

Annex A Register of monitoring sites

ID	District	Site Reference Number ¹	Stakeholder Group	Monitoring Responsibility	Monitoring Site	* UTM Co-ordinates			* Lat / Long		# Approx Ground Elevation (m ASL)	Primary Water Source Type	Monitoring Measurements							
						Grid Zone	Easting (metres East)	Northing (metres North)	Latitude (N)	Longitude (W)			Rainfall	Groundwater Level (using loggers)	Barometric Pressure (using loggers)	Stream Flow	Thermo-tolerant Coliforms	Turbidity	pH	Iron
1	Bombali	SN01	Industry	MWR	Addax - Environmental Office	28P	804204	963936	8.71030	-12.23554	61	Borehole (monitoring)	√R	√L	√B					
2	Bombali	SN02	Industry	MWR	Addax - Lungi Nursery	28P	795966	968605	8.75302	-12.31005	68 ²	Borehole (water supply)	√A	√L						
3	Bombali	SN03	Government	MWR	Makeni - Bombali DC Office	28P	820984	982787	8.87945	-12.08185	85	Hand dug well with electric pump	√R	√L	√B					
4	Bombali	SN04	School	MWR	Mayagba - Chester Heath Memorial Secondary Technical School	29P	173455	969020	8.75470	-11.96767	89 ²	Rain gauge only	√R							
5	Bombali	SN05	School	MWR	Mayawlaw - Primary School	29P	175396	967257	8.73891	-11.94992	98	Hand dug well / No pump	√R	√L	√B					
6	Bombali	SN06	School	MWR	Mayawlaw - SDA Secondary School	29P	174697	966947	8.73605	-11.95625	94 ²	Rain gauge only	√R							
7	Bombali	SN07	School	MWR	Rosinth - WCSL Primary School	29P	170206	970795	8.77055	-11.99724	77 ²	Rain gauge only	√R							
8	Tonkolili	SN08	School	BWMA	Bumbuna - Boyo Memorial Baptist Schools	29P	198360	1001147	9.04666	-11.74368	129 ²	Hand dug well with handpump	√R	√L	√B					
9	Tonkolili	SN09	Government	BWMA	BWMA Office	29P	199833	1003195	9.06526	-11.73043	247 ²	Barometric Pressure Station	√R		√BB					
10	Tonkolili	SN10	Community	BWMA	Kadala Spring	29P	200265	1004912	9.08080	-11.72662	281 ²	Surface Water (Unprotected Spring)				(√L 45°)				
11	Tonkolili	SN11	Community	BWMA	Kakutan Spring	29P	201199	1013382	9.15739	-11.71871	275	Surface Water (Unprotected Spring)	√R			√L 60°				
12	Tonkolili	SN12	Industry	BWMA	Kamathor 1 (Joule Africa Borehole 4)	29P	199418	1002971	9.06321	-11.73418	231	Borehole (monitoring)		√L						
13	Tonkolili	SN13	Community	BWMA	Kamathor 2 Stream	29P	198175	1002901	9.06249	-11.74548	142	Surface Water (Unprotected Stream)	√R		√B	√L 45°				
14	Tonkolili	SN13b	Industry	BWMA	Kamathor 2 (Joule Africa Borehole 8)	29P	198418	1002141	9.05564	-11.74322	118	Borehole (monitoring)		√L						
15	Tonkolili	SN14	Community	BWMA	Kasokira Stream	29P	199325	1005209	9.08342	-11.73518	402	Surface Water (Unprotected Stream)	√R		√B	√L 60°				
16	Tonkolili	SN15	School	BWMA	Mabonto - TDC Primary & Secondary Schools	29P	190014	980510	8.85965	-11.81809	117 ²	Hand dug well with handpump	√R	√L						
17	Tonkolili	SN16	School	MWR	Magburaka - Boys Secondary School	29P	175847	964989	8.71845	-11.94566	100	Hand dug well with handpump	√R	√L	√B					
18	Tonkolili	SN17	School	MWR	Magburaka - National Commercial Secondary School	29P	177255	965252	8.72092	-11.93289	103 ²	Rain gauge only	√R							

Continued on next page

						* UTM Co-ordinates			* Lat / Long		Monitoring Measurements									
ID	District	Site Reference Number ¹	Stakeholder Group	Monitoring Responsibility	Monitoring Site	UTM Grid Zone	UTM Easting (metres East)	UTM Northing (metres North)	Latitude (N)	Longitude (W)	# Approx Ground Elevation (m ASL)	Primary Water Source Type	Rainfall	Water Level (using Loggers)	Barometric Pressure (using loggers)	Stream Flow	Thermo-tolerant Coliforms	Turbidity	pH	Iron
19	Tonkolili	SN18	Government	MWR	Magburaka - Tonkolili DC (WSD Office)	29P	177052	965161	8.72009	-11.93473	104 ²	Hand dug well with handpump	VR	VL						
20	Tonkolili	SN19	School	MWR	Maraka - SLMB Primary School	29P	181370	967596	8.74239	-11.89570	92 ²	Rain gauge only	VR							
21	Bombali	SN20	Community	BWMA	Masongbo	29P	182413	993993	8.98092	-11.88809	120	Hand dug well with handpump	VR	VL	VB					
22	Tonkolili	SN21	School	MWR	Mathora - RC Primary School	29P	180778	966762	8.73725	-11.89903	98 ²	Hand dug well with handpump	VR	VL						
23	Tonkolili	SN22	School	BWMA	Kathombo - RC Primary School	29P	196344	1003053	9.06375	-11.76213	147 ²	Hand dug well with handpump	VR	VL						
24	Koinadugu	SN23	Community	BWMA	Waia	29P	204108	1010577	9.13225	-11.69207	311	Rain Gauge	VR							
25	Bombali	AD01	Industry	ADDAX	Addax - Automatic Weather Station	28P	811658	961246	8.68550	-12.16804	60	Rain Gauge	VA							
26	Bombali	AD02	Industry	ADDAX	Addax - Rokel River (Upstream Gauging Site)	28P	817378	958835	8.73351	-12.31435	60	Rokel River				V				
27	Bombali	AD03	Industry	ADDAX	Addax - Rokel River (Downstream Gauging Site)	28P	795507	966442	8.66333	-12.11628	60	Rokel River				V				
28	Tonkolili	AD04	Industry	MWR	Addax - Block 7 - Rain Gauge	28P	804713	959474	8.66995	-12.23121	61	Rain Gauge	VA							
29	Bombali	AD05	Industry	MWR	Addax - Block 11 - Rain Gauge	28P	816749	963057	8.70152	-12.12170	61	Rain Gauge	VA							
30	Tonkolili	BD01	Government	Salini	Bumbuna HEP Dam - Rain Gauge	29P	199640	1003243	9.06568	-11.73218	265 ²	Rain Gauge	VA							
31	Tonkolili	BD02	Government	Salini	Bumbuna HEP Dam - Weir	29P	200400	1003283	9.06610	-11.72528	165 ³	Rokel River			VB	VL				
32	Tonkolili	BD03	Government	Salini	Bumbuna HEP Dam - Reservoir	29P	200864	1003958	9.07222	-11.72111	244	Dam Reservoir		V						
33	Bombali	MD01	Government	SL Met Dept	Makeni Weather Station (SL Met Dept)	28P	824908	982773	8.87904	-12.04621	80	Rain Gauge	VA							

¹ 1 to 21 are monitoring sites established during this project and are identified by the prefix "SN" (Site Number) in

² Where there is more than one monitoring installation, the grid reference used is that of the main water source (i.e. well or spring).

Elevation is estimated from 10m interval contours on "Motion X" GPS Terrain Maps.

² Site GPS Elevation readings are used where these correlate with above contour plan.

³ Elevation is based on a digital logger sited at Bumbuna Dam Weir.

	V	Equipment Installed - Monitoring in Progress
R, A		Project rain gauge (R) or another type of rain gauge (A) in use
L, B		Project Logger (L) and/or BaroLogger (B) in use. BB = 2 Baros
()		Equipment installed from May to July 2013.
45°, 60°		V-notch weir in use (angle of weir indicated)

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Annex B Project monitoring sites - information sheets and graphical data summaries

SN01

ADDAX Environmental Office Borehole (FS01)

Bombali District

Borehole with electric pump

GPS Co-ordinates

Location	Latitude	Longitude
Borehole	8.71030	-12.23554
Rain gauge	Within 10m	

Notes on Water Source

Pump is installed as a back-up water supply to the camp bur is not used. Borehole is located outside of perimeter fence and within 100m of the Rokel River.



Borehole Measurements

Date	1/11/2012
Time	09:30
Datum description	Top of borehole lining
Datum height	0.43 m above ground level

Inside diameter	190 mm
Depth to water	10.12 m below datum
BH depth	36.36 m below datum

Logging Equipment Installed in Borehole

Model	Rugged TROLL 100 / 30m
Serial number	323507
Depth in well	20 m below datum

Baro logger	Rugged Baro TROLL
Serial number	342998 (311532 up to Nov 13)
Depth	3 m below datum

Loggers are suspended in borehole using Kevlar cord.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	None – within site
First record date	21 February 2013

ADDAX have a separate automatic climate station which provides rainfall data.

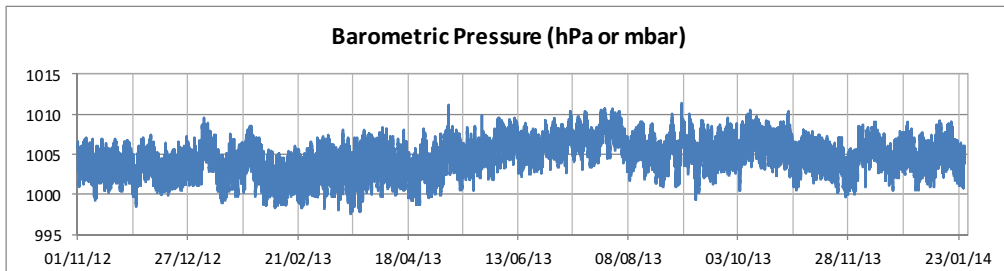
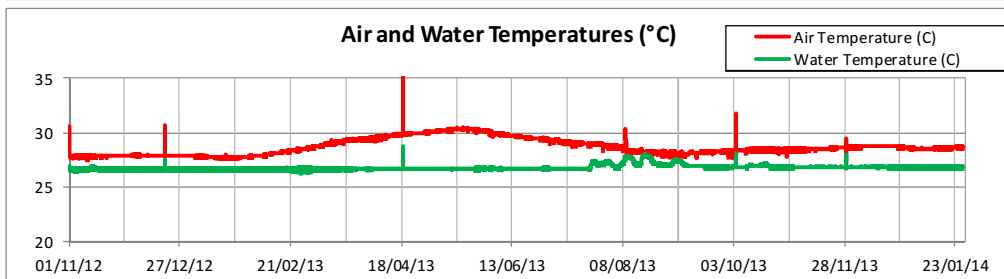
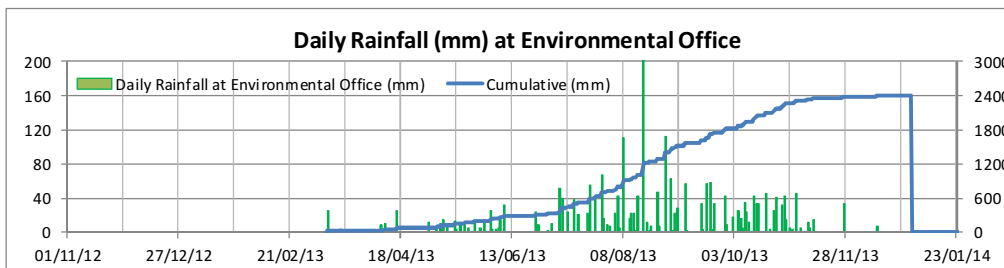
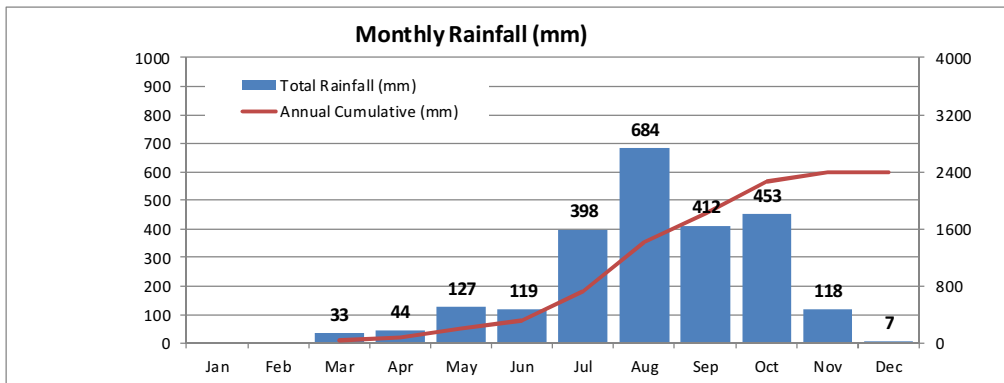
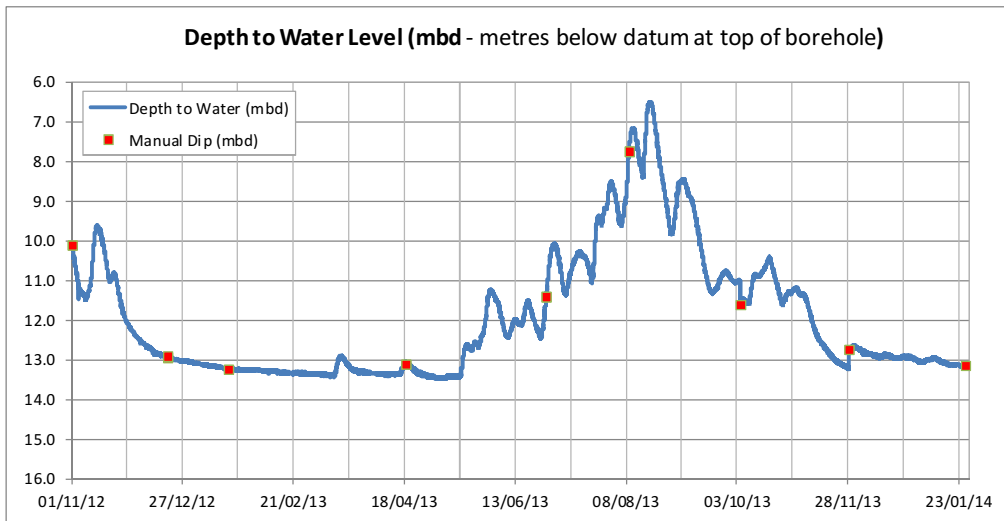


Rain gauge is located on inside of camp fence – approximately 10m from borehole.

Contacts (Addax Bioenergy)

Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

SN01 - ADDAX Environmental Office - Borehole FS01



SN02

ADDAX Lungi Estate Nursery

Bombali District

Borehole with electric pump

GPS Co-ordinates

Location	Latitude	Longitude
Borehole	8.753020	-12.31005
Rain gauge	Within 50m	

Notes on Water Source

Well is used as main water supply for the site. Water is pumped to storage tanks as needed. Located within site compound within 50m of Rokel River.



Borehole Measurements

Date	11/5/2003
Time	16:30
Datum description	Top of borehole lining
Datum height	0.10 m above ground level

Inside diameter	190 mm
Depth to water	10.58 m below datum
BH depth	30.88 m below datum

Logging Equipment Installed in Borehole

Model	Rugged TROLL 100 / 30m
Serial number	323504 (10m)
Depth in well	25 m below datum

Baro logger	n/a
Serial number	
Depth	

Loggers are suspended in borehole using Kevlar cord. / Previous logger (SN 337776 lost)

Rain Gauge

Model	Own - Conical / 100mm
Fencing	None – within site
First record date	Monthly summaries

Site has its own 100mm capacity Rain gauge for crop management located approx 50m from borehole

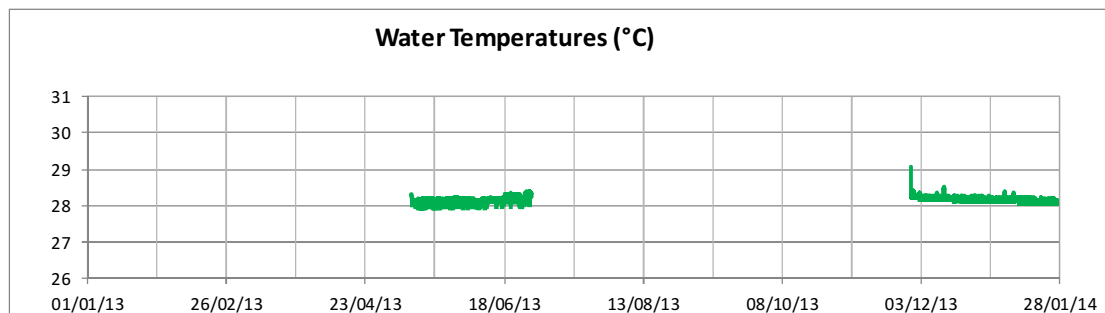
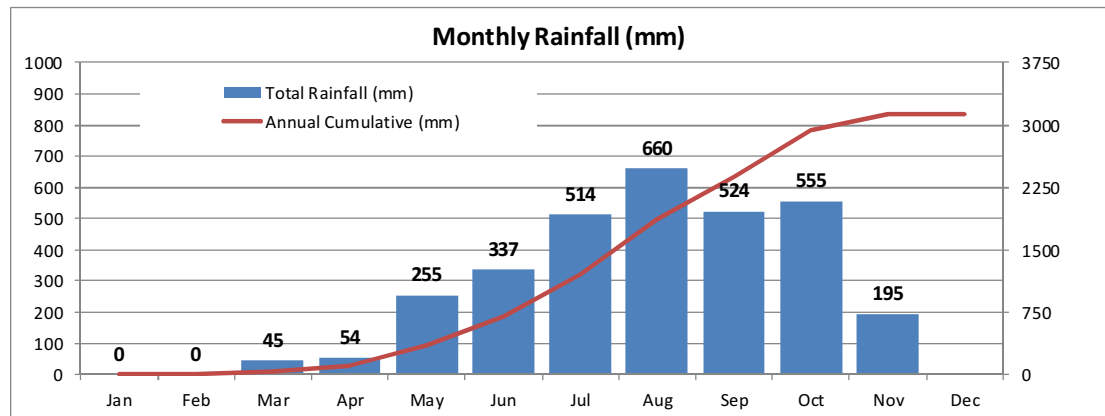
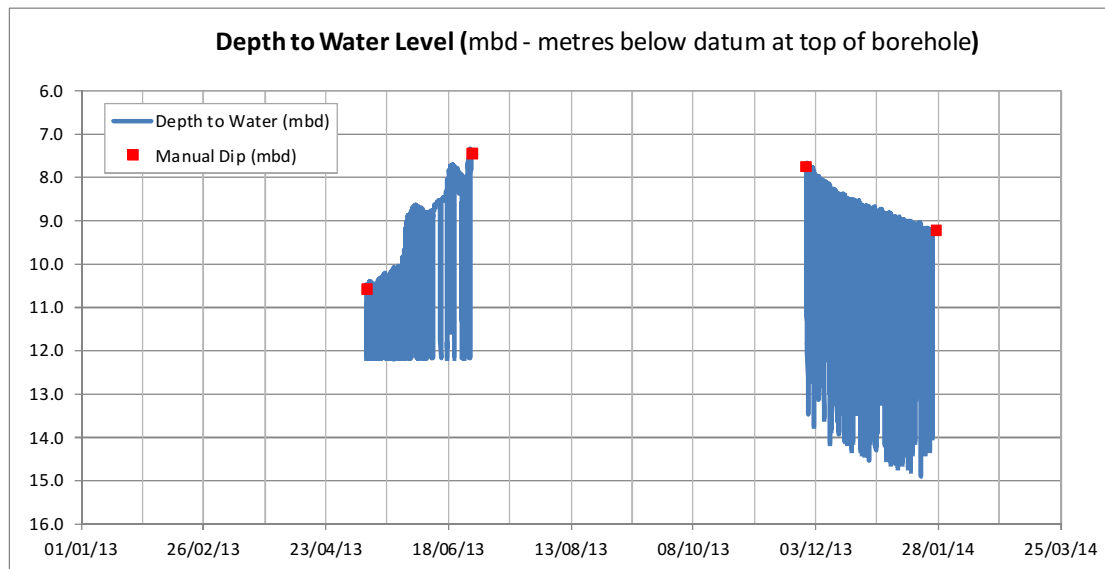


Site rain gauge

Contacts (Addax Bioenergy)

Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

SN02 - ADDAX Lungi Estate Borehole



SN03

Makeni – Bombali District Council

Bombali District

Hand dug well with electric and hand pump

GPS Co-ordinates

Location	Latitude	Longitude
Well	8.87945	-12.08185
Rain gauge	8.87935	-12.08184

Notes on Water Source

Both an electric and hand pump are fitted to the well. The electric pump delivers water to a 2m³ storage tank serving the District Office.



Well Measurements

Date	18/1/2013
Time	12:45
Datum description	Rim edge of access cover.
Datum height	0.59 m above ground level

Inside diameter	1.2 m
Depth to water	5.87 m below datum
Well depth	8.57 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 30m
Serial number	328770
Depth in well	On base in container.

Baro logger	Rugged Baro TROLL
Serial number	328857
Depth	1.5 m below datum

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	31 May 2013

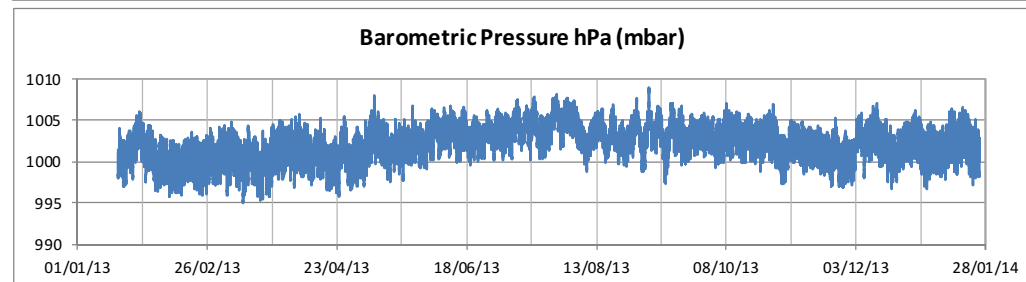
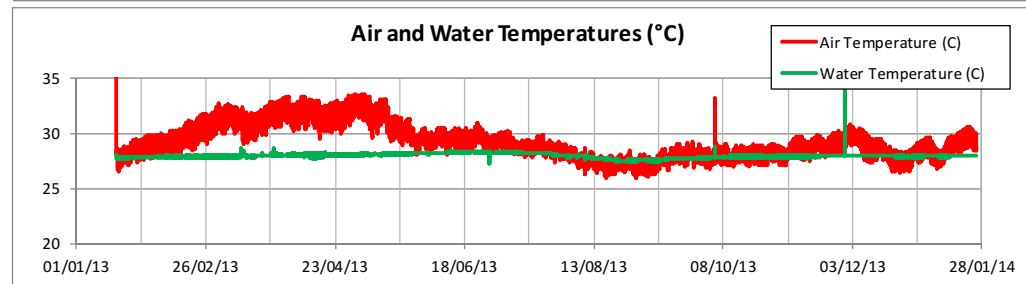
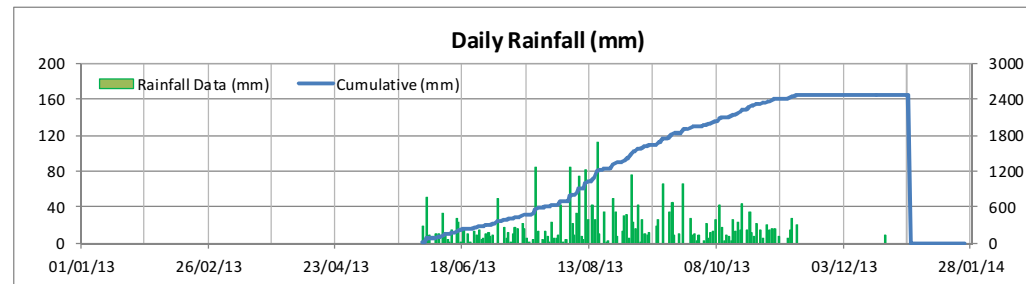
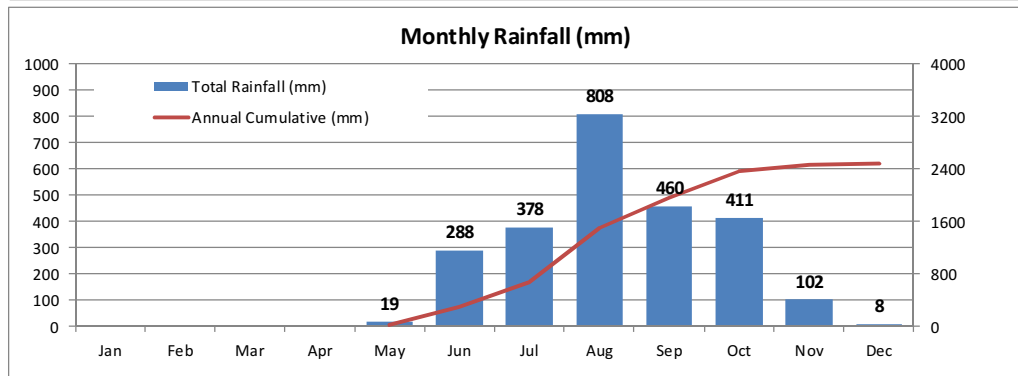
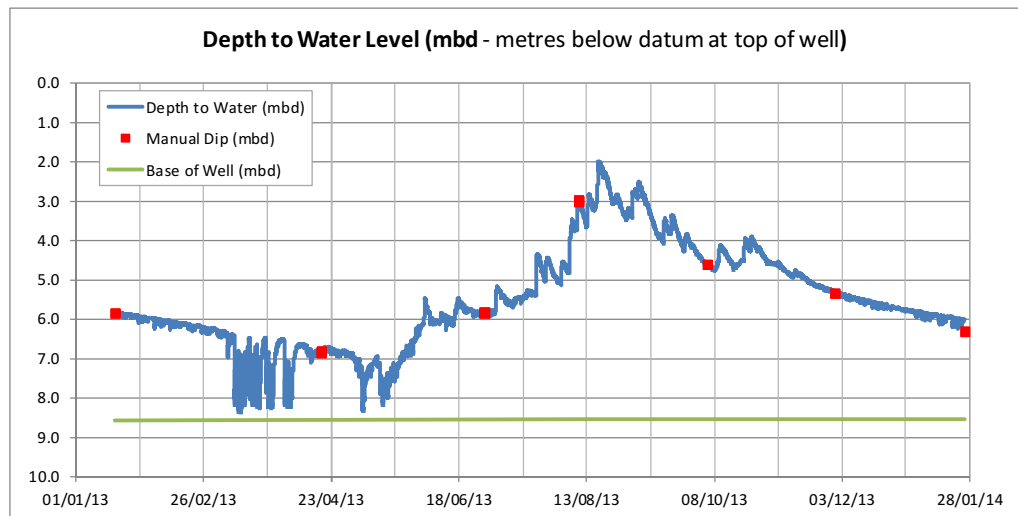
Fenced compound for rain gauge is located within 5m of well.



Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Mohamed Sesay (T)	WSD Supervisor	077 157 936
Sanunu A Sesay (T)	Lab Technician	030 437 204

SN03 - Makeni - Bombali DC - BSD Well



SN04

**Mayagba – Chester Heath Memorial
Secondary School**

Bombali District

Rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.75470	-11.96767

Notes on Water Source

n/a



Rain gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	4 June 2013

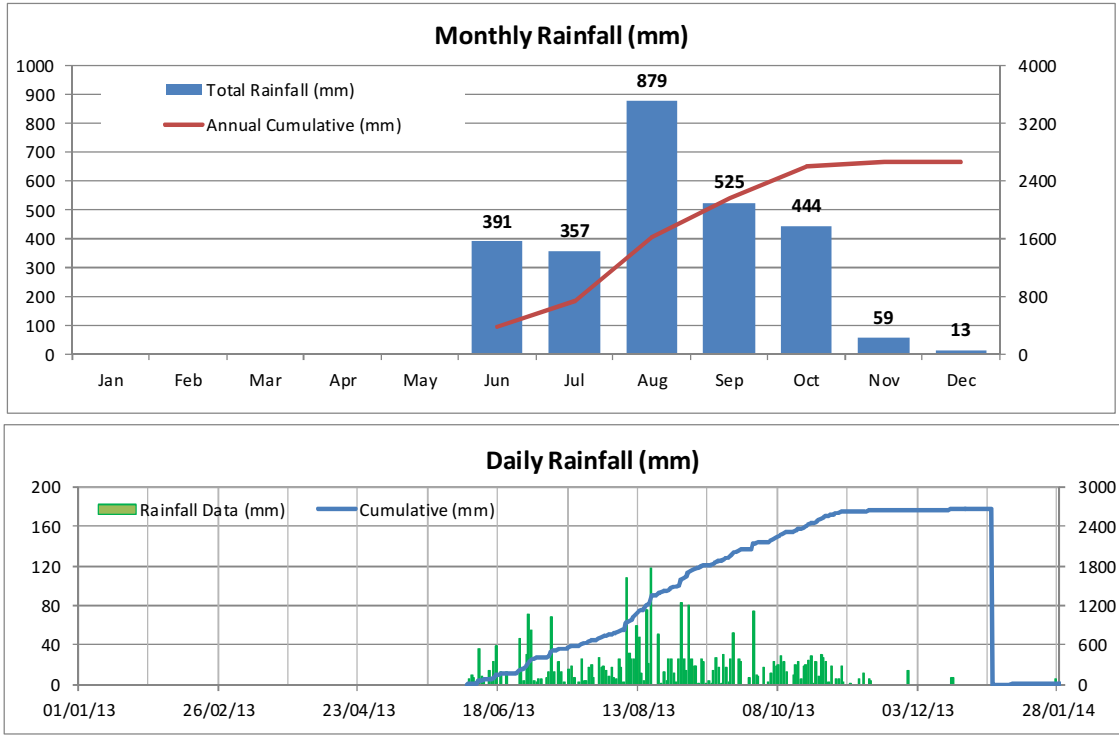


Training on 5 May 2013

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Pastor M.O. Bangura	Teacher, RME	088 861 370
Jeremiah J.O. Thullah (T)	Teacher, English Language	030 391 019
Abdul K. Thullah	Teacher, Science	

SN04 - Mayagba - Chester Heath Memorial Secondary School



SN05**Mayawlaw Primary School****Bombali District****Hand dug well with hand pump****GPS Co-ordinates**

Location	Latitude	Longitude
Well	8.73891	-11.94992
Rain gauge	8.73836	-11.95028

Notes on Water Source

Hand pump does not work. Occasionally bailed.
Students use a different community well for water supply.

**Well Measurements**

Date	18/1/2013
Time	15:15
Datum description	Rim edge of access cover.
Datum height	0.64 m above ground level

Inside diameter	1.2 m
Depth to water	7.96 m below datum
Well depth	9.95 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 30m
Serial number	328768
Depth in well	On base in container.

Baro logger	Rugged Baro TROLL
Serial number	326196
Depth	1.5 m below datum

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	4 June 2013

Fenced compound is within assembly area of main school.

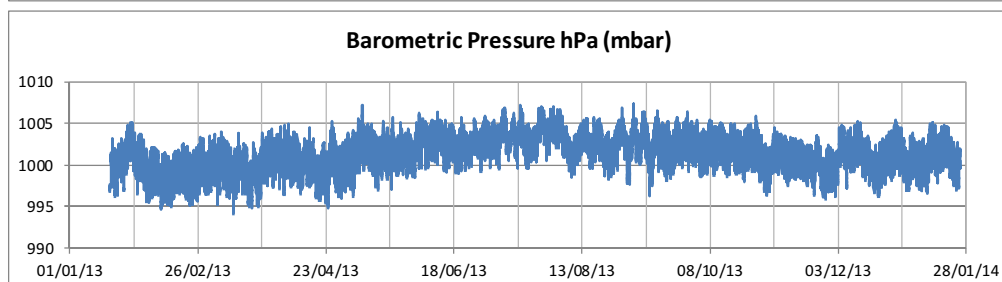
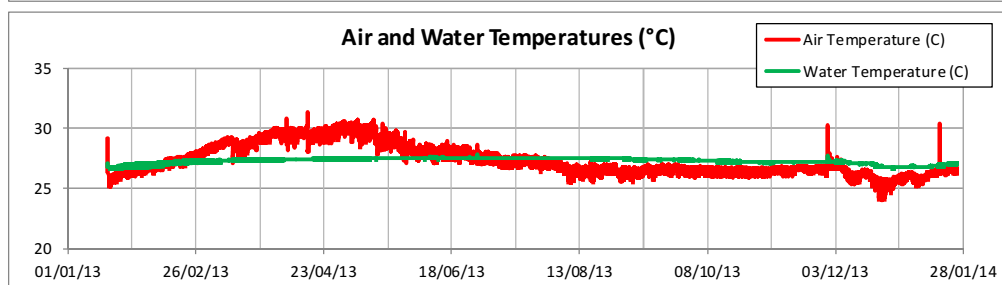
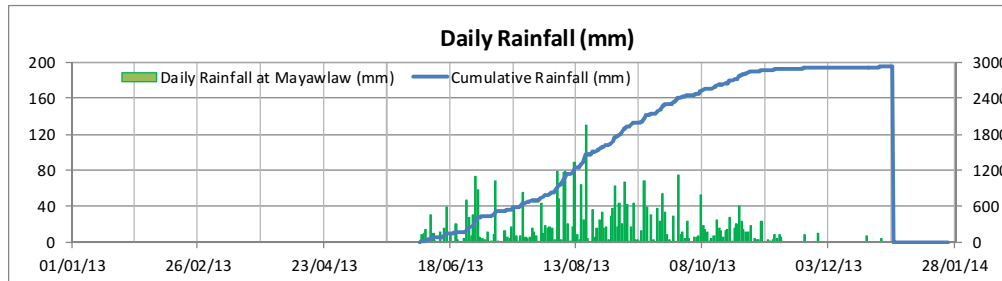
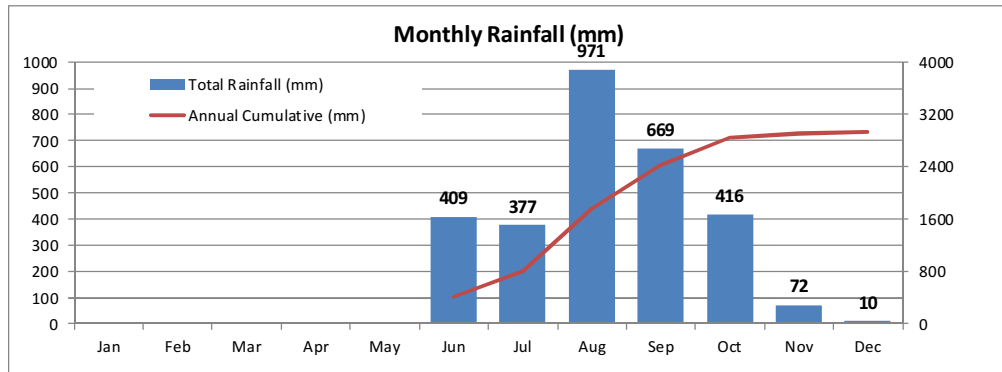
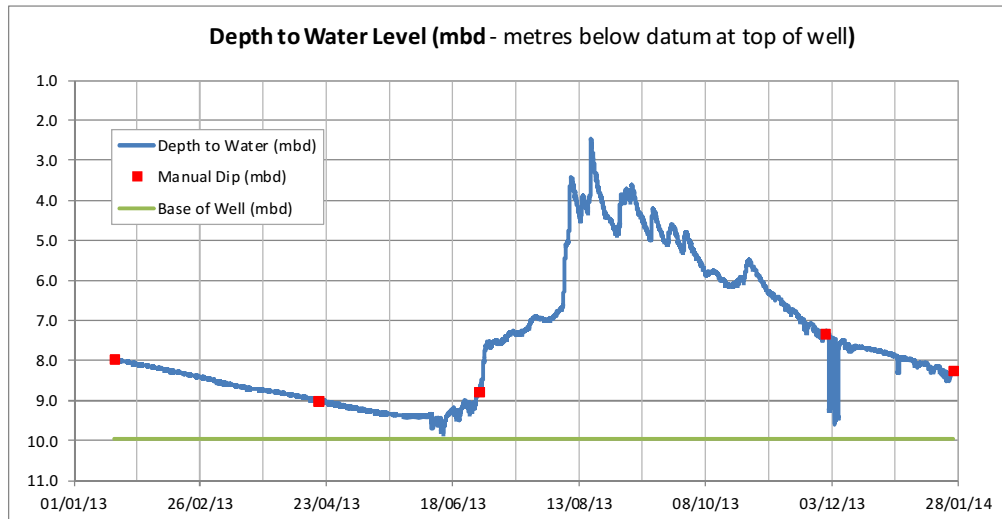


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Sanuel A. Koroma	Head master	076 921 110
John S. Kamara (T)	Deputy Head	077 527 456

SN05 - Mayawlaw Primary School



SN06

Mayawlaw – SDA Secondary School

Bombali District

Rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.73605	-11.95625

Notes on Water Source

Hand dug well under construction



Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	5 June 2013

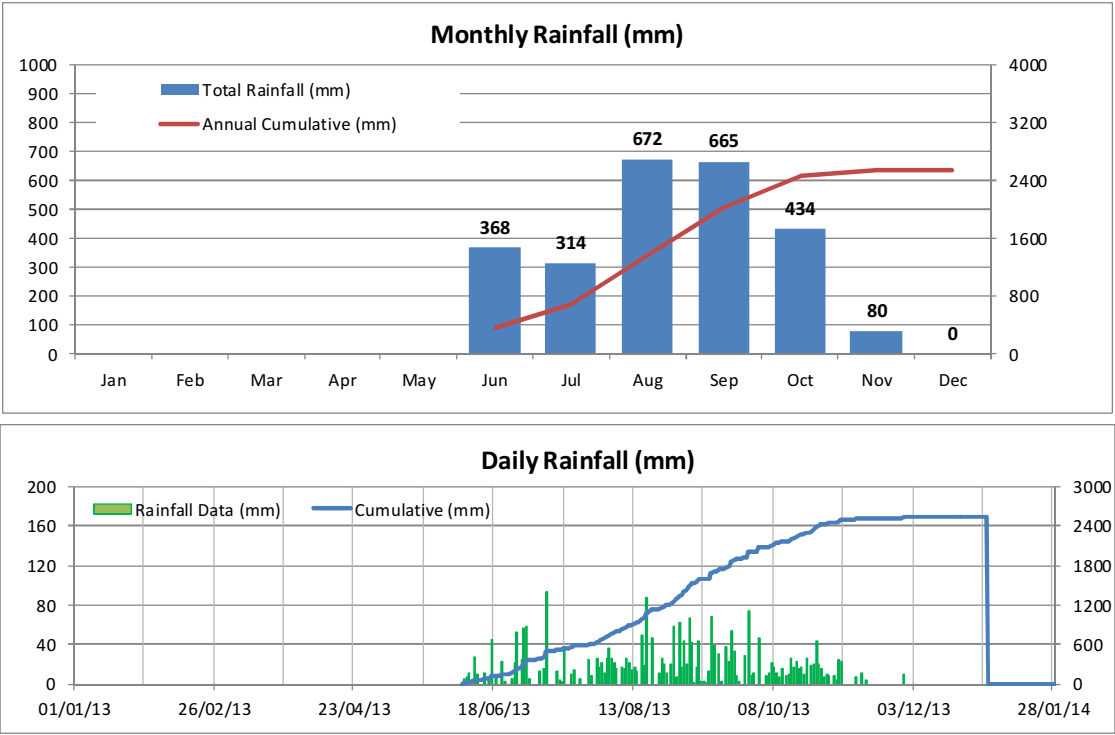


Training on 10 May 2013

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
James B Thullah	Owner	076 838 179
Samuel A.J. Kargbo	Principal	076 497 671
Hassan K. Thullah (T)	Vice-principal	030 728 287 / 088 128 300

SN06 - Mayawlaw - SDA Secondary School



SN07**Rosinth – WCSL Primary School****Bombali District****Rain gauge site****GPS Co-ordinates**

Location	Latitude	Longitude
Rain gauge	8.77055	-11.99724
Well	8.77050	-11.99729

Notes on Water Source

Hand dug well within 50m of Rain gauge.

**Rain Gauge**

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	3 June 2013

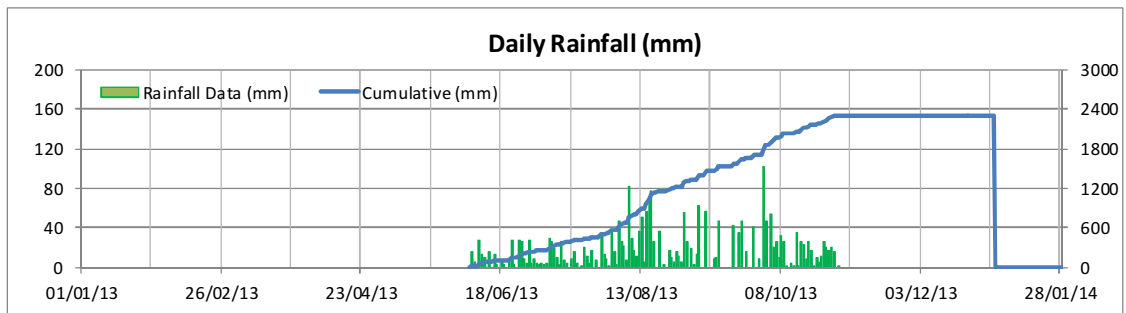
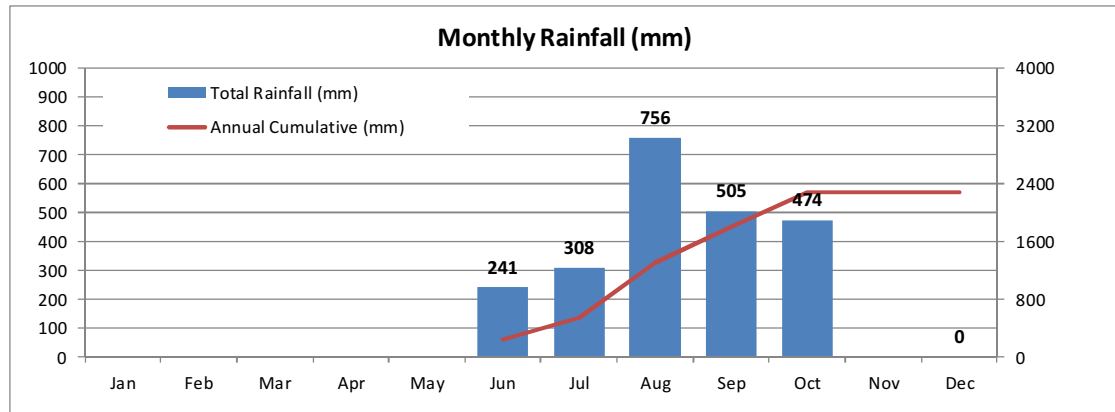


Training on 8 May 2013

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
B.S. Kamara (T)	Assistant Head Teacher	077 661 390
Samuel Y. Thullah (T)	Teacher	

SN07 - Rosinth - WCSL Primary School



SN08

**Bumbuna – Boyo Memorial Baptist
Primary and Secondary Schools**

Tonkolili District

Hand dug well with hand pump

GPS Co-ordinates

Location	Latitude	Longitude
Well	9.04666	-11.74368
Rain gauge	9.04685	-11.74330

Notes on Water Source

Well constructed during 2012. Shared between primary and secondary schools.



Well Measurements

Date	17/1/2013
Time	18:00
Datum description	Rim edge of access cover.
Datum height	0.5 m above ground level

Inside diameter	1.2 m
Depth to water	5.85 m below datum
Well depth	7.29 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 30m
Serial number	328885
Depth in well	On base in container.

Baro logger	Rugged Baro TROLL
Serial number	328872
Depth	2.5 m below datum

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	6 June 2013

Fenced compound is mid-way between school.

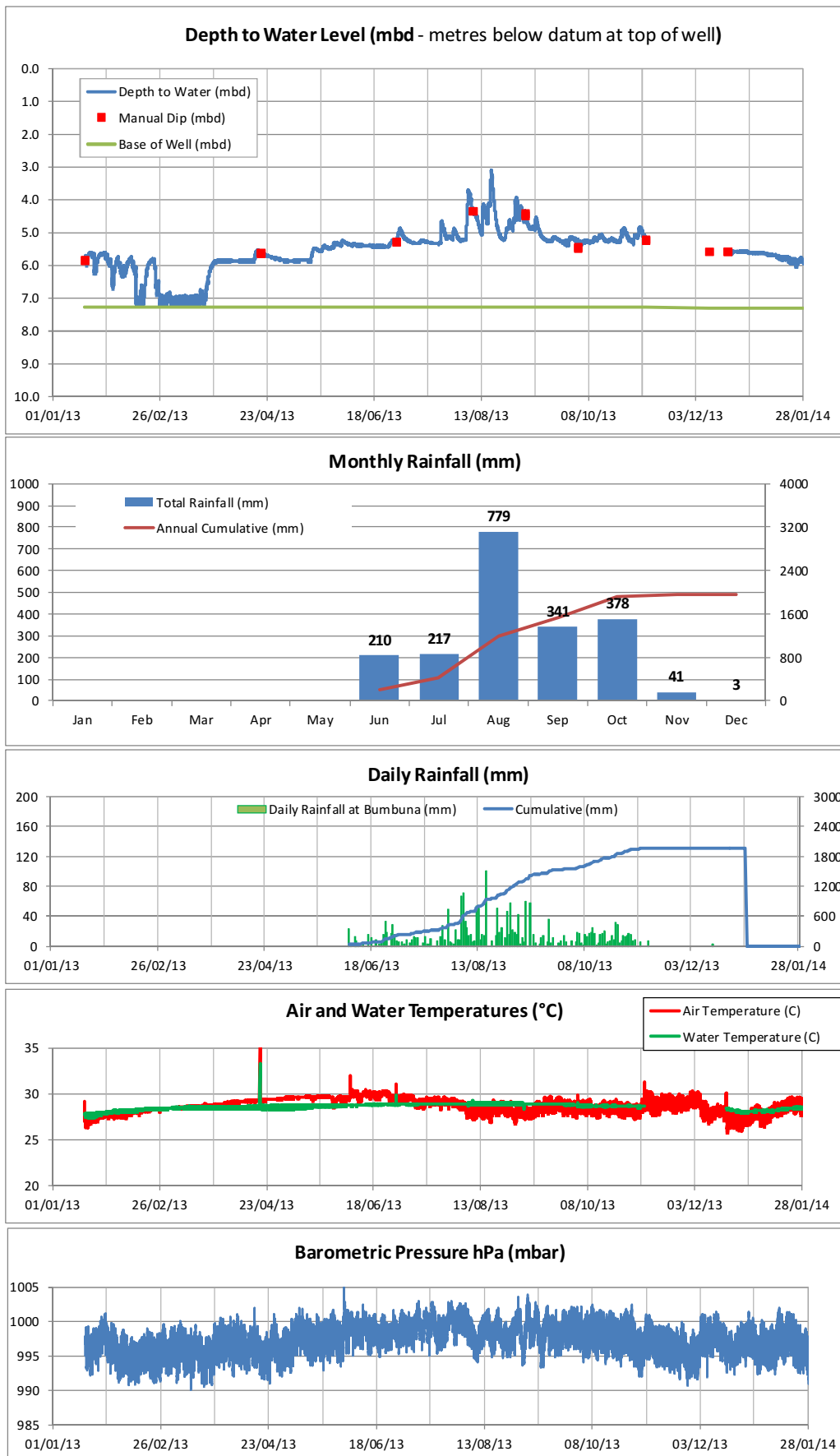


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Simeon B. Mattia (T)	Teacher (English Language)	073 186 461
Margaret M. Sesay	Head Teacher (Primary School)	088 426 032
Phillip Marrah (T)	Teacher	077 832 049

SN08 - Bumbuna Boyo Memorial Schools



SN09

Bumbuna – BWMA Office

Tonkolili District

Barometric and rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Baro Tubes	9.06526	-11.73043
Rain gauge	9.06523	-11.73011

Notes

Bumbuna Dam camp.



Baro Tube Measurements

Reference	T1
Depth	0.99 m below top of tube
Stick-up	0.32 m above ground level

Reference	T2
Depth	0.68 m below top of tube
Stick-up	0.38 m above ground level

Baro loggers Installed in Tubes

Serial No.	337948
Logger depth	0.77m below top of tube

Serial No.	337950
	(337949 also used)
Logger depth	0.59 m below top of tube

Baro loggers are installed in two separate sub-surface tubes outside front of BWMA office.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	None
First record date	5 June 2013

Rain gauge is at rear of office. Unfenced.

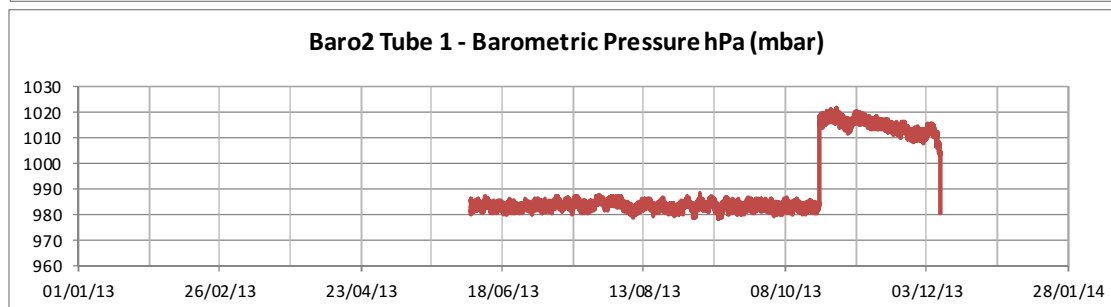
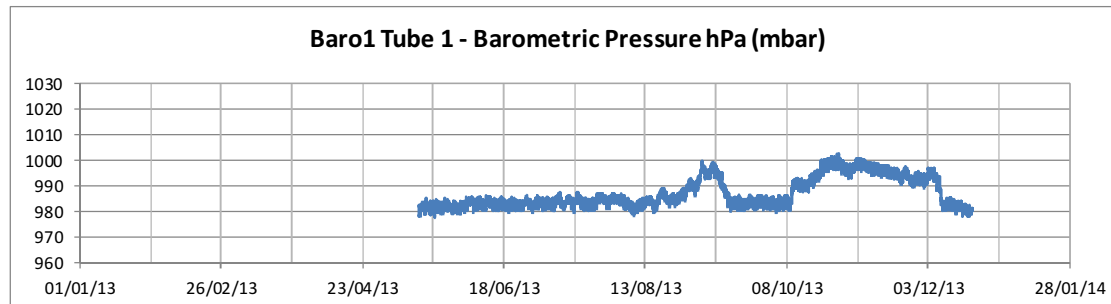
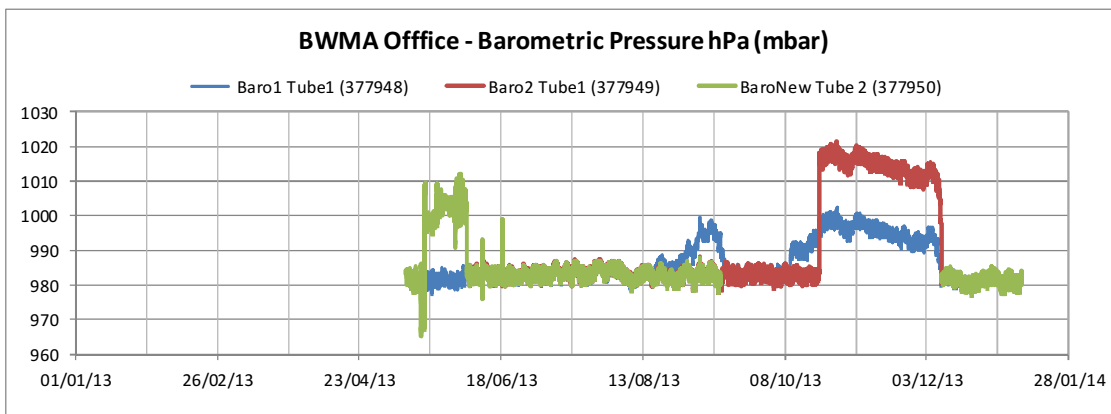
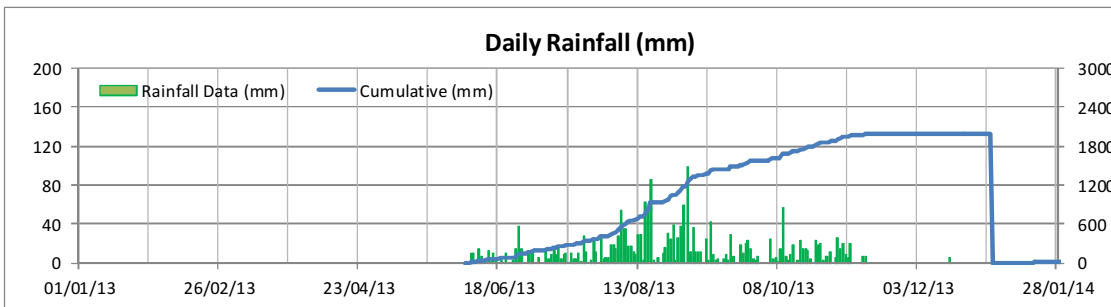
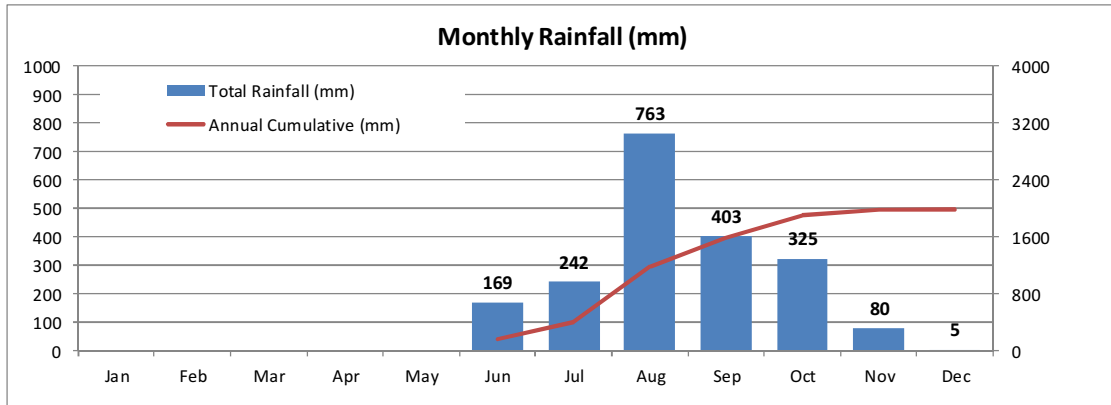


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Abubakarr Mansaray	Water Resources Scientist	079 599 430
Khadijah Moses (T)	WASH co-ordinator	078 218 043
Kadija Barrie (T)	Office Assistant	076 707 396
Olaimahu Sadiya Karim (T)	Community Liaison	
Gerald M Macarthy (T)	Community Liaison	076 105 444

SN09 - Bumbuna Watershed Management Authority Office



SN10**Kadala Spring****Tonkolili District****Unprotected spring
45° V-notch weir****GPS Co-ordinates**

Location	Latitude	Longitude
Spring	9.08080	-11.72662

Notes on Water Source

Only water source for community. Originally unprotected. Weir installed from May to July 2013. Removed and replaced with spring box on 22 July 2013.



Completed spring box

V-notch Weir Description

Date	15/5/2013
Time	11:00
Datum description	Bottom of "V" plate.
Datum height	0.0 cm on staff gauge ruler.

Weir type	45° v-notch
Max head	14 cm
Max flow	4.23 l/s
Initial head	0.0 cm (no flow)

Logging Equipment Installed

Model	Rugged TROLL 100 / 10m
Serial number	337937
Location:	10cm above base of tube

Baro logger	None
Serial number	
Depth	

Logger is installed within a 40mm diameter stilling tube in stream bed upstream of weir.

Rain Gauge

Model	None
Fencing	n/a
First record date	n/a

Site is close to BWMA Office.



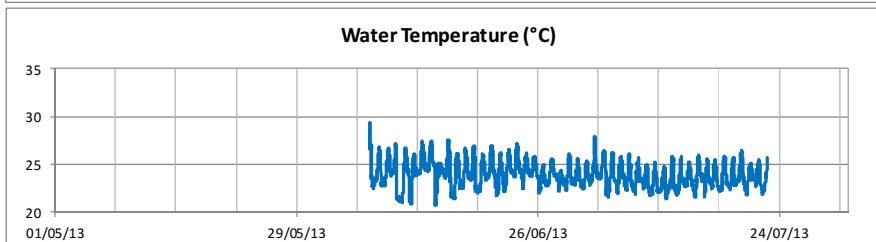
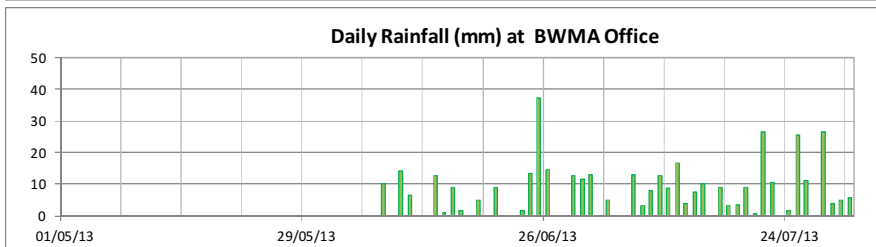
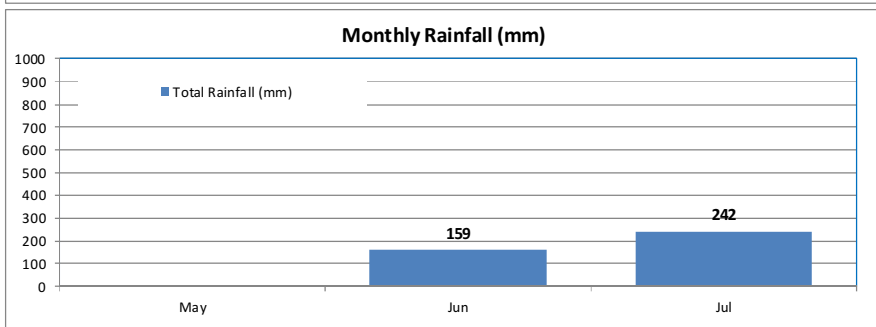
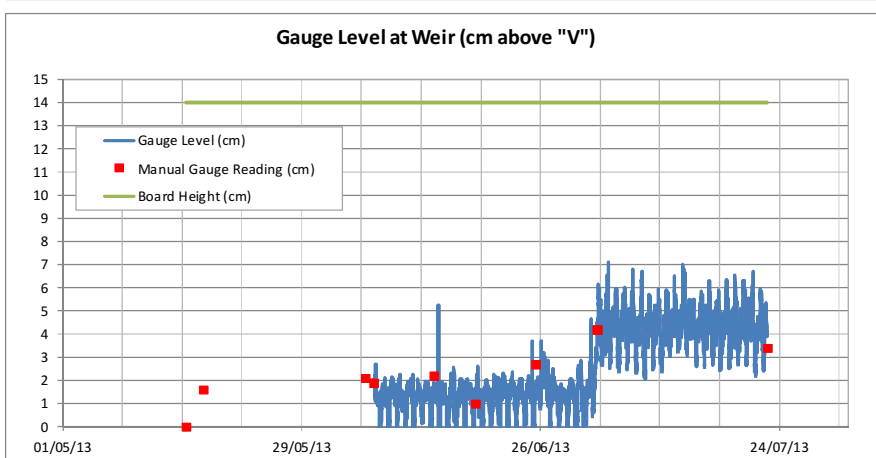
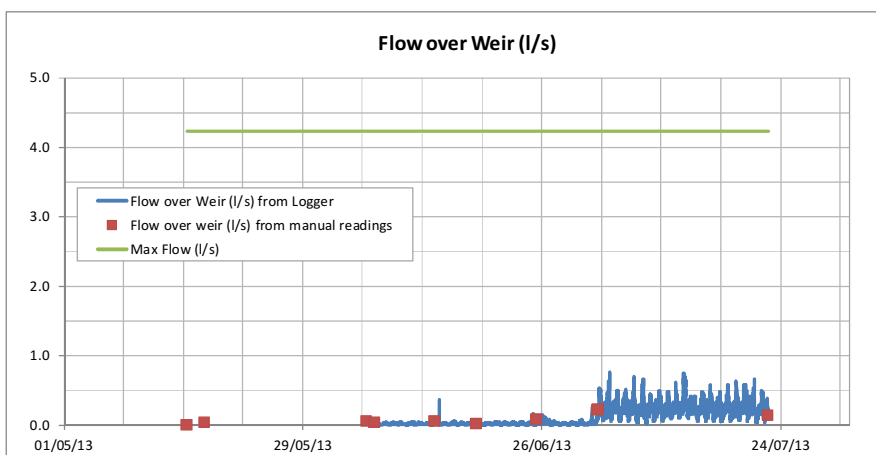
Weir during construction

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
BWMA staff		

SN10 - KADALA Spring - 45° V-notch Weir

NOTE: V Notch installed on 15 May and removed on 22 July 2013 when a Spring Box was installed.



SN11

Kakutan Spring

Tonkolili District

Unprotected spring
60° V-notch weir

GPS Co-ordinates

Location	Latitude	Longitude
Spring	9.15739	-11.71871
Rain gauge	In village centre	

Notes on Water Source

Traditional water source for community. New well under construction in village centre.



V-notch Weir Description

Date	9/5/2013
Time	16:00
Datum description	Bottom of "V" plate.
Datum height	0.0 cm on staff gauge ruler.

Weir type	60° v-notch
Max head	16 cm
Max flow	8.24 l/s
Initial head	1.4 cm (0.03 l/s)

Logging Equipment Installed

Model	Rugged TROLL 100 / 10m
Serial number	337777
Location:	10cm above base of tube

Baro logger	None
Serial number	
Depth	

Logger is installed within a 40mm diameter stilling tube in stream bed upstream of weir.

Rain Gauge

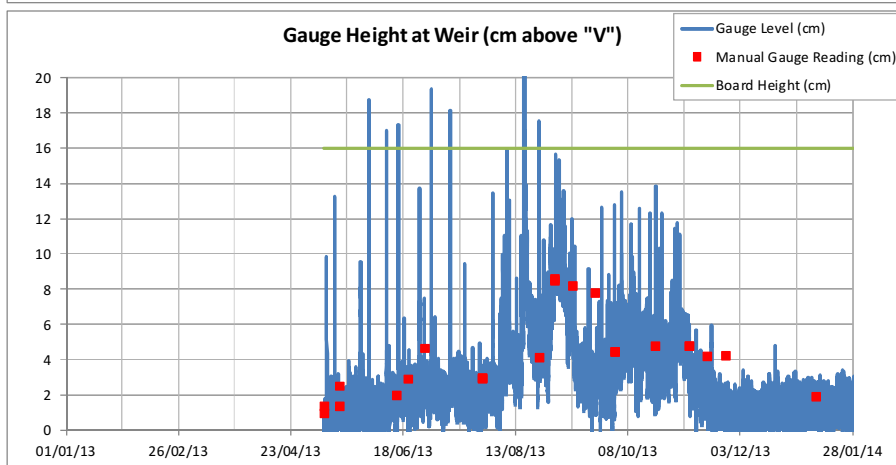
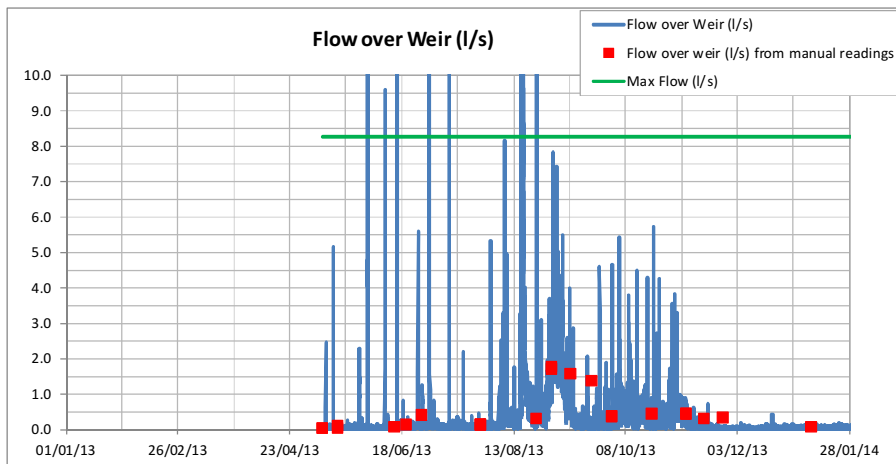
Model	ClimeMet 106 / 225mm
Fencing	None
First record date	20 June 2013



Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Susan S. Kamara (T)	Youth	n/a
(Contact via BWMA staff)		

SN11 - KAKUTAN Spring - 60° V-notch Weir



SN12

Kamathor 1 Village

Tonkolili District

Unprotected spring and Joule Africa Borehole 04

GPS Co-ordinates

Location	Latitude	Longitude
Borehole	9.06321	-11.73418
Spring	9.06321	-11.73418

Notes on Water Source

Spring is downhill from the village, but site is not suited for a v-notch installation. Borehole 4 is a site investigation borehole for the development of the Bumbuna Dam.



Borehole Measurements

Date	6/6/2013
Time	12:20
Datum description	Top of borehole lining
Datum height	0.10 m above ground level

Inside diameter	45 mm
Depth to water	24.67 m below datum
BH Depth	>50m below datum

Logging Equipment Installed in Borehole

Model	Rugged TROLL 100 / 10m
Serial number	337931
Depth in well	30 m below datum

Baro logger	None
Serial number	
Depth	

Loggers are suspended in borehole using Kevlar cord.

Rain Gauge

Model	None
Fencing	n/a
First record date	n/a

Site is close to BWMA Office

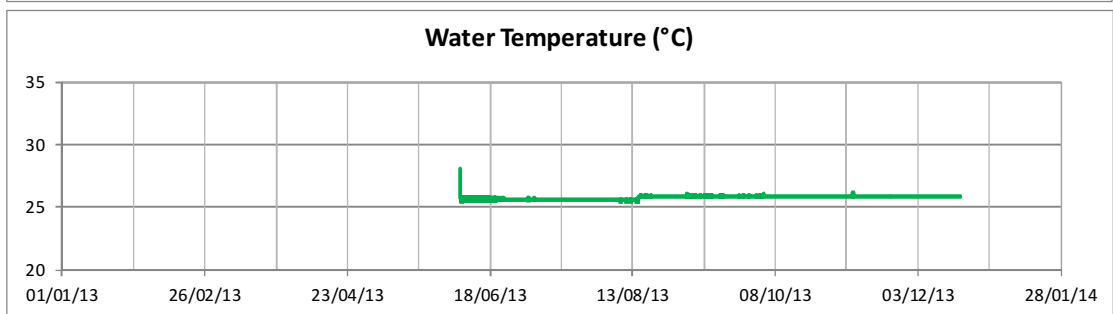
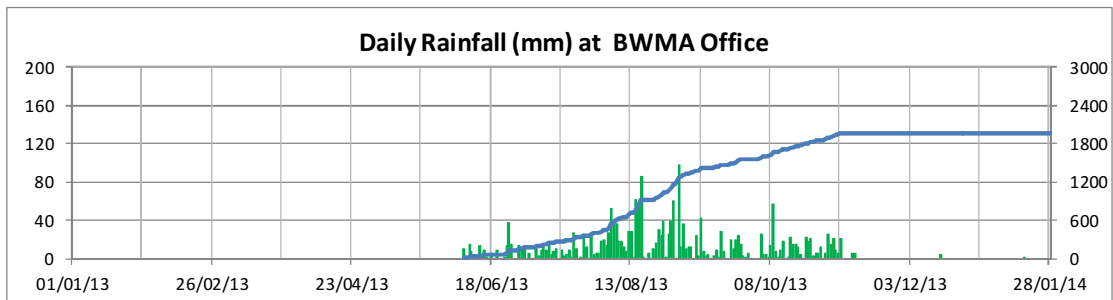
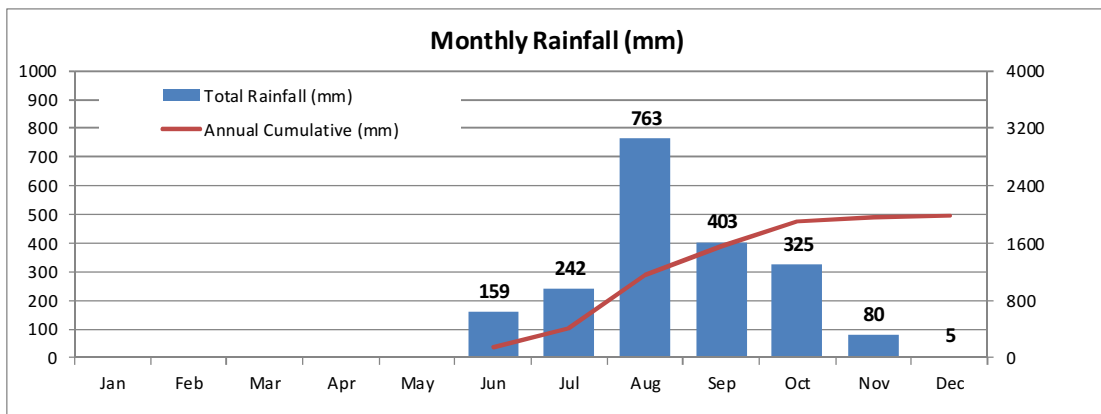
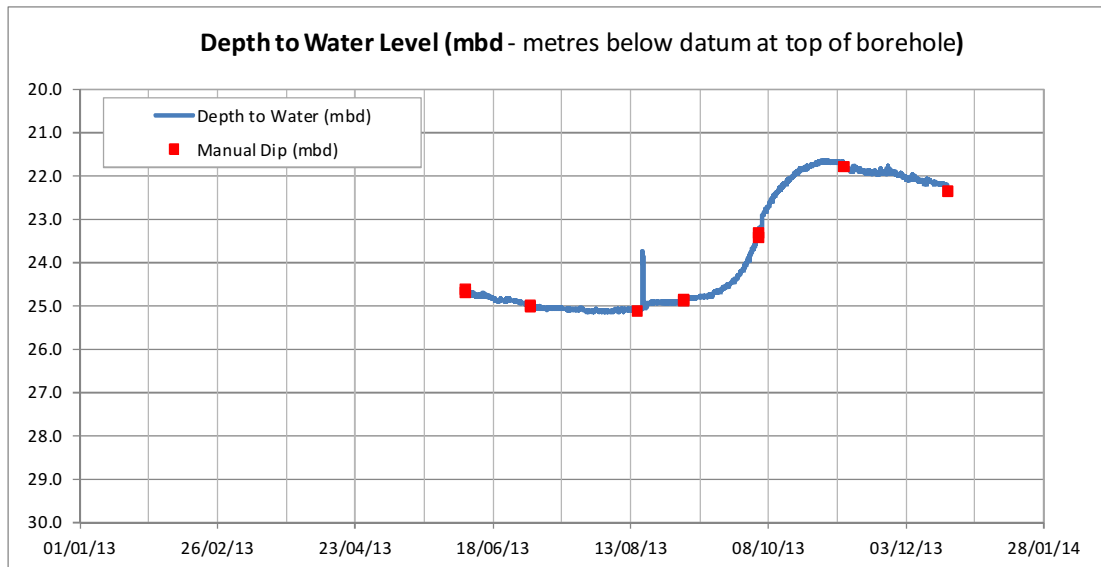


Site of Borehole 04

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
BWMA Staff		

SN12 - KAMATHOR 1 - Joule Africa Borehole 04



SN13

Kamathor 2 Stream

Tonkolili District

Unprotected stream 45° V-notch weir

GPS Co-ordinates

Location	Latitude	Longitude
Stream	9.06249	-11.74548
Rain gauge	9.05958	-11.74253

Notes on Water Source

Traditional water source located 0.5km from village.
Well with hand pump in village centre.



V-notch Weir Description

Date	16/5/2013
Time	16:45
Datum description	Bottom of "V" plate.
Datum height	0.0 cm on staff gauge ruler.

Weir type	45° v-notch
Max head	14 cm
Max flow	4.23 l/s
Initial head	4.0 cm (0.18 l/s)

Logging Equipment Installed

Model	Rugged TROLL 100 / 10m
Serial number	335913
Location:	10cm above base of tube

Baro logger	Rugged Baro TROLL
Serial number	189827
Depth	Top of tube

Logger and baro are installed within a 40mm diameter stilling tube in stream bed upstream of weir.

Rain Gauge

Model	ClimeMet 106 / 225mm
Fencing	3 x 3m Fencing
First record date	11 June 2013

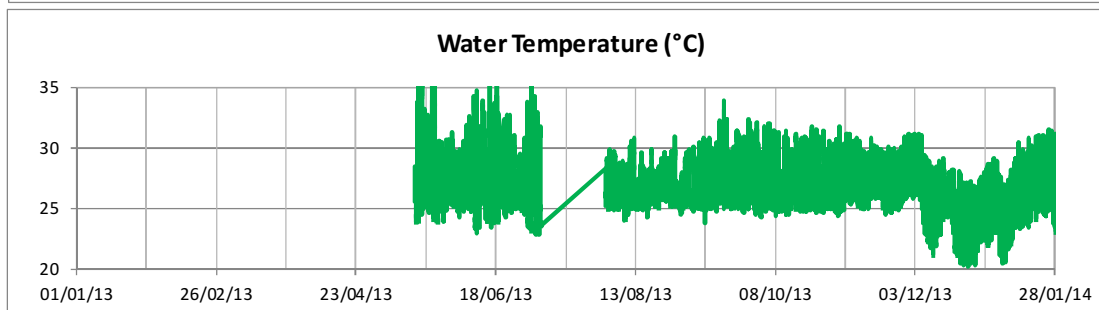
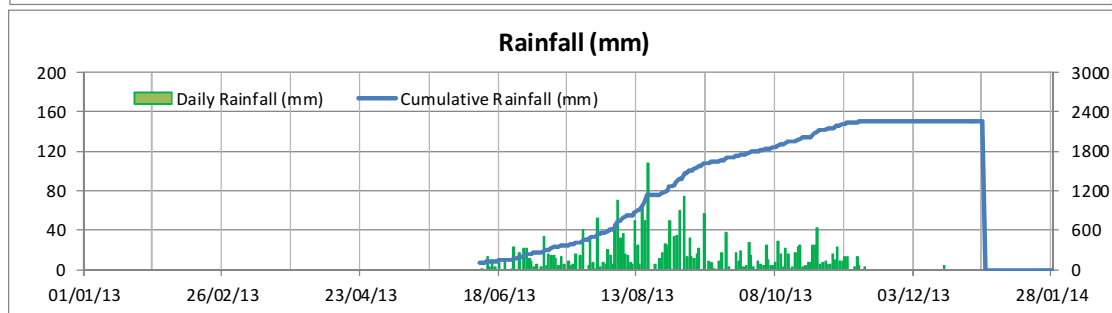
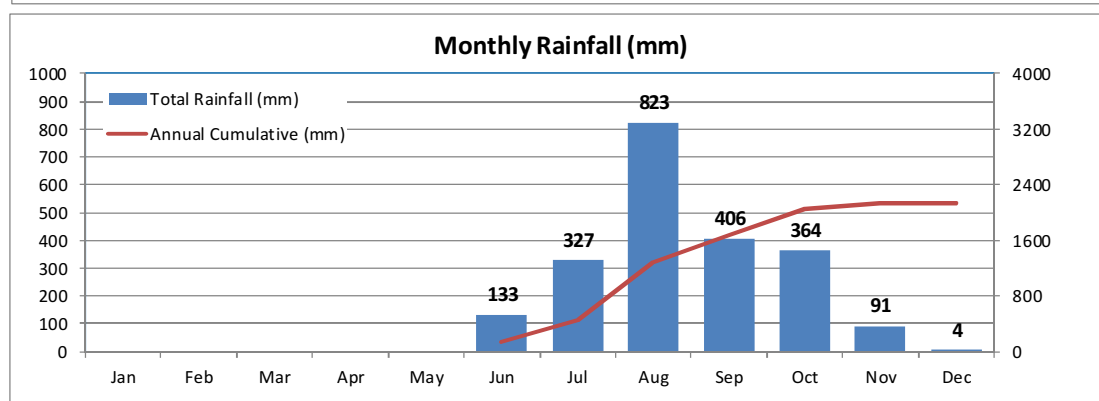
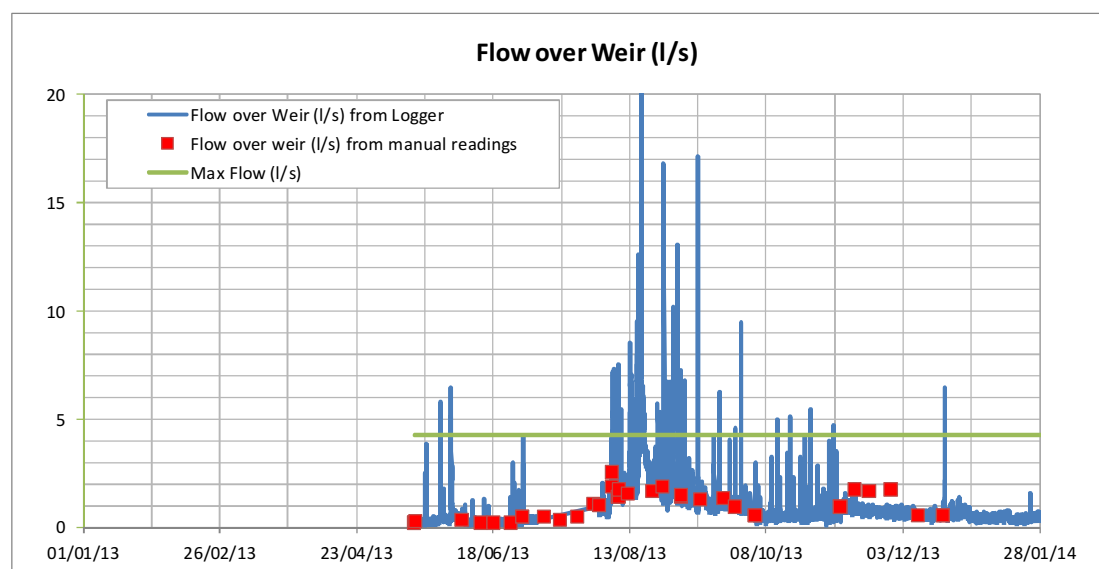


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Kenulay Kamara (T)	Youth	088 819996
Mohammed Bio (T)	Army Sergeant	

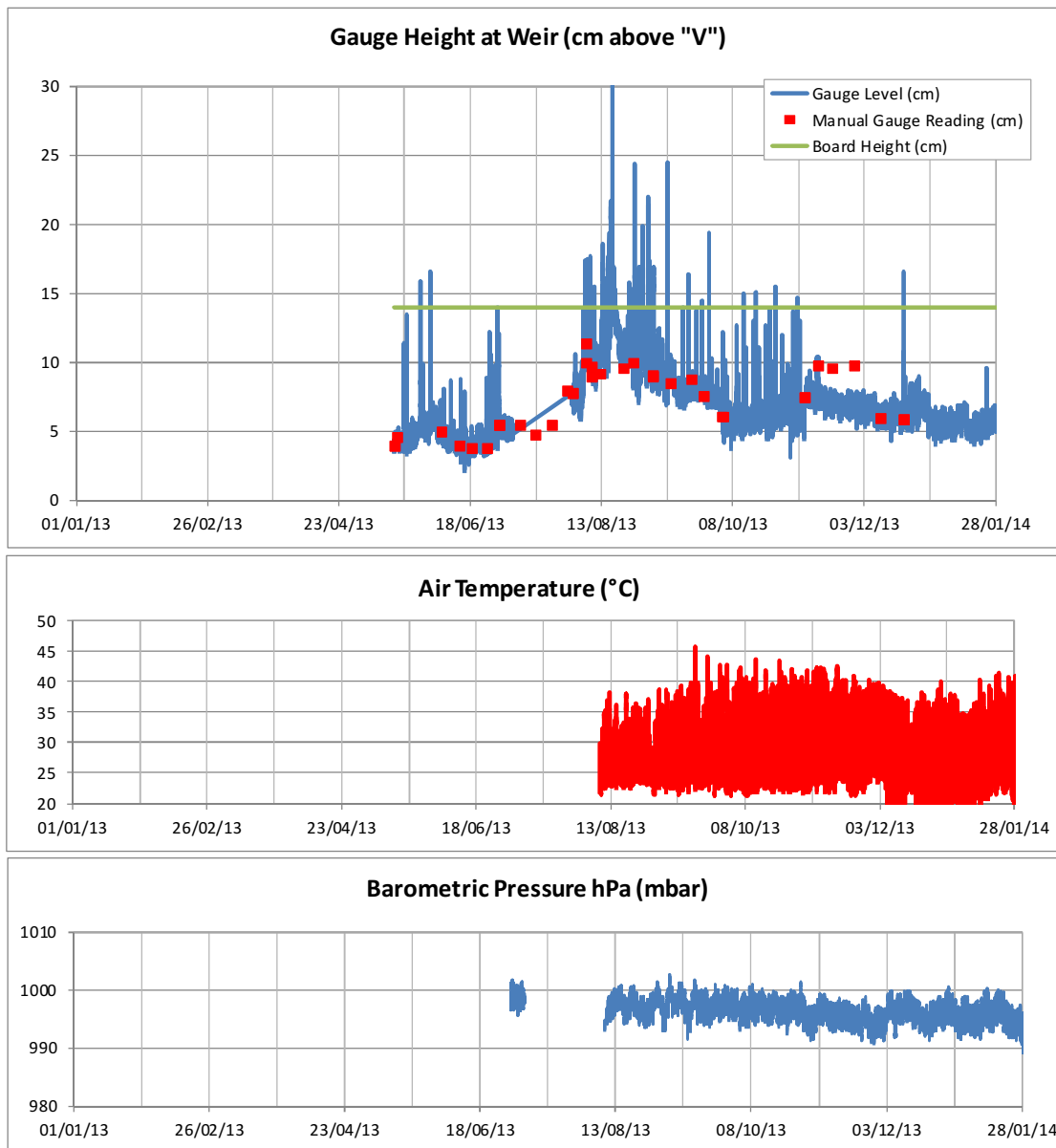
SN13 - KAMATHOR 2 Spring - 45° V-notch Weir



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SN13 - KAMATHOR 2 Spring - 45° V-notch Weir

Page 2



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SN13b

Kamathor 2 Village

Tonkolili District

Joule Africa Borehole 08

GPS Co-ordinates

Location	Latitude	Longitude
Borehole	9.05564	-11.74322

Notes

Borehole is in an enclosed upland depression which is a wetland area. Borehole 08 is A site Investigation borehole for the development of the Bumbuna Dam.



Borehole Measurements

Date	16/5/2013
Time	16:00
Datum description	Top of borehole lining
Datum height	0.20 m above ground level

Inside diameter	45 mm
Depth to water	1.79 m below datum
BH Depth	19.95 m below datum

Logging Equipment Installed in Borehole

Model	Rugged TROLL 100 / 10m
Serial number	337779
Depth in well	12 m below datum

Baro logger	None
Serial number	
Depth	

Loggers are suspended in borehole using Kevlar cord.

Rain Gauge

Model	None
Fencing	n/a
First record date	n/a

Site is close to Kamathor 2 rain gauge

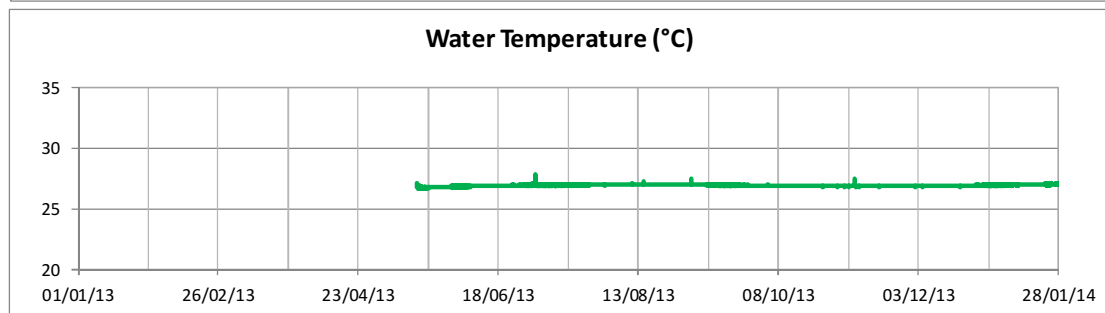
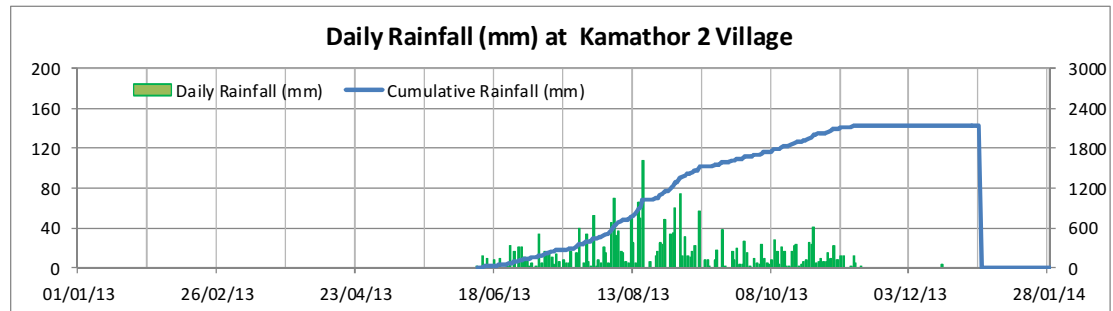
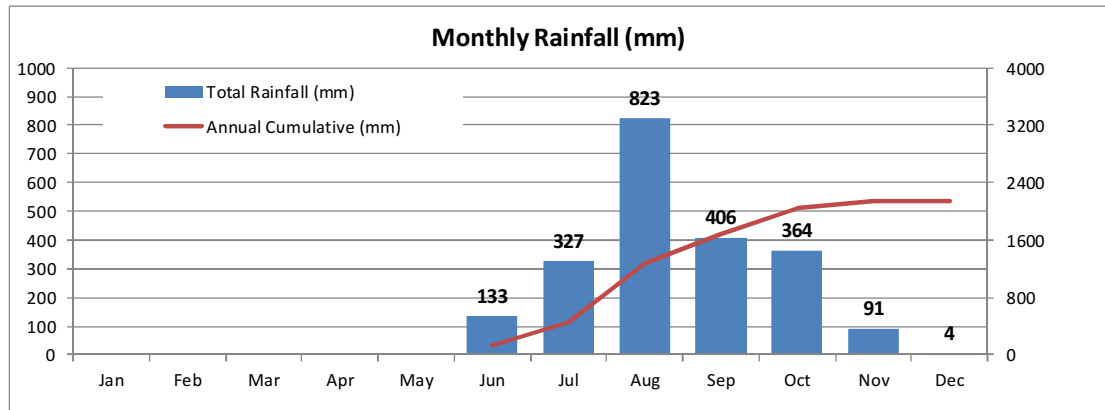
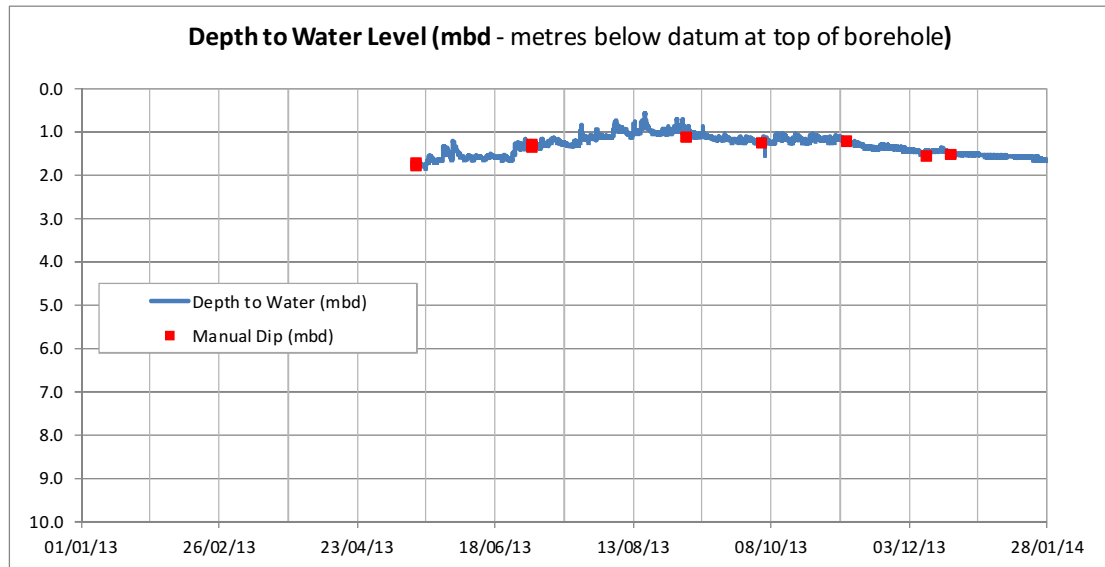


Site of Borehole 08

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
BWMA Staff		

SN13b - KAMATHOR 2 - Joule Africa Borehole 08



SN14

Kasokira Stream

Tonkolili District

Unprotected stream
60° V-notch weir

GPS Co-ordinates

Location	Latitude	Longitude
Stream	9.08342	-11.73518
Rain gauge	9.08280	-11.73381

Notes on Water Source

Community water source. Being assessed for improvement by BWMA.



V-notch Weir Description

Date	18/5/2013
Time	09:40
Datum description	Bottom of "V" plate.
Datum height	0.0 cm on staff gauge ruler.

Weir type	60° v-notch
Max head	16 cm
Max flow	8.24 l/s
Initial head	6.0 cm (0.71 l/s)

Logging Equipment Installed

Model	Rugged TROLL 100 / 10m
Serial number	337775
Location:	10cm above base of tube

Baro logger	Rugged Baro TROLL
Serial number	342843
Depth	In top of tube.

Logger and Baro are installed within a 40mm diameter stilling tube in stream bed upstream of weir.

Rain Gauge

Model	ClimeMet 106 / 225mm
Fencing	Traditional wooden stockade
First Record	6 June 2013

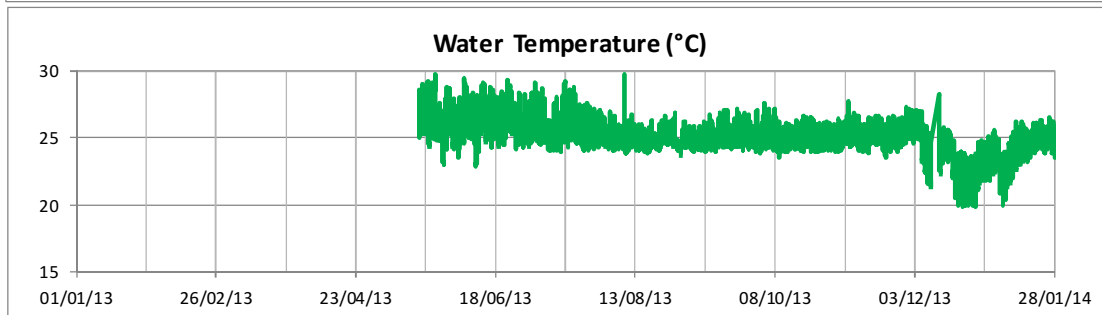
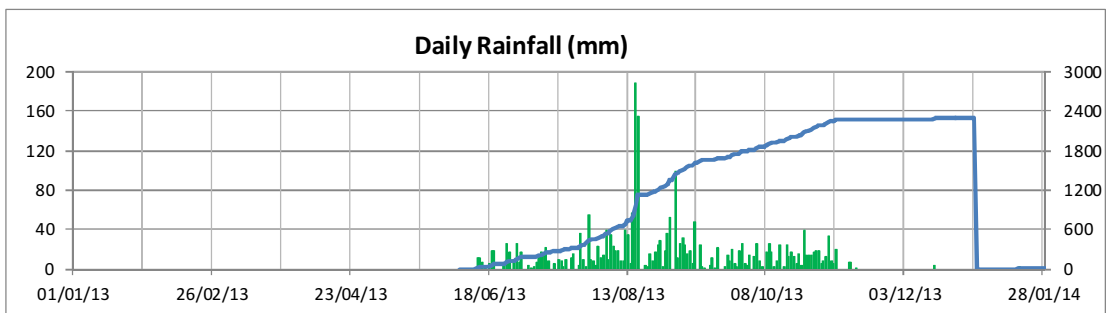
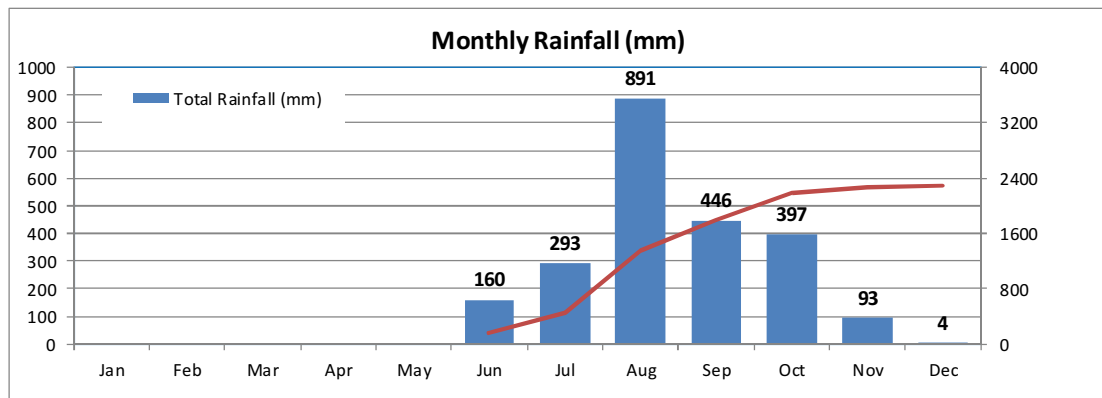
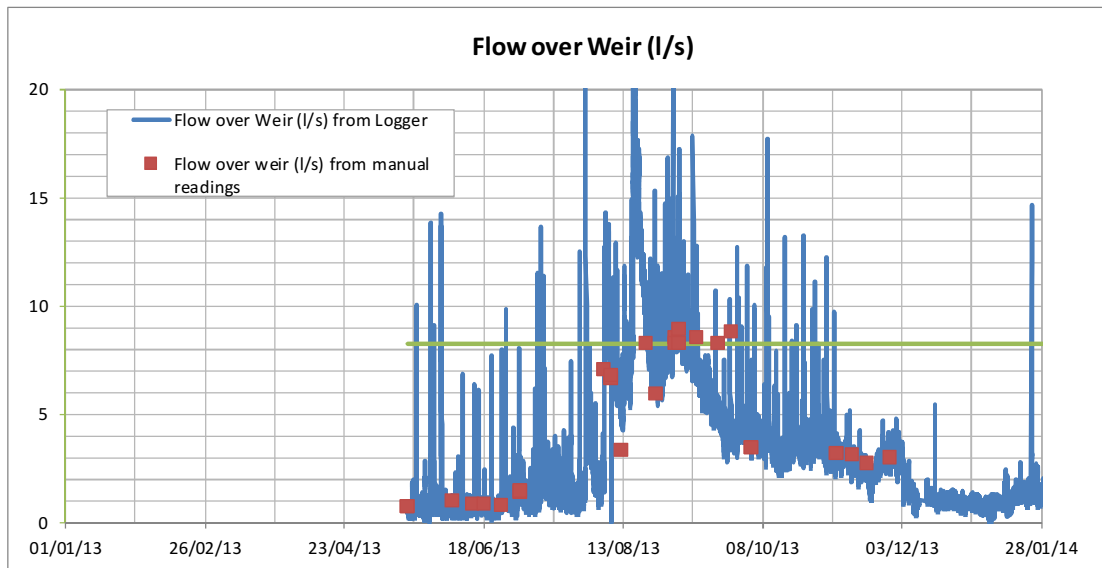


Rain gauge compound

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Francis Sawoh Turay (T)	Head Teacher	030 767 628

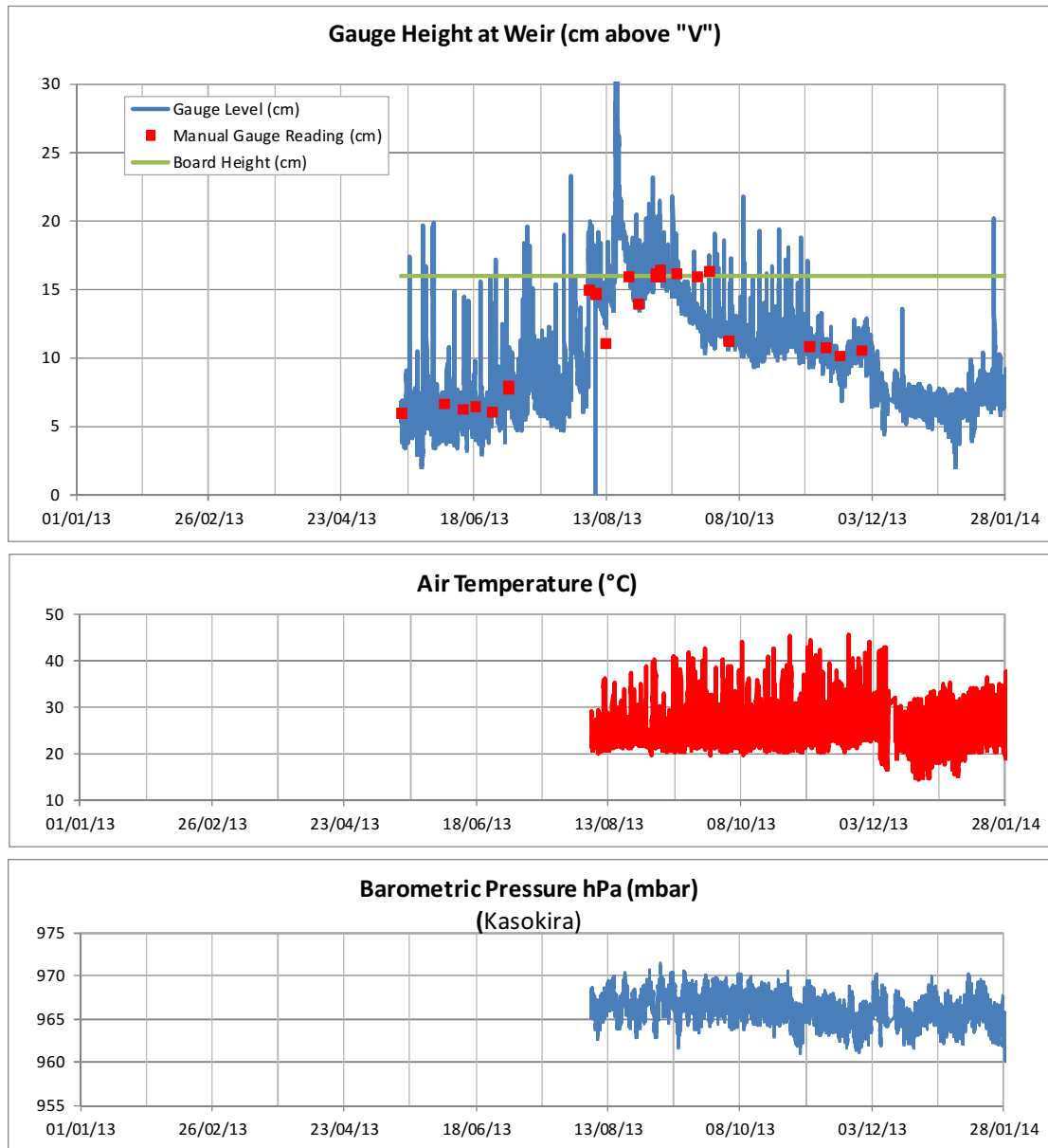
SN14 - KASOKIRA Stream - 60° V-notch Weir



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SN14 - KASOKIRA Stream - 60° V-notch Weir

Page 2



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SN15

Mabonto – TDC primary and Secondary Schools

Tonkolili District

Hand dug well with hand pump

GPS Co-ordinates

Location	Latitude	Longitude
Well	8.85965	-11.81809
Rain gauge	8.85966	-11.81845

Notes on Water Source

Schools also has a spring water supply feeding to a standpipe tap in the school grounds.



Well Measurements

Date	15/5/2013
Time	11:00
Datum description	Rim edge of access cover.
Datum height	0.36 m above ground level

Inside diameter	1.2 m
Depth to water	5.12 m below datum
Well depth	6.85 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 10m
Serial number	337774
Depth in well	On base in container.

Baro logger	None
Serial number	
Depth	

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	30 June 2013

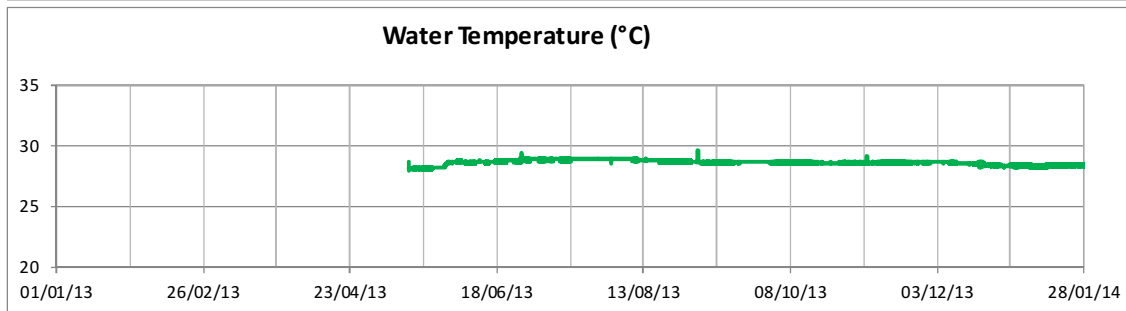
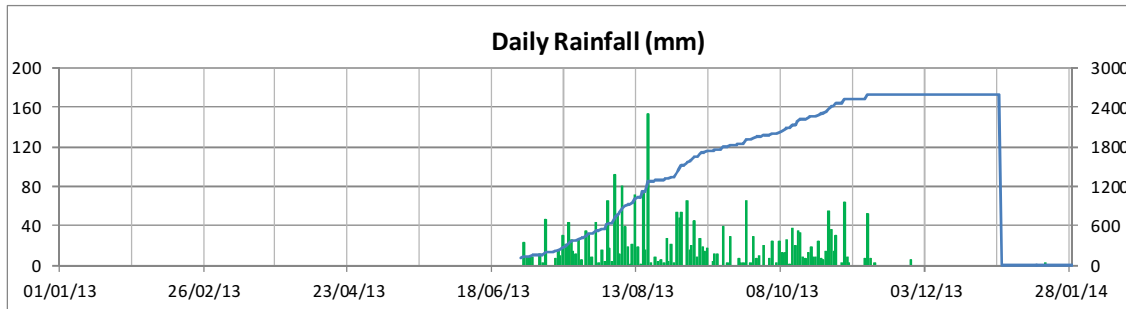
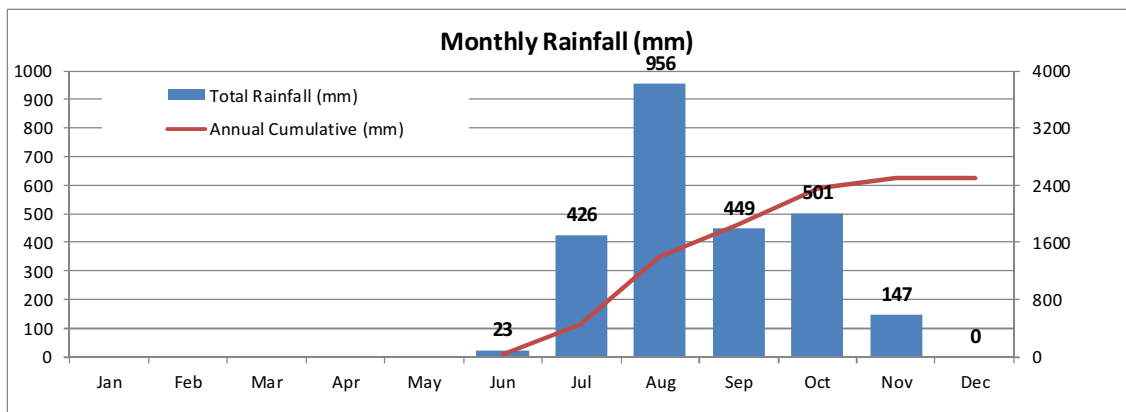
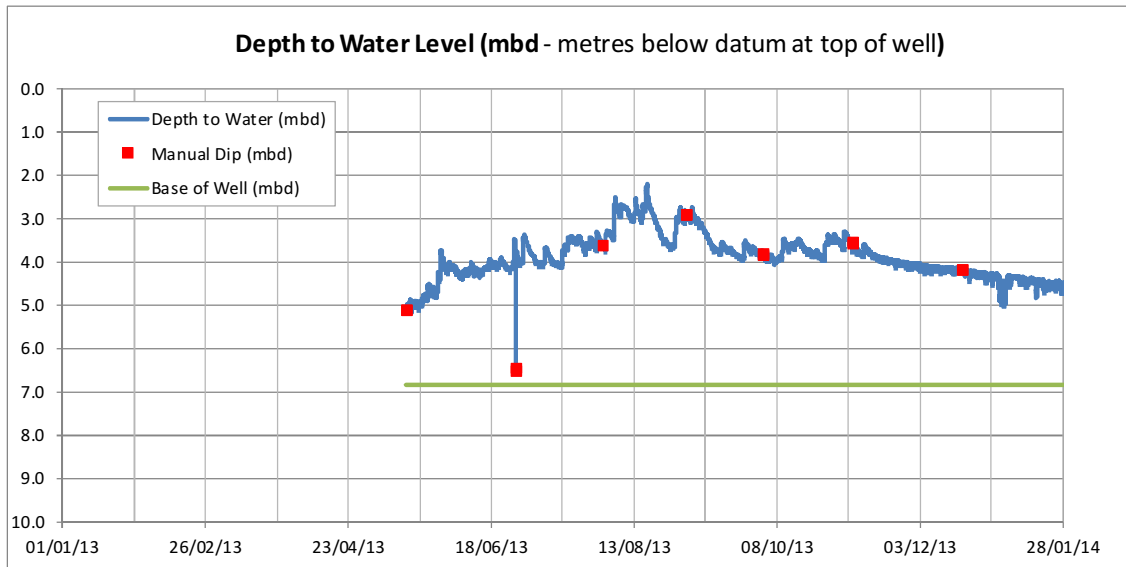


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Momoh B. Kargbo...(T)	Headmaster	076 827 223
Foday S. Tholley (T)	Teacher	
Khalil G. Bangura	Principal	

SN15 - Mabonto - TDC Primary and Secondary Schools



SN16**Magburaka Boys Secondary School****Tonkolili District****Hand dug well with hand pump****GPS Co-ordinates**

Location	Latitude	Longitude
Well	8.71845	-11.94566
Rain gauge	8.71783	-11.94397

Notes on Water Source

Students well at school where the current President and Minister for Education were pupils.

**Well Measurements**

Date	17/1/2013
Time	16:00
Datum description	Rim edge of access cover.
Datum height	0.57 m above ground level

Inside diameter	1.2 m
Depth to water	6.65 m below datum
Well depth	9.90 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 10m
Serial number	337774
Depth in well	On base in container.

Baro logger	Rugged Baro TROLL
Serial number	327314
Depth	1.5m below datum

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	4 June 2013

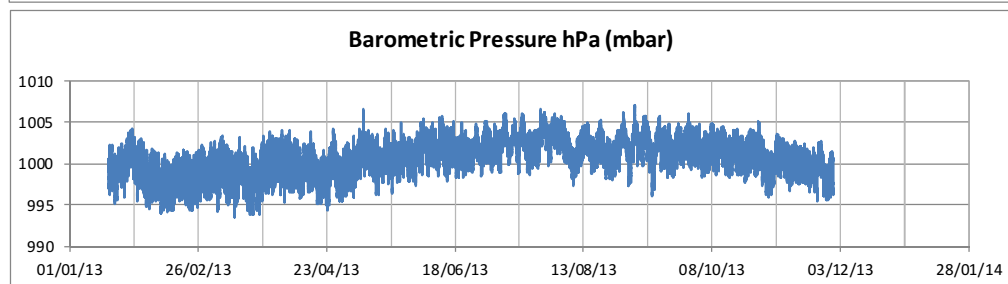
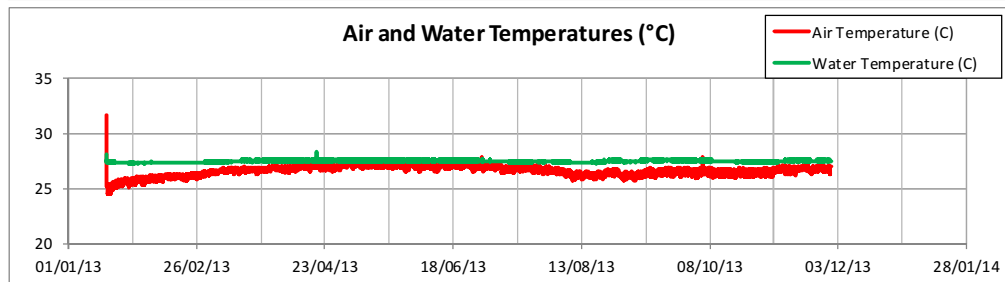
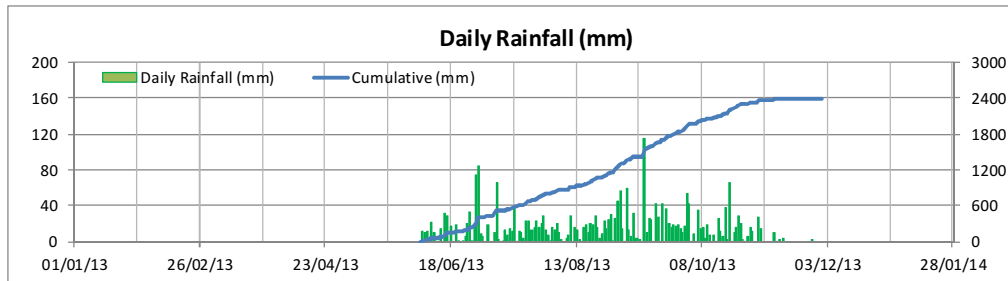
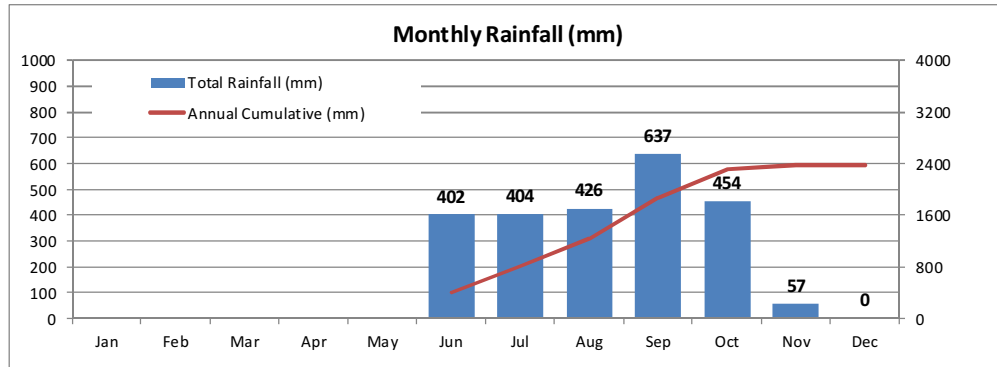
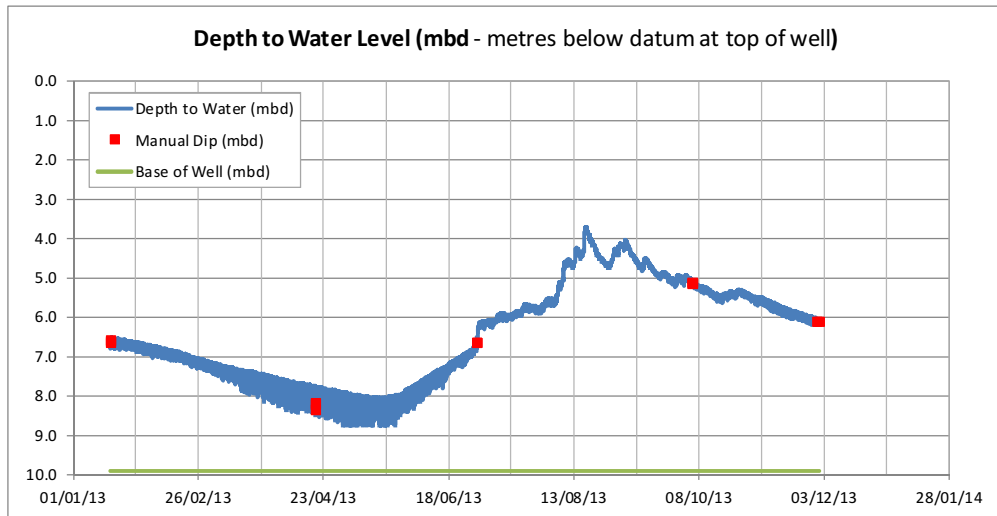


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Mohamed Lamin Sesay	Principal	076/033/088 628 638
Alimamy P. Kalokoh (T)		030 436 822

SN16 - Magburaka - Boys Secondary School



SN17**Magburaka – National Commercial
Secondary School****Tonkolili District****Rain gauge site****GPS Co-ordinates**

Location	Latitude	Longitude
Rain gauge	8.72092	-11.93289

Notes on Water Source

Hand dug well in school grounds. Top is sealed (no access). School has 1000 pupils.



Rain gauge site

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	4 June 2013

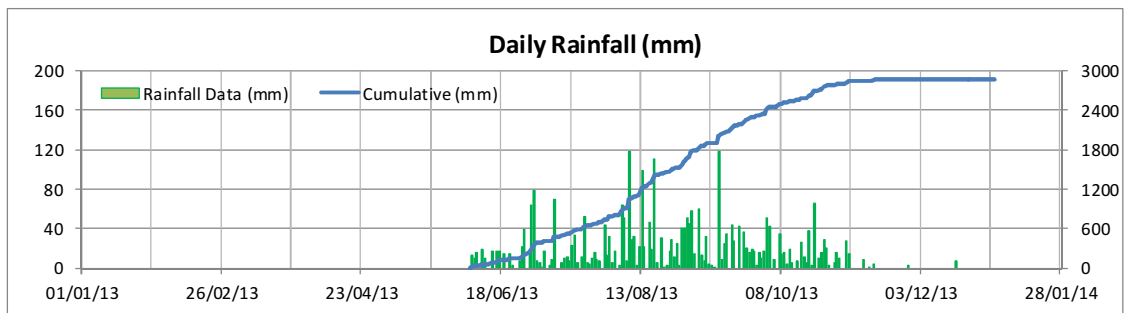
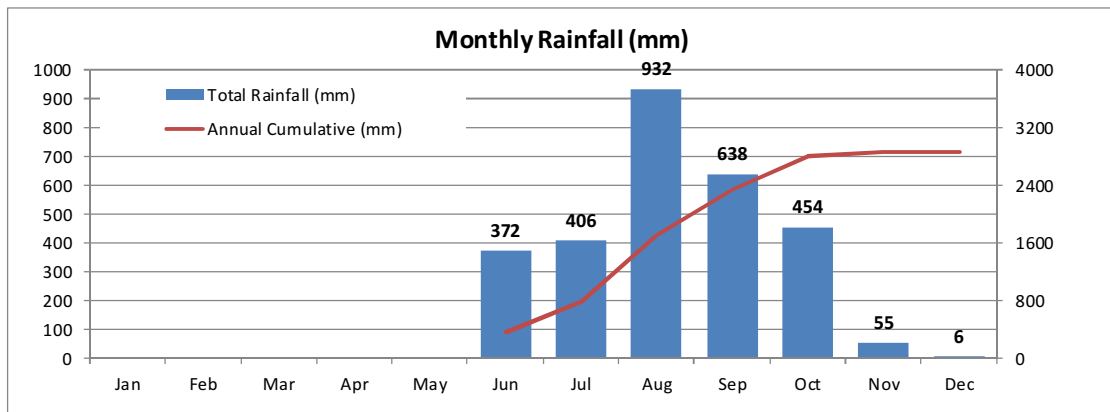


School well – no access

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Henry Sankoh (T)	Teacher (Geography)	077 821 699

SN17 - National Commercial Secondary School



SN18

Magburaka – Tonkolili District Council
(WSD Office)

Tonkolili District

Hand dug well with hand pump

GPS Co-ordinates

Location	Latitude	Longitude
Well	8.72009	-11.93473
Rain gauge	8.72009	-11.93450

Notes on Water Source

Well is regularly used by community.



Well Measurements

Date	10/5/2013
Time	17:00
Datum description	Rim edge of access cover.
Datum height	0.64 m above ground level

Inside diameter	1.2 m
Depth to water	14.74 m below datum
Well depth	14.92 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 10m
Serial number	337939
Depth in well	On base in container.

Baro logger	None
Serial number	
Depth	

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	4 June 2013

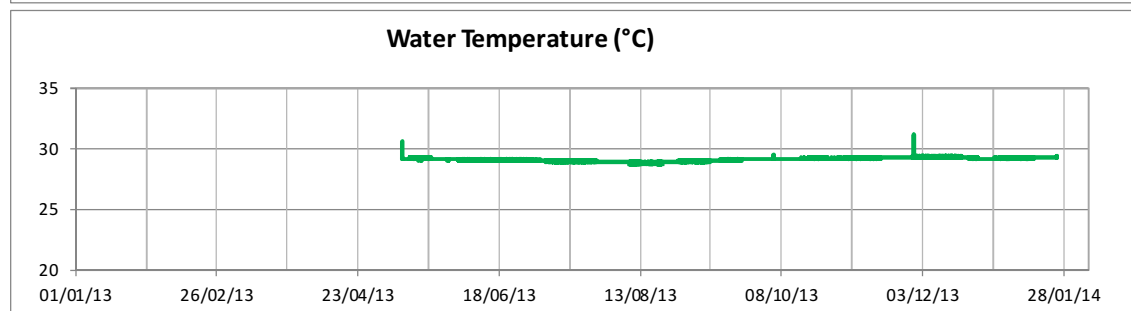
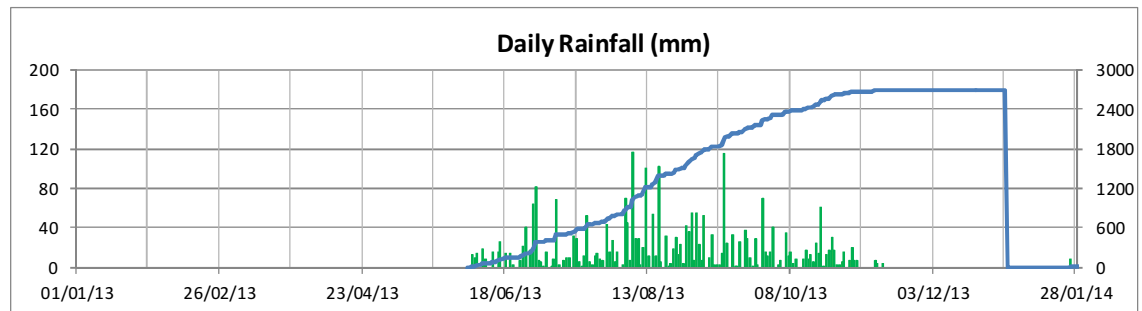
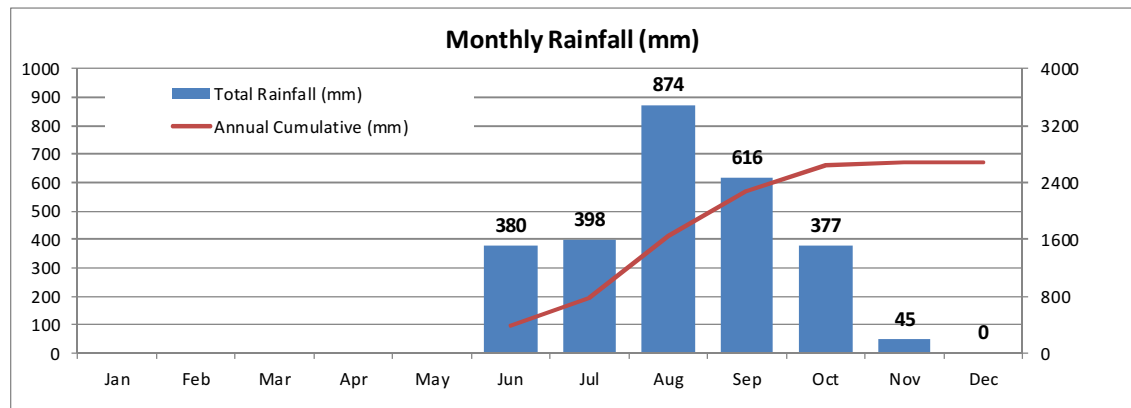
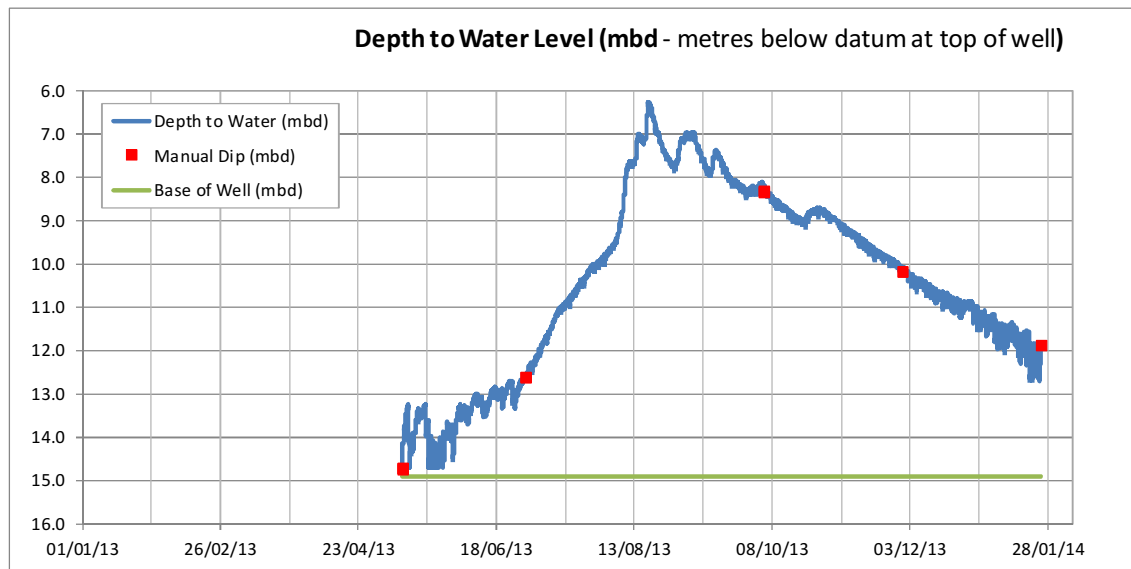


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Andrew Moseray (T)	WSD Supervisor	
David Koroma (T)	Laboratory Technican	076 803 209

SN18 - Magburaka - Tonkolili District Council WSD Well



SN19

Maraka – SLMB Primary School

Tonkolili District

Rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.74239	-11.89570

Notes on Water Source

None at school.



Rain gauge site

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fencing
First record date	5 June 2013

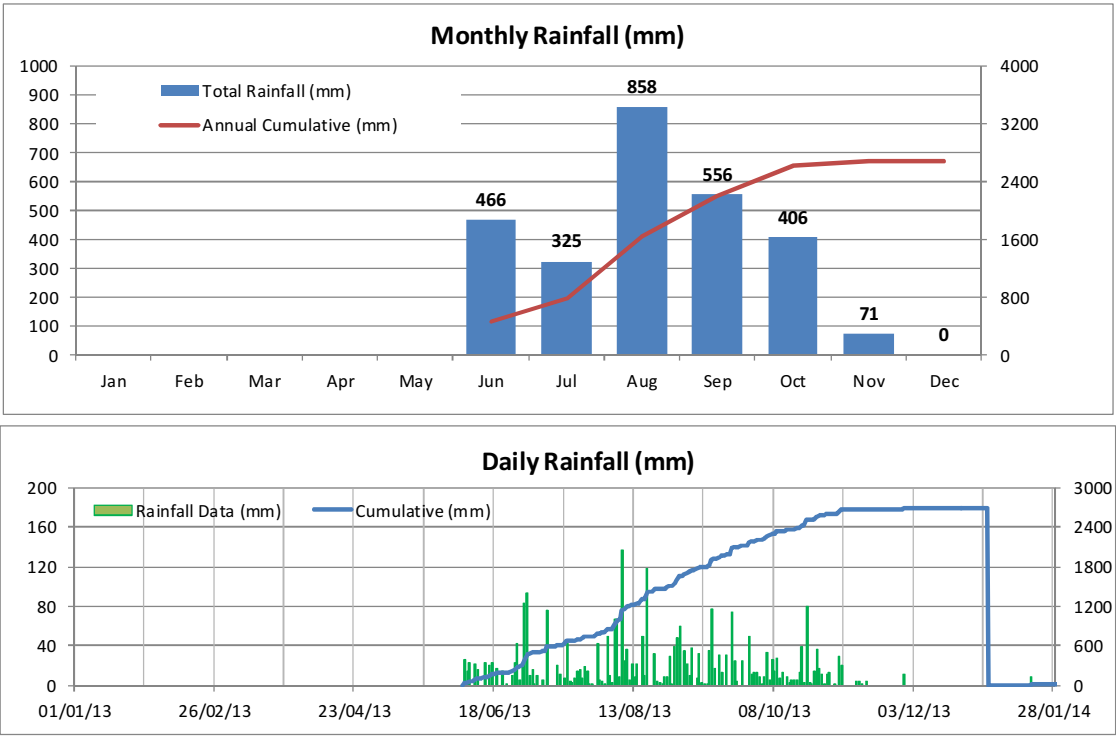


Training on 8 May 2013

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Amadu S. Koroma (T)	Head Teacher	076 501 945 / 077 200 238
Karim A. Turay	Teacher	076 999 816 / 077 401 853

SN19 - Maraka SLMB Primary School



SN20

Masongbo Village

Bombali District

Hand dug well with hand pump

GPS Co-ordinates

Location	Latitude	Longitude
Well	8.98092	-11.88809
Rain gauge	8.98114	-11.88734

Notes on Water Source

Community well in regular use. Hand pump leaky and in need of repair.



Well Measurements

Date	16/5/2013
Time	14:30
Datum description	Rim edge of access cover.
Datum height	0.50 m above ground level

Inside diameter	1.2 m
Depth to water	9.22 m below datum
Well depth	10.40 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 30m
Serial number	338765
Depth in well	On base in container.

Baro logger	Rugged Baro TROLL
Serial number	326157
Depth	1.5m below datum

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 2m Wooden Stockade
First Record	11 June 2013

Rain gauge is located outside CLC Chairman's house.

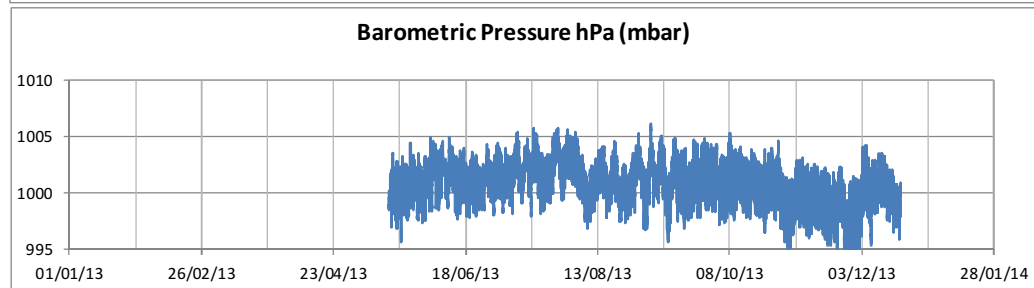
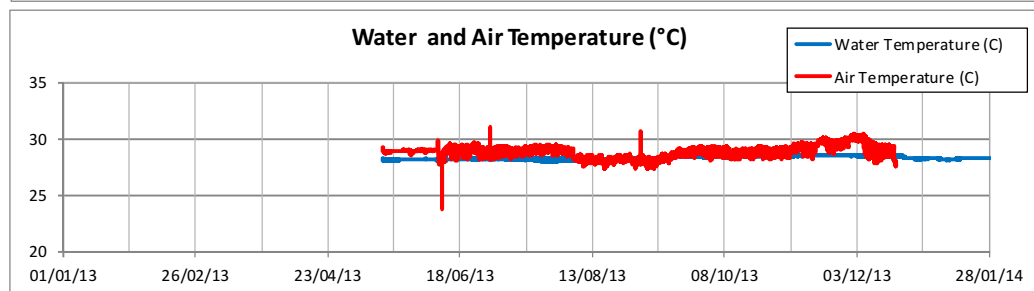
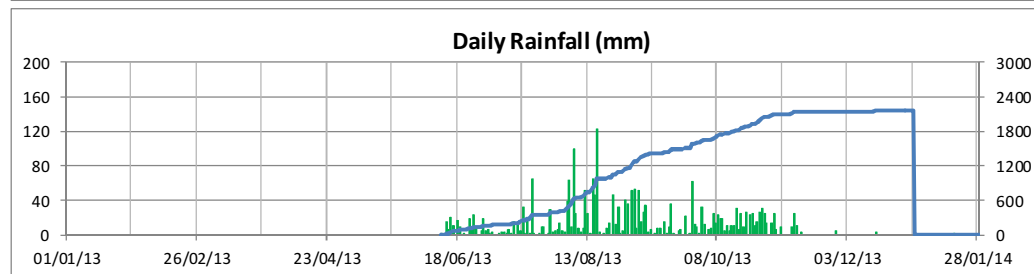
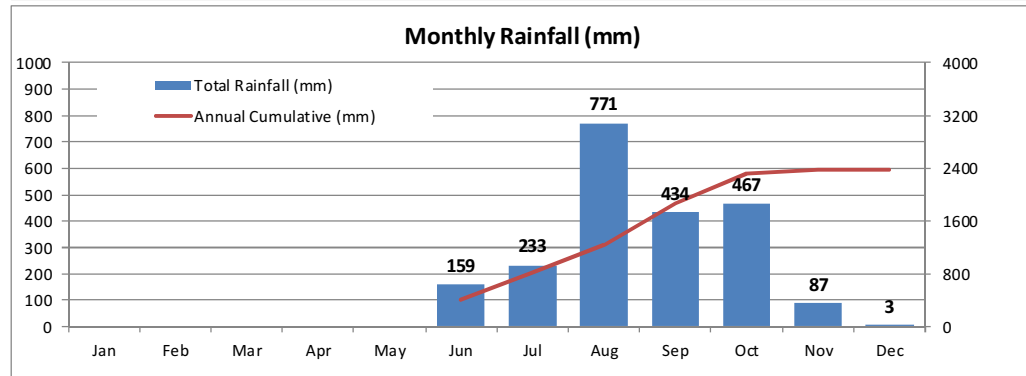
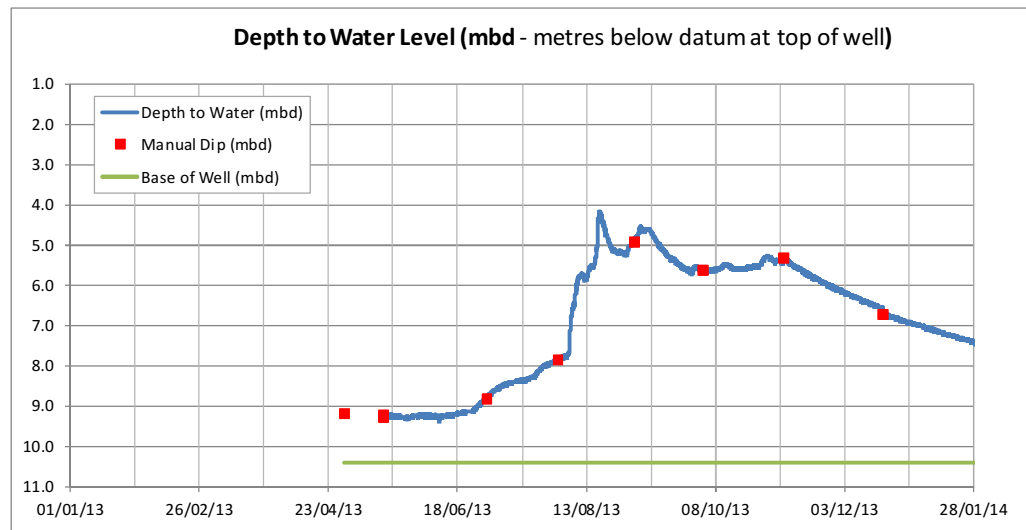


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Sanpha Mansara (T)	CLC Chairman / Fisherman	078 583 360

SN20 - MASONGBO Community Well



SN21**Mathora – RC Primary School****Tonkolili District****Hand dug well with hand pump****GPS Co-ordinates**

Location	Latitude	Longitude
Well	8.73725	-11.89903
Rain gauge	8.73481	-11.90101

Notes on Water Source

New well. Pump intake is not deep enough to draw water from base. School uses swamp water.

**Well Measurements**

Date	10/5/2013
Time	12:30
Datum description	Rim edge of access cover.
Datum height	0.50 m above ground level

Inside diameter	1.2 m
Depth to water	9.53 m below datum
Well depth	10.46 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 10m
Serial number	337942
Depth in well	On base in container.

Baro logger	None
Serial number	
Depth	

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 3m Fenced
First Record	6 June 2013

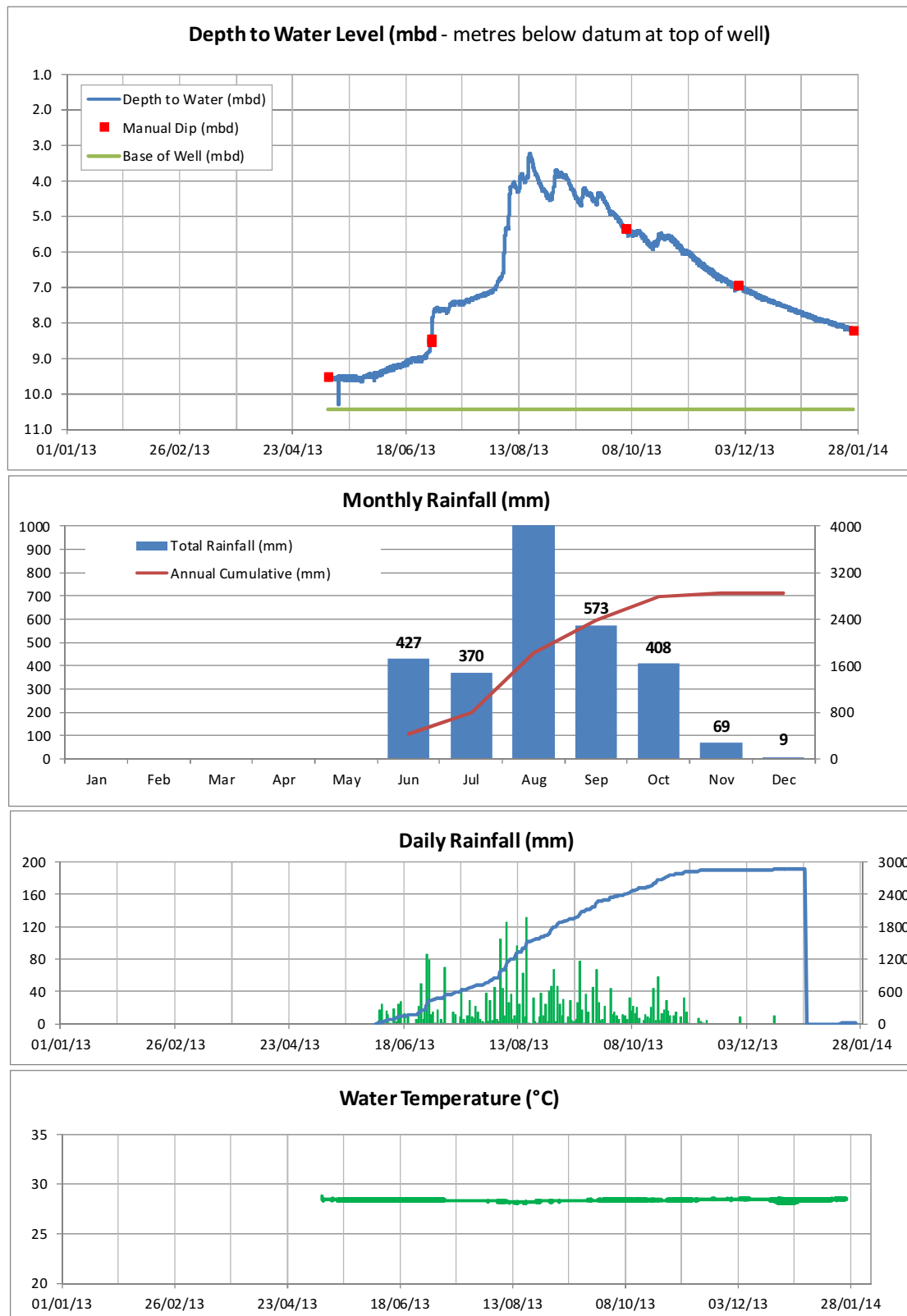


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Yeabu Tholley	Head Teacher	077 436 972
Hawa M. Thoronka	Deputy Head	030 240 467
Momoh S. Tholley (T)	Lives locally	076 517 148

SN21 - Mathora - RC Primary School



SN22**Kathombo – St George RC Primary School****Tonkolili District****Hand dug well with hand pump****GPS Co-ordinates**

Location	Latitude	Longitude
Well	9.06375	-11.76213
Rain gauge	9.06353	-11.76226

Notes on Water Source

Well has problems with suspended solids content.

**Well Measurements**

Date	12/12/2013
Time	11:00
Datum description	Rim edge of access cover.
Datum height	0.60 m above ground level

Inside diameter	1.2 m
Depth to water	5.46 m below datum
Well depth	8.70 m below datum

Logging Equipment Installed in Well

Model	Rugged TROLL 100 / 10m
Serial number	337780
Depth in well	On base in container.

Baro logger	None
Serial number	
Depth	

Loggers is installed within a 2.5 litre plastic container, weighted with gravel, on base of well.

Rain Gauge

Model	ClimeMet 1016 / 225mm
Fencing	3m x 2m Fenced
First Record	13 June 2013

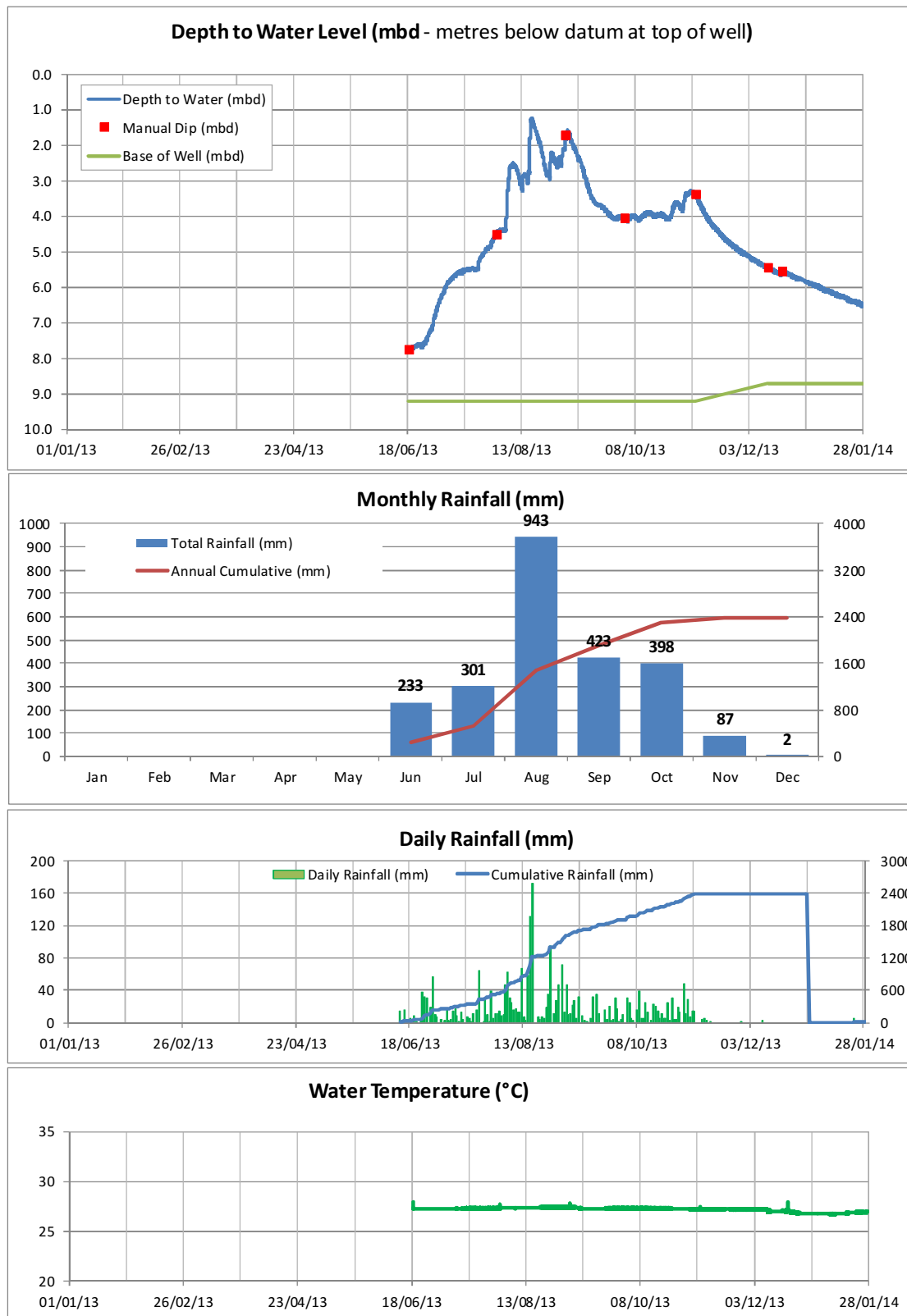


Rain gauge site

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Gibrilla J. Kamara	Teacher	076 256 110 / 078 786 085

SN22 - Kathombo RC School Well



SN23**Waia Village****Koinadugu District****Rain gauge site****GPS Co-ordinates**

Location	Latitude	Longitude
Rain gauge	9.13225	-11.69207

Notes on Water Source

Well under construction.



Rain gauge site

Rain gauge

Model	ClimeMet 1016 / 225mm
Fencing	None
First record date	21 June 2013

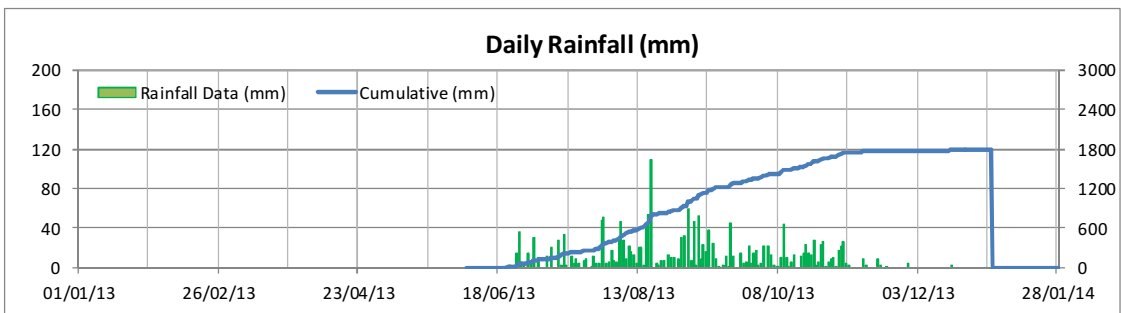
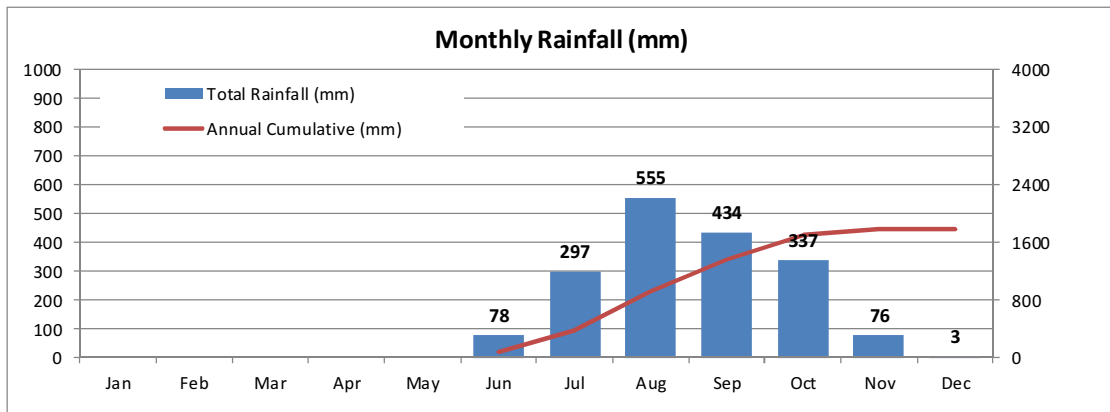


New well under construction

Contacts / Trained Rain Gauge Observers (T)

Name	Title	Telephone
Balansama Kamara (T)	Youth	076 309 459

SN23 - Waia



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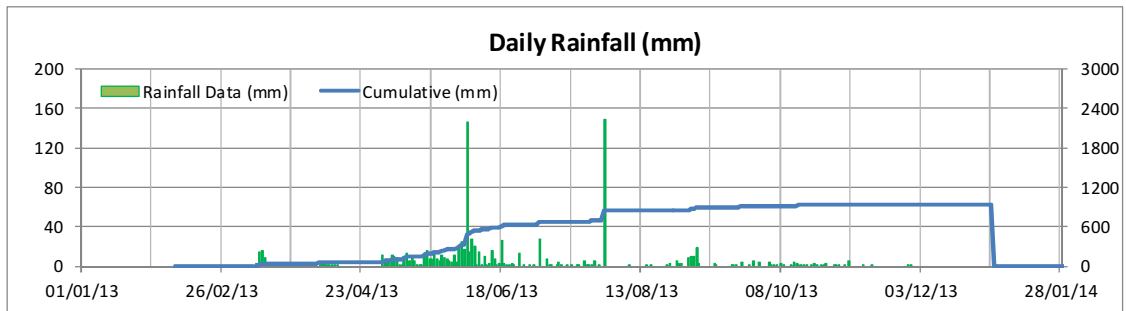
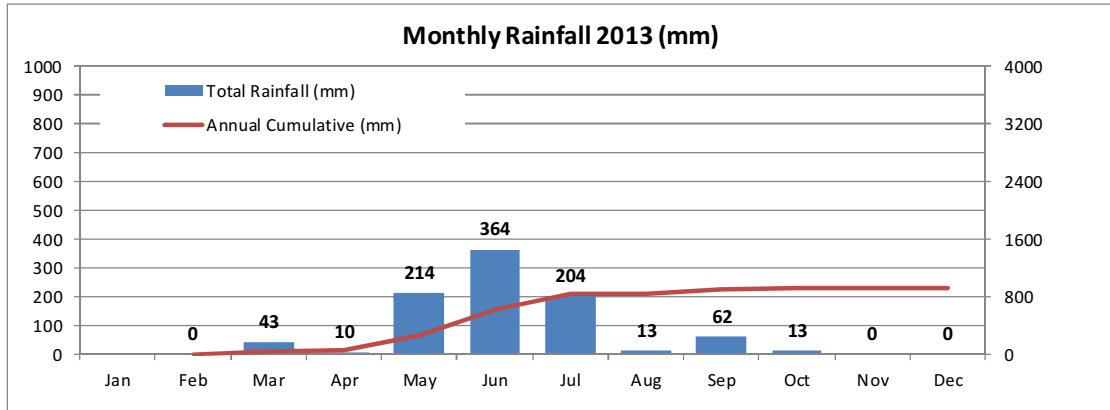
Annex C Other monitoring sites - information sheets and graphical data summaries

AD01 ADDAX Automatic Weather Station	Bombali District Automatic weather station with rain gauge									
GPS Co-ordinates <table><tr><th>Location</th><th>Latitude</th><th>Longitude</th></tr><tr><td>Rain gauge</td><td>8.68550</td><td>-12.16804</td></tr><tr><td></td><td></td><td></td></tr></table> Notes Automatic climate station located in centre of estate.	Location	Latitude	Longitude	Rain gauge	8.68550	-12.16804				No picture
Location	Latitude	Longitude								
Rain gauge	8.68550	-12.16804								
Rain Gauge <table><tr><td>Model</td><td>Tipping Bucket</td></tr><tr><td>Fencing</td><td>No data</td></tr><tr><td>First record date</td><td>7 February 2013</td></tr></table>	Model	Tipping Bucket	Fencing	No data	First record date	7 February 2013				
Model	Tipping Bucket									
Fencing	No data									
First record date	7 February 2013									

Contacts (Addax Bioenergy)

Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

AD01 - Addax - Automatic Weather Station



AD02 and AD03

**ADDAX - Rokel River Upstream (AD02)
and downstream (AD03) of Addax Estate.**

Bombali District

**Manual river flow gauging
locations**

GPS Co-ordinates

Location	Latitude	Longitude
Upstream(AD02)	8.73351	-12.31435
Downstream (AD03)	8.66333	-12.11628

Notes

GPS co-ordinates provided by Addax.

No picture

Installation Details

Type	Manual – surface flows
First Record Date	April 2012

Notes:

Depth profile every 4 m

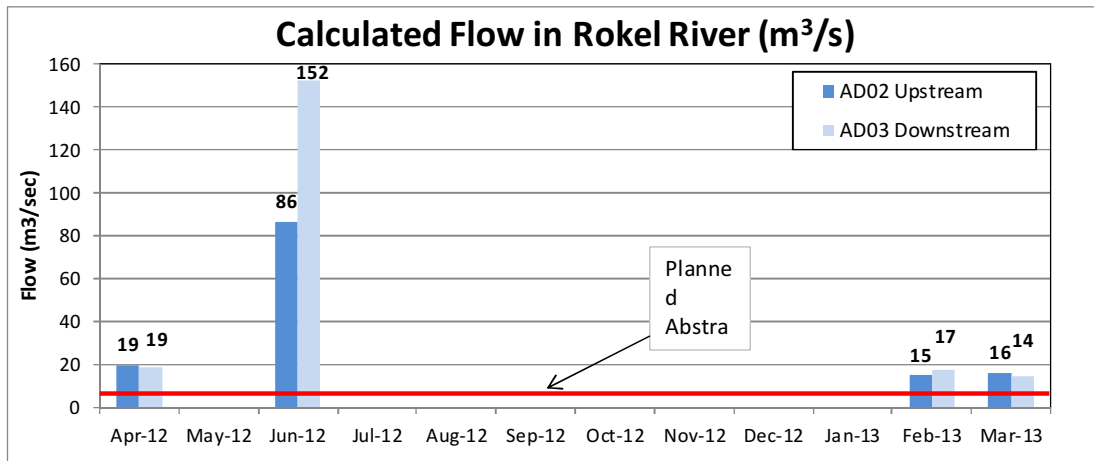
Flow measurement every 12m

Contacts (Addax Bioenergy)

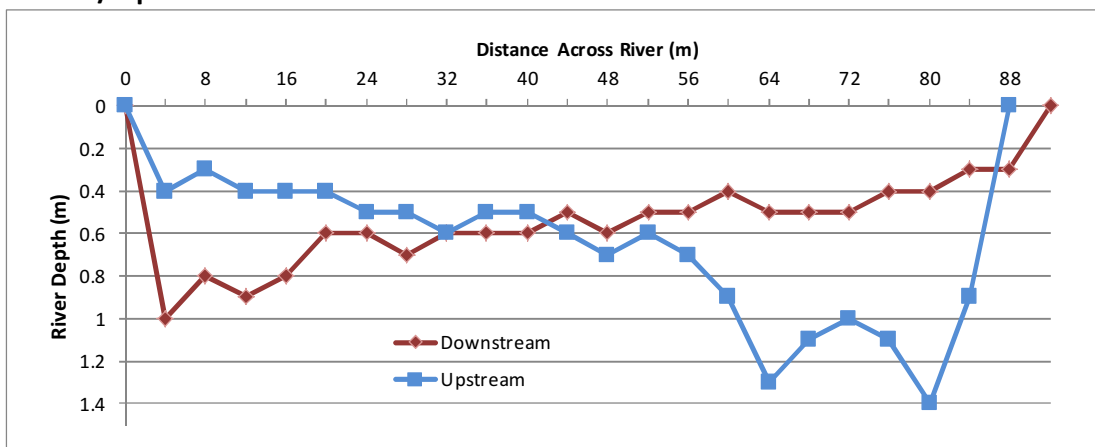
Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

AD02 (Upstream) & AD03 (Downstream) Rokel River

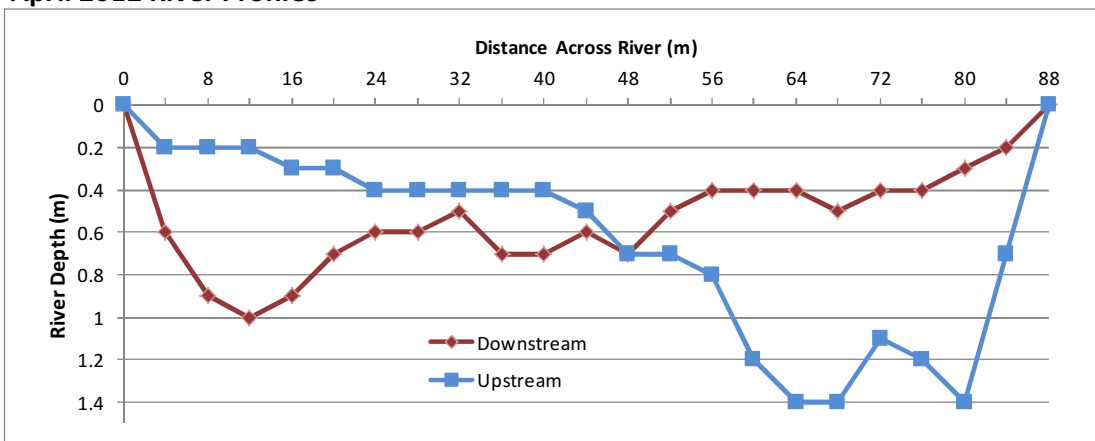
Flow in Rokel Rver (m ³ /second)		
All flow rates should be treated as approximations.		
Month	AD02	AD03
	Upstream	Downstream
Apr-12	19.5	18.7
Jun-12	85.9	152.4
Feb-13	14.7	17.3
Mar-13	15.7	14.2



March / April 2013 River Profiles



April 2012 River Profiles



AD04

ADDAX Irrigation Block 7

Tonkolili District

Rain gauge

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.66995	-12.23121

No picture

Notes

Location is estimated – positioned in centre of irrigation block.

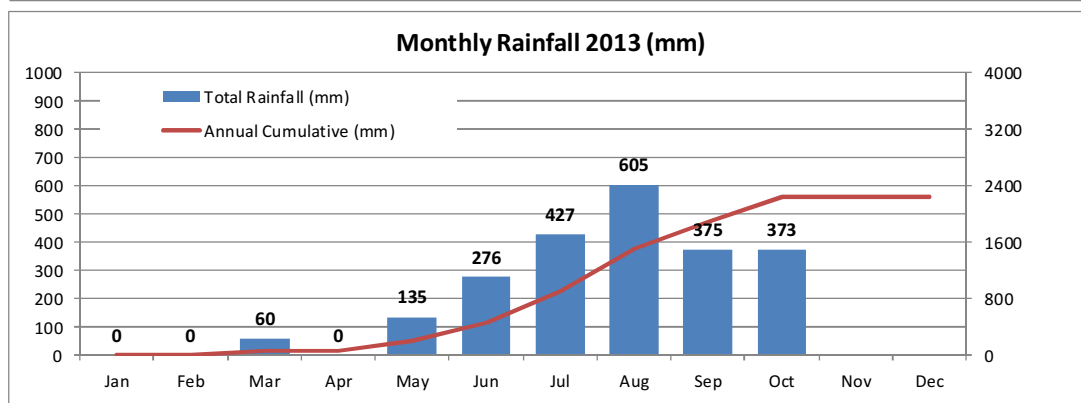
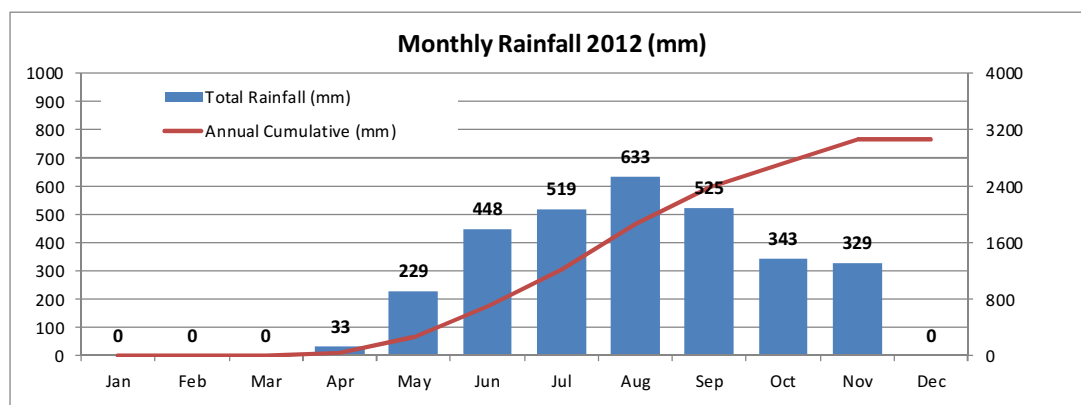
Rain Gauge

Model	Funnel?
Fencing	No data
First record date	

Contacts (Addax Bioenergy)

Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

AD04 - Addax Block 7 Rain Gauge



AD05

ADDAX Irrigation Block 11

Bombali District

Rain gauge

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.70152	-12.12170

No picture

Notes

Location is estimated – positioned in centre of irrigation block.

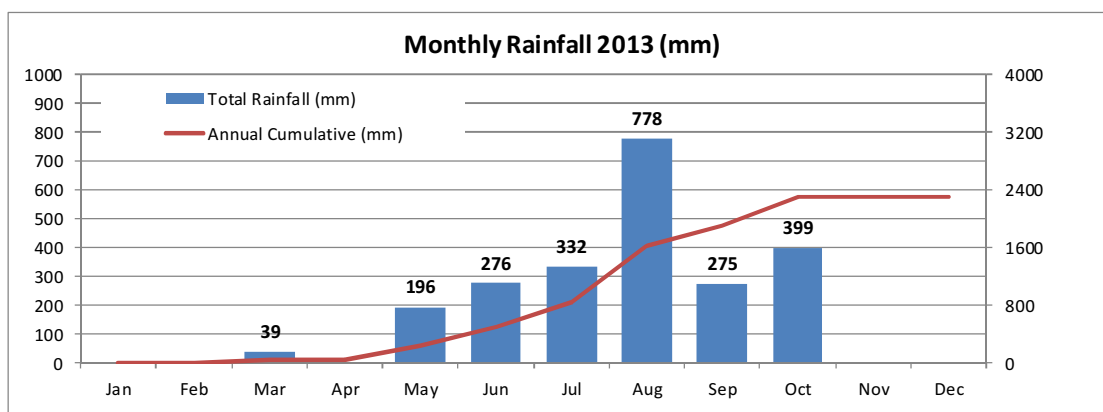
Rain Gauge

Model	Funnel?
Fencing	No data
First record date	

Contacts (Addax Bioenergy)

Name	Title	Telephone
Safea Mansa-Musa	Environmental Officer	078 660 455
Lily Kainwo	Trainee	078 154 762

AD05 - Addax Block 11 Rain Gauge



BD01

Bumbuna Dam Site Offices

Tonkolili District

Rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	9.06568	-11.73218

Notes

Automatic recording Rain gauge in Dam Site office compound.



Rain gauge site

Rain Gauge

Model	Tipping bucket
Fencing	None
First record date	Uncertain – before 2007



Chart recorder for Rain gauge

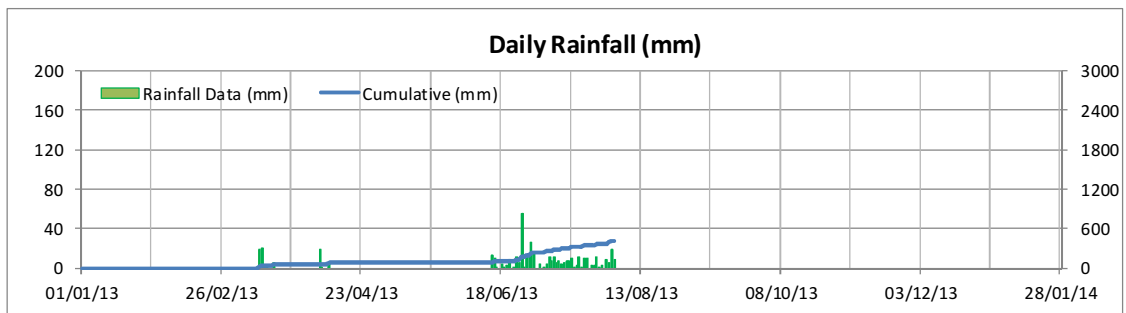
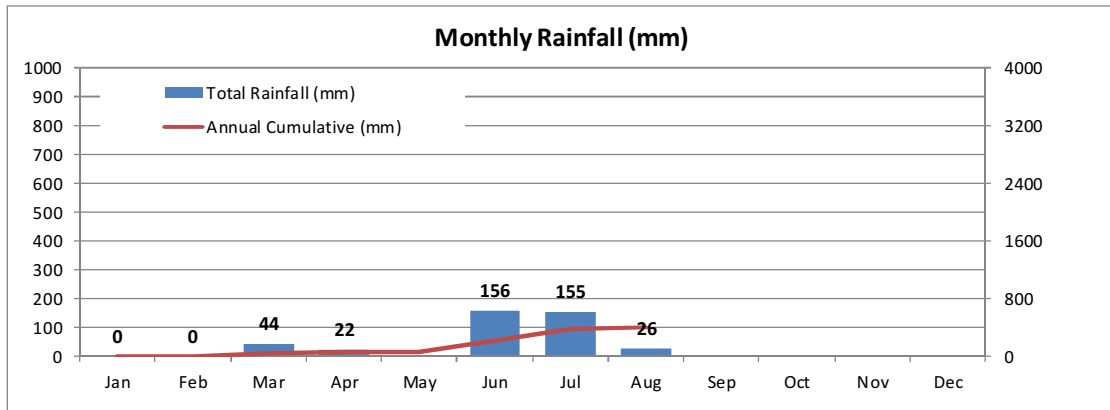


Close up of Rain gauge

Contacts (Salini – Bumbuna Dam Operators)

Name	Title	Telephone / email
David S Conteh	Civil Engineer	033 548 210 / 076 850 549 dasacone@gmail.com
Mr. Ciro	Bumbuna Dam Manager	

BD01 - Bumbuna Dam Rain Gauge



BD02**Bumbuna Dam Site Weir****Tonkolili District****River flow gauging weir
on Rokel River****GPS Co-ordinates**

Location	Latitude	Longitude
Stream	9.066410	-11.72528

Notes on Water Source

4-section ogee crest weir recording flow immediately downstream of Bumbuna Dam.



Ogee crest weir and stilling well

Stilling Well

Date / Time	9/8/2013 09:00
Datum description	Manhole cover.
Datum height	At ground level.
Depth to water level	5.98 m below datum
Water elevation	159.326 m ASL

Weir Construction

Weir type	4 x 15m sections
Low crest level	159.00 m ASL
High crest level	161.25 m ASL
Depth of stilling well	6.92 m below datum
Base of stilling well	158.29 mASL

Logging Equipment Installed

Model	Rugged TROLL 100 / 10m
Serial number	193039
Location:	6.5m below daum

Baro logger	Rugged Baro TROLL
Serial number	328826
Depth	In top of stilling well

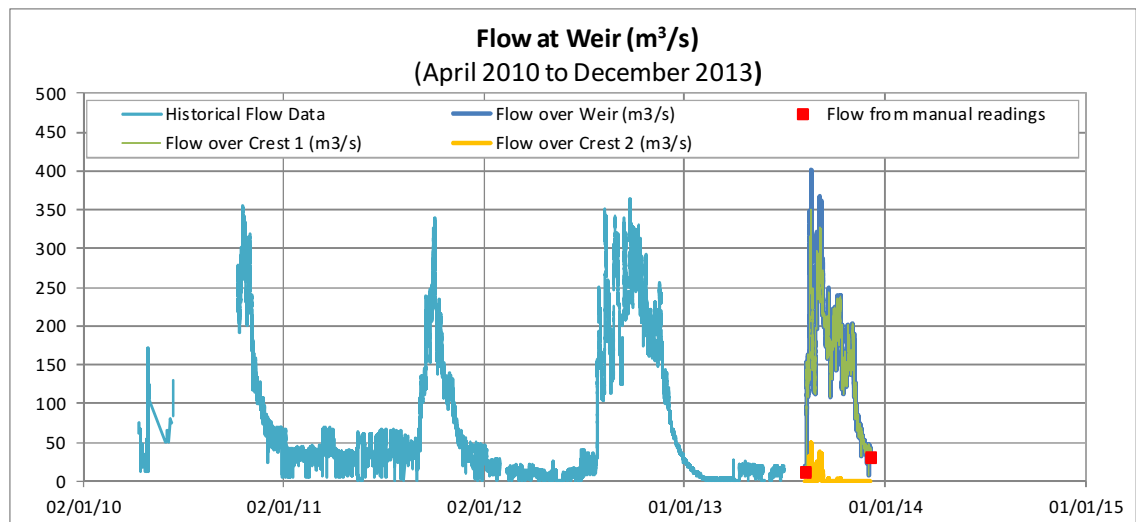
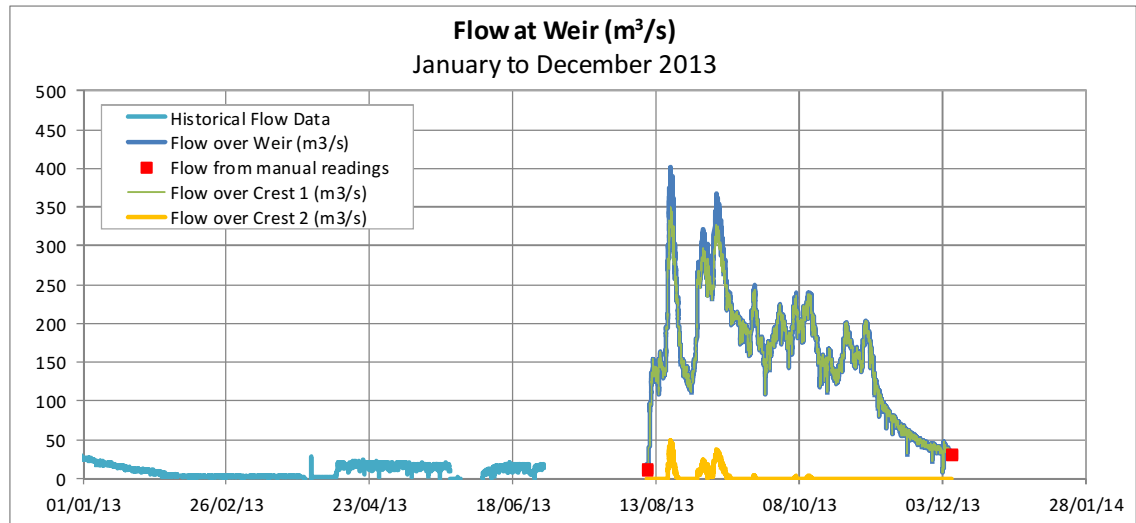
Logger and Baro are installed within a 40mm diameter stilling tube in stream bed upstream of weir.

Air photo of Bumbuna Dam and downstream weir.

**Contacts (Studio Pietrangeli Consultants)**

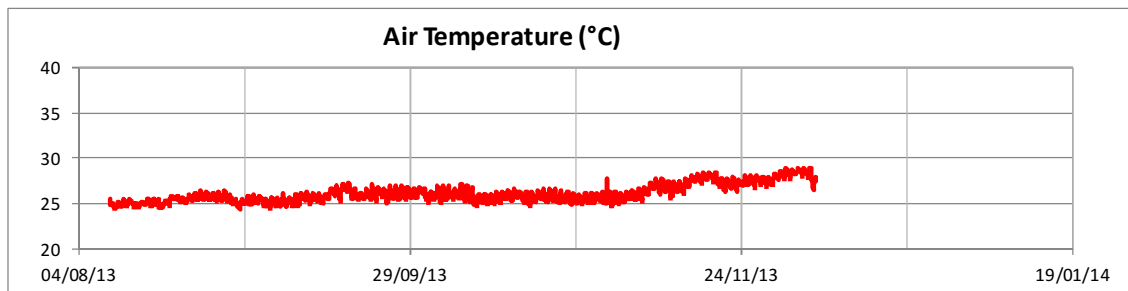
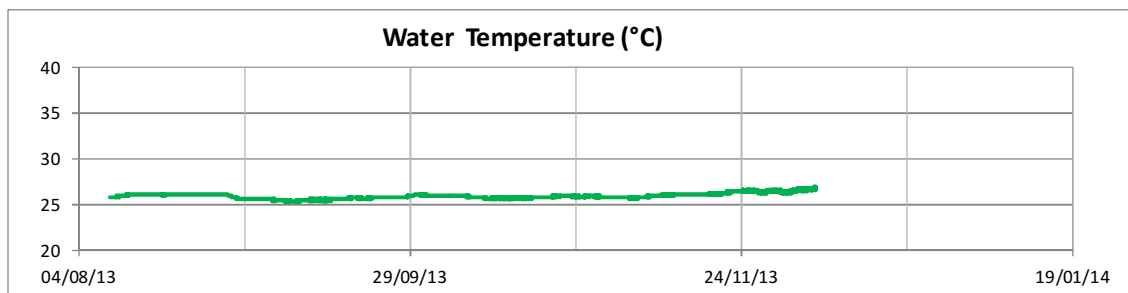
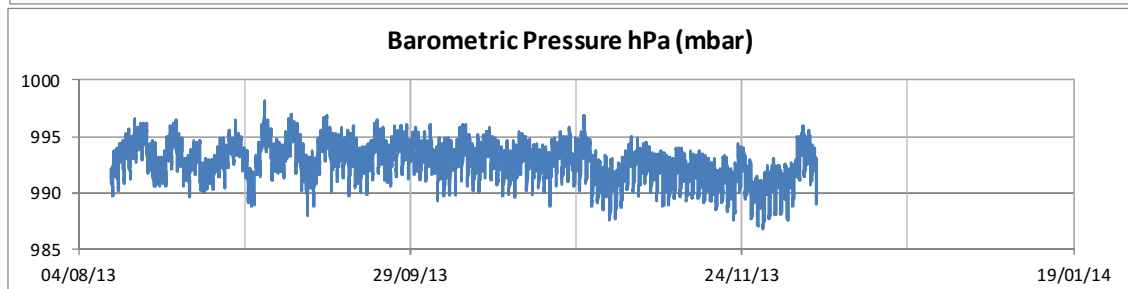
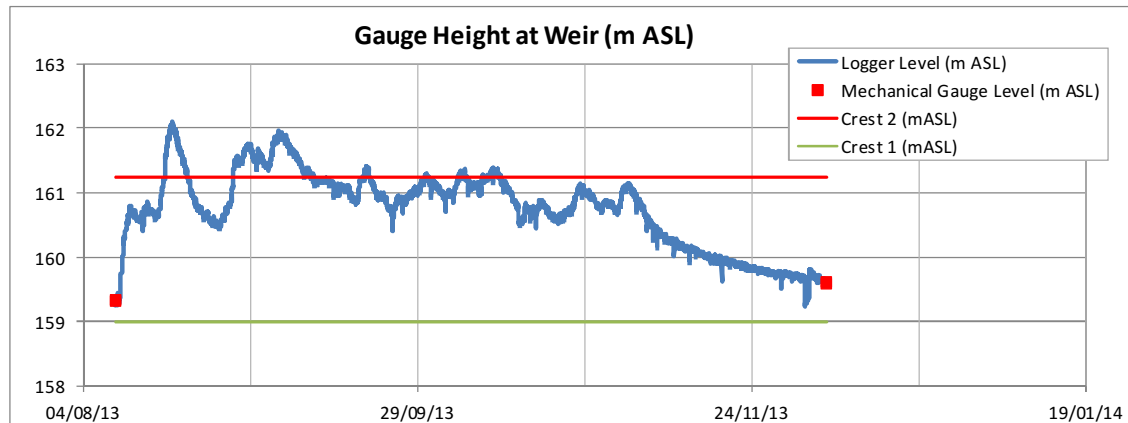
Name	Title	Telephone / email
David S Conteh	Civil Engineer	033 548 210 / 076 850 549 dasacone@gmail.com
Mr.Ciro	Bumbuna Dam Manager	

BD02 - BUMBUNA DAM Weir



continued on next page

BD02 - BUMBUNA DAM Weir



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BD03

Bumbuna Dam Reservoir

Tonkolili District

Water Levels in Reservoir

GPS Co-ordinates

Location	Latitude	Longitude
Logger	9.07222	-11.72111

Notes on Water Source

Reservoir for Hydro Electric Power.



Dam wall and reservoir near to measuring location

Reservoir Levels

Dam crest	244.00 mASL
Left spillway	238.00 mASL
Right spillway	236.00 mASL
Base of reservoir	TBA

Max water level	241.96 mASL
Max operating level	241.75 mASL
Min operating level	210.00 mASL

Logging Equipment Installed

Model	Vented pressure logger
Location:	Base of reservoir



Air photo of dam during construction looking downstream

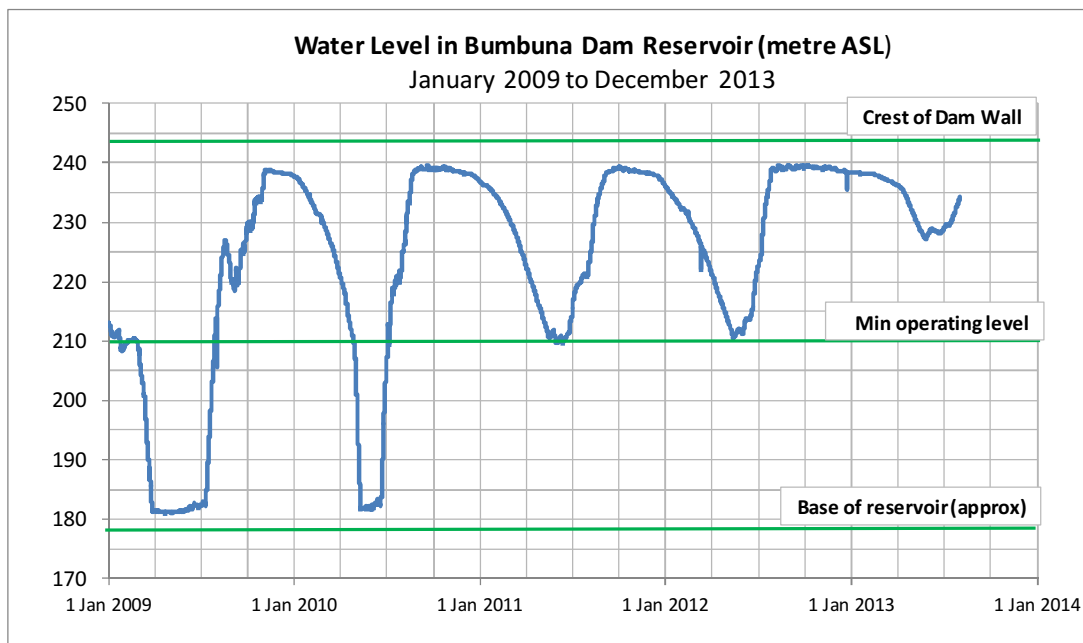
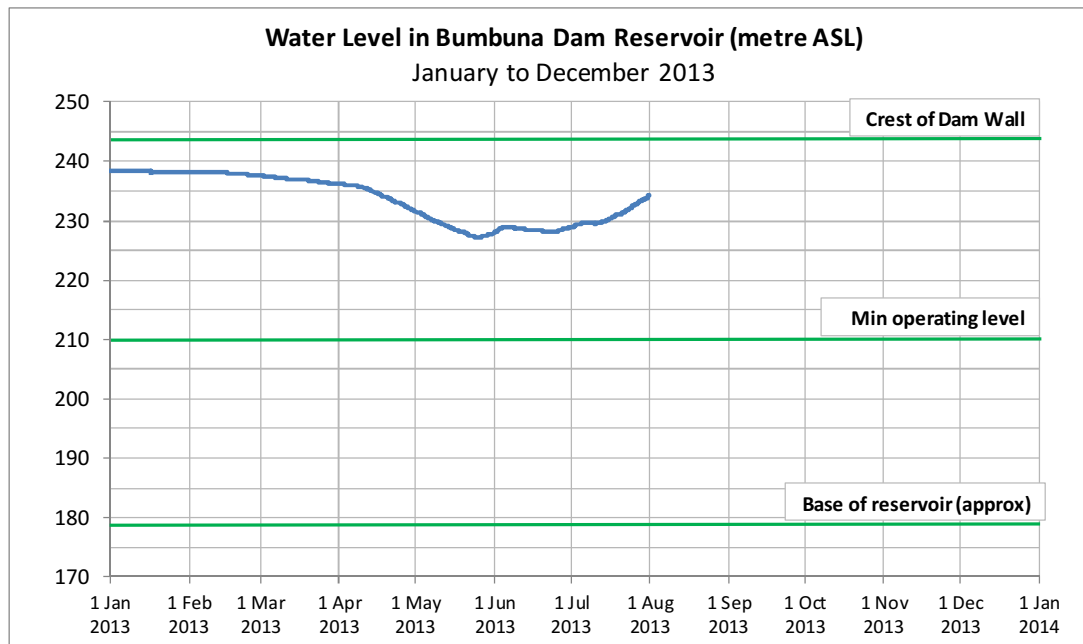
Air photo of reservoir looking upstream



Contacts (Studio Pietrangeli Consultants)

Name	Title	Telephone / email
David S Conteh	Civil Engineer	033 548 210 / 076 850 549 dasacone@gmail.com
Mr.Ciro	Bumbuna Dam Manager	

BD03 - Bumbuna Dam Reservoir



MD01

Makeni Weather Station
(Sierra Leone Meteorological Department)

Bombali District

Rain gauge site

GPS Co-ordinates

Location	Latitude	Longitude
Rain gauge	8.87904	-12.04621

Notes

Manned Met Dept Site. Rainfall recorded hourly during daylight hours. Also collects temperature and humidity data from thermometers in Stephenson screen.



Stevenson screen and rain gauge site

Rain Gauge

Model	Manual Cylinder
Fencing	None
First record date	1921

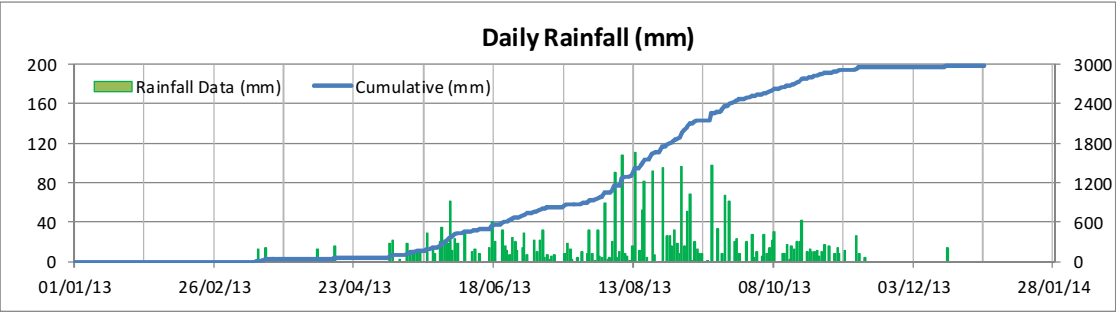
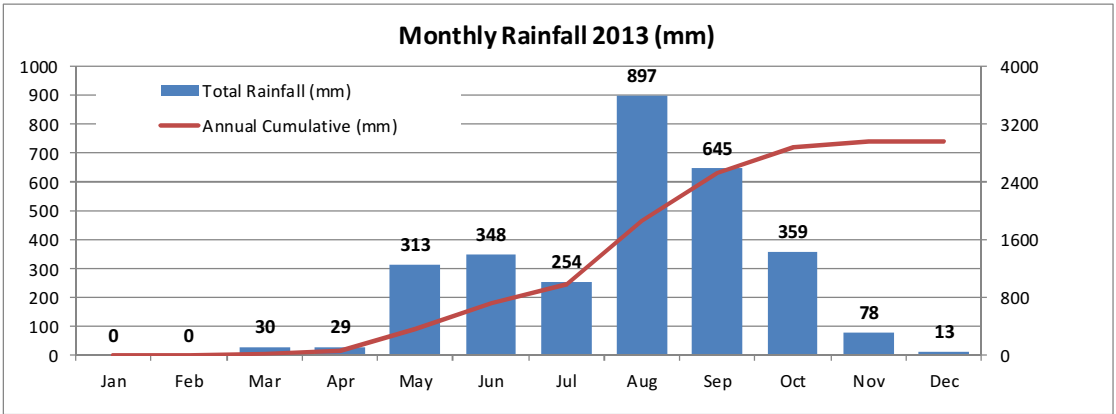


Mr Kargbo at his desk with record books.

Contacts (Sierra Leone Meteorological Department, Makeni)

Name	Title	Telephone / email
Mr Kargbo	Supervisor	

MD01 - Makeni Weather Station



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Annex D Monthly rainfall records at Makeni (1921 to 2013)

Makeni Monthly Rainfall (mm)

1921 - 2013

Sources

1921-1978	Nippon Koei UK	(Assumed rainfall year 1921 starts Dec 1920, and so on).
1975-1998*	Makeni weather station summary sheet	
2003-2013*	Makeni weather station daily sheets	

* Note: Mr Kargbo des not add up well, so 1975-98 data is suspect

All Record Statistics

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean 1921-1978	4.4	9.1	33.8	94.4	222.6	392.6	486.9	648.7	553.4	418.0	197.4	29.4	3090.7
Mean 1921-2013	4.2	9.8	27.4	86.1	226.1	394.2	505.2	647.8	535.3	411.3	172.4	24.1	3043.7
Min 1921-2013	0.0	0.0	0.0	0.0	20.2	199.5	221.5	240.2	168.3	204.3	8.6	0.0	2136.7
Max 1921-2013	43.0	122.7	169.4	298.7	833.0	748.0	977.1	1008.4	923.9	643.1	393.2	130.3	4094.4
Std Dev 1921-201	8.4	17.9	30.7	53.4	99.8	101.3	138.5	142.6	123.1	88.7	80.9	25.4	351.5

50 Year mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1970	4.8	9.1	33.1	91.9	223.3	397.1	490.9	649.1	556.5	421.4	197.5	30.1	3104.9	
1931-1980	4.9	8.7	31.6	92.7	221.6	396.1	493.3	652.3	555.4	420.8	195.2	28.9	3101.4	-0.1%
1941-1990	4.6	8.8	25.4	94.7	218.4	392.3	507.1	657.1	549.9	424.5	178.0	26.9	3087.7	-0.4%
1951-2000	4.3	9.5	23.7	89.8	231.0	404.6	524.5	661.7	549.9	421.4	170.9	24.1	3115.3	0.9%
1961-2010	3.7	10.6	15.5	88.2	224.9	400.0	537.1	670.8	519.5	402.9	148.4	19.9	3041.5	-2.4%
50 years to 2013	3.3	9.2	15.9	81.3	228.0	400.0	521.7	664.5	523.0	406.4	140.8	19.2	3013.3	-0.9%

20 Year Mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1910-1940	3.0	10.7	38.9	79.2	232.8	393.5	473.9	634.1	543.2	412.3	211.8	31.6	3065.0	
1941-1960	7.2	8.5	42.1	92.6	220.0	387.5	474.4	610.5	563.0	431.0	195.4	28.8	3060.8	-0.1%
1961-1980	4.4	8.3	18.4	104.0	217.0	410.3	524.4	702.8	563.2	420.9	185.3	29.8	3188.8	4.2%
1981-2000	0.2	9.0	11.1	69.9	242.9	394.0	572.1	662.0	514.4	410.1	116.7	16.3	3018.6	-5.3%
20 years to 2013	3.1	10.7	15.9	69.3	226.3	380.6	541.8	633.3	466.4	379.1	121.1	10.0	2857.4	-5.3%

10 Year Mean

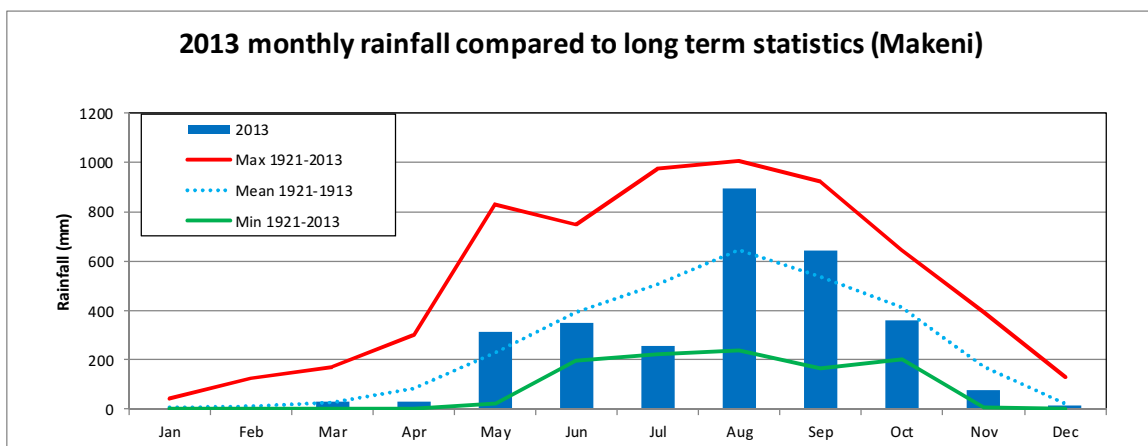
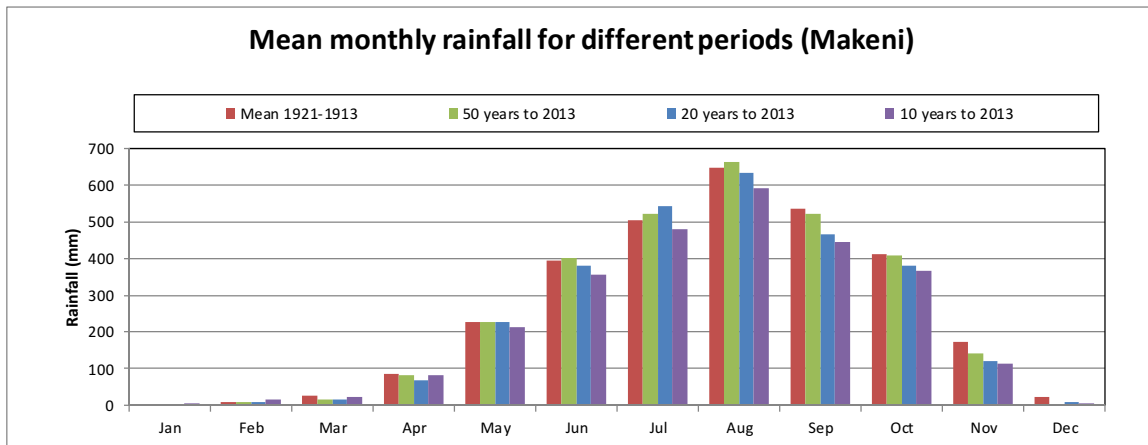
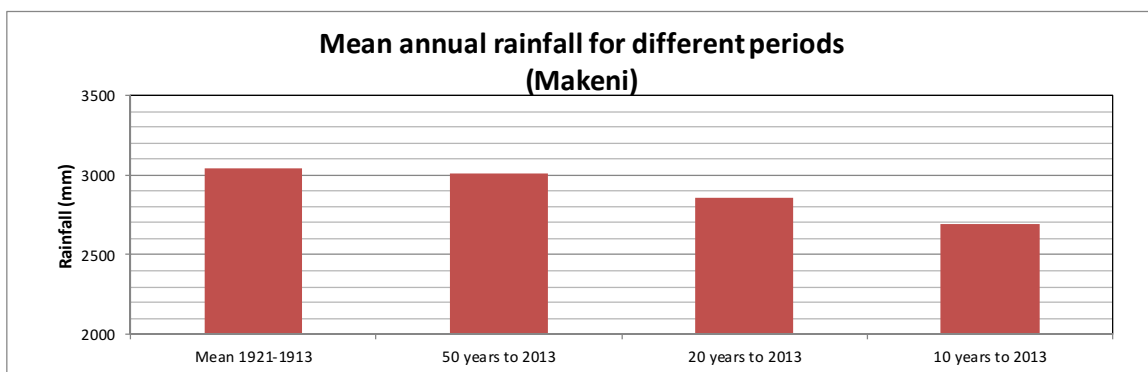
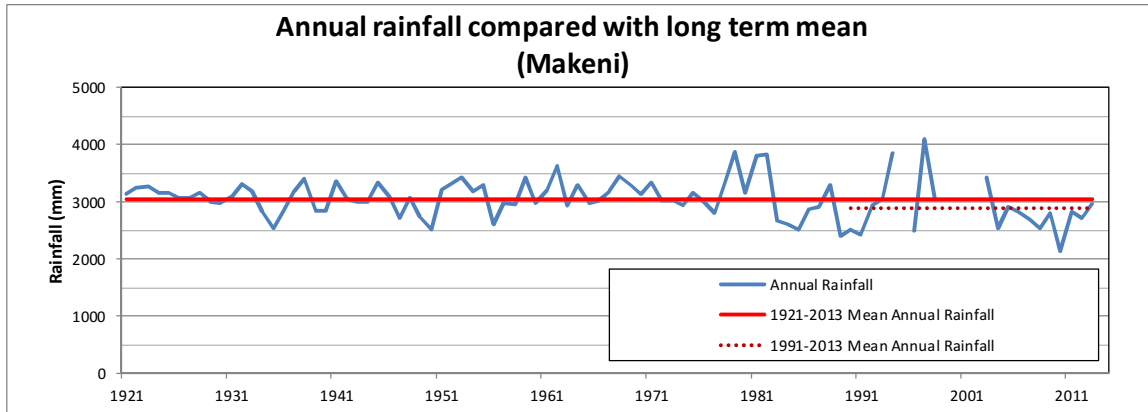
Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1930	4.5	11.6	41.0	88.2	231.5	401.9	479.0	633.5	561.9	424.5	209.1	35.7	3122.3	
1931-1940	1.5	9.8	36.9	70.2	234.1	385.1	468.9	634.7	524.5	400.1	214.5	27.6	3007.8	-3.7%
1941-1950	3.1	4.1	28.6	90.2	201.4	363.4	505.2	642.1	542.3	420.2	156.6	30.9	2988.1	-0.7%
1951-1960	11.2	12.8	55.6	95.1	238.6	411.5	443.7	578.9	583.8	441.7	234.2	26.6	3133.5	4.9%
1961-1970	3.9	10.6	23.7	103.3	213.5	398.5	546.0	705.0	563.4	391.1	224.6	26.6	3210.2	2.4%
1971-1980	4.9	6.0	13.1	104.8	220.6	422.0	502.7	700.7	563.0	450.7	146.1	33.4	3167.7	-1.3%
1981-1990	0.0	10.5	6.0	80.5	218.0	365.9	538.0	658.9	497.2	418.6	128.4	17.7	2939.6	-7.2%
1991-2000	0.4	6.9	18.4	54.7	278.4	434.1	620.9	666.4	538.9	397.8	99.9	14.3	3131.4	6.5%
2001-2010	9.3	19.5	17.6	87.6	206.4	387.3	494.6	616.1	432.3	349.3	126.4	5.7	2752.0	-12.1%
10 years to 2013	7.4	15.4	22.9	82.4	212.5	354.9	480.4	590.7	444.0	366.1	112.3	6.1	2695.0	-2.1%

Monthly Total Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall	% Change
1921	4.1	2.0	81.0	102.9	294.1	357.4	477.3	618.0	513.3	411.0	206.8	68.3	3136.2	
1922	4.1	2.0	33.5	81.0	279.4	470.9	479.8	641.3	575.8	399.5	222.0	53.1	3242.4	3.4%
1923	4.1	2.0	48.8	104.9	194.8	422.4	482.1	624.3	576.1	416.8	346.5	45.0	3267.8	0.8%
1924	4.6	46.5	14.5	62.5	235.7	409.2	478.0	651.0	566.4	407.2	265.9	19.8	3161.3	-3.3%
1925	4.1	14.0	60.5	50.5	232.4	423.4	472.9	618.2	543.3	452.1	238.0	37.3	3146.7	-0.5%
1926	4.3	2.0	25.7	53.8	202.7	382.3	480.0	673.1	582.2	400.6	238.0	26.2	3070.9	-2.4%
1927	4.1	3.8	20.6	99.3	249.7	413.0	468.6	590.3	598.4	465.8	138.9	25.9	3078.4	0.2%
1928	4.8	2.0	38.1	174.8	207.3	362.2	496.6	646.7	555.2	470.7	161.5	30.5	3150.4	2.3%
1929	4.1	2.0	67.3	97.0	207.0	396.5	469.4	642.4	545.8	415.0	125.2	19.8	2991.5	-5.0%
1930	6.3	39.4	19.6	55.6	212.1	381.5	485.1	629.4	562.6	406.4	148.6	30.7	2977.3	-0.5%
1931	6.9	2.0	41.1	140.0	213.9	428.5	484.9	620.0	520.4	406.9	193.8	26.7	3085.1	3.6%
1932	4.1	20.1	72.9	143.8	205.5	426.0	484.9	669.8	525.0	424.7	317.0	19.8	3313.6	7.4%
1933	4.1	55.9	22.4	87.9	219.5	411.5	484.9	743.7	525.0	375.7	216.9	41.4	3188.9	-3.8%
1934	0.0	0.0	35.6	57.4	107.9	312.2	542.5	610.4	561.3	494.0	99.6	0.0	2820.9	-11.5%
1935	0.0	4.6	5.3	24.4	114.8	259.8	473.2	548.4	480.3	284.5	272.5	74.4	2542.2	-9.9%
1936	0.0	8.1	38.1	77.7	316.7	235.7	615.2	452.6	501.9	393.2	180.6	34.8	2854.6	12.3%
1937	0.0	0.8	100.6	52.6	234.4	335.5	407.2	813.6	583.4	491.5	163.1	7.6	3190.3	11.8%
1938	0.0	6.3	33.5	64.8	399.5	471.4	357.4	733.3	627.6	413.0	287.3	0.0	3394.1	6.4%
1939	0.0	0.3	0.0	38.4	332.2	596.1	364.7	586.7	468.4	268.7	170.2	25.4	2851.1	-16.0%
1940	0.0	0.0	19.6	14.7	196.6	373.9	473.7	568.7	451.4	448.8	243.6	45.7	2836.7	-0.5%
1941	12.2	0.0	0.0	66.8	85.9	611.1	632.7	812.5	579.1	355.6	194.3	5.3	3355.5	18.3%
1942	0.0	0.0	31.7	72.6	334.8	339.6	458.0	526.0	444.2	608.8	141.2	100.1	3057.0	-8.9%
1943	1.5	14.0	50.0	145.0	152.4	419.1	434.3	510.3	555.2	554.2	127.3	39.1	3002.4	-1.8%
1944	10.2	5.3	21.1	60.7	287.0	371.1	646.9	554.0	628.1	317.2	109.0	0.5	3011.1	0.3%
1945	0.3	2.0	22.6	163.1	192.3	411.5	576.6	853.4	520.7	339.1	228.3	25.1	3335.0	10.8%
1946	6.9	0.0	24.4	115.1	190.2	238.0	631.2	851.2	372.9	448.8	158.0	62.0	3098.7	-7.1%
1947	0.0	13.5	54.9	42.2	169.7	400.0	486.9	672.3	483.6	338.3	42.9	6.1	2710.4	-12.5%
1948	0.0	6.6	14.7	66.3	300.7	287.5	429.3	734.3	776.7	344.9	96.3	1.5	3058.8	12.9%
1949	0.0	0.0	28.7	105.2	169.9	248.9	380.2	505.5	571.2	446.3	214.6	64.8	2735.3	-10.6%
1950	0.0	0.0	37.6	65.0	130.8	307.6	375.7	401.3	491.2	448.8	254.3	4.1	2516.4	-8.0%
1951	20.6	27.4	36.1	110.7	249.4	392.2	417.3	614.7	519.4	643.1	159.8	3.0	3193.7	26.9%
1952	5.8	17.5	25.4	84.3	227.8	354.3	608.3	742.2	486.7	427.0	300.5	29.7	3309.5	3.6%
1953	12.7	2.5	33.3	136.1	139.4	506.2	583.7	709.9	657.6	415.3	166.4	69.3	3432.4	3.7%
1954	0.0	21.1	36.6	47.0	371.3	393.7	438.7	666.7	374.6	424.7	393.2	16.0	3183.6	-7.2%
1955	0.0	1.5	165.6	173.5	310.9	463.5	302.3	623.8	578.9	444.8	189.7	30.0	3284.5	3.2%
1956	0.0	37.3	53.8	56.9	200.2	249.2	455.9	506.2	556.5	290.8	143.0	57.9	2607.7	-20.6%
1957	0.0	0.0	5.1	121.9	78.2	459.7	619.0	460.5	669.3	399.5	156.2	3.6	2973.0	14.0%
1958	9.9	0.0	169.4	199.6	191.8	321.3	231.4	463.3	615.7	422.1	292.6	35.3	2952.4	-0.7%
1959	35.3	0.0	30.2	20.6	357.4	460.2	375.7	523.7	676.4	605.0	338.3	0.8	3423.6	16.0%
1960	27.7	20.6	0.0	0.0	259.6	514.6	404.4	477.5	702.6	344.7	202.2	20.8	2974.7	-13.1%
1961	0.0	22.9	0.0	101.6	151.6	287.5	977.1	676.0	502.9	272.0	176.8	33.8	3202.2	7.6%
1962	0.0	0.0	3.0	280.4	316.7	364.5	603.8	719.8	590.5	352.3	379.0	11.2	3621.2	13.1%
1963	14.0	38.6	67.1	98.3	110.7	415.8	436.1	803.1	369.6	421.6	165.1	0.0	2940.0	-18.8%
1964	0.0	0.0	11.7	56.1	164.3	346.2	456.4	1008.4	634.0	341.6	196.6	68.1	3283.4	11.7%
1965	25.1	1.0	3.0	55.4	215.6	331.7	507.7	694.9	519.7	428.5	204.7	0.0	2987.3	-9.0%
1966	0.0	9.7	34.8	111.5	238.3	368.8	289.6	721.1	622.3	323.6	263.9	32.0	3015.6	0.9%
1967	0.0	0.0	9.4	88.9	203.5	426.2	511.8	671.8	480.1	473.5	294.1	9.4	3168.7	5.1%
1968	0.0	27.2	33.0	46.0	289.3	605.8	389.1	593.3	745.5	495.3	184.7	44.7	3453.9	9.0%
1969	0.0	3.8	44.2	132.6	237.7	452.6	475.5	695.7	570.5	448.3	188.5	52.3	3301.7	-4.4%
1970	0.0	2.5	31.2	61.7	207.5	385.8	813.1	466.1	598.4	354.3	193.0	14.0	3127.6	-5.3%
1971	0.0	0.0	1.3	298.7	120.1	303.3	509.3	726.4	741.2	323.1	191.8	130.3	3345.5	7.0%
1972	0.0	5.6	45.7	95.2	255.5	432.3	542.0	751.1	481.6	391.2	24.1	0.0	3024.3	-9.6%
1973	0.0	0.0	16.0	51.3	272.3	368.8	324.1	977.6	332.5	527.8	152.1	0.0	3022.5	-0.1%
1974	0.0	0.0	0.0	62.7	192.8	400.8	477.5	544.3	660.4	423.4	177.3	0.0	2939.2	-2.8%
1975	0.0	0.0	7.4	99.3	254.0	373.9	707.4	690.4	482.1	472.2	24.9	36.8	3148.4	7.1%

1976	0.0	3.3	17.8	116.8	134.1	598.4	289.3	489.2	580.4	507.0	229.1	31.0	2996.4	-4.8%
1977	1.5	2.0	5.8	112.5	193.5	317.0	385.8	834.4	509.3	381.5	59.2	7.6	2810.1	-6.2%
1978	9.4	30.5	11.9	166.9	295.4	372.6	578.1	669.0	553.7	439.2	200.7		3327.4	18.4%
1979	21.2	0.0	0.0	2.0	272.3	595.6	741.2	723.6	662.2	605.5	196.6	46.7	3866.9	16.2%
1980	16.5	18.5	24.9	42.1	215.5	457.5	472.4	600.5	626.9	435.9	204.7	48.0	3163.4	-18.2%
1981	0.0	19.0	10.8	81.1	318.1	330.1	620.7	873.9	748.2	630.8	150.9	26.2	3809.8	20.4%
1982	0.0	19.0	10.8	81.1	318.9	370.1	620.7	873.9	748.2	630.3	130.9	20.2	3824.1	0.4%
1983	0.0	3.8	0.2	163.8	203.6	648.9	221.5	496.2	631.6	204.3	58.3	40.0	2672.2	-30.1%
1984	0.0	0.0	8.0	132.3	339.5	358.4	432.4	464.2	389.2	399.9	81.1	2.0	2607.0	-2.4%
1985	0.0	56.0	0.0	1.8	119.1	226.6	525.0	613.6	458.4	435.7	69.6	0.0	2505.8	-3.9%
1986	0.0	0.7	0.0	118.6	357.4	251.5	453.5	642.2	543.9	321.4	183.3	0.0	2872.5	14.6%
1987	0.0	5.1	14.0	105.7	180.6	368.1	551.7	527.5	488.5	486.1	162.7	23.8	2913.8	1.4%
1988	0.0	1.4	0.0	47.7	117.1	457.4	863.8	875.1	470.1	359.1	89.9	0.0	3281.6	12.6%
1989	0.0	0.0	0.0	66.5	205.0	263.5	545.6	620.6	168.3	345.9	185.2	0.0	2400.6	-26.8%
1990	0.0	0.2	15.7	6.2	20.2	384.5	544.8	602.2	325.2	372.5	172.3	64.9	2508.7	4.5%
1991	0.0	0.0	3.8	65.8	94.2	362.1	300.1	731.6	321.3	398.6	102.7	34.8	2415.0	-3.7%
1992	0.0	0.6	4.2	17.2	289.6	748.0	637.0	240.2	317.5	533.4	148.7	0.6	2937.0	21.6%
1993	0.0	0.0	39.6	43.2	171.7	348.6	606.0	711.5	653.6	442.8	40.1	0.0	3057.1	4.1%
1994	0.0	0.0	18.3	47.9	127.3	452.6	945.7	796.1	923.9	390.6	117.7	34.3	3854.4	26.1%
1995														
1996	1.2	17.8	53.0	57.8	277.0	456.9	484.5	524.4	304.1	261.7	40.1	19.6	2498.1	
1997	1.7	0.0	0.4	76.8	833.0	471.2	628.6	723.1	707.7	475.8	175.0	1.1	4094.4	63.9%
1998	0.0	30.2	9.7	74.4	156.2	199.5	744.6	937.9	544.3	282.0	75.2	9.8	3063.8	-25.2%
1999														
2000														
2001														
2002								617.0	576.2	370.0	103.0	0.0		
2003	0.0	2.6	1.6	45.4	244.8	616.8	477.3	931.0	494.3	319.0	279.9	7.4	3420.1	
2004	2.2	10.9	34.4	96.8	197.0	216.7	543.0	729.0	330.0	238.2	113.5	34.0	2545.7	-25.6%
2005	43.0	16.5	67.2	72.8	233.5	438.4	561.4	681.6	320.3	368.2	117.2	3.7	2923.8	14.9%
2006	28.8	0.0	0.0	144.8	285.0	377.2	434.2	565.2	442.8	388.6	155.2	0.0	2821.8	-3.5%
2007	0.0	3.4	0.0	70.4	114.5	421.6	514.6	551.8	490.3	370.7	151.9	5.6	2694.8	-4.5%
2008	0.0	0.0	6.7	158.8	166.1	363.8	560.9	497.5	486.1	284.4	8.6	0.5	2533.4	-6.0%
2009	0.0	122.7	15.2	30.9	133.4	371.1	508.7	636.1	395.8	431.8	157.6	0.0	2803.3	10.7%
2010	0.0	0.0	15.6	80.7	276.6	292.9	356.8	335.7	354.6	372.8	51.0	0.0	2136.7	-23.8%
2011	0.0	0.0	60.2	63.4	206.2	342.0	426.3	592.8	537.9	513.3	72.4	3.5	2818.0	31.9%
2012	0.0	0.0	0.0	77.0	199.6	376.8	643.8	419.9	437.3	334.2	217.5	0.0	2706.1	-4.0%
2013	0.0	0.0	29.6	28.8	312.6	348.1	254.3	896.9	645.3	358.8	78.2	13.3	2965.9	5.2%

Makeni Monthly Rainfall (mm) 1921 - 2013



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Annex E Monthly rainfall records at Kabala (1921 to 1978)

Kabala Monthly Rainfall (mm)

1921 - 1978

Sources and Notes

2005 Nippon Koei UK, 2005. Bumbuna hydroelectric project EIA.

Web source: <http://www.ecowrex.org/eg/bumbuna>

Notes: Assumed rainfall year 1921 starts Dec 1920, and so on.

All Record Statistics

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean 1921-1978	7.6	11.6	47.8	103.7	201.8	315.0	314.3	369.2	397.8	336.4	102.1	15.5	2222.8
Min 1921-1978	0.0	0.0	0.0	23.9	35.8	167.4	121.4	204.5	230.1	163.3	2.5	0.0	1677.9
Max 1921-1978	136.7	87.6	151.9	367.8	491.0	569.2	496.6	644.1	553.5	527.8	277.1	97.3	2871.3
Std Dev 1921-1978	20.1	18.9	41.7	63.8	72.3	84.0	72.6	84.8	68.3	96.6	67.3	22.2	279.6

50 Year mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1970	8.1	12.6	50.9	101.5	203.5	321.7	319.0	374.8	399.2	339.6	108.0	17.4	2256.2	
50 years to 1978	8.4	11.5	46.0	104.1	195.4	311.6	311.2	376.1	393.2	331.4	97.2	13.3	2199.4	-2.5%

20 Year Mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1940	6.0	16.3	59.6	99.5	204.3	346.4	335.1	363.0	399.1	353.2	106.0	18.5	2307.0	
1941-1960	11.8	10.7	49.8	104.9	197.3	298.7	309.4	375.9	408.5	332.5	107.7	20.7	2227.9	-3.4%
20 years to 1978	4.3	7.2	29.9	105.3	205.0	302.2	295.1	363.3	382.0	325.8	91.9	5.9	2117.6	-5.0%

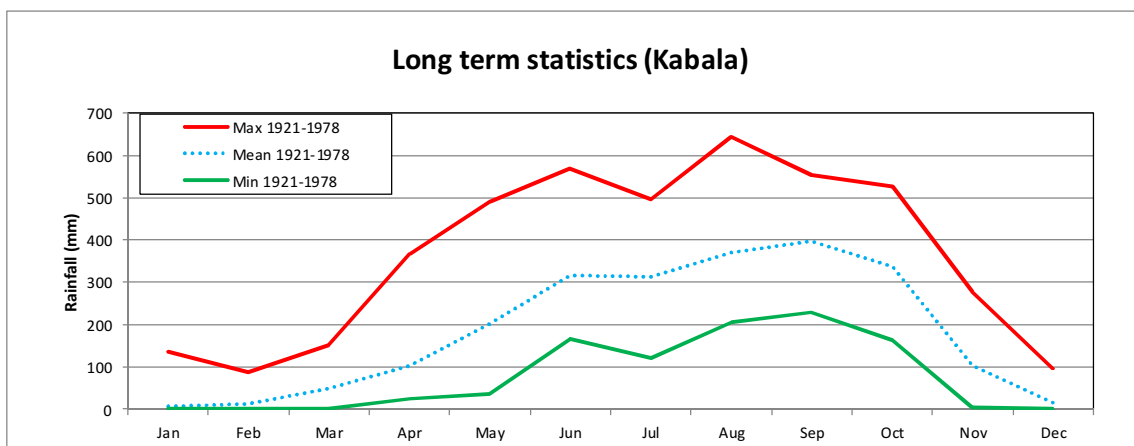
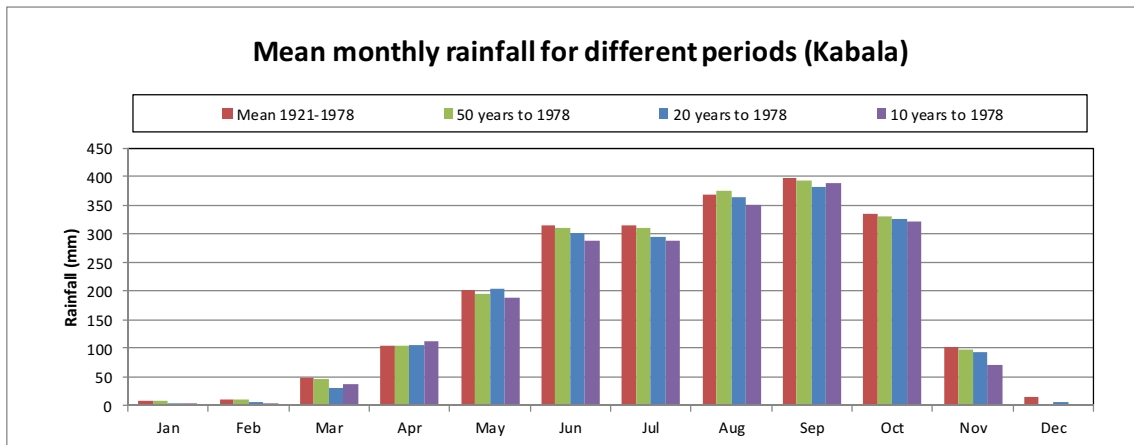
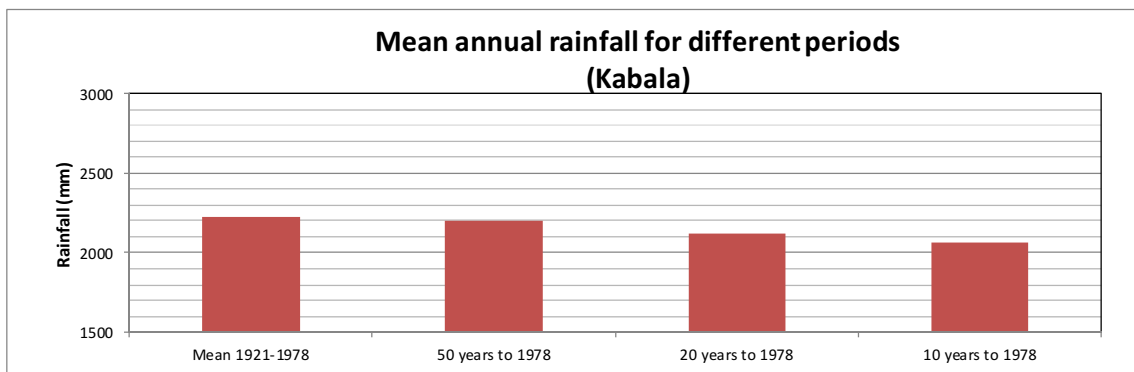
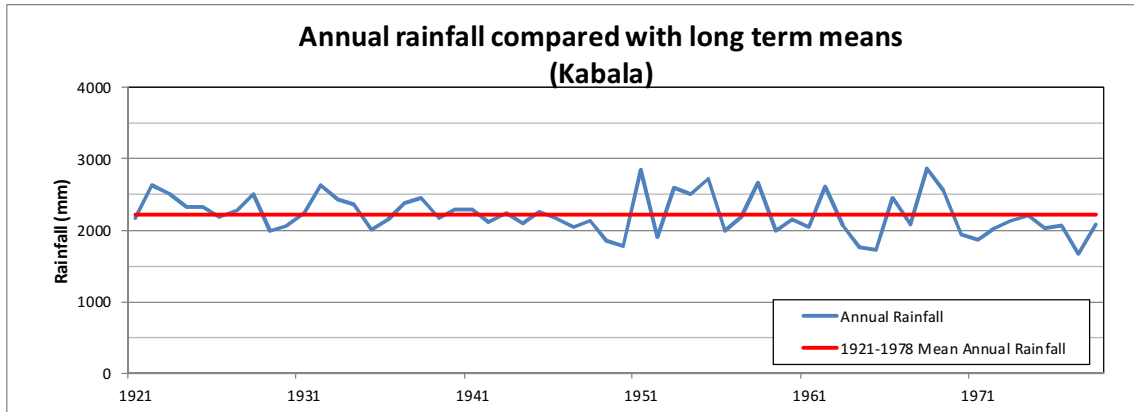
10 Year Mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1930	5.1	15.6	60.4	96.5	228.1	324.7	329.7	328.2	420.4	354.9	111.4	24.9	2299.9	
1931-1940	6.9	17.0	58.9	102.5	180.6	368.1	340.5	397.8	377.9	351.6	100.5	12.1	2314.2	0.6%
1941-1950	4.7	5.2	35.9	104.7	197.6	282.2	304.3	362.3	397.0	308.2	85.9	9.7	2097.5	-9.4%
1951-1960	18.9	16.2	63.8	105.1	197.0	315.3	314.4	389.6	420.0	356.9	129.4	31.7	2358.3	12.4%
1961-1970	5.2	8.7	35.4	98.7	214.1	318.4	306.3	396.2	380.7	326.4	112.8	8.4	2211.3	-6.2%
10 years to 1978	3.8	4.6	37.9	113.9	188.0	288.1	289.4	351.7	388.5	321.5	70.7	1.9	2060.0	-6.8%

Monthly Total Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall	% Change
1921	0.0	0.0	140.5	119.6	381.8	167.4	311.7	283.7	272.5	304.5	108.5	76.2	2166.4	
1922	0.0	0.0	45.7	85.1	345.4	569.2	336.5	350.5	463.0	261.1	127.0	52.1	2635.6	21.7%
1923	0.0	0.0	76.2	122.7	138.2	397.5	357.6	302.3	463.3	325.9	277.1	39.6	2500.4	-5.1%
1924	8.1	72.4	7.9	55.9	238.5	350.5	320.3	378.7	434.3	290.1	180.1	0.0	2336.8	-6.5%
1925	0.0	19.6	99.3	37.1	230.6	401.1	271.0	284.7	363.5	458.0	146.3	27.4	2338.6	0.1%
1926	2.8	0.0	29.7	42.2	157.2	255.3	347.5	441.5	481.8	265.4	146.3	10.2	2179.9	-6.8%
1927	0.0	2.8	19.8	113.8	272.5	364.0	229.9	204.5	531.6	509.5	26.7	9.7	2284.8	4.8%
1928	8.9	0.0	54.6	232.9	168.4	184.4	496.6	366.0	399.8	527.8	53.8	16.8	2510.0	9.9%
1929	0.0	0.0	112.8	110.5	167.9	305.3	237.7	353.3	371.3	319.8	9.9	0.0	1988.5	-20.8%
1930	31.0	61.0	17.8	45.0	180.3	252.7	388.6	316.5	422.7	287.0	38.4	17.0	2058.0	3.5%
1931	37.3	0.0	61.0	177.8	184.9	418.3	386.1	289.3	294.4	289.1	93.0	10.9	2242.1	8.9%
1932	0.0	29.5	124.0	194.1	164.3	410.2	385.3	422.1	308.4	355.9	241.6	0.0	2635.4	17.5%
1933	1.0	87.6	23.4	96.0	198.4	358.6	385.8	644.1	308.4	172.0	120.9	33.8	2430.0	-7.8%
1934	0.0	39.1	57.4	48.5	35.8	322.1	328.2	442.7	553.5	508.3	37.4	1.0	2374.0	-2.3%
1935	17.3	1.0	1.8	34.3	185.7	428.2	351.5	245.1	330.7	254.5	106.4	53.1	2009.6	-15.3%
1936	5.6	9.4	47.2	90.9	233.7	278.9	309.6	351.0	392.9	326.9	91.2	16.3	2153.6	7.2%
1937	0.0	0.0	112.0	158.2	217.9	402.6	159.5	442.7	390.1	470.9	32.5	1.0	2387.4	10.9%
1938	0.0	3.3	91.2	103.6	201.4	297.4	437.9	452.9	405.1	368.8	87.1	0.0	2448.7	2.6%
1939	7.6	0.0	19.8	74.4	171.7	349.8	347.5	398.5	366.3	342.6	88.4	5.1	2171.7	-11.3%
1940	0.0	0.0	50.8	46.7	212.1	415.0	313.2	289.1	429.3	426.7	106.4	0.0	2289.3	5.4%
1941	1.8	0.0	27.4	65.3	196.8	258.6	384.6	409.2	504.4	243.3	194.3	2.0	2287.7	-0.1%
1942	0.8	0.0	7.6	189.7	281.7	222.2	289.1	315.7	281.7	337.8	178.1	19.3	2123.7	-7.2%
1943	6.3	14.2	55.1	143.0	175.0	315.0	304.3	358.1	401.8	386.1	62.7	17.8	2239.4	5.4%
1944	11.2	7.4	36.3	77.7	223.0	305.6	310.4	363.7	414.0	299.0	53.1	3.8	2105.2	-6.0%
1945	5.8	5.3	37.3	157.0	189.2	313.4	308.4	402.1	396.2	307.1	116.6	12.7	2251.1	6.9%
1946	9.4	3.0	38.4	119.6	188.5	279.1	310.1	401.8	371.6	347.5	79.0	25.9	2173.9	-3.4%
1947	5.6	13.7	58.2	63.2	181.1	311.1	305.8	379.0	389.9	306.8	17.8	5.8	2038.0	-6.3%
1948	5.6	8.4	32.3	82.0	228.1	289.1	304.3	386.8	438.4	309.1	46.2	4.3	2134.6	4.7%
1949	0.0	0.0	17.8	123.4	192.3	167.4	276.6	316.5	411.0	280.4	53.1	5.1	1843.6	-13.6%
1950	0.0	0.0	48.5	25.7	120.4	360.4	249.4	289.8	360.7	264.7	58.4	0.0	1778.0	-3.6%
1951	31.7	31.7	146.8	39.9	272.8	386.1	390.9	450.3	514.6	452.4	135.4	0.0	2852.6	60.4%
1952	0.0	34.5	32.8	23.9	191.8	263.4	275.3	331.5	433.6	163.3	132.8	15.7	1898.6	-33.4%
1953	2.5	0.0	151.9	59.9	111.5	435.9	402.1	563.4	387.9	319.8	67.6	97.3	2599.8	36.9%
1954	0.0	21.6	30.7	116.6	153.2	238.8	372.1	490.7	387.9	382.8	254.5	63.5	2512.4	-3.4%
1955	17.0	5.6	129.0	203.5	181.4	357.9	400.3	382.5	500.1	464.6	68.8	15.2	2725.9	8.5%
1956	0.0	38.1	14.0	65.3	175.0	341.4	252.0	369.3	425.2	165.9	88.9	56.4	1991.5	-26.9%
1957	0.0	3.0	20.3	175.5	119.6	240.5	367.5	290.6	453.6	400.3	112.0	0.0	2182.9	9.6%
1958	136.7	14.7	98.0	187.2	336.3	211.3	121.4	390.4	375.7	498.6	247.9	58.4	2676.6	22.6%
1959	1.0	3.8	13.0	95.2	231.6	309.1	239.8	332.0	401.8	212.1	150.6	0.0	1990.0	-25.7%
1960	0.0	9.4	1.0	84.1	196.6	368.3	322.8	295.4	319.5	509.3	35.3	10.7	2152.4	8.2%
1961	0.0	5.6	49.5	56.9	180.3	238.5	273.8	489.5	362.5	258.6	122.4	0.0	2037.6	-5.3%
1962	0.0	0.0	13.7	367.8	188.0	363.5	304.0	497.3	396.5	216.9	263.4	0.0	2611.1	28.1%
1963	46.5	23.4	39.4	39.4	175.8	249.2	399.3	373.1	281.7	376.4	64.6	0.0	2068.8	-20.8%
1964	0.0	0.0	28.4	40.6	161.5	214.9	253.7	292.9	497.1	182.1	43.7	41.4	1756.3	-15.1%
1965	0.8	21.6	0.0	40.4	158.2	212.1	328.2	221.2	366.8	338.6	45.0	0.0	1732.9	-1.3%
1966	0.0	18.0	40.4	34.9	261.4	443.0	322.1	315.7	444.5	432.1	135.1	13.5	2460.7	42.0%
1967	0.0	0.0	1.8	117.9	175.5	295.7	208.0	521.7	230.1	416.8	105.7	0.0	2073.2	-15.7%
1968	0.0	16.8	30.7	89.2	491.0	468.9	357.6	409.7	454.2	358.6	165.1	29.5	2871.3	38.5%
1969	5.1	2.0	149.4	115.3	128.8	420.6	346.2	524.3	372.1	482.1	23.6	0.0	2569.5	-10.5%
1970	0.0	0.0	0.8	84.1	220.0	277.4	270.0	316.7	401.1	201.9	159.3	0.0	1931.3	-24.8%
1971	0.0	0.0	0.0	216.4	104.4	260.9	241.3	374.4	356.9	182.1	114.6	15.0	1866.0	-3.4%
1972	0.0	0.0	42.2	123.2	201.9	267.2	245.1	320.0	410.0	419.6	2.5	0.0	2031.7	8.9%
1973	0.0	0.0	26.7	38.4	328.7	355.1	334.0	290.8	388.6	325.4	55.6	0.0	2143.3	5.5%
1974	0.0	0.0	36.1	88.9	223.0	381.5	469.9	292.9	385.3	229.9	97.0	0.0	2204.5	2.9%
1975	0.0	0.0	8.6	131.3	181.9	177.5	251.5	415.3	536.2	314.2	13.5	1.5	2031.5	-7.8%
1976	2.3	0.0	22.1	165.6	236.5	253.2	201.7	326.9	340.6	388.6	124.7	0.0	2062.2	1.5%
1977	0.0	0.0	38.1	81.8	99.1	227.1	183.6	374.6	361.7	296.4	14.7	0.8	1677.9	-18.6%
1978	31.0	43.9	55.1	94.2	155.4	260.6	350.3	281.2	332.0	374.9	101.3		2079.9	24.0%

Kabala Monthly Rainfall (mm) 1921 - 1978



Annex F Monthly rainfall records at Teko Livestock Station (1921 to 1978)

Teko Monthly Rainfall (mm)

1921 - 1978

Sources and Notes

2005 Nippon Koei UK, 2005. Bumbuna hydroelectric project EIA.

Web source: <http://www.ecowrex.org/eg/bumbuna>

Notes: Assumed rainfall year 1921 starts Dec 1920, and so on.

All Record Statistics

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean 1921-1978	6.1	11.8	32.2	85.9	225.8	407.7	485.7	587.5	556.4	412.6	167.1	24.3	3003.1
Min 1921-1978	0.0	0.0	0.0	14.7	81.0	261.6	206.0	314.2	357.1	269.7	4.1	0.0	2567.8
Max 1921-1978	71.9	58.9	156.0	234.7	377.7	855.5	820.9	831.6	863.6	567.2	421.6	64.3	3561.8
Std Dev 1921-1978	11.7	15.3	28.6	46.4	60.1	105.3	107.2	94.0	97.8	62.9	79.0	18.4	205.5

50 Year mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1970	6.9	12.1	35.3	81.3	227.9	404.9	490.9	587.8	562.0	405.4	172.8	25.1	3012.6	
50 years to 1978	6.2	11.8	31.4	86.3	224.1	405.8	486.6	588.7	555.3	411.5	162.9	23.5	2994.0	-0.6%

20 Year Mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1940	4.2	13.3	36.2	74.6	233.2	408.4	476.2	580.3	548.1	408.6	179.6	25.5	2988.3	
1941-1960	9.0	10.3	38.7	90.9	228.3	411.1	468.4	561.1	574.9	419.0	166.4	26.3	3004.3	0.5%
20 years to 1978	7.4	10.7	21.3	87.6	220.6	428.1	502.1	606.4	548.8	410.4	156.7	19.0	3018.1	0.5%

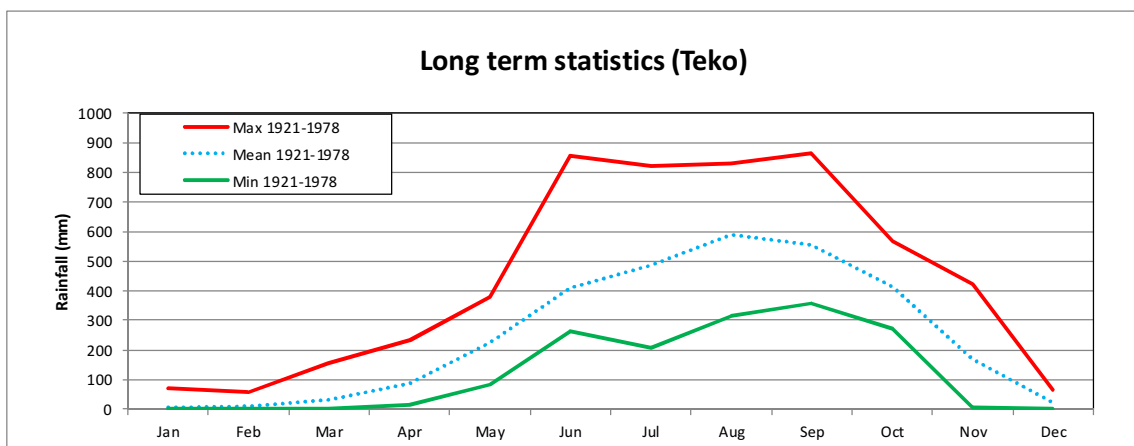
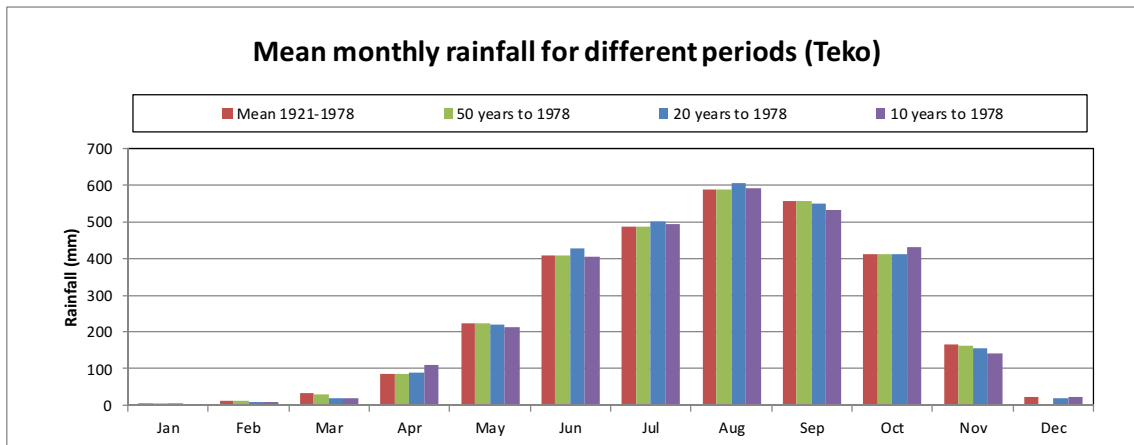
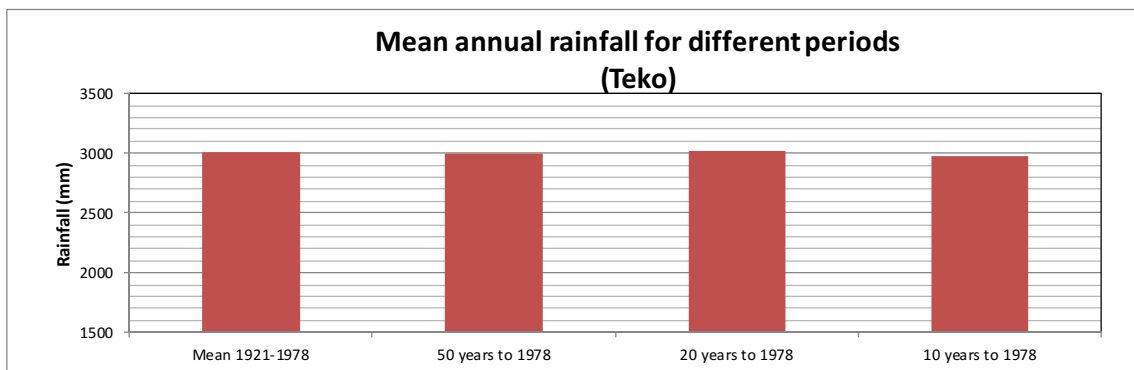
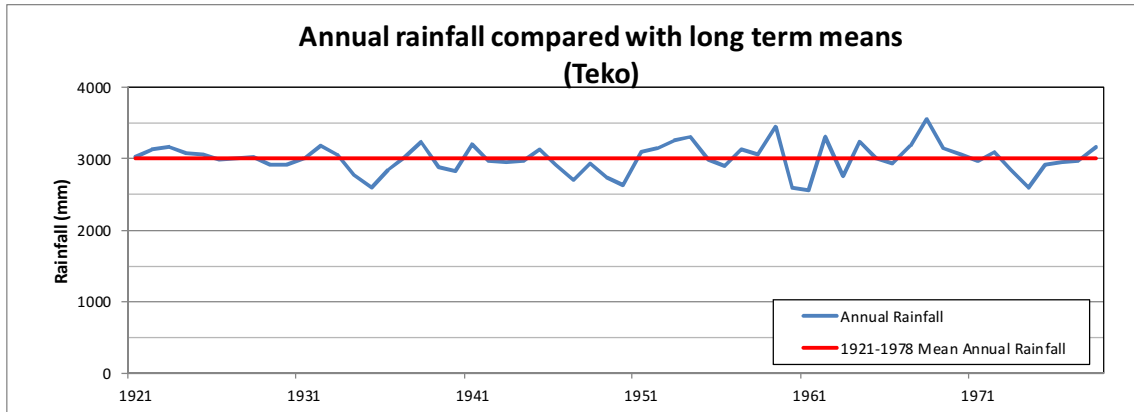
10 Year Mean

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	% Change
1921-1930	6.1	14.3	37.8	81.3	232.2	416.2	479.9	580.0	562.2	417.0	177.5	27.8	3032.2	
1931-1940	2.3	12.4	34.7	67.9	234.1	400.7	472.4	580.6	534.0	400.3	181.8	23.2	2944.3	-2.9%
1941-1950	4.4	6.8	28.2	82.8	210.4	380.8	499.0	584.1	547.4	414.1	131.1	25.1	2914.2	-1.0%
1951-1960	13.5	13.8	49.2	99.0	246.2	441.3	437.8	538.0	602.4	424.0	201.6	27.6	3094.4	6.2%
1961-1970	8.2	13.3	26.8	75.6	216.6	385.8	565.6	656.2	564.1	371.6	171.8	22.1	3077.7	-0.5%
10 years to 1978	1.1	10.2	20.2	108.6	214.6	403.8	494.7	592.4	532.3	432.5	142.6	23.8	2976.6	-3.3%

Monthly Total Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall	% Change
1921	5.6	4.6	69.1	92.2	277.6	375.2	478.5	572.0	525.5	407.7	175.3	46.2	3029.5	
1922	5.6	4.6	32.0	75.9	267.0	479.8	480.6	583.7	572.8	399.8	188.7	37.6	3128.1	3.3%
1923	5.6	4.6	43.9	93.7	205.7	435.1	482.1	575.8	572.8	411.7	298.7	33.0	3162.7	1.1%
1924	6.3	49.5	17.3	62.2	235.2	422.9	479.0	588.3	565.7	405.1	227.6	18.8	3077.9	-2.7%
1925	5.6	16.8	53.1	53.3	232.9	435.9	475.5	572.8	548.1	435.9	202.9	28.7	3061.5	-0.5%
1926	6.1	4.6	25.9	55.9	211.3	398.0	481.1	598.9	577.3	400.6	202.9	22.4	2985.0	-2.5%
1927	5.6	6.3	21.8	89.7	245.4	426.5	472.2	559.6	589.8	445.3	115.6	22.4	3000.2	0.5%
1928	6.6	4.6	35.6	145.5	214.6	379.7	492.8	586.2	557.3	448.6	135.4	24.9	3031.8	1.1%
1929	5.6	4.6	58.4	87.9	214.4	411.2	472.9	584.2	550.2	410.5	103.4	18.8	2922.1	-3.6%
1930	8.6	42.4	21.1	57.1	218.2	397.5	484.4	578.1	562.6	404.6	124.0	24.9	2923.5	0.0%
1931	9.4	4.6	38.1	119.6	219.5	440.7	484.1	573.5	530.9	404.9	163.8	22.6	3011.7	3.0%
1932	5.6	22.9	62.7	122.4	213.4	438.4	484.1	597.4	534.4	417.1	272.5	18.8	3189.7	5.9%
1933	5.6	58.9	23.4	81.0	223.5	424.9	484.1	632.5	534.4	383.5	181.1	31.0	3063.9	-3.9%
1934	0.3	2.5	33.5	58.4	142.5	333.5	526.3	569.0	561.8	464.8	80.8	7.6	2781.0	-9.2%
1935	0.3	7.1	9.9	34.0	147.6	285.5	475.7	539.5	500.6	320.8	233.4	49.8	2604.2	-6.4%
1936	0.3	10.7	35.6	73.7	294.1	263.1	579.4	494.0	516.9	395.5	152.4	27.2	2842.9	9.2%
1937	0.3	3.3	84.6	54.9	234.4	355.1	427.2	665.7	578.4	463.0	136.9	11.9	3015.7	6.1%
1938	0.3	8.9	32.0	64.0	354.1	480.1	390.9	627.4	611.6	409.2	246.4	7.6	3232.5	7.2%
1939	0.3	2.8	5.8	44.4	305.3	594.9	396.2	557.8	491.7	310.1	143.0	21.8	2874.1	-11.1%
1940	0.3	2.5	21.1	26.9	207.0	390.4	476.0	549.1	478.8	433.6	207.8	33.5	2827.0	-1.6%
1941	16.5	2.5	5.8	65.5	126.5	608.8	592.3	665.2	575.1	369.8	164.3	10.7	3203.0	13.3%
1942	0.3	2.5	30.7	69.8	307.1	358.9	464.6	529.1	473.5	543.6	117.6	64.3	2962.0	-7.5%
1943	2.3	16.8	45.0	123.4	174.8	432.1	447.3	521.5	557.3	506.0	105.2	29.7	2961.4	0.0%
1944	14.0	7.9	22.4	61.0	272.5	387.9	602.7	542.3	612.1	343.4	89.2	7.9	2963.3	0.1%
1945	0.5	5.3	23.6	136.9	203.7	424.9	551.2	684.5	531.1	358.4	194.3	21.8	3136.2	5.8%
1946	9.4	2.5	24.9	101.3	202.2	265.4	591.1	683.5	419.6	433.6	132.3	42.7	2908.5	-7.3%
1947	0.3	16.0	48.8	47.2	187.5	414.5	485.6	598.4	503.2	357.9	30.7	10.9	2701.0	-7.1%
1948	0.3	9.1	17.3	65.0	282.4	310.9	443.5	627.9	724.2	362.5	78.0	8.4	2929.5	8.5%
1949	0.3	2.5	28.2	94.0	187.5	275.3	407.7	519.2	569.2	432.1	182.4	44.2	2742.6	-6.4%
1950	0.3	2.5	35.3	64.3	159.3	329.4	404.4	469.6	509.0	433.6	217.2	9.9	2634.8	-3.9%
1951	27.7	30.2	34.0	98.0	245.1	407.2	434.8	571.0	530.1	567.2	133.9	9.4	3088.6	17.2%
1952	8.1	20.3	25.7	78.5	229.6	372.4	574.5	631.7	505.5	418.6	258.1	24.4	3147.4	1.9%
1953	17.3	5.1	31.7	116.8	165.4	512.1	556.5	616.5	634.2	410.7	139.7	47.0	3253.0	3.4%
1954	0.3	23.9	34.5	50.8	333.8	408.7	450.3	595.9	421.1	509.8	421.6	55.4	3306.1	1.6%
1955	0.3	4.1	135.4	144.5	289.8	472.9	358.6	574.8	575.1	428.5	10.4	0.0	2994.4	-9.4%
1956	0.0	48.5	18.8	26.9	294.4	261.6	443.0	485.9	725.7	369.8	156.5	63.5	2894.6	-3.3%
1957	0.0	0.0	0.0	160.8	81.0	329.9	591.0	604.0	808.0	356.1	190.0	14.5	3135.3	8.3%
1958	25.4	5.6	156.0	234.7	276.9	342.1	206.0	417.3	661.7	346.7	344.2	49.0	3065.6	-2.2%
1959	36.1	0.0	0.0	48.8	377.7	855.5	308.9	440.2	590.0	510.8	289.6	0.0	3457.6	12.8%
1960	19.8	0.5	55.4	30.0	168.7	450.8	453.9	442.5	573.0	321.8	71.9	13.2	2601.5	-24.8%
1961	0.0	10.7	0.0	77.2	235.2	301.5	820.9	404.6	357.1	275.3	85.3	0.0	2567.8	-1.3%
1962	0.0	0.0	4.3	194.8	279.4	365.5	627.4	657.6	517.1	365.3	282.7	12.2	3306.3	28.8%
1963	8.9	33.8	38.4	70.4	156.5	404.6	373.6	696.7	405.1	465.8	94.7	0.0	2748.5	-16.9%
1964	0.0	0.0	29.5	14.7	165.6	356.6	617.7	721.1	730.5	397.3	152.1	56.9	3242.0	18.0%
1965	71.9	4.8	10.2	48.0	167.4	428.5	508.0	706.9	499.4	372.1	194.1	0.0	3011.3	-7.1%
1966	0.0	39.4	29.7	56.6	182.4	374.1	341.4	753.6	610.1	347.7	169.2	30.2	2934.4	-2.6%
1967	0.0	0.0	31.2	44.2	251.2	360.4	644.9	698.0	508.0	435.1	211.1	3.3	3187.4	8.6%
1968	0.0	22.4	25.4	81.5	283.0	625.6	397.5	683.0	863.6	391.4	156.7	31.7	3561.8	11.7%
1969	1.3	19.0	59.2	106.7	180.1	339.1	542.3	640.1	649.7	396.7	173.0	48.0	3155.2	-11.4%
1970	0.0	2.5	40.4	62.2	265.2	301.8	782.3	600.5	500.1	269.7	199.1	38.4	3062.2	-2.9%
1971	0.0	11.4	3.6	226.3	170.9	306.3	229.9	831.6	568.7	338.6	222.0	61.0	2970.3	-3.0%
1972	0.0	0.0	46.2	97.3	223.3	596.6	544.6	744.7	360.7	478.8	4.1	0.0	3096.3	4.2%
1973	0.0	0.0	6.3	52.6	288.8	342.9	370.1	635.3	436.9	517.7	193.5	3.6	2847.7	-8.0%
1974	0.0	0.0	27.9	81.0	125.2	336.8	510.8	426.0	454.9	474.7	162.8	0.0	2600.1	-8.7%
1975	0.0	0.0	0.0	116.8	258.6	342.6	574.0	656.1	429.0	448.8	56.9	33.5	2916.3	12.2%
1976	0.0	10.4	2.8	139.2	146.8	598.4	386.8	314.2	585.5	532.4	207.5	27.4	2951.4	1.2%
1977	0.0	0.0	4.3	48.0	207.3	496.3	531.6	479.0	745.2	425.2	36.8	2.5	2976.2	0.8%
1978	9.4	58.4	11.2	155.4	279.4	377.2	474.7	596.9	591.8	442.2	170.2		3166.8	6.4%

Teko Monthly Rainfall (mm) 1921 - 1978



Annex G Monthly mean rainfall for 38 stations in Sierra Leone (1941 to 1960)

Mean monthly rainfall values for 38 stations in Sierra Leone 1941 to 1960

Source

S. Gregory, 1965 Rainfall over Sierra Leone, Department of Geography University of Liverpool Research Paper No 2. The Acorn Press. 58pp

Monthly Rainfall (source data in inches)

Table 1 Direct from Gregory, all values in inches

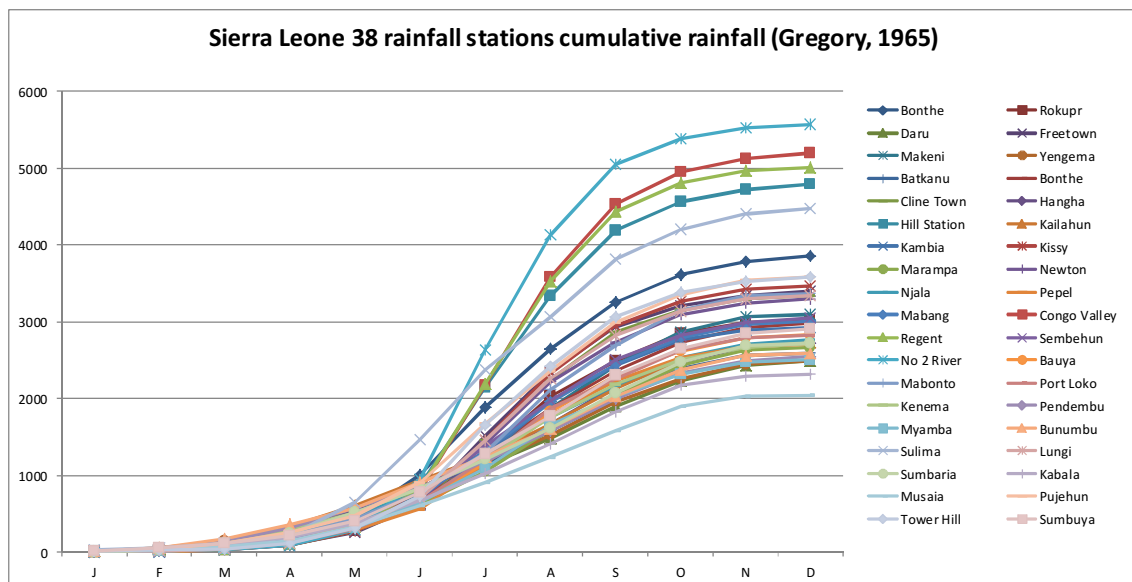
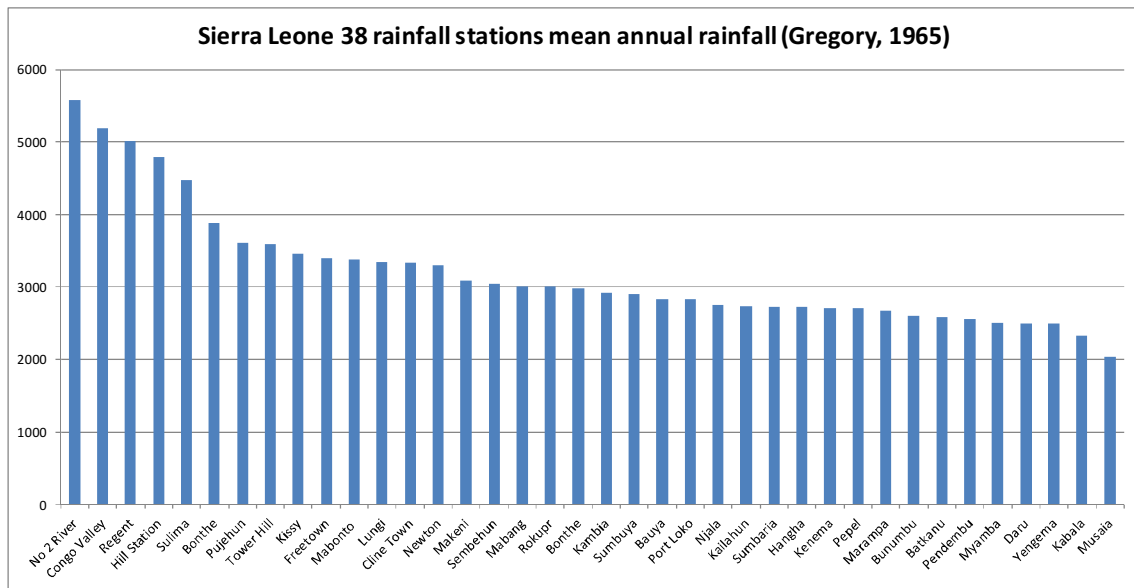
Years	Station	J	F	M	A	M	J	J	A	S	O	N	D	Dry (Dec-Apr)	Wet (May-Nov)	Year (Jan-Dec)
20	Bonthe	0.7	1.0	0.7	4.4	10.5	22.5	34.7	29.7	24.2	13.8	7.0	2.6	10.8	142.5	153.0
	Rokupr	0.2	0.6	0.6	2.5	6.9	14.8	24.8	29.4	18.1	14.1	6.0	1.0	4.5	114.1	118.4
	Daru	0.5	1.3	4.2	5.8	9.9	11.2	11.2	14.5	16.1	13.1	8.1	2.5	14.3	84.1	98.3
	Freetown	0.4	0.5	0.8	2.2	6.5	14.0	35.1	32.9	23.3	10.8	5.2	1.9	5.9	127.7	133.5
	Makeni	0.4	0.3	1.7	3.9	8.8	15.2	19.2	24.2	22.3	17.0	7.7	1.1	7.6	114.4	121.9
	Yengema	0.5	1.1	4.0	5.9	8.6	12.5	12.3	15.5	16.8	12.1	7.1	1.9	13.3	85.8	98.1
	Batkanu	0.3	0.2	1.2	2.9	7.9	14.6	17.5	18.0	16.2	15.3	6.9	0.9	5.7	96.3	101.8
	Bo	0.6	1.0	3.0	5.1	9.4	13.3	19.1	22.3	19.5	14.7	7.4	2.1	11.9	105.7	117.5
	Cline Town	0.5	0.5	0.6	2.2	7.0	13.2	33.5	31.2	24.2	11.3	5.8	1.7	5.3	126.2	131.5
	Hangha	0.5	1.1	4.5	6.3	9.1	10.8	13.4	19.9	19.2	13.0	7.6	1.8	14.4	93.1	107.2
	Hill Station	0.8	0.5	0.6	2.4	8.7	21.0	50.8	46.8	33.5	14.7	6.4	2.5	7.0	181.9	188.6
	Kailahun	0.7	1.5	3.7	7.3	10.4	13.3	12.4	16.8	17.7	14.8	7.2	1.9	15.2	92.6	107.7
	Kambia	0.2	0.1	0.8	2.4	7.8	13.6	24.6	28.0	18.2	13.0	5.5	1.0	4.6	110.6	115.0
	Kissy	0.2	0.3	0.8	2.3	7.4	14.2	31.9	34.5	24.8	12.2	6.0	1.8	5.5	130.9	136.3
	Marampa	0.2	0.2	1.4	3.3	7.8	11.3	17.0	21.6	17.4	15.6	8.1	1.2	6.5	98.8	105.2
	Newton	0.4	0.5	0.8	2.6	8.1	14.5	28.8	31.4	20.8	14.0	5.8	2.0	6.4	123.5	129.8
	Njala	0.5	0.7	3.1	5.0	9.3	13.3	17.5	20.0	16.4	13.8	7.2	1.9	11.4	97.5	108.7
	Pepel	0.2	0.1	0.8	2.7	7.3	11.2	23.2	24.9	17.6	11.9	5.4	1.3	5.0	101.4	106.5
	Mabang	0.5	0.4	1.4	3.7	8.7	13.8	23.5	25.4	18.8	13.8	7.0	1.7	7.6	111.0	118.7
18	Congo Valley	0.4	0.6	0.8	2.7	8.5	19.0	53.6	55.8	37.1	16.3	7.2	2.5	6.4	197.6	204.5
	Regent	0.7	0.5	0.6	2.7	8.9	19.1	53.6	52.6	36.1	14.6	6.0	1.9	5.8	190.9	197.3
17	Sembehun	0.2	0.6	1.7	4.6	9.1	14.2	24.0	23.2	21.2	12.6	6.8	1.8	8.0	111.2	120.1
	No 2 River	0.3	0.4	0.5	2.0	7.9	26.1	66.7	58.6	36.4	13.1	5.9	1.7	4.2	214.6	219.5
16	Bauya	0.3	0.7	1.2	2.8	9.0	12.2	19.8	26.3	18.7	12.1	6.7	1.8	5.3	104.7	111.4
	Mabonto	0.5	0.7	2.3	4.8	8.8	13.3	20.7	32.4	22.4	18.0	7.5	1.5	7.9	123.2	133.1
15	Port Loko	0.2	0.4	1.1	3.3	7.2	13.8	21.5	26.1	15.7	14.5	6.2	1.4	5.0	105.0	111.3
	Kenema	0.7	1.3	3.8	5.8	8.7	12.7	14.9	21.5	16.9	12.2	6.6	1.8	10.0	93.4	106.8
	Pendembu	0.6	1.2	4.2	6.6	9.9	11.3	12.8	16.0	16.0	13.5	6.3	2.1	11.2	85.8	100.5
14	Myamba	0.2	0.4	1.1	3.2	7.7	13.1	17.6	21.8	15.0	11.4	5.9	1.4	4.9	92.6	98.9
	Bunumbu	0.4	1.9	4.5	7.7	8.5	13.0	12.7	14.7	16.8	13.5	7.0	1.6	11.3	86.2	102.3
	Sulima	1.2	1.0	2.4	4.1	16.9	32.3	35.5	27.1	30.0	15.2	7.5	3.0	8.4	164.6	176.2
13	Lungi	0.5	0.2	1.2	2.6	8.8	14.5	29.5	31.9	22.0	12.3	6.3	1.7	4.0	125.3	131.7
	Sumbaria	0.3	1.0	3.5	5.0	10.4	12.5	14.8	16.3	17.6	16.3	8.2	1.4	7.1	96.1	107.3
12	Kabala	0.6	0.5	2.3	4.0	7.5	12.0	13.3	15.4	16.3	13.7	4.6	1.1	5.0	82.9	91.4
	Musaia	0.5	0.6	1.8	3.1	7.4	10.6	12.0	12.7	13.9	12.5	5.1	0.6	3.8	74.1	80.5
11	Pujehun	0.9	1.0	2.5	5.7	8.9	16.7	30.2	27.0	25.3	13.8	7.4	2.0	6.4	129.8	142.0
	Tower Hill	0.8	0.4	0.8	2.3	8.0	16.7	36.0	30.4	25.3	12.4	5.9	2.3	3.6	134.7	141.4
10	Sumbuya	0.8	1.6	2.4	3.7	7.6	14.5	19.7	19.4	21.1	13.4	7.9	2.2	5.4	103.6	114.4

Monthly Rainfall (converted to mm)

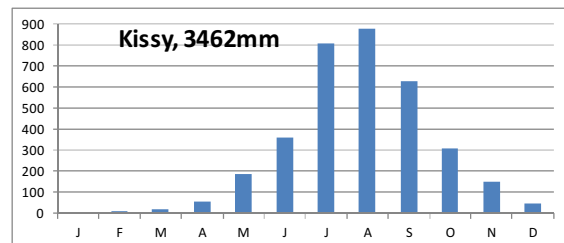
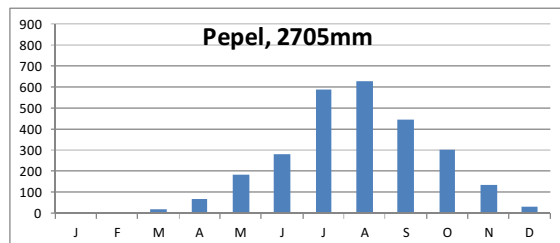
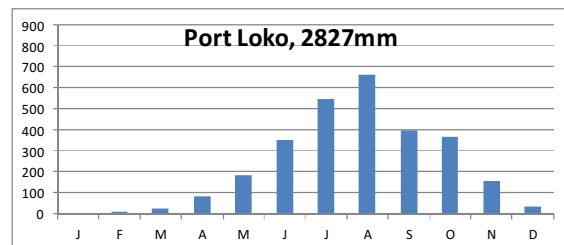
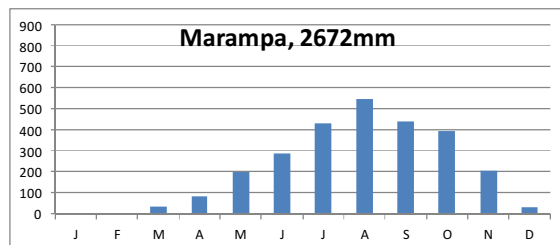
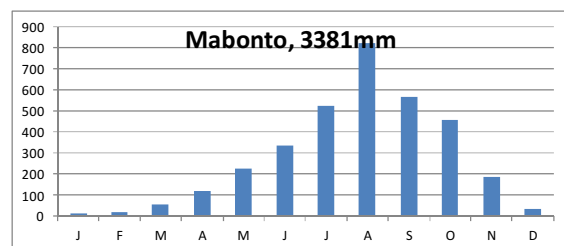
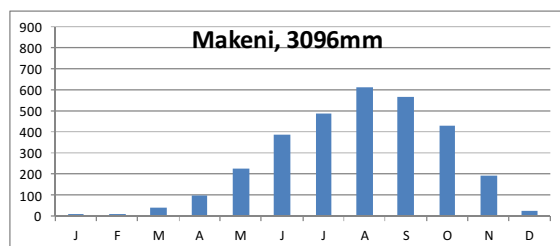
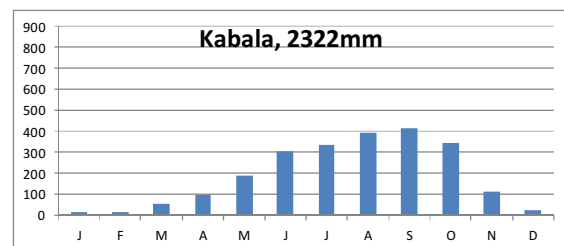
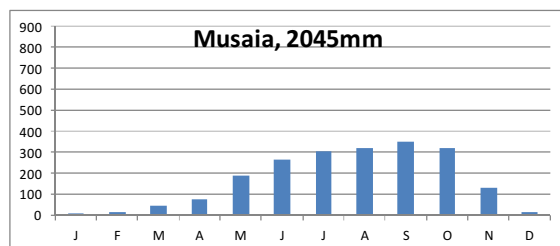
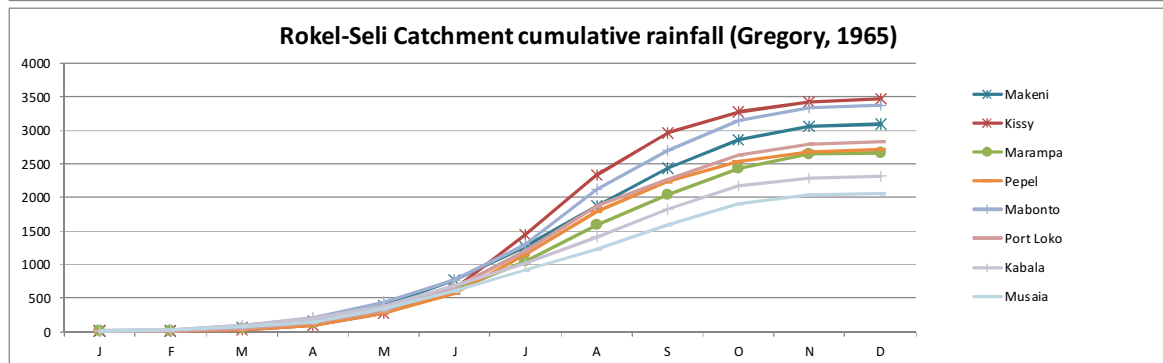
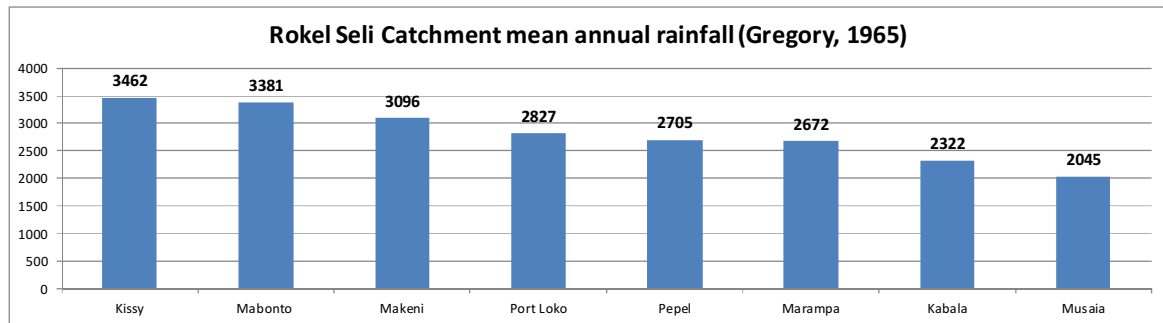
Table 2 all values converted to mm

Years	Station	J	F	M	A	M	J	J	A	S	O	N	D	Dry (Dec-Apr)	Wet (May-Nov)	Year (Jan-Dec)
20	Bonthe	16.8	24.6	16.5	111.8	266.7	571.5	881.4	754.4	614.7	350.5	177.8	66.0	274.3	3619.5	3886.2
	Rokupr	6.1	14.5	14.7	63.5	175.3	375.9	629.9	746.8	459.7	358.1	152.4	25.4	114.3	2898.1	3007.4
	Daru	11.7	33.0	106.7	147.3	251.5	284.5	284.5	368.3	408.9	332.7	205.7	63.5	363.2	2136.1	2496.8
	Freetown	11.2	11.4	20.6	55.9	165.1	355.6	891.5	835.7	591.8	274.3	132.1	48.3	149.9	3243.6	3390.9
	Makeni	9.1	8.6	43.2	99.1	223.5	386.1	487.7	614.7	566.4	431.8	195.6	27.9	193.0	2905.8	3096.3
	Yengema	11.4	27.9	101.6	149.9	218.4	317.5	312.4	393.7	426.7	307.3	180.3	48.3	337.8	2179.3	2491.7
	Batkanu	6.6	4.8	30.5	73.7	200.7	370.8	444.5	457.2	411.5	388.6	175.3	22.9	144.8	2446.0	2585.7
	Bonthe	14.5	24.4	76.2	129.5	238.8	337.8	485.1	566.4	495.3	373.4	188.0	53.3	302.3	2684.8	2984.5
	Cline Town	11.9	12.2	14.0	55.9	177.8	335.3	850.9	792.5	614.7	287.0	147.3	43.2	134.6	3205.5	3340.1
	Hangha	12.7	27.9	114.3	160.0	231.1	274.3	340.4	505.5	487.7	330.2	193.0	45.7	365.8	2364.7	2722.9
	Hill Station	19.6	11.9	14.7	61.0	221.0	533.4	1290.3	1188.7	850.9	373.4	162.6	63.5	177.8	4620.3	4790.4
	Kailahun	17.3	38.1	94.0	185.4	264.2	337.8	315.0	426.7	449.6	375.9	182.9	48.3	386.1	2352.0	2735.6
	Kambia	4.1	3.6	20.6	61.0	198.1	345.4	624.8	711.2	462.3	330.2	139.7	25.4	116.8	2809.2	2921.0
	Kissy	6.1	8.4	20.3	58.4	188.0	360.7	810.3	876.3	629.9	309.9	152.4	45.7	139.7	3324.9	3462.0
	Marampa	6.1	5.8	35.6	83.8	198.1	287.0	431.8	548.6	442.0	396.2	205.7	30.5	165.1	2509.5	2672.1
	Newton	10.4	11.7	20.1	66.0	205.7	368.3	731.5	797.6	528.3	355.6	147.3	50.8	162.6	3136.9	3296.9
	Njala	13.7	16.8	78.7	127.0	236.2	337.8	444.5	508.0	416.6	350.5	182.9	48.3	289.6	2476.5	2761.0
19	Pepel	5.1	3.0	20.3	68.6	185.4	284.5	589.3	632.5	447.0	302.3	137.2	33.0	127.0	2575.6	2705.1
	Mabang	13.7	8.9	35.6	94.0	221.0	350.5	596.9	645.2	477.5	350.5	177.8	43.2	193.0	2819.4	3015.0
18	Congo Valley	10.9	14.0	20.1	68.6	215.9	482.6	1361.4	1417.3	942.3	414.0	182.9	63.5	162.6	5019.0	5194.3
	Regent	17.5	11.4	15.7	68.6	226.1	485.1	1361.4	1336.0	916.9	370.8	152.4	48.3	147.3	4848.9	5011.4
	Sembehun	4.6	15.2	43.2	116.8	231.1	360.7	609.6	589.3	538.5	320.0	172.7	45.7	203.2	2824.5	3050.5
17	No 2 River	7.9	10.7	12.4	50.8	200.7	662.9	1694.2	1488.4	924.6	332.7	149.9	43.2	106.7	5450.8	5575.3
16	Bauya	7.4	16.8	30.5	71.1	228.6	309.9	502.9	668.0	475.0	307.3	170.2	45.7	134.6	2659.4	2829.6
	Mabonto	13.7	17.8	58.4	121.9	223.5	337.8	525.8	823.0	569.0	457.2	190.5	38.1	200.7	3129.3	3380.7
	Port Loko	3.8	10.2	27.9	83.8	182.9	350.5	546.1	662.9	398.8	368.3	157.5	35.6	127.0	2667.0	2827.0
15	Kenema	18.5	33.0	96.5	147.3	221.0	322.6	378.5	546.1	429.3	309.9	167.6	45.7	254.0	2372.4	2712.7
	Pendembu	14.5	30.5	106.7	167.6	251.5	287.0	325.1	406.4	406.4	342.9	160.0	53.3	284.5	2179.3	2552.7
	Myamba	4.3	10.7	27.9	81.3	195.6	332.7	447.0	553.7	381.0	289.6	149.9	35.6	124.5	2352.0	2512.1
14	Bunumbu	9.9	48.3	114.3	195.6	215.9	330.2	322.6	373.4	426.7	342.9	177.8	40.6	287.0	2189.5	2598.4
	Sulima	31.0	25.4	61.0	104.1	429.3	820.4	901.7	688.3	762.0	386.1	190.5	76.2	213.4	4180.8	4475.5
13	Lungi	13.2	5.6	30.5	66.0	223.5	368.3	749.3	810.3	558.8	312.4	160.0	43.2	101.6	3182.6	3345.2
	Sumbaria	7.9	25.4	88.9	127.0	264.2	317.5	375.9	414.0	447.0	414.0	208.3	35.6	180.3	2440.9	2725.4
12	Kabala	15.7	13.5	58.4	101.6	190.5	304.8	337.8	391.2	414.0	348.0	116.8	27.9	127.0	2105.7	2321.6
	Musaia	11.4	14.0	45.7	78.7	188.0	269.2	304.8	322.6	353.1	317.5	129.5	15.2	96.5	1882.1	2044.7
11	Pujehun	22.9	25.4	63.5	144.8	226.1	424.2	767.1	685.8	642.6	350.5	188.0	50.8	162.6	3296.9	3606.8
	Tower Hill	19.8	10.7	20.6	58.4	203.2	424.2	914.4	772.2	642.6	315.0	149.9	58.4	91.4	3421.4	3591.6
10	Sumbuya	19.6	40.6	61.0	94.0	193.0	368.3	500.4	492.8	535.9	340.4	200.7	55.9	137.2	2631.4	2905.8

Mean monthly rainfall values for 38 stations in Sierra Leone 1941 to 1960



Mean monthly rainfall values for 38 stations in Sierra Leone
Sites in or adjacent to Rokel- Seli Catchment
1941 to 1960



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Annex H Monthly rainfall records at Bumbuna Dam Site (2007 to 2013)

Bumbuna Dam Monthly Rainfall (mm)

2007-2013

Sources

2007-2013	Studio Pietrangeli Consultants (Spreadsheet)
Note	No data collected between 15 April and 8 June 2013 (Industrial Action) Last record is 13 August 2013

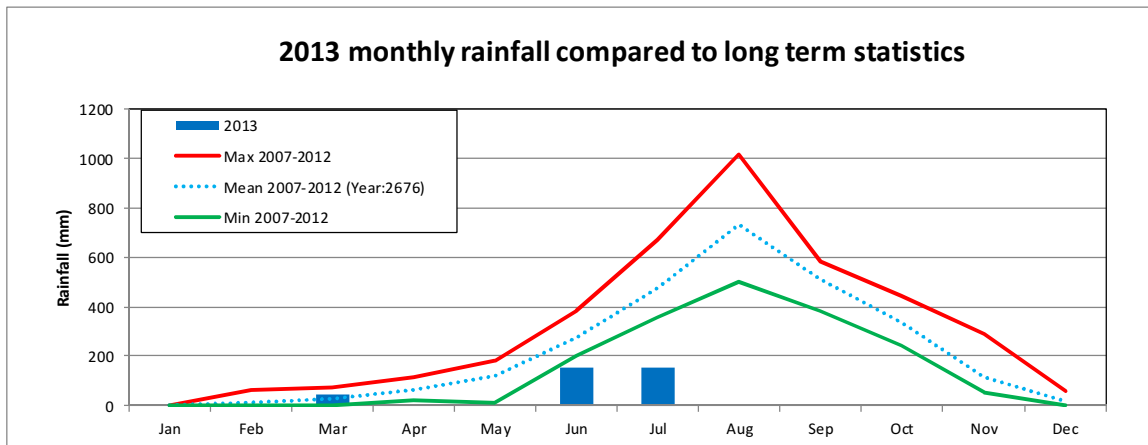
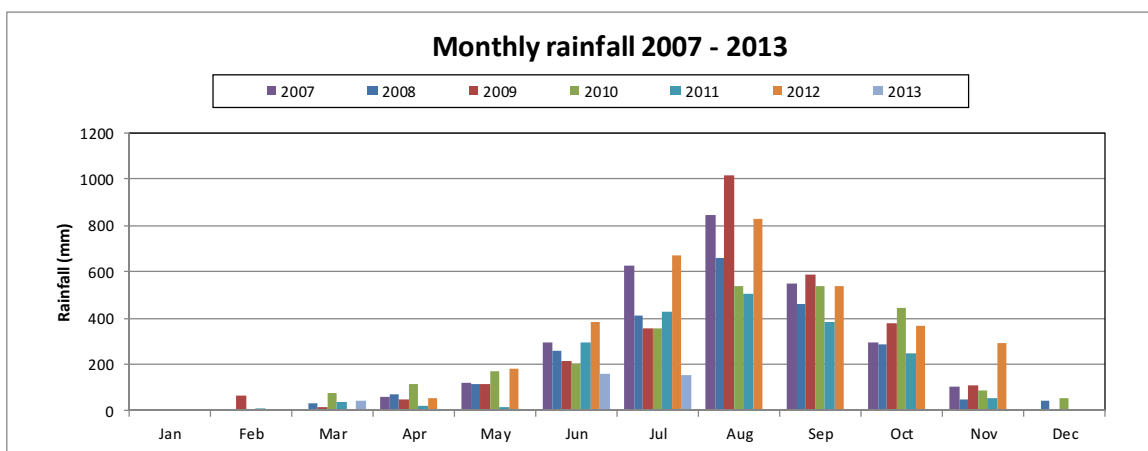
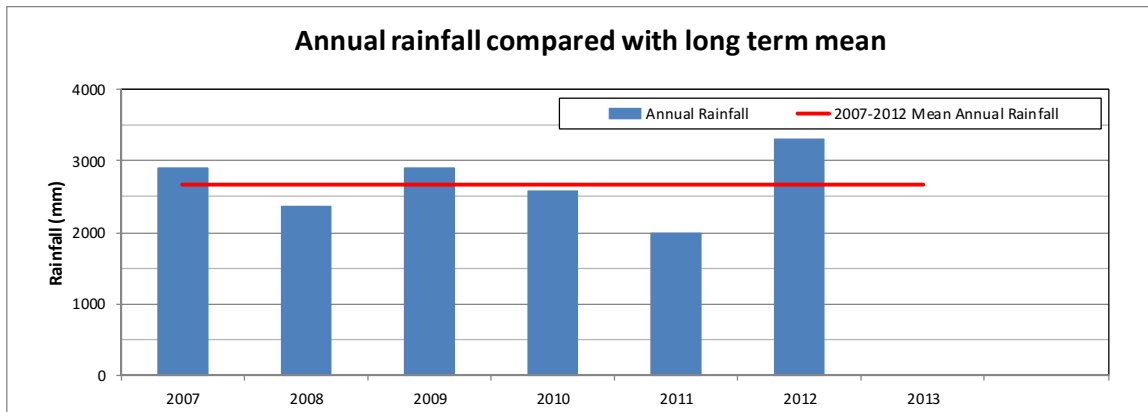
All Record Statistics

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean 2007-2012 ('	0.0	12.5	27.8	61.1	118.4	274.2	474.7	730.9	508.9	334.9	116.2	16.3	2676.0
Min 2007-2012	0.0	0.0	3.0	23.4	12.8	203.4	355.8	503.0	381.6	245.8	50.8	0.0	1995.4
Max 2007-2012	0.0	64.0	75.1	114.0	179.8	381.8	668.7	1017.2	584.6	442.6	290.0	56.4	3311.7
Std Dev 2007-2012	0.0	25.6	27.0	29.9	58.9	65.6	136.9	199.9	74.4	73.2	88.6	25.5	462.7

Monthly Total Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall	% Change
2007	0.0	0.0	3.0	58.2	121.6	295.9	624.1	845.5	550.8	293.5	103.8	0.6	2897.0	
2008	0.0	0.0	30.8	68.5	114.2	256.2	412.8	655.8	460.8	283.0	50.8	40.6	2373.5	-18.1%
2009	0.0	64.0	14.4	49.6	114.8	213.2	357.7	1017.2	584.6	378.2	110.8	0.0	2904.5	22.4%
2010	0.0	0.0	75.1	114.0	167.4	203.4	355.8	536.6	536.8	442.6	85.8	56.4	2573.9	-11.4%
2011	0.0	11.0	38.0	23.4	12.8	294.8	429.2	503.0	381.6	245.8	55.8	0.0	1995.4	-22.5%
2012	0.0	0.0	5.6	53.2	179.8	381.8	668.7	827.2	539.0	366.4	290.0	0.0	3311.7	66.0%
2013	0.0	0.0	44.4	nd	nd	155.6	155.3							

Bumbuna Dam Monthly Rainfall (mm) 2007-2013



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Annex I Monthly mean flow data for the Rokel-Seli river at Bumbuna (1970 to 1979)

Mean monthly river flow for Rokel-seli River at Bumbuna 1970 - 1979

Sources

2006 Report Bumbuna hydrological studies update, 2006. Data photographed at Bumbuna HEP powerhouse on 8 August 2013

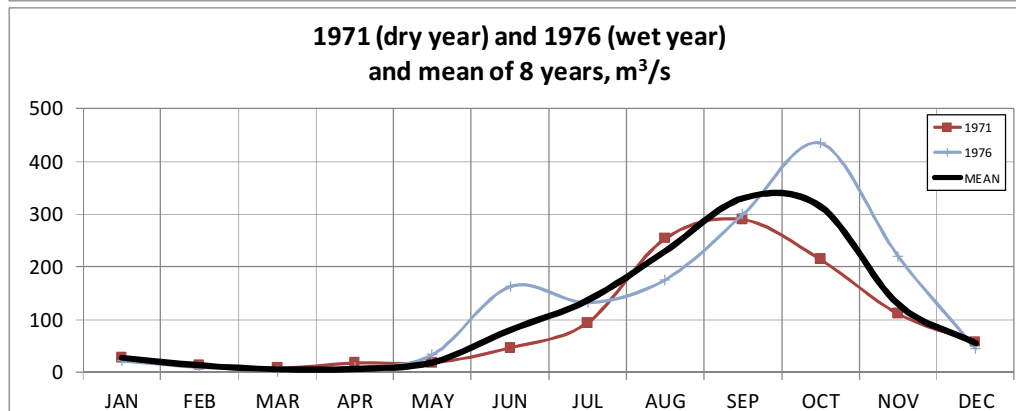
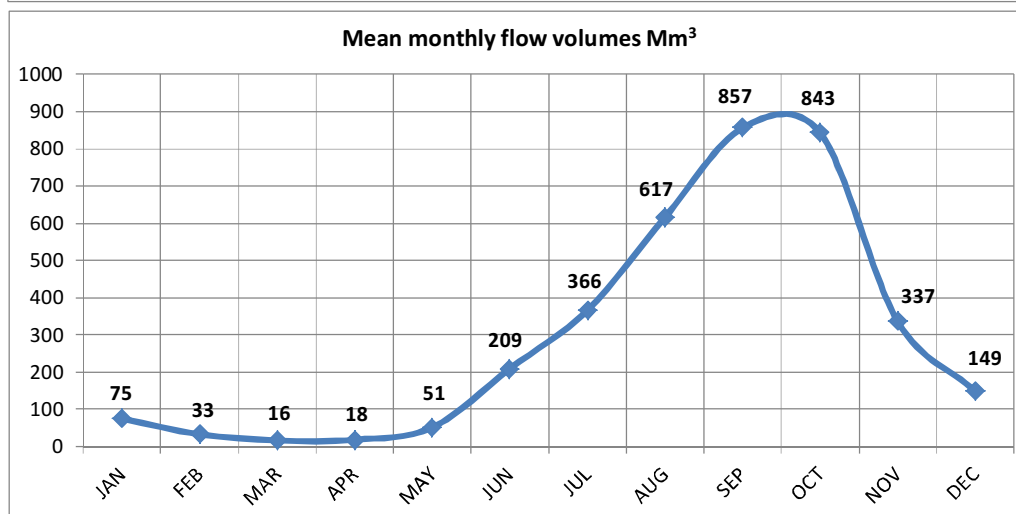
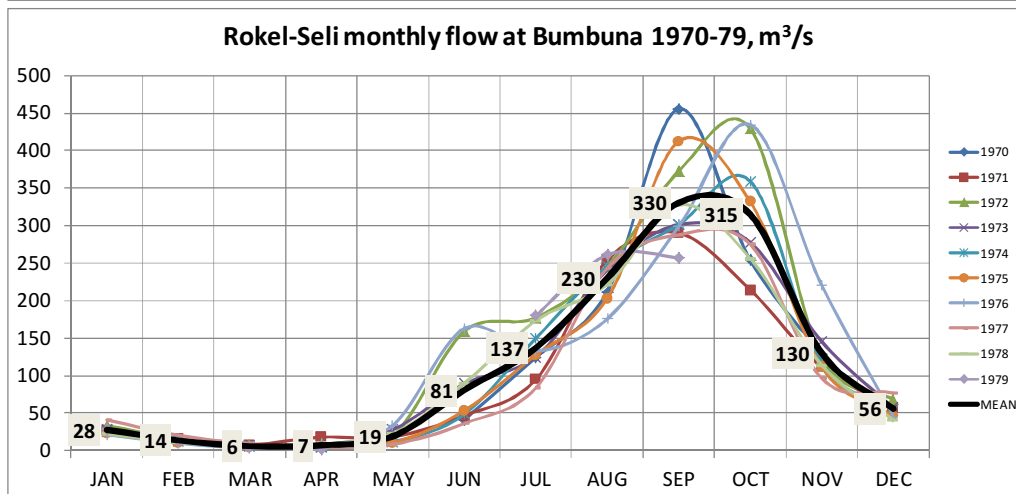
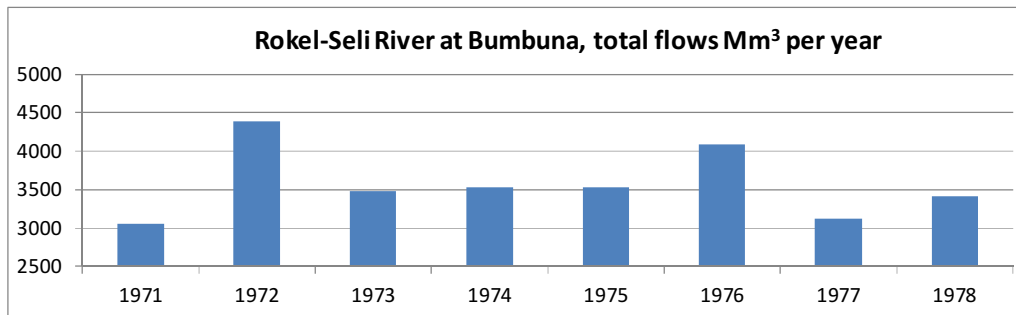
Mean Monthly Flow (Source data - m³/s)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1970						41.2	124.1	211.4	455.4	253.8	129.1		
1971	27.4	15.0	7.9	18.1	18.5	46.8	94.7	254.1	290.0	214.4	111.4	58.1	1156
1972	33.6	15.8	7.0	8.5	19.9	159.0	177.3	245.9	372.5	429.3	123.3	68.1	1660
1973	28.7	13.6	7.1	4.5	27.9	89.2	125.0	241.0	301.5	277.6	145.5	57.0	1319
1974	26.0	13.2	6.0	3.9	11.7	48.5	149.7	245.3	301.4	359.1	117.3	53.6	1336
1975	22.4	10.6	3.9	4.7	10.3	53.5	127.8	203.0	412.2	332.1	111.7	46.0	1338
1976	21.4	10.2	3.4	8.1	33.8	162.8	132.8	175.7	299.3	434.6	220.6	45.5	1548
1977	41.0	20.3	9.8	4.7	8.4	36.2	83.6	243.4	287.9	274.9	96.4	76.9	1184
1978	22.1	11.1	5.3	9.0	22.8	89.8	173.3	221.4	327.9	256.2	113.9	41.1	1294
1979	28.8	12.9	4.6	1.7			179.6	261.0	256.5				
MEAN	27.9	13.6	6.1	7.0	19.2	80.8	136.8	230.2	330.5	314.7	129.9	55.8	112.7
MAX	41.0	20.3	9.8	18.1	33.8	162.8	179.6	261.0	455.4	434.6	220.6	76.9	455.4
MIN	21.4	10.2	3.4	1.7	8.4	36.2	83.6	175.7	256.5	214.4	96.4	41.1	1.7

Mean Monthly Flow (Converted to Mm³/month)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1970						106.8	332.4	566.2	1180.4	679.8	334.6		
1971	73.4	36.3	21.2	46.9	49.6	121.3	253.6	680.6	751.7	574.2	288.7	155.6	3053
1972	90.0	38.2	18.7	22.0	53.3	412.1	474.9	658.6	965.5	1149.8	319.6	182.4	4385
1973	76.9	32.9	19.0	11.7	74.7	231.2	334.8	645.5	781.5	743.5	377.1	152.7	3481
1974	69.6	31.9	16.1	10.1	31.3	125.7	401.0	657.0	781.2	961.8	304.0	143.6	3533
1975	60.0	25.6	10.4	12.2	27.6	138.7	342.3	543.7	1068.4	889.5	289.5	123.2	3531
1976	57.3	24.7	9.1	21.0	90.5	422.0	355.7	470.6	775.8	1164.0	571.8	121.9	4084
1977	109.8	49.1	26.2	12.2	22.5	93.8	223.9	651.9	746.2	736.3	249.9	206.0	3128
1978	59.2	26.9	14.2	23.3	61.1	232.8	464.2	593.0	849.9	686.2	295.2	110.1	3416
1979	77.1	31.2	12.3	4.4			481.0	699.1	664.8				
MEAN	74.8	33.0	16.4	18.2	51.3	209.4	366.4	616.6	856.6	842.8	336.7	149.4	3577
MAX	109.8	49.1	26.2	46.9	90.5	422.0	481.0	699.1	1180.4	1164.0	571.8	206.0	
MIN	57.3	24.7	9.1	4.4	22.5	93.8	223.9	470.6	664.8	574.2	249.9	110.1	

Mean monthly river flow for Rokel-seli River at Bumbuna 1970 - 1979



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Annex J Monthly mean flow data for the Rokel-Seli river at Badala (1970 to 1976)

Station Information

The station is 25 miles from Kabala in a south-easterly direction, 6 miles from Kondembaia town; and located on the left bank about 100 metres upstream of the concrete bridge over the Seli river.

1976 Hydrological Year Boo (Assumed rainfall year 1921 starts Dec 1920, and so on).
UNDP / MEP (Water Supply Division) SIL/72/007

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean	11	6	3	4	8	40	68	110	176	158	60	25	669
Min	9	5	3	2	6	22	43	92	142	115	51	19	561
Max	13	7	3	7	13	86	99	129	209	205	71	31	812
Std Dev	1	0	0	2	3	26	19	15	24	31	8	4	94

[illegible][illegible]

Mean Monthly River Flow for the Rokel-Seli River at Badala **June 1970 to March 1976**

