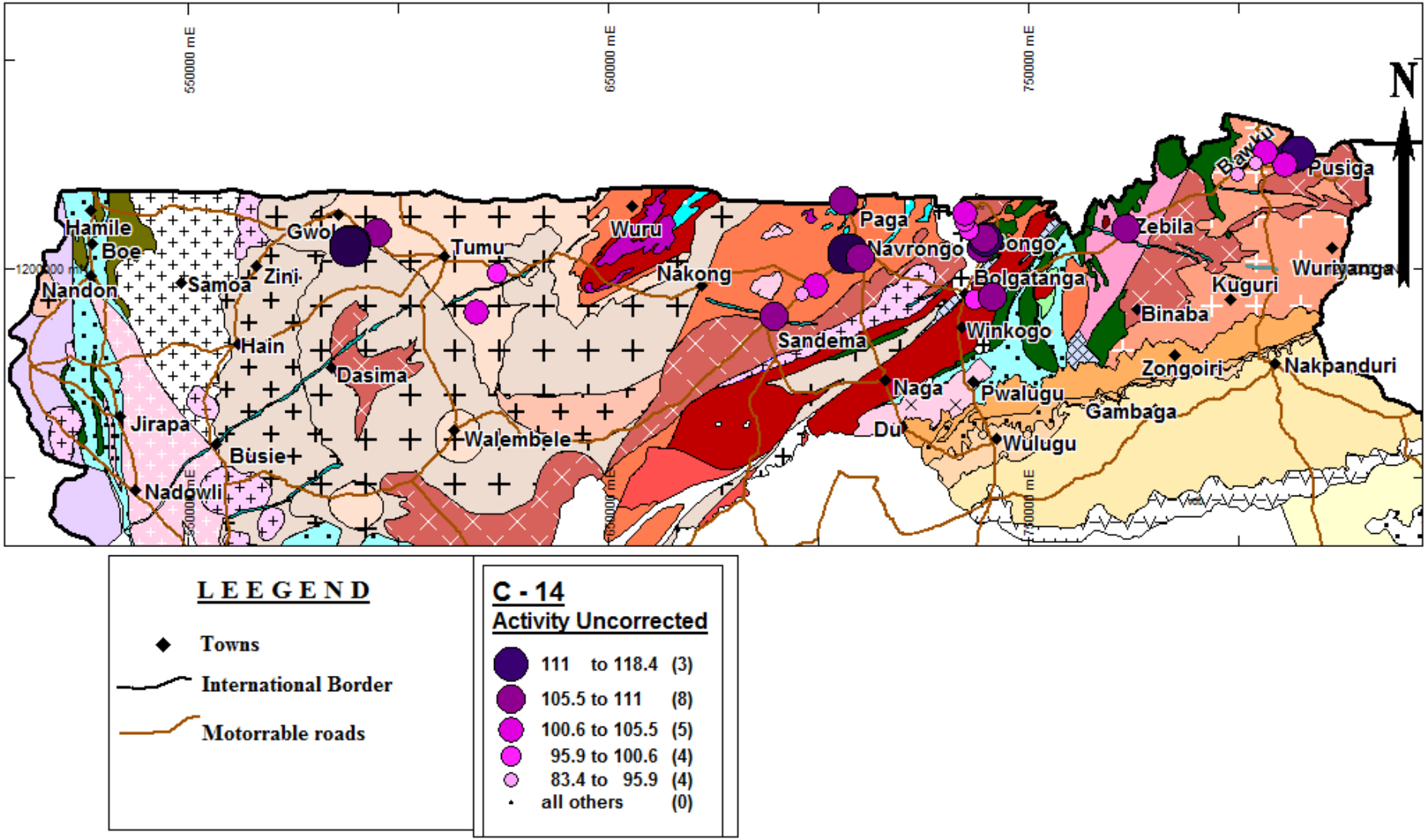
pH


Hamile
Boe
Nandon
Samoa
Zini
Hain
Dasima
Jirapa
Busie
Nadowli
Walembele
Wuru
Nakong
Tumu
Paga
Navrongo
Bongo
Sandema
Gatanga
Winkogo
Naga
Pwalugu
Du
Wulugu
Zebila
Pusiga
Kuguri
Binaba
Zongoiri
Nakpanduri
Wuriyanga
N
pH
7.36 to 7.83 (25)
7.09 to 7.36 (45)
6.85 to 7.09 (55)
6.51 to 6.85 (44)
6.03 to 6.51 (31)

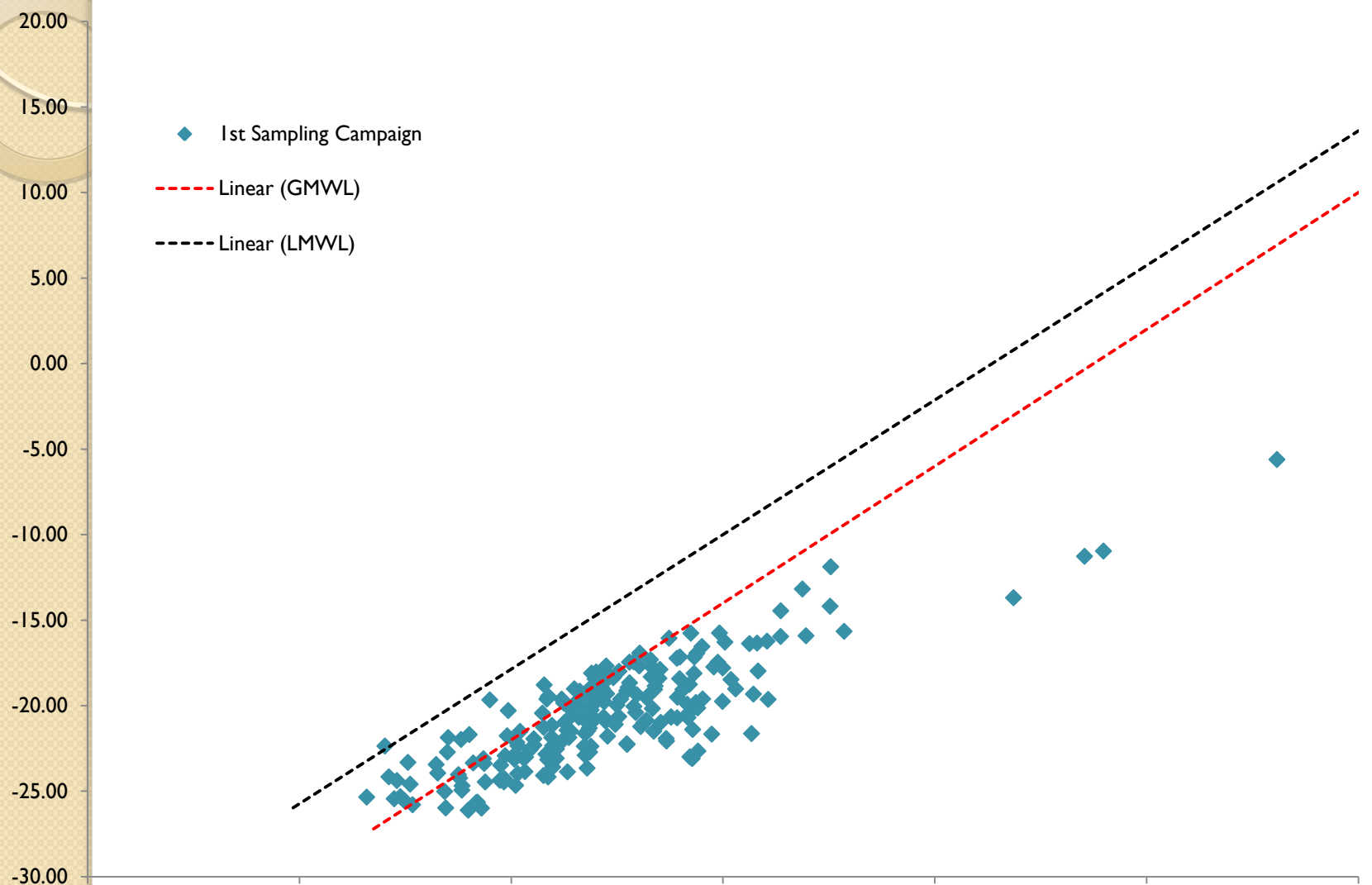
Ec


Hemile
Boe
Nandon
Samoa
Zim
Hain
Dasima
Jirapa
Busie
Nadowli
Wuru
Nakong
Sandema
Winkogo
Naga
Pwalugu
Walembele
Wulugu
Zebila
Kuguri
Binaba
Zongoiri
Nakpanduri
N
Conductivity µs/cm
90 to 230 (40)
230 to 370 (52)
370 to 540 (73)
540 to 1,060 (31)
1,060 to 2,190 (4)

Carbon 14 (C-14)



DISCUSSION OF AVAILABLE DATA



WORKS TO BE CARRIED OUT

- Collection of meteorological data for recharge estimation
- Collection of rainwater for stable isotope studies
- Sampling of surface water and groundwater

PERSONNEL INVOLVED IN SAMPLING AND DATA INTERPRETATION

- Prof. Dickson Adomako
- Michael Saah Hayford : Sampling and hydrochemistry
- Musah Salifu : Sampling, hydrochemistry and isotope interpretation, recharge estimation.
- Felix Aidoo : Sampling and GIS applications

THE SAMPLING TEAM

Thanks very much for your attention