

エチオピア連邦民主共和国

水エネルギー省

ソマリ州水資源局

エチオピア連邦民主共和国
ジャラル溪谷及びシェベレ川流域
水資源開発計画策定・緊急給水プロジェクト

最終報告書（7/7）

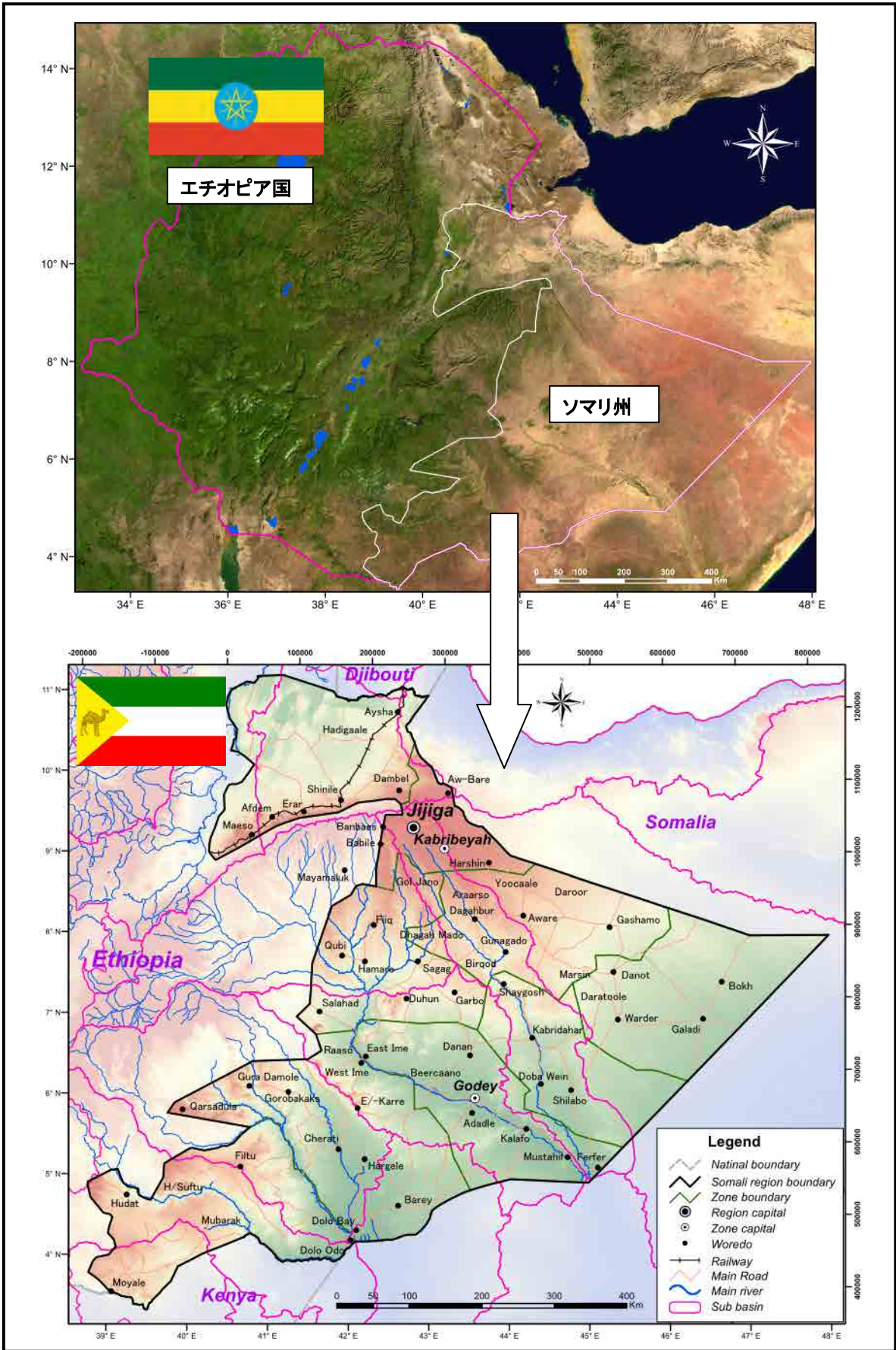
データブック

平成25年8月

（2013年）

独立行政法人
国際協力機構（JICA）

国際航業株式会社



調査地域図

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(第1卷)

1. 気象と水文

1. 気象と水文

Data 1.1.1 Hydrometric Station Installed in the Wabi Shebele River Basin

Annex I: Hydrometric stations installed in the Wabi Shebelle River Basin.

Station Code	WS No.	River	Town near by	Coordinates			year of Install. m/d/y	Watershed area (MWR) km ²	Watershed area (Current Project) km ²	Installed instruments			Station status
				Lat. (North) deg -min	Lon. (East) deg -min	Altitude (masl)				Staff	Rec.	BOC	
Western Upper Course													
61004	H1	Wabi	@Bridge	7 - 01	39 - 02	2500	1967/1/30	1035	1040	*	*	*	Operational
61009	H2	Wabi	@Melkawakana	7 - 11	39 - 26	2485	1967/7/22	4388	4452	*	*	*	Dammed in 1984
61003	H3	Ukuma	Nr. Dodloa	7 - 00	39 - 03	2450	1967/1/25	137	137	*			Operational
61016	H4	Fruna	Nr. Adaba	7 - 01	39 - 25	2405	1989/4/5	8	86	*			Operational
61005	H5	Assassa	Nr. Assassa	7 - 06	39 - 12	2360	1967/2/25	68	142	*			Operational
61012	H6	Robe	Nr. Robe	7 - 51	39 - 38	2355	1969/3/8	175	169	*	*	*	Operational
61014	H7	Herero	@ Herero	7 - 00	39 - 12	2355	1967/1/24	133	122	*			Operational
61006	H8	Wolkessa	Nr. Azazera Kerey	7 - 50	39 - 33	2350	1967/3/8	27	31	*			Not Operational
61010	H9	Maribo	Nr. Confluence	7 - 06	39 - 22	2350	1968/1/1	1039	1008	*			Overflooded by the Melka Wakana Dam
61015	H10	Maribo	Nr. Kara Birole	6 - 57	39 - 22	2350	1967/7/5	200	179	*	*	*	Operational
61001	H11	Lelisso	Nr. Adaba	7 - 00	39 - 23	2345	1967/1/10	135	120	*	*	*	Operational
61002	H12	Maribo	Nr. Adaba	7 - 00	39 - 20	2330	1967/1/24	185	192	*	*	*	Operational
61007	H13	Ululu	Nr. Azazera Kerey	7 - 50	39 - 33	2300	1967/3/9	21	27	*			Not Operational
61008	H14	Hareghe	Nr. Assa Osman	7 - 46	39 - 33	2100	1967/6/25	41	59	*			Operational
61013	H15	Wabi	@ Hako	7 - 13	39 - 27	2100	1972/5/2	4581	4540	*	*	*	Release from the Melka Wakana dam
Eastern Upper Course													
62009	H16	Hirma	Nr. Hirma	9 - 13	41 - 06	2100	1980/12/2	25	40	*			Operational
	H17	Galeti	Nr. Hirma	9 - 07	41 - 08	1400			523	*			Is being installed
62006	H18	Lake Adele	@ Adele	9 - 25	41 - 56	2000	1980/5/25	48	24	*			Operational
62010	H19	Dawe	Nr. Gara Muleta	9 - 20	41 - 48	2000	1981/2/12	344	29	*	*	*	Operational
62005	H20	L. Alamaya	@ Alamaya	9 - 24	42 - 01	1900	1975/3/27	50		*			Operational
62007	H21	Hamaressa	Nr. Harar	9 - 20	42 - 05	1900	2008/11/26	56	29	*	*	*	Operational
62015	H22	Jawes	Nr. Bedesa	8 - 55	40 - 47	1800	1984/1/18	22	21	*			Operational
62018	H23	Kella	Nr. Bedesa	8 - 54	40 - 46	1800	1987/5/27	12	11	*			Operational
62019	H24	Kollu	Nr. Bedesa	8 - 54	40 - 47	1800	1987/5/27	21	21	*			Operational
	H25	Medhido	Nr. Bedessa	8 - 50	40 - 44	1680				*			New station
62012	H26	Upper Dac.	@ Dacata Bridge	9 - 12	42 - 25	1350	1983/2/3	312	312	*	*	*	Not Operational
62008	H27	Bissidimo	@ Bissidimo	9 - 13	42 - 12	1340	2008/11/25	147		*			Operational
62013	H28	Upper Erer	Nr. Babile	9 - 14	42 - 15	1400		469	494	*	*	*	Operational
Middle Course													
61011	H29	Wabi	@Legehida	7 - 58	40 - 54	950	1968/4/4	20473	19793	*	*	*	Abandoned due to their in accessibility
62004	H30	Sulul	Nr. Segag	7 - 39	42 - 50	800	1972/6/23	3589	2314	*			Abandoned
62001	H31	Dacata	Nr. Hamaro	7 - 20	42 - 17	500	1968/2/5	15188	15262	*	*	*	Abandoned
62002	H32	Wabi	Nr. Hamaro	7 - 24	42 - 11	470	1968/2/11	63644	63242	*	*	*	Abandoned
62003	H33	Erer	Nr. Hamaro	7 - 37	42 - 02	450	1968/5/23	15132	14760	*	*	*	Abandoned

Station Code	WS No.	River	Town near by	Coordinates			years of Installation	Watershed area km ²	Watershed area (Current Project) km ²	Installed instruments			Station status
				Lat. (North) deg -min	Lon. (East) deg -min	Altitude (masl)				Staff	Rec.	BOC	
Lower Course													
63006	H34	Wabi	@ Imi	6 - 29	42 - 08	405	1969/3/1	91600	90918	*	*		Is being rehabilitated
63008	H35	Wabi	@ Buliche	6 - 26	42 - 13	360	1974/12/4		109488	*	*	*	Abandoned
63012	H36	Wabi	At Dam Site			298	1986/4/21			*	*	*	Operational
63001	H37	Wabi	@ Gode	5 - 56	43 - 33	285	1967/10/4	127300		*	*		Relocated
63002	H38	Wabi	@ Gode Bridge	5 - 53	43 - 34	284	1977/2/26	127300	124108	*	*	*	Operational
63011	H39	Wabi	Below Dam site	6 - 00	43 - 09	280	1986/2/24			*	*	*	Operational
63010	H40	Wabi	@ Kelafo	5 - 36	44 - 08	249	1969/1/8	139100	134334	*	*		Abandoned
63009	H41	Wabi	@ Mustahil	5 - 14	44 - 43	248	1977/2/5		146386	*	*		Abandoned
63005	H42	Wabi	@ Burkur	5 - 11	44 - 48	247	1969/1/6	144000	146804	*	*		Abandoned
		Wabi	Nr Tubis	6 - 57	42 - 08	500			88105				
The closed watershed of Fafen (46 414 km2)													
Upper course													
	H43	Toga	@ Jijiga	9 - 21	42 - 48	1700			344				
62016	H44	Jijiga	@ Jijiga	9 - 21	42 - 48	1700	1985/3/11	947	731	*	*	*	Operational
62014	H45	Upp. Fafam	@ Bridge	9 - 14	42 - 36	1520	1983/6/19	900	910	*	*		Operational
62013	H45	Upper Jerer	@ Jerer	9 - 14	42 - 15	1450	1983/2/4	469	386	*	*		Operational
Middle course													
63003	H46	Jerer	Nr. Degehabour	8 - 13	43 - 33	1050	1967/10/9	6338	5246	*	*	*	Not Operational
Lower course													
63004	H47	Fafen	@ Kebridehar	6 - 45	44 - 17	525	1968/6/28	26670	24956	*	*	*	Not Operational
The closed watershed of Bio Adi (8 387 km2)													

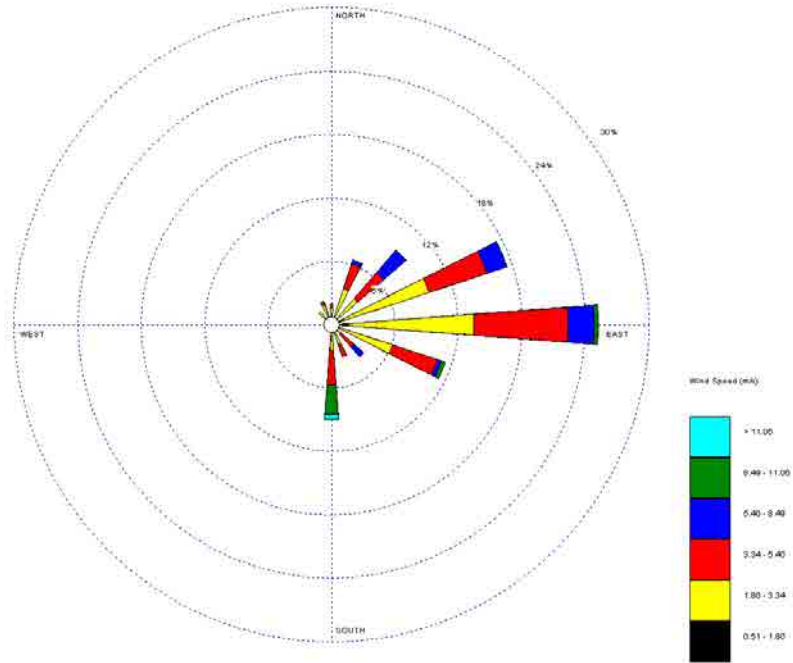
D1.1-2

* provided by MoWE

Data 1.1.2 Gode 観測所の風配図(1/6)

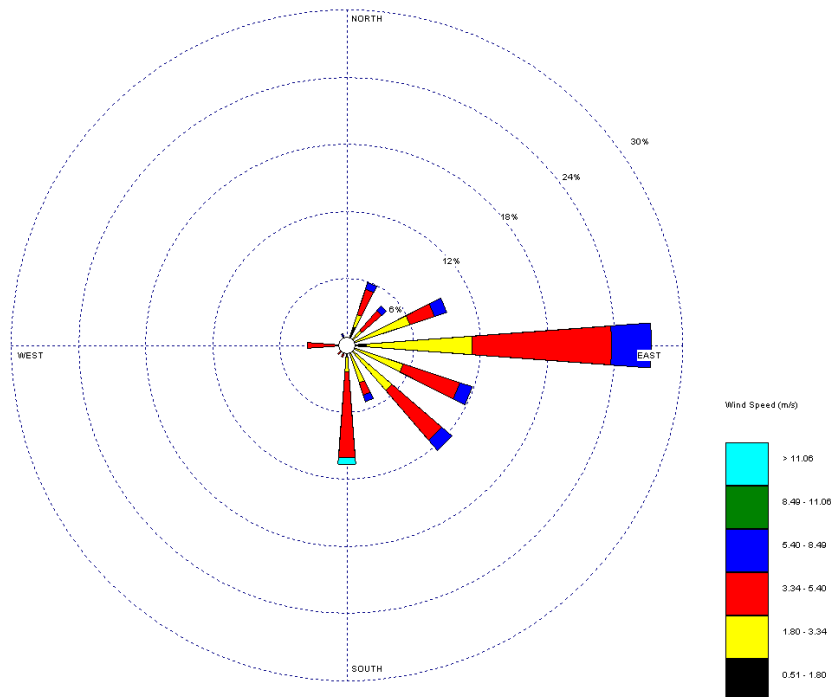
1. Wind-rose diagram of Gode for the month of January

Based on 1966-2002 data at 1200 GMT



2. Wind-rose diagram of Gode for the month of February

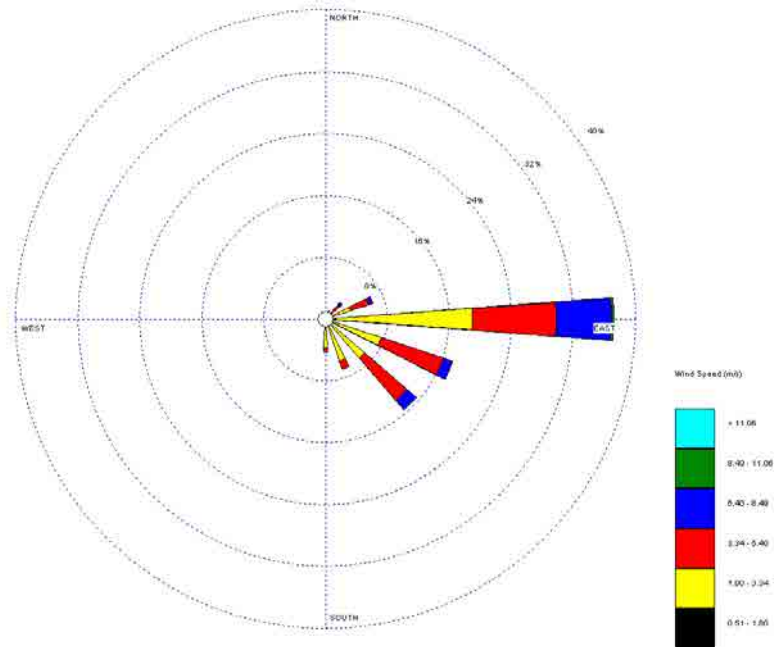
Based on 1966-2002 data at 1200 GMT



Data 1.1.2 Gode 観測所の風配図 (2/6)

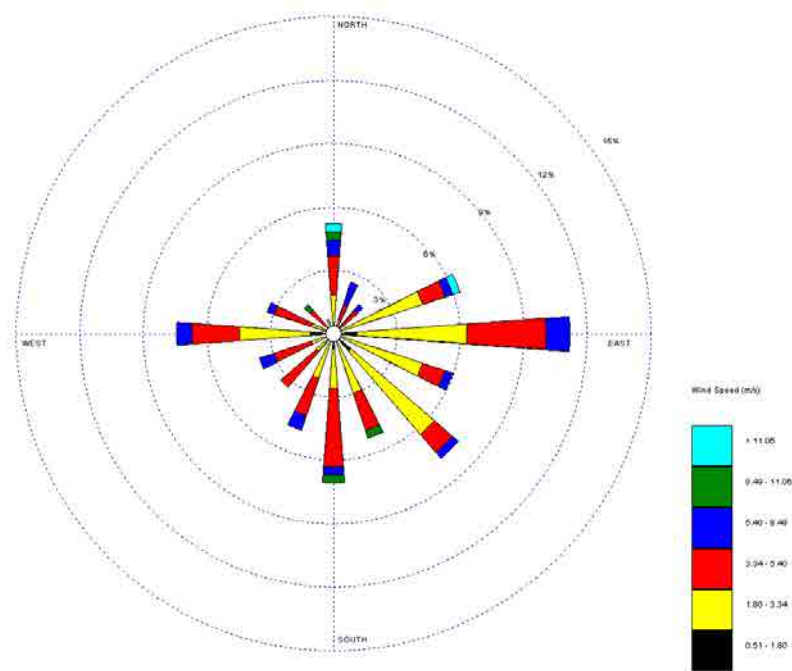
3. Wind-rose diagram of Gode for the month of March

Based on 1966-2002 data at 1500 GMT



4. Wind-rose diagram of Gode for the month of April

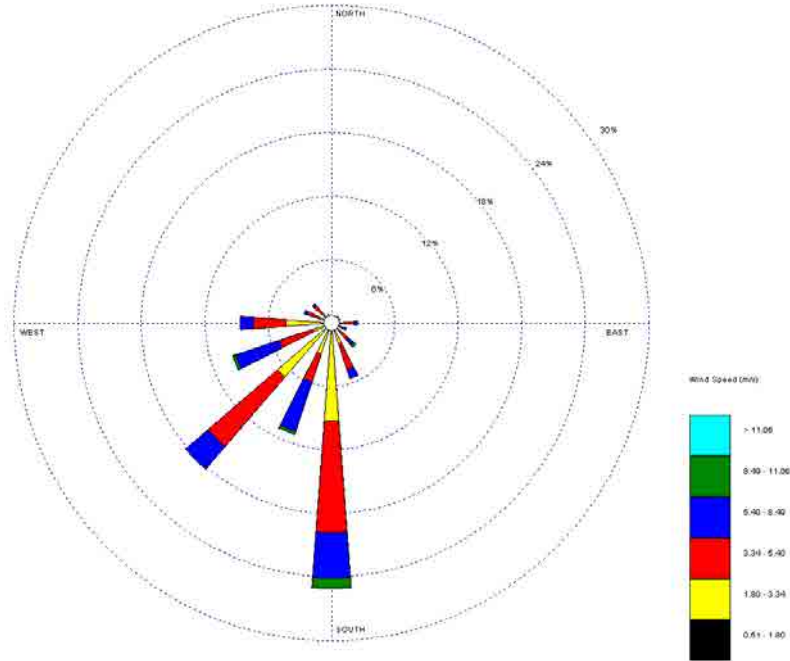
Based on 1966-2002 data at 1200 GMT



Data 1.1.2 Gode 観測所の風配図 (3/6)

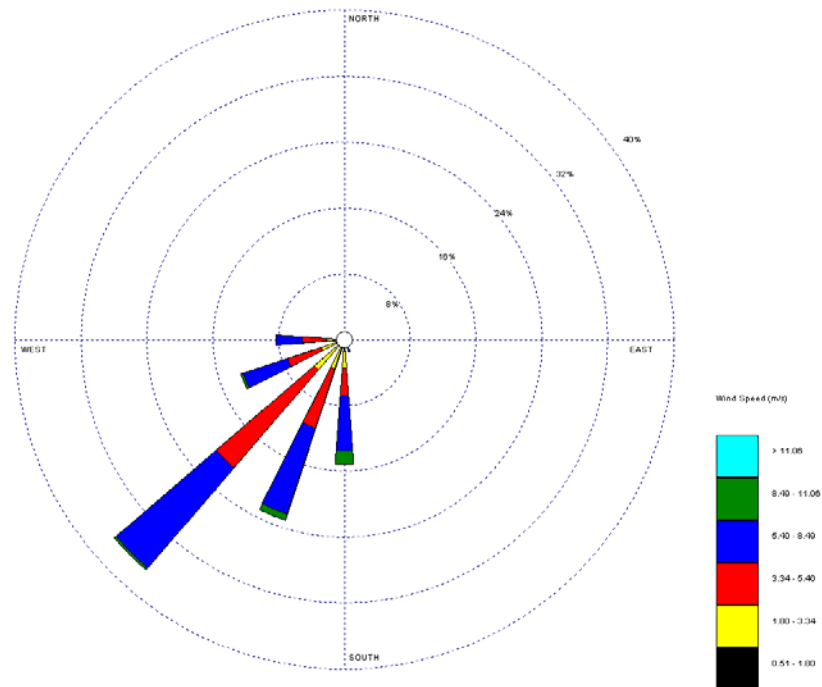
5. Wind-rose diagram of Gode for the month of May

Based on 1966-2002 data at 1500 GMT



6. Wind-rose diagram of Gode for the month of June

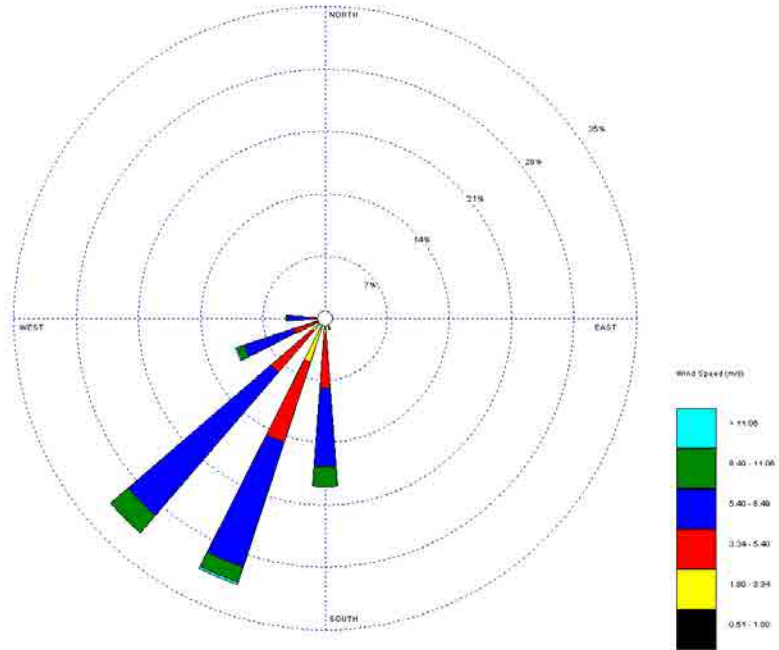
Based on 1966-2002 data at 1500 GMT



Data 1.1.2 Gode 観測所の風配図 (4/6)

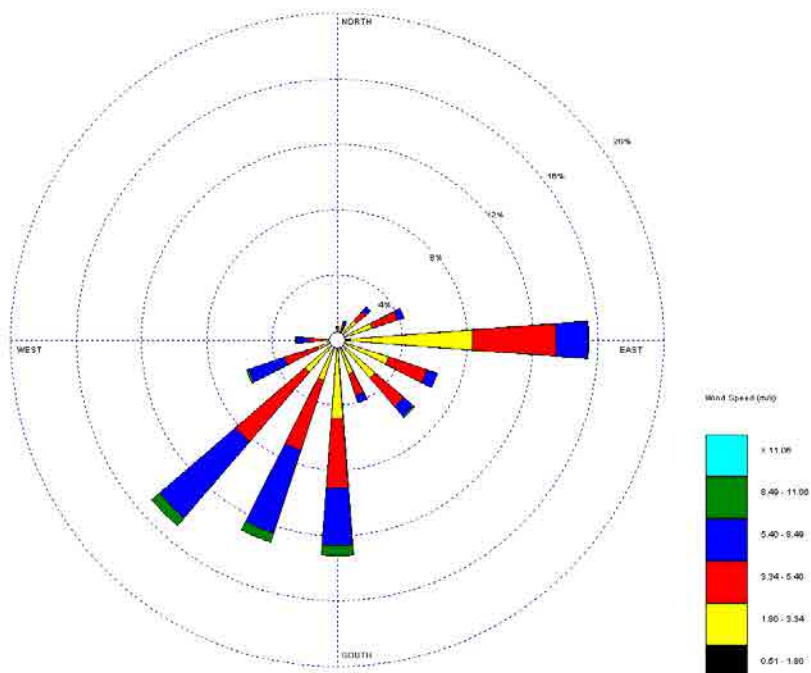
7. Wind-rose diagram of Gode for the month of July

Based on 1966-2002 data at 1500 GMT



8. Wind-rose diagram of Gode for the month of August

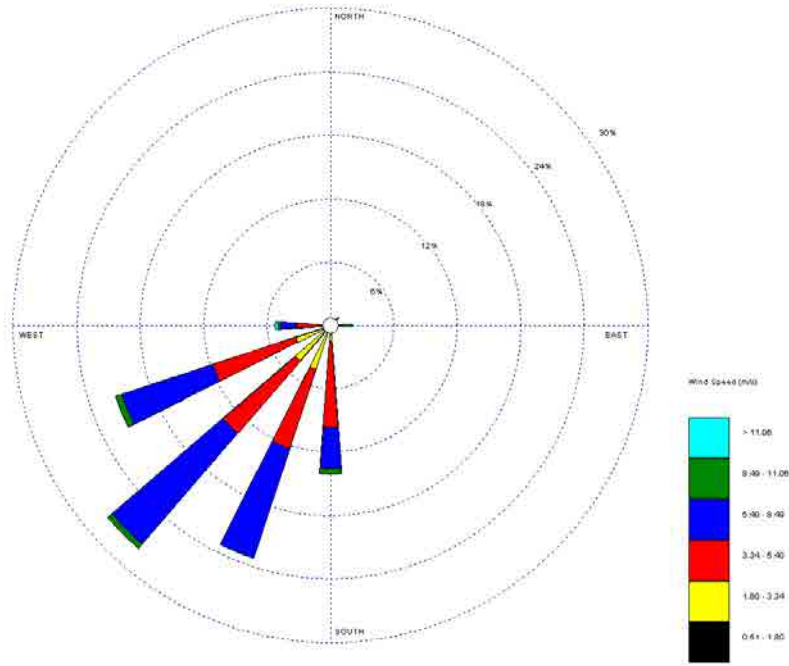
Based on 1966-2002 data at 1500 GMT



Data 1.1.2 Gode 観測所の風配図 (5/6)

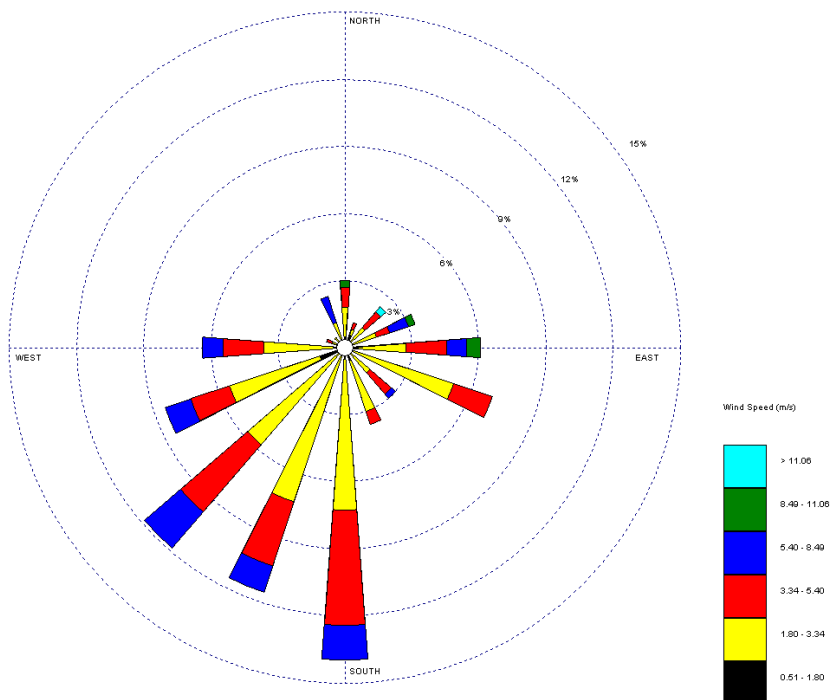
9. Wind-rose diagram of Gode for the month of September

Based on 1966-2002 data at 1200 GMT



10. Wind-rose diagram of Gode for the month of October

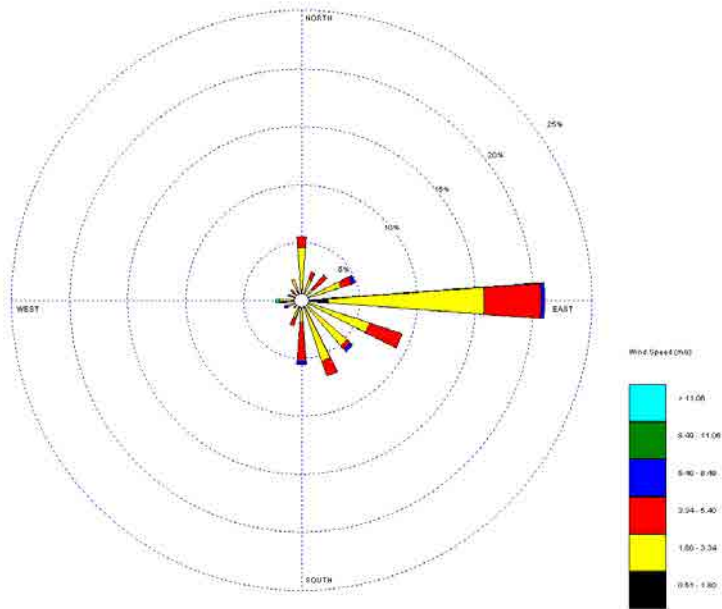
Based on 1966-2002 data at 1200 GMT



Data 1.1.2 Gode 観測所の風配図(6/6)

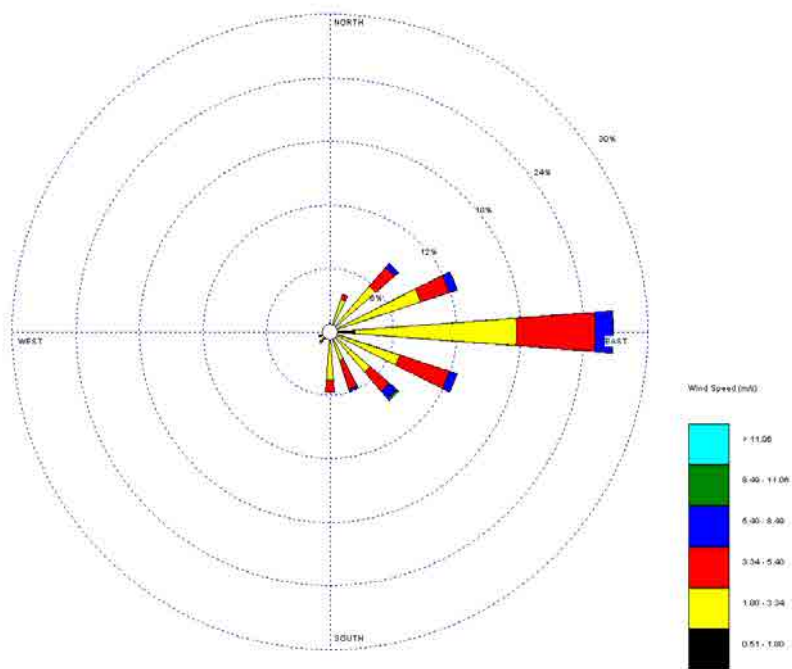
11. Wind-rose diagram of Gode for the month of November

Based on 1966-2002 data at 1200 GMT



12. Wind-rose diagram of Gode for the month of December

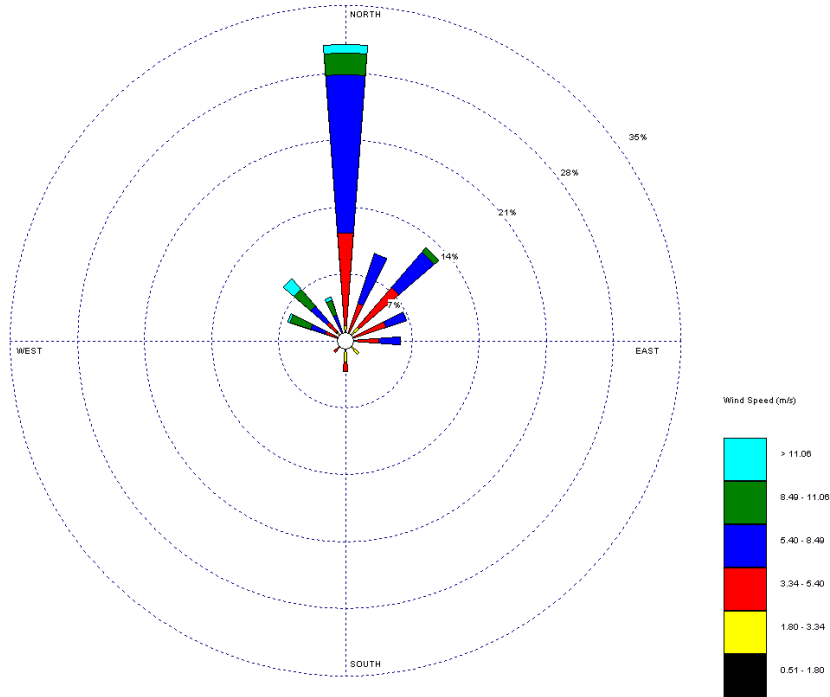
Based on 1966-2002 data at 1500 GMT



Data 1.1.3 Jijiga 観測所の風配図 (1/6)

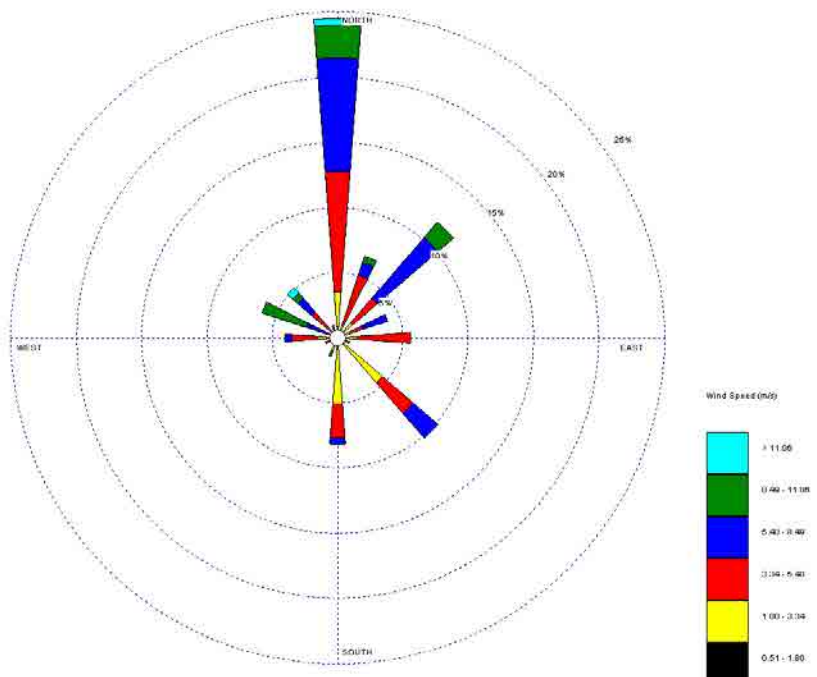
1. Wind-rose diagram of Jijiga for the month of January

Based on 1980-2003 data at 1500 GMT



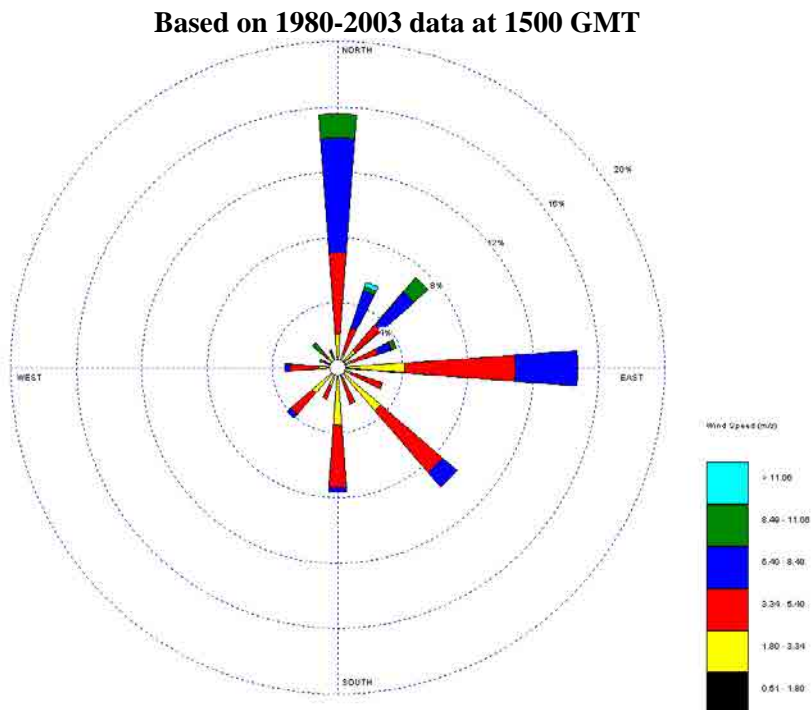
2. Wind-rose diagram of Jijiga for the month of February

Based on 1980-2003 data at 1500 GMT

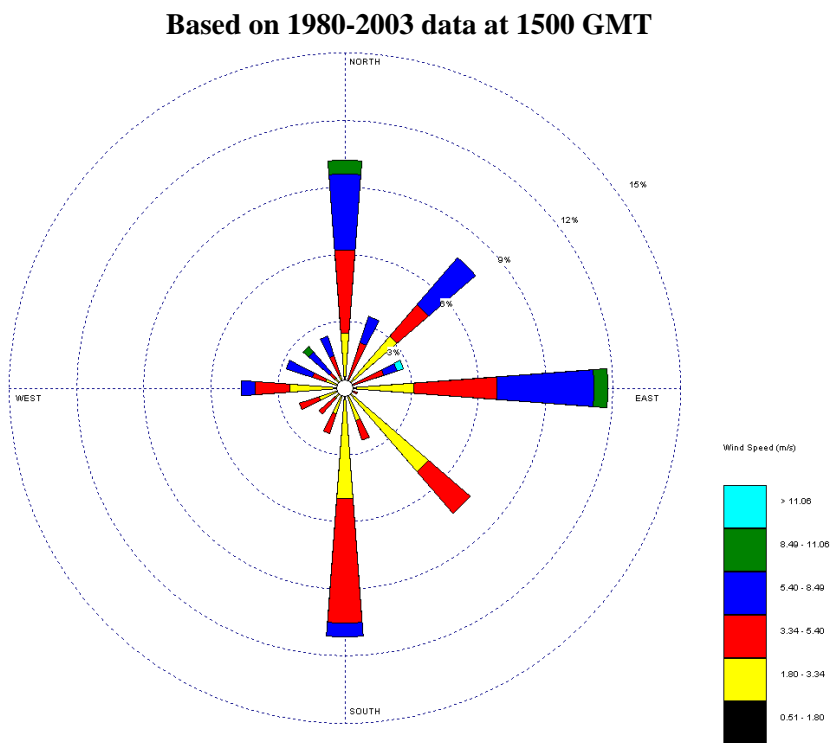


Data 1.1.3 Jijiga 観測所の風配図 (2/6)

3. Wind-rose diagram of Jijiga for the month of March



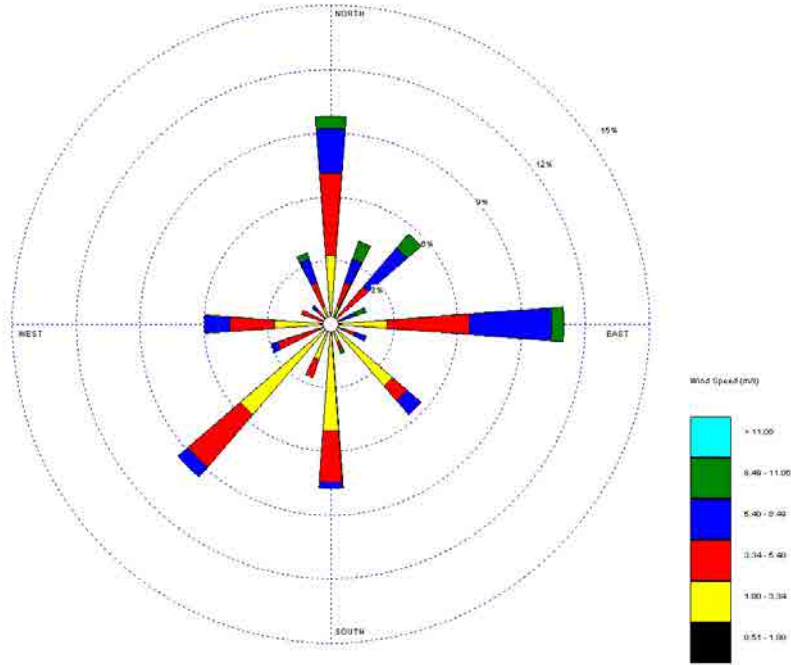
4. Wind-rose diagram of Jijiga for the month of April



Data 1.1.3 Jijiga 観測所の風配図 (3/6)

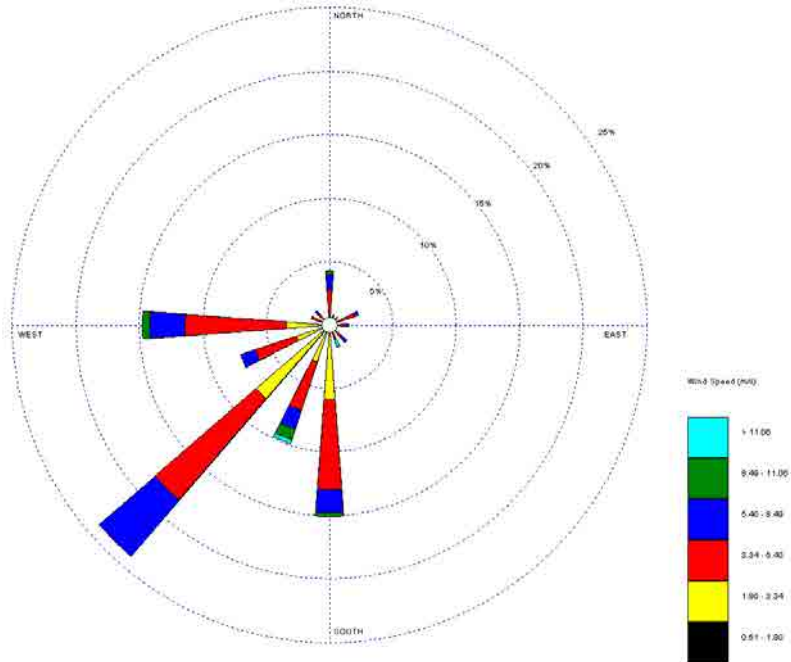
5. Wind-rose diagram of Jijiga for the month of May

Based on 1980-2003 data at 1500 GMT



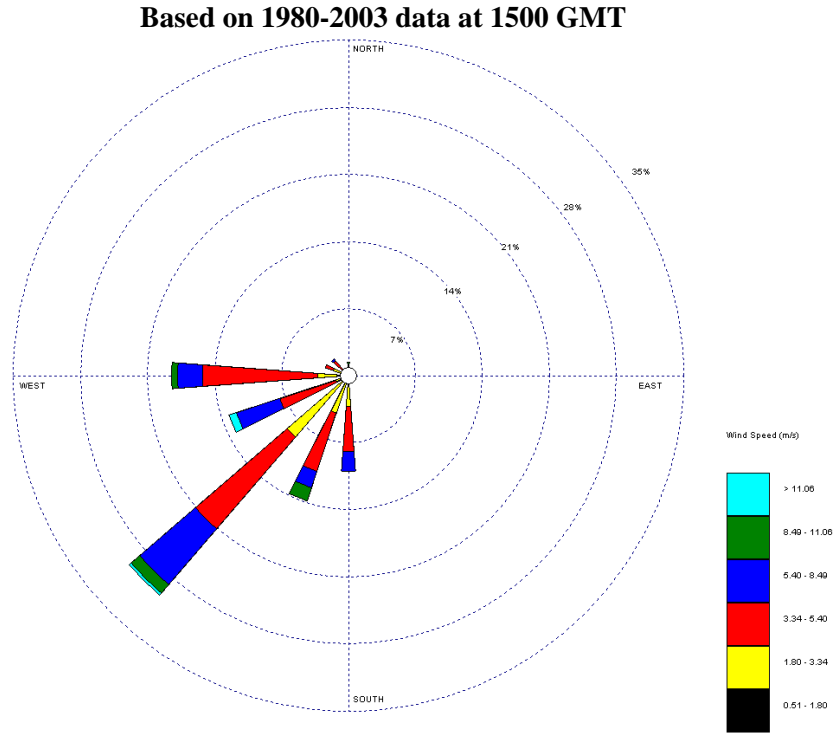
6. Wind-rose diagram of Jijiga for the month of June

Based on 1980-2003 data at 1500 GMT

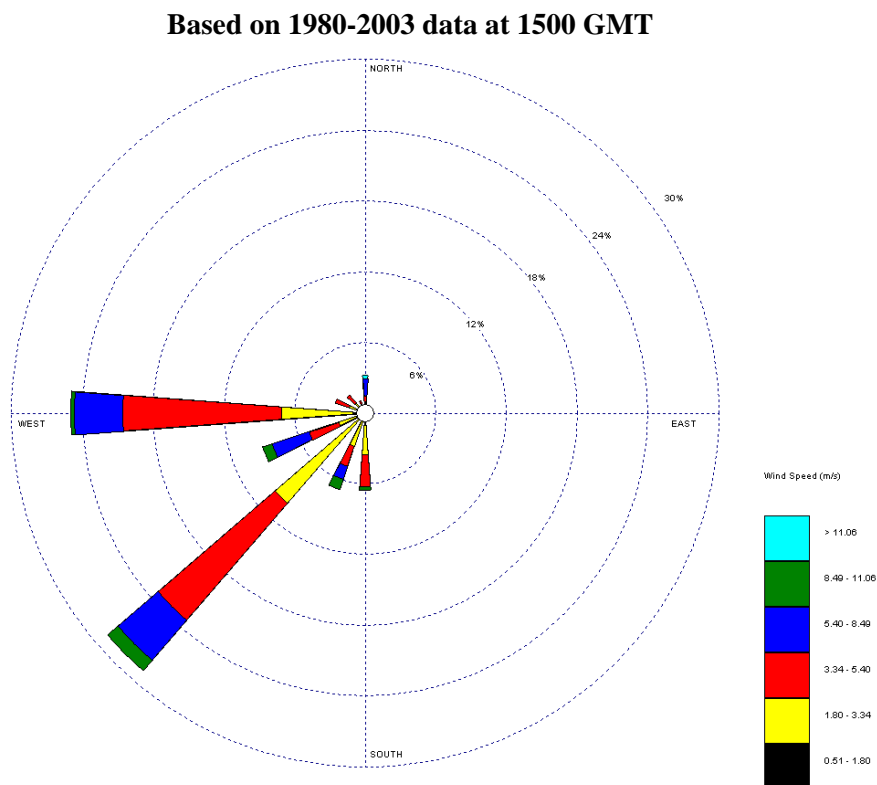


Data 1.1.3 Jijiga 観測所の風配図 (4/6)

7. Wind-rose diagram of Jijiga for the month of July



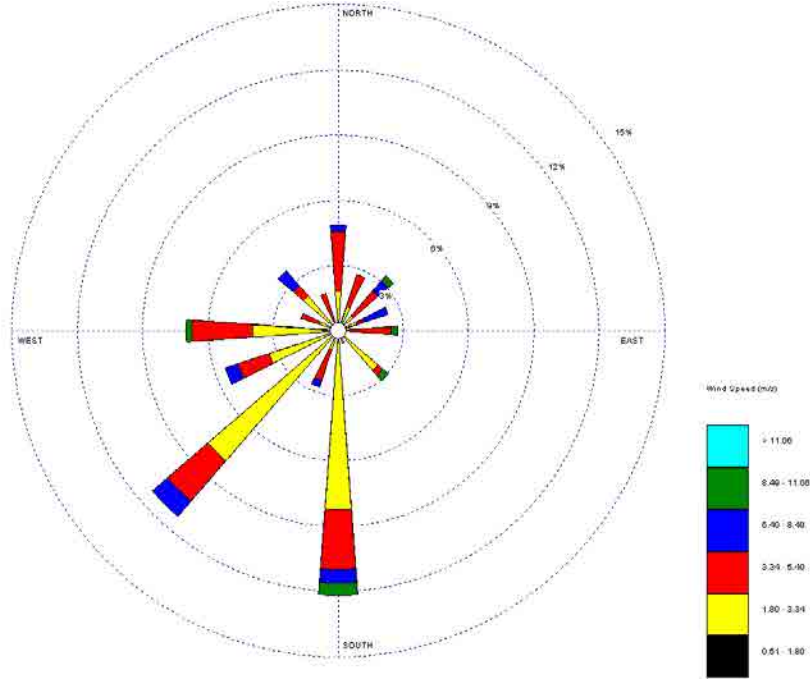
8. Wind-rose diagram of Jijiga for the month of August



Data 1.1.3 Jijiga 観測所の風配図 (5/6)

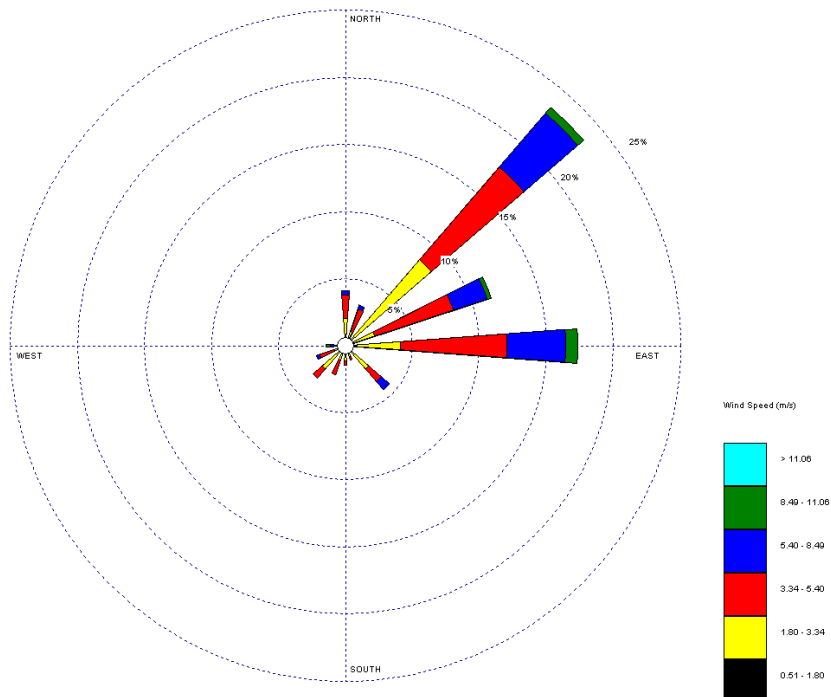
9. Wind-rose diagram of Jijiga for the month of September

Based on 1980-2003 data at 1500 GMT



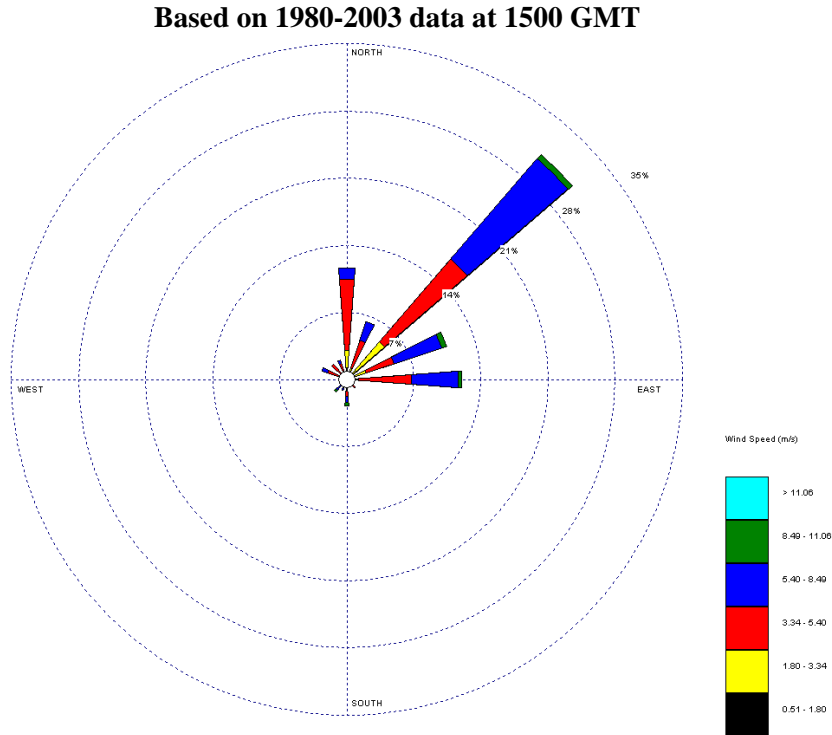
10. Wind-rose diagram of Jijiga for the month of October

Based on 1980-2003 data at 1500 GMT

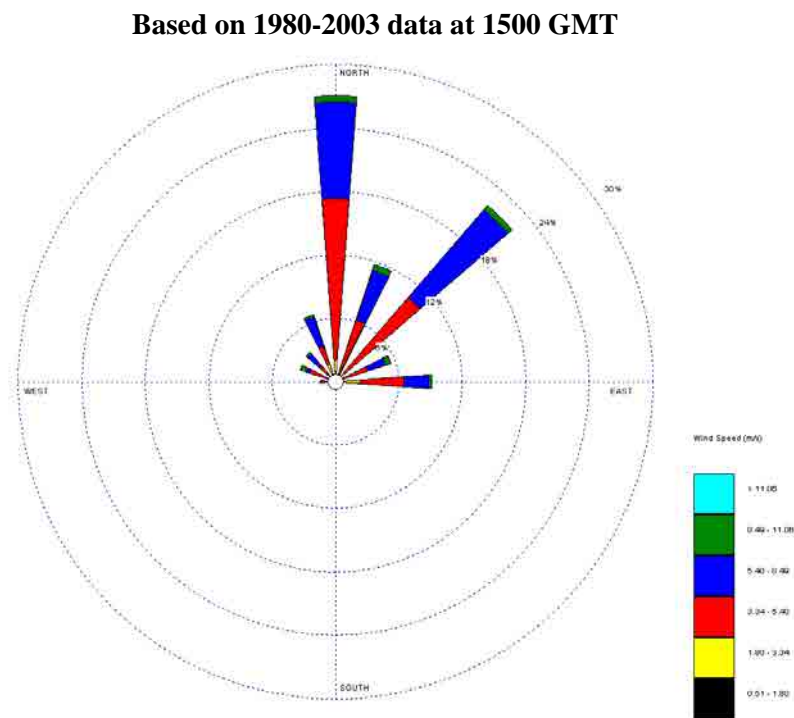


Data 1.1.3 Jijiga 観測所の風配図 (6/6)

11. Wind-rose diagram of Jijiga for the month of November



12. Wind-rose diagram of Jijiga for the month of December



(第1卷)

2. 地質と水理地質

200000

250000

300000

350000

400000

450000

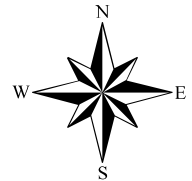
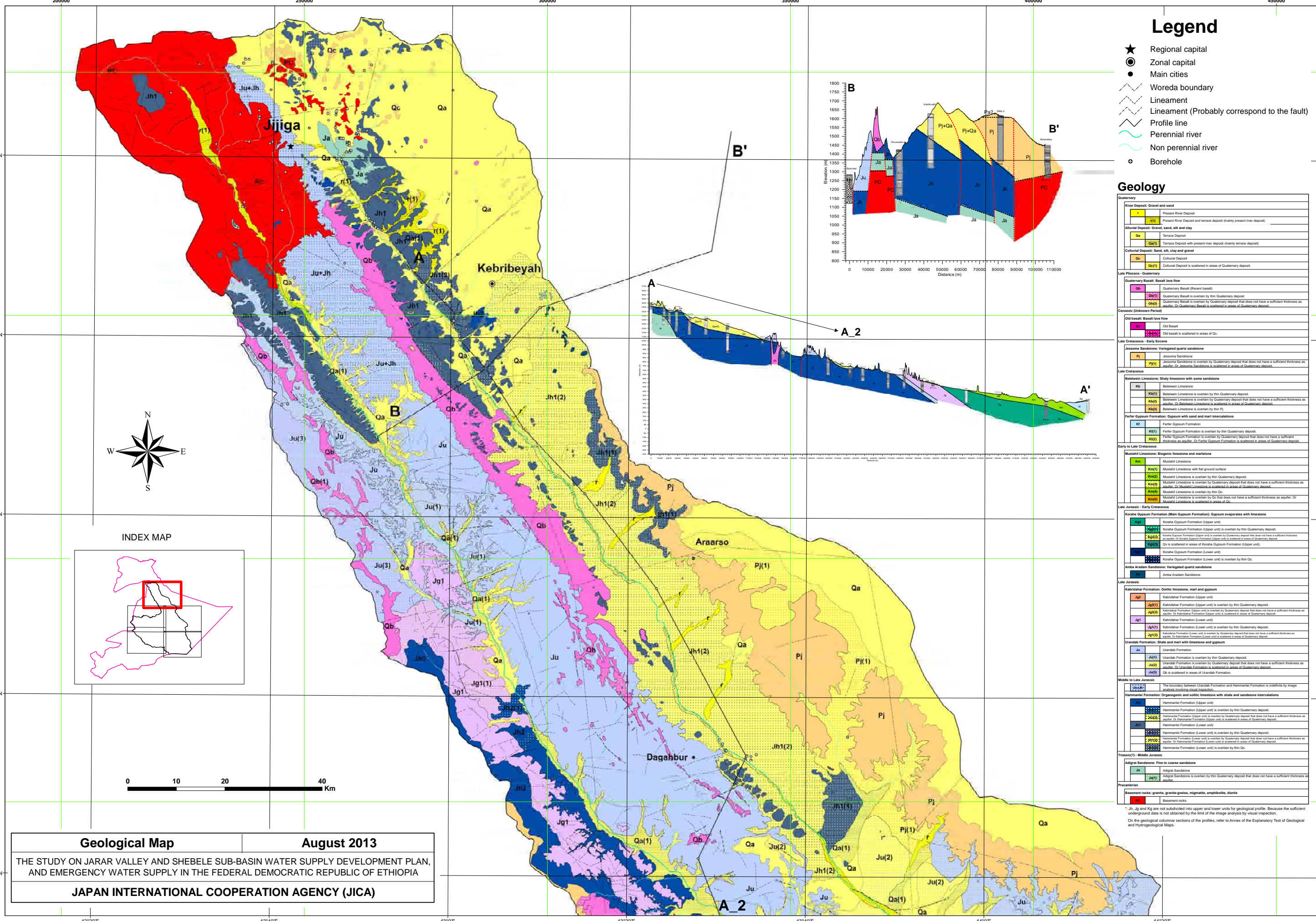
Legend

- ★ Regional capital
- Zonal capital
- Main cities
- Woreda boundary
- Lineament
- Lineament (Probably correspond to the fault)
- Profile line
- ~ Perennial river
- ~ Non perennial river
- Borehole

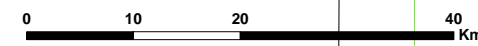
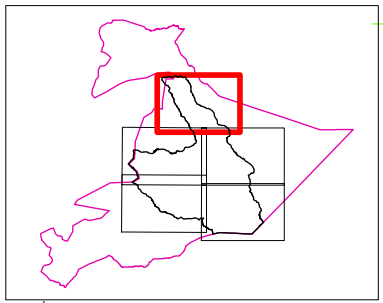
Geology

Quaternary	
	River Deposit: Gravel and sand
	Present River Deposit
	Present River Deposit and terrace deposit (mainly present river deposit)
Alluvial Deposit: Gravel, sand, silt and clay	
	Terrace Deposit
	Terrace Deposit with present river deposit (mainly terrace deposit)
Colluvial Deposit: Sand, silt, clay and gravel	
	Colluvial Deposit
	Colluvial Deposit is scattered in areas of Quaternary deposit.
Late Pliocene - Quaternary	
Quaternary Basalt: Basalt lava flow	
	Quaternary Basalt (Recent basalt)
	Quaternary Basalt is overlain by thin Quaternary deposit
	Quaternary Basalt is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Quaternary Basalt is scattered in areas of Quaternary deposit.
Old basalt: Basalt lava flow	
	Old Basalt
	Old basalt is scattered in areas of Qc.
Late Cretaceous - Early Eocene	
Jessona Sandstone: Variegated quartz sandstone	
	Jessona Sandstone
	Jessona Sandstone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Jessona Sandstone is scattered in areas of Quaternary deposit.
Recent Limestone: Shaly limestone with some sandstone	
	Recent Limestone
	Recent Limestone is overlain by thin Quaternary deposit.
	Recent Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Recent Limestone is scattered in areas of Quaternary deposit.
	Recent Limestone is overlain by thin Qc.
Ferfer Gypsum Formation: Gypsum with sand and marl intercalations	
	Ferfer Gypsum Formation
	Ferfer Gypsum Formation is overlain by thin Quaternary deposit.
	Ferfer Gypsum Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Ferfer Gypsum Formation is scattered in areas of Quaternary deposit.
Early to Late Cretaceous	
Mustahil Limestone: Biogenic limestone and marlstone	
	Mustahil Limestone
	Mustahil Limestone with flat ground surface
	Mustahil Limestone is overlain by thin Quaternary deposit.
	Mustahil Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Mustahil Limestone is scattered in areas of Quaternary deposit.
	Mustahil Limestone is overlain by thin Qc.
	Mustahil Limestone is overlain by Qc that does not have a sufficient thickness as aquifer. Or Mustahil Limestone is scattered in areas of Qc.
Late Jurassic - Early Cretaceous	
Korah Gypsum Formation (Main Gypsum Formation): Gypsum evaporites with limestone	
	Korah Gypsum Formation (Upper unit)
	Korah Gypsum Formation (Upper unit) is overlain by thin Quaternary deposit.
	Korah Gypsum Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Korah Gypsum Formation (Upper unit) is scattered in areas of Quaternary deposit.
	Or is scattered in areas of Korah Gypsum Formation (Upper unit).
	Korah Gypsum Formation (Lower unit)
	Korah Gypsum Formation (Lower unit) is overlain by thin Qc.
Amba Aradam Sandstone: Variegated quartz sandstone	
	Amba Aradam Sandstone
Late Jurassic	
Kabardahar Formation: Oolitic limestone, marl and gypsum	
	Kabardahar Formation (Upper unit)
	Kabardahar Formation (Upper unit) is overlain by thin Quaternary deposit.
	Kabardahar Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabardahar Formation (Upper unit) is scattered in areas of Quaternary deposit.
	Kabardahar Formation (Lower unit)
	Kabardahar Formation (Lower unit) is overlain by thin Quaternary deposit.
	Kabardahar Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabardahar Formation (Lower unit) is scattered in areas of Quaternary deposit.
Urandib Formation: Sand and marl with limestone and gypsum	
	Urandib Formation
	Urandib Formation is overlain by thin Quaternary deposit.
	Urandib Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Urandib Formation is scattered in areas of Quaternary deposit.
	Or is scattered in areas of Urandib Formation.
Middle to Late Jurassic	
Hammahel Formation: Organic and oolitic limestone with shale and sandstone intercalations	
	Hammahel Formation (Upper unit)
	Hammahel Formation (Upper unit) is overlain by thin Quaternary deposit.
	Hammahel Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammahel Formation (Upper unit) is scattered in areas of Quaternary deposit.
	Hammahel Formation (Lower unit)
	Hammahel Formation (Lower unit) is overlain by thin Quaternary deposit.
	Hammahel Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammahel Formation (Lower unit) is scattered in areas of Quaternary deposit.
Triassic(?) - Middle Jurassic	
Adigrat Sandstone: Fine to coarse sandstone	
	Adigrat Sandstone
	Adigrat Sandstone is overlain by thin Quaternary deposit that does not have a sufficient thickness as aquifer.
Precambrian	
Basement rocks: granite-gneiss, migmatite, amphibolite, diorite	
	Basement rocks

* Jh, Jg and Kg are not subdivided into upper and lower units for geological profile. Because the sufficient underground data is not obtained by the limit of the image analysis by visual inspection.
On the geological cross-sections of the profiles, refer to Annex of the Explanatory Text of Geological and Hydrogeological Maps.



INDEX MAP



Geological Map August 2013
 THE STUDY ON JARAR VALLEY AND SHEBELE SUB-BASIN WATER SUPPLY DEVELOPMENT PLAN,
 AND EMERGENCY WATER SUPPLY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Geological Map **August 2013**

THE STUDY ON JARAR VALLEY AND SHEBELE SUB-BASIN WATER SUPPLY DEVELOPMENT PLAN, AND EMERGENCY WATER SUPPLY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

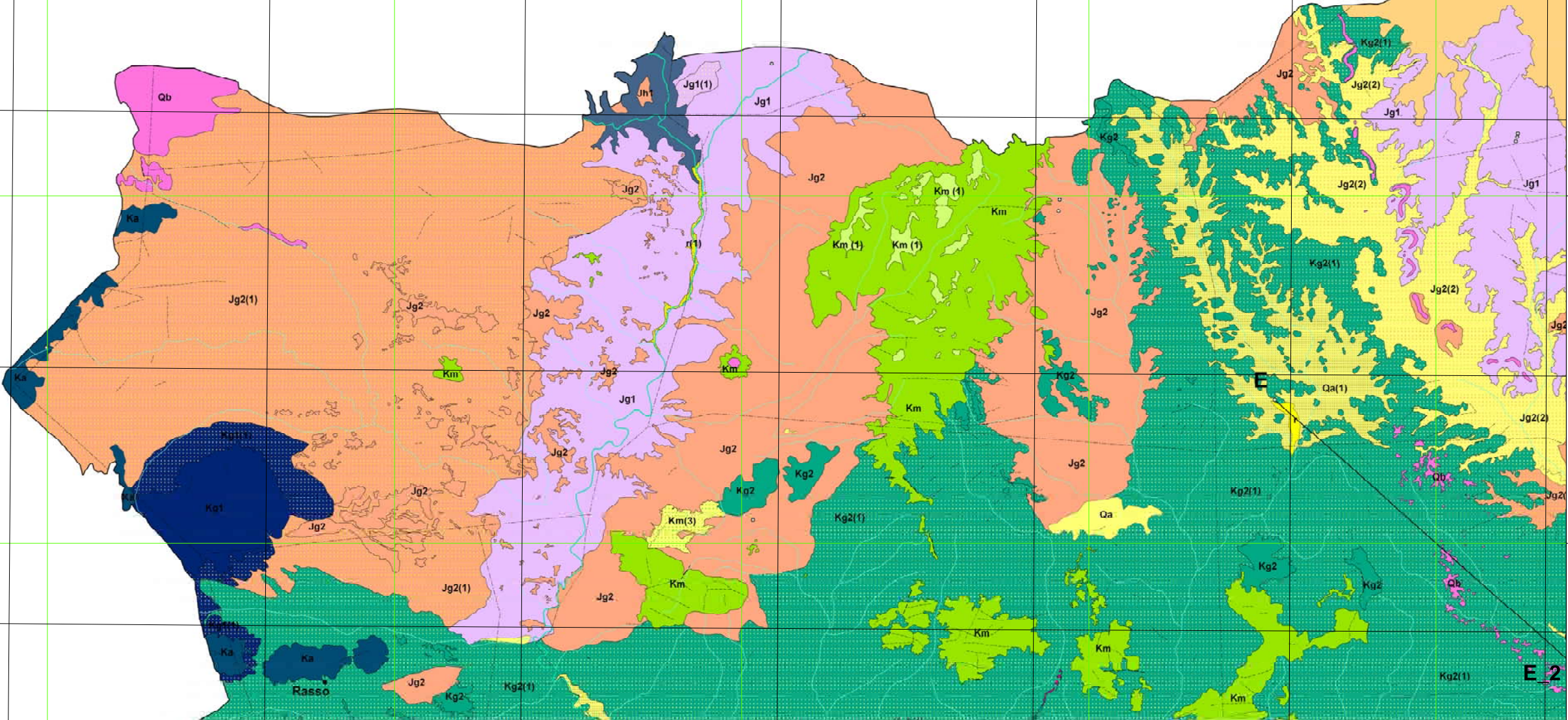
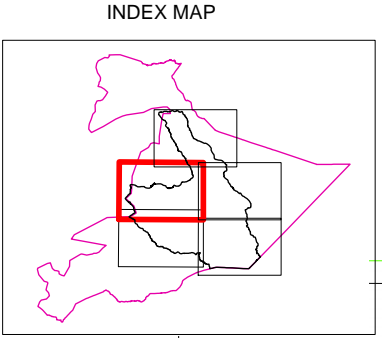
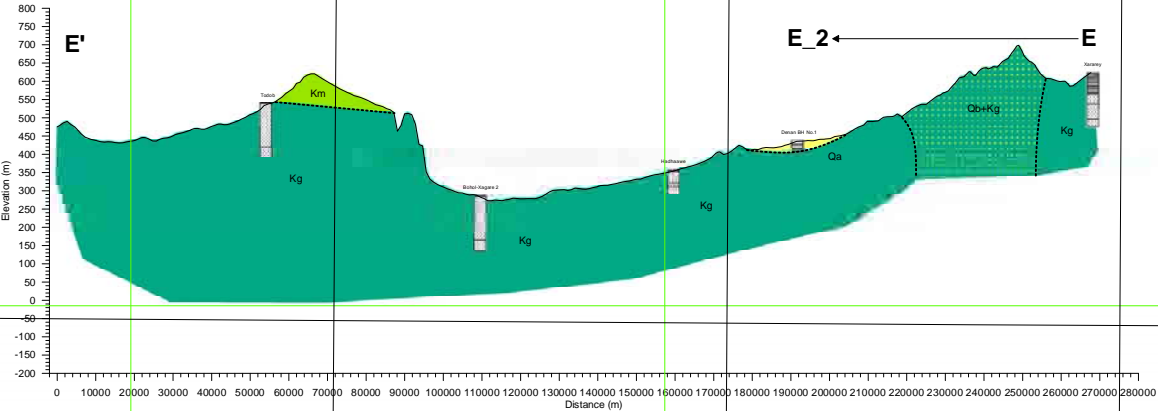
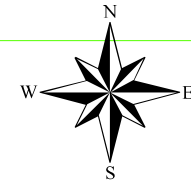
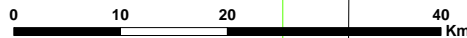
- Legend**
- ★ Regional capital
 - Zonal capital
 - Main cities
 - Woreda boundary
 - Lineament
 - Lineament (Probably correspond to the fault)
 - Profile line
 - Perennial river
 - Non perennial river
 - Borehole

Geology

Quaternary	
Quaternary	River Deposit: Gravel and sand
Qr	Present River Deposit
Qp	Present River Deposit and terrace deposit (mainly present river deposit)
Holocene	
Qh	Terrace Deposit
Qh1	Terrace Deposit with present river deposit (mainly terrace deposit)
Colombel	
Qc	Cultural Deposit
Qc1	Cultural Deposit is scattered in areas of Quaternary deposit.
Late Pleistocene - Quaternary	
Quaternary Basalt: Basalt lava flow	
Qb	Quaternary Basalt (Recent basalt)
Qb1	Quaternary Basalt is overlain by thin Quaternary deposit
Qb2	Quaternary Basalt is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Quaternary Basalt is scattered in areas of Quaternary deposit.
Cenozoic (Unknown Period)	
Old basalt: Basalt lava flow	
Ob	Old Basalt
Ob1	Old basalt is scattered in areas of Qc.
Late Cretaceous - Early Eocene	
Jessama Sandstone: Variegated quartz sandstone	
Jj	Jessama Sandstone
Jj1	Jessama Sandstone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Jessama Sandstone is scattered in areas of Quaternary deposit.
Late Cretaceous	
Belaitan Limestone: Shaly limestone with some sandstone	
Bl	Belaitan Limestone
Bl1	Belaitan Limestone is overlain by thin Quaternary deposit.
Bl2	Belaitan Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Belaitan Limestone is scattered in areas of Quaternary deposit.
Bl3	Belaitan Limestone is overlain by thin Jj.
Ferfer Gypsum Formation: Gypsum with sand and marl intercalations	
Fg	Ferfer Gypsum Formation
Fg1	Ferfer Gypsum Formation is overlain by thin Quaternary deposit.
Fg2	Ferfer Gypsum Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Ferfer Gypsum Formation is scattered in areas of Quaternary deposit.
Early to Late Cretaceous	
Mustahil Limestone: Biogenic limestone and marlstone	
Ml	Mustahil Limestone
Ml1	Mustahil Limestone with flat ground surface
Ml2	Mustahil Limestone is overlain by thin Quaternary deposit.
Ml3	Mustahil Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Mustahil Limestone is scattered in areas of Quaternary deposit.
Ml4	Mustahil Limestone is overlain by thin Jj.
Ml5	Mustahil Limestone is overlain by Qc that does not have a sufficient thickness as aquifer. Or Mustahil Limestone is scattered in areas of Qc.
Late Jurassic - Early Cretaceous (Main Gypsum Formations): Gypsum evaporates with limestone	
Gp	Kozobe Gypsum Formation (Upper unit)
Gp1	Kozobe Gypsum Formation (Upper unit) is overlain by thin Quaternary deposit.
Gp2	Kozobe Gypsum Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kozobe Gypsum Formation (Upper unit) is scattered in areas of Quaternary deposit.
Gp3	Qc is scattered in areas of Kozobe Gypsum Formation (Upper unit).
Gp4	Kozobe Gypsum Formation (Lower unit)
Gp5	Kozobe Gypsum Formation (Lower unit) is overlain by thin Qc.
Amba Aradam Sandstone: Variegated quartz sandstone	
Aa	Amba Aradam Sandstone
Late Jurassic	
Kabudihar Formation: Oolitic limestone, marl and gypsum	
Kb	Kabudihar Formation (Upper unit)
Kb1	Kabudihar Formation (Upper unit) is overlain by thin Quaternary deposit.
Kb2	Kabudihar Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabudihar Formation (Upper unit) is scattered in areas of Quaternary deposit.
Kb3	Kabudihar Formation (Lower unit)
Kb4	Kabudihar Formation (Lower unit) is overlain by thin Quaternary deposit.
Kb5	Kabudihar Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabudihar Formation (Lower unit) is scattered in areas of Quaternary deposit.
Urandaib Formation: Shale and marl with limestone and gypsum	
Ur	Urandaib Formation
Ur1	Urandaib Formation is overlain by thin Quaternary deposit.
Ur2	Urandaib Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Urandaib Formation is scattered in areas of Quaternary deposit.
Ur3	Qc is scattered in areas of Urandaib Formation.
Middle to Late Jurassic	
Hammarite Formation: Organogenic and oolitic limestone with shale and sandstone intercalations	
Hm	Hammarite Formation (Upper unit)
Hm1	Hammarite Formation (Upper unit) is overlain by thin Quaternary deposit.
Hm2	Hammarite Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammarite Formation (Upper unit) is scattered in areas of Quaternary deposit.
Hm3	Hammarite Formation (Lower unit)
Hm4	Hammarite Formation (Lower unit) is overlain by thin Quaternary deposit.
Hm5	Hammarite Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammarite Formation (Lower unit) is scattered in areas of Quaternary deposit.
Hm6	Hammarite Formation (Lower unit) is overlain by thin Qc.
Thasite(?) - Middle Jurassic	
Adigrat Sandstone: Fine to coarse sandstone	
Ad	Adigrat Sandstone
Ad1	Adigrat Sandstone is overlain by thin Quaternary deposit that does not have a sufficient thickness as aquifer.
Ad2	Adigrat Sandstone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Adigrat Sandstone is scattered in areas of Quaternary deposit.
Ad3	Adigrat Sandstone is overlain by thin Qc.
Proterozoic	
Basement rocks: granite, granite-gneiss, migmatite, amphibolite, diorite	
Bs	Basement rocks

* Jj, Jg and Kg are not subdivided into upper and lower units for geological profile. Because the sufficient underground data is not obtained by the limit of the image analysis by visual inspection.

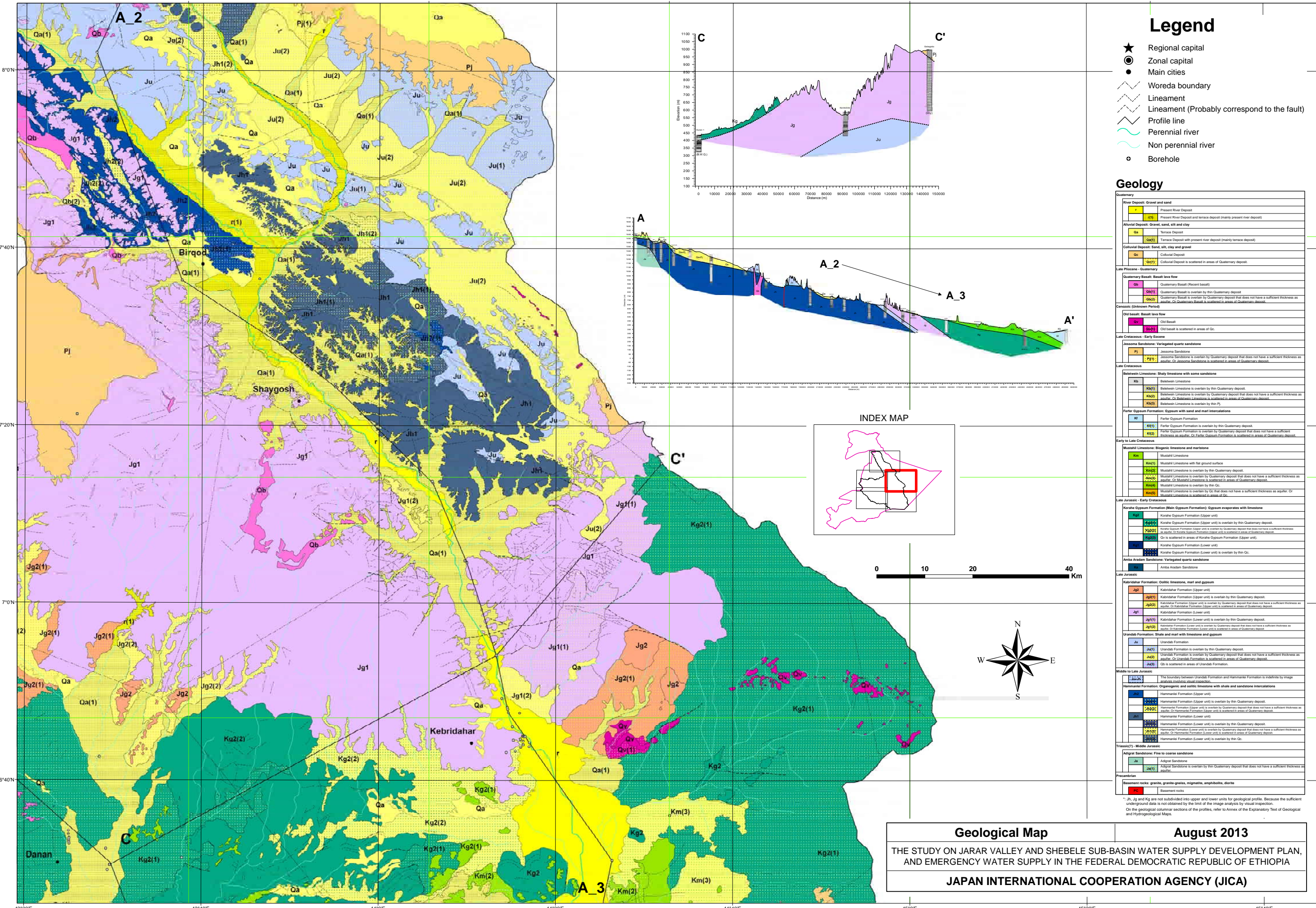
On the geological columnar sections of the profiles, refer to Annex of the Explanatory Text of Geological and Hydrological Maps.



Latitude (Adindan)

Longitude (Adindan)

UTM zone 38N Northing

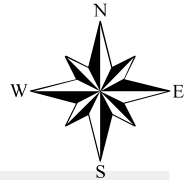
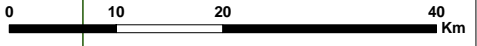
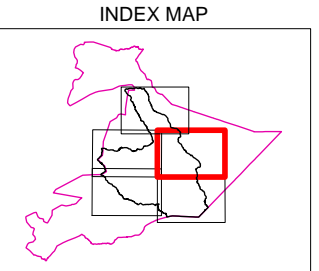


Legend

- ★ Regional capital
- Zonal capital
- Main cities
- Woreda boundary
- Lineament
- Lineament (Probably correspond to the fault)
- Profile line
- Perennial river
- Non perennial river
- ⊕ Borehole

Geology

Quaternary	
Qa(1)	Present River Deposit
Qa	Present River Deposit and terrace deposit (mainly present river deposit)
Qa(2)	Terrace Deposit
Qa(1)	Terrace Deposit with present river deposit (mainly terrace deposit)
Qc	Colluvial Deposit
Qc(1)	Colluvial Deposit is scattered in areas of Quaternary deposit.
Late Pliocene - Quaternary	
Quaternary Basalt: Basalt lava flow	
Qb	Quaternary Basalt (Recent basalt)
Qb(1)	Quaternary Basalt is overlain by thin Quaternary deposit
Qb(2)	Quaternary Basalt is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Quaternary Basalt is scattered in areas of Quaternary deposit.
Cenozoic (Unknown Period)	
Old basalt: Basalt lava flow	
Qr	Old Basalt
Qr(1)	Old basalt is scattered in areas of Qc.
Late Cretaceous - Early Eocene	
Jessoma Sandstone: Variegated quartz sandstone	
Pj	Jessoma Sandstone
Pj(1)	Jessoma Sandstone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Jessoma Sandstone is scattered in areas of Quaternary deposit.
Late Cretaceous	
Beleweh Limestone: Shaly limestone with some sandstone	
Kb	Beleweh Limestone
Kb(1)	Beleweh Limestone is overlain by thin Quaternary deposit.
Kb(2)	Beleweh Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Beleweh Limestone is scattered in areas of Quaternary deposit.
Kb(3)	Beleweh Limestone is overlain by thin Pj.
Farfer Gypsum Formation: Gypsum with sand and marl intercalations	
Kf	Farfer Gypsum Formation
Kf(1)	Farfer Gypsum Formation is overlain by thin Quaternary deposit.
Kf(2)	Farfer Gypsum Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Farfer Gypsum Formation is scattered in areas of Quaternary deposit.
Early to Late Cretaceous	
Musahl Limestone: Siliceous limestone and marlstone	
Km	Musahl Limestone
Km(1)	Musahl Limestone with flat ground surface
Km(2)	Musahl Limestone is overlain by thin Quaternary deposit.
Km(3)	Musahl Limestone is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Musahl Limestone is scattered in areas of Quaternary deposit.
Km(4)	Musahl Limestone is overlain by the Qa.
Km(5)	Musahl Limestone is overlain by Qc that does not have a sufficient thickness as aquifer. Or Musahl Limestone is scattered in areas of Qc.
Late Jurassic - Early Cretaceous	
Koraha Gypsum Formation (Main Gypsum Formation): Gypsum evaporites with limestone	
Kg	Koraha Gypsum Formation (Upper unit)
Kg(1)	Koraha Gypsum Formation (Upper unit) is overlain by thin Quaternary deposit.
Kg(2)	Koraha Gypsum Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Koraha Gypsum Formation (Upper unit) is scattered in areas of Quaternary deposit.
Kg(3)	Koraha Gypsum Formation (Upper unit) is overlain by thin Qa.
Kg(4)	Koraha Gypsum Formation (Upper unit) is overlain by thin Qc.
Kg(5)	Koraha Gypsum Formation (Lower unit)
Kg(6)	Koraha Gypsum Formation (Lower unit) is overlain by thin Qc.
Amba Aradam Sandstone: Variegated quartz sandstone	
Ka	Amba Aradam Sandstone
Late Jurassic	
Kabridahar Formation: Oolitic limestone, marl and gypsum	
Jg	Kabridahar Formation (Upper unit)
Jg(1)	Kabridahar Formation (Upper unit) is overlain by thin Quaternary deposit.
Jg(2)	Kabridahar Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabridahar Formation (Upper unit) is scattered in areas of Quaternary deposit.
Jg(3)	Kabridahar Formation (Lower unit)
Jg(4)	Kabridahar Formation (Lower unit) is overlain by thin Quaternary deposit.
Jg(5)	Kabridahar Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Kabridahar Formation (Lower unit) is scattered in areas of Quaternary deposit.
Urundab Formation: Shale and marl with limestone and gypsum	
Ju	Urundab Formation
Ju(1)	Urundab Formation is overlain by thin Quaternary deposit.
Ju(2)	Urundab Formation is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Urundab Formation is scattered in areas of Quaternary deposit.
Ju(3)	Qb is scattered in areas of Urundab Formation.
Middle to Late Jurassic	
Hammarke Formation: Organogenic and oolitic limestone with shale and sandstone intercalations	
Hm	Hammarke Formation (Upper unit)
Hm(1)	Hammarke Formation (Upper unit) is overlain by thin Quaternary deposit.
Hm(2)	Hammarke Formation (Upper unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammarke Formation (Upper unit) is scattered in areas of Quaternary deposit.
Hm(3)	Hammarke Formation (Lower unit)
Hm(4)	Hammarke Formation (Lower unit) is overlain by thin Quaternary deposit.
Hm(5)	Hammarke Formation (Lower unit) is overlain by Quaternary deposit that does not have a sufficient thickness as aquifer. Or Hammarke Formation (Lower unit) is scattered in areas of Quaternary deposit.
Hm(6)	Hammarke Formation (Lower unit) is overlain by thin Qc.
Triassic(?) - Middle Jurassic	
Adigral Sandstone: Fine to coarse sandstone	
Ad	Adigral Sandstone
Ad(1)	Adigral Sandstone is overlain by thin Quaternary deposit that does not have a sufficient thickness as aquifer.
Precambrian	
B	Basement rocks



Geological Map **August 2013**

THE STUDY ON JARAR VALLEY AND SHEBELE SUB-BASIN WATER SUPPLY DEVELOPMENT PLAN,
AND EMERGENCY WATER SUPPLY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

UTM zone 38N Northing
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870000

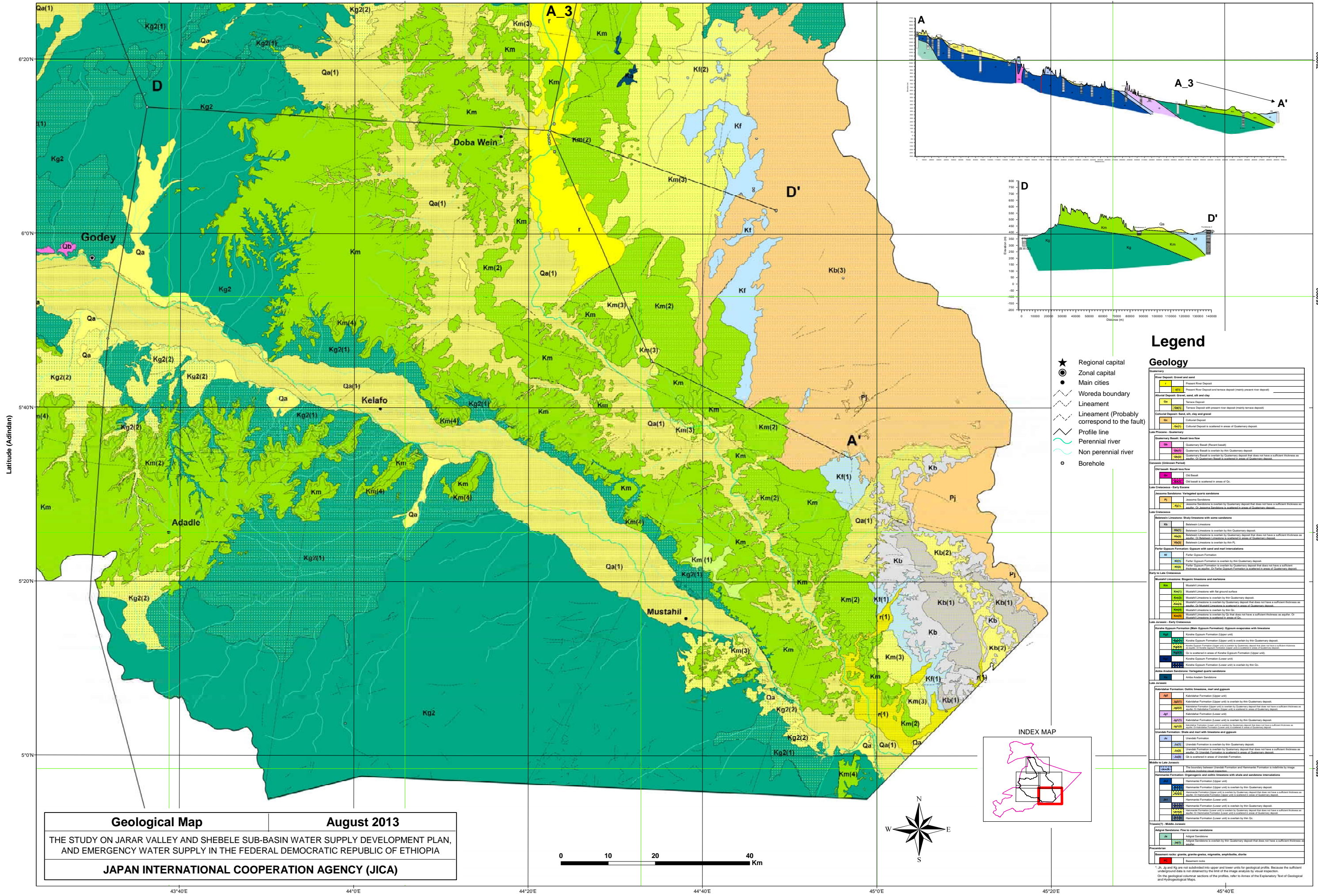
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Geological Map August 2013

THE STUDY ON JARAR VALLEY AND SHEBELE SUB-BASIN WATER SUPPLY DEVELOPMENT PLAN, AND EMERGENCY WATER SUPPLY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Legend

- ★ Regional capital
- Zonal capital
- Main cities
- Woreda boundary
- Lineament
- Lineament (Probably correspond to the fault)
- Profile line
- Perennial river
- Non perennial river
- Borehole

Geology

Geological Unit	Description
Qa	Present River Deposit
Qa(1)	Present River Deposit and terrace deposit (mainly present river deposit)
Qa(2)	Present River Deposit
Qa(3)	Present River Deposit
Qa(4)	Present River Deposit
Qa(5)	Present River Deposit
Qa(6)	Present River Deposit
Qa(7)	Present River Deposit
Qa(8)	Present River Deposit
Qa(9)	Present River Deposit
Qa(10)	Present River Deposit
Qa(11)	Present River Deposit
Qa(12)	Present River Deposit
Qa(13)	Present River Deposit
Qa(14)	Present River Deposit
Qa(15)	Present River Deposit
Qa(16)	Present River Deposit
Qa(17)	Present River Deposit
Qa(18)	Present River Deposit
Qa(19)	Present River Deposit
Qa(20)	Present River Deposit
Qa(21)	Present River Deposit
Qa(22)	Present River Deposit
Qa(23)	Present River Deposit
Qa(24)	Present River Deposit
Qa(25)	Present River Deposit
Qa(26)	Present River Deposit
Qa(27)	Present River Deposit
Qa(28)	Present River Deposit
Qa(29)	Present River Deposit
Qa(30)	Present River Deposit
Qa(31)	Present River Deposit
Qa(32)	Present River Deposit
Qa(33)	Present River Deposit
Qa(34)	Present River Deposit
Qa(35)	Present River Deposit
Qa(36)	Present River Deposit
Qa(37)	Present River Deposit
Qa(38)	Present River Deposit
Qa(39)	Present River Deposit
Qa(40)	Present River Deposit
Qa(41)	Present River Deposit
Qa(42)	Present River Deposit
Qa(43)	Present River Deposit
Qa(44)	Present River Deposit
Qa(45)	Present River Deposit
Qa(46)	Present River Deposit
Qa(47)	Present River Deposit
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Qa(49)	Present River Deposit
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Qa(54)	Present River Deposit
Qa(55)	Present River Deposit
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Qa(71)	Present River Deposit
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Qa(82)	Present River Deposit
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Qa(84)	Present River Deposit
Qa(85)	Present River Deposit
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Qa(94)	Present River Deposit
Qa(95)	Present River Deposit
Qa(96)	Present River Deposit
Qa(97)	Present River Deposit
Qa(98)	Present River Deposit
Qa(99)	Present River Deposit
Qa(100)	Present River Deposit

UTM zone 38N Northing

600000

650000