

Sub-Theme IV-1: Global Monitoring on the Environmental Change

- Meteorological observations in Southern Province of Zambia -

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1. Introduction

Precipitation is an important forcing to modulate the Zambian ecological environment and its variability has an impact on rural households. In the Sub-Theme IV-1 we investigate the climatorological/meteorological changes, in and around Zambia from a view of two spatial scales, that is, a continent-country scale and a province-district scale. We focus mainly on the two following objectives:

- i) To Analyze of archived global meteorological data sets to identify meteorological characteristics of Zambia and to investigate temporal and spatial precipitation variabilities on a continent-country scale.
- ii) To compile and analyze of rain-gauge based data sets to get better understanding precipitation variability on a province-district scale and to identify the time and geographical extent of “meteorological” drought.

Based on field research in the pre-research year (FY2006), we have planned to install weather-monitoring sensors in Southern and Eastern Provinces of Zambia to monitor local meteorological conditions of the research fields. In September 2007 two weather stations and rain gauges have been installed in Southern Province. Ground-based meteorological data were also collected for the objective ii above. This report outlines the observations and obtained ground-based data.

2. Installation of meteorological equipment in Sinazongwe area

With cooperation from members of the other themes and Zambian counterparts in Mt. Makulu Central Research Station, Zambian Ministry of Agriculture and Cooperatives (ZARI), 2 weather stations and 48 rain gauges have been installed in Sinazongwe area of Southern Province in September 2007 and at work since then. Sinazongwe area (Sinazongwe and Choma districts) is located in agro-ecological zone I where receives less than 800mm of annual precipitation and is ecologically vulnerable. Villagers in this area have been also affected by social and historical events like construction of Kariba dam. Accordingly, Sinazongwe area was chosen as one of main research fields of Resilience Project.

2.1 Weather stations

Among five villages at which Theme 2 household survey has been conducted in Sinazongwe

area, we selected two villages as weather monitoring sites in terms of topography and the surroundings. The selected sites are Siachaya and Sianemba which are located at the top and the foot of a slope in Sinazongwe area, respectively. Weather stations were installed at each site to monitor weather conditions at top and bottom of the slope. Outline of the site are summarized in Table 1 and Figure 1. At this stage the weather stations observe six meteorological parameters; temperature, humidity, wind speed and direction, solar radiation, precipitation, and pressure. Components of the stations are listed in Table 2. The two stations have the same specification except for calibration factors of the pyranometers.

2.2. Rain gauges

As a part of Theme 2 household survey, 48 sets of rain gauges and loggers were installed at the five villages in Sinazongwe area to monitor local precipitation received to farmers' crop fields. The numbers of installed rain gauges were 16 at Siachaya (upper slope area), 8 at Chanzika and at 8 at Kanego (middle slope area), 4 at Siameja and 12 at Sianemba (lower slope area). The detailed of installation locations would be described elsewhere. Rain gauge stands were manufactured by a steel factory in Lusaka (Fig. 2a). The stand was settled under the ground in the crop field with cement and a 0.5 mm tipping bucket rain gauge was set on it with a logger inside (Fig. 2b). The log interval was set to be 30 minutes.

3. Ground-based meteorological data in Zambia

The Zambia Meteorological Department (ZMD), Ministry of Communications and Transport have observed meteorological elements at dozens of stations which cover wide geographical area in Zambia. In this September we obtained ZMD meteorological data set on a monthly basis at 40 ZMD stations. The obtained ZMD station specification and observed elements at each station are summarized in Tables 3a and 3b. The data analysis remains further research.

Besides ZMD stations, there are lots of local voluntary stations. Observed data at such voluntary stations have not been compiled by ZMD. These stations may cover unobserved area by ZMD, hence it is worthwhile to look for such data to get knowledge of rural environmental conditions. Owing to Dr. Matsumura, a member of theme IV, we got precipitation data at Maamba and Sinazongwe in this September. These stations are close to the research fields, which data may help us to know historical record of precipitation.

4. Summary and outlook for the next fiscal year

We set up the meteorological observations in Sinazongwe area and plan to carry out the observations during the full research years of the resilience project. The observed data will be provided to other themes as fundamental ecological data to analyze socio-ecological resilience. We also start to collect local meteorological data sets in Zambia.

In the next fiscal year Sub-Theme IV-1 will propose:

- ✓ to maintain the installed equipment with the project members,
- ✓ to collect further meteorological data over Zambia,
- ✓ to analyze the global meteorological data and ground-based data in focus on Zambia and to identify the timing and geographical extent of meteorological drought.

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(a)



(b)



Figure 1 Installed weather stations at (a) Siachaya and (b) Sianemba.

(a)



(b)



(Photo by Chieko Umetsu)

Figure 2. (a) Rain gauge stands and (b) installation of a rain gauge.

Table 1. Outlines of two weather monitoring sites in Sinazongwe area

Village	Siachaya (Upper Slope)	Sianemba (Lower Slope)
Name of station	Luwo Siachaya	Luwo Sianemba
Place	Old field next to a headman's house	Clear space between houses near headman's
Location	S 16°98025' E 027°33947' 1091 m a.s.l.	S 17.08714° E 027.52253° 511m a.s.l.
Starting date of monitoring	2007.9.14	2007.9.13
Monitoring interval	Every 30 min	Every 30 min
Calibration factor of pyranometer	16.31	16.58
Uploaded program	FIELD_South1631.CR1	FIELD_South1658.CR1

* "Luwo" means "wind" in Tonga.

Table 2. Components of the meteorological stations

Category		Manufacturer/Model number or Specification
Sensor	Temperature and humidity measurement probe	Campbell Scientific Inc./ CS215-L6
	Wind speed and direction sensor	Campbell Scientific Inc./ 034B-L11
	Pyranometer	Kipp&Zonen/ P-CMP3 Prede Co.
	Rain gauge	Campbell Scientific Inc./ TE525MM-L25
	Barometric pressure sensor	Campbell Scientific Inc./ CS115
Logger	Datalogger	Campbell Scientific Inc./ CR1000-XT
peripherals and related equipment	Solar panel 20W	Campbell Scientific Inc./ MSX20, SP20
	12V Battery	Campbell Scientific Inc./ PS100
	Enclosure	Campbell Scientific Inc./ ENC16, 16-TN
	Compact flash card slot	Campbell Scientific Inc./ CFM 100, 100-XT
	Shade	Campbell Scientific Inc./ 41303-5A
Related hardware	Solar radiation sensor mount	Campbell Scientific Inc./ CM225
	Main pole	Pype 42.8mmØ
	Sub pole	Pype 25mmØ
	Raingauge stand	Pype 25mmØ
	Brace	Angle 40x40x3mm
Joint	Galaken Co./ DM3882	

Table 3a. Locations of meteorological stations of ZMD

CLICOM ID	LAT DG	MIN	LON DG	G. MN	ELEV. (m)	STATION NAME
'CHIPAT01'	13	33	32	35	1032	CHIPATA MET
'CHIPEP01'	16	80	27	83	0	CHIPEPO MET
'CHOMA001'	16	51	27	4	1267	CHOMA MET
'ISOKA001'	10	10	32	38	1360	ISOKA MET
'KABOMP01'	13	36	24	12	1075	KABOMPO MET
'KABWE001'	14	25	28	29	1165	KABWE MET
'KABWE002'	14	24	28	30	1207	KABWE AGROMET
'KAFIRO01'	12	36	28	7	1243	KAFIRONDA AGROMET
'KAFUE001'	15	46	27	55	987	KAFUE POLDER
'KALABO01'	14	57	22	42	1053	KALABO MET
'KAOMA001'	14	48	24	48	1152	KAOMA MET
'KASAMA01'	10	13	31	8	1384	KASAMA MET
'KASEMP01'	13	32	25	51	1134	KASEMPA MET
'KAWAMB01'	9	48	29	5	1324	KAWAMBWA MET
'LIVING01'	17	49	25	49	986	LIVINGSTONE MET
'LUNDAZ01'	12	17	33	12	1143	LUNDAZI MET
'LUSAKA01'	15	25	28	19	1252	LUSAKA CITY AIRPORT
'LUSAKA02'	15	19	28	27	1154	LUSAKA INT. AIRPORT
'LUSITU01'	16	18	28	82	392	LUSITU MET
'MAGOYE01'	16	8	27	38	1018	MAGOYE AGROMET
'MANSA001'	11	6	28	51	1259	MANSA MET
'MANSA002'	11	6	28	51	1259	MANSA AGROMET
'MBALA001'	8	51	31	20	1673	MBALA MET
'MFUWE001'	13	16	31	56	570	MFUWE MET
'MISAMF01'	10	11	31	13	1535	MISAMFU AGROMET
'MKUSHI01'	13	60	29	80	1250	MKUSHI MET
'MONGU002'	15	15	23	9	1053	MONGU MET
'MPIKA001'	11	45	31	26	1402	MPIKA MET
'MSEKER01'	13	39	32	34	1025	MSEKERA AGROMET
'MTMAKU01'	15	33	28	15	1213	MT. MAKULU AGROMET
'MUMBWA01'	14	59	27	4	1218	MUMBWA MET
'MWINIL01'	11	45	24	26	1363	MWINILUNGA MET
'NDOLA001'	13	0	28	39	1270	NDOLA MET
'PETAUK01'	14	15	31	17	1036	PETAUKE MET
'SAMFYA01'	11	21	29	32	1172	SAMFYA MET
'SENANG01'	16	7	23	16	1027	SENANGA MET
'SERENJ01'	13	14	30	13	1384	SERENJE MET
'SESHEK01'	17	28	24	18	951	SESHEKE MET
'SOLWEZ01'	12	11	26	23	1333	SOLWEZI MET
'ZAMBEZ01'	13	32	23	7	1078	ZAMBEZI MET

Table 3b. Meteorological elements observed at ZMD stations.

ID	Average Temperature	Cloud cover	Dewpoint	Evaporation	GRND_M_T	Humidity	Maximum temperature	Minimum temperature	Pressure	Rainfall	Soil moisture (5m)	Soil moisture (10m)	Soil moisture (20m)	Soil moisture (30m)	Soil moisture (120m)	Sunshine	Wind speed
'CHIPAT01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'CHIPEP01'	x					x	x	x		x							x
'CHOMA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'ISOKA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KABOMP01'	x	x	x		x	x	x	x		x	x	x	x	x	x		x
'KABWE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KABWE002'	x	x	x		x	x	x	x		x	x	x	x		x	x	x
'KAFIRO01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KAFUE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KALABO01'	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
'KAOMA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KASAMA01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KASEMP01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KAWAMB01'	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x
'LIVING01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUNDAZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSAKA01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSAKA02'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSITU01'	x		x			x	x	x									x
'MAGOYE01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MANSA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MANSA002'	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MBALA001'	x	x	x			x	x	x		x							x
'MFUWE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MISAMF01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MKUSHI01'	x		x			x	x	x		x							x
'MONGU002'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MPIKA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MSEKER01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MTMAKU01'	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
'MUMBWA01'	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MWINIL01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'NDOLA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'PETAUK01'	x	x	x	x	x	x	x	x		x	x	x					
'SAMFYA01'	x	x	x		x	x	x	x	x	x	x		x		x		x
'SENANG01'	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
'SERENJ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'SESHEK01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'SOLWEZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'ZAMBEZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Total	40	36	38	31	36	40	40	40	31	39	36	35	35	33	35	32	40