ナイジェリア連邦共和国
連邦水資源省（FMWR）

ナイジェリア国
全国水資源管理開発基本計画策定
プロジェクト報告書

第５編

サポーティングレポート（英）

平成 26 年 1 月
(2014)

独立行政法人
国際協力機構（JICA）

八千代エンジニヤリング株式会社
株式会社建設技研インターナショナル
株式会社三祐コンサルタンツ

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(2012 年 12 月 31 日)

Contents

List of Abbreviations

Abbreviation & Acronym	Explanation
ACGSF	Agricultural Credit Guarantee Scheme Fund
ADP	Agricultural Development Project
AEPB	Abuja Environmental Protection Board
AfDB	African Development Bank
BADC	British Atmospheric Data Centre
BCM	Billion Cubicmeter
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
CCU	Climate Change Unit
CD	Capacity Development
CITES	Convention on International Trade in Endangered Species
CMCC	Catchment Management Coordinating Committee
CMO	Catchment Management Office
CMP	Catchment Management Plan
CPI	Consumer Price Index
CWIQS	Core Welfare Indicators Questionnaire Survey
DDRO	Department of Dam and Reservoir Operations
DEM	Digital Elevation Model
DFID	Department for International Development in UK (UKAID)
DID	Department of Irrigation and Drainage
DO	Disolved Oxygen
DPRS	Department of Planning and Research and Statistics
DRBOI	Department of River Basin Operation and Inspectorate
DWQ&S	Department of Water Quality Control and Sanitation
DWS	Department of Water Supply
EA	Environmental Assessment
EC	European Commission
ECN	Energy Commission of Nigeria
EIA	Environment Impact Assessment
EL	Elevation
EMSS	Environmental Management Support System
ERICA	European Rivers and Catchment
ET	Evapotranspiration
EU	European Union
FAO	Food and Agriculture Organization
FCA	Fadama Association Committee
FCT	Federal Capital Territory
FEPA	Federal Environmental Protection Agency
FEWS	Flood Early Warning System
FGN	Federal Government of Nigeria
FIWD	Federal Inland Waterways Department
FMANR	Federal Ministry of Agriculture and Natural Resources
FMARD	Federal Ministry of Agriculture and Rural Development
FME(d)	Federal Ministry of Education
FME(n)	Federal Ministry of Environment
FMH	Federal Ministry of Health
FMP	Federal Ministry of Power
FMT	Federal Ministry of Transport
FMWA	Federal Ministry of Women's Affairs
FMWR	Federal Ministry of Water Resources
FMWRRD	Federal Ministry of Water Resources and Rural Development
GCM	Global Climate Models
GDMA	Gurara Dam Management Authority

Abbreviation & Acronym	Explanation
GDP	Gross Domestic Product
GIS	Geographical Information System
GWMA	Gurara Water Management Authority
HA	Hydrological Area
HYCOS	Hydrological Cycle Observation System
ICT	Information and Communication Technology
IEE	Initial Environmental Evaluation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Programme
kW	Kilowatt
kWh	Kilowatt-Hour
LCBC	Lake Chad Basin Commission
LGA	Local Government Authority
M&E	Monitoring and Evaluation
M/P	Master Plan
MANR	Ministry of Agriculture and Natural Resources
MCM	Million Cubicmeter
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
MLIT	Ministry of Land, Infrastructure and Transport of Japan
MW	Megawatt
MWh	Megawatt-Hour
NACRDB	Nigeria Agricultural Cooperative and Rural Development Bank
NAFDAC	Nigeria Food Drag Administration and Control
NAFSS	National Agriculture and Food Security Strategy
NASRADA	Nigeria Space Research and Development Agency
NBA	Niger Basin Authority
NBN	National Bank of Nigeria
NBS	National Bureau of Statistics
NCC	Nigeria Cameroon Commission
NCWR	National Council on Water Resources
NDHS	National Demographic and Health Survey
NEED	National Economic Empowerment and Development Strategy
NEMA	National Emergency Management Agency
NERA	National Emergency Relief Agency
NESREA	National Environmental Standards and Regulations Enforcement Agency
NEWMAP	Nigerian Erosion and Watershed Management Project
NFDP	National Fadama Development Project
NFSSP	National Food Security Support Project
NGO	Non Governmental Organization
NGSA	Nigeria Geological Survey Agency
NIHSA	Nigeria Hydrological Services Agency
NIMET	Nigerian Meteorological Agency
NIS	Nigerian Industrial Standard
NIWA	National Inland Waterways Authority
NIWRMC	Nigeria Integrated Water Resources Management Commission
NNJC	Niger-Nigeria Joint Commission
NPC	National Population Commission
NPC	Nigeria Planning Commission
NRDS	National Rice Development Strategy
NRW	Non Revenue Water
NTN	National Training Network

Abbreviation & Acronym	Explanation
NWRI	National Water Resources Institute
NWSSBS	National Water Supply and Sanitation Baseline Survey
OORBDA	Ogun-Osun River Basin Development Authority
PET	Potential Evapotranspiration
PHCH	Power Holding Company of Nigeria
PPP	Public-Private Partnership
PSP	Private Sector Participation
RBDA	River Basin Development Authority
RBMC	River Bain Management Commission
RCM	Regional Climate Models
ROPSIN	Review of the Public Irrigation Sector of Nigeria
RUWASSA	Rural Water Supply and Sanitation Agency
SEA	Strategic Environmental Assessment
SHA	Sub Hydrological Area
SON	Standards Organisation of Nigeria
SRRBDA	Sokoto-Rima River Basin Development Authority
SRTM	Shuttle Radar Topography Mission
SSHA	Small Sub Hydrological Area
STWSS	Small Town Water Supply and Sanitation
STWSSA	Small Town Water Supply and Sanitation Project
STWSSP	Small Town Water Supply and Sanitation Agency
SWA	State Water Agencies
TOR	Terms of Reference
UAC	Users Association Committee
UFW	Unaccounted for Water
UNDP	United Nations Development Programme
UNEP	UN Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
VAB	Visual Basic Application
WASHCOM	Water, Sanitation and Hygiene Committee
WATSAN	Water and Sanitation
WB	World Bank
WCA	Water Consumers Association
WHO	World Health Organization
WRDP	Water Resources Development Plan
WRMP	Water Resources Management Plan
WRUP	Water Resources Utilization Plan
WSSSRP	Water Supply Sanitation Sector Reform Programme
WTP or WTW	Water Treatment Plant or Works
WUA	Water Users Association

SUPPORTING REPORT 1

PROJECTION OF FUTURE WATER DEMAND

PROJECTION OF FUTURE WATER DEMAND

Projection of Future Water Demand

- **SR1.1 Future Socio-Economic Framework**
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- **SR1.2 Municipal Water**
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Contents

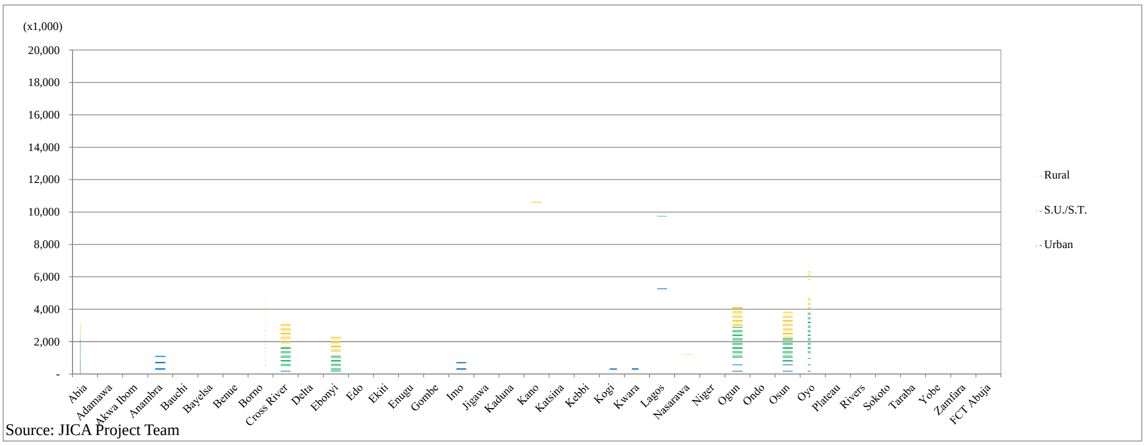
SR1 PROJECTION OF FUTURE WATER DEMAND

SR1.1 Future Socio-Economic Framwork

SR1.1.1 Population

(1) Population in 2010

Figure SR1.1-1 shows population in 2010.

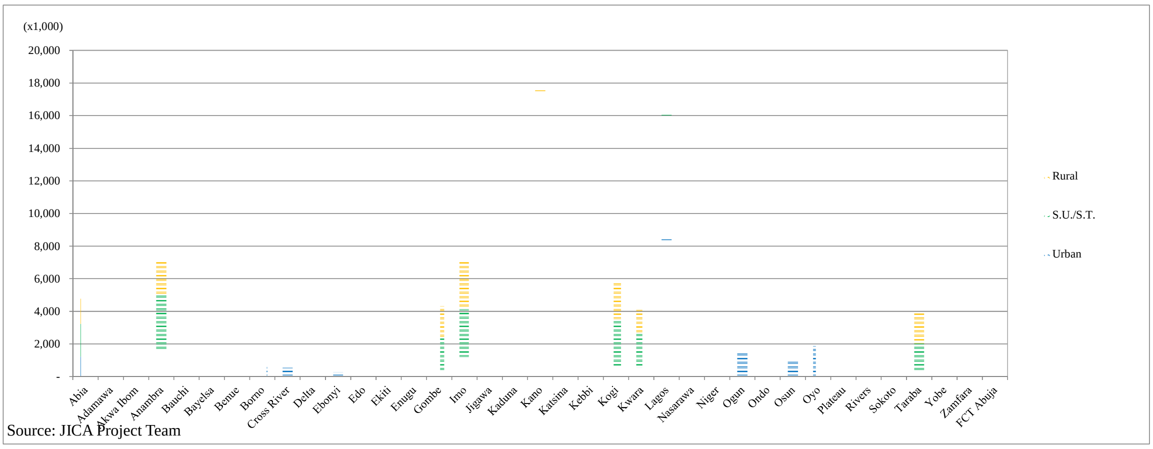


Source: JICA Project Team

Figure SR1.1-1 Population in 2010

(2) Population in 2030

Figure SR1.1-2 shows population in 2030.

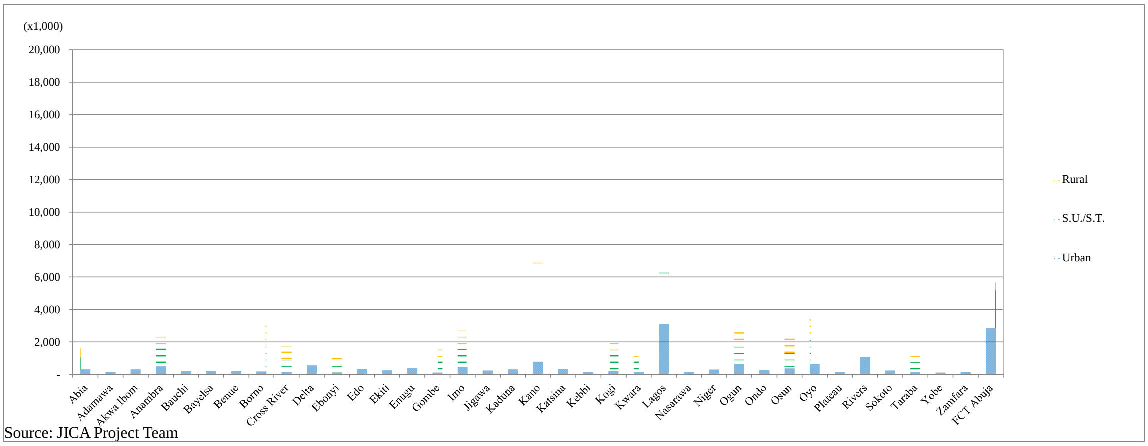


Source: JICA Project Team

Figure SR1.1-2 Population in 2030

(3) Population Growth from 2010 to 2030

Figure SR1.1-3 shows population growth from 2010 to 2030.

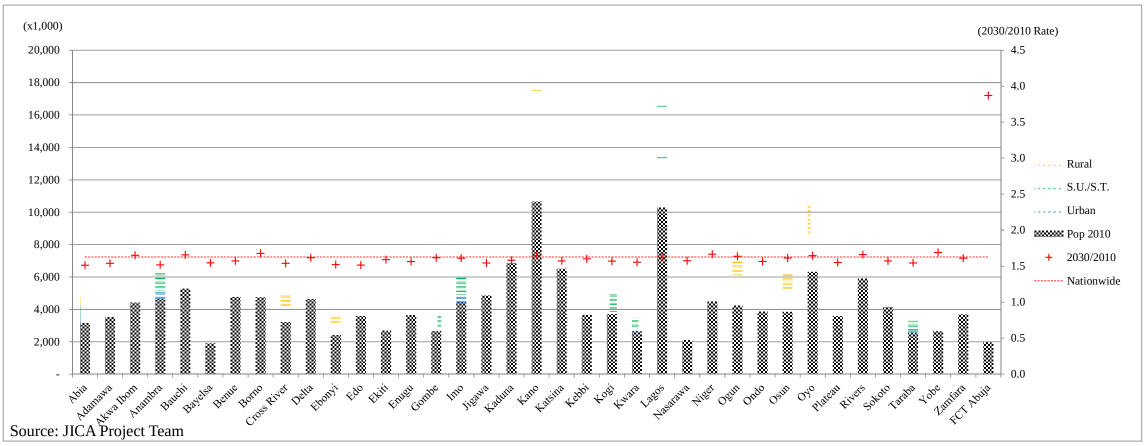


Source: JICA Project Team

Figure SR1.1-3 Population Growth from 2010 to 2030

(4) Population Growth Ratio

Figure SR1.1-4 shows population growth (2030/2010) ratio.

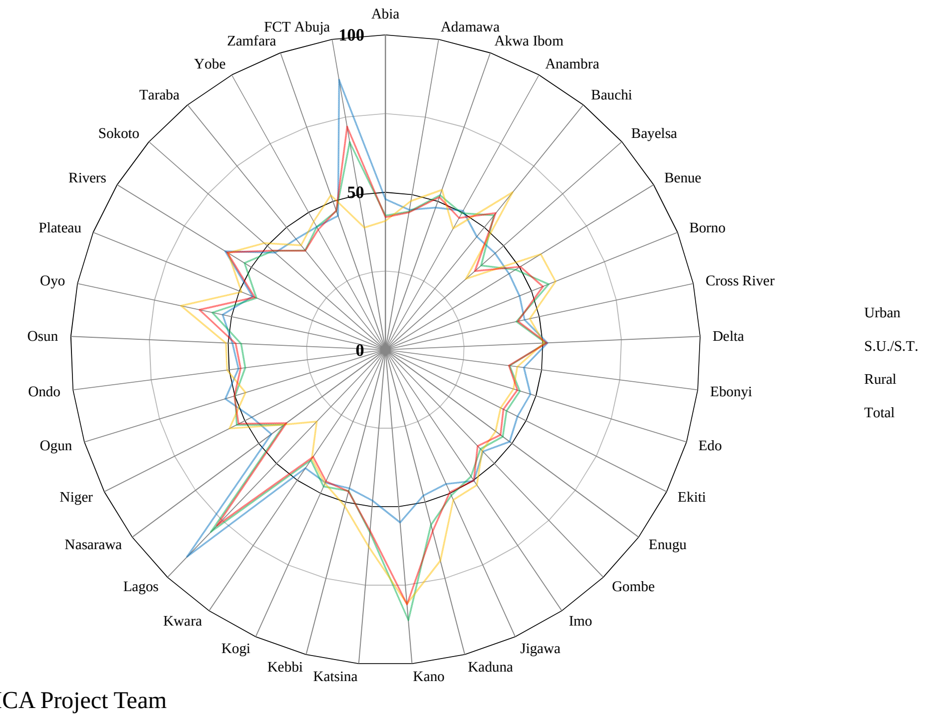


Source: JICA Project Team

Figure SR1.1-4 Population Growth (2030/2010) Ratio

(5) Deviation Score of Population Growth

Figure SR1.1-5 shows deviation score of population growth from 2010 to 2030 among states for reference.



Source: JICA Project Team

Figure SR1.1-5 Deviation Score of Population Growth from 2010 to 2030

SR1.2 Municipal Water

SR1.2.1 Method of Water Demand Projection

(1) Commercial Water

Table SR1.2-1 shows how the Project set commercial water consumption rate to domestic water consumption, based on other instances.

Table SR1.2-1 Commercial Water Consumption Rate to Domestic Water Consumption

	Year of Data	To Domestic Water	To All Users
Indonesia (Bali)	2004	9.1%	7.1%
Brazil (Sergipe)	1997	9.5%	7.6%
Colombia (Bogota)	2002	16.5%	12.5%
Philippines (Manila)	2005	36.0%	25.2%
Japan	2009	24.5%	18.7%
		↓	
Nigeria			
Lagos, Kano States and FCT Abuja		**20%**	
Other States		**10%**	

Source: JICA Project Team

(2) Industrial Water

Table SR1.2-2 shows how the Project set commercial water consumption rate to domestic water consumption, based on other instances.

Table SR1.2-2 Commercial Water Consumption Rate to Domestic Water Consumption

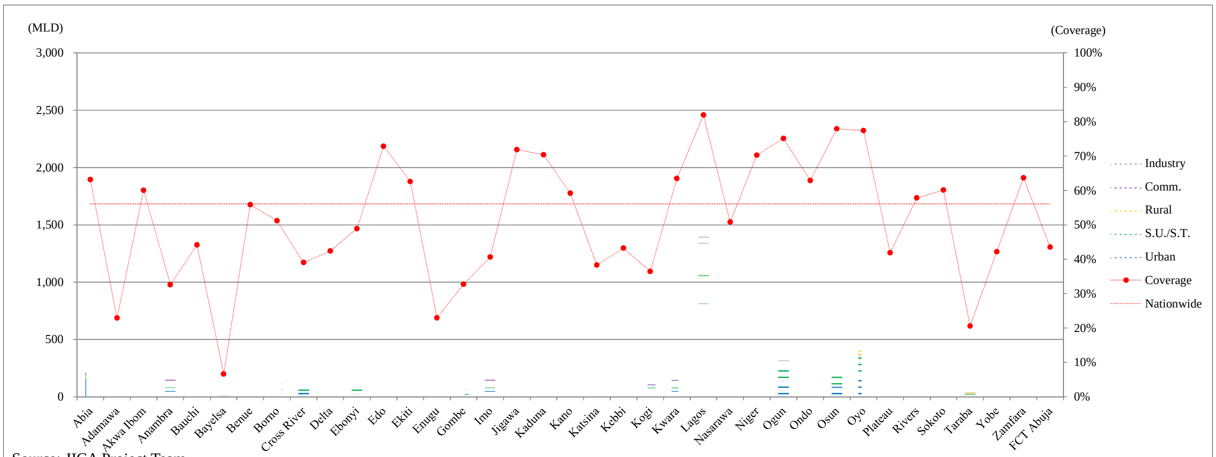
	Year of Data	To Domestic Water	To All Users	Industry Sector Distribution to GRDP
Indonesia (Bali)	2004	5.4%	4.2%	9.8% (2003))
Brazil (Sergipe)	1997	7.3%	5.8%	
Colombia (Bogota)	2002	7.4%	5.6%	22.0% (1998)
Philippines (Manila)	2005	6.8%	4.8%	18.0% (2010)
Japan	2009	4.3%	3.3%	27.2% (2010)
		↓		
Nigeria				5.0% (2010)
Lagos and Kano States		**5.0%**		
Other States		**2.5%**		

Source: JICA Project Team

SR1.2.2 Result of Water Demand Projection

(1) Water Demand in 2010

Figure SR1.2-1 shows water demand in 2010.

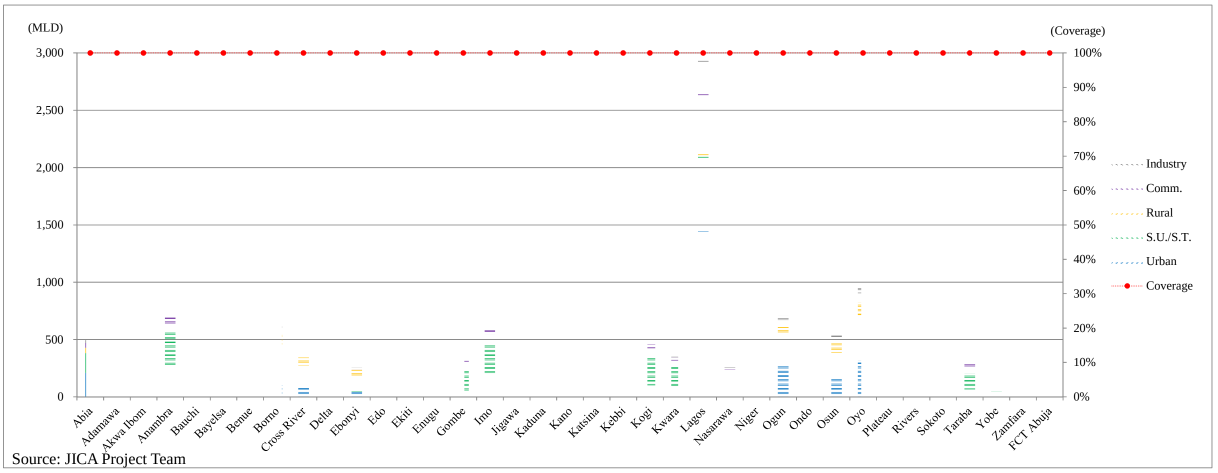


Source: JICA Project Team

Figure SR1.2-1 Water Demand in 2010

(2) Water Demand in 2030

Figure SR1.2-2 shows water demand in 2030.

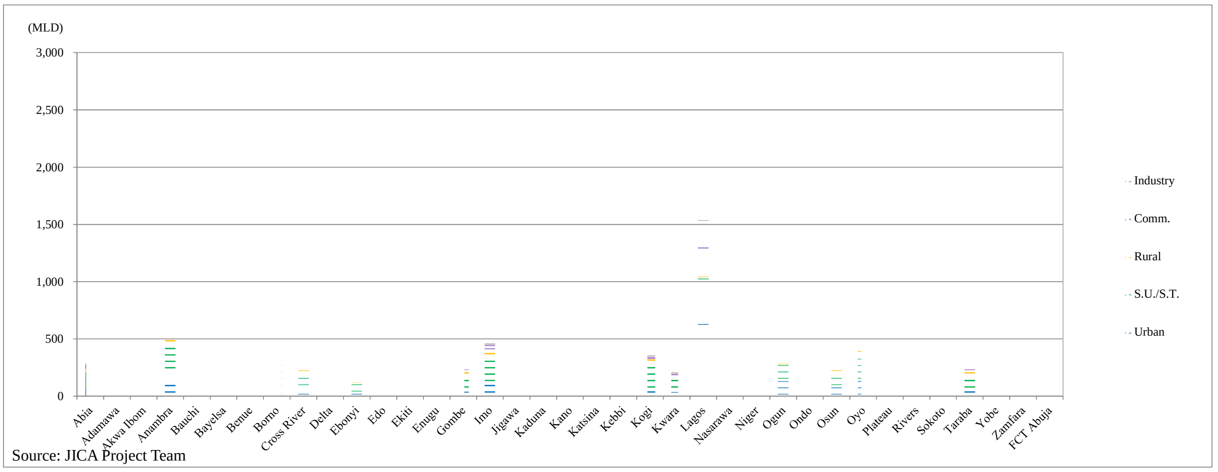


Source: JICA Project Team

Figure SR1.2-2 Water Demand in 2030

(3) Water Demand Increase from 2010 to 2030

Figure SR1.2-3 shows water demand increase from 2010 to 2030.

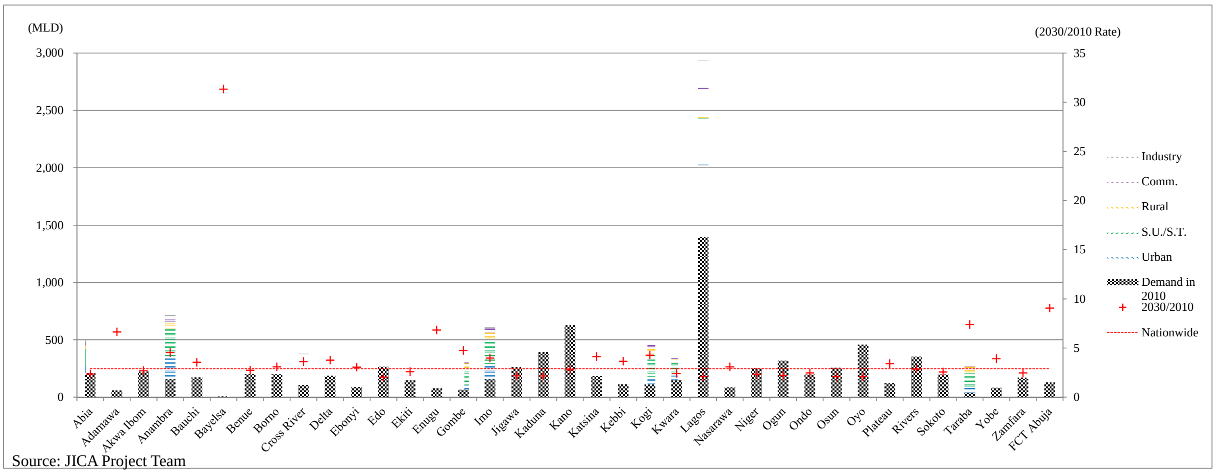


Source: JICA Project Team

Figure SR1.3-3 Water Demand Increase from 2010 to 2030

(4) Water Demand Increase Ratio

Figure SR1.2-4 shows water demand increase (2030/2010) ratio.

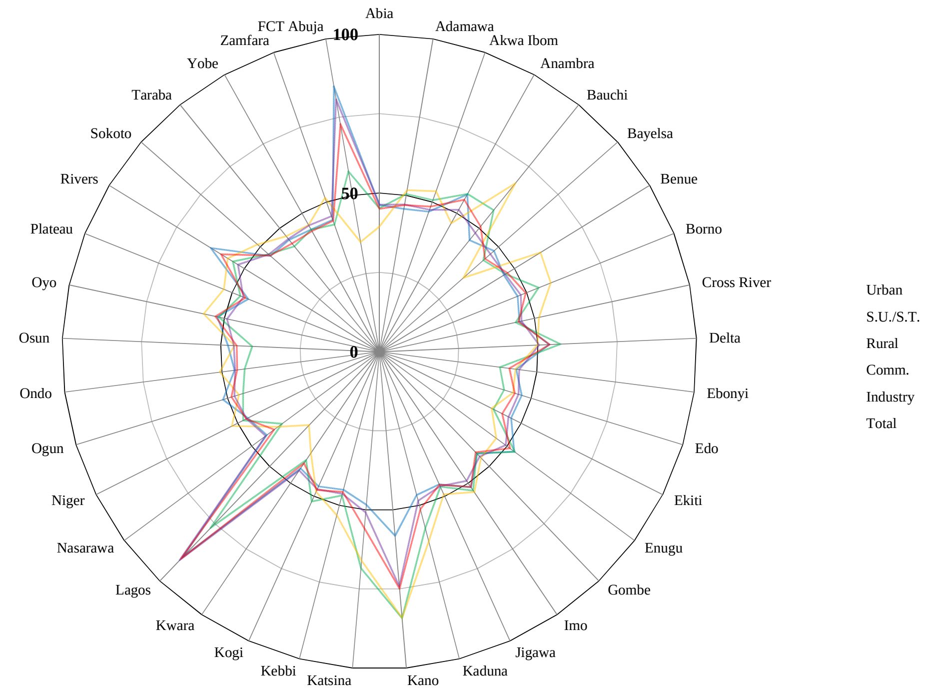


Source: JICA Project Team

Figure SR1.2-4 Water Demand Increase (2030/2010) Ratio

(5) Deviation Score of Water Demand Increase

Figure SR1.2-5 shows deviation score of water demand increase from 2010 to 2030 among states for reference.



Source: JICA Project Team

Figure SR1.2-5 Deviation Score of Water Demand Increase from 2010 to 2030

(6) Water Demand Projection by State and Water Usage Category

Table SR1.2-3 shows water demand projection by state and water usage category.

Table SR1.2-3 Water Demand Projection by State and Water Usage Category

State		Water Usage Category	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
1	Abia	State Total	211	276	355	447	495
		Urban	147	161	178	194	209
		Semi-U, Small T	25	60	103	155	172
		Rural	15	23	31	42	46
		Commercial	19	25	31	39	42
		Industrial	5	7	11	17	25
2	Adamawa	State Total	60	142	241	360	398
		Urban	17	30	46	65	71
		Semi-U, Small T	26	72	128	195	215
		Rural	11	27	45	68	76
		Commercial	5	11	19	29	32
		Industrial	1	1	2	3	4
3	Akwa Ibom	State Total	225	308	411	534	606
		Urban	71	87	105	126	141
		Semi-U, Small T	108	151	204	267	299
		Rural	20	36	56	80	90
		Commercial	20	26	34	44	49
		Industrial	5	8	12	18	27
4	Anambra	State Total	157	292	454	646	714
		Urban	76	126	186	254	277
		Semi-U, Small T	53	111	183	267	295
		Rural	10	22	36	54	60
		Commercial	14	26	41	58	64
		Industrial	4	6	8	13	19
5	Bauchi	State Total	174	274	398	547	617
		Urban	46	57	70	84	94
		Semi-U, Small T	91	147	216	299	336
		Rural	19	44	75	114	129
		Commercial	15	23	32	43	48
		Industrial	2	3	5	7	11
6	Bayelsa	State Total	9	70	149	245	275
		Urban	1	20	45	76	87
		Semi-U, Small T	2	33	73	122	137
		Rural	6	11	17	23	25
		Commercial	0	6	13	22	25
		Industrial	0	0	1	1	1
7	Benue	State Total	202	282	378	492	552
		Urban	49	63	80	100	109
		Semi-U, Small T	103	140	185	236	263
		Rural	28	48	73	102	114
		Commercial	17	23	29	37	41
		Industrial	5	7	11	17	25
8	Borno	State Total	199	293	407	545	613
		Urban	31	48	69	93	102
		Semi-U, Small T	132	181	241	313	351
		Rural	16	34	57	86	98
		Commercial	18	25	34	45	50
		Industrial	2	4	5	8	12
9	Cross River	State Total	107	173	253	348	386
		Urban	46	58	72	87	94
		Semi-U, Small T	43	76	115	163	180
		Rural	6	21	40	63	70
		Commercial	10	15	21	28	30
		Industrial	2	4	6	8	13
10	Delta	State Total	189	309	457	635	713
		Urban	101	138	183	234	260
		Semi-U, Small T	49	105	176	261	291
		Rural	18	32	48	69	78
		Commercial	17	27	40	55	61
		Industrial	5	7	10	15	23

State		Water Usage Category	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
11	Ebonyi	State Total	88	131	182	242	270
		Urban	21	27	35	43	47
		Semi-U, Small T	45	67	93	124	137
		Rural	13	23	35	49	54
		Commercial	7	10	14	19	20
		Industrial	2	3	5	7	11
12	Edo	State Total	266	328	401	486	541
		Urban	124	140	159	179	195
		Semi-U, Small T	101	128	160	196	216
		Rural	10	20	33	48	53
		Commercial	25	30	35	42	46
		Industrial	6	9	14	21	31
13	Ekiti	State Total	150	203	267	343	388
		Urban	49	64	82	102	114
		Semi-U, Small T	68	93	123	158	176
		Rural	16	23	32	42	47
		Commercial	13	17	23	29	32
		Industrial	4	5	8	12	18
14	Enugu	State Total	78	186	319	479	534
		Urban	41	76	119	171	189
		Semi-U, Small T	19	69	132	207	230
		Rural	10	21	35	52	58
		Commercial	7	16	28	42	47
		Industrial	2	3	4	6	10
15	Gombe	State Total	67	125	198	285	319
		Urban	13	22	33	47	52
		Semi-U, Small T	40	72	113	161	180
		Rural	8	19	34	51	57
		Commercial	6	10	16	23	26
		Industrial	1	1	2	3	4
16	Imo	State Total	155	260	390	548	618
		Urban	74	104	141	184	206
		Semi-U, Small T	44	92	152	225	252
		Rural	20	37	56	80	89
		Commercial	13	22	33	45	51
		Industrial	4	6	9	13	19
17	Jigawa	State Total	265	335	419	516	576
		Urban	52	64	80	97	108
		Semi-U, Small T	147	183	227	276	306
		Rural	41	55	71	90	99
		Commercial	22	28	34	41	46
		Industrial	3	5	7	11	17
18	Kaduna	State Total	394	498	622	767	852
		Urban	137	153	170	189	204
		Semi-U, Small T	164	221	290	369	409
		Rural	55	75	100	130	147
		Commercial	33	42	51	62	68
		Industrial	5	7	11	16	25
19	Kano	State Total	629	869	1,165	1,521	1,741
		Urban	126	176	237	309	346
		Semi-U, Small T	324	428	552	699	784
		Rural	39	74	118	171	192
		Commercial	113	151	197	252	283
		Industrial	27	40	60	91	136
20	Katsina	State Total	186	322	489	689	770
		Urban	57	77	102	131	147
		Semi-U, Small T	79	158	255	371	412
		Rural	33	58	88	123	137
		Commercial	15	26	40	56	62
		Industrial	2	3	5	8	12
21	Kebbi	State Total	114	183	268	370	416
		Urban	25	35	47	62	70
		Semi-U, Small T	59	96	142	196	219
		Rural	19	35	55	78	87
		Commercial	9	15	21	29	32

State		Water Usage Category	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
		Industrial	1	2	3	5	7
22	Kogi	State Total	111	195	298	422	473
		Urban	32	47	66	88	98
		Semi-U, Small T	53	100	159	228	253
		Rural	14	27	43	62	69
		Commercial	9	16	25	35	39
		Industrial	3	4	6	9	14
23	Kwara	State Total	151	200	259	327	364
		Urban	53	62	72	84	90
		Semi-U, Small T	66	93	126	164	181
		Rural	16	22	30	39	44
		Commercial	13	17	22	28	30
		Industrial	4	5	8	12	18
24	Lagos	State Total	1,397	1,716	2,102	2,555	2,934
		Urban	813	955	1,118	1,298	1,446
		Semi-U, Small T	253	341	449	577	654
		Rural	8	11	15	18	19
		Commercial	267	324	392	469	525
		Industrial	57	85	128	193	290
25	Nasarawa	State Total	87	128	178	237	267
		Urban	25	33	42	53	60
		Semi-U, Small T	42	63	89	120	133
		Rural	10	18	27	38	42
		Commercial	7	11	15	19	21
		Industrial	2	3	5	7	11
26	Niger	State Total	253	327	417	523	592
		Urban	67	82	99	118	132
		Semi-U, Small T	130	167	213	266	300
		Rural	31	46	64	86	97
		Commercial	22	28	35	43	48
		Industrial	3	5	7	10	16
27	Ogun	State Total	319	402	502	620	707
		Urban	134	163	196	234	266
		Semi-U, Small T	132	165	204	249	278
		Rural	15	27	41	58	65
		Commercial	30	36	44	54	60
		Industrial	7	11	17	25	38
28	Ondo	State Total	197	262	341	433	486
		Urban	70	83	99	116	128
		Semi-U, Small T	82	112	148	189	210
		Rural	24	39	56	77	86
		Commercial	17	22	27	34	38
		Industrial	5	7	11	16	24
29	Osun	State Total	258	319	392	478	541
		Urban	86	105	127	151	168
		Semi-U, Small T	110	134	162	194	217
		Rural	33	44	57	72	81
		Commercial	22	27	32	38	43
		Industrial	6	9	14	21	32
30	Oyo	State Total	458	566	696	848	959
		Urban	179	211	248	289	320
		Semi-U, Small T	182	227	281	343	382
		Rural	45	62	83	108	123
		Commercial	40	49	59	70	78
		Industrial	11	16	25	37	56
31	Plateau	State Total	123	194	280	381	422
		Urban	55	64	75	86	94
		Semi-U, Small T	47	87	135	191	210
		Rural	9	25	44	68	76
		Commercial	11	17	23	31	34
		Industrial	1	2	3	5	7
32	Rivers	State Total	355	500	679	893	1,014
		Urban	193	254	328	415	467
		Semi-U, Small T	96	147	209	283	315
		Rural	26	43	64	90	103

State		Water Usage Category	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
		Commercial	32	44	60	77	87
		Industrial	8	13	19	28	43
33	Sokoto	State Total	197	268	353	453	506
		Urban	62	75	89	106	116
		Semi-U, Small T	90	127	172	223	248
		Rural	25	40	58	79	88
		Commercial	17	22	29	37	41
		Industrial	2	4	5	8	12
34	Taraba	State Total	39	99	172	261	291
		Urban	12	23	38	55	62
		Semi-U, Small T	17	47	85	130	144
		Rural	6	19	34	52	57
		Commercial	3	8	14	21	23
		Industrial	1	1	2	3	5
35	Yobe	State Total	84	138	206	289	327
		Urban	16	23	33	44	50
		Semi-U, Small T	47	78	117	164	185
		Rural	13	24	37	54	61
		Commercial	7	11	17	23	26
		Industrial	1	2	2	3	5
36	Zamfara	State Total	171	227	294	374	420
		Urban	27	35	44	55	61
		Semi-U, Small T	102	131	165	204	228
		Rural	24	39	57	79	88
		Commercial	14	18	23	29	32
		Industrial	2	3	5	7	11
37	FCT Abuja	State Total	130	267	496	855	1,182
		Urban	78	152	274	466	648
		Semi-U, Small T	22	55	110	198	270
		Rural	2	5	10	16	21
		Commercial	25	52	96	166	229
		Industrial	3	4	6	9	14
	National	Grand Total	8,254	11,666	15,890	20,994	23,876
		Urban	3,205	4,096	5,185	6,487	7,326
		Semi-U, Small T	3,191	4,761	6,687	8,986	10,067
		Rural	718	1,225	1,855	2,613	2,929
		Commercial	935	1,277	1,700	2,212	2,509
		Industrial	205	308	463	695	1,046

Source: JICA Project Team

(7) Water Demand Projection by Hydrological Area and Water Usage Category

Table SR1.2-4 shows water demand projection by Hydrological Are (HA) and water usage category.

Table SR1.2-4 Water Demand Projection by Hydrological Area and Water Usage Category

HA		Water Usage Category	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
1	Niger North	HA Total	663	974	1,354	1,804	2,020
		Urban	169	217	275	341	380
		Semi-U, Small T	332	500	705	947	1,055
		Rural	99	165	246	342	381
		Commercial	56	80	110	145	161
		Industrial	8	13	19	28	43
2	Niger Central	HA Total	937	1,318	1,831	2,511	3,000
		Urban	334	444	603	826	1,019
		Semi-U, Small T	391	560	779	1,054	1,216
		Rural	105	154	216	291	331
		Commercial	92	136	199	287	356
		Industrial	15	23	35	52	78
3	Upper Benue	HA Total	304	567	891	1,279	1,426
		Urban	81	123	174	233	257
		Semi-U, Small T	155	299	477	689	765
		Rural	38	92	159	241	269
		Commercial	26	47	72	102	114
		Industrial	4	6	9	14	21
4	Lower Benue	HA Total	341	514	738	1,019	1,184
		Urban	109	147	199	266	317
		Semi-U, Small T	154	237	341	469	532
		Rural	40	73	113	163	183
		Commercial	33	49	70	97	115
		Industrial	7	11	16	25	37
5	Niger South	HA Total	771	1,288	1,922	2,680	3,006
		Urban	379	555	769	1,021	1,138
		Semi-U, Small T	238	467	747	1,082	1,202
		Rural	67	124	195	280	313
		Commercial	69	114	169	234	260
		Industrial	18	28	42	63	94
6	Western Littoral	HA Total	3,026	3,819	4,777	5,904	6,715
		Urban	1,462	1,740	2,063	2,425	2,700
		Semi-U, Small T	904	1,198	1,553	1,967	2,200
		Rural	154	232	326	439	492
		Commercial	410	506	619	749	836
		Industrial	95	143	215	324	487
7	Eastern Littoral	HA Total	905	1,339	1,868	2,496	2,789
		Urban	402	503	621	756	828
		Semi-U, Small T	313	527	787	1,097	1,218
		Rural	88	162	254	365	407
		Commercial	79	114	156	205	227
		Industrial	21	32	48	73	110
8	Lake Chad	HA Total	1,306	1,847	2,510	3,302	3,736
		Urban	270	366	482	618	687
		Semi-U, Small T	704	973	1,299	1,681	1,880
		Rural	128	224	345	492	552
		Commercial	169	231	305	393	440
		Industrial	34	52	78	117	176
	National	Grand Total	8,254	11,666	15,890	20,994	23,876
		Urban	3,205	4,096	5,185	6,487	7,326
		Semi-U, Small T	3,191	4,761	6,687	8,986	10,067
		Rural	718	1,225	1,855	2,613	2,929
		Commercial	935	1,277	1,700	2,212	2,509
		Industrial	205	308	463	695	1,046

Source: JICA Project Team

SR1.2.3 Result of SensivityAnalysis and Comparison of Scenarios

(1) Result of SensivityAnalysis and Comparison of Scenarios by State

Table SR1.2-5 shows result of result of sensitivity analysis of water demand projction by state.

Table SR1.2-5 Reusult of Sensitivity Analysis of Water Demand Projection by State

	State	Scenario	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
1	Abia	Basic	211	276	355	447	495
		1	211	265	330	406	495
		2	211	259	314	376	395
		3	211	249	292	341	395
2	Adamawa	Basic	60	142	241	360	398
		1	60	123	200	291	398
		2	60	134	217	308	326
		3	60	116	180	249	326
3	Akwa Ibom	Basic	225	308	411	534	606
		1	225	296	382	485	606
		2	225	290	367	454	491
		3	225	278	341	411	491
4	Anambra	Basic	157	292	454	646	714
		1	157	263	390	539	714
		2	157	274	402	541	569
		3	157	246	345	452	569
5	Bauchi	Basic	174	274	398	547	617
		1	174	255	355	475	617
		2	174	258	357	471	508
		3	174	240	318	407	508
6	Bayelsa	Basic	9	70	149	245	275
		1	9	55	114	187	275
		2	9	66	132	206	219
		3	9	52	102	157	219
7	Benue	Basic	202	282	378	492	552
		1	202	268	348	442	552
		2	202	266	340	423	455
		3	202	253	313	379	455
8	Borno	Basic	199	293	407	545	613
		1	199	276	370	482	613
		2	199	275	364	464	499
		3	199	260	330	409	499
9	Cross River	Basic	107	173	253	348	386
		1	107	159	223	298	386
		2	107	163	227	298	316
		3	107	150	199	254	316
10	Delta	Basic	189	309	457	635	713
		1	189	285	404	546	713
		2	189	290	406	535	572
		3	189	268	359	460	572
11	Ebonyi	Basic	88	131	182	242	270
		1	88	123	164	213	270
		2	88	124	164	208	222
		3	88	116	148	183	222
12	Edo	Basic	266	328	401	486	541
		1	266	320	384	457	541
		2	266	307	355	409	432
		3	266	300	339	383	432
13	Ekiti	Basic	150	203	267	343	388
		1	150	195	249	313	388
		2	150	191	238	290	312
		3	150	183	222	264	312
14	Enugu	Basic	78	186	319	479	534
		1	78	161	264	387	534
		2	78	175	283	403	428
		3	78	152	235	327	428
15	Gombe	Basic	67	125	198	285	319
		1	67	113	170	238	319

	State	Scenario	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
		2	67	118	177	244	261
		3	67	107	152	203	261
16	Imo	Basic	155	260	390	548	618
		1	155	240	344	469	618
		2	155	245	349	465	501
		3	155	226	307	398	501
17	Jigawa	Basic	265	335	419	516	576
		1	265	326	398	481	576
		2	265	317	375	440	470
		3	265	308	357	411	470
18	Kaduna	Basic	394	498	622	767	852
		1	394	483	589	711	852
		2	394	470	557	655	695
		3	394	456	527	607	695
19	Kano	Basic	629	869	1,165	1,521	1,741
		1	629	833	1,083	1,383	1,741
		2	629	816	1,034	1,283	1,397
		3	629	782	961	1,164	1,397
20	Katsina	Basic	186	322	489	689	770
		1	186	294	427	584	770
		2	186	305	439	589	629
		3	186	278	383	500	629
21	Kebbi	Basic	114	183	268	370	416
		1	114	170	238	319	416
		2	114	173	241	319	343
		3	114	160	214	275	343
22	Kogi	Basic	111	195	298	422	473
		1	111	177	259	357	473
		2	111	184	266	359	383
		3	111	167	231	303	383
23	Kwara	Basic	151	200	259	327	364
		1	151	192	241	298	364
		2	151	188	230	276	293
		3	151	181	214	252	293
24	Lagos	Basic	1,397	1,716	2,102	2,555	2,934
		1	1,397	1,689	2,039	2,449	2,934
		2	1,397	1,603	1,841	2,108	2,286
		3	1,397	1,577	1,785	2,020	2,286
25	Nasarawa	Basic	87	128	178	237	267
		1	87	120	161	210	267
		2	87	120	159	202	217
		3	87	113	144	178	217
26	Niger	Basic	253	327	417	523	592
		1	253	318	396	487	592
		2	253	309	373	446	482
		3	253	300	354	414	482
27	Ogun	Basic	319	402	502	620	707
		1	319	393	483	586	707
		2	319	377	445	521	564
		3	319	369	427	491	564
28	Ondo	Basic	197	262	341	433	486
		1	197	253	319	396	486
		2	197	248	305	370	397
		3	197	238	285	338	397
29	Osun	Basic	258	319	392	478	541
		1	258	313	378	453	541
		2	258	301	350	406	439
		3	258	295	338	385	439
30	Oyo	Basic	458	566	696	848	959
		1	458	554	669	803	959
		2	458	532	619	717	773
		3	458	521	595	679	773
31	Plateau	Basic	123	194	280	381	422
		1	123	180	248	328	422
		2	123	183	251	326	345

	State	Scenario	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
		3	123	169	222	280	345
32	Rivers	Basic	355	500	679	893	1,014
		1	355	477	626	804	1,014
		2	355	470	602	751	812
		3	355	448	555	676	812
33	Sokoto	Basic	197	268	353	453	506
		1	197	257	328	410	506
		2	197	253	316	387	413
		3	197	242	293	350	413
34	Taraba	Basic	39	99	172	261	291
		1	39	85	142	210	291
		2	39	93	155	224	239
		3	39	81	127	180	239
35	Yobe	Basic	84	138	206	289	327
		1	84	127	182	248	327
		2	84	130	185	247	268
		3	84	120	163	212	268
36	Zamfara	Basic	171	227	294	374	420
		1	171	218	276	343	420
		2	171	214	265	322	346
		3	171	206	248	294	346
37	FCT Abuja	Basic	130	267	496	855	1,182
		1	130	248	440	737	1,182
		2	130	250	436	707	924
		3	130	231	386	609	924
	National	Basic	8,254	11,666	15,890	20,994	23,876
		1	8,254	11,106	14,614	18,827	23,876
		2	8,254	10,970	14,135	17,750	19,221
		3	8,254	10,440	12,990	15,896	19,221

Source: JICA Project Team

(7) Result of SensivityAnalysis and Comparison of Scenarios by Hydrological Area

Table SR1.2-6 shows result of result of sensitivity analysis of water demand projction by Hydrological Area (HA).

Table SR1.2-6 Reusult of Sensitivity Analysis of Water Demand Projection by HA

	HA	Scenario	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
1	Niger North	Basic	663	974	1,354	1,804	2,020
		1	663	919	1,228	1,593	2,020
		2	663	920	1,215	1,546	1,656
		3	663	868	1,102	1,363	1,656
2	Niger Central	Basic	937	1,318	1,831	2,511	3,000
		1	937	1,261	1,694	2,259	3,000
		2	937	1,240	1,629	2,119	2,407
		3	937	1,187	1,506	1,906	2,407
3	Upper Benue	Basic	304	567	891	1,279	1,426
		1	304	511	765	1,068	1,426
		2	304	535	799	1,096	1,169
		3	304	482	686	914	1,169
4	Lower Benue	Basic	341	514	738	1,019	1,184
		1	341	484	668	897	1,184
		2	341	485	659	868	962
		3	341	457	596	763	962
5	Niger South	Basic	771	1,288	1,922	2,680	3,006
		1	771	1,185	1,691	2,294	3,006
		2	771	1,210	1,706	2,257	2,408
		3	771	1,113	1,501	1,931	2,408
6	Western Littoral	Basic	3,026	3,819	4,777	5,904	6,715
		1	3,026	3,728	4,571	5,557	6,715
		2	3,026	3,580	4,221	4,940	5,332
		3	3,026	3,494	4,037	4,645	5,332
7	Eastern Littoral	Basic	905	1,339	1,868	2,496	2,789
		1	905	1,259	1,688	2,194	2,789
		2	905	1,261	1,666	2,120	2,260
		3	905	1,185	1,504	1,861	2,260
8	Lake Chad	Basic	1,306	1,847	2,510	3,302	3,736
		1	1,306	1,758	2,309	2,963	3,736
		2	1,306	1,739	2,240	2,806	3,028
		3	1,306	1,655	2,058	2,513	3,028
	National	Basic	8,254	11,666	15,890	20,994	23,876
		1	8,254	11,106	14,614	18,827	23,876
		2	8,254	10,970	14,135	17,750	19,221
		3	8,254	10,440	12,990	15,896	19,221

Source: JICA Project Team

SR1.3 Irrigation Water

SR1.3.1 Annual growth rates of cropping area and yield Irrigation Water

(1) Rice policies established by the Government of Nigeria

The Government of Nigeria has placed rice as an important commodity item for national food security as well for exportable commodity in future and tackles for improving its productivity. However, current domestic annual rice production remains at 3.5 million ton (as of 2008) as paddy, depending additional demand of 3.1 million ton on its imports.

Among the vast Nigerian territory, the area suitable for rice production is estimated at 4.6 million ha, accounting for around 5% of the national territory. Currently, rice is produced on 1.8 million ha. The area of irrigable farmland has been conceived as wide as 3.14 million ha, but in reality the irrigated perimeter is only measured at 47,799 ha. Current rice production share of rain-fed upland, rain-fed lowland and irrigated lowland consists of 24%, 71% and 5%, respectively. It follows that rice cultivation under rain-fed condition occupies majority, with very low rate of irrigated lowland. In general, 6-9ton/ha of paddy yield can be expected at maximum in the case of production in irrigated lowland, and this is why rehabilitation of existing irrigation schemes and newly reclaimed ones have so far been challenged in Nigeria.

According to "National Rice Development Strategy (NRDS)", the targets of rice cropping area and production are issued as following:

Table SR1.3-1 Targets on Paddy Cropping Area, Yield Levels and Production Quantity

	Rain-fed upland			Rain-fed lowland		
	Area (ha)	Yield (t/ha)	Production (ton)	Area (ha)	Yield (t/ha)	Production (ton)
2008	510,050	1.62	826,281	1,243,151	1.99	2,473,870
2013	714,927	1.72	1,229,674	1,663,271	2.20	3,659,196
2018	875,000	2.00	1,750,000	2,065,000	3.40	7,021,000
	Irrigated lowland			Total		
	Area (ha)	Yield (t/ha)	Production (ton)	Area (ha)	Yield (t/ha)	Production (ton)
2008	47,799	3.50	167,297	1,801,000	1.92	3,467,448
2013	269,802	4.50	1,214,109	2,648,,000	2.30	6,102,979
2018	560,000	8,00	4,480,000	3,500,000	3.79	13,251,000

Source: National Rice Development Strategy (NRDS)

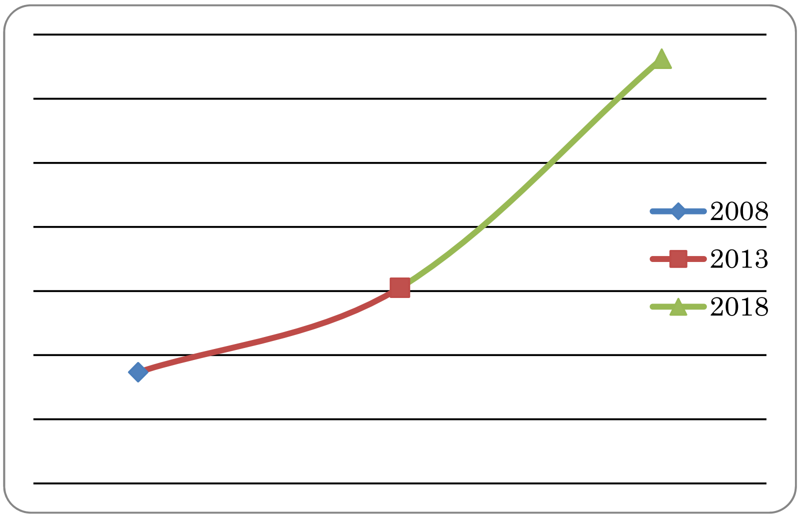
Table below summarizes the targeted annual growth rate of cropping area and crop yield. Judging from hitherto performances on budgetary provision, mechanisms of project/ scheme implementation and development process of agricultural development in Nigeria, the rate of annual yield increment given in this table, i.e., 9.10% and that of cropping area expansion, i.e., 14.4% seem to too much diverged from what has been experienced so far, thus it is understood exceedingly difficult to attain these targets until 2018.

Table SR1.3-2 Targeted Annual Increment Rates of Rice Cropping Acreage and Yield (%/year)

	Rain-fed upland		Rain-fed lowland		Irrigated lowland	
	Area	Yield	Area	Yield	Area	Yield
2008→2013	6.99	1.21	6.00	2.03	41.4	5.15
2013→2018	4.12	3.06	4.42	9.10	15.7	12.2

Source: National Rice Development Strategy (NRDS)

Following figure shows the total rice paddy production shown in table 4-11. Referring to past and current situations in Nigeria, such a rapid increase in rice production during the period 2013-2018 would be unrealistic.



Source: JICA Project Team

Figure SR1.3-1 Targeted rice paddy production

(2) Annual growth rates of cropping areas and yields of rain-fed upland and lowland rice

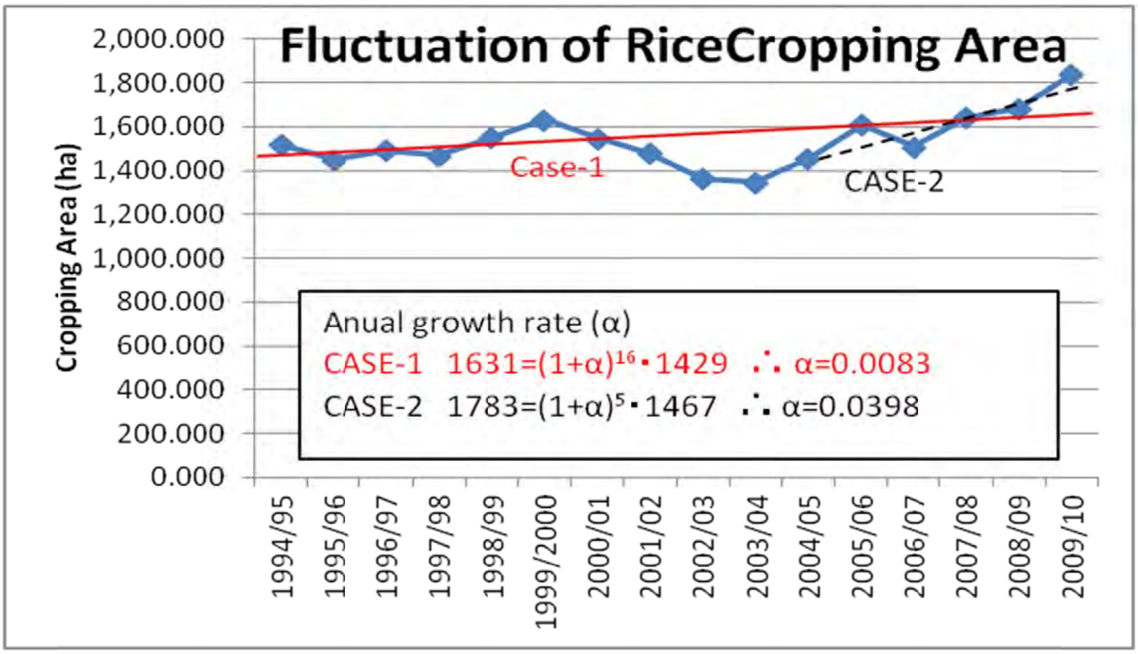
The trends of rice cropping area, yield and production obtained from the statistical data by NBS and state-wise information are given in the table below: As shown in table 2-1, cropping area comprises mainly rain-fed upland and lowland with very limited area under irrigated lowland.

Table SR1.3-3 Trend of rice cropping area, yield and production

Crop year	Cropping area(ha)	Yield (ton/ha)	Production (ton)
1994/95	1,518,781	1.31	1,994,020
1995/96	1,449,543	2.15	3,120,940
1996/97	1,494,013	1.95	2,911,060
1997/98	1,469,341	1.92	2,826,540
1998/99	1,549,932	1.92	2,974,210
1999/2000	1,633,202	2.05	3,343,760
2000/01	1,547,396	2.04	3,159,650
2001/02	1,479,610	1.95	2,879,530
2002/03	1,362,370	2.01	2,757,610
2003/04	1,346,520	2.13	2,874,080
2004/05	1,454,570	2.19	3,183,390
2005/06	1,609,890	2.04	3,286,500
2006/07	1,508,000	2.18	3,281,990
2007/08	1,640,730	2.13	3,499,760
2008/09	1,685,330	1.96	3,311,070
2009/10	1,836,880	1.90	3,481,620

(2-1) Annual growth rate of rice cropping area

As a performance, annual growth rate of rice cropped area during 16-year period from 1994/95 to 2009/10 (CASE-1) is as small as 0.83%n however, if the duration is limited to more recent 5-year period from 2005/06 to 2009/10 (CASE-2), it becomes higher, as high as 3.98%. Meanwhile, about 4-7% (5.4% as an average) was assumed as rain-fed upland and lowland rice paddy in "National Rice Development Strategy (NRDS)".

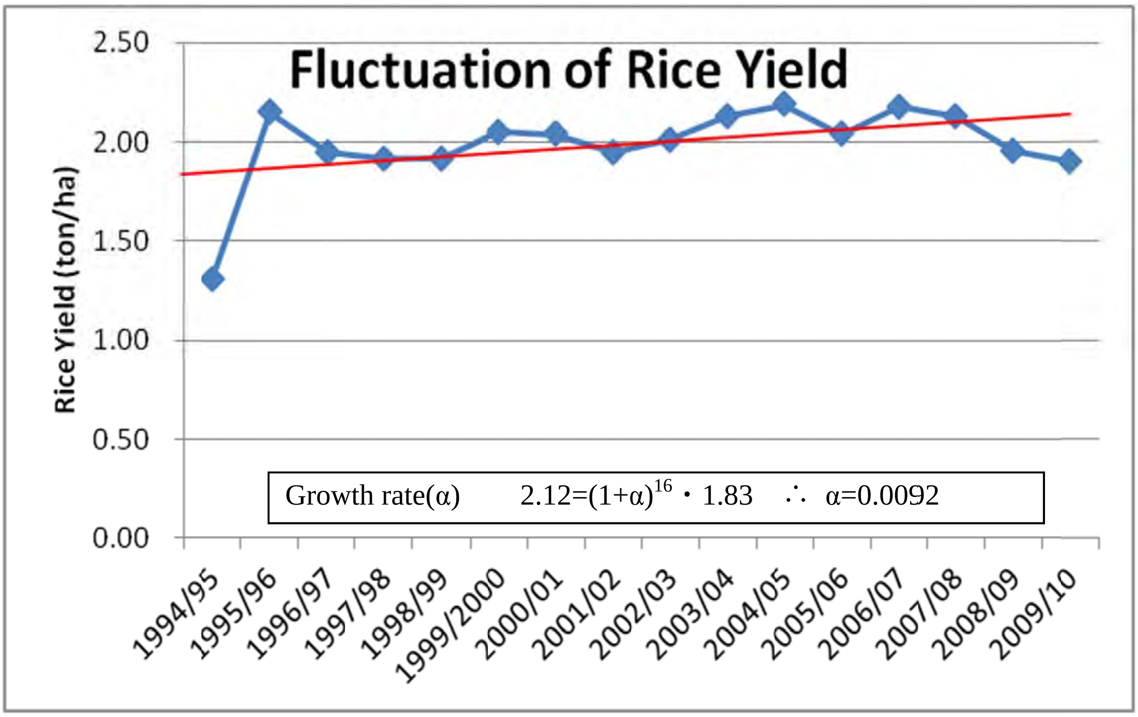


Source: JICA Project Team

Figure SR1.3-2 Fluctuation of Rice Cropping Area

(2-2) Annual growth rate of paddy yield

As a performance, annual growth rate of paddy yield during 16-year period from 1994/95 to 2009/10 is calculated at 0.92%. In recent years, no outstanding yield change has been observed in contrast with cropping area that recently marked a rapidly increasing trend. Whereas, according to "National Rice Development Strategy (NRDS)", the growth rate of yield of rain-fed upland rice was estimated at around 1 - 3% and that of rain-fed lowland rice was assumed at about 2 - 9%. Yet, this 9% may seem fairly unusual projection.



Source: JICA Project Team

Figure SR1.3-3 Fluctuation of Rice Yield

(3) Annual growth rate of cropping area and yield of rain-fed upland crops

Major upland crops in Nigeria consist of millet sorghum (Guinea Corn), maize, yam, cassava, groundnut, pulses and rice. Referring to the data by NBS, trends of cropping area、yield and production of these major crops as a whole is shown in table below.

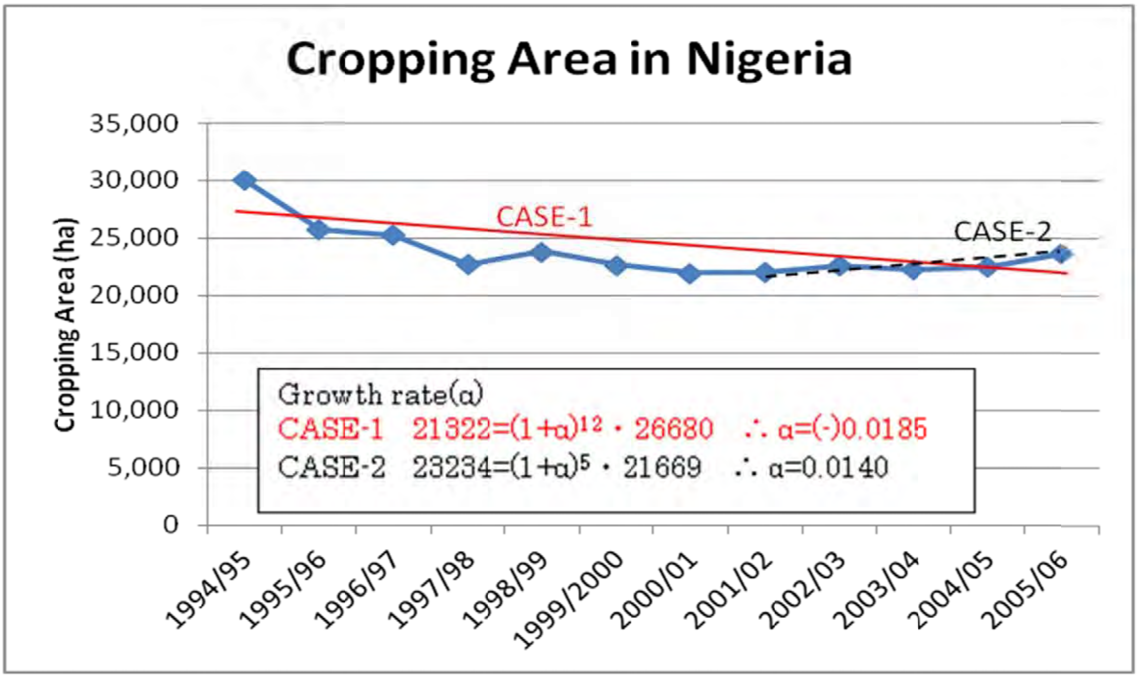
Table SR1.3-4 Trends of cropping area, yield and production of these major crops as a whole

Crop year	Cropping area(ha)	Yield (ton/ha)	Production (ton)
1994/95	30,044.67	2.52	75,609,16
1995/96	25,760,02	2.90	74,717,65
1996/97	25,318,04	3.15	79,761.73
1997/98	22,696,06	3.37	76,566.87
1998/99	23,839,35	3.35	79,79312
1999/2000	22,671,97	3.57	80,872.51
2000/01	21,966,89	3.44	75,506.56
2001/02	22,052,18	3.65	80,467.34
2002/03	22,584,81	3.45	77,869.35
2003/04	22,232,83	3.61	80,339.42
2004/05	22,524,60	3.60	80,997.09
2005/06	23,647,14	3.68	87,136.97

Source: Agricultural Survey Report 1994/95-2005-2006, NBS

(3-1) Annual growth rate of cropped area of upland crops

The annual growth rate of cropped area of upland crops has shown a declining tendency of (-)1.85% during 12-year period from 1994/95 to 2005/06 (Case-1), however, trend of recent 5-year period (Case-2) gave a positive value of 1.40%.

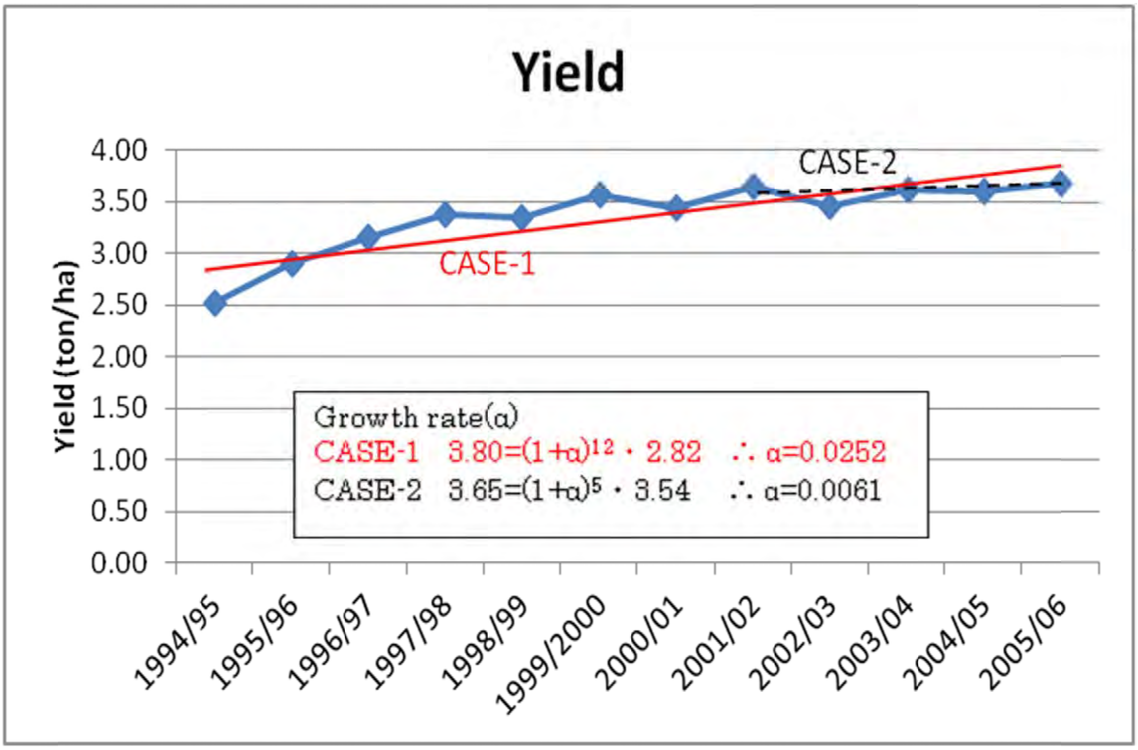


Source: JICA Project Team

Figure SR1.3-4 Fluctuation of Cropping Area

(3-2) Annual growth rate of upland crops' yield as a whole

The annual growth rate of major upland crops' yields as a whole is 2.52% during 12-year period from 1994/95 to 2005/06 (Case-1), however, trend of recent 5-year period (Case-2) indicates 0.61%, thus the growth of yield has somewhat been stagnated.



Source: JICA Project Team

Figure SR1.3-5 Fluctuation of Yield

SR1.3.2 Irrigated Rice Production by Yield

According to irrigation development plan in Vol.4, planned irrigation areas of public irrigation scheme become 468,752ha until 2030 and rice cultivated areas 385,711ha depending on planned cultivation pattern.
Rice production is estimated based on annual increase ratio of yield and shown in the tables of next pages.

On the other hand, farmland areas of private small scale irrigation farming are 335,000ha up to 2030 in which rice cultivation areas are 39,319ha.

Private small scale irrigation farming A=128,000ha as of 2010

After 20 years the future area is estimated, assuming the growth rate of 4%;

$$128{,}000 \times (1+0.04)^{20} \fallingdotseq 280{,}000\text{ha}$$

Taking into account of the outcome 55,000ha of National Fadama Development Program achieved by World Bank,

Private small scale irrigation farming as of 2030 is estimated, 280,000 + 55,000 = 335,000 ha

The intensive area where is assumed that irrigated rice would be produced is 196,000ha as 70% of 280,000ha, and the remain supposed as fadama farming would be produced vegetables and cereals.

Table SR1.3-5 Calculation of Private Small Scale Irrigated Rice Production

HA	Season	Crop Intensity (%)		Unit Production (t/ha)	Net Unit Production (t/ha)	Planned irrigation area (ha)	Total Production (ton)
		Rice	Other Cereal	Rice	Rice		Rice
1	Wet	20	70	4.4	0.88	23,680	20,838
	Dry	0	80	4.4	0.00	23,680	0
2	Wet	10	80	4.4	0.44	26,418	11,624
	Dry	0	80	4.4	0.00	26,418	0
3	Wet	10	80	4.4	0.44	24,266	10,677
	Dry	0	80	4.4	0.00	24,266	0
4	Wet	10	80	4.4	0.44	18,712	8,233
	Dry	0	80	4.4	0.00	18,712	0
5	Wet	30	60	4.4	1.32	16,105	21,259
	Dry	0	80	4.4	0.00	16,105	0
6	Wet	20	70	4.4	0.88	32,340	28,459
	Dry	0	80	4.4	0.00	32,340	0
7	Wet	30	60	4.4	1.32	22,196	29,299
	Dry	0	80	4.4	0.00	22,196	0
8	Wet	30	60	4.4	1.32	32,283	42,614
	Dry	0	80	4.4	0.00	32,283	0
Total	Wet	Above unit production is correspond to yield 1.0% growth rate per year				196,000	173,003
	Dry					196,000	0
	Total					**196,000**	**173,003**

Net Unit Production 0.88 ton/ha
Net Crop Intencity 0.20
Paddy Field Irrigated 39,319ha

Table SR1.3-6 Calculation of Public Irrigated Rice Production with Yield 1.0% growth rate per year

HA	Season	Crop Intensity (%)		Total Waer Loss (%)	Unit Production (t/ha)	Net Unit Production (t/ha)	Irrigable area by Land (ha)	2.1 Supplementary Irrigation Scheme: HA-5, HA-7		
		Rice	Other Cereal		Rice	Rice		Ratio of Wet Season Irrigated Area against Irrigable Area (%)	Wet Season Irrigated Area by Land Preparation Only (ha)	Total Production (ton) Rice
		a	b	c	d	f(=axd)	h	i	j (=hxi)	k (=jxf)
1	Wet	40	50	50	4.4	1.8	9,583,760	0	0	0
	Dry	0	50	50	4.4	0.0	9,583,760	0	0	0
2	Wet	60	30	50	4.4	2.6	4,630,467	0	0	0
	Dry	20	60	50	4.4	0.9	4,630,467	0	0	0
3	Wet	60	30	50	4.4	2.6	7,260,499	0	0	0
	Dry	20	60	50	4.4	0.9	7,260,499	0	0	0
4	Wet	60	30	50	4.4	2.6	2,842,298	0	0	0
	Dry	20	60	50	4.4	0.9	2,842,298	0	0	0
5	Wet	80	10	50	4.4	3.5	1,420,765	1.33731	19,000	66,880
	Dry	60	20	50	4.4	2.6	1,420,765	0	0	0
6	Wet	60	30	50	4.4	2.6	1,818,148	0	0	0
	Dry	40	40	50	4.4	1.8	1,818,148	0	0	0
7	Wet	80	10	50	4.4	3.5	2,259,559	1.28344	29,000	102,080
	Dry	60	20	50	4.4	2.6	2,259,559	0	0	0
8	Wet	80	10	50	4.4	3.5	14,715,575	0	0	0
	Dry	0	50	50	4.4	0.0	14,715,575	0	0	0
	Wet						44,531,071		48,000	168,960
	Dry						44,531,071		0	0
	Total						**44,531,071**		**48,000**	**168,960**
									Net Unit Production	**3.52**
									Net Crop Intensity	**0.80**

HA	Season	1.1 Completion with no Extension 1.2 On-going Scheme 1.3 Extension Scheme		2.2 Dam Irrigation Scheme 2.3 Integration Scheme			Total	
		Future irrigation area (ha)	Total Production (ton) Rice	Active Storage (MCM)	Total irrigation area (ha)	Total Production (ton) Rice	Total irrigation area (ha)	Total Production (ton) Rice
		m	n (=mxj)	p	q	r (=qxj)	t (=j+m+q)	u (=k+n+r)
1	Wet	41,041	72,232	18	1,500	2,640	42,541	74,872
	Dry	41,041	0	18	1,500	0	42,541	0
2	Wet	26,946	71,137	41	7,400	19,536	34,346	90,673
	Dry	26,946	23,712	41	7,400	6,512	34,346	30,224
3	Wet	20,265	53,500	0	111,700	294,888	131,965	348,388
	Dry	20,265	17,833	0	111,700	98,296	131,965	116,129
4	Wet	12,494	32,984	371	48,000	126,720	60,494	159,704
	Dry	12,494	10,995	371	48,000	42,240	60,494	53,235
5	Wet	17,700	62,304	58	4,100	14,432	40,800	143,616
	Dry	17,700	46,728	58	4,100	10,824	21,800	57,552
6	Wet	29,398	77,611	28	1,500	3,960	30,898	81,571
	Dry	29,398	51,740	28	1,500	2,640	30,898	54,380
7	Wet	8,410	29,603	86	5,700	20,064	43,110	151,748
	Dry	8,410	22,202	86	5,700	15,048	14,110	37,250
8	Wet	84,598	297,785	0	0	0	84,598	297,785
	Dry	84,598	0	0	0	0	84,598	0
	Wet	240,852	697,156	602	179,900	482,240	468,752	1,348,357
	Dry	240,852	173,211	602	179,900	175,560	420,752	348,771
	Total	**240,852**	**870,368**	**602**	**179,900**	**657,800**	**468,752**	**1,697,128**
		Net Unit Production	**3.61**		**Net Unit Production**	**3.66**	**Net Unit Production**	**3.62**
		Net Crop Intensity	**0.82**		**Net Crop Intensity**	**0.83**	**Net Crop Intensity**	**0.82**
							Rice Planting Area	**385,711**

Table SR1.3-7 Calculation of Public Irrigated Rice Production with Yield 1.5% growth rate per year

HA	Season	Crop Intensity (%) Rice	Crop Intensity (%) Other Cereal	Total Waer Loss (%)	Unit Production (t/ha) Rice	Net Unit Production (t/ha) Rice	Irrigable area by Land (ha)	2.1 Supplementary Irrigation Scheme: HA-5, HA-7 Ratio of Wet Season Irrigated Area againast Irrigable Area (%)	Wet Season Irrigated Area by Land Preparaton Only (ha)	Total Production (ton) Rice
		a	b	c	d	f(=axd)	h	i	j (=hxi)	k (=jxf)
1	Wet	40	50	50	4.9	2.0	9,583,760	0	0	0
	Dry	0	50	50	4.9	0.0	9,583,760	0	0	0
2	Wet	60	30	50	4.9	2.9	4,630,467	0	0	0
	Dry	20	60	50	4.9	1.0	4,630,467	0	0	0
3	Wet	60	30	50	4.9	2.9	7,260,499	0	0	0
	Dry	20	60	50	4.9	1.0	7,260,499	0	0	0
4	Wet	60	30	50	4.9	2.9	2,842,298	0	0	0
	Dry	20	60	50	4.9	1.0	2,842,298	0	0	0
5	Wet	80	10	50	4.9	3.9	1,420,765	1.33731	19,000	74,480
	Dry	60	20	50	4.9	2.9	1,420,765	0	0	0
6	Wet	60	30	50	4.9	2.9	1,818,148	0	0	0
	Dry	40	40	50	4.9	2.0	1,818,148	0	0	0
7	Wet	80	10	50	4.9	3.9	2,259,559	1.28344	29,000	113,680
	Dry	60	20	50	4.9	2.9	2,259,559	0	0	0
8	Wet	80	10	50	4.9	3.9	14,715,575	0	0	0
	Dry	0	50	50	4.9	0.0	14,715,575	0	0	0
	Wet						44,531,071		48,000	188，160
	Dry						44,531,071		0	0
	Total						**44,531,071**		**48,000**	**188，160**
									Net Unit Production	**3.92**
									Net Crop Intencity	**0.80**

HA	Season	1.1 Completion with no Extension 1.2 On-going Scheme 1.3 Extension Scheme: Future irrigation area (ha)	Total Production (ton) Rice	2.2 Dam Irrigation Scheme 2.3 Integration Scheme: Active Storage (MCM)	Total irrigation area (ha)	Total Production (ton) Rice	Total: Total irrigation area (ha)	Total Production (ton) Rice
		m	n (=mxj)	p	q	r (=qxj)	t (=j+m+q)	u (=k+n+r)
1	Wet	41,041	80,440	18	1,500	2,940	42,541	83,380
	Dry	41,041	0	18	1,500	0	42,541	0
2	Wet	26,946	79,221	41	7,400	21,756	34,346	100,977
	Dry	26,946	26,407	41	7,400	7,252	34,346	33,659
3	Wet	20,265	59,579	0	111,700	328,398	131,965	387,977
	Dry	20,265	19,860	0	111,700	109,466	131,965	129,326
4	Wet	12,494	36,732	371	48,000	141,120	60,494	177,852
	Dry	12,494	12,244	371	48,000	47,040	60,494	59,284
5	Wet	17,700	69,384	58	4,100	16,072	40,800	159,936
	Dry	17,700	52,038	58	4,100	12,054	21,800	64,092
6	Wet	29,398	86,430	28	1,500	4,410	30,898	90,840
	Dry	29,398	57,620	28	1,500	2,940	30,898	60,560
7	Wet	8,410	32,967	86	5,700	22,344	43,110	168,992
	Dry	8,410	24,725	86	5,700	16,758	14,110	41,483
8	Wet	84,598	331,624	0	0	0	84,598	331,624
	Dry	84,598	0	0	0	0	84,598	0
	Wet	240,852	776,379	602	179,900	537,040	468,752	1,501,579
	Dry	240,852	192,894	602	179,900	195,510	420,752	388,404
	Total	**240,852**	**969,273**	**602**	**179,900**	**732,550**	**468,752**	**1,889,983**
		Net Unit Production	**4.02**		**Net Unit Production**	**4.07**	**Net Unit Production**	**4.03**
		Net Crop Intensity	**0.82**		**Net Crop Intensity**	**0.83**	**Net Crop Intensity**	**0.82**
							Rice Planting Area	**385,711**

Table SR1.3-8 Calculation of Public Irrigated Rice Production with Yield 2.0% growth rate per year

HA	Season	Crop Intensity (%)		Total Waer Loss (%)	Unit Producti on (t/ha)	Net Unit Producti on (t/ha)	Irrigable area by Land (ha)	2.1 Supplementary Irrigation Scheme: HA-5, HA-7		
		Rice	Other Cereal		Rice	Rice		Ratio of Wet Season Irrigated Area againast Irrigable Area (%)	Wet Season Irrigated Area by Land Preparaton Only (ha)	Total Production (ton) Rice
		a	b	c	d	f(=axd)	h	i	j (=hxi)	k (=jxf)
1	Wet	40	50	50	5.4	2.2	9,583,760	0	0	0
	Dry	0	50	50	5.4	0.0	9,583,760	0	0	0
2	Wet	60	30	50	5.4	3.2	4,630,467	0	0	0
	Dry	20	60	50	5.4	1.1	4,630,467	0	0	0
3	Wet	60	30	50	5.4	3.2	7,260,499	0	0	0
	Dry	20	60	50	5.4	1.1	7,260,499	0	0	0
4	Wet	60	30	50	5.4	3.2	2,842,298	0	0	0
	Dry	20	60	50	5.4	1.1	2,842,298	0	0	0
5	Wet	80	10	50	5.4	4.3	1,420,765	1.33731	19,000	82,080
	Dry	60	20	50	5.4	3.2	1,420,765	0	0	0
6	Wet	60	30	50	5.4	3.2	1,818,148	0	0	0
	Dry	40	40	50	5.4	2.2	1,818,148	0	0	0
7	Wet	80	10	50	5.4	4.3	2,259,559	1.28344	29,000	125,280
	Dry	60	20	50	5.4	3.2	2,259,559	0	0	0
8	Wet	80	10	50	5.4	4.3	14,715,575	0	0	0
	Dry	0	50	50	5.4	0.0	14,715,575	0	0	0
	Wet						44,531,071		48,000	207,361
	Dry						44,531,071		0	0
	Total						**44,531,071**		**48,000**	**207,361**
									Net Unit Production	**4.32**
									Net Crop Intencity	**0.80**

HA	Season	1.1 Completion with no Extension 1.2 On-going Scheme 1.3 Extension Scheme		2.2 Dam Irrigation Scheme 2.3 Integration Scheme			Total	
		Fiture irrigation area (ha)	Total Production (ton) Rice	Active Storage (MCM)	Total irrigation area (ha)	Total Production (ton) Rice	Total irrigation area (ha)	Total Production (ton) Rice
		m	n (=mxj)	p	q	r (=qxj)	t (=j+m+q)	u (=k+n+r)
1	Wet	41,041	88,649	18	1,500	3,240	42,541	91,889
	Dry	41,041	0	18	1,500	0	42,541	0
2	Wet	26,946	87,305	41	7,400	23,976	34,346	111,281
	Dry	26,946	29,102	41	7,400	7,992	34,346	37,094
3	Wet	20,265	65,659	0	111,700	361,908	131,965	427,567
	Dry	20,265	21,886	0	111,700	120,636	131,965	142,522
4	Wet	12,494	40,481	371	48,000	155,520	60,494	196,001
	Dry	12,494	13,494	371	48,000	51,840	60,494	65,334
5	Wet	17,700	76,464	58	4,100	17,712	40,800	176,256
	Dry	17,700	57,348	58	4,100	13,284	21,800	70,632
6	Wet	29,398	95,250	28	1,500	4,860	30,898	100,110
	Dry	29,398	63,500	28	1,500	3,240	30,898	66,740
7	Wet	8,410	36,331	86	5,700	24,624	43,110	186,236
	Dry	8,410	27,248	86	5,700	18,468	14,110	45,716
8	Wet	84,598	365,463	0	0	0	84,598	365,463
	Dry	84,598	0	0	0	0	84,598	0
	Wet	240,852	855,601	602	179,900	591,840	468,752	1,654,801
	Dry	240,852	212,577	602	179,900	215,460	420,752	428,037
	Total	**240,852**	**1,068,178**	**602**	**179,900**	**807,300**	**468,752**	**2,082,839**
		Net Unit Production	**4.43**		**Net Unit Production**	**4.49**	**Net Unit Production**	**4.44**
		Net Crop Intensity	**0.82**		**Net Crop Intensity**	**0.83**	**Net Crop Intensity**	**0.82**
							Rice Planting Area	**385,711**

Table SR1.3- 9Calculation of Public Irrigated Rice Production with Yield 2.5% growth rate per year

HA	Season	Crop Intensity (%)		Total Waer Loss (%)	Unit Production (t/ha)	Net Unit Production (t/ha)	Irrigable area by Land (ha)	2.1 Supplementary Irrigation Scheme: HA-5, HA-7 Ratio of Wet Season Irrigated Area againast Irrigable Area (%)	Wet Season Irrigated Area by Land Preparaton Only (ha)	Total Production (ton)
		Rice	Other Cereal		Rice	Rice				Rice
		a	b	c	d	f(=axd)	h	i	j (=hxi)	k (=jxf)
1	Wet	40	50	50	6.0	2.4	9,583,760	0	0	0
	Dry	0	50	50	6.0	0.0	9,583,760	0	0	0
2	Wet	60	30	50	6.0	3.6	4,630,467	0	0	0
	Dry	20	60	50	6.0	1.2	4,630,467	0	0	0
3	Wet	60	30	50	6.0	3.6	7,260,499	0	0	0
	Dry	20	60	50	6.0	1.2	7,260,499	0	0	0
4	Wet	60	30	50	6.0	3.6	2,842,298	0	0	0
	Dry	20	60	50	6.0	1.2	2,842,298	0	0	0
5	Wet	80	10	50	6.0	4.8	1,420,765	1.33731	19,000	91,200
	Dry	60	20	50	6.0	3.6	1,420,765	0	0	0
6	Wet	60	30	50	6.0	3.6	1,818,148	0	0	0
	Dry	40	40	50	6.0	2.4	1,818,148	0	0	0
7	Wet	80	10	50	6.0	4.8	2,259,559	1.28344	29,000	139,200
	Dry	60	20	50	6.0	3.6	2,259,559	0	0	0
8	Wet	80	10	50	6.0	4.8	14,715,575	0	0	0
	Dry	0	50	50	6.0	0.0	14,715,575	0	0	0
	Wet						44,531,071		48,000	230,401
	Dry						44,531,071		0	0
	Total						**44,531,071**		**48,000**	**230,401**
									Net Unit Production	**4.80**
									Net Crop Intencity	**0.80**

HA	Season	1.1 Completion with no Extension 1.2 On-going Scheme 1.3 Extension Scheme Future irrigation area (ha)	Total Production (ton)	2.2 Dam Irrigation Scheme 2.3 Integration Scheme Active Storage (MCM)	Total irrigation area (ha)	Total Production (ton)	Total: Total irrigation area (ha)	Total Production (ton)
			Rice			Rice		Rice
		m	n (=mxj)	p	q	r (=qxj)	t (=j+m+q)	u (=k+n+r)
1	Wet	41,041	98,498	18	1,500	3,600	42,541	102,098
	Dry	41,041	0	18	1,500	0	42,541	0
2	Wet	26,946	97,006	41	7,400	26,640	34,346	123,646
	Dry	26,946	32,335	41	7,400	8,880	34,346	41,215
3	Wet	20,265	72,954	0	111,700	402,120	131,965	475,074
	Dry	20,265	24,318	0	111,700	134,040	131,965	158,358
4	Wet	12,494	44,978	371	48,000	172,800	60,494	217,778
	Dry	12,494	14,993	371	48,000	57,600	60,494	72,593
5	Wet	17,700	84,960	58	4,100	19,680	40,800	195,840
	Dry	17,700	63,720	58	4,100	14,760	21,800	78,480
6	Wet	29,398	105,833	28	1,500	5,400	30,898	111,233
	Dry	29,398	70,555	28	1,500	3,600	30,898	74,155
7	Wet	8,410	40,368	86	5,700	27,360	43,110	206,928
	Dry	8,410	30,276	86	5,700	20,520	14,110	50,796
8	Wet	84,598	406,070	0	0	0	84,598	406,070
	Dry	84,598	0	0	0	0	84,598	0
	Wet	240,852	950,668	602	179,900	657,600	468,752	1,838,668
	Dry	240,852	236,197	602	179,900	239,400	420,752	475,597
	Total	**240,852**	**1,186,865**	**602**	**179,900**	**897,000**	**468,752**	**2,314,265**
		Net Unit Production	**4.92**		**Net Unit Production**	**4.99**	**Net Unit Production**	**4.94**
		Net Crop Intensity	**0.82**		**Net Crop Intensity**	**0.83**	**Net Crop Intensity**	**0.82**
							Rice Planting Area	**385,711**

Table SR1.3- 10 Calculation of Irrigated Rice Production at Existing Public Irrigation Scheme

HA	Season	Existing Crop Intensity (%)		Total Waer Loss (%)	Unit Production (t/ha)	Net Unit Production (t/ha)	Irrigable area by Land (ha)
		Rice	Other Cereal		Rice	Rice	
		a	b	c	d	f(=axd)	h
1	Wet	40	25	50	3.5	1.4	9,583,760
	Dry	5	60	50	3.5	0.2	9,583,760
2	Wet	10	60	50	3.5	0.4	4,630,467
	Dry	10	30	50	3.5	0.4	4,630,467
3	Wet	10	60	50	3.5	0.4	7,260,499
	Dry	10	30	50	3.5	0.4	7,260,499
4	Wet	10	60	50	3.5	0.4	2,842,298
	Dry	10	30	50	3.5	0.4	2,842,298
5	Wet	70	5	50	3.5	2.5	1,420,765
	Dry	0	0	50	3.5	0.0	1,420,765
6	Wet	35	25	50	3.5	1.2	1,818,148
	Dry	0	35	50	3.5	0.0	1,818,148
7	Wet	70	30	50	3.5	2.5	2,259,559
	Dry	5	15	50	3.5	0.2	2,259,559
8	Wet	80	15	50	3.5	2.8	14,715,575
	Dry	0	25	50	3.5	0.0	14,715,575
	Wet						44,531,071
	Dry						44,531,071
	Total						**44,531,071**

HA	Season	**1.1 Completion with no Extension**		**Total**	
		Future irrigation area (ha)	Total Production (ton)	Total irrigation area (ha)	Total Production (ton)
			Rice		Rice
		m	n (=mxj)	t (=j+m+q)	u (=k+n+r)
1	Wet	24,441	34,217	24,441	34,217
	Dry	24,441	4,277	24,441	4,277
2	Wet	3,048	1,067	3,048	1,067
	Dry	3,048	1,067	3,048	1,067
3	Wet	905	317	905	317
	Dry	905	317	905	317
4	Wet	877	307	877	307
	Dry	877	307	877	307
5	Wet	630	1,544	630	1,544
	Dry	630	0	630	0
6	Wet	1,449	1,775	1,449	1,775
	Dry	1,449	0	1,449	0
7	Wet	2,250	5,513	2,250	5,513
	Dry	2,250	394	2,250	394
8	Wet	4,418	12,370	4,418	12,370
	Dry	4,418	0	4,418	0
	Wet	38,018	57,109	38,018	57,109
	Dry	38,018	6,361	38,018	6,361
	Total	**38,018**	**63,471**	**38,018**	**63,471**
		Net Unit Production	**1.67**	**Net Unit Production**	**1.67**
		Net Crop Intensity	**0.48**	**Net Crop Intensity**	**0.48**
				Rice Planting Area	**18,135**

SR1.3.3 Proposed Cropping Pattern

(1) Existing Cropping Pattern

(1-1) Current Cropping Calendar

The following table shows cropping seasons in the three large hydrological basins of Nigeria, which are gained from various materials and interview surveys.

Table SR1.3-10 Cropping Seasons

Area	HA	Crop	Cropping Season	Wet Period
Northern	1 / 8	Rice (wet season) Wheat Other grain Tomato & onion Maize Millet Sorghum Cassava	Feb/March –June/July[1)] Nov. - March[1)] May – Sep., Dec. - April[1) 2)] Oct./Nov. – Feb./March[3)] June – Sep. July – Oct. June/July – Aug./Sep. May – Feb.	Eastern: June – Sep. Western: May – Oct.
Central	2 / 3 /4	Rice (wet season) Rice (dry season) Tomato Maize Sorghum Cassava	May – Sep.[4)] Nov. - March[5)] Dec. - March[6)] June – Sep. June – Sep. April – Dec.	Eastern: April – Oct. Western: April – Oct.
Southern	5 / 6 / 7	Rice (wet season) Rice (dry season) Maize Cotton Tomato	May – Sep.[7)] Nov. - March[7)] May – Aug, Sep. – Dec. May – Nov. July – Nov.	North-eastern: Feb. – Nov. South-eastern: Year-round Western: March/April – Oct.

Source: 1)Bakalori 2)Jibiya 3)Swashi 4)Tada Shonga 5)Geriyan 6)Svannah 7)Lower Anambra, Isi Uzo

(1-2) Currently practiced Cropping Pattern in Public Irrigation Schemes

- Northern part of Nigeria belongs to semi-arid zone with scanty annual rainfall, however, irrigated rice cultivation during rainy season has widely been practiced in HA-8. Irrigation is required in this area where irrigated farming has well been practiced with so far learnt ample experiences/ performances. In dry season, wheat and other cereal crops as well as vegetables are mainly cultivated because rainfall is too short for rice cultivation, and atmospheric temperature is too low for the growth of rice. The farming type in public irrigation schemes in HA-1 is similar though the irrigated perimeter is smaller than that of HA-8.
- In the central part including HA-2, HA-3 and HA-4, irrigated rice cropping is not active both in rainy and dry seasons. Several limiting factors are considered in this inactiveness, above all fuel for driving pumps is too expensive to purchase, spare-parts for them are hardly procured, irrigation facilities do not function well due to maintenance management has not properly practiced etc.
- Southern part of Nigeria is one of the areas where irrigated rice cultivation is widely practiced, among others HA-5 and HA-7 are known as popular rice cropping in rainy season. Double cropping of rice was practiced until 1998 in the irrigated perimeter of Lower Anambra irrigation scheme that has the largest irrigated area in this zone, where cropping intensity of rice during dry seasons was averaged at 60%. However, irrigation in dry season could not be maintained since 1999 by the reasons that fuel for pumps could not be purchased and spare-parts for them could no more be procured. This withdrawal led to current slump of rice cultivation in dry season. Annual rainfall has been comparatively less in HA-6 as compared with HAs–5/7 and hills, plateau widely occupy in it. Such climatic and topographic conditions have made cropping type of HA-6 dependent on yam and cassava as major cultivation. This is the reason why rice cultivation during rainy season has somewhat been inactive in comparison with that in HAs-7/8.

<u>**Current Cropping Pattern**</u>

The following table shows the current cropping rate set based on RBDA’s materials and cropping acreages of large-scale irrigation schemes.

Table SR1.3-11 Current Cropping Pattern (%)

HA	Irrigation scheme (%)				Small-scale private irrigation (%)			
	Wet Season		Dry Season		Wet Season		Dry Season	
	Paddy	Upland	Paddy	Upland	Paddy	Upland	Paddy	Upland
1	40	25	5	60	20	50	0	70
2	10	60	10	30	10	60	0	70
3	10	60	10	30	10	60	0	70
4	10	60	10	30	10	60	0	70
5	70	5	0	0	30	40	0	70
6	35	25	0	35	20	50	0	70
7	70	30	5	15	30	40	0	70
8	80	15	0	25	30	40	0	70

HA-1 Existing Cropping Pattern

Scheme	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
Shagari	Rice	50	0	25	0	200
	Others	110	80	55	40	
Middle Rima Valley	Rice	80	0	7	0	1,188
	Others	1,000	950	84	80	
Bakalori	Rice	7,200	0	90	0	8,000
	Others	800	4,000	10	50	
Jibiya	Rice	0		0	0	3,000
	Others	2,700	1,500	90	50	
Zauro Polder	Rice	85	0	85	0	100
	Others	15	15	15	15	
Niger Valley	Rice	0	700	0	10	7,000
	Others	1,400	6,300	20	90	
Total	Rice	7,335	700	38	4	19,488
	Others	5,025	11,895	26	61	

Source: Inventry survey, Data collected from SRRBDA, Interview at Project site

HAs-2/3/4 Existing Cropping Pattern

Scheme	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
Kampe dam (Omi I.P.) (HA-2)	Rice	40	0	4	0	1,000
	Others	710	250	71	25	
Oke-Oyi (HA-2)	Rice	1	0	2	0	50
	Others	21	24	42	48	
Tada-shonga (HA-2)	Rice	43	0	10	0	435
	Others	392	100	90	23	
Lake Geriyo (HA-3)	Rice	0	150	0	43	350
	Others	0	170	0	49	
Dadin Kowa (HA-3)	Rice	70	0	70	0	100
	Others	30	70	30	70	
Total	Rice	154	150	8	8	1,935
	Others	1,153	614	60	32	

Source: Inventry survey, Data collected from UBRBDA, Interview at Project site

HA-5 Existing Cropping Pattern

Year	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
1991	Rice	2,600	2,400	68	62	3,850
	Others	0	0	0	0	
1992	Rice	2,400	3,000	62	78	3,850
	Others	0	0	0	0	
1993	Rice	1,637	3,049	43	79	3,850
	Others	0	0	0	0	
1995	Rice	3,000	1,000	78	26	3,850
	Others	0	0	0	0	
1996	Rice	3,000	2,150	78	56	3,850
	Others	0	0	0	0	
1997	Rice	3,100	2,750	81	71	3,850
	Others	0	0	0	0	
1998	Rice	3,200	1,572	83	41	3,850
	Others	0	0	0	0	
Average	Rice	2,705	2,274	70	59	3,850
	Others	0	0	0	0	

Source: Lower Anumbura Irrigation Project by AIRBDA

Note: Since 1999, Irrigation performance in dry season has been stopped due to lack of budget of fuel for pum running and difficulty of purchse of spear-part of pump facilities. Hence rice crop intensity in dry season is zero.

Scheme	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
Isokpo	Rice	0	0	0	0	11
	Others	11	0	100	0	
Kpong	Rice	0	0	0	0	89
	Others	89	0	100	0	
Ekporo	Rice	0	0	0	0	40
	Others	40	0	100	0	
Egberu	Rice	0	0	0	0	20
	Others	20	0	100	0	
Perrmabiri	Rice	340	0	100	0	340
	Others	0	0	0	0	
Isampou	Rice	70	0	100	0	70
	Others	0	0	0	0	
Anyama-Ogbia	Rice	24	0	100	0	24
	Others	0	0	0	0	
Fand	Rice	20	0	100	0	20
	Others	0	0	0	0	
Egbuou	Rice	10	0	100	0	10
	Others	0	0	0	0	
Average	Rice	464	0	74	0	624
	Others	160	0	26	0	

Source: Inventry survey, Data collected from NDRBDA

Wet season Rice (2705+464)/(3850+624) = 71% Others 160/(3850+624) = 4%

HA-6 Existing Cropping Pattern

Scheme	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
Mokoloki (Lower Ogun I. P.)	Rice	120	0	18	0	680
	Others	80	460	12	68	
Ilishi/ Ega/ Oria	Rice	300	0	100	0	300
	Others	0	0	0	0	
Ukpoke	Rice	0	0	0	0	75
	Others	45	0	60	0	
Ewulu	Rice	30	0	60	0	50
	Others	0	0	0	0	
Ero	Rice	0	0	0	0	200
	Others	200	0	100	0	
Total	Rice	450	0	34	0	1,305
	Others	325	460	25	35	

Source: Inventory survey, Data collected from OORBDA and BORBDA, Interview at Project site

HA-7 Existing Cropping Pattern

Scheme	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
Obubu	Rice	92	0	80	0	115
	Others	23	0	20	0	
Obubra	Rice	90	0	80	0	112
	Others	22	22	20	20	
Itu	Rice	100	0	100	0	100
	Others	0	0	0	0	
Ijegu/ Iyala	Rice	70	0	88	0	80
	Others	10	10	13	13	
Abak	Rice	62	42	100	68	62
	Others	0	20	0	32	
Oniong Nung Ndem	Rice	17	0	10	0	177
	Others	160	0	90	0	
Ogaja	Rice	125	0	100	0	125
	Others	0	60	0	48	
Total	Rice	556	42	72	5	771
	Others	215	112	28	15	

Source: Inventry survey, Data collected from CRBDA

HA-8 Existing Cropping Pattern

Year	Crop	Wet season Area (ha)	Dry season Area (ha)	Crop intensity Wet (%)	Crop intensity Dry (%)	Developed Area (ha)
2006	Rice	15,000	0	83	0	18,000
	Others	1,750	2,626	10	15	
2007	Rice	14,200	0	79	0	18,000
	Others	1,900	2,800	11	16	
2008	Rice	14,300	0	79	0	18,000
	Others	2,300	4,500	13	25	
2009	Rice	14,500	0	81	0	18,000
	Others	2,500	3,600	14	20	
2010	Rice	14,600	0	81	0	18,000
	Others	3,400	6,865	19	38	
Average	Rice	14,520	0	81	0	18,000
	Others	2,370	4,078	13	23	

Source: Data collected from HJRBDA

(2) Proposed Cropping Pattern

(2-1) Proposed Cropping Calendar

Proposed cropping calendar is set, taking into account of monthly reinfall and growing period of crops. Rice planting requires plenty of irrigatin water in rice transplanting period. Thus it is prehered to set rice transplanting period around the same time of much reinfall. In north region it is recommended that the commencement of rice planting is converted from conventional Febrary to May becase of the abovet reason. In addition, rice cropping period are planned with gradual shift of planting date so that monthly supply of irrigation wataer can be leveled. The standard proposed cropping seasons in each area is as follows:

Northern Area :	Rice	May - Oct. (wet)
	Other grain, vegetables	May - Oct. (wet), Nov.- April (dry)
Central Area and Southern Area :	Rice	May - Oct. (wet), Oct. - March (dry)
	Other grain, vegetables	May - Oct. (wet), Nov. - April (dry)

(2-2) Cropping Acreage Plan

Proposed cropping pattern on public irrigation schemes is set taking into account of regional climate and agricultural strategy that identifies rice as prime crop. The rate of fallow farmland is set at 10% and 20% in wet and dry season respectively according to actual conditions.

- **Northern Area (HAs-1/8)**

Water resources for late-developed irrigation schemes are limited because (a) the northern area has insufficient annual precipitation, 400-800mm, and (b) existing available water is consumed by large-scale irrigation projects. Therefore cropping pattern of rice that consumpt plenty of water is set at the same as current condition, and it is recommended that crops introduced into the irrigated area have relatively small water requirement, e.g. wheat, maize. The cropping acreage plan of irrigation schemes in HA-1 is set to be 140% (rice 40% and grain & vegetables 100%). Meanwhile at the irrigation schemes in HA-8 is set to be 140% (rice 80% and grain & vegetables 60%)

- **Central Area (HAs-2/3/4)**

The annual precipitation in the central area is 800-1,400mm, which is much more than that in the northern area and is adecuate for rice planting. The cropping acreage plan of irrigation schemes is set to be 170% (rice 80% and grain & vegetables 90%).

- **Southern Area (HAs-5/6/7)**

The annual precipitation in the southern area is 1,400-2,500mm. Therefore, this area has abundant water resources compared to the other two areas. It is recommended to carry out rice double cropping a year at the irrigation schemes in HAs-5/7, the cropping acreage plan of irrigation schemes is set to be 170% (rice 140% and grain & vegetables 30%). Meanwhile at the irrigation schemes in HA-6 that precipitation is a little low comparatively, the cropping acreage plan of irrigation schemes is set to be 170% (rice 100% and grain & vegetables 70%).

- **Small-scale Private Irrigation**

It is presumed that the paddy cropping acreage is the same as the current one, because both private irrigation schemes and fadama farming systems use small pumps for irrigation and their rice cultivation is small-scale. Meanwhile, upland cropping acreage is set higher than the current one because increased yield is promoted.

Table SR1.3-12 Proposed Cropping Pattern (%)

HA	Irrigation scheme (%)				Small-scale private irrigation (%)			
	Wet Season		Dry Season		Wet Season		Dry Season	
	Paddy	Upland	Paddy	Upland	Paddy	Paddy	Upland	Paddy
1	40	50	0	50	20	70	0	80
2	60	30	20	60	10	80	0	80
3	60	30	20	60	10	80	0	80
4	60	30	20	60	10	80	0	80
5	80	10	60	20	30	60	0	80
6	60	30	40	40	20	70	0	80
7	80	10	60	20	30	60	0	80
8	80	10	0	50	30	60	0	80

Note that the above cropping plan will be further considered in this M/P from now on.

(2-3) Crop coefficient (Kc)

Crop coefficient (Kc) on growth stage is selected based on FAO technical text. Wind condition is clam or weak.

Rice

HA	Season	Initial stage(1) First month 15 days	Initial stage(2) Second month 30 days	Middle stage 30 days	Tardive stage 30 days
Common	Wet	1.1	1.1	1.05	0.95
Common	Dry	1.1	1.1	1.25	1.0

Maize

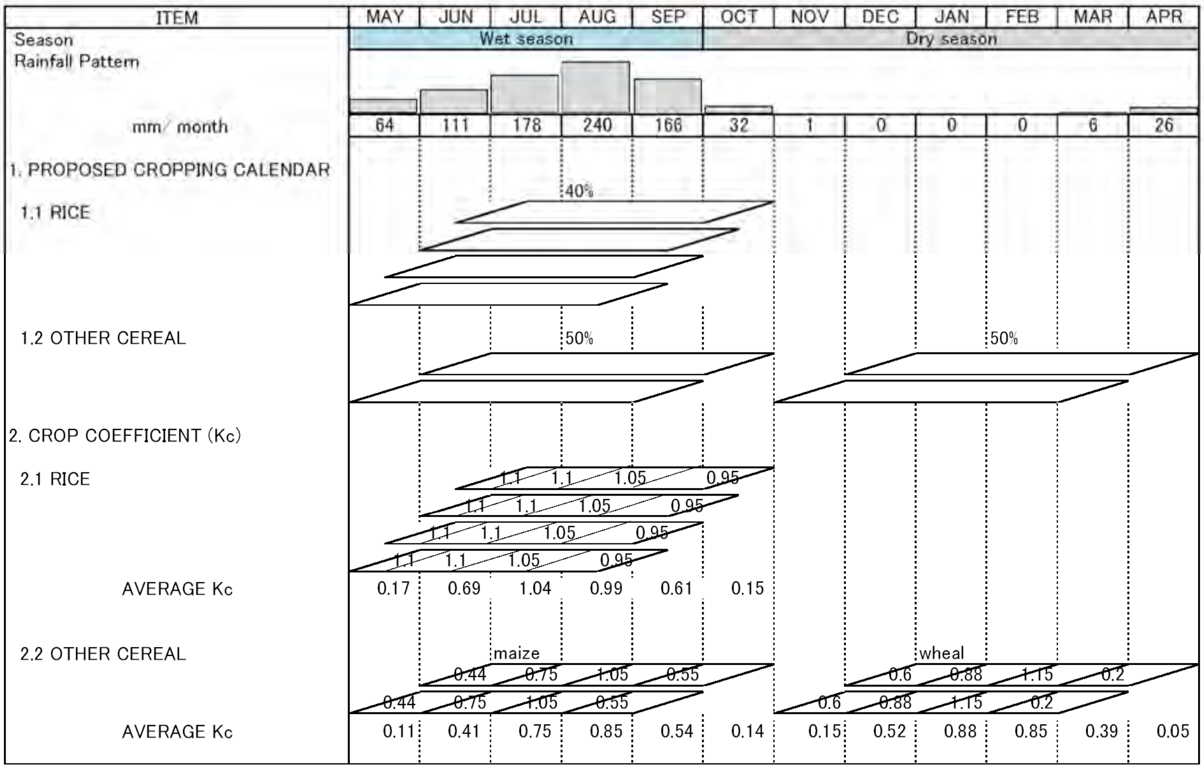
HA	Season	Sowing time	ETo (mm/ day)	Irrigation interval	Initial stage(1) 30days	Initial stage(2) 30days	Middle stage 30days	Tardive stage 30days
HA-1	Wet	May	5.8	7	0.44	0.75	1.05	0.55
	Dry	Nov.	3.2	7	0.58	0.87	1.15	0.60
HA-2	Wet	May	4.4	7	0.50	0.78	1.05	0.55
	Dry	Nov.	3.3	7	0.58	0.84	1.1	0.58
HA-3	Wet	May	4.4	7	0.50	0.78	1.05	0.55
	Dry	Nov.	3.2	7	0.58	0.84	1.1	0.58
HA-4	Wet	May	4.1	7	0.52	0.79	1.05	0.55
	Dry	Nov.	3.3	7	0.57	0.84	1.1	0.58
HA-5	Wet	May	4.1	7	0.52	0.79	1.05	0.55
	Dry	Nov.	3.5	7	0.56	0.81	1.05	0.55
HA-6	Wet	May	4.1	7	0.52	0.79	1.05	0.55
	Dry	Nov.	3.5	7	0.56	0.81	1.05	0.55
HA-7	Wet	May	4.0	7	0.52	0.79	.1.05	1.05
	Dry	Dec.	3.5	7	0.56	0.81	1.05	0.55

Wheat

HA	Season	Sowing time	ETo (mm /day)	Irrigation interval	Initial stage(1) 30days	Initial stage(2) 30days	Middle stage 30days	Tardive stage 30days
HA-1	Dry	Dec.	2.7	7	0.6	0.88	1.15	0.2
HA-8	Dry	Dec.	2.5	7	0.62	0.89	1.15	0.2

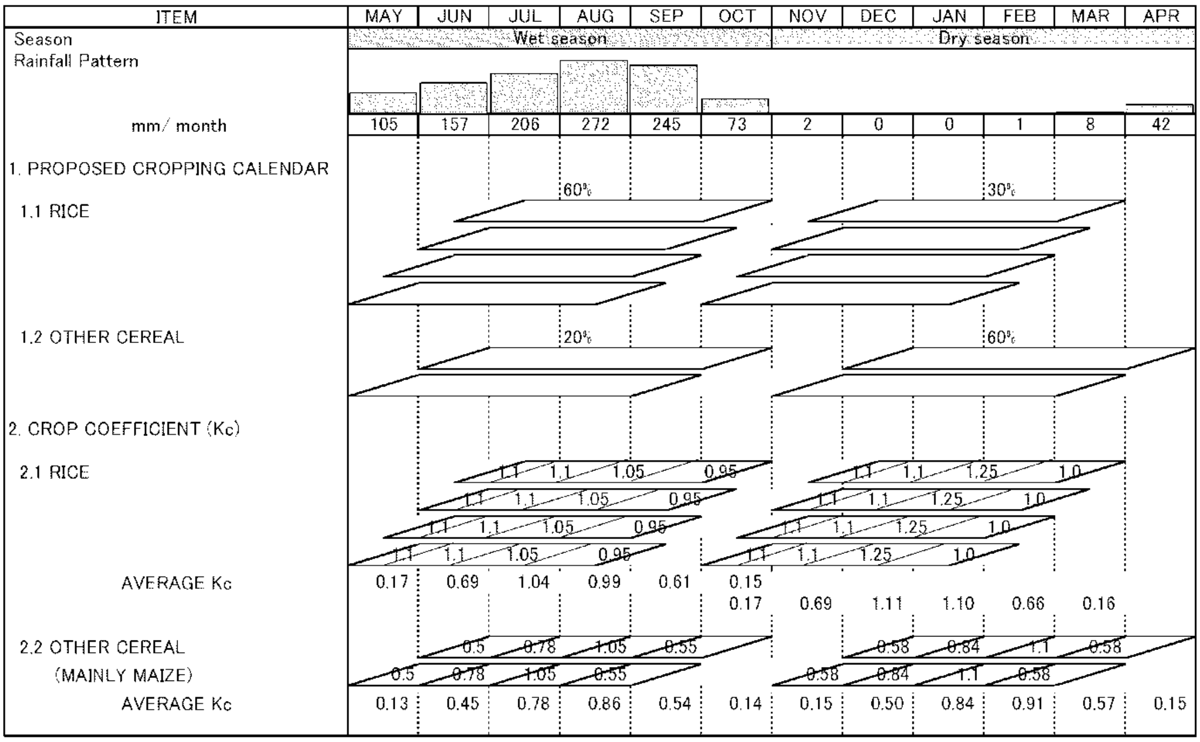
(2-4) Proposed Cropping Pattern by Hydrological Area

HA-1: Proposed Cropping Calendar



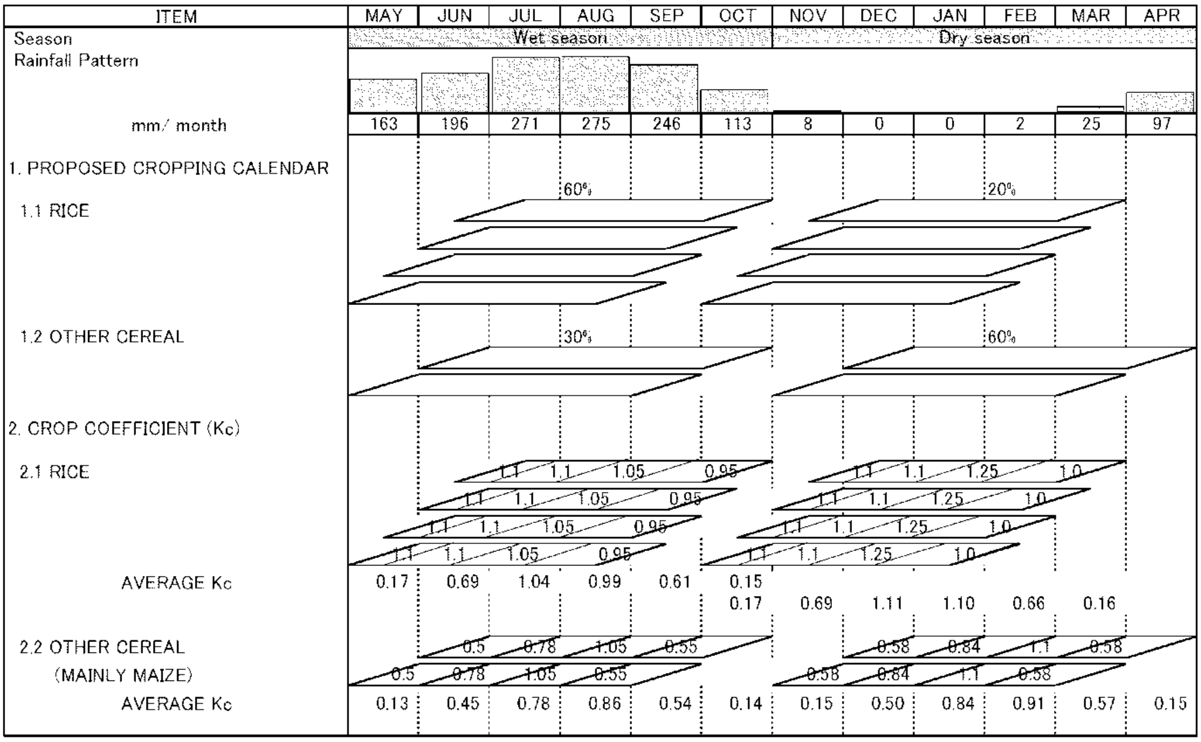
Source: JICA Project Team

HA-2: Proposed Cropping Calendar



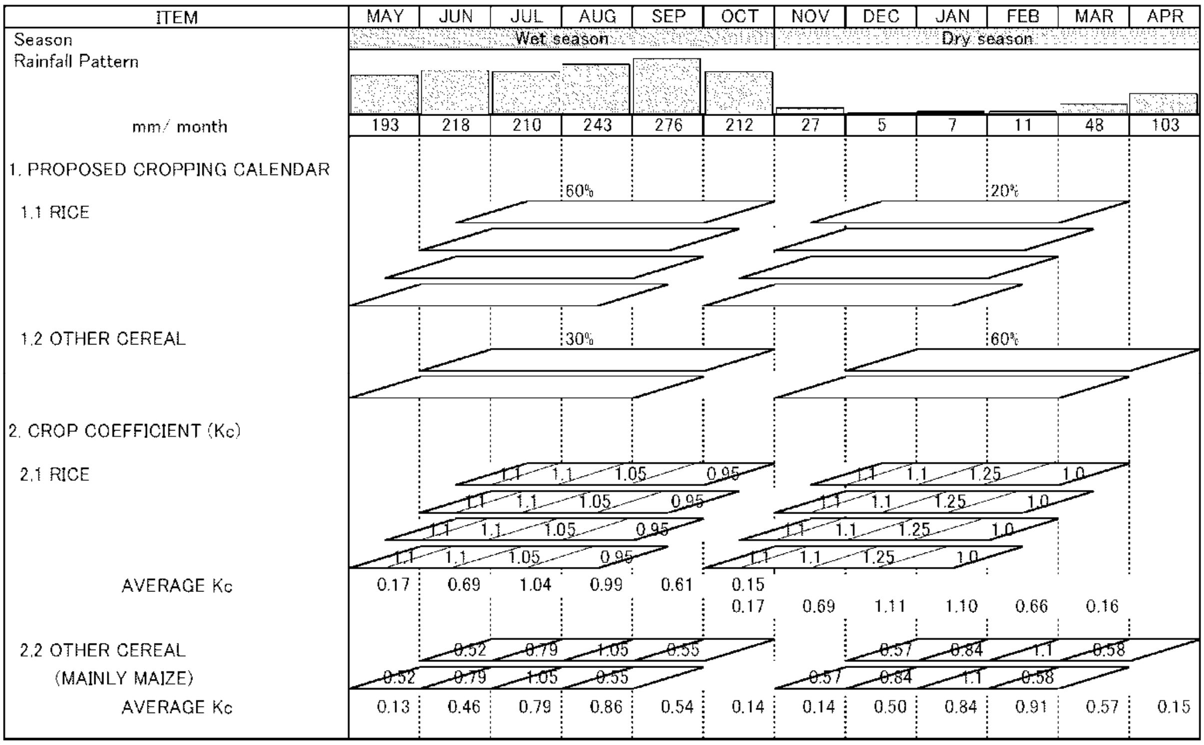
Source: JICA Project Team

HA-3: Proposed Cropping Calendar



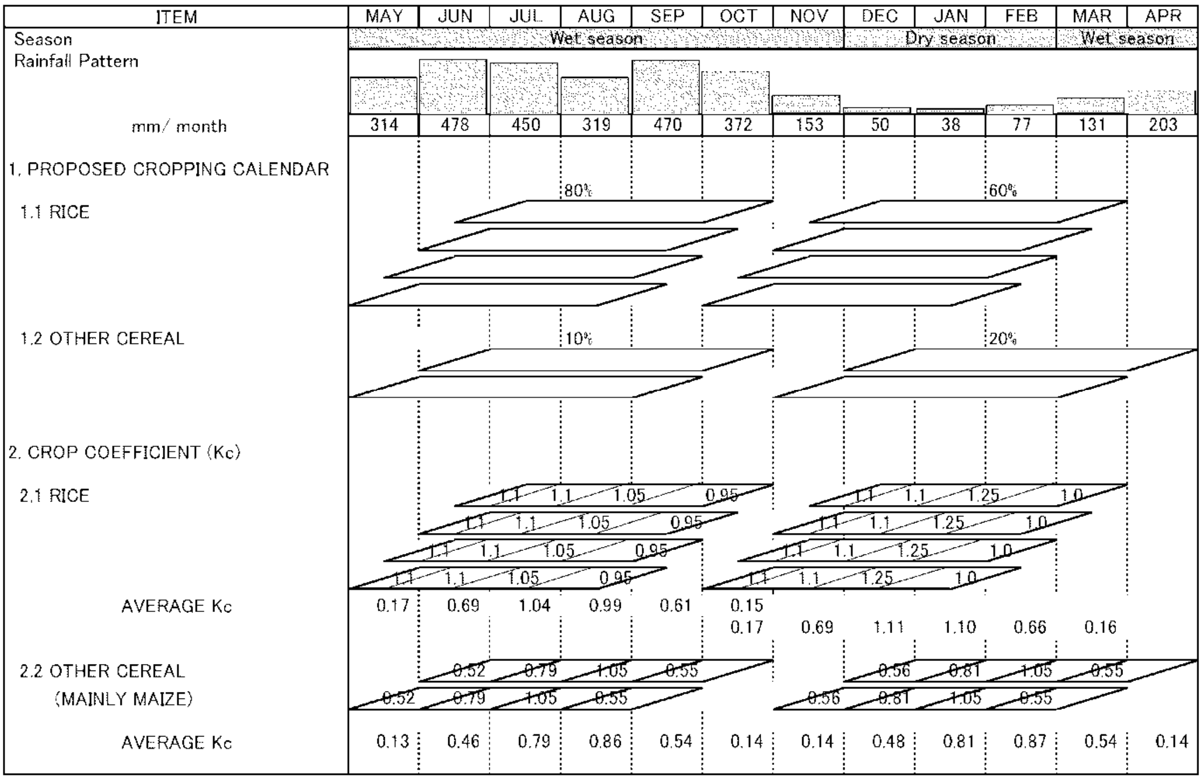
Source: JICA Project Team

HA-4: Proposed Cropping Calendar



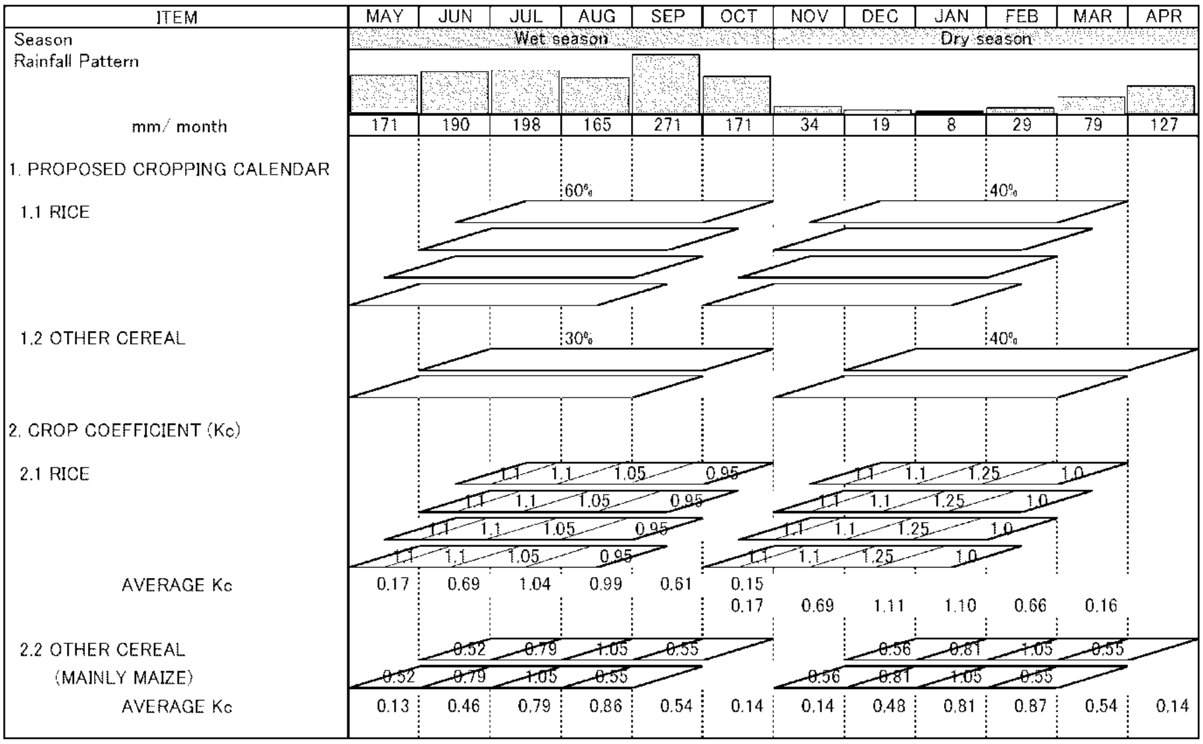
Source: JICA Project Team

HA-5: Proposed Cropping Calendar



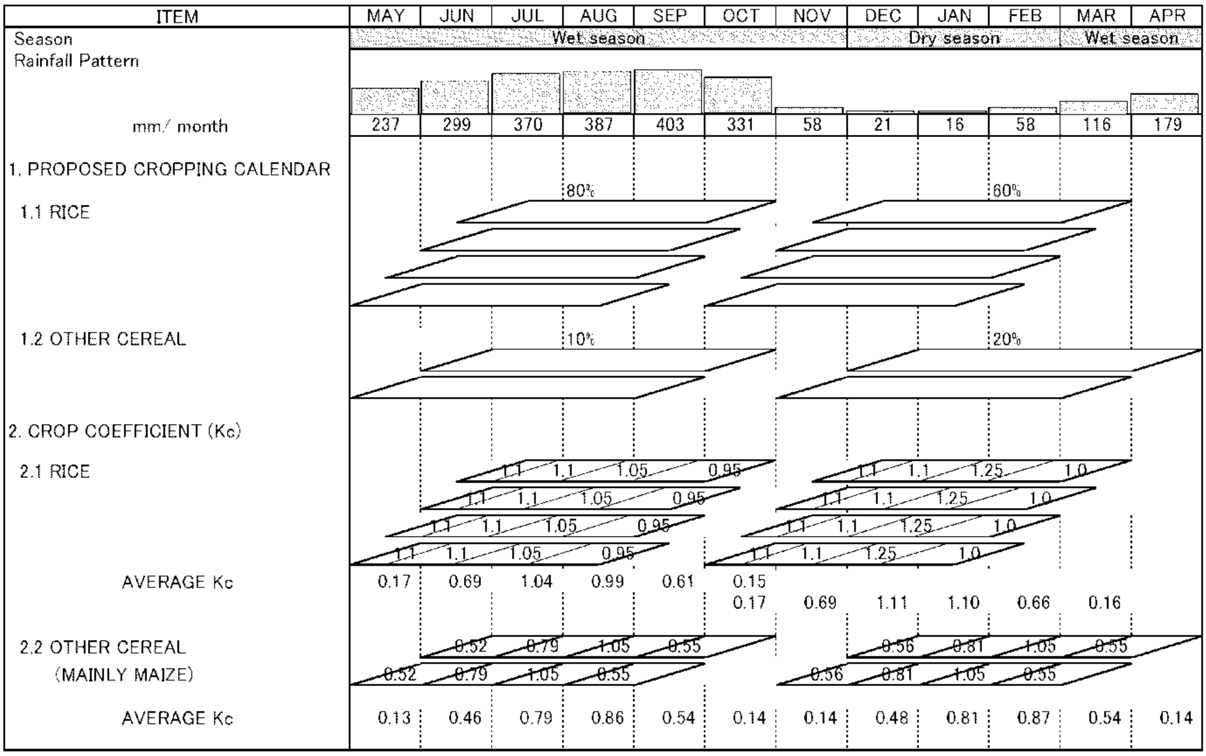
Source: JICA Project Team

HA-6: Proposed Cropping Calendar



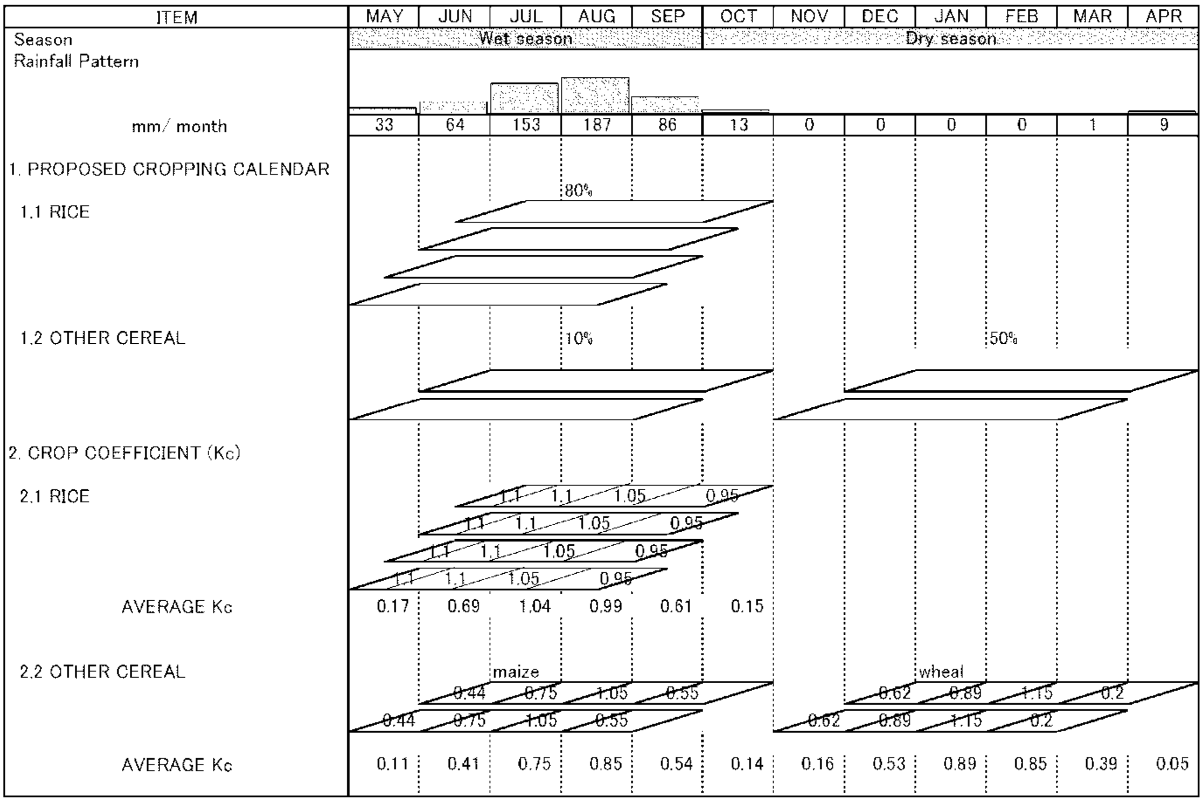
Source: JICA Project Team

HA-7: Proposed Cropping Calendar



Source: JICA Project Team

HA-8: Proposed Cropping Calendar



Source: JICA Project Team

SR1.3.4 Water Demand of Existing Irrigation Schemes

(1) Water Demand of Existing Irrigation Schemes

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
1	135,128.3	101	101	9,355.4	870	5,737	3,864	5.0	3.4	8.4
		102	102	9,127.2	300	5,737	3,864	1.7	1.2	2.9
		103	103	3,387.3	0	5,737	3,864	0.0	0.0	0.0
		104	104	2,933.6	0	5,737	3,864	0.0	0.0	0.0
		105	105	3,456.6	0	5,737	3,864	0.0	0.0	0.0
		10601	10601	689.1	0	5,737	3,864	0.0	0.0	0.0
		10602	10602	10,960.3	0	5,737	3,864	0.0	0.0	0.0
		10603	10603	1,084.9	0	5,737	3,864	0.0	0.0	0.0
		10604	10604	17,476.6	0	5,737	3,864	0.0	0.0	0.0
		10605	10605	6,335.9	200	5,737	3,864	1.1	0.8	1.9
		10606	10606	5,817.2	470	5,737	3,864	2.7	1.8	4.5
		10607	10607	2,706.1	0	5,737	3,864	0.0	0.0	0.0
		106081	106081_e	2,220.3						
			106081_i	4,132.3	1400	5,737	3,864	8.0	5.4	13.4
		106082	106082_e	80,006.8						
			106082_i1	1,322.2	0	5,737	3,864	0.0	0.0	0.0
			106082_i2	6,043.4	1315	5,737	3,864	7.5	5.1	12.6
		106083	106083	412.5	1308	5,737	3,864	7.5	5.1	12.6
		106085	106085_e	290.3						
			106085_i	1,499.6	0	5,737	3,864	0.0	0.0	0.0
		1060861	1060861_e	6,067.9						
			1060861_i1	164.7	0	5,737	3,864	0.0	0.0	0.0
			1060861_i2	548.0	3000	5,737	3,864	17.2	11.6	28.8
		1060863	1060863	3,509.3	50	5,737	3,864	0.3	0.2	0.5
		106087	106087_e	632.3						
			106087_i	1,216.5	0	5,737	3,864	0.0	0.0	0.0
		1060881	1060881	5,750.6	160	5,737	3,864	0.9	0.6	1.5
		1060883	1060883	2,513.8	0	5,737	3,864	0.0	0.0	0.0
		106089	106089	8,354.1	0	5,737	3,864	0.0	0.0	0.0
		106091	106091	7,636.2	23000	5,737	3,864	132.0	88.9	220.9
		106093	106093	4,746.6	76	5,737	3,864	0.4	0.3	0.7
		107	107_e	1,924.1						
			107_i	6,223.4	0	5,737	3,864	0.0	0.0	0.0
		108	108_e	63,517.4						
			108_i	7,724.9	0	5,737	3,864	0.0	0.0	0.0
		109	109	14,037.5						
	Total				**32,149**			**184.3**	**124.4**	**308.7**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
2	154,615.9	201	201	2,646.9	23	528	3,612	0.0	0.1	0.1
		20201	20201	5,088.0	400	528	3,612	0.2	1.4	1.6
		202021	202021	2,739.0	0	528	3,612	0.0	0.0	0.0
		202023	202023	190.7	0	528	3,612	0.0	0.0	0.0
		20203	20203	4,599.3	112	528	3,612	0.1	0.4	0.5
		20205	20205	2,636.8	44	528	3,612	0.0	0.2	0.2
		203	203	4,436.7	0	528	3,612	0.0	0.0	0.0
		20401	20401	5,985.0	1753	528	3,612	0.9	6.3	7.2
		20403	20403	1,596.0	0	528	3,612	0.0	0.0	0.0
		205	205	375.0	0	528	3,612	0.0	0.0	0.0
		206	206	7,358.0	1493	528	3,612	0.8	5.4	6.2
		207	207	1,056.1	90	528	3,612	0.0	0.3	0.3
		20801	20801	1,936.8	1024	528	3,612	0.5	3.7	4.2
		20802	20802	2,240.6	0	528	3,612	0.0	0.0	0.0
		20803	20803	725.1	0	528	3,612	0.0	0.0	0.0
		20804	20804	17,359.5	410	528	3,612	0.2	1.5	1.7
		20805	20805	4,325.9	1100	528	3,612	0.6	4.0	4.6
		20806	20806	3,503.9	150	528	3,612	0.1	0.5	0.6
		20807	20807	557.0	0	528	3,612	0.0	0.0	0.0
		20809	20809	3,692.3	0	528	3,612	0.0	0.0	0.0
		20810	20810	3,449.6	460	528	3,612	0.2	1.7	1.9
		20811	20811	1,561.0	0	528	3,612	0.0	0.0	0.0
		20812	20812	5,919.2	280	528	3,612	0.1	1.0	1.1
		20813	20813	2,483.4	1320	528	3,612	0.7	4.8	5.5
		20814	20814	6,713.9	240	528	3,612	0.1	0.9	1.0
		20815	20815	10,882.2	310	528	3,612	0.2	1.1	1.3
		209	209	15,015.3	7165	528	3,612	3.8	25.9	29.7
		211	211	6.2	0	528	3,612	0.0	0.0	0.0
		212	212	6,740.8	49	528	3,612	0.0	0.2	0.2

		213	213	4,145.9	10	528	3,612	0.0	0.0	0.0
		214	214_e	257.9						
			214_i	9,792.7	5	528	3,612	0.0	0.0	0.0
		215	215	2,109.7	0	528	3,612	0.0	0.0	0.0
		216	216_e	3,698.9						
			216_i	7,957.2	0	528	3,612	0.0	0.0	0.0
		217	217	127.2	0	528	3,612	0.0	0.0	0.0
		218	218	4,644.4	430	528	3,612	0.2	1.6	1.8
		219	219	19.0	0	528	3,612	0.0	0.0	0.0
	Total				**16,868**			**8.7**	**61.0**	**69.7**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
3	156,546.0	30201	30201	587.0	0	578	3,512	0.0	0.0	0.0
		30202	30202	5,145.8	0	578	3,512	0.0	0.0	0.0
		30203	30203_e	2,826.1						
			30203_i	11,384.8	60	578	3,512	0.0	0.2	0.2
		303	303	1,463.0	0	578	3,512	0.0	0.0	0.0
		304	304	4,997.2	100	578	3,512	0.1	0.4	0.5
		305	305	808.7	0	578	3,512	0.0	0.0	0.0
		30601	30601	2,266.4	30	578	3,512	0.0	0.1	0.1
		30602	30602	5,395.0	0	578	3,512	0.0	0.0	0.0
		30603	30603_e	559.0						
			30603_i	13,799.2	0	578	3,512	0.0	0.0	0.0
		307	307	5,737.4	0	578	3,512	0.0	0.0	0.0
		308	308	15,173.5	0	578	3,512	0.0	0.0	0.0
		309	309	87.1	0	578	3,512	0.0	0.0	0.0
		310	310	2,512.7	0	578	3,512	0.0	0.0	0.0
		311	311	11,883.8	7115	578	3,512	4.1	25.0	29.1
		312	312	2,748.4	0	578	3,512	0.0	0.0	0.0
		313	313	48.5	0	578	3,512	0.0	0.0	0.0
		31401	31401	717.6	0	578	3,512	0.0	0.0	0.0
		31403	31403	1,658.9	160	578	3,512	0.1	0.6	0.7
		31404	31404	11,229.0	20	578	3,512	0.0	0.1	0.1
		31405	31405	6,890.1	1109	578	3,512	0.6	3.9	4.5
		31407	31407	7,702.1	300	578	3,512	0.2	1.1	1.3
		31408	31408	5,303.7	0	578	3,512	0.0	0.0	0.0
		31409	31409	19,178.0	240	578	3,512	0.1	0.8	0.9
		315	315	1,616.6	0	578	3,512	0.0	0.0	0.0
		316	316	5,536.5	50	578	3,512	0.0	0.2	0.2
		317	317	3,400.3	520	578	3,512	0.3	1.8	2.1
		318	318	5,441.5	200	578	3,512	0.1	0.7	0.8
		319	319_e	2,088.9						
			319_i	1,726.6	0	578	3,512	0.0	0.0	0.0
		320	320_e	25,211.5						
			320_i	2,106.7	0	578	3,512	0.0	0.0	0.0
		321	321	65,499.3						
	Total				**9,904**			**5.6**	**34.9**	**40.5**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	74,518.7	401	401	3,642.9	100	226	3,482	0.0	0.3	0.3
		402	402	9,075.9	0	226	3,482	0.0	0.0	0.0
		403	403	4,906.6	50	226	3,482	0.0	0.2	0.2
		404	404	9,347.8	2030	226	3,482	0.5	7.1	7.6
		405	405	11,303.0	345	226	3,482	0.1	1.2	1.3
		406	406_e	10,331.5						
			406_i	12,618.8	254	226	3,482	0.1	0.9	1.0
		407	407	4,277.1	520	226	3,482	0.1	1.8	1.9
		408	408	10,587.4	398	226	3,482	0.1	1.4	1.5
		409	409	2,471.0	0	226	3,482	0.0	0.0	0.0
		410	410	4,839.1	1300	226	3,482	0.3	4.5	4.8
		411	411	1,449.1	0	226	3,482	0.0	0.0	0.0

	Total				**4,997**			**1.2**	**17.4**	**18.6**

A: Surface water (existing)

5	53,913.6	500	500	19,112.1	911	294	0	0.3	0.0	0.3
		502	502	3,156.9	0	294	0	0.0	0.0	0.0
		50401	50401	1,580.8	0	294	0	0.0	0.0	0.0
		50402	50402	14,104.9	5970	294	0	1.8	0.0	1.8
		50403	50403	11,821.3	3150	294	0	0.9	0.0	0.9
		506	506	4,137.6	0	294	0	0.0	0.0	0.0
	Total				**10,031**			**3.0**	**0.0**	**3.0**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	1,660	2,317	0.0	0.0	0.0
		60002	60002	8,252.4	0	1,660	2,317	0.0	0.0	0.0
		601	601	391.8	0	1,660	2,317	0.0	0.0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	1,660	2,317	0.4	0.6	1.0
		603	603	1,965.7	340	1,660	2,317	0.6	0.8	1.4
		60401	60401	2,034.9	545	1,660	2,317	0.9	1.3	2.2
		604021	604021	168.9	0	1,660	2,317	0.0	0.0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	44	1,660	2,317	0.1	0.1	0.2
		60403	60403	6,011.7	750	1,660	2,317	1.2	1.7	2.9
		60405	60405	4,704.2	80	1,660	2,317	0.1	0.2	0.3
		605	605	2,167.8	0	1,660	2,317	0.0	0.0	0.0
		606	606	3,425.1	451	1,660	2,317	0.7	1.0	1.7
		607	607	325.1	0	1,660	2,317	0.0	0.0	0.0
		608	608	9,764.4	1680	1,660	2,317	2.8	3.9	6.7
		609	609	113.5	0	1,660	2,317	0.0	0.0	0.0
		610	610	6,462.0	100	1,660	2,317	0.2	0.2	0.4
		611	611	4,227.7	0	1,660	2,317	0.0	0.0	0.0
		612	612	5,869.5	500	1,660	2,317	0.8	1.2	2.0
		614	614	13,271.7	882	1,660	2,317	1.5	2.0	3.5
		616	616	8,417.4	25	1,660	2,317	0.0	0.1	0.1
		617	617	1,896.8	100	1,660	2,317	0.2	0.2	0.4
		699	699	4,809.4	0	1,660	2,317	0.0	0.0	0.0
	Total				**5,747**			**9.5**	**13.3**	**22.8**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
7	57,440.2	702	702	8,146.5	490	0	1,534	0.0	0.8	0.8
		703	703	4,318.8	239	0	1,534	0.0	0.4	0.4
		70401	70401	6,054.6	2305	0	1,534	0.0	3.5	3.5
		70402	70402	7,090.9	1216	0	1,534	0.0	1.9	1.9
		70403	70403	3,625.5	1315	0	1,534	0.0	2.0	2.0
		704041	704041	1,236.3	0	0	1,534	0.0	0.0	0.0
		704042	704042	7,702.7	235	0	1,534	0.0	0.4	0.4
		704043	704043	7,382.6	150	0	1,534	0.0	0.2	0.2
		70405	70405_e	13,407.4				0.0	0.0	
			70405_i	6,028.1	62	0	1,534	0.0	0.1	0.1
		705	705	5,854.2	50	0	1,534	0.0	0.1	0.1
	Total				**6,062**			**0.0**	**9.4**	**9.4**

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
8	178,483.2	800	800	5,221.9	0	9,553	1,520	0.0	0.0	0.0
		802	802_e	13,857.3						
			802_i	2,422.8	0	9,553	1,520	0.0	0.0	0.0
		80401	80401	4,647.6	23540	9,553	1,520	224.9	35.8	260.7
		80402	80402_e	626.1						
			80402_i	7,171.8	0	9,553	1,520	0	0	0.0
		80403	80403_e	253.1						
			80403_i	6,656.5	880	9,553	1,520	8.4	1.3	9.7
		806	806	21,903.0	0	9,553	1,520	0.0	0.0	0.0
		807	807	14,280.8	2000	9,553	1,520	19.1	3.0	22.1
		80801	80801_e	1,438.6						
			80801_i	946.1	697	9,553	1,520	6.7	1.1	7.8
		80802	80802	30,141.6	0	9,553	1,520	0.0	0.0	0.0
		80803	80803_e	8,391.9						

			80803_i	1,528.3	0	9,553	1,520	0.0	0.0	0.0
		80804	80804_e	21,200.9						
			80804_i	6,230.7	0	9,553	1,520	0.0	0.0	0.0
		80805	80805	9,381.6	128	9,553	1,520	1.2	0.2	1.4
		808061	808061	5,200.0	1180	9,553	1,520	11.3	1.8	13.1
		808062	808062	6,129.6	40	9,553	1,520	0.4	0.1	0.5
		808063	808063	12,632.1	142	9,553	1,520	1.4	0.2	1.6
		808071	808071	274.9	0	9,553	1,520	0.0	0.0	0.0
		8080721	8080721_e	19,574.1						
			8080721_i	18,041.8	3520	9,553	1,520	33.6	5.4	39.0
		8080723	8080723	1,145.5	60	9,553	1,520	0.6	0.1	0.7
		808073	808073	9,609.9	5758	9,553	1,520	55.0	8.8	63.8
		8080741	8080741	244.3	0	9,553	1,520	0.0	0.0	0.0
		80807421	80807421	861.8	273	9,553	1,520	2.6	0.4	3.0
		80807423	80807423	653.9	0	9,553	1,520	0.0	0.0	0.0
		8080743	8080743	1,581.2	830	9,553	1,520	7.9	1.3	9.2
		8080745	8080745	3,841.5	0	9,553	1,520	0.0	0.0	0.0
		808075	808075	1,196.2	16300	9,553	1,520	155.7	24.8	180.5
		808077	808077	6,537.9	0	9,553	1,520	0.0	0.0	0.0
	Total				**55,348**			**528.8**	**84.3**	**613.1**
	Grand Total				**141,106**			**741.1**	**344.7**	**1,085.8**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
1	101	101	0	0	0	3,757	0.0	8.4
	102	102	0	0	0	3,757	0.0	2.9
	103	103	0	0	0	3,757	0.0	0.0
	104	104	23	16	39	3,757	0.1	0.1
	105	105	1,233	852	2,085	3,757	7.8	7.8
	10601	10601	359	248	607	3,757	2.3	2.3
	10602	10602	388	268	656	3,757	2.5	2.5
	10603	10603	458	316	774	3,757	2.9	2.9
	10604	10604	1,142	789	1,931	3,757	7.3	7.3
	10605	10605	2,073	1,432	3,505	3,757	13.2	15.1
	10606	10606	100	69	169	3,757	0.6	5.1
	10607	10607	733	507	1,240	3,757	4.7	4.7
	106081	106081_e						
		106081_i	1,291	892	2,183	3,757	8.2	21.6
	106082	106082_e						
		106082_i1	983	679	1,662	3,757	6.2	6.2
		106082_i2	187	129	316	3,757	1.2	13.8
	106083	106083	177	122	299	3,757	1.1	13.7
	106085	106085_e						
		106085_i	409	283	692	3,757	2.6	2.6
	1060861	1060861_e						
		1060861_i1	50	34	84	3,757	0.3	0.3
		1060861_i2	0	0	0	3,757	0.0	28.8
	1060863	1060863	0	0	0	3,757	0.0	0.5
	106087	106087_e						
		106087_i	148	102	250	3,757	0.9	0.9
	1060881	1060881	360	249	609	3,757	2.3	3.8
	1060883	1060883	324	224	548	3,757	2.1	2.1
	106089	106089	424	293	717	3,757	2.7	2.7
	106091	106091	575	397	972	3,757	3.7	224.6
	106093	106093	0	0	0	3,757	0.0	0.7
	107	107_e						
		107_i	1,246	861	2,107	3,757	7.9	7.9
	108	108_e						
		108_i	22	15	37	3,757	0.1	0.1
	109	109						
	Total		**12,705**	**8,777**	**21,482**		**80.7**	**389.4**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
2	201	201	292	202	494	4,223	2.1	2.2
	20201	20201	188	130	318	4,223	1.3	2.9
	202021	202021	0	0	0	4,223	0.0	0.0
	202023	202023	0	0	0	4,223	0.0	0.0
	20203	20203	0	0	0	4,223	0.0	0.5
	20205	20205	0	0	0	4,223	0.0	0.2
	203	203	1,643	1,135	2,778	4,223	11.7	11.7
	20401	20401	175	121	296	4,223	1.3	8.5
	20403	20403	0	0	0	4,223	0.0	0.0

	205	205	302	208	510	4,223	2.2	2.2
	206	206	322	222	544	4,223	2.3	8.5
	207	207	727	502	1,229	4,223	5.2	5.5
	20801	20801	437	302	739	4,223	3.1	7.3
	20802	20802	0	0	0	4,223	0.0	0.0
	20803	20803	256	177	433	4,223	1.8	1.8
	20804	20804	113	78	191	4,223	0.8	2.5
	20805	20805	15	11	26	4,223	0.1	4.7
	20806	20806	0	0	0	4,223	0.0	0.6
	20807	20807	0	0	0	4,223	0.0	0.0
	20809	20809	0	0	0	4,223	0.0	0.0
	20810	20810	0	0	0	4,223	0.0	1.9
	20811	20811	0	0	0	4,223	0.0	0.0
	20812	20812	690	476	1,166	4,223	4.9	6.0
	20813	20813	51	35	86	4,223	0.4	5.9
	20814	20814	488	337	825	4,223	3.5	4.5
	20815	20815	202	139	341	4,223	1.4	2.7
	209	209	3,083	2,130	5,213	4,223	22.0	51.7
	211	211	0	0	0	4,223	0.0	0.0
	212	212	0	0	0	4,223	0.0	0.2
	213	213	0	0	0	4,223	0.0	0.0
	214	214_e						
		214_i	0	0	0	4,223	0.0	0.0
	215	215	0	0	0	4,223	0.0	0.0
	216	216_e						
		216_i	0	0	0	4,223	0.0	0.0
	217	217	0	0	0	4,223	0.0	0.0
	218	218	7	5	12	4,223	0.1	1.9
	219	219	0	0	0	4,223	0.0	0.0
	Total		**8,991**	**6,210**	**15,201**		**64.2**	**133.9**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
3	30201	30201	156	108	264	4,083	1.1	1.1
	30202	30202	100	69	169	4,083	0.7	0.7
	30203	30203_e						
		30203_i	392	271	663	4,083	2.7	2.9
	303	303	480	332	812	4,083	3.3	3.3
	304	304	38	27	65	4,083	0.3	0.8
	305	305	149	103	252	4,083	1.0	1.0
	30601	30601	501	346	847	4,083	3.5	3.6
	30602	30602	100	69	169	4,083	0.7	0.7
	30603	30603_e						
		30603_i	38	26	64	4,083	0.3	0.3
	307	307	1,883	1,301	3,184	4,083	13.0	13.0
	308	308	394	272	666	4,083	2.7	2.7
	309	309	73	51	124	4,083	0.5	0.5
	310	310	5	3	8	4,083	0.0	0.0
	311	311	3,543	2,448	5,991	4,083	24.5	53.6
	312	312	166	115	281	4,083	1.1	1.1
	313	313	71	49	120	4,083	0.5	0.5
	31401	31401	241	166	407	4,083	1.7	1.7
	31403	31403	16	11	27	4,083	0.1	0.8
	31404	31404	0	0	0	4,083	0.0	0.1
	31405	31405	59	41	100	4,083	0.4	4.9
	31407	31407	26	18	44	4,083	0.2	1.5
	31408	31408	467	323	790	4,083	3.2	3.2
	31409	31409	753	520	1,273	4,083	5.2	6.1
	315	315	487	336	823	4,083	3.4	3.4
	316	316	362	250	612	4,083	2.5	2.7
	317	317	359	248	607	4,083	2.5	4.6
	318	318	25	17	42	4,083	0.2	1.0
	319	319_e						
		319_i	151	105	256	4,083	1.0	1.0
	320	320_e						
		320_i	230	159	389	4,083	1.6	1.6
	321	321						
	Total		**11,265**	**7,784**	**19,049**		**77.9**	**118.4**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
4	401	401	716	494	1,210	4,165	5.0	5.3
	402	402	159	110	269	4,165	1.1	1.1
	403	403	1,188	821	2,009	4,165	8.4	8.6
	404	404	454	313	767	4,165	3.2	10.8
	405	405	813	562	1,375	4,165	5.7	7.0

	406	406_e						
		406_i	0	0	0	4,165	0.0	1.0
	407	407	342	236	578	4,165	2.4	4.3
	408	408	457	316	773	4,165	3.2	4.7
	409	409	351	242	593	4,165	2.5	2.5
	410	410	505	349	854	4,165	3.6	8.4
	411	411	392	271	663	4,165	2.8	2.8
	Total		**5,377**	**3,714**	**9,091**		**37.9**	**56.5**

B. Underflow Water (existing)

5	500	500	240	166	406	3,617	1.5	1.8
	502	502	0	0	0	3,617	0.0	0.0
	50401	50401	926	639	1,565	3,617	5.7	5.7
	50402	50402	38	26	64	3,617	0.2	2.0
	50403	50403	1,567	1,083	2,650	3,617	9.6	10.5
	506	506	27	19	46	3,617	0.2	0.2
	Total		**2,798**	**1,933**	**4,731**		**17.2**	**20.2**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	3,862	0.0	0.0
	60002	60002	0	0	0	3,862	0.0	0.0
	601	601	0	0	0	3,862	0.0	0.0
	602	602_e						
		602_i	0	0	0	3,862	0.0	1.0
	603	603	0	0	0	3,862	0.0	1.4
	60401	60401	0	0	0	3,862	0.0	2.2
	604021	604021	0	0	0	3,862	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	3,862	0.0	0.2
	60403	60403	0	0	0	3,862	0.0	2.9
	60405	60405	0	0	0	3,862	0.0	0.3
	605	605	0	0	0	3,862	0.0	0.0
	606	606	0	0	0	3,862	0.0	1.7
	607	607	0	0	0	3,862	0.0	0.0
	608	608	0	0	0	3,862	0.0	6.7
	609	609	0	0	0	3,862	0.0	0.0
	610	610	0	0	0	3,862	0.0	0.4
	611	611	0	0	0	3,862	0.0	0.0
	612	612	0	0	0	3,862	0.0	2.0
	614	614	0	0	0	3,862	0.0	3.5
	616	616	0	0	0	3,862	0.0	0.1
	617	617	0	0	0	3,862	0.0	0.4
	699	699	0	0	0	3,862	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**22.8**

B. Underflow Water (existing

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
7	702	702	0	0	0	3,640	0.0	0.8
	703	703	0	0	0	3,640	0.0	0.4
	70401	70401	0	0	0	3,640	0.0	3.5
	70402	70402	2	1	3	3,640	0.0	1.9
	70403	70403	165	114	279	3,640	1.0	3.0
	704041	704041	75	52	127	3,640	0.5	0.5
	704042	704042	43	30	73	3,640	0.3	0.7
	704043	704043	77	54	131	3,640	0.5	0.7
	70405	70405_e						
		70405_i	41	28	69	3,640	0.3	0.4
	705	705	0	0	0	3,640	0.0	0.1
	Total		**403**	**279**	**682**		**2.6**	**12.0**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
8	800	800	0	0	0	3,547	0.0	0.0
	802	802_e						
		802_i	0	0	0	3,547	0.0	0.0
	80401	80401	0	0	0	3,547	0.0	260.7
	80402	80402_e						
		80402_i	0	0	0	3,547	0.0	0.0
	80403	80403_e						
		80403_i	0	0	0	3,547	0.0	9.7
	806	806	0	0	0	3,547	0.0	0.0
	807	807	0	0	0	3,547	0.0	22.1
	80801	80801_e						
		80801_i	140	97	237	3,547	0.8	8.6

	80802	80802	1,954	1,350	3,304	3,547	11.7	11.7
	80803	80803_e						
		80803_i	300	207	507	3,547	1.8	1.8
	80804	80804_e						
		80804_i	20	14	34	3,547	0.1	0.1
	80805	80805	1,775	1,227	3,002	3,547	10.6	12.0
	808061	808061	1,520	1,050	2,570	3,547	9.1	22.2
	808062	808062	975	673	1,648	3,547	5.8	6.3
	808063	808063	784	542	1,326	3,547	4.7	6.3
	808071	808071	184	127	311	3,547	1.1	1.1
	8080721	8080721_e						
		8080721_i	564	390	954	3,547	3.4	42.4
	8080723	8080723	0	0	0	3,547	0.0	0.7
	808073	808073	5,208	3,601	8,809	3,547	31.2	95.0
	8080741	8080741	0	0	0	3,547	0.0	0.0
	80807421	80807421	37	25	62	3,547	0.2	3.2
	80807423	80807423	0	0	0	3,547	0.0	0.0
	8080743	8080743	0	0	0	3,547	0.0	9.2
	8080745	8080745	0	0	0	3,547	0.0	0.0
	808075	808075	0	0	0	3,547	0.0	180.5
	808077	808077	0	0	0	3,547	0.0	0.0
	Total		**13,461**	**9,303**	**22,764**		**80.5**	**693.6**
Grand Total			**55,000**	**38,000**	**93,000**		**361.0**	**1,446.8**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
1	101	101	781	3,772	3,757	2.9	2.9	5.8
	102	102	185	3,772	3,757	0.7	0.7	1.4
	103	103	124	3,772	3,757	0.5	0.5	1.0
	104	104	134	3,772	3,757	0.5	0.5	1.0
	105	105	79	3,772	3,757	0.3	0.3	0.6
	10601	10601	64	3,772	3,757	0.2	0.2	0.4
	10602	10602	389	3,772	3,757	1.5	1.5	3.0
	10603	10603	98	3,772	3,757	0.4	0.4	0.8
	10604	10604	1,014	3,772	3,757	3.8	3.8	7.6
	10605	10605	654	3,772	3,757	2.5	2.5	5.0
	10606	10606	834	3,772	3,757	3.1	3.1	6.2
	10607	10607	142	3,772	3,757	0.5	0.5	1.0
	106081	106081_e						
		106081_i	309	3,772	3,757	1.2	1.2	2.4
	106082	106082_e						
		106082_i1	0	3,772	3,757	0.0	0.0	0.0
		106082_i2	1,240	3,772	3,757	4.7	4.7	9.4
	106083	106083	0	3,772	3,757	0.0	0.0	0.0
	106085	106085_e						
		106085_i	0	3,772	3,757	0.0	0.0	0.0
	1060861	1060861_e						
		1060861_i1	0	3,772	3,757	0.0	0.0	0.0
		1060861_i2	58	3,772	3,757	0.2	0.2	0.4
	1060863	1060863	515	3,772	3,757	1.9	1.9	3.8
	106087	106087_e						
		106087_i	0	3,772	3,757	0.0	0.0	0.0
	1060881	1060881	541	3,772	3,757	2.0	2.0	4.0
	1060883	1060883	478	3,772	3,757	1.8	1.8	3.6
	106089	106089	1,290	3,772	3,757	4.9	4.8	9.7
	106091	106091	547	3,772	3,757	2.1	2.1	4.2
	106093	106093	636	3,772	3,757	2.4	2.4	4.8
	107	107_e						
		107_i	296	3,772	3,757	1.1	1.1	2.2
	108	108_e						
		108_i	467	3,772	3,757	1.8	1.8	3.6
	109	109						
	Total		**10,875**			**41.0**	**40.9**	**81.9**

C: Groundwater (existing)o

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
2	201	201	318	440	4,223	0.1	1.3	1.4
	20201	20201	487	440	4,223	0.2	2.1	2.3
	202021	202021	224	440	4,223	0.1	0.9	1.0
	202023	202023	13	440	4,223	0.0	0.1	0.1
	20203	20203	360	440	4,223	0.2	1.5	1.7
	20205	20205	246	440	4,223	0.1	1.0	1.1
	203	203	547	440	4,223	0.2	2.3	2.5
	20401	20401	584	440	4,223	0.3	2.5	2.8
	20403	20403	242	440	4,223	0.1	1.0	1.1

	205	205	53	440	4,223	0.0	0.2	0.2
	206	206	794	440	4,223	0.3	3.4	3.7
	207	207	132	440	4,223	0.1	0.6	0.7
	20801	20801	151	440	4,223	0.1	0.6	0.7
	20802	20802	40	440	4,223	0.0	0.2	0.2
	20803	20803	72	440	4,223	0.0	0.3	0.3
	20804	20804	709	440	4,223	0.3	3.0	3.3
	20805	20805	303	440	4,223	0.1	1.3	1.4
	20806	20806	18	440	4,223	0.0	0.1	0.1
	20807	20807	47	440	4,223	0.0	0.2	0.2
	20809	20809	183	440	4,223	0.1	0.8	0.9
	20810	20810	102	440	4,223	0.0	0.4	0.4
	20811	20811	24	440	4,223	0.0	0.1	0.1
	20812	20812	817	440	4,223	0.4	3.5	3.9
	20813	20813	254	440	4,223	0.1	1.1	1.2
	20814	20814	1,300	440	4,223	0.6	5.5	6.1
	20815	20815	1,134	440	4,223	0.5	4.8	5.3
	209	209	1,390	440	4,223	0.6	5.9	6.5
	211	211	0	440	4,223	0.0	0.0	0.0
	212	212	796	440	4,223	0.4	3.4	3.8
	213	213	111	440	4,223	0.0	0.5	0.5
	214	214_e						
		214_i	203	440	4,223	0.1	0.9	1.0
	215	215	38	440	4,223	0.0	0.2	0.2
	216	216_e						
		216_i	87	440	4,223	0.0	0.4	0.4
	217	217	2	440	4,223	0.0	0.0	0.0
	218	218	350	440	4,223	0.2	1.5	1.7
	219	219	1	440	4,223	0.0	0.0	0.0
	Total		**12,132**			**5.2**	**51.6**	**56.8**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
3	30201	30201	84	482	4,083	0.0	0.3	0.3
	30202	30202	450	482	4,083	0.2	1.8	2.0
	30203	30203_e						
		30203_i	627	482	4,083	0.3	2.6	2.9
	303	303	178	482	4,083	0.1	0.7	0.8
	304	304	712	482	4,083	0.3	2.9	3.2
	305	305	40	482	4,083	0.0	0.2	0.2
	30601	30601	363	482	4,083	0.2	1.5	1.7
	30602	30602	87	482	4,083	0.0	0.4	0.4
	30603	30603_e						
		30603_i	170	482	4,083	0.1	0.7	0.8
	307	307	281	482	4,083	0.1	1.1	1.2
	308	308	1,024	482	4,083	0.5	4.2	4.7
	309	309	0	482	4,083	0.0	0.0	0.0
	310	310	260	482	4,083	0.1	1.1	1.2
	311	311	503	482	4,083	0.2	2.1	2.3
	312	312	310	482	4,083	0.1	1.3	1.4
	313	313	0	482	4,083	0.0	0.0	0.0
	31401	31401	45	482	4,083	0.0	0.2	0.2
	31403	31403	165	482	4,083	0.1	0.7	0.8
	31404	31404	603	482	4,083	0.3	2.5	2.8
	31405	31405	1,011	482	4,083	0.5	4.1	4.6
	31407	31407	864	482	4,083	0.4	3.5	3.9
	31408	31408	398	482	4,083	0.2	1.6	1.8
	31409	31409	1,899	482	4,083	0.9	7.8	8.7
	315	315	100	482	4,083	0.0	0.4	0.4
	316	316	385	482	4,083	0.2	1.6	1.8
	317	317	162	482	4,083	0.1	0.7	0.8
	318	318	318	482	4,083	0.2	1.3	1.5
	319	319_e						
		319_i	102	482	4,083	0.0	0.4	0.4
	320	320_e						
		320_i	1	482	4,083	0.0	0.0	0.0
	321	321						
	Total		**11,142**			**5.1**	**45.7**	**50.8**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
4	401	401	491	188	4,165	0.1	2.0	2.1
	402	402	709	188	4,165	0.1	3.0	3.1
	403	403	696	188	4,165	0.1	2.9	3.0
	404	404	1,017	188	4,165	0.2	4.2	4.4
	405	405	1,848	188	4,165	0.3	7.7	8.0

	406	406_e						
		406_i	1,552	188	4,165	0.3	6.5	6.8
	407	407	348	188	4,165	0.1	1.4	1.5
	408	408	745	188	4,165	0.1	3.1	3.2
	409	409	385	188	4,165	0.1	1.6	1.7
	410	410	715	188	4,165	0.1	3.0	3.1
	411	411	86	188	4,165	0.0	0.4	0.4
	Total		**8,592**			**1.5**	**35.8**	**37.3**

C: Groundwater (existing)

5	500	500	905	105	3,617	0.1	3.3	3.4
	502	502	497	105	3,617	0.1	1.8	1.9
	50401	50401	108	105	3,617	0.0	0.4	0.4
	50402	50402	2,855	105	3,617	0.3	10.3	10.6
	50403	50403	2,316	105	3,617	0.2	8.4	8.6
	506	506	714	105	3,617	0.1	2.6	2.7
	Total		**7,395**			**0.8**	**26.8**	**27.6**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
6	60001	60001	175	1,058	3,862	0.2	0.7	0.9
	60002	60002	269	1,058	3,862	0.3	1.0	1.3
	601	601	80	1,058	3,862	0.1	0.3	0.4
	602	602_e						
		602_i	703	1,058	3,862	0.7	2.7	3.4
	603	603	281	1,058	3,862	0.3	1.1	1.4
	60401	60401	380	1,058	3,862	0.4	1.5	1.9
	604021	604021	23	1,058	3,862	0.0	0.1	0.1
	604023	604023_e						
		604023_i	1,270	1,058	3,862	1.3	4.9	6.2
	60403	60403	1,172	1,058	3,862	1.2	4.5	5.7
	60405	60405	447	1,058	3,862	0.5	1.7	2.2
	605	605	492	1,058	3,862	0.5	1.9	2.4
	606	606	611	1,058	3,862	0.6	2.4	3.0
	607	607	61	1,058	3,862	0.1	0.2	0.3
	608	608	1,778	1,058	3,862	1.9	6.9	8.8
	609	609	16	1,058	3,862	0.0	0.1	0.1
	610	610	999	1,058	3,862	1.1	3.9	5.0
	611	611	713	1,058	3,862	0.8	2.8	3.6
	612	612	808	1,058	3,862	0.9	3.1	4.0
	614	614	2,324	1,058	3,862	2.5	9.0	11.5
	616	616	1,468	1,058	3,862	1.6	5.7	7.3
	617	617	427	1,058	3,862	0.5	1.6	2.1
	699	699	354	1,058	3,862	0.4	1.4	1.8
	Total		**14,851**			**15.9**	**57.5**	**73.4**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
7	702	702	1,661	0	3,640	0.0	6.0	6.0
	703	703	859	0	3,640	0.0	3.1	3.1
	70401	70401	1,169	0	3,640	0.0	4.3	4.3
	70402	70402	1,581	0	3,640	0.0	5.8	5.8
	70403	70403	718	0	3,640	0.0	2.6	2.6
	704041	704041	206	0	3,640	0.0	0.7	0.7
	704042	704042	1,605	0	3,640	0.0	5.8	5.8
	704043	704043	1,611	0	3,640	0.0	5.9	5.9
	70405	70405_e						
		70405_i	415	0	3,640	0.0	1.5	1.5
	705	705	367	0	3,640	0.0	1.3	1.3
	Total		**10,192**			**0.0**	**37.0**	**37.0**

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
8	800	800	2	4,148	3,547	0.0	0.0	0.0
	802	802_e						
		802_i	4	4,148	3,547	0.0	0.0	0.0
	80401	80401	132	4,148	3,547	0.5	0.5	1.0
	80402	80402_e						
		80402_i	167	4,148	3,547	0.7	0.6	1.3
	80403	80403_e						
		80403_i	647	4,148	3,547	2.7	2.3	5.0
	806	806	1,100	4,148	3,547	4.6	3.9	8.5
	807	807	0	4,148	3,547	0.0	0.0	0.0
	80801	80801_e						

		80801_i	0	4,148	3,547	0.0	0.0	0.0
	80802	80802	2,127	4,148	3,547	8.8	7.5	16.3
	80803	80803_e	0					
		80803_i	0	4,148	3,547	0.0	0.0	0.0
	80804	80804_e						
		80804_i	0	4,148	3,547	0.0	0.0	0.0
	80805	80805	569	4,148	3,547	2.4	2.0	4.4
	808061	808061	806	4,148	3,547	3.3	2.9	6.2
	808062	808062	837	4,148	3,547	3.5	3.0	6.5
	808063	808063	1,128	4,148	3,547	4.7	4.0	8.7
	808071	808071	0	4,148	3,547	0.0	0.0	0.0
	8080721	8080721_e						
		8080721_i	3,114	4,148	3,547	12.9	11.0	23.9
	8080723	8080723	206	4,148	3,547	0.9	0.7	1.6
	808073	808073	1,458	4,148	3,547	6.0	5.2	11.2
	8080741	8080741	42	4,148	3,547	0.2	0.1	0.3
	80807421	80807421	199	4,148	3,547	0.8	0.7	1.5
	80807423	80807423	139	4,148	3,547	0.6	0.5	1.1
	8080743	8080743	333	4,148	3,547	1.4	1.2	2.6
	8080745	8080745	777	4,148	3,547	3.2	2.8	6.0
	808075	808075	246	4,148	3,547	1.0	0.9	1.9
	808077	808077	788	4,148	3,547	3.3	2.8	6.1
	Total		**14,821**			**61.5**	**52.6**	**114.1**

Grand Total		**90,000**			**131.0**	**347.9**	**478.9**

(2) Surface Water Demand of Existing Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	101	101	I	870	5,737	3,864			
			Swashi Valley	200	5,737	3,864	1.1	0.8	1.9
			Wara	200	5,737	3,864	1.1	0.8	1.9
			Gafara	150	5,737	3,864	0.9	0.6	1.5
			Dongongari	320	5,737	3,864	1.8	1.2	3.0
	102	102	I	300					
			Nasko	200	5,737	3,864	1.1	0.8	1.9
			Rijau	100	5,737	3,864	0.6	0.4	1.0
	103	103	I	0					
	104	104	I	0			0.0	0.0	0.0
	105	105	I	0			0.0	0.0	0.0
	10601	10601	I	0			0.0	0.0	0.0
	10602	10602	I	0			0.0	0.0	0.0
	10603	10603	I	0			0.0	0.0	0.0
	10604	10604	I	0			0.0	0.0	0.0
	10605	10605	I	200					
			Zauro Polder	100	5,737	3,864	0.6	0.4	1.0
			Argungu/ Tabarau	100	5,737	3,864	0.6	0.4	1.0
	10606	10606	I	470					
			Shagari	220	5,737	3,864	1.3	0.9	2.2
			Kwakwazo	250	5,737	3,864	1.4	1.0	2.4
	10607	10607	I	0					
1	106081	106081_e	O						
		106081_i	I	1400					
			Wurno	700	5,737	3,864	4.0	2.7	6.7
			Kware	300	5,737	3,864	1.7	1.2	2.9
			Kalmalo	400	5,737	3,864	2.3	1.5	3.8
	106082	106082_e	O						
		106082_i1	I	0					
		106082_i2	I	1315					
			Sabke	540	5,737	3,864	3.1	2.1	5.2
			Ajiwa	500	5,737	3,864	2.9	1.9	4.8
			Mashigi	35	5,737	3,864	0.2	0.1	0.3
			Mangwal	0	5,737	3,864	0.0	0.0	0.0
			Deberam	240	5,737	3,864	1.4	0.9	2.3
	106083	106083	I	1308					
			Goronyo	120	5,737	3,864	0.7	0.5	1.2
			Middle Rima Valley	1188	5,737	3,864	6.8	4.6	11.4
	106085	106085_e	O						
		106085_i	I	0					
	1060861	1060861_e	O						
		1060861_i1	I	0					0.0
		1060861_i2	I	3000					
			Jibiya	3000	5,737	3,864	17.2	11.6	28.8
	1060863	1060863	I	50					
			Raddewa	50	5,737	3,864	0.3	0.2	0.5

	106087	106087_e	O						
		106087_i	I	0			0.0	0.0	0.0
	1060881	1060881	I	160					
			Zobe	60	5,737	3,864	0.3	0.2	0.5
			Makere	100	5,737	3,864	0.6	0.4	1.0
	1060883	1060883	I	0			0.0	0.0	0.0
	106089	106089	I	0					
			Gagere	0	5,737	3,864	0.0	0.0	0.0
	106091	106091	I	23000					
			Bakolori	23000	5,737	3,864	132.0	88.9	220.9
					5,737	3,864	0.0	0.0	0.0
	106093	106093	I	76					
			Mairuwa	76	5,737	3,864	0.4	0.3	0.7
	107	107_e	O						
		107_i	I	0					
			Illo	0	5,737	3,864	0.0	0.0	0.0
	108	108_e	O						
		108_i	I	0					
	109	109	O						
	Total			**32,149**			**184.4**	**124.4**	**308.8**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	201	201	I	23	528	3,612			0.0
			Otibe	3	528	3,612	0.0	0.0	0.0
			Serki Noma	20	528	3,612	0.0	0.1	0.1
	20201	20201	I	400					0.0
			Gerinyan	400	528	3,612	0.2	1.4	1.6
	202021	202021	I	0			0.0	0.0	0.0
	202023	202023	I	0			0.0	0.0	0.0
	20203	20203	I	112					0.0
			Tafa/ Jere	52	528	3,612	0.0	0.2	0.2
			Pambegua	60	528	3,612	0.0	0.2	0.2
	20205	20205	I	44					0.0
			Hunkuyi	40	528	3,612	0.0	0.1	0.1
			Tadanni	4	528	3,612	0.0	0.0	0.0
	203	203	I	0			0.0	0.0	0.0
	20401	20401	I	1753					0.0
			Kampe/Omi	1000	528	3,612	0.5	3.6	4.1
			Kpada	150	528	3,612	0.1	0.5	0.6
			Ikale	420	528	3,612	0.2	1.5	1.7
			Adorun	80	528	3,612	0.0	0.3	0.3
			Odugbo	100	528	3,612	0.1	0.4	0.5
			Aiyetoro	3	528	3,612	0.0	0.0	0.0
	20403	20403	I	0					0.0
	205	205	I	0					0.0
	206	206	I	1493					0.0
			Agaie/ Lapai	20	528	3,612	0.0	0.1	0.1
			E.Lapai	100	528	3,612	0.1	0.4	0.5
			Bakogi	100	528	3,612	0.1	0.4	0.5
2			Badeggi	830	528	3,612	0.4	3.0	3.4
			Pandegi	25	528	3,612	0.0	0.1	0.1
			Chanchanga	302	528	3,612	0.2	1.1	1.3
			Agaie	76	528	3,612	0.0	0.3	0.3
			Lioji	40	528	3,612	0.0	0.1	0.1
			Zara	0	528	3,612	0.0	0.0	0.0
	207	207	I	90					0.0
			Duro-Gakpan	90	528	3,612	0.0	0.3	0.3
	20801	20801	I	1024					0.0
			Guzan	400	528	3,612	0.2	1.4	1.6
			Wuya	25	528	3,612	0.0	0.1	0.1
			Doko	400	528	3,612	0.2	1.4	1.6
			Bangi	50	528	3,612	0.0	0.2	0.2
			Edozhigi	100	528	3,612	0.1	0.4	0.5
			Baratsu	49	528	3,612	0.0	0.2	0.2
	20802	20802	I	0			0.0	0.0	0.0
	20803	20803	I	0			0.0	0.0	0.0
	20804	20804	I	410					0.0
			Bagoma	50	528	3,612	0.0	0.2	0.2
			Zara	50	528	3,612	0.0	0.2	0.2
			Birnin Gwari	200	528	3,612	0.1	0.7	0.8
			Kuta	30	528	3,612	0.0	0.1	0.1
			Toroko	80	528	3,612	0.0	0.3	0.3
	20805	20805	I	1100					0.0
			Tungan Kowa	800	528	3,612	0.4	2.9	3.3
			Manta	300	528	3,612	0.2	1.1	1.3
	20806	20806	I	150					0.0
			Kogun	150	528	3,612	0.1	0.5	0.6
	20807	20807	I	0			0.0	0.0	0.0

	20809	20809	I	0			0.0	0.0	0.0
	20810	20810	I	460					0.0
			Loguma	100	528	3,612	0.1	0.4	0.5
			Gurama/ Sarkin Fawa	60	528	3,612	0.0	0.2	0.2
			Galama	300	528	3,612	0.2	1.1	1.3
	20811	20811	I	0			0.0	0.0	0.0
	20812	20812	I	280					0.0
			Kidandan	40	528	3,612	0.0	0.1	0.1
			Tubo	100	528	3,612	0.1	0.4	0.5
			Kerawa	100	528	3,612	0.1	0.4	0.5
			S.Birni	40	528	3,612	0.0	0.1	0.1
			Gongara	0	528	3,612	0.0	0.0	0.0
	20813	20813	I	1320					0.0
			Kangimi	1200	528	3,612	0.6	4.3	4.9
			Igabi	120	528	3,612	0.1	0.4	0.5
	20814	20814	I	240					0.0
			Galma	55	528	3,612	0.0	0.2	0.2
			Shika	80	528	3,612	0.0	0.3	0.3
			Kazuntu	65	528	3,612	0.0	0.2	0.2
			Dawanta	40	528	3,612	0.0	0.1	0.1
	20815	20815	I	310					0.0
			Zangon-Kataf	30	528	3,612	0.0	0.1	0.1
			Lere	40	528	3,612	0.0	0.1	0.1
			G.Kurama	40	528	3,612	0.0	0.1	0.1
			Jagindi	100	528	3,612	0.1	0.4	0.5
			Kagoro	100	528	3,612	0.1	0.4	0.5
	209	209	I	7165					0.0
			Omu-Aran	400	528	3,612	0.2	1.4	1.6
			Tada Shonga	435	528	3,612	0.2	1.6	1.8
			Oke Oyi	100	528	3,612	0.1	0.4	0.5
			Oro-Ago	80	528	3,612	0.0	0.3	0.3
			Duku-Lade	200	528	3,612	0.1	0.7	0.8
			Rabba	110	528	3,612	0.1	0.4	0.5
			Bacita	5600	528	3,612	3.0	20.2	23.2
			Jebba North	20	528	3,612	0.0	0.1	0.1
			Lafiagi	5	528	3,612	0.0	0.0	0.0
			Ajasse-Ipo	3	528	3,612	0.0	0.0	0.0
			Shao	3	528	3,612	0.0	0.0	0.0
			Ero	200	1,660	3,612	0.3	0.7	1.0
			Bussamu	9	528	3,612	0.0	0.0	0.0
	211	211	I	0			0.0	0.0	0.0
	212	212	I	49					0.0
			Oloru	20	528	3,612	0.0	0.1	0.1
			Obbo-Ile	12	528	3,612	0.0	0.0	0.0
			Passa Elepo	17	528	3,612	0.0	0.1	0.1
	213	213	I	10					0.0
			Tamani	10	528	3,612	0.0	0.0	0.0
	214	214_e	O						
		214_i	I	5					0.0
			Moshi	5	528	3,612	0.0	0.0	0.0
	215	215	I	0			0.0	0.0	0.0
	216	216_e	O						
		216_i	I	0			0.0	0.0	0.0
	217	217	I	0			0.0	0.0	0.0
	218	218	I	430					0.0
			Kontagora	250	528	3,612	0.1	0.9	1.0
			Nasarawa	100	528	3,612	0.1	0.4	0.5
			Papiri	80	528	3,612	0.0	0.3	0.3
	219	219	I	0	528	3,612	0.0	0.0	0.0
	Total			**16,868**			**8.8**	**60.7**	**69.5**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
3	30201	30201	I	0	578	3,512	0.0	0.0	0.0
	30202	30202	I	0			0.0	0.0	0.0
	30203	30203_e	O						
		30203_i	I	60					0.0
			Donga	60	578	3,512	0.0	0.2	0.2
	303	303	I	0			0.0	0.0	0.0
	304	304	I	100					0.0
			Wase	100	578	3,512	0.1	0.4	0.5
	305	305	I	0			0.0	0.0	0.0
	30601	30601	I	30					0.0
			Lower Taraba (Gassol)	30	578	3,512	0.0	0.1	0.1
	30602	30602	I	0			0.0	0.0	0.0
	30603	30603_e	O						
		30603_i	I	0			0.0	0.0	0.0

	307	307	I	0			0.0	0.0	0.0
	308	308	I	0					0.0
	309	309	I	0			0.0	0.0	0.0
	310	310	I	0			0.0	0.0	0.0
	311	311	I	7115			0.0	0.0	0.0
			Savannah Sugar	7000	578	3,512	4.0	24.6	28.6
			Cham	115	578	3,512	0.1	0.4	0.5
	312	312	I	0					0.0
	313	313	I	0			0.0	0.0	0.0
	31401	31401	I	0			0.0	0.0	0.0
	31403	31403	I	160					0.0
			Tallum	160	578	3,512	0.1	0.6	0.7
	31404	31404	I	20					0.0
			Jaffi	20	578	3,512	0.0	0.1	0.1
	31405	31405	I	1109					0.0
			Dadin Kowa	250	578	3,512	0.1	0.9	1.0
			Kushimaga	200	578	3,512	0.1	0.7	0.8
			Gora	50	578	3,512	0.0	0.2	0.2
			Balanga	500	578	3,512	0.3	1.8	2.1
			Kaititingo	0	578	3,512	0.0	0.0	0.0
			Savannah Integrated Farm	109	578	3,512	0.1	0.4	0.5
	31407	31407	I	300					0.0
			Gari Abudullahi	0					
			Vegetablefru	300	578	3,512	0.2	1.1	1.3
	31408	31408	I	0			0.0	0.0	0.0
	31409	31409	I	240					0.0
			Waya	30	578	3,512	0.0	0.1	0.1
			Ngalda	200	578	3,512	0.1	0.7	0.8
			Bagal	10	578	3,512	0.0	0.0	0.0
	315	315	I	0			0.0	0.0	0.0
	316	316	I	50			0.0	0.0	0.0
			Mayo	50	578	3,512	0.0	0.2	0.2
	317	317	I	520					0.0
			Lake Geriyo	320	578	3,512	0.2	1.1	1.3
			Chouchi	0	578	3,512	0.0	0.0	0.0
			Dasin Hausa	200	578	3,512	0.1	0.7	0.8
	318	318	I	200					0.0
			Dwan	200	578	3,512	0.1	0.7	0.8
	319	319_e	O						
		319_i	I	0			0.0	0.0	0.0
	320	320_e	O						
		320_i	I	0			0.0	0.0	0.0
	321	321	O						
	Total			**9,904**			**5.6**	**35.0**	**40.6**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	401	401	I	100	226	3,482			0.0
			Oguma	100	226	3,482	0.0	0.3	0.3
	402	402	I	0			0.0	0.0	0.0
	403	403	I	50					0.0
			Loko	50	226	3,482	0.0	0.2	0.2
	404	404	I	2030					0.0
			Doma	1600	226	3,482	0.4	5.6	6.0
			Rutu	50	226	3,482	0.0	0.2	0.2
			Sabon Gida	200	226	3,482	0.0	0.7	0.7
			Bassa	50	226	3,482	0.0	0.2	0.2
			Ganauri	130	226	3,482	0.0	0.5	0.5
	405	405	I	345					0.0
			Makurdi	200	226	3,482	0.0	0.7	0.7
			Umogidi	0	226	3,482	0.0	0.0	0.0
			Kiroki	15	226	3,482	0.0	0.1	0.1
			Naka	20	226	3,482	0.0	0.1	0.1
			Mu	60	226	3,482	0.0	0.2	0.2
			Allam	50	226	3,482	0.0	0.2	0.2
	406	406_e	O						
		406_i	I	254					0.0
			Katsina-Ala	200	226	3,482	0.0	0.7	0.7
			Jato-Aka	20	226	3,482	0.0	0.1	0.1
			Adi	24	226	3,482	0.0	0.1	0.1
			Akata	10	226	3,482	0.0	0.0	0.0
	407	407	I	520					0.0
			Obagaji	500	226	3,482	0.1	1.7	1.8
			Awe	0	226	3,482	0.0	0.0	0.0
			Awuma	20	226	3,482	0.0	0.1	0.1

	408	408	I	398					0.0
			Dep	300	226	3,482	0.1	1.0	1.1
			Bokkos	18	226	3,482	0.0	0.1	0.1
			Wuse	50	226	3,482	0.0	0.2	0.2
			Gidan Adamu	30	226	3,482	0.0	0.1	0.1
	409	409	I	0			0.0	0.0	0.0
	410	410	I	1300					0.0
			Shendam(1)	500	226	3,482	0.1	1.7	1.8
			Longkat	800	226	3,482	0.2	2.8	3.0
	411	411	I	0	226	3,482	0.0	0.0	0.0
	Total			**4,997**			**0.9**	**17.6**	**18.5**

5	500	500	I	911	294	0			0.0
			Ewu	100	294	0	0.0	0.0	0.0
			Isampou Rice	110	294	0	0.0	0.0	0.0
			Peremabiri Rice	348	294	0	0.1	0.0	0.1
			Kolo Rice	140	294	0	0.0	0.0	0.0
			Anyama-Ogbia	24	294	0	0.0	0.0	0.0
			Ewulu	50	294	0	0.0	0.0	0.0
			Kpong	89	294	1,534	0.0	0.1	0.1
			Otuokpoti	50	294	0	0.0	0.0	0.0
	502	502	I	0			0.0	0.0	0.0
	50401	50401	I	0			0.0	0.0	0.0
	50402	50402	I	5,970					0.0
			Lower Anambra	3850	294	0	1.1	0.0	1.1
			Adoru	100	294	0	0.0	0.0	0.0
			Ejule Ojebe	25	294	0	0.0	0.0	0.0
			Ofarachi	10	294	0	0.0	0.0	0.0
			Ada-Rice	1000	294	0	0.3	0.0	0.3
			Uzo Uwani	315	294	0	0.1	0.0	0.1
			Egume	100	294	0	0.0	0.0	0.0
			Ifite Ogwari	120	294	0	0.0	0.0	0.0
			Enugu abor Ufuwa	350	294	0	0.1	0.0	0.1
			Ogboji	100	294	0	0.0	0.0	0.0
	50403	50403	I	3150					0.0
			Ilush-Ega	3000	294	0	0.9	0.0	0.9
			Illahi Ebuh	100	294	0	0.0	0.0	0.0
			Ukhun/ Erah	50	294	0	0.0	0.0	0.0
	506	506	I	0			0.0	0.0	0.0
	Total			**10,031**			**2.6**	**0.1**	**2.7**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
6	60001	60001	I		1,660	2,317			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250					0.0
			Oke-Odan	250	1,660	2,317	0.4	0.6	1.0
	603	603	I	340					0.0
			Otta	340	1,660	2,317	0.6	0.8	1.4
	60401	60401	I	545					0.0
			Owiwi	45	1,660	2,317	0.1	0.1	0.2
			Mokoloki	500	1,660	2,317	0.8	1.2	2.0
	604021	604021	I	0			0.0	0.0	0.0
					1,660	2,317	0.0	0.0	0.0
	604023	604023_e	O						
		604023_i	I	44					0.0
			Upper Ogun	10	1,660	2,317	0.0	0.0	0.0
			Ofiki(A)	24	1,660	2,317	0.0	0.1	0.1
			Ofiki(B)	10	1,660	2,317	0.0	0.0	0.0
			Ilero	0	1,660	2,317	0.0	0.0	0.0
	60403	60403	I	750					0.0
			Middle Ogun (I.G)	750	1,660	2,317	1.2	1.7	2.9
	60405	60405	I	80					0.0
			Sepeteri(A)	80	1,660	2,317	0.1	0.2	0.3
			Sepeteri(B)	0	1,660	2,317	0.0	0.0	0.0
	605	605	I	0					0.0
	606	606	I	451					0.0
			Eyinwa	300	1,660	2,317	0.5	0.7	1.2
			Itokin	141	1,660	2,317	0.2	0.3	0.5
			Eniosa	10	1,660	2,317	0.0	0.0	0.0
	607	607	I	0			0.0	0.0	0.0
	608	608	I	1680					0.0

			Esa Odo Dam	800	1,660	2,317	1.3	1.9	3.2
			Igbonla	130	1,660	2,317	0.2	0.3	0.5
			New Erinle	500	1,660	2,317	0.8	1.2	2.0
			Asa	0	1,660	2,317	0.0	0.0	0.0
			Okuku	0	1,660	2,317	0.0	0.0	0.0
			Iwo	0	1,660	2,317	0.0	0.0	0.0
			Osun Ekiti	100	1,660	2,317	0.2	0.2	0.4
			Old Erinle Dam	150	1,660	2,317	0.2	0.3	0.5
	609	609	I	0			0.0	0.0	0.0
	610	610	I	100					0.0
			Oogi	0	1,660	2,317	0.0	0.0	0.0
			Ipetu-Ijesha	0	1,660	2,317	0.0	0.0	0.0
			Orile Owu	100	1,660	2,317	0.2	0.2	0.4
	611	611	I	0			0.0	0.0	0.0
	612	612	I	500					0.0
			Owena	500	1,660	2,317	0.8	1.2	2.0
			Iju-Itaogbolu	0	1,660	2,317	0.0	0.0	0.0
	614	614	I	882					0.0
			Ikere-Ogbese	32	1,660	2,317	0.1	0.1	0.2
			Oye	100	1,660	2,317	0.2	0.2	0.4
			Obayantor	100	1,660	2,317	0.2	0.2	0.4
			Erusu	0	1,660	2,317	0.0	0.0	0.0
			Ayo-Kudun	300	1,660	2,317	0.5	0.7	1.2
			Apariko	250	1,660	2,317	0.4	0.6	1.0
			Ijero	100	1,660	2,317	0.2	0.2	0.4
			Ado-Ekiti (Osin)	0	1,660	2,317	0.0	0.0	0.0
	616	616	I	25					0.0
			Ukpok	25	1,660	2,317	0.0	0.1	0.1
	617	617	I	100					0.0
			Ilah-Ebu	50	1,660	2,317	0.1	0.1	0.2
			Ewule	50	1,660	2,317	0.1	0.1	0.2
	699	699	I	0			0.0	0.0	0.0
	Total			**5,747**			**9.4**	**13.3**	**22.7**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	702	702	I	490	0	1,534			0.0
			Imo (Igwu and Ibu)	80	294	0	0.0	0.0	0.0
			Ihitti-Uboma	200	0	1,534	0.0	0.3	0.3
			Umlopara	210	0	1,534	0.0	0.3	0.3
	703	703	I	239					0.0
			Abak	62	0	1,534	0.0	0.1	0.1
			Oniong Nung Nden	177	0	1,534	0.0	0.3	0.3
	70401	70401	I	2305					0.0
			Utuma	200	0	1,534	0.0	0.3	0.3
			Nkari	0	0	1,534	0.0	0.0	0.0
			Itu	100	0	1,534	0.0	0.2	0.2
			Igbere	250	0	1,534	0.0	0.4	0.4
			Ekoi	80	0	1,534	0.0	0.1	0.1
			Adim Rice	545	0	1,534	0.0	0.8	0.8
			Idomi	100	0	1,534	0.0	0.2	0.2
			Mbiabet	100	0	1,534	0.0	0.2	0.2
			Bende	150	0	1,534	0.0	0.2	0.2
			Igwu-Ohafia	160	0	1,534	0.0	0.2	0.2
7			Igwu-Ndiojo Oguwo	150	0	1,534	0.0	0.2	0.2
			Igwu-Ndiebe	100	0	1,534	0.0	0.2	0.2
			Nung Obong	100	0	1,534	0.0	0.2	0.2
			Uzu Abam	70	0	1,534	0.0	0.1	0.1
			Idim Abam	200	0	1,534	0.0	0.3	0.3
	70402	70402	I	1216					0.0
			Isi-Uzo	71	0	1,534	0.0	0.1	0.1
			Owutu	280	0	1,534	0.0	0.4	0.4
			Akaeze	200	0	1,534	0.0	0.3	0.3
			Umuhu	200	0	1,534	0.0	0.3	0.3
			Ofiawu	115	0	1,534	0.0	0.2	0.2
			Ezamgbe	100	0	1,534	0.0	0.2	0.2
			Ezeiyieku Esu	0	0	1,534	0.0	0.0	0.0
			Ezillo Farm	150	0	1,534	0.0	0.2	0.2
			Ozara Okangwu	0	0	1,534	0.0	0.0	0.0
			Item-Ikwo	100	0	1,534	0.0	0.2	0.2
	70403	70403	I	1315					0.0
			Obubra	315	0	1,534	0.0	0.5	0.5
			Abakaliki/ Iwa	1000	0	1,534	0.0	1.5	1.5
			Ofodun	0	0	1,534	0.0	0.0	0.0

	704041	704041	I	0			0.0	0.0	0.0
	704042	704042	I	235					0.0
			Ijegu Yala	80	0	1,534	0.0	0.1	0.1
			Bausara	0	0	1,534	0.0	0.0	0.0
			Ukum	0	0	1,534	0.0	0.0	0.0
			Ogoja	125	0	1,534	0.0	0.2	0.2
			Obudu	30	0	1,534	0.0	0.0	0.0
	704043	704043	I	150					0.0
			Iboko	150	0	1,534	0.0	0.2	0.2
	70405	70405_e	O				0.0	0.0	
		70405_i	I	62					0.0
			Amaeki Abam	62	0	1,534	0.0	0.1	0.1
	705	705	I	50					0.0
			Uwet	50	0	1,534	0.0	0.1	0.1
			Itogodi	0	0	1,534	0.0	0.0	0.0
	Total			**6,062**			**0.0**	**9.2**	**9.1**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
8	800	800	I	0	9,553	1,520	0.0	0.0	0.0
	802	802_e	O						
		802_i	I	0			0.0	0.0	0.0
	80401	80401	I	23540					0.0
			South Chad	22000	9,553	1,520	210.2	33.4	243.6
			South Chad Pilot	800	9,553	1,520	7.6	1.2	8.8
			Ebeji	140	9,553	1,520	1.3	0.2	1.5
			Gamboru	400	9,553	1,520	3.8	0.6	4.4
			Ngabu	200	9,553	1,520	1.9	0.3	2.2
	80402	80402_e	O						
		80402_i	I	0	9,553	1,520	0	0	0.0
	80403	80403_e	O						
		80403_i	I	880					0.0
			Yau	420	9,553	1,520	4.0	0.6	4.6
			Michika	200	9,553	1,520	1.9	0.3	2.2
			Abadam	260	9,553	1,520	2.5	0.4	2.9
	806	806	I	0					0.0
			Jere Bowl Rice	0	9,553	1,520	0.0	0.0	0.0
	807	807	I	2000					0.0
			Baga Polder	2000	9,553	1,520	19.1	3.0	22.1
	80801	80801_e	O						
		80801_i	I	697					0.0
			Yobe	637	9,553	1,520	6.1	1.0	7.1
			Jaffi	30	9,553	1,520	0.3	0.0	0.3
			Damasak	30	9,553	1,520	0.3	0.0	0.3
	80802	80802	I	0			0.0	0.0	0.0
	80803	80803_e	O						
		80803_i	I	0			0.0	0.0	0.0
	80804	80804_e	O						
		80804_i	I	0			0.0	0.0	0.0
	80805	80805	I	128					0.0
			Gashua	100	9,553	1,520	1.0	0.2	1.2
			Mugura	28	9,553	1,520	0.3	0.0	0.3
	808061	808061	I	1180					0.0
			Abir	130	9,553	1,520	1.2	0.2	1.4
			Katagum	50	9,553	1,520	0.5	0.1	0.6
			Daya	960	9,553	1,520	9.2	1.5	10.7
			Warwada	40	9,553	1,520	0.4	0.1	0.5
			Yamidi	0	9,553	1,520	0.0	0.0	0.0
	808062	808062	I	40					0.0
			K.Gana	40	9,553	1,520	0.4	0.1	0.5
	808063	808063	I	142					0.0
			Jamaare(Sewa Pilot)	20	9,553	1,520	0.2	0.0	0.2
			Galala	72	9,553	1,520	0.7	0.1	0.8
			Diya	30	9,553	1,520	0.3	0.0	0.3
			Maladumba	20	9,553	1,520	0.2	0.0	0.2
	808071	808071	I	0			0.0	0.0	0.0
	8080721	8080721_e	O						
		8080721_i	I	3520					0.0
			Gari	2200	9,553	1,520	21.0	3.3	24.3
			Tomas	400	9,553	1,520	3.8	0.6	4.4
			Jakara	820	9,553	1,520	7.8	1.2	9.0
			Jakarade	100	9,553	1,520	1.0	0.2	1.2
			Dambo	0	9,553	1,520	0.0	0.0	0.0
	8080723	8080723	I	60					0.0
			Dembo	60	9,553	1,520	0.6	0.1	0.7
	808073	808073	I	5758					0.0
			Kano River	203	9,553	1,520	1.9	0.3	2.2

			Phase II						
			Hadejia Valley	5255	9,553	1,520	50.2	8.0	58.2
			Kafin Chiri	0	9,553	1,520	0.0	0.0	0.0
			Aguja	120	9,553	1,520	1.1	0.2	1.3
			Jahun	100	9,553	1,520	1.0	0.2	1.2
			Gunuar Kukaf	0	9,553	1,520	0.0	0.0	0.0
			Mai-alkama	0	9,553	1,520	0.0	0.0	0.0
			Arawa	0	9,553	1,520	0.0	0.0	0.0
			Hantsu	30	9,553	1,520	0.3	0.0	0.3
			Walu	50	9,553	1,520	0.5	0.1	0.6
			Tsuwa	0	9,553	1,520	0.0	0.0	0.0
			Joda	0	9,553	1,520	0.0	0.0	0.0
	8080741	8080741	I	0			0.0	0.0	0.0
	80807421	80807421	I	273					0.0
			Baguwai (Watari)	273	9,553	1,520	2.6	0.4	3.0
	80807423	80807423	I	0					0.0
	8080743	8080743	I	830					0.0
			Guzuguzu	530	9,553	1,520	5.1	0.8	5.9
			Magaga	300	9,553	1,520	2.9	0.5	3.4
	8080745	8080745	I	0			0.0	0.0	0.0
			Gwarzo	0	9,553	1,520	0.0	0.0	0.0
	808075	808075	I	16300					0.0
			Kano River Phase I	16000	9,553	1,520	152.8	24.3	177.1
			Bagauda	300	9,553	1,520	2.9	0.5	3.4
	808077	808077	I	0					0.0
			Tudun Wada	0	9,553	1,520	0.0	0.0	0.0
	Total			**55,348**			**528.9**	**84.0**	**612.9**
Grand Total				**141,106**			**740.6**	**344.3**	**1,084.8**

(3) Existing Diversion Water Requirement of Irrigation Project

Water Resources: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	579	221	11,580	4,420	40	25	5,737
	Dry	0	322	0	6,440	5	60	3,864
2	Wet	204	10	4,080	200	10	60	528
	Dry	720	362	14,400	7,240	10	30	3,612
3	Wet	187	17	3,740	340	10	60	578
	Dry	706	350	14,120	7,000	10	30	3,512
4	Wet	113	0	2,260	0	10	60	226
	Dry	670	357	13,400	7,140	10	30	3,482
5	Wet	21	0	420	0	70	5	294
	Dry	593	310	11,860	6,200	0	0	0
6	Wet	205	45	4,100	900	35	25	1,660
	Dry	642	331	12,840	6,620	0	35	2,317
7	Wet	0	0	0	0	70	30	0
	Dry	598	312	11,960	6,240	5	15	1,534
8	Wet	559	203	11,180	4,060	80	15	9,553
	Dry	0	304	0	6,080	0	25	1,520

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	579	221	9,650	3,683	20	50	3,772
	Dry	0	322	0	5,367	0	70	3,757
2	Wet	204	10	3,400	167	10	60	440
	Dry	720	362	12,000	6,033	0	70	4,223
3	Wet	187	17	3,117	283	10	60	482
	Dry	706	350	11,767	5,833	0	70	4,083
4	Wet	113	0	1,883	0	10	60	188
	Dry	670	357	11,167	5,950	0	70	4,165
5	Wet	21	0	350	0	30	40	105
	Dry	593	310	9,883	5,167	0	70	3,617
6	Wet	205	45	3,417	750	20	50	1,058
	Dry	642	331	10,700	5,517	0	70	3,862
7	Wet	0	0	0	0	30	40	0
	Dry	598	312	9,967	5,200	0	70	3,640
8	Wet	559	203	9,317	3,383	30	40	4,148
	Dry	0	304	0	5,067	0	70	3,547

(4) Net Irrigation Requirement (for Existing Irrigation scheme)

Hydrological Area: **HA-1** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	81	92	133	161	175	155	137	123	118	120	96	82	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					30	107	142	122	72	18			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					135	212	202	182	102	48			881
⑤ Effective rainfall	mm	0	0	2	4	18	40	82	100	56	6	0	0	
⑥ Net Irrigation Requirement	mm					117	172	120	82	46	42			579
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	81	92	133	161	175	155	137	123	118	120	96	82	
Kc						0.11	0.41	0.75	0.85	0.54	0.14			
① Etcrop (ETo×Kc)	mm					19	64	103	105	64	17			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					49	94	103	105	64	17			432
④ Effective rainfall	mm					13	28	57	70	39	4			
⑤ Net Irrigation Requirement	mm					36	66	46	35	25	13			221

Hydrological Area: **HA-1** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm													
Kc														
① Etcrop (ETo×Kc)	mm													
② Percoration	mm													
③ Land Preparation	mm													
④ =①+②+③	mm													
⑤ Effective rainfall	mm													
⑥ Net Irrigation Requirement	mm													
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	81	92	133	161	175	155	137	123	118	120	96	82	
Kc		0.88	0.85	0.39	0.05							0.15	0.52	
① Etcrop (ETo×Kc)	mm	71	78	52	8							14	43	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	71	78	52	8							44	73	326
④ Effective rainfall	mm	0	0	1	3							0	0	
⑤ Net Irrigation Requirement	mm	71	78	51	5							44	73	322

Hydrological Area: **HA-2** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	96	103	129	134	132	115	111	104	99	104	98	94	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					22	79	115	103	60	16			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					127	184	175	163	90	46			785
⑤ Effective rainfall	mm	1	0	9	29	76	105	122	146	150	42	2	1	
⑥ Net Irrigation Requirement	mm					51	79	53	17	0	4			204
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	96	103	129	134	132	115	111	104	99	104	98	94	
Kc						0.13	0.45	0.78	0.86	0.54	0.14			
① Etcrop (ETo×Kc)	mm					17	52	87	89	53	15			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					47	82	87	89	53	15			373
④ Effective rainfall	mm					53	74	85	102	105	29			
⑤ Net Irrigation Requirement	mm					0	8	2	0	0	0			10

Hydrological Area: **HA-2** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	96	103	129	134	132	115	111	104	99	104	98	94	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① Etcrop (ETo×Kc)	mm	106	68	21							18	68	104	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	166	98	51							123	173	164	775
⑤ Effective rainfall	mm	1	0	9							42	2	1	
⑥ Net Irrigation Requirement	mm	165	98	42							81	171	163	720
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	96	103	129	134	132	115	111	104	99	104	98	94	
Kc		0.84	0.91	0.57	0.15							0.15	0.5	
① Etcrop (ETo×Kc)	mm	81	94	74	20							15	47	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	81	94	74	20							45	77	391

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
④ Effective rainfall	mm	1	0	6	20							1	1	
⑤ Net Irrigation Requirement	mm	80	94	68	0							44	76	362

Hydrological Area: **HA-3** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	88	96	129	136	133	115	110	104	98	104	95	88	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					23	79	114	103	60	16			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					128	184	174	163	90	46			785
⑤ Effective rainfall	mm	0	0	5	26	67	93	145	167	122	40	2	0	
⑥ Net Irrigation Requirement	mm			0	0	61	91	29	0	0	6			187
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	88	96	129	136	133	115	110	104	98	104	95	88	
Kc						0.13	0.45	0.78	0.86	0.54	0.14			
① Etcrop (ETo×Kc)	mm					17	52	86	89	53	15			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					47	82	86	89	53	15			372
④ Effective rainfall	mm					47	65	102	117	85	28			
⑤ Net Irrigation Requirement	mm					0	17	0	0	0	0			17

Hydrological Area: **HA-3** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	88	96	129	136	133	115	110	104	98	104	95	88	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① Etcrop (ETo×Kc)	mm	97	63	21							18	66	98	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	157	93	51							123	171	158	753
⑤ Effective rainfall	mm	0	0	5							40	2	0	
⑥ Net Irrigation Requirement	mm	157	93	46							83	169	158	706
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	88	96	129	136	133	115	110	104	98	104	95	88	
Kc		0.84	0.91	0.57	0.15							0.15	0.5	
① Etcrop (ETo×Kc)	mm	74	87	74	20							14	44	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	74	87	74	20							44	74	373
④ Effective rainfall	mm	0	0	4	18							1	0	
⑤ Net Irrigation Requirement	mm	74	87	70	2							43	74	350

Hydrological Area: **HA-4** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	99	104	128	126	124	111	109	105	100	104	100	95	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					21	77	113	104	61	16			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					126	182	173	164	91	46			782
⑤ Effective rainfall	mm	1	0	15	46	106	123	139	169	174	88	6	0	
⑥ Net Irrigation Requirement	mm					20	59	34	0	0	0			113
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	99	104	128	126	124	111	109	105	100	104	100	95	
Kc						0.13	0.46	0.79	0.86	0.54	0.14			
① ETcrop (ETo×Kc)	mm					16	51	86	90	54	15			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					46	81	86	90	54	15			372
④ Effective rainfall	mm					74	86	97	118	122	62			
⑤ Net Irrigation Requirement	mm					0	0	0	0	0	0			0

Hydrological Area: **HA-4** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	99	104	128	126	124	111	109	105	100	104	100	95	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① ETcrop (ETo×Kc)	mm	109	69	20							18	69	105	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	169	99	50							123	174	165	780
⑤ Effective rainfall	mm	1	0	15							88	6	0	
⑥ Net Irrigation Requirement	mm	168	99	35	0						35	168	165	670
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	99	104	128	126	124	111	109	105	100	104	100	95	
Kc		0.84	0.91	0.57	0.15							0.14	0.5	
① Etcrop (ETo×Kc)	mm	83	95	73	19							14	48	

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	83	95	73	19							44	78	392
④ Effective rainfall	mm	1	0	11	32							4	0	
⑤ Net Irrigation Requirement	mm	82	95	62	0							40	78	357

Hydrological Area: **HA-5** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	107	107	125	122	122	111	108	105	102	106	106	105	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					21	77	112	104	62	16			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					126	182	172	164	92	46			782
⑤ Effective rainfall	mm	6	0	46	83	151	206	183	143	225	153	33	6	
⑥ Net Irrigation Requirement	mm					0	0	0	21	0	0			21
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	107	107	125	122	122	111	108	105	102	106	106	105	
Kc						0.13	0.46	0.79	0.86	0.54	0.14			
① ETcrop (ETo×Kc)	mm					16	51	85	90	55	15			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					46	81	85	90	55	15			372
④ Effective rainfall	mm					106	144	128	100	158	107			
⑤ Net Irrigation Requirement	mm					0	0	0	0	0	0			0

Hydrological Area: **HA-5** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	107	107	125	122	122	111	108	105	102	106	106	105	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① ETcrop (ETo×Kc)	mm	118	71	20							18	73	117	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	178	101	50							123	178	177	807
⑤ Effective rainfall	mm	6	0	46							153	33	6	
⑥ Net Irrigation Requirement	mm	172	101	4							0	145	171	593
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	107	107	125	122	122	111	108	105	102	106	106	105	
Kc		0.81	0.87	0.54	0.14							0.14	0.48	
① Etcrop (ETo×Kc)	mm	87	93	68	17							15	50	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	87	93	68	17							45	80	390
④ Effective rainfall	mm	4	0	32	58							23	4	
⑤ Net Irrigation Requirement	mm	83	93	36	0							22	76	310

Hydrological Area: **HA-6** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					21	77	110	101	61	16			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					126	182	170	161	91	46			776
⑤ Effective rainfall	mm	3	0	37	71	112	140	116	66	154	105	15	3	
⑥ Net Irrigation Requirement	mm					14	42	54	95	0	0			205
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
Kc						0.13	0.46	0.79	0.86	0.54	0.14			
① ETcrop (ETo×Kc)	mm					16	51	84	88	54	15			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					46	81	84	88	54	15			368
④ Effective rainfall	mm					78	98	81	46	108	74			
⑤ Net Irrigation Requirement	mm					0	0	3	42	0	0			45

Hydrological Area: **HA-6** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① ETcrop (ETo×Kc)	mm	117	71	20							18	72	117	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	177	101	50							123	177	177	805
⑤ Effective rainfall	mm	3	0	37							105	15	3	
⑥ Net Irrigation Requirement	mm	174	101	13							18	162	174	642
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	

	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	86	93	68	17							15	50	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	86	93	68	17							45	80	389
④	Effective rainfall	mm	2	0	26	50							11	2	
⑤	Net Irrigation Requirement	mm	84	93	42	0							34	78	331

Hydrological Area: **HA-7** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	106	107	123	118	120	110	108	104	102	105	105	104	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					20	76	112	103	62	16			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					125	181	172	163	92	46			779
⑤	Effective rainfall	mm	3	0	51	95	158	192	203	200	226	178	26	3	
⑥	Net Irrigation Requirement	mm					0	0	0	0	0	0			0
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	106	107	123	118	120	110	108	104	102	105	105	104	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					16	51	85	89	55	15			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					46	81	85	89	55	15			371
④	Effective rainfall	mm					111	134	142	140	158	125			
⑤	Net Irrigation Requirement	mm					0	0	0	0	0	0			0

Hydrological Area: **HA-7** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	106	107	123	118	120	110	108	104	102	105	105	104	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	117	71	20							18	72	115	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	177	101	50							123	177	175	803
⑤	Effective rainfall	mm	3	0	51							178	26	3	
⑥	Net Irrigation Requirement	mm	174	101	0							0	151	172	598
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	106	107	123	118	120	110	108	104	102	105	105	104	
	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	86	93	66	17							15	50	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	86	93	66	17							45	80	387
④	Effective rainfall	mm	2	0	36	67							18	2	
⑤	Net Irrigation Requirement	mm	84	93	30	0							27	78	312

Hydrological Area: **HA-8** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	74	83	122	150	164	147	129	115	112	114	90	76	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					28	101	134	114	68	17			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					133	206	194	174	98	47			852
⑤	Effective rainfall	mm	0	0	0	4	15	32	88	111	43	4	0	0	
⑥	Net Irrigation Requirement	mm					118	174	106	63	55	43			559
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	74	83	122	150	164	147	129	115	112	114	90	76	
	Kc						0.11	0.41	0.75	0.85	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					18	60	97	98	60	16			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					48	90	97	98	60	16			409
④	Effective rainfall	mm					11	22	62	78	30	3			
⑤	Net Irrigation Requirement	mm					37	68	35	20	30	13			203

Hydrological Area: **HA-8** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm													
	Kc														
①	ETcrop (ETo×Kc)	mm													
②	Percoration	mm													
③	Land Preparation	mm													
④	=①+②+③	mm													
⑤	Effective rainfall	mm													
⑥	Net Irrigation Requirement	mm													

2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	74	83	122	150	164	147	129	115	112	114	90	76	
	Kc		0.89	0.85	0.39	0.05							0.16	0.53	
①	Etcrop (ETo×Kc)	mm	66	71	48	8							14	40	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	66	71	48	8							44	70	307
④	Effective rainfall	mm	0	0	0	3							0	0	
⑤	Net Irrigation Requirement	mm	66	71	48	5							44	70	304

SR1.3.5 Water Demand of Proposed Irrigation Schemes

(1) Water Demand of Proposed Irrigation Schemes

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
1	135,128.3	101	101	9,355.4	3920	6,842	3,220	26.8	12.5	39.3
		102	102	9,127.2	300	6,842	3,220	2.1	0.9	3.0
		103	103	3,387.3	1500	6,842	3,220	10.3	4.8	15.1
		104	104	2,933.6	0	6,842	3,220	0	0	0.0
		105	105	3,456.6	0	6,842	3,220	0	0	0.0
		10601	10601	689.1	0	6,842	3,220	0	0	0.0
		10602	10602	10,960.3	0	6,842	3,220	0	0	0.0
		10603	10603	1,084.9	0	6,842	3,220	0	0	0.0
		10604	10604	17,476.6	0	6,842	3,220	0	0	0.0
		10605	10605	6,335.9	200	6,842	3,220	1.4	0.6	2.0
		10606	10606	5,817.2	470	6,842	3,220	3.2	1.5	4.7
		10607	10607	2,706.1	0	6,842	3,220	0	0	0.0
		106081	106081_e	2,220.3						
			106081_i	4,132.3	3100	6,842	3,220	21.3	10	31.3
		106082	106082_e	80,006.8						
			106082_i1	1,322.2	0	6,842	3,220	0	0	0.0
			106082_i2	6,043.4	405			2.7	1.3	4.0
		106083	106083	412.5	5120	6,842	3,220	35	16.5	51.5
		106085	106085_e	290.3						
			106085_i	1,499.6	0	6,842	3,220	0	0	0.0
		1060861	1060861_e	6,067.9						
			1060861_i1	164.7	0	6,842	3,220	0	0	0.0
			1060861_i2	548.0	2300			15.7	7.4	23.1
		1060863	1060863	3,509.3	50	6,842	3,220	0.3	0.2	0.5
		106087	106087_e	632.3						
			106087_i	1,216.5	0	6,842	3,220	0	0	0.0
		1060881	1060881	5,750.6	2100	6,842	3,220	14.4	6.7	21.1
		1060883	1060883	2,513.8	0	6,842	3,220	0	0	0.0
		106089	106089	8,354.1	0	6,842	3,220	0	0	0.0
		106091	106091	7,636.2	23000	6,842	3,220	157.4	74.1	231.5
		106093	106093	4,746.6	76	6,842	3,220	0.5	0.2	0.7
		107	107_e	1,924.1						
			107_i	6,223.4	0	6,842	3,220	0	0	0.0
		108	108_e	63,517.4						
			108_i	7,724.9	0	6,842	3,220	0	0	0.0
		109	109	14,037.5						
	Total				**42,541**			**291.1**	**136.7**	**427.8**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
2	154,615.9	201	201	2,646.9	23	2,508	7,224	0.1	0.1	0.2
		20201	20201	5,088.0	400	2,508	7,224	1	2.9	3.9
		202021	202021	2,739.0	0	2,508	7,224	0	0	0.0
		202023	202023	190.7	0	2,508	7,224	0	0	0.0
		20203	20203	4,599.3	415	2,508	7,224	1.1	3	4.1
		20205	20205	2,636.8	44	2,508	7,224	0.1	0.3	0.4
		203	203	4,436.7	0	2,508	7,224	0	0	0.0
		20401	20401	5,985.0	4803	2,508	7,224	12.1	34.7	46.8
		20403	20403	1,596.0	0	2,508	7,224	0	0	0.0
		205	205	375.0	0	2,508	7,224	0	0	0.0
		206	206	7,358.0	6273	2,508	7,224	15.8	45.2	61.0
		207	207	1,056.1	90	2,508	7,224	0.2	0.7	0.9
		20801	20801	1,936.8	624	2,508	7,224	1.6	4.6	6.2
		20802	20802	2,240.6	0	2,508	7,224	0	0	0.0
		20803	20803	725.1	0	2,508	7,224	0	0	0.0
		20804	20804	17,359.5	8440	2,508	7,224	21.2	60.9	82.1
		20805	20805	4,325.9	800	2,508	7,224	2	5.8	7.8
		20806	20806	3,503.9	400	2,508	7,224	1	2.9	3.9
		20807	20807	557.0	0	2,508	7,224	0	0	0.0
		20809	20809	3,692.3	0	2,508	7,224	0	0	0.0

		20810	20810	3,449.6	485	2,508	7,224	1.3	3.5	4.8
		20811	20811	1,561.0	0	2,508	7,224	0	0	0.0
		20812	20812	5,919.2	780	2,508	7,224	2	5.6	7.6
		20813	20813	2,483.4	1720	2,508	7,224	4.3	12.5	16.8
		20814	20814	6,713.9	795	2,508	7,224	2	5.8	7.8
		20815	20815	10,882.2	310	2,508	7,224	0.9	2.2	3.1
		209	209	15,015.3	14720	2,508	7,224	37	106.2	143.2
		211	211	6.2	0	2,508	7,224	0	0	0.0
		212	212	6,740.8	29	2,508	7,224	0	0.2	0.2
		213	213	4,145.9	10	2,508	7,224	0	0.1	0.1
		214	214_e	257.9						
			214_i	9,792.7	5	2,508	7,224	0	0	0.0
		215	215	2,109.7	0	2,508	7,224	0	0	0.0
		216	216_e	3,698.9						
			216_i	7,957.2	0	2,508	7,224	0	0	0.0
		217	217	127.2	0	2,508	7,224	0	0	0.0
		218	218	4,644.4	2180	2,508	7,224	5.5	15.7	21.2
		219	219	19.0	0	2,508	7,224	0	0	0.0
	Total				**43,346**			**109.2**	**312.9**	**422.1**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
3	156,546.0	30201	30201	587.0	35000	2,346	7,024	82.1	245.8	327.9
		30202	30202	5,145.8	0	2,346	7,024	0	0	0.0
		30203	30203_e	2,826.1						
			30203_i	11,384.8	60	2,346	7,024	0.1	0.4	0.5
		303	303	1,463.0	10000	2,346	7,024	23.5	70.2	93.7
		304	304	4,997.2	2290	2,346	7,024	5.4	16.1	21.5
		305	305	808.7	7500	2,346	7,024	17.6	52.7	70.3
		30601	30601	2,266.4	18000	2,346	7,024	42.2	126.5	168.7
		30602	30602	5,395.0	5000	2,346	7,024	11.7	35.1	46.8
		30603	30603_e	559.0						
			30603_i	13,799.2	0	2,346	7,024	0	0	0.0
		307	307	5,737.4	0	2,346	7,024	0	0	0.0
		308	308	15,173.5	0	2,346	7,024	0	0	0.0
		309	309	87.1	0	2,346	7,024	0	0	0.0
		310	310	2,512.7	0	2,346	7,024	0	0	0.0
		311	311	11,883.8	12315	2,346	7,024	28.9	86.5	115.4
		312	312	2,748.4	18000	2,346	7,024	42.2	126.4	168.6
		313	313	48.5	0	2,346	7,024	0	0	0.0
		31401	31401	717.6	0	2,346	7,024	0	0	0.0
		31403	31403	1,658.9	160	2,346	7,024	0.4	1.1	1.5
		31404	31404	11,229.0	20	2,346	7,024	0	0.1	0.1
		31405	31405	6,890.1	14710	2,346	7,024	34.5	103.4	137.9
		31407	31407	7,702.1	300	2,346	7,024	0.7	2.1	2.8
		31408	31408	5,303.7	0	2,346	7,024	0	0	0.0
		31409	31409	19,178.0	460	2,346	7,024	1.1	3.3	4.4
		315	315	1,616.6	0	2,346	7,024	0	0	0.0
		316	316	5,536.5	9050	2,346	7,024	21.2	63.6	84.8
		317	317	3,400.3	5400	2,346	7,024	12.7	37.9	50.6
		318	318	5,441.5	10200	2,346	7,024	24	71.6	95.6
		319	319_e	2,088.9						
			319_i	1,726.6	0	2,346	7,024	0	0	0.0
		320	320_e	25,211.5						
			320_i	2,106.7	0	2,346	7,024	0	0	0.0
		321	321	65,499.3						
	Total				**148,465**			**348.3**	**1,042.8**	**1,391.1**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	74,518.7	401	401	3,642.9	1000	1,356	6,964	1.4	7	8.4
		402	402	9,075.9	4000	1,356	6,964	5.4	27.9	33.3
		403	403	4,906.6	15050	1,356	6,964	20.4	104.8	125.2
		404	404	9,347.8	2467	1,356	6,964	3.5	17.1	20.6
		405	405	11,303.0	3145	1,356	6,964	4.3	21.8	26.1
		406	406_e	10,331.5						
			406_i	12,618.8	5034	1,356	6,964	6.8	35.1	41.9
		407	407	4,277.1	2100	1,356	6,964	2.8	14.6	17.4
		408	408	10,587.4	2098	1,356	6,964	2.8	14.5	17.3
		409	409	2,471.0	0	1,356	6,964	0	0	0.0
		410	410	4,839.1	18100	1,356	6,964	24.6	126.1	150.7
		411	411	1,449.1	7500	1,356	6,964	10.2	52.2	62.4
	Total				**60,494**			**82.2**	**421.1**	**503.3**

5	53,913.6	500	500	19,112.1	4390	336	8,356	1.3	36.6	37.9
		502	502	3,156.9	1800	336	8,356	0.6	0	0.6

		50401	50401	1,580.8	0	336	8,356	0	0	0.0
		50402	50402	14,104.9	16060	336	8,356	5.2	66.5	71.7
		50403	50403	11,821.3	16150	336	8,356	5.5	79	84.5
		506	506	4,137.6	2400	336	8,356	0.8	0	0.8
	Total				**40,800**			**13.4**	**182.1**	**195.5**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	2,730	7,784	0	0	0.0
		60002	60002	8,252.4	0	2,730	7,784	0	0	0.0
		601	601	391.8	0	2,730	7,784	0	0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	2,730	7,784	0.7	1.9	2.6
		603	603	1,965.7	0	2,730	7,784	0	0	0.0
		60401	60401	2,034.9	12302	2,730	7,784	33.6	95.8	129.4
		604021	604021	168.9	0	2,730	7,784	0	0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	114	2,730	7,784	0.3	0.9	1.2
		60403	60403	6,011.7	12000	2,730	7,784	32.8	93.4	126.2
		60405	60405	4,704.2	30	2,730	7,784	0.1	0.2	0.3
		605	605	2,167.8	0	2,730	7,784	0	0	0.0
		606	606	3,425.1	335	2,730	7,784	0.9	2.7	3.6
		607	607	325.1	0	2,730	7,784	0	0	0.0
		608	608	9,764.4	2210	2,730	7,784	6.2	17.2	23.4
		609	609	113.5	0	2,730	7,784	0	0	0.0
		610	610	6,462.0	750	2,730	7,784	2.1	5.8	7.9
		611	611	4,227.7	0	2,730	7,784	0	0	0.0
		612	612	5,869.5	500	2,730	7,784	1.4	3.9	5.3
		614	614	13,271.7	2282	2,730	7,784	6.3	17.7	24.0
		616	616	8,417.4	25	2,730	7,784	0.1	0.2	0.3
		617	617	1,896.8	100	2,730	7,784	0.2	0.8	1.0
		699	699	4,809.4	0	2,730	7,784	0	0	0.0
	Total				**30,898**			**84.7**	**240.5**	**325.2**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
7	57,440.2	702	702	8,146.5	6420	0	8,424	0	4.4	4.4
		703	703	4,318.8	3662	0	8,424	0	3.9	3.9
		70401	70401	6,054.6	3500	0	8,424	0	29.4	29.4
		70402	70402	7,090.9	7316	0	8,424	0	17.8	17.8
		70403	70403	3,625.5	4015	0	8,424	0	11.1	11.1
		704041	704041	1,236.3	900	0	8,424	0	0	0.0
		704042	704042	7,702.7	7435	0	8,424	0	14.7	14.7
		704043	704043	7,382.6	9750	0	8,424	0	36.6	36.6
		70405	70405_e	13,407.4						
			70405_i	6,028.1	62	0	8,424	0	0.5	0.5
		705	705	5,854.2	50	0	8,424	0	0	0.4
	Total				**43,110**			**0.0**	**118.8**	**118.8**

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
8	178,483.2	800	800	5,221.9	0	9350	3040	0	0	0.0
		802	802_e	13,857.3						
			802_i	2,422.8	0	0	0	0	0	0.0
		80401	80401	4,647.6	23540	0	0	220.1	71.5	291.6
		80402	80402_e	626.1						
			80402_i	7,171.8	0	9,350	3,040	0	0	0.0
		80403	80403_e	253.1						
			80403_i	6,656.5	680	9,350	3,040	6.3	2.1	8.4
		806	806	21,903.0	0	9,350	3,040	0	0	0.0
		807	807	14,280.8	2000	9,350	3,040	18.7	6.1	24.8
		80801	80801_e	1,438.6						
			80801_i	946.1	2880	9,350	3,040	27	8.8	35.8
		80802	80802	30,141.6	0	9,350	3,040	0	0	0.0
		80803	80803_e	8,391.9						
			80803_i	1,528.3	0	9,350	3,040	0	0	0.0
		80804	80804_e	21,200.9						
			80804_i	6,230.7	0	9,350	3,040	0	0	0.0
		80805	80805	9,381.6	2028	9,350	3,040	19	6.2	25.2
		808061	808061	5,200.0	1830	9,350	3,040	17.1	5.5	22.6
		808062	808062	6,129.6	40	9,350	3,040	0.4	0.1	0.5
		808063	808063	12,632.1	200	9,350	3,040	1.9	0.7	2.6
		808071	808071	274.9	0	9,350	3,040	0	0	0.0
		8080721	8080721_e	19,574.1						

			8080721_i	18,041.8	1230	9,350	3,040	11.4	3.7	15.1
		8080723	8080723	1,145.5	0	9,350	3,040	0	0	0.0
		808073	808073	9,609.9	27800	9,350	3,040	260	84.6	344.6
		8080741	8080741	244.3	0	9,350	3,040	0	0	0.0
		80807421	80807421	861.8	0	9,350	3,040	0	0	0.0
		80807423	80807423	653.9	0	9,350	3,040	0	0	0.0
		8080743	8080743	1,581.2	70	9,350	3,040	0.7	0.2	0.9
		8080745	8080745	3,841.5	0	9,350	3,040	0	0	0.0
		808075	808075	1,196.2	22300	9,350	3,040	208.5	67.8	276.3
		808077	808077	6,537.9	0	9,350	3,040	0	0	0.0
	Total				**84,598**			**791.1**	**257.3**	**1,048.4**
	Grand Total				**494,252**			**1720.0**	**2712.2**	**4,432.2**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
1	101	101	0	0	0	4,294	0.0	39.3
	102	102	0	0	0	4,294	0.0	3.0
	103	103	0	0	0	4,294	0.0	15.1
	104	104	23	35	58	4,294	0.2	0.2
	105	105	1,233	1,883	3,116	4,294	13.4	13.4
	10601	10601	359	549	908	4,294	3.9	3.9
	10602	10602	388	593	981	4,294	4.2	4.2
	10603	10603	458	700	1,158	4,294	5.0	5.0
	10604	10604	1,142	1,745	2,887	4,294	12.4	12.4
	10605	10605	2,073	3,166	5,239	4,294	22.5	24.5
	10606	10606	100	153	253	4,294	1.1	5.8
	10607	10607	733	1,120	1,853	4,294	8.0	8.0
	106081	106081_e						
		106081_i	1,291	1,972	3,263	4,294	14.0	45.3
	106082	106082_e						
		106082_i1	983	1,501	2,484	4,294	10.7	10.7
		106082_i2	187	286	473	4,294	2.0	6.0
	106083	106083	177	271	448	4,294	1.9	53.4
	106085	106085_e						
		106085_i	409	625	1,034	4,294	4.4	4.4
	1060861	1060861_e						
		1060861_i1	50	76	126	4,294	0.5	0.5
		1060861_i2	0	0	0	4,294	0.0	23.1
	1060863	1060863	0	0	0	4,294	0.0	0.5
	106087	106087_e						
		106087_i	148	226	374	4,294	1.6	1.6
	1060881	1060881	360	549	909	4,294	3.9	25.0
	1060883	1060883	324	495	819	4,294	3.5	3.5
	106089	106089	424	648	1,072	4,294	4.6	4.6
	106091	106091	575	877	1,452	4,294	6.2	237.7
	106093	106093	0	0	0	4,294	0.0	0.7
	107	107_e						
		107_i	1,246	1,903	3,149	4,294	13.5	13.5
	108	108_e						
		108_i	22	33	55	4,294	0.2	0.2
	109	109						
	Total		**12,705**	**19,406**	**32,111**		**137.7**	**565.5**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
2	201	201	292	446	738	4,826	3.6	3.8
	20201	20201	188	286	474	4,826	2.3	6.2
	202021	202021	0	0	0	4,826	0.0	0.0
	202023	202023	0	0	0	4,826	0.0	0.0
	20203	20203	0	0	0	4,826	0.0	4.1
	20205	20205	0	0	0	4,826	0.0	0.4
	203	203	1,643	2,510	4,153	4,826	20.0	20.0
	20401	20401	175	267	442	4,826	2.1	48.9
	20403	20403	0	0	0	4,826	0.0	0.0
	205	205	302	461	763	4,826	3.7	3.7
	206	206	322	491	813	4,826	3.9	64.9
	207	207	727	1,111	1,838	4,826	8.9	9.8
	20801	20801	437	668	1,105	4,826	5.3	11.5
	20802	20802	0	0	0	4,826	0.0	0.0
	20803	20803	256	391	647	4,826	3.1	3.1
	20804	20804	113	172	285	4,826	1.4	83.5
	20805	20805	15	23	38	4,826	0.2	8.0
	20806	20806	0	0	0	4,826	0.0	3.9
	20807	20807	0	0	0	4,826	0.0	0.0
	20809	20809	0	0	0	4,826	0.0	0.0

	20810	20810	0	0	0	4,826	0.0	4.8
	20811	20811	0	0	0	4,826	0.0	0.0
	20812	20812	690	1,053	1,743	4,826	8.4	16.0
	20813	20813	51	78	129	4,826	0.6	17.4
	20814	20814	488	745	1,233	4,826	6.0	13.8
	20815	20815	202	308	510	4,826	2.5	5.6
	209	209	3,083	4,708	7,791	4,826	37.6	180.8
	211	211	0	0	0	4,826	0.0	0.0
	212	212	0	0	0	4,826	0.0	0.2
	213	213	0	0	0	4,826	0.0	0.1
	214	214_e						
		214_i	0	0	0	4,826	0.0	0.0
	215	215	0	0	0	4,826	0.0	0.0
	216	216_e						
		216_i	0	0	0	4,826	0.0	0.0
	217	217	0	0	0	4,826	0.0	0.0
	218	218	7	11	18	4,826	0.1	21.3
	219	219	0	0	0	4,826	0.0	0.0
	Total		**8,991**	**13,729**	**22,720**		**109.7**	**531.8**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
3	30201	30201	156	238	394	4,666	1.8	329.7
	30202	30202	100	152	252	4,666	1.2	1.2
	30203	30203_e						
		30203_i	392	598	990	4,666	4.6	5.1
	303	303	480	733	1,213	4,666	5.7	99.4
	304	304	38	59	97	4,666	0.5	22.0
	305	305	149	228	377	4,666	1.8	72.1
	30601	30601	501	765	1,266	4,666	5.9	174.6
	30602	30602	100	153	253	4,666	1.2	48.0
	30603	30603_e						
		30603_i	38	58	96	4,666	0.4	0.4
	307	307	1,883	2,876	4,759	4,666	22.2	22.2
	308	308	394	601	995	4,666	4.6	4.6
	309	309	73	112	185	4,666	0.9	0.9
	310	310	5	7	12	4,666	0.1	0.1
	311	311	3,543	5,411	8,954	4,666	41.8	157.2
	312	312	166	254	420	4,666	2.0	170.6
	313	313	71	109	180	4,666	0.8	0.8
	31401	31401	241	367	608	4,666	2.8	2.8
	31403	31403	16	25	41	4,666	0.2	1.7
	31404	31404	0	0	0	4,666	0.0	0.1
	31405	31405	59	90	149	4,666	0.7	138.6
	31407	31407	26	40	66	4,666	0.3	3.1
	31408	31408	467	714	1,181	4,666	5.5	5.5
	31409	31409	753	1,150	1,903	4,666	8.9	13.3
	315	315	487	743	1,230	4,666	5.7	5.7
	316	316	362	553	915	4,666	4.3	89.1
	317	317	359	549	908	4,666	4.2	54.8
	318	318	25	39	64	4,666	0.3	95.9
	319	319_e						
		319_i	151	231	382	4,666	1.8	1.8
	320	320_e						
		320_i	230	351	581	4,666	2.7	2.7
	321	321						
	Total		**11,265**	**17,206**	**28,471**		**132.9**	**1,524.0**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
4	401	401	716	1,093	1,809	4,760	8.6	17.0
	402	402	159	242	401	4,760	1.9	35.2
	403	403	1,188	1,815	3,003	4,760	14.3	139.5
	404	404	454	693	1,147	4,760	5.5	26.1
	405	405	813	1,242	2,055	4,760	9.8	35.9
	406	406_e						
		406_i	0	0	0	4,760	0.0	41.9
	407	407	342	522	864	4,760	4.1	21.5
	408	408	457	698	1,155	4,760	5.5	22.8
	409	409	351	536	887	4,760	4.2	4.2
	410	410	505	772	1,277	4,760	6.1	156.8
	411	411	392	599	991	4,760	4.7	67.1
	Total		**5,377**	**8,212**	**13,589**		**64.7**	**568.0**

B. Underflow Water (proposed)

5	500	500	240	366	606	4,134	2.5	40.4
	502	502	0	0	0	4,134	0.0	0.6

	50401	50401	926	1,414	2,340	4,134	9.7	9.7
	50402	50402	38	58	96	4,134	0.4	72.1
	50403	50403	1,567	2,393	3,960	4,134	16.4	100.9
	506	506	27	41	68	4,134	0.3	1.1
	Total		**2,798**	**4,272**	**7,070**		**29.3**	**224.8**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	4,414	0.0	0.0
	60002	60002	0	0	0	4,414	0.0	0.0
	601	601	0	0	0	4,414	0.0	0.0
	602	602_e						
		602_i	0	0	0	4,414	0.0	2.6
	603	603	0	0	0	4,414	0.0	0.0
	60401	60401	0	0	0	4,414	0.0	129.4
	604021	604021	0	0	0	4,414	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	4,414	0.0	1.2
	60403	60403	0	0	0	4,414	0.0	126.2
	60405	60405	0	0	0	4,414	0.0	0.3
	605	605	0	0	0	4,414	0.0	0.0
	606	606	0	0	0	4,414	0.0	3.6
	607	607	0	0	0	4,414	0.0	0.0
	608	608	0	0	0	4,414	0.0	23.4
	609	609	0	0	0	4,414	0.0	0.0
	610	610	0	0	0	4,414	0.0	7.9
	611	611	0	0	0	4,414	0.0	0.0
	612	612	0	0	0	4,414	0.0	5.3
	614	614	0	0	0	4,414	0.0	24.0
	616	616	0	0	0	4,414	0.0	0.3
	617	617	0	0	0	4,414	0.0	1.0
	699	699	0	0	0	4,414	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**325.2**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
7	702	702	0	0	0	4,160	0.0	4.4
	703	703	0	0	0	4,160	0.0	3.9
	70401	70401	0	0	0	4,160	0.0	29.4
	70402	70402	2	3	5	4,160	0.0	17.8
	70403	70403	165	252	417	4,160	1.7	12.8
	704041	704041	75	115	190	4,160	0.8	0.8
	704042	704042	43	66	109	4,160	0.5	15.2
	704043	704043	77	118	195	4,160	0.8	37.4
	70405	70405_e						
		70405_i	41	63	104	4,160	0.4	0.9
	705	705	0	0	0	4,160	0.0	0.4
	Total		**403**	**617**	**1,020**		**4.2**	**123.0**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
8	800	800	0	0	0	4,054	0.0	0.0
	802	802_e						
		802_i	0	0	0	4,054	0.0	0.0
	80401	80401	0	0	0	4,054	0.0	291.6
	80402	80402_e						
		80402_i	0	0	0	4,054	0.0	0.0
	80403	80403_e						
		80403_i	0	0	0	4,054	0.0	8.4
	806	806	0	0	0	4,054	0.0	0.0
	807	807	0	0	0	4,054	0.0	24.8
	80801	80801_e						
		80801_i	140	214	354	4,054	1.4	37.2
	80802	80802	1,954	2,984	4,938	4,054	20.0	20.0
	80803	80803_e						
		80803_i	300	458	758	4,054	3.1	3.1
	80804	80804_e						
		80804_i	20	30	50	4,054	0.2	0.2
	80805	80805	1,775	2,711	4,486	4,054	18.2	43.4
	808061	808061	1,520	2,321	3,841	4,054	15.6	38.2
	808062	808062	975	1,489	2,464	4,054	10.0	10.5
	808063	808063	784	1,197	1,981	4,054	8.0	10.6
	808071	808071	184	281	465	4,054	1.9	1.9
	8080721	8080721_e						

		8080721_i	564	862	1,426	4,054	5.8	20.9
	8080723	8080723	0	0	0	4,054	0.0	0.0
	808073	808073	5,208	7,955	13,163	4,054	53.4	398.0
	8080741	8080741	0	0	0	4,054	0.0	0.0
	80807421	80807421	37	56	93	4,054	0.4	0.4
	80807423	80807423	0	0	0	4,054	0.0	0.0
	8080743	8080743	0	0	0	4,054	0.0	0.9
	8080745	8080745	0	0	0	4,054	0.0	0.0
	808075	808075	0	0	0	4,054	0.0	276.3
	808077	808077	0	0	0	4,054	0.0	0.0
	Total		**13,461**	**20,558**	**34,019**		**138.0**	**1,186.4**
Grand Total			**55,000**	**84,000**	**139,000**		**616.5**	**5,048.7**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
1	101	101	1,701	4,508	4,294	7.7	7.3	15.0
	102	102	403	4,508	4,294	1.8	1.7	3.5
	103	103	270	4,508	4,294	1.2	1.2	2.4
	104	104	291	4,508	4,294	1.3	1.2	2.5
	105	105	172	4,508	4,294	0.8	0.7	1.5
	10601	10601	139	4,508	4,294	0.6	0.6	1.2
	10602	10602	847	4,508	4,294	3.8	3.6	7.4
	10603	10603	213	4,508	4,294	1.0	0.9	1.9
	10604	10604	2,209	4,508	4,294	10.0	9.5	19.5
	10605	10605	1,424	4,508	4,294	6.4	6.1	12.5
	10606	10606	1,816	4,508	4,294	8.2	7.8	16.0
	10607	10607	310	4,508	4,294	1.4	1.3	2.7
	106081	106081_e						
		106081_i	672	4,508	4,294	3.0	2.9	5.9
	106082	106082_e						
		106082_i1	0	4,508	4,294	0.0	0.0	0.0
		106082_i2	2,702	4,508	4,294	12.2	11.6	23.8
	106083	106083	0	4,508	4,294	0.0	0.0	0.0
	106085	106085_e						
		106085_i	0	4,508	4,294	0.0	0.0	0.0
	1060861	1060861_e						
		1060861_i1	0	4,508	4,294	0.0	0.0	0.0
		1060861_i2	126	4,508	4,294	0.6	0.5	1.1
	1060863	1060863	1,121	4,508	4,294	5.1	4.8	9.9
	106087	106087_e						
		106087_i	0	4,508	4,294	0.0	0.0	0.0
	1060881	1060881	1,177	4,508	4,294	5.3	5.1	10.4
	1060883	1060883	1,041	4,508	4,294	4.7	4.5	9.2
	106089	106089	2,809	4,508	4,294	12.7	12.1	24.8
	106091	106091	1,190	4,508	4,294	5.4	5.1	10.5
	106093	106093	1,385	4,508	4,294	6.2	5.9	12.1
	107	107_e						
		107_i	645	4,508	4,294	2.9	2.8	5.7
	108	108_e						
		108_i	1,017	4,508	4,294	4.6	4.4	9.0
	109	109						
	Total		**23,680**			**106.9**	**101.6**	**208.5**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
2	201	201	692	474	4,826	0.3	3.3	3.6
	20201	20201	1,060	474	4,826	0.5	5.1	5.6
	202021	202021	489	474	4,826	0.2	2.4	2.6
	202023	202023	28	474	4,826	0.0	0.1	0.1
	20203	20203	785	474	4,826	0.4	3.8	4.2
	20205	20205	535	474	4,826	0.3	2.6	2.9
	203	203	1,192	474	4,826	0.6	5.8	6.4
	20401	20401	1,272	474	4,826	0.6	6.1	6.7
	20403	20403	528	474	4,826	0.3	2.5	2.8
	205	205	114	474	4,826	0.1	0.6	0.7
	206	206	1,728	474	4,826	0.8	8.3	9.1
	207	207	288	474	4,826	0.1	1.4	1.5
	20801	20801	329	474	4,826	0.2	1.6	1.8
	20802	20802	87	474	4,826	0.0	0.4	0.4
	20803	20803	157	474	4,826	0.1	0.8	0.9
	20804	20804	1,544	474	4,826	0.7	7.5	8.2
	20805	20805	660	474	4,826	0.3	3.2	3.5
	20806	20806	38	474	4,826	0.0	0.2	0.2
	20807	20807	103	474	4,826	0.0	0.5	0.5
	20809	20809	398	474	4,826	0.2	1.9	2.1

	20810	20810	222	474	4,826	0.1	1.1	1.2
	20811	20811	51	474	4,826	0.0	0.2	0.2
	20812	20812	1,779	474	4,826	0.8	8.6	9.4
	20813	20813	554	474	4,826	0.3	2.7	3.0
	20814	20814	2,830	474	4,826	1.3	13.7	15.0
	20815	20815	2,470	474	4,826	1.2	11.9	13.1
	209	209	3,026	474	4,826	1.4	14.6	16.0
	211	211	0	474	4,826	0.0	0.0	0.0
	212	212	1,733	474	4,826	0.8	8.4	9.2
	213	213	242	474	4,826	0.1	1.2	1.3
	214	214_e						
		214_i	443	474	4,826	0.2	2.1	2.3
	215	215	83	474	4,826	0.0	0.4	0.4
	216	216_e						
		216_i	189	474	4,826	0.1	0.9	1.0
	217	217	5	474	4,826	0.0	0.0	0.0
	218	218	762	474	4,826	0.4	3.7	4.1
	219	219	2	474	4,826	0.0	0.0	0.0
	Total		**26,418**			**12.4**	**127.6**	**140.0**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
3	30201	30201	184	538	4,666	0.1	0.9	1.0
	30202	30202	979	538	4,666	0.5	4.6	5.1
	30203	30203_e						
		30203_i	1,366	538	4,666	0.7	6.4	7.1
	303	303	387	538	4,666	0.2	1.8	2.0
	304	304	1,550	538	4,666	0.8	7.2	8.0
	305	305	87	538	4,666	0.0	0.4	0.4
	30601	30601	791	538	4,666	0.4	3.7	4.1
	30602	30602	189	538	4,666	0.1	0.9	1.0
	30603	30603_e						
		30603_i	371	538	4,666	0.2	1.7	1.9
	307	307	613	538	4,666	0.3	2.9	3.2
	308	308	2,230	538	4,666	1.2	10.4	11.6
	309	309	0	538	4,666	0.0	0.0	0.0
	310	310	566	538	4,666	0.3	2.6	2.9
	311	311	1,096	538	4,666	0.6	5.1	5.7
	312	312	674	538	4,666	0.4	3.1	3.5
	313	313	0	538	4,666	0.0	0.0	0.0
	31401	31401	98	538	4,666	0.1	0.5	0.6
	31403	31403	360	538	4,666	0.2	1.7	1.9
	31404	31404	1,313	538	4,666	0.7	6.1	6.8
	31405	31405	2,201	538	4,666	1.2	10.3	11.5
	31407	31407	1,882	538	4,666	1.0	8.8	9.8
	31408	31408	867	538	4,666	0.5	4.0	4.5
	31409	31409	4,136	538	4,666	2.2	19.3	21.5
	315	315	217	538	4,666	0.1	1.0	1.1
	316	316	838	538	4,666	0.5	3.9	4.4
	317	317	352	538	4,666	0.2	1.6	1.8
	318	318	693	538	4,666	0.4	3.2	3.6
	319	319_e						
		319_i	223	538	4,666	0.1	1.0	1.1
	320	320_e						
		320_i	3	538	4,666	0.0	0.0	0.0
	321	321						
	Total		**24,266**			**13.0**	**113.1**	**126.1**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
4	401	401	1,070	188	4,760	0.2	5.1	5.3
	402	402	1,544	188	4,760	0.3	7.3	7.6
	403	403	1,515	188	4,760	0.3	7.2	7.5
	404	404	2,215	188	4,760	0.4	10.5	10.9
	405	405	4,025	188	4,760	0.8	19.2	20.0
	406	406_e						
		406_i	3,380	188	4,760	0.6	16.1	16.7
	407	407	757	188	4,760	0.1	3.6	3.7
	408	408	1,623	188	4,760	0.3	7.7	8.0
	409	409	838	188	4,760	0.2	4.0	4.2
	410	410	1,558	188	4,760	0.3	7.4	7.7
	411	411	187	188	4,760	0.0	0.9	0.9
	Total		**18,712**			**3.5**	**89.0**	**92.5**

5	500	500	1,972	105	4,134	0.2	8.2	8.4
	502	502	1,083	105	4,134	0.1	4.5	4.6

	50401	50401	235	105	4,134	0.0	1.0	1.0
	50402	50402	6,217	105	4,134	0.7	25.7	26.4
	50403	50403	5,043	105	4,134	0.5	20.8	21.3
	506	506	1,555	105	4,134	0.2	6.4	6.6
	Total		**16,105**			**1.7**	**66.6**	**68.3**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
6	60001	60001	381	1,208	4,414	0.5	1.7	2.2
	60002	60002	585	1,208	4,414	0.7	2.6	3.3
	601	601	175	1,208	4,414	0.2	0.8	1.0
	602	602_e						
		602_i	1,531	1,208	4,414	1.8	6.8	8.6
	603	603	611	1,208	4,414	0.7	2.7	3.4
	60401	60401	826	1,208	4,414	1.0	3.6	4.6
	604021	604021	51	1,208	4,414	0.1	0.2	0.3
	604023	604023_e						
		604023_i	2,766	1,208	4,414	3.3	12.2	15.5
	60403	60403	2,552	1,208	4,414	3.1	11.3	14.4
	60405	60405	973	1,208	4,414	1.2	4.3	5.5
	605	605	1,071	1,208	4,414	1.3	4.7	6.0
	606	606	1,330	1,208	4,414	1.6	5.9	7.5
	607	607	133	1,208	4,414	0.2	0.6	0.8
	608	608	3,872	1,208	4,414	4.7	17.1	21.8
	609	609	36	1,208	4,414	0.0	0.2	0.2
	610	610	2,176	1,208	4,414	2.6	9.6	12.2
	611	611	1,554	1,208	4,414	1.9	6.9	8.8
	612	612	1,759	1,208	4,414	2.1	7.8	9.9
	614	614	5,061	1,208	4,414	6.1	22.3	28.4
	616	616	3,196	1,208	4,414	3.9	14.1	18.0
	617	617	930	1,208	4,414	1.1	4.1	5.2
	699	699	771	1,208	4,414	0.9	3.4	4.3
	Total		**32,340**			**39.0**	**142.9**	**181.9**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
7	702	702	3,618	0	4,160	0.0	15.1	15.1
	703	703	1,871	0	4,160	0.0	7.8	7.8
	70401	70401	2,547	0	4,160	0.0	10.6	10.6
	70402	70402	3,442	0	4,160	0.0	14.3	14.3
	70403	70403	1,564	0	4,160	0.0	6.5	6.5
	704041	704041	449	0	4,160	0.0	1.9	1.9
	704042	704042	3,494	0	4,160	0.0	14.5	14.5
	704043	704043	3,507	0	4,160	0.0	14.6	14.6
	70405	70405_e						
		70405_i	904	0	4,160	0.0	3.8	3.8
	705	705	800	0	4,160	0.0	3.3	3.3
	Total		**22,196**			**0.0**	**92.4**	**92.4**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
8	800	800	5	4,825	4,054	0.0	0.0	0.0
	802	802_e						
		802_i	9	4,825	4,054	0.0	0.0	0.0
	80401	80401	289	4,825	4,054	1.4	1.2	2.6
	80402	80402_e						
		80402_i	363	4,825	4,054	1.8	1.5	3.3
	80403	80403_e						
		80403_i	1,409	4,825	4,054	6.8	5.7	12.5
	806	806	2,396	4,825	4,054	11.6	9.7	21.3
	807	807	0	4,825	4,054	0.0	0.0	0.0
	80801	80801_e						
		80801_i	0	4,825	4,054	0.0	0.0	0.0
	80802	80802	4,632	4,825	4,054	22.3	18.8	41.1
	80803	80803_e	0					
		80803_i	0	4,825	4,054	0.0	0.0	0.0
	80804	80804_e						
		80804_i	0	4,825	4,054	0.0	0.0	0.0
	80805	80805	1,240	4,825	4,054	6.0	5.0	11.0
	808061	808061	1,756	4,825	4,054	8.5	7.1	15.6
	808062	808062	1,823	4,825	4,054	8.8	7.4	16.2
	808063	808063	2,457	4,825	4,054	11.9	10.0	21.9
	808071	808071	0	4,825	4,054	0.0	0.0	0.0
	8080721	8080721_e						

		8080721_i	6,782	4,825	4,054	32.7	27.5	60.2
	8080723	8080723	449	4,825	4,054	2.2	1.8	4.0
	808073	808073	3,177	4,825	4,054	15.3	12.9	28.2
	8080741	8080741	91	4,825	4,054	0.4	0.4	0.8
	80807421	80807421	434	4,825	4,054	2.1	1.8	3.9
	80807423	80807423	302	4,825	4,054	1.5	1.2	2.7
	8080743	8080743	725	4,825	4,054	3.5	2.9	6.4
	8080745	8080745	1,692	4,825	4,054	8.2	6.9	15.1
	808075	808075	536	4,825	4,054	2.6	2.2	4.8
	808077	808077	1,716	4,825	4,054	8.3	7.0	15.3
	Total		**32,283**			**155.9**	**131.0**	**286.9**

Grand Total			**196,000**			**332.4**	**864.2**	**1,196.6**

(2) Surface Water Demand of Proposed Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	101	101	I	3920	6,842	3,220	26.8	12.5	39.3
			Swashi Valley	2900	6,842	3,220	19.8	9.3	29.1
			Wara	200	6,842	3,220	1.4	0.6	2.0
			Gafara	500	6,842	3,220	3.4	1.6	5.0
			Dongongari	320	6,842	3,220	2.2	1.0	3.2
	102	102	I	300			2.1	0.9	3
			Nasko	200	6,842	3,220	1.4	0.6	2.0
			Rijau	100	6,842	3,220	0.7	0.3	1.0
	103	103	I	1500			10.3	4.8	15.1
			2009 Kasanu	1500	6,842	3,220	10.3	4.8	15.1
	104	104	I	0			0.0	0.0	0.0
	105	105	I	0			0.0	0.0	0.0
	10601	10601	I	0			0.0	0.0	0.0
	10602	10602	I	0			0.0	0.0	0.0
	10603	10603	I	0			0.0	0.0	0.0
	10604	10604	I	0			0.0	0.0	0.0
	10605	10605	I	200			1.4	0.6	2
			Zauro Polder	100	6,842	3,220	0.7	0.3	1.0
			Argungu/ Tabarau	100	6,842	3,220	0.7	0.3	1.0
	10606	10606	I	470			3.2	1.5	4.7
			Shagari	220	6,842	3,220	1.5	0.7	2.2
			Kwakwazo	250	6,842	3,220	1.7	0.8	2.5
	10607	10607	I	0					
	106081	106081_e	O						
		106081_i	I	3100			21.3	10	31.3
			Wurno	1500	6,842	3,220	10.3	4.8	15.1
			Kware	800	6,842	3,220	5.5	2.6	8.1
			Kalmalo	800	6,842	3,220	5.5	2.6	8.1
1	106082	106082_e	O						
		106082_i1	I	0					
		106082_i2	I	405			2.7	1.3	4
			Sabke	130	6,842	3,220	0.9	0.4	1.3
			Ajiwa	0	6,842	3,220	0.0	0.0	0.0
			Mashigi	35	6,842	3,220	0.2	0.1	0.3
			Mangwal	0	6,842	3,220	0.0	0.0	0.0
			Deberam	240	6,842	3,220	1.6	0.8	2.4
	106083	106083	I	5120			35	16.5	51.5
			Goronyo	120	6,842	3,220	0.8	0.4	1.2
			Middle Rima Valley	5000	6,842	3,220	34.2	16.1	50.3
	106085	106085_e	O						
		106085_i	I	0					
	1060861	1060861_e	O						
		1060861_i1	I	0					0.0
		1060861_i2	I	2300			15.7	7.4	23.1
			Jibiya	2300	6,842	3,220	15.7	7.4	23.1
	1060863	1060863	I	50			0.3	0.2	0.5
			Raddewa	50	6,842	3,220	0.3	0.2	0.5
	106087	106087_e	O						
		106087_i	I	0			0.0	0.0	0.0
	1060881	1060881	I	2100			14.4	6.7	21.1
			Zobe	2000	6,842	3,220	13.7	6.4	20.1
			Makere	100	6,842	3,220	0.7	0.3	1.0
	1060883	1060883	I	0			0	0	0
	106089	106089	I	0					
			Gagere	0	6,842	3,220	0.0	0.0	0.0
	106091	106091	I	23000			157.4	74.1	231.5
			Bakolori	23000	6,842	3,220	157.4	74.1	231.5
			Bakura		6,842	3,220	0.0	0.0	0.0

	106093	106093	I	76			0.5	0.2	0.7
			Mairuwa	76	6,842	3,220	0.5	0.2	0.7
	107	107_e	O						
		107_i	I	0			0	0	0
			Illo	0	6,842	3,220	0.0	0.0	0.0
	108	108_e	O						
		108_i	I	0			0.0	0.0	0.0
	109	109	O						
	Total			**42,541**			**291.1**	**136.7**	427.8

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	201	201	I	23	2,508	7,224	0.1	0.1	0.2
			Otibe	3	2,508	7,224	0.0	0.0	0.0
			Serki Noma	20	2,508	7,224	0.1	0.1	0.2
	20201	20201	I	400			1	2.9	3.9
			Gerinyan	400	2,508	7,224	1.0	2.9	3.9
	202021	202021	I	0			0.0	0.0	0.0
	202023	202023	I	0			0.0	0.0	0.0
	20203	20203	I	415			1.1	3	4.1
			Tafa/ Jere	355	2,508	7,224	0.9	2.6	3.5
			Pambegua	60	2,508	7,224	0.2	0.4	0.6
	20205	20205	I	44			0.1	0.3	0.4
			Hunkuyi	40	2,508	7,224	0.1	0.3	0.4
			Tadanni	4	2,508	7,224	0.0	0.0	0.0
	203	203	I	0			0.0	0.0	0.0
	20401	20401	I	4803			12.1	34.7	46.8
			Kampe/Omi	4000	2,508	7,224	10.0	28.9	38.9
			Kpada	150	2,508	7,224	0.4	1.1	1.5
			Ikale	420	2,508	7,224	1.1	3.0	4.1
			Adorun	80	2,508	7,224	0.2	0.6	0.8
			Odugbo	150	2,508	7,224	0.4	1.1	1.5
			Aiyetoro	3	2,508	7,224	0.0	0.0	0.0
	20403	20403	I	0					0.0
	205	205	I	0					0.0
	206	206	I	6273			15.8	45.2	61
			Agaie/ Lapai	1000	2,508	7,224	2.5	7.2	9.7
			E.Lapai	2000	2,508	7,224	5.0	14.4	19.4
			Bakogi	2000	2,508	7,224	5.0	14.4	19.4
			Badeggi	830	2,508	7,224	2.1	6.0	8.1
			Pandegi	25	2,508	7,224	0.1	0.2	0.3
			Chanchanga	302	2,508	7,224	0.8	2.2	3.0
			Agaie	76	2,508	7,224	0.2	0.5	0.7
			Lioji	40	2,508	7,224	0.1	0.3	0.4
			Zara	0	2,508	7,224	0.0	0.0	0.0
2	207	207	I	90			0.2	0.7	0.9
			Duro-Gakpan	90	2,508	7,224	0.2	0.7	0.9
	20801	20801	I	624			1.6	4.6	6.2
			Guzan	0	2,508	7,224	0.0	0.0	0.0
			Wuya	25	2,508	7,224	0.1	0.2	0.3
			Doko	400	2,508	7,224	1.0	2.9	3.9
			Bangi	50	2,508	7,224	0.1	0.4	0.5
			Edozhigi	100	2,508	7,224	0.3	0.7	1.0
			Baratsu	49	2,508	7,224	0.1	0.4	0.5
	20802	20802	I	0			0.0	0.0	0.0
	20803	20803	I	0			0.0	0.0	0.0
	20804	20804	I	8440			21.2	60.9	82.1
			Bagoma	500	2,508	7,224	1.3	3.6	4.9
			Zara	0	2,508	7,224	0.0	0.0	0.0
			Birnin Gwari	430	2,508	7,224	1.1	3.1	4.2
			Kuta	30	2,508	7,224	0.1	0.2	0.3
			Toroko	80	2,508	7,224	0.2	0.6	0.8
			2039 Ukusu	1400	2,508	7,224	3.5	10.1	13.6
			3008 Bajagira	6000	2,508	7,224	15.0	43.3	58.3
	20805	20805	I	800			2	5.8	7.8
			Tungan Kowa	800	2,508	7,224	2.0	5.8	7.8
			Manta	0	2,508	7,224	0.0	0.0	0.0
	20806	20806	I	400			1	2.9	3.9
			Kogun	400	2,508	7,224	1.0	2.9	3.9
	20807	20807	I	0			0.0	0.0	0.0
	20809	20809	I	0			0.0	0.0	0.0
	20810	20810	I	485			1.3	3.5	4.8
			Loguma	125	2,508	7,224	0.3	0.9	1.2
			Gurama/ Sarkin Fawa	60	2,508	7,224	0.2	0.4	0.6
			Galama	300	2,508	7,224	0.8	2.2	3.0
	20811	20811	I	0			0.0	0.0	0.0
	20812	20812	I	780			2	5.6	7.6
			Kidandan	40	2,508	7,224	0.1	0.3	0.4

			Tubo	600	2,508	7,224	1.5	4.3	5.8
			Kerawa	100	2,508	7,224	0.3	0.7	1.0
			S.Birni	40	2,508	7,224	0.1	0.3	0.4
			Gongara	0	2,508	7,224	0.0	0.0	0.0
	20813	20813	I	1720			4.3	12.5	16.8
			Kangimi	1600	2,508	7,224	4.0	11.6	15.6
			Igabi	120	2,508	7,224	0.3	0.9	1.2
	20814	20814	I	795			2	5.8	7.8
			Galma	610	2,508	7,224	1.5	4.4	5.9
			Shika	80	2,508	7,224	0.2	0.6	0.8
			Kazuntu	65	2,508	7,224	0.2	0.5	0.7
			Dawanta	40	2,508	7,224	0.1	0.3	0.4
	20815	20815	I	310			0.9	2.2	3.1
			Zangon-Kataf	30	2,508	7,224	0.1	0.2	0.3
			Lere	40	2,508	7,224	0.1	0.3	0.4
			G.Kurama	40	2,508	7,224	0.1	0.3	0.4
			Jagindi	100	2,508	7,224	0.3	0.7	1.0
			Kagoro	100	2,508	7,224	0.3	0.7	1.0
	209	209	I	14720			37	106.2	143.2
			Omu-Aran	0	2,508	7,224	0.0	0.0	0.0
			Tada Shonga	4100	2,508	7,224	10.3	29.6	39.9
			Oke Oyi	60	2,508	7,224	0.2	0.4	0.6
			Oro-Ago	10	2,508	7,224	0.0	0.1	0.1
			Duku-Lade	1200	2,508	7,224	3.0	8.7	11.7
			Rabba	110	2,508	7,224	0.3	0.8	1.1
			Bacita	9000	2,508	7,224	22.6	65.0	87.6
			Jebba North	20	2,508	7,224	0.1	0.1	0.2
			Lafiagi	5	2,508	7,224	0.0	0.0	0.0
			Ajasse-Ipo	3	2,508	7,224	0.0	0.0	0.0
			Shao	3	2,508	7,224	0.0	0.0	0.0
			Ero	200	2,730	7,224	0.5	1.4	1.9
			Bussamu	9	2,508	7,224	0.0	0.1	0.1
	211	211	I	0			0.0	0.0	0.0
	212	212	I	29			0	0.2	0.2
			Oloru	0	2,508	7,224	0.0	0.0	0.0
			Obbo-Ile	12	2,508	7,224	0.0	0.1	0.1
			Passa Elepo	17	2,508	7,224	0.0	0.1	0.1
	213	213	I	10			0	0.1	0.1
			Tamani	10	2,508	7,224	0.0	0.1	0.1
	214	214_e	O						
		214_i	I	5			0	0	0
			Moshi	5	2,508	7,224	0.0	0.0	0.0
	215	215	I	0			0.0	0.0	0.0
	216	216_e	O						
		216_i	I	0			0.0	0.0	0.0
	217	217	I	0			0.0	0.0	0.0
	218	218	I	2180			5.5	15.7	21.2
			Kontagora	2000	2,508	7,224	5.0	14.4	19.4
			Nasarawa	100	2,508	7,224	0.3	0.7	1.0
			Papiri	80	2,508	7,224	0.2	0.6	0.8
	219	219	I	0	2,508	7,224	0.0	0.0	0.0
	Total			**43,346**			**109.2**	**312.9**	422.1

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
3	30201	30201	I	35000	2,346	7,024	82.1	245.8	327.9
			Donga-Int.2	35000	2,346	7,024	82.1	245.8	327.9
	30202	30202	I	0			0.0	0.0	0.0
	30203	30203_e	O						
		30203_i	I	60			0.1	0.4	0.5
			Donga	60	2,346	7,024	0.1	0.4	0.5
	303	303	I	10000			23.5	70.2	93.7
			Taraba-Int.3	10000	2,346	7,024	23.5	70.2	93.7
	304	304	I	2290			5.4	16.1	21.5
			Wase	90	2,346	7,024	0.2	0.6	0.8
			2112 Bada	2200	2,346	7,024	5.2	15.5	20.7
	305	305	I	7500			17.6	52.7	70.3
			Taraba-Int.3	7500	2,346	7,024	17.6	52.7	70.3
	30601	30601	I	18000			42.2	126.5	168.7
			Lower Taraba (Gassol)	3000	2,346	7,024	7.0	21.1	28.1
			Taraba-Int.2	15000	2,346	7,024	35.2	105.4	140.6
	30602	30602	I	5000			11.7	35.1	46.8
			Taraba-Int.1	5000	2,346	7,024	11.7	35.1	46.8
	30603	30603_e	O						
		30603_i	I	0			0.0	0.0	0.0
	307	307	I	0					0.0
	308	308	I	0					0.0
	309	309	I	0			0.0	0.0	0.0

	310	310	I	0			0.0	0.0	0.0
	311	311	I	12315			28.9	86.5	115.4
			Savannah Sugar	12200	2,346	7,024	28.6	85.7	114.3
			Cham	115	2,346	7,024	0.3	0.8	1.1
	312	312	I	18000			42.2	126.4	168.6
			2091 Mayo Belwa	18000	2,346	7,024	42.2	126.4	168.6
	313	313	I	0			0.0	0.0	0.0
	31401	31401	I	0			0.0	0.0	0.0
	31403	31403	I	160			0.4	1.1	1.5
			Tallum	160	2,346	7,024	0.4	1.1	1.5
	31404	31404	I	20			0	0.1	0.1
			Jaffi	20	2,346	7,024	0.0	0.1	0.1
	31405	31405	I	14710			34.5	103.4	137.9
			Dadin Kowa	6660	2,346	7,024	15.6	46.8	62.4
			Kushimaga	200	2,346	7,024	0.5	1.4	1.9
			Gora	50	2,346	7,024	0.1	0.4	0.5
			Balanga	3800	2,346	7,024	8.9	26.7	35.6
			Kaititingo	0	2,346	7,024	0.0	0.0	0.0
			Savannah Integrated Farm	4000	2,346	7,024	9.4	28.1	37.5
	31407	31407	I	300			0.7	2.1	2.8
			Gari Abudullahi	0	2,346	7,024	0.0	0.0	0.0
			Vegetablefru	300	2,346	7,024	0.7	2.1	2.8
	31408	31408	I	0			0.0	0.0	0.0
	31409	31409	I	460			1.1	3.3	4.4
			Waya	250	2,346	7,024	0.6	1.8	2.4
			Ngalda	200	2,346	7,024	0.5	1.4	1.9
			Bagal	10	2,346	7,024	0.0	0.1	0.1
	315	315	I	0			0.0	0.0	0.0
	316	316	I	9050			21.2	63.6	84.8
			Mayo	50	2,346	7,024	0.1	0.4	0.5
			2089 Mayo Ine	9000	2,346	7,024	21.1	63.2	84.3
	317	317	I	5400			12.7	37.9	50.6
			Lake Geriyo	4000	2,346	7,024	9.4	28.1	37.5
			Chouchi	1200	2,346	7,024	2.8	8.4	11.2
			Dasin Hausa	200	2,346	7,024	0.5	1.4	1.9
	318	318	I	10200			24	71.6	95.6
			Dwan	200	2,346	7,024	0.5	1.4	1.9
			3012 Mulemg	10000	2,346	7,024	23.5	70.2	93.7
	319	319_e	O						
		319_i	I	0			0.0	0.0	0.0
	320	320_e	O						
		320_i	I	0			0.0	0.0	0.0
	321	321	O						
	Total			**148,465**			**348.3**	**1,042.8**	1,391.1

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	401	401	I	1000	1,356	6,964	1.4	7	8.4
			Oguma	1000	1,356	6,964	1.4	7.0	8.4
	402	402	I	4000			5.4	27.9	33.3
			3011 Ragwa	4000	1,356	6,964	5.4	27.9	33.3
	403	403	I	15050			20.4	104.8	125.2
			Loko	50	1,356	6,964	0.1	0.3	0.4
			Nasarawa-Int.	15000	1,356	6,964	20.3	104.5	124.8
	404	404	I	2467			3.5	17.1	20.6
			Doma	2037	1,356	6,964	2.8	14.2	17.0
			Rutu	50	1,356	6,964	0.1	0.3	0.4
			Sabon Gida	200	1,356	6,964	0.3	1.4	1.7
			Bassa	50	1,356	6,964	0.1	0.3	0.4
			Ganauri	130	1,356	6,964	0.2	0.9	1.1
	405	405	I	3145			4.3	21.8	26.1
			Makurdi	1000	1,356	6,964	1.4	7.0	8.4
			Umogidi	0	1,356	6,964	0.0	0.0	0.0
			Kiroki	15	1,356	6,964	0.0	0.1	0.1
			Naka	20	1,356	6,964	0.0	0.1	0.1
			Mu	60	1,356	6,964	0.1	0.4	0.5
			2142 Kereke	2000	1,356	6,964	2.7	13.9	16.6
			Allam	50	1,356	6,964	0.1	0.3	0.4
	406	406_e	O						
		406_i	I	5034			6.8	35.1	41.9
			Katsina-Ala	2000	1,356	6,964	2.7	13.9	16.6
			Jato-Aka	1000	1,356	6,964	1.4	7.0	8.4
			Adi	24	1,356	6,964	0.0	0.2	0.2
			Akata	10	1,356	6,964	0.0	0.1	0.1
			2148 Dula	2000	1,356	6,964	2.7	13.9	16.6
	407	407	I	2100			2.8	14.6	17.4
			Obagaji	500	1,356	6,964	0.7	3.5	4.2

			Awe	80	1,356	6,964	0.1	0.6	0.7
			Awuma	20	1,356	6,964	0.0	0.1	0.1
			2139 Aneri	1500	1,356	6,964	2.0	10.4	12.4
	408	408	I	2098			2.8	14.5	17.3
			Dep	2000	1,356	6,964	2.7	13.9	16.6
			Bokkos	18	1,356	6,964	0.0	0.1	0.1
			Wuse	50	1,356	6,964	0.1	0.3	0.4
			Gidan Adamu	30	1,356	6,964	0.0	0.2	0.2
	409	409	I	0			0.0	0.0	0.0
	410	410	I	18100			24.6	126.1	150.7
			Shendam(1)	1000	1,356	6,964	1.4	7.0	8.4
			Longkat	1100	1,356	6,964	1.5	7.7	9.2
			2124 Shemankar	16000	1,356	6,964	21.7	111.4	133.1
	411	411	I	7,500			10	52	62
			Taraba-Int.3	7500	1,356	6,964	10.2	52.2	62.4
	Total			**60,494**			**82.2**	**421.1**	**503.3**

5	500	500	I	4,390	336	8,356	1	37	38
			Ewu	100	336	8,356	0.0	0.8	0.8
			Isampou Rice	1280	336	8,356	0.4	10.7	11.1
			Peremabiri Rice	1280	336	8,356	0.4	10.7	11.1
			Kolo Rice	1300	336	8,356	0.4	10.9	11.3
			Anyama-Ogbia	180	336	8,356	0.1	1.5	1.6
			Ewulu	50	336	8,356	0.0	0.4	0.4
			Kpong	100	336	8,424	0.0	0.8	0.8
			Otuokpoti	100	336	8,356	0.0	0.8	0.8
	502	502	I	1,800			1	0	1
			Land Reclam.	1800	336	0	0.6	0.0	0.6
	50401	50401	I	0			0.0	0.0	0.0
	50402	50402	I	16,060			5	67	72
			Lower Anambra	5000	336	8,356	1.7	41.8	43.5
			Adoru	100	336	8,356	0.0	0.8	0.8
			Ejule Ojebe	1100	336	8,356	0.4	9.2	9.6
			Ofarachi	10	336	8,356	0.0	0.1	0.1
			Ada-Rice	1000	336	8,356	0.3	8.4	8.7
			Uzo Uwani	50	336	8,356	0.0	0.4	0.4
			Egume	100	336	8,356	0.0	0.8	0.8
			Ifite Ogwari	120	336	8,356	0.0	1.0	1.0
			Enugu abor Ufuwa	350	336	8,356	0.1	2.9	3.0
			Ogboji	130	336	8,356	0.0	1.1	1.1
			Land Reclam.	8100	336	0	2.7	0.0	2.7
	50403	50403	I	16150			5.5	79	84.5
			Ilush-Ega	5000	336	8,356	1.7	41.8	43.5
			Illahi Ebuh	100	336	8,356	0.0	0.8	0.8
			Ukhun/ Erah	250	336	8,356	0.1	2.1	2.2
			2175 Obe	4100	336	8,356	1.4	34.3	35.7
			Land Reclam.	6700	336	0	2.3	0.0	2.3
	506	506	I	2,400			1	0	1
			Land Reclam.	2400	336	0	0.8	0.0	0.8
	Total			**40,800**			**13.4**	**182.1**	**195.5**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
6	60001	60001	I		2,730	7,784			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250			0.7	1.9	2.6
			Oke-Odan	250	2,730	7,784	0.7	1.9	2.6
	603	603	I	0			0	0	0
			Otta	0	2,730	7,784	0.0	0.0	0.0
	60401	60401	I	12,302			34	96	129
			Owiwi	302	2,730	7,784	0.8	2.4	3.2
			Mokoloki	12000	2,730	7,784	32.8	93.4	126.2
	604021	604021	I	0			0	0	0
			Lower Ogun		2,730	7,784	0.0	0.0	0.0
	604023	604023_e	O						
		604023_i	I	114			0.3	0.9	0.5
			Upper Ogun	10	2,730	7,784	0.0	0.1	0.1
			Ofiki(A)	24	2,730	7,784	0.1	0.2	0.3
			Ofiki(B)	10	2,730	7,784	0.0	0.1	0.1
			Ilero	70	2,730	7,784	0.2	0.5	0.7
	60403	60403	I	12000			32.8	93.4	126.2
			Middle Ogun (I.G)	12000	2,730	7,784	32.8	93.4	126.2
	60405	60405	I	30			0.1	0.2	0.3
			Sepeteri(A)	30	2,730	7,784	0.1	0.2	0.3
			Sepeteri(B)	0	2,730	7,784	0.0	0.0	0.0

	605	605	I	0					0.0
	606	606	I	335			0.9	2.7	3.6
			Eyinwa	10	2,730	7,784	0.0	0.1	0.1
			Itokin	315	2,730	7,784	0.9	2.5	3.4
			Eniosa	10	2,730	7,784	0.0	0.1	0.1
	607	607	I	0			0.0	0.0	0.0
	608	608	I	2210			6.2	17.2	23.4
			Esa Oke Dam	800	2,730	7,784	2.2	6.2	8.4
			Igbonla	130	2,730	7,784	0.4	1.0	1.4
			New Erinle	500	2,730	7,784	1.4	3.9	5.3
			Asa	500	2,730	7,784	1.4	3.9	5.3
			Okuku	30	2,730	7,784	0.1	0.2	0.3
			Iwa	0	2,730	7,784	0.0	0.0	0.0
			Osun Ekiti	100	2,730	7,784	0.3	0.8	1.1
			Old Erinle Dam	150	2,730	7,784	0.4	1.2	1.6
	609	609	I	0			0.0	0.0	0.0
	610	610	I	750			2.1	5.8	7.9
			Oogi	400	2,730	7,784	1.1	3.1	4.2
			Ipetu-Ijesha	250	2,730	7,784	0.7	1.9	2.6
			Orile Owu	100	2,730	7,784	0.3	0.8	1.1
	611	611	I	0			0.0	0.0	0.0
	612	612	I	500			1.4	3.9	5.3
			Owena	500	2,730	7,784	1.4	3.9	5.3
			Iju-Itaogbolu	0	2,730	7,784	0.0	0.0	0.0
	614	614	I	2282			6.3	17.7	24
			Ikere-Ogbese	32	2,730	7,784	0.1	0.2	0.3
			Oye	0	2,730	7,784	0.0	0.0	0.0
			Obayantor	100	2,730	7,784	0.3	0.8	1.1
			Erusu	0	2,730	7,784	0.0	0.0	0.0
			Ayo-Kudun	300	2,730	7,784	0.8	2.3	3.1
			Apariko	250	2,730	7,784	0.7	1.9	2.6
			Ado-Ekiti (Osin)	0	2,730	7,784	0.0	0.0	0.0
			Ijero	100	2,730	7,784	0.3	0.8	1.1
			2224 Okhuo	1500	2,730	7,784	4.1	11.7	15.8
	616	616	I	25			0.1	0.2	0.3
			Ukpok	25	2,730	7,784	0.1	0.2	0.3
	617	617	I	100			0.2	0.8	1
			Ilah-Ebu	50	2,730	7,784	0.1	0.4	0.5
			Elule	50	2,730	7,784	0.1	0.4	0.5
	699	699	I	0			0.0	0.0	0.0
	Total			**30,898**			**84.7**	**240.5**	**324.9**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	702	702	I	6420	0	8,424	0	4.4	4.4
			Imo (Igwu and Ibu)	0	336	8,356	0.0	0.0	0.0
			Ihitti-Uboma	310	0	8,424	0.0	2.6	2.6
			Umlopara	210	0	8,424	0.0	1.8	1.8
			Land Reclam.	5900	0	0	0.0	0.0	0.0
	703	703	I	3662			0	3.9	3.9
			Abak	62	0	8,424	0.0	0.5	0.5
			Oniong Nung Nden	400	0	8,424	0.0	3.4	3.4
			Land Reclam.	3200	0	0	0.0	0.0	0.0
	70401	70401	I	3500			0	29.4	29.4
			Utuma	200	0	8,424	0.0	1.7	1.7
			Nkari	0	0	8,424	0.0	0.0	0.0
			Itu	100	0	8,424	0.0	0.8	0.8
			Igbere	440	0	8,424	0.0	3.7	3.7
			Ekoi	500	0	8,424	0.0	4.2	4.2
7			Adim Rice	340	0	8,424	0.0	2.9	2.9
			Idomi	100	0	8,424	0.0	0.8	0.8
			Mbiabet	500	0	8,424	0.0	4.2	4.2
			Bende	300	0	8,424	0.0	2.5	2.5
			Igwu-Ohafia	300	0	8,424	0.0	2.5	2.5
			Igwu-Ndiojo Oguwo	150	0	8,424	0.0	1.3	1.3
			Igwu-Ndiebe	100	0	8,424	0.0	0.8	0.8
			Nung Obong	200	0	8,424	0.0	1.7	1.7
			Uzu Abam	70	0	8,424	0.0	0.6	0.6
			Idim Abam	200	0	8,424	0.0	1.7	1.7
	70402	70402	I	7316			0	17.8	17.8
			Isi-Uzo	71	0	8,424	0.0	0.6	0.6
			Owutu	480	0	8,424	0.0	4.0	4.0
			Akaeze	200	0	8,424	0.0	1.7	1.7
			Umuhu	200	0	8,424	0.0	1.7	1.7
			Ofiawu	115	0	8,424	0.0	1.0	1.0
			Ezamgbe	100	0	8,424	0.0	0.8	0.8

			Ezeiyieku Esu	200	0	8,424	0.0	1.7	1.7
			Ezillo Farm	150	0	8,424	0.0	1.3	1.3
			Ozara Okangwu	300	0	8,424	0.0	2.5	2.5
			Item-Ikwo	300	0	8,424	0.0	2.5	2.5
			Land Reclam.	5200	0	0	0.0	0.0	0.0
	70403	70403	I	4015			0	11.1	11.1
			Obubra	315	0	8,424	0.0	2.7	2.7
			Abakaliki/ Iwa	1000	0	8,424	0.0	8.4	8.4
			Ofodun	0	0	8,424	0.0	0.0	0.0
			Land Reclam.	2700	0	0	0.0	0.0	0.0
	704041	704041	I	900			0	0	0
			Land Reclam.	900	0	0	0.0	0.0	0.0
	704042	704042	I	7435			0	14.7	14.7
			Ijegu Yala	80	0	8,424	0.0	0.7	0.7
			Bausara	0	0	8,424	0.0	0.0	0.0
			Ukum	0	0	8,424	0.0	0.0	0.0
			Ogoja	125	0	8,424	0.0	1.1	1.1
			Obudu	30	0	8,424	0.0	0.3	0.3
			2240 Koshisha	1500	0	8,424	0.0	12.6	12.6
			Land Reclam.	5700	0	0	0.0	0.0	0.0
	704043	704043	I	9750			0	36.6	36.6
			Iboko	150	0	8,424	0.0	1.3	1.3
			2229 Ombi	2000	0	8,424	0.0	16.8	16.8
			2231 Ogege	1000	0	8,424	0.0	8.4	8.4
			2237 Abe	1200	0	8,424	0.0	10.1	10.1
			Land Reclam.	5400	0	0	0.0	0.0	0.0
	70405	70405_e	O				0.0	0.0	
		70405_i	I	62			0	0.5	0.5
			Amaeki Abam	62	0	8,424	0.0	0.5	0.5
	705	705	I	50			0	0.4	0.4
			Uwet	50	0	8,424	0.0	0.4	0.4
			Itogodi	0	0	8,424	0.0	0.0	0.0
	Total			**43,110**			**0**	**118.8**	**118.8**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	800	800	I	0	9,350	3,040	0.0	0.0	0.0
	802	802_e	O						
		802_i	I	0			0.0	0.0	0.0
	80401	80401	I	23540			220.1	71.5	291.6
			South Chad	22000	9,350	3,040	205.7	66.9	272.6
			South Chad Pilot	800	9,350	3,040	7.5	2.4	9.9
			Ebeji	140	9,350	3,040	1.3	0.4	1.7
			Gamboru	400	9,350	3,040	3.7	1.2	4.9
			Ngabu	200	9,350	3,040	1.9	0.6	2.5
	80402	80402_e	O						
		80402_i	I	0	9,350	3,040	0	0	0.0
	80403	80403_e	O						
		80403_i	I	680			6.3	2.1	8.4
			Yau	420	9,350	3,040	3.9	1.3	5.2
			Michika	0	9,350	3,040	0.0	0.0	0.0
			Abadam	260	9,350	3,040	2.4	0.8	3.2
	806	806	I	0			0	0	0
			Jere Bowl Rice	0	9,350	3,040	0.0	0.0	0.0
	807	807	I	2000			18.7	6.1	24.8
			Baga Polder	2000	9,350	3,040	18.7	6.1	24.8
8	80801	80801_e	O						
		80801_i	I	2880			27	8.8	35.8
			Yobe	2820	9,350	3,040	26.4	8.6	35.0
			Jaffi	30	9,350	3,040	0.3	0.1	0.4
			Damasak	30	9,350	3,040	0.3	0.1	0.4
	80802	80802	I	0			0.0	0.0	0.0
	80803	80803_e	O						
		80803_i	I	0			0.0	0.0	0.0
	80804	80804_e	O						
		80804_i	I	0			0.0	0.0	0.0
	80805	80805	I	2028			19	6.2	25.2
			Gashua	2000	9,350	3,040	18.7	6.1	24.8
			Mugura	28	9,350	3,040	0.3	0.1	0.4
	808061	808061	I	1830			17.1	5.5	22.6
			Abir	130	9,350	3,040	1.2	0.4	1.6
			Katagum	700	9,350	3,040	6.5	2.1	8.6
			Daya	960	9,350	3,040	9.0	2.9	11.9
			Warwada	40	9,350	3,040	0.4	0.1	0.5
			Yamidi	0	9,350	3,040	0.0	0.0	0.0
	808062	808062	I	40			0.4	0.1	0.5
			K.Gana	40	9,350	3,040	0.4	0.1	0.5
	808063	808063	I	200			1.9	0.7	2.6

			Jamaare(Sewa Pilot)	20	9,350	3,040	0.2	0.1	0.3
			Galala	130	9,350	3,040	1.2	0.4	1.6
			Diya	30	9,350	3,040	0.3	0.1	0.4
			Maladumba	20	9,350	3,040	0.2	0.1	0.3
	808071	808071	I	0			0.0	0.0	0.0
	8080721	8080721_e	O						
		8080721_i	I	1230			11.4	3.7	15.1
			Gari	300	9,350	3,040	2.8	0.9	3.7
			Tomas	400	9,350	3,040	3.7	1.2	4.9
			Jakara	430	9,350	3,040	4.0	1.3	5.3
			Jakarade	100	9,350	3,040	0.9	0.3	1.2
			Dambo	0	9,350	3,040	0.0	0.0	0.0
	8080723	8080723	I	0			0	0	0
			Dembo	0	9,350	3,040	0.0	0.0	0.0
	808073	808073	I	27800			260	84.6	344.6
			Kano River Phase II	15000	9,350	3,040	140.3	45.6	185.9
			Hadejia Valley	12500	9,350	3,040	116.9	38.0	154.9
			Kafin Chiri	0	9,350	3,040	0.0	0.0	0.0
			Aguja	120	9,350	3,040	1.1	0.4	1.5
			Jahun	100	9,350	3,040	0.9	0.3	1.2
			Gunuar Kukaf	0	9,350	3,040	0.0	0.0	0.0
			Mai-alkama	0	9,350	3,040	0.0	0.0	0.0
			Arawa	0	9,350	3,040	0.0	0.0	0.0
			Hantsu	30	9,350	3,040	0.3	0.1	0.4
			Walu	50	9,350	3,040	0.5	0.2	0.7
			Tsuwa	0	9,350	3,040	0.0	0.0	0.0
			Joda	0	9,350	3,040	0.0	0.0	0.0
	8080741	8080741	I	0			0.0	0.0	0.0
	80807421	80807421	I	0			0	0	0
			Baguwai (Watari)	0	9,350	3,040	0.0	0.0	0.0
	80807423	80807423	I	0					0.0
	8080743	8080743	I	70			0.7	0.2	0.9
			Guzuguzu	0	9,350	3,040	0.0	0.0	0.0
			Magaga	70	9,350	3,040	0.7	0.2	0.9
	8080745	8080745	I	0			0	0	0
			Gwarzo	0	9,350	3,040	0.0	0.0	0.0
	808075	808075	I	22300			208.5	67.8	276.3
			Kano River Phase I	22000	9,350	3,040	205.7	66.9	272.6
			Bagauda	300	9,350	3,040	2.8	0.9	3.7
	808077	808077	I	0			0	0	0
			Tudun Wada	0	9,350	3,040	0.0	0.0	0.0
	Total			**84,598**			**791.1**	**257.3**	**1,048.4**
Grand Total				**494,252**			**1,720.0**	**2,712.2**	**4,431.9**

(3) Proposed Diversion Water Requirement of Irrigation Project

Water Resirces: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	579	221	11,580	4,420	40	50	6,842
	Dry	0	322	0	6,440	0	50	3,220
2	Wet	204	10	4,080	200	60	30	2,508
	Dry	720	362	14,400	7,240	20	60	7,224
3	Wet	187	17	3,740	340	60	30	2,346
	Dry	706	350	14,120	7,000	20	60	7,024
4	Wet	113	0	2,260	0	60	30	1,356
	Dry	670	357	13,400	7,140	20	60	6,964
5	Wet	21	0	420	0	80	10	336
	Dry	593	310	11,860	6,200	60	20	8,356
6	Wet	205	45	4,100	900	60	30	2,730
	Dry	642	331	12,840	6,620	40	40	7,784
7	Wet	0	0	0	0	80	10	0
	Dry	598	312	11,960	6,240	60	20	8,424
8	Wet	559	203	11,180	4,060	80	10	9,350
	Dry	0	304	0	6,080	0	50	3,040

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	579	221	9,650	3,683	20	70	4,508
	Dry	0	322	0	5,367	0	80	4,294

2	Wet	204	10	3,400	167	10	80	474
	Dry	720	362	12,000	6,033	0	80	4,826
3	Wet	187	17	3,117	283	10	80	538
	Dry	706	350	11,767	5,833	0	80	4,666
4	Wet	113	0	1,883	0	10	80	188
	Dry	670	357	11,167	5,950	0	80	4,760
5	Wet	21	0	350	0	30	60	105
	Dry	593	310	9,883	5,167	0	80	4,134
6	Wet	205	45	3,417	750	20	70	1,208
	Dry	642	331	10,700	5,517	0	80	4,414
7	Wet	0	0	0	0	30	60	0
	Dry	598	312	9,967	5,200	0	80	4,160
8	Wet	559	203	9,317	3,383	30	60	4,825
	Dry	0	304	0	5,067	0	80	4,054

(4) Net Irrigation Requirement (for Proposed Irrigation scheme)

Net water requirement for proposed irrigation scheme is the same as existing one.

SR1.3.6 Water Demand of Climate Change

(1) Water Demand of Existing Irrigation Schemes

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
1	135,128.3	101	101	9,355.4	3920	8,116	3,670	31.8	14.3	46.1
		102	102	9,127.2	300	8,116	3,670	2.4	1.1	3.5
		103	103	3,387.3	1500	8,116	3,670	12.2	5.5	17.7
		104	104	2,933.6	0	8,116	3,670	0	0	0.0
		105	105	3,456.6	0	8,116	3,670	0	0	0.0
		10601	10601	689.1	0	8,116	3,670	0	0	0.0
		10602	10602	10,960.3	0	8,116	3,670	0	0	0.0
		10603	10603	1,084.9	0	8,116	3,670	0	0	0.0
		10604	10604	17,476.6	0	8,116	3,670	0	0	0.0
		10605	10605	6,335.9	200	8,116	3,670	1.6	0.8	2.4
		10606	10606	5,817.2	470	8,116	3,670	3.8	1.7	5.5
		10607	10607	2,706.1	0	8,116	3,670	0	0	0.0
		106081	106081_e	2,220.3						
			106081_i	4,132.3	3100	8,116	3,670	25.2	11.3	36.5
		106082	106082_e	80,006.8						
			106082_i1	1,322.2	0	8,116	3,670	0	0	0.0
			106082_i2	6,043.4	405			3.3	1.5	4.8
		106083	106083	412.5	5120	8,116	3,670	41.6	18.8	60.4
		106085	106085_e	290.3						
			106085_i	1,499.6	0	8,116	3,670	0	0	0.0
		1060861	1060861_e	6,067.9						
			1060861_i1	164.7	0	8,116	3,670	0	0	0.0
			1060861_i2	548.0	2300			18.7	8.4	27.1
		1060863	1060863	3,509.3	50	8,116	3,670	0.4	0.2	0.6
		106087	106087_e	632.3						
			106087_i	1,216.5	0	8,116	3,670	0	0	0.0
		1060881	1060881	5,750.6	2100	8,116	3,670	17	7.7	24.7
		1060883	1060883	2,513.8	0	8,116	3,670	0	0	0.0
		106089	106089	8,354.1	0	8,116	3,670	0	0	0.0
		106091	106091	7,636.2	23000	8,116	3,670	186.7	84.4	271.1
		106093	106093	4,746.6	76	8,116	3,670	0.6	0.3	0.9
		107	107_e	1,924.1						
			107_i	6,223.4	0	8,116	3,670	0	0	0.0
		108	108_e	63,517.4						
			108_i	7,724.9	0	8,116	3,670	0	0	0.0
		109	109	14,037.5						
	Total				**42,541**			**345.3**	**156.0**	**501.3**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	SHA Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
2	154,615.9	201	201	2,646.9	23	3,312	8,080	0.1	0.2	0.3
		20201	20201	5,088.0	400	3,312	8,080	1.3	3.2	4.5
		202021	202021	2,739.0	0	3,312	8,080	0	0	0.0
		202023	202023	190.7	0	3,312	8,080	0	0	0.0
		20203	20203	4,599.3	415	3,312	8,080	1.4	3.4	4.8
		20205	20205	2,636.8	44	3,312	8,080	0.1	0.3	0.4
		203	203	4,436.7	0	3,312	8,080	0	0	0.0
		20401	20401	5,985.0	4803	3,312	8,080	15.9	38.7	54.6

		20403	20403	1,596.0	0	3,312	8,080	0	0	0.0
		205	205	375.0	0	3,312	8,080	0	0	0.0
		206	206	7,358.0	6273	3,312	8,080	20.7	50.7	71.4
		207	207	1,056.1	90	3,312	8,080	0.3	0.7	1.0
		20801	20801	1,936.8	624	3,312	8,080	2.1	5	7.1
		20802	20802	2,240.6	0	3,312	8,080	0	0	0.0
		20803	20803	725.1	0	3,312	8,080	0	0	0.0
		20804	20804	17,359.5	8440	3,312	8,080	28	68.1	96.1
		20805	20805	4,325.9	800	3,312	8,080	2.6	6.5	9.1
		20806	20806	3,503.9	400	3,312	8,080	1.3	3.2	4.5
		20807	20807	557.0	0	3,312	8,080	0	0	0.0
		20809	20809	3,692.3	0	3,312	8,080	0	0	0.0
		20810	20810	3,449.6	485	3,312	8,080	1.6	3.9	5.5
		20811	20811	1,561.0	0	3,312	8,080	0	0	0.0
		20812	20812	5,919.2	780	3,312	8,080	2.5	6.2	8.7
		20813	20813	2,483.4	1720	3,312	8,080	5.7	13.9	19.6
		20814	20814	6,713.9	795	3,312	8,080	2.6	6.3	8.9
		20815	20815	10,882.2	310	3,312	8,080	0.9	2.4	3.3
		209	209	15,015.3	14720	3,312	8,080	48.8	118.9	167.7
		211	211	6.2	0	3,312	8,080	0	0	0.0
		212	212	6,740.8	29	3,312	8,080	0.1	0.2	0.3
		213	213	4,145.9	10	3,312	8,080	0	0.1	0.1
		214	214_e	257.9						
			214_i	9,792.7	5	3,312	8,080	0	0	0.0
		215	215	2,109.7	0	3,312	8,080	0	0	0.0
		216	216_e	3,698.9						
			216_i	7,957.2	0	3,312	8,080	0	0	0.0
		217	217	127.2	0	3,312	8,080	0	0	0.0
		218	218	4,644.4	2180	3,312	8,080	7.2	17.6	24.8
		219	219	19.0	0	3,312	8,080	0	0	0.0
	Total				**43,346**			**143.2**	**349.5**	**492.7**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
3	156,546.0	30201	30201	587.0	35000	3,012	7,872	105.4	275.5	380.9
		30202	30202	5,145.8	0	3,012	7,872	0	0	0.0
		30203	30203_e	2,826.1						
			30203_i	11,384.8	60	3,012	7,872	0.2	0.5	0.7
		303	303	1,463.0	10000	3,012	7,872	30.1	78.7	108.8
		304	304	4,997.2	2290	3,012	7,872	6.9	18	24.9
		305	305	808.7	7500	3,012	7,872	22.6	59	81.6
		30601	30601	2,266.4	18000	3,012	7,872	54.2	141.7	195.9
		30602	30602	5,395.0	5000	3,012	7,872	15.1	39.4	54.5
		30603	30603_e	559.0						
			30603_i	13,799.2	0	3,012	7,872	0	0	0.0
		307	307	5,737.4	0	3,012	7,872	0	0	0
		308	308	15,173.5	0	3,012	7,872	0	0	0.0
		309	309	87.1	0	3,012	7,872	0	0	0.0
		310	310	2,512.7	0	3,012	7,872	0	0	0.0
		311	311	11,883.8	12315	3,012	7,872	37	96.9	133.9
		312	312	2,748.4	18000	3,012	7,872	54.2	141.7	195.9
		313	313	48.5	0	3,012	7,872	0	0	0.0
		31401	31401	717.6	0	3,012	7,872	0	0	0.0
		31403	31403	1,658.9	160	3,012	7,872	0.5	1.3	1.8
		31404	31404	11,229.0	20	3,012	7,872	0.1	0.2	0.3
		31405	31405	6,890.1	14710	3,012	7,872	44.3	115.8	160.1
		31407	31407	7,702.1	300	3,012	7,872	0.9	2.4	3.3
		31408	31408	5,303.7	0	3,012	7,872	0	0	0.0
		31409	31409	19,178.0	460	3,012	7,872	1.4	3.7	5.1
		315	315	1,616.6	0	3,012	7,872	0	0	0.0
		316	316	5,536.5	9050	3,012	7,872	27.3	71.2	98.5
		317	317	3,400.3	5400	3,012	7,872	16.2	42.5	58.7
		318	318	5,441.5	10200	3,012	7,872	30.7	80.3	111.0
		319	319_e	2,088.9						
			319_i	1,726.6	0	3,012	7,872	0	0	0.0
		320	320_e	25,211.5						
			320_i	2,106.7	0	3,012	7,872	0	0	0.0
		321	321	65,499.3						
	Total				**148,465**			**447.1**	**1,168.8**	**1,615.9**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	74,518.7	401	401	3,642.9	1000	1,908	7,764	1.9	7.8	9.7
		402	402	9,075.9	4000	1,908	7,764	7.6	31.1	38.7
		403	403	4,906.6	15050	1,908	7,764	28.7	116.9	145.6
		404	404	9,347.8	2467	1,908	7,764	4.7	19.2	23.9

		405	405	11,303.0	3145	1,908	7,764	5.9	24.5	30.4
		406	406_e	10,331.5						
			406_i	12,618.8	5034	1,908	7,764	9.5	39.1	48.6
		407	407	4,277.1	2100	1,908	7,764	4.1	16.3	20.4
		408	408	10,587.4	2098	1,908	7,764	4	16.2	20.2
		409	409	2,471.0	0	1,908	7,764	0	0	0.0
		410	410	4,839.1	18100	1,908	7,764	34.5	140.5	175.0
		411	411	1,449.1	7500	1,908	7,764	14.3	58.2	72.5
	Total				**60,494**			**115.2**	**469.8**	**585.0**

5	53,913.6	500	500	19,112.1	4390	662	9,192	2.9	40.4	43.3
		502	502	3,156.9	1800	662	9,192	1.2	0	1.2
		50401	50401	1,580.8	0	662	9,192	0	0	0.0
		50402	50402	14,104.9	16060	662	9,192	10.7	73.2	83.9
		50403	50403	11,821.3	16150	662	9,192	10.7	86.9	97.6
		506	506	4,137.6	2400	662	9,192	1.6	0	1.6
	Total				**40,800**			**27.1**	**200.5**	**227.6**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	3,420	8,608	0	0	0.0
		60002	60002	8,252.4	0	3,420	8,608	0	0	0.0
		601	601	391.8	0	3,420	8,608	0	0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	3,420	8,608	0.9	2.2	3.1
		603	603	1,965.7	0	3,420	8,608	0	0	0.0
		60401	60401	2,034.9	12302	3,420	8,608	42	105.9	147.9
		604021	604021	168.9	0	3,420	8,608	0	0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	114	3,420	8,608	0.3	1	1.3
		60403	60403	6,011.7	12000	3,420	8,608	41	103.3	144.3
		60405	60405	4,704.2	30	3,420	8,608	0.1	0.3	0.4
		605	605	2,167.8	0	3,420	8,608	0	0	0.0
		606	606	3,425.1	335	3,420	8,608	1.1	2.9	4.0
		607	607	325.1	0	3,420	8,608	0	0	0.0
		608	608	9,764.4	2210	3,420	8,608	7.4	19.1	26.5
		609	609	113.5	0	3,420	8,608	0	0	0.0
		610	610	6,462.0	750	3,420	8,608	2.6	6.5	9.1
		611	611	4,227.7	0	3,420	8,608	0	0	0.0
		612	612	5,869.5	500	3,420	8,608	1.7	4.3	6.0
		614	614	13,271.7	2282	3,420	8,608	7.7	19.8	27.5
		616	616	8,417.4	25	3,420	8,608	0.1	0.2	0.3
		617	617	1,896.8	100	3,420	8,608	0.4	0.8	1.2
		699	699	4,809.4	0	3,420	8,608	0	0	0.0
	Total				**30,898**			**105.3**	**266.3**	**371.6**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
7	57,440.2	702	702	8,146.5	6420	0	9,276	0	4.8	4.8
		703	703	4,318.8	3662	0	9,276	0	4.3	4.3
		70401	70401	6,054.6	3500	0	9,276	0	32.5	32.5
		70402	70402	7,090.9	7316	0	9,276	0	19.9	19.9
		70403	70403	3,625.5	4015	0	9,276	0	12.2	12.2
		704041	704041	1,236.3	900	0	9,276	0	0	0.0
		704042	704042	7,702.7	7435	0	9,276	0	16.1	16.1
		704043	704043	7,382.6	9750	0	9,276	0	40.4	40.4
		70405	70405_e	13,407.4						
			70405_i	6,028.1	62	0	9,276	0	0.6	0.6
		705	705	5,854.2	50	0	9,276	0	1	0.5
	Total				**43,110**			**0.0**	**131.3**	**131.3**

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
8	178,483.2	800	800	5,221.9	0	10,750	3,440	0	0	0.0
		802	802_e	13,857.3						
			802_i	2,422.8	0	0	0	0	0	0.0
		80401	80401	4,647.6	23540	0	0	253.1	81.1	334.2
		80402	80402_e	626.1						
			80402_i	7,171.8	0	10,750	3,440	0	0	0.0
		80403	80403_e	253.1						
			80403_i	6,656.5	680	10,750	3,440	7.3	2.3	9.6
		806	806	21,903.0	0	10,750	3,440	0	0	0.0
		807	807	14,280.8	2000	10,750	3,440	21.5	6.9	28.4
		80801	80801_e	1,438.6						

			80801_i	946.1	2880	10,750	3,440	30.9	9.9	40.8
		80802	80802	30,141.6	0	10,750	3,440	0	0	0.0
		80803	80803_e	8,391.9						
			80803_i	1,528.3	0	10,750	3,440	0	0	0.0
		80804	80804_e	21,200.9						
			80804_i	6,230.7	0	10,750	3,440	0	0	0.0
		80805	80805	9,381.6	2028	10,750	3,440	21.8	7	28.8
		808061	808061	5,200.0	1830	10,750	3,440	19.6	6.2	25.8
		808062	808062	6,129.6	40	10,750	3,440	0.4	0.1	0.5
		808063	808063	12,632.1	200	10,750	3,440	2.1	0.7	2.8
		808071	808071	274.9	0	10,750	3,440	0	0	0.0
		8080721	8080721_e	19,574.1						
			8080721_i	18,041.8	1230	10,750	3,440	13.2	4.2	17.4
		8080723	8080723	1,145.5	0	10,750	3,440	0	0	0.0
		808073	808073	9,609.9	27800	10,750	3,440	298.9	95.6	394.5
		8080741	8080741	244.3	0	10,750	3,440	0	0	0.0
		80807421	80807421	861.8	0	10,750	3,440	0	0	0.0
		80807423	80807423	653.9	0	10,750	3,440	0	0	0.0
		8080743	8080743	1,581.2	70	10,750	3,440	0.8	0.2	1.0
		8080745	8080745	3,841.5	0	10,750	3,440	0	0	0.0
		808075	808075	1,196.2	22300	10,750	3,440	239.7	76.7	316.4
		808077	808077	6,537.9	0	10,750	3,440	0	0	0.0
	Total				**84,598**			**909.3**	**290.9**	**1,200.2**
	Grand Total				**494,252**			**2,092.5**	**3,033.1**	**5,125.6**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
	101	101	0	0	0	4,894	0.0	46.1
	102	102	0	0	0	4,894	0.0	3.5
	103	103	0	0	0	4,894	0.0	17.7
	104	104	23	35	58	4,894	0.3	0.3
	105	105	1,233	1,883	3,116	4,894	15.2	15.2
	10601	10601	359	549	908	4,894	4.4	4.4
	10602	10602	388	593	981	4,894	4.8	4.8
	10603	10603	458	700	1,158	4,894	5.7	5.7
	10604	10604	1,142	1,745	2,887	4,894	14.1	14.1
	10605	10605	2,073	3,166	5,239	4,894	25.6	28.0
	10606	10606	100	153	253	4,894	1.2	6.7
	10607	10607	733	1,120	1,853	4,894	9.1	9.1
	106081	106081_e						
		106081_i	1,291	1,972	3,263	4,894	16.0	52.5
	106082	106082_e						
		106082_i1	983	1,501	2,484	4,894	12.2	12.2
		106082_i2	187	286	473	4,894	2.3	7.1
1	106083	106083	177	271	448	4,894	2.2	62.6
	106085	106085_e						
		106085_i	409	625	1,034	4,894	5.1	5.1
	1060861	1060861_e						
		1060861_i1	50	76	126	4,894	0.6	0.6
		1060861_i2	0	0	0	4,894	0.0	27.1
	1060863	1060863	0	0	0	4,894	0.0	0.6
	106087	106087_e						
		106087_i	148	226	374	4,894	1.8	1.8
	1060881	1060881	360	549	909	4,894	4.4	29.1
	1060883	1060883	324	495	819	4,894	4.0	4.0
	106089	106089	424	648	1,072	4,894	5.2	5.2
	106091	106091	575	877	1,452	4,894	7.1	278.2
	106093	106093	0	0	0	4,894	0.0	0.9
	107	107_e						
		107_i	1,246	1,903	3,149	4,894	15.4	15.4
	108	108_e						
		108_i	22	33	55	4,894	0.3	0.3
	109	109						
	Total		**12,705**	**19,406**	**32,111**		**157.0**	**658.3**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
	201	201	292	446	738	5,506	4.1	4.4
	20201	20201	188	286	474	5,506	2.6	7.1
	202021	202021	0	0	0	5,506	0.0	0.0
2	202023	202023	0	0	0	5,506	0.0	0.0
	20203	20203	0	0	0	5,506	0.0	4.8
	20205	20205	0	0	0	5,506	0.0	0.4
	203	203	1,643	2,510	4,153	5,506	22.9	22.9
	20401	20401	175	267	442	5,506	2.4	57.0

	20403	20403	0	0	0	5,506	0.0	0.0
	205	205	302	461	763	5,506	4.2	4.2
	206	206	322	491	813	5,506	4.5	75.9
	207	207	727	1,111	1,838	5,506	10.1	11.1
	20801	20801	437	668	1,105	5,506	6.1	13.2
	20802	20802	0	0	0	5,506	0.0	0.0
	20803	20803	256	391	647	5,506	3.6	3.6
	20804	20804	113	172	285	5,506	1.6	97.7
	20805	20805	15	23	38	5,506	0.2	9.3
	20806	20806	0	0	0	5,506	0.0	4.5
	20807	20807	0	0	0	5,506	0.0	0.0
	20809	20809	0	0	0	5,506	0.0	0.0
	20810	20810	0	0	0	5,506	0.0	5.5
	20811	20811	0	0	0	5,506	0.0	0.0
	20812	20812	690	1,053	1,743	5,506	9.6	18.3
	20813	20813	51	78	129	5,506	0.7	20.3
	20814	20814	488	745	1,233	5,506	6.8	15.7
	20815	20815	202	308	510	5,506	2.8	6.1
	209	209	3,083	4,708	7,791	5,506	42.9	210.6
	211	211	0	0	0	5,506	0.0	0.0
	212	212	0	0	0	5,506	0.0	0.3
	213	213	0	0	0	5,506	0.0	0.1
	214	214_e						
		214_i	0	0	0	5,506	0.0	0.0
	215	215	0	0	0	5,506	0.0	0.0
	216	216_e						
		216_i	0	0	0	5,506	0.0	0.0
	217	217	0	0	0	5,506	0.0	0.0
	218	218	7	11	18	5,506	0.1	24.9
	219	219	0	0	0	5,506	0.0	0.0
	Total		**8,991**	**13,729**	**22,720**		**125.2**	**617.9**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
3	30201	30201	156	238	394	5,360	2.1	383.0
	30202	30202	100	152	252	5,360	1.4	1.4
	30203	30203_e						
		30203_i	392	598	990	5,360	5.3	6.0
	303	303	480	733	1,213	5,360	6.5	115.3
	304	304	38	59	97	5,360	0.5	25.4
	305	305	149	228	377	5,360	2.0	83.6
	30601	30601	501	765	1,266	5,360	6.8	202.7
	30602	30602	100	153	253	5,360	1.4	55.9
	30603	30603_e						
		30603_i	38	58	96	5,360	0.5	0.5
	307	307	1,883	2,876	4,759	5,360	25.5	25.5
	308	308	394	601	995	5,360	5.3	5.3
	309	309	73	112	185	5,360	1.0	1.0
	310	310	5	7	12	5,360	0.1	0.1
	311	311	3,543	5,411	8,954	5,360	48.0	181.9
	312	312	166	254	420	5,360	2.3	198.2
	313	313	71	109	180	5,360	1.0	1.0
	31401	31401	241	367	608	5,360	3.3	3.3
	31403	31403	16	25	41	5,360	0.2	2.0
	31404	31404	0	0	0	5,360	0.0	0.3
	31405	31405	59	90	149	5,360	0.8	160.9
	31407	31407	26	40	66	5,360	0.4	3.7
	31408	31408	467	714	1,181	5,360	6.3	6.3
	31409	31409	753	1,150	1,903	5,360	10.2	15.3
	315	315	487	743	1,230	5,360	6.6	6.6
	316	316	362	553	915	5,360	4.9	103.4
	317	317	359	549	908	5,360	4.9	63.6
	318	318	25	39	64	5,360	0.3	111.3
	319	319_e						
		319_i	151	231	382	5,360	2.0	2.0
	320	320_e						
		320_i	230	351	581	5,360	3.1	3.1
	321	321						
	Total		**11,265**	**17,206**	**28,471**		**152.7**	**1,768.6**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
4	401	401	716	1,093	1,809	5,386	9.7	19.4
	402	402	159	242	401	5,386	2.2	40.9
	403	403	1,188	1,815	3,003	5,386	16.2	161.8
	404	404	454	693	1,147	5,386	6.2	30.1

	405	405	813	1,242	2,055	5,386	11.1	41.5
	406	406_e						
		406_i	0	0	0	5,386	0.0	48.6
	407	407	342	522	864	5,386	4.7	25.1
	408	408	457	698	1,155	5,386	6.2	26.4
	409	409	351	536	887	5,386	4.8	4.8
	410	410	505	772	1,277	5,386	6.9	181.9
	411	411	392	599	991	5,386	5.3	77.8
	Total		**5,377**	**8,212**	**13,589**		**73.3**	**658.3**

B. Underflow Water (climate change)

5	500	500	240	366	606	4,720	2.9	46.2
	502	502	0	0	0	4,720	0.0	1.2
	50401	50401	926	1,414	2,340	4,720	11.0	11.0
	50402	50402	38	58	96	4,720	0.5	84.4
	50403	50403	1,567	2,393	3,960	4,720	18.7	116.3
	506	506	27	41	68	4,720	0.3	1.9
	Total		**2,798**	**4,272**	**7,070**		**33.4**	**261.0**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	5,014	0.0	0.0
	60002	60002	0	0	0	5,014	0.0	0.0
	601	601	0	0	0	5,014	0.0	0.0
	602	602_e						
		602_i	0	0	0	5,014	0.0	3.1
	603	603	0	0	0	5,014	0.0	0.0
	60401	60401	0	0	0	5,014	0.0	147.9
	604021	604021	0	0	0	5,014	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	5,014	0.0	1.3
	60403	60403	0	0	0	5,014	0.0	144.3
	60405	60405	0	0	0	5,014	0.0	0.4
	605	605	0	0	0	5,014	0.0	0.0
	606	606	0	0	0	5,014	0.0	4.0
	607	607	0	0	0	5,014	0.0	0.0
	608	608	0	0	0	5,014	0.0	26.5
	609	609	0	0	0	5,014	0.0	0.0
	610	610	0	0	0	5,014	0.0	9.1
	611	611	0	0	0	5,014	0.0	0.0
	612	612	0	0	0	5,014	0.0	6.0
	614	614	0	0	0	5,014	0.0	27.5
	616	616	0	0	0	5,014	0.0	0.3
	617	617	0	0	0	5,014	0.0	1.2
	699	699	0	0	0	5,014	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**371.6**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
7	702	702	0	0	0	4,760	0.0	4.8
	703	703	0	0	0	4,760	0.0	4.3
	70401	70401	0	0	0	4,760	0.0	32.5
	70402	70402	2	3	5	4,760	0.0	19.9
	70403	70403	165	252	417	4,760	2.0	14.2
	704041	704041	75	115	190	4,760	0.9	0.9
	704042	704042	43	66	109	4,760	0.5	16.6
	704043	704043	77	118	195	4,760	0.9	41.3
	70405	70405_e						
		70405_i	41	63	104	4,760	0.5	1.1
	705	705	0	0	0	4,760	0.0	0.5
	Total		**403**	**617**	**1,020**		**4.8**	**136.1**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B) (MCM)	Total (A)+(B) (MCM)
8	800	800	0	0	0	4,586	0.0	0.0
	802	802_e						
		802_i	0	0	0	4,586	0.0	0.0
	80401	80401	0	0	0	4,586	0.0	334.2
	80402	80402_e						
		80402_i	0	0	0	4,586	0.0	0.0
	80403	80403_e						
		80403_i	0	0	0	4,586	0.0	9.6
	806	806	0	0	0	4,586	0.0	0.0
	807	807	0	0	0	4,586	0.0	28.4
	80801	80801_e						

		80801_i	140	214	354	4,586	1.6	42.4
	80802	80802	1,954	2,984	4,938	4,586	22.6	22.6
	80803	80803_e						
		80803_i	300	458	758	4,586	3.5	3.5
	80804	80804_e						
		80804_i	20	30	50	4,586	0.2	0.2
	80805	80805	1,775	2,711	4,486	4,586	20.6	49.4
	808061	808061	1,520	2,321	3,841	4,586	17.6	43.4
	808062	808062	975	1,489	2,464	4,586	11.3	11.8
	808063	808063	784	1,197	1,981	4,586	9.1	11.9
	808071	808071	184	281	465	4,586	2.1	2.1
	8080721	8080721_e						
		8080721_i	564	862	1,426	4,586	6.5	23.9
	8080723	8080723	0	0	0	4,586	0.0	0.0
	808073	808073	5,208	7,955	13,163	4,586	60.4	454.9
	8080741	8080741	0	0	0	4,586	0.0	0.0
	80807421	80807421	37	56	93	4,586	0.4	0.4
	80807423	80807423	0	0	0	4,586	0.0	0.0
	8080743	8080743	0	0	0	4,586	0.0	1.0
	8080745	8080745	0	0	0	4,586	0.0	0.0
	808075	808075	0	0	0	4,586	0.0	316.4
	808077	808077	0	0	0	4,586	0.0	0.0
	Total		**13,461**	**20,558**	**34,019**		**155.9**	**1,356.1**
Grand Total			**55,000**	**84,000**	**139,000**		**702.3**	**6,044.0**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
1	101	101	1,701	5,497	4,894	9.4	8.3	17.7
	102	102	403	5,497	4,894	2.2	2.0	4.2
	103	103	270	5,497	4,894	1.5	1.3	2.8
	104	104	291	5,497	4,894	1.6	1.4	3.0
	105	105	172	5,497	4,894	0.9	0.8	1.7
	10601	10601	139	5,497	4,894	0.8	0.7	1.5
	10602	10602	847	5,497	4,894	4.7	4.1	8.8
	10603	10603	213	5,497	4,894	1.2	1.0	2.2
	10604	10604	2,209	5,497	4,894	12.1	10.8	22.9
	10605	10605	1,424	5,497	4,894	7.8	7.0	14.8
	10606	10606	1,816	5,497	4,894	10.0	8.9	18.9
	10607	10607	310	5,497	4,894	1.7	1.5	3.2
	106081	106081_e						
		106081_i	672	5,497	4,894	3.7	3.3	7.0
	106082	106082_e						
		106082_i1	0	5,497	4,894	0.0	0.0	0.0
		106082_i2	2,702	5,497	4,894	14.9	13.2	28.1
	106083	106083	0	5,497	4,894	0.0	0.0	0.0
	106085	106085_e						
		106085_i	0	5,497	4,894	0.0	0.0	0.0
	1060861	1060861_e						
		1060861_i1	0	5,497	4,894	0.0	0.0	0.0
		1060861_i2	126	5,497	4,894	0.7	0.6	1.3
	1060863	1060863	1,121	5,497	4,894	6.2	5.5	11.7
	106087	106087_e						
		106087_i	0	5,497	4,894	0.0	0.0	0.0
	1060881	1060881	1,177	5,497	4,894	6.5	5.8	12.3
	1060883	1060883	1,041	5,497	4,894	5.7	5.1	10.8
	106089	106089	2,809	5,497	4,894	15.4	13.7	29.1
	106091	106091	1,190	5,497	4,894	6.5	5.8	12.3
	106093	106093	1,385	5,497	4,894	7.6	6.8	14.4
	107	107_e						
		107_i	645	5,497	4,894	3.5	3.2	6.7
	108	108_e						
		108_i	1,017	5,497	4,894	5.6	5.0	10.6
	109	109						
	Total		**23,680**			**130.2**	**115.8**	**246.0**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
2	201	201	692	885	5,506	0.6	3.8	4.4
	20201	20201	1,060	885	5,506	0.9	5.8	6.7
	202021	202021	489	885	5,506	0.4	2.7	3.1
	202023	202023	28	885	5,506	0.0	0.2	0.2
	20203	20203	785	885	5,506	0.7	4.3	5.0
	20205	20205	535	885	5,506	0.5	2.9	3.4
	203	203	1,192	885	5,506	1.1	6.6	7.7
	20401	20401	1,272	885	5,506	1.1	7.0	8.1

	20403	20403	528	885	5,506	0.5	2.9	3.4
	205	205	114	885	5,506	0.1	0.6	0.7
	206	206	1,728	885	5,506	1.5	9.5	11.0
	207	207	288	885	5,506	0.3	1.6	1.9
	20801	20801	329	885	5,506	0.3	1.8	2.1
	20802	20802	87	885	5,506	0.1	0.5	0.6
	20803	20803	157	885	5,506	0.1	0.9	1.0
	20804	20804	1,544	885	5,506	1.4	8.5	9.9
	20805	20805	660	885	5,506	0.6	3.6	4.2
	20806	20806	38	885	5,506	0.0	0.2	0.2
	20807	20807	103	885	5,506	0.1	0.6	0.7
	20809	20809	398	885	5,506	0.4	2.2	2.6
	20810	20810	222	885	5,506	0.2	1.2	1.4
	20811	20811	51	885	5,506	0.0	0.3	0.3
	20812	20812	1,779	885	5,506	1.6	9.8	11.4
	20813	20813	554	885	5,506	0.5	3.1	3.6
	20814	20814	2,830	885	5,506	2.5	15.6	18.1
	20815	20815	2,470	885	5,506	2.2	13.6	15.8
	209	209	3,026	885	5,506	2.7	16.7	19.4
	211	211	0	885	5,506	0.0	0.0	0.0
	212	212	1,733	885	5,506	1.5	9.5	11.0
	213	213	242	885	5,506	0.2	1.3	1.5
	214	214_e						
		214_i	443	885	5,506	0.4	2.4	2.8
	215	215	83	885	5,506	0.1	0.5	0.6
	216	216_e						
		216_i	189	885	5,506	0.2	1.0	1.2
	217	217	5	885	5,506	0.0	0.0	0.0
	218	218	762	885	5,506	0.7	4.2	4.9
	219	219	2	885	5,506	0.0	0.0	0.0
	Total		**26,418**			**23.5**	**145.4**	**168.9**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
3	30201	30201	184	769	5,360	0.1	1.0	1.1
	30202	30202	979	769	5,360	0.8	5.2	6.0
	30203	30203_e						
		30203_i	1,366	769	5,360	1.1	7.3	8.4
	303	303	387	769	5,360	0.3	2.1	2.4
	304	304	1,550	769	5,360	1.2	8.3	9.5
	305	305	87	769	5,360	0.1	0.5	0.6
	30601	30601	791	769	5,360	0.6	4.2	4.8
	30602	30602	189	769	5,360	0.1	1.0	1.1
	30603	30603_e						
		30603_i	371	769	5,360	0.3	2.0	2.3
	307	307	613	769	5,360	0.5	3.3	3.8
	308	308	2,230	769	5,360	1.7	12.0	13.7
	309	309	0	769	5,360	0.0	0.0	0.0
	310	310	566	769	5,360	0.4	3.0	3.4
	311	311	1,096	769	5,360	0.8	5.9	6.7
	312	312	674	769	5,360	0.5	3.6	4.1
	313	313	0	769	5,360	0.0	0.0	0.0
	31401	31401	98	769	5,360	0.1	0.5	0.6
	31403	31403	360	769	5,360	0.3	1.9	2.2
	31404	31404	1,313	769	5,360	1.0	7.0	8.0
	31405	31405	2,201	769	5,360	1.7	11.8	13.5
	31407	31407	1,882	769	5,360	1.4	10.1	11.5
	31408	31408	867	769	5,360	0.7	4.6	5.3
	31409	31409	4,136	769	5,360	3.2	22.2	25.4
	315	315	217	769	5,360	0.2	1.2	1.4
	316	316	838	769	5,360	0.6	4.5	5.1
	317	317	352	769	5,360	0.3	1.9	2.2
	318	318	693	769	5,360	0.5	3.7	4.2
	319	319_e						
		319_i	223	769	5,360	0.2	1.2	1.4
	320	320_e						
		320_i	3	769	5,360	0.0	0.0	0.0
	321	321						
	Total		**24,266**			**18.7**	**130.0**	**148.7**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
4	401	401	1,070	340	5,386	0.4	5.8	6.2
	402	402	1,544	340	5,386	0.5	8.3	8.8
	403	403	1,515	340	5,386	0.5	8.2	8.7
	404	404	2,215	340	5,386	0.8	11.9	12.7

	405	405	4,025	340	5,386	1.4	21.7	23.1
	406	406_e						
		406_i	3,380	340	5,386	1.1	18.2	19.3
	407	407	757	340	5,386	0.3	4.1	4.4
	408	408	1,623	340	5,386	0.6	8.7	9.3
	409	409	838	340	5,386	0.3	4.5	4.8
	410	410	1,558	340	5,386	0.5	8.4	8.9
	411	411	187	340	5,386	0.1	1.0	1.1
	Total		**18,712**			**6.5**	**100.8**	**107.3**

C: Groundwater (climate change)

5	500	500	1,972	235	4,720	0.5	9.3	9.8
	502	502	1,083	235	4,720	0.3	5.1	5.4
	50401	50401	235	235	4,720	0.1	1.1	1.2
	50402	50402	6,217	235	4,720	1.5	29.3	30.8
	50403	50403	5,043	235	4,720	1.2	23.8	25.0
	506	506	1,555	235	4,720	0.4	7.3	7.7
	Total		**16,105**			**4.0**	**75.9**	**79.9**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
6	60001	60001	381	1,650	5,014	0.6	1.9	2.5
	60002	60002	585	1,650	5,014	1.0	2.9	3.9
	601	601	175	1,650	5,014	0.3	0.9	1.2
	602	602_e						
		602_i	1,531	1,650	5,014	2.5	7.7	10.2
	603	603	611	1,650	5,014	1.0	3.1	4.1
	60401	60401	826	1,650	5,014	1.4	4.1	5.5
	604021	604021	51	1,650	5,014	0.1	0.3	0.4
	604023	604023_e						
		604023_i	2,766	1,650	5,014	4.6	13.9	18.5
	60403	60403	2,552	1,650	5,014	4.2	12.8	17.0
	60405	60405	973	1,650	5,014	1.6	4.9	6.5
	605	605	1,071	1,650	5,014	1.8	5.4	7.2
	606	606	1,330	1,650	5,014	2.2	6.7	8.9
	607	607	133	1,650	5,014	0.2	0.7	0.9
	608	608	3,872	1,650	5,014	6.4	19.4	25.8
	609	609	36	1,650	5,014	0.1	0.2	0.3
	610	610	2,176	1,650	5,014	3.6	10.9	14.5
	611	611	1,554	1,650	5,014	2.6	7.8	10.4
	612	612	1,759	1,650	5,014	2.9	8.8	11.7
	614	614	5,061	1,650	5,014	8.4	25.4	33.8
	616	616	3,196	1,650	5,014	5.3	16.0	21.3
	617	617	930	1,650	5,014	1.5	4.7	6.2
	699	699	771	1,650	5,014	1.3	3.9	5.2
	Total		**32,340**			**53.6**	**162.4**	**216.0**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
7	702	702	3,618	0	4,760	0.0	17.2	17.2
	703	703	1,871	0	4,760	0.0	8.9	8.9
	70401	70401	2,547	0	4,760	0.0	12.1	12.1
	70402	70402	3,442	0	4,760	0.0	16.4	16.4
	70403	70403	1,564	0	4,760	0.0	7.4	7.4
	704041	704041	449	0	4,760	0.0	2.1	2.1
	704042	704042	3,494	0	4,760	0.0	16.6	16.6
	704043	704043	3,507	0	4,760	0.0	16.7	16.7
	70405	70405_e						
		70405_i	904	0	4,760	0.0	4.3	4.3
	705	705	800	0	4,760	0.0	3.8	3.8
	Total		**22,196**			**0.0**	**105.5**	**105.5**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
8	800	800	5	5,825	4,586	0.0	0.0	0.0
	802	802_e						
		802_i	9	5,825	4,586	0.1	0.0	0.1
	80401	80401	289	5,825	4,586	1.7	1.3	3.0
	80402	80402_e						
		80402_i	363	5,825	4,586	2.1	1.7	3.8
	80403	80403_e						
		80403_i	1,409	5,825	4,586	8.2	6.5	14.7
	806	806	2,396	5,825	4,586	14.0	11.0	25.0
	807	807	0	5,825	4,586	0.0	0.0	0.0
	80801	80801_e						

		80801_i	0	5,825	4,586	0.0	0.0	0.0
	80802	80802	4,632	5,825	4,586	27.0	21.2	48.2
	80803	80803_e	0					
		80803_i	0	5,825	4,586	0.0	0.0	0.0
	80804	80804_e						
		80804_i	0	5,825	4,586	0.0	0.0	0.0
	80805	80805	1,240	5,825	4,586	7.2	5.7	12.9
	808061	808061	1,756	5,825	4,586	10.2	8.1	18.3
	808062	808062	1,823	5,825	4,586	10.6	8.4	19.0
	808063	808063	2,457	5,825	4,586	14.3	11.3	25.6
	808071	808071	0	5,825	4,586	0.0	0.0	0.0
	8080721	8080721_e						
		8080721_i	6,782	5,825	4,586	39.5	31.1	70.6
	8080723	8080723	449	5,825	4,586	2.6	2.1	4.7
	808073	808073	3,177	5,825	4,586	18.5	14.6	33.1
	8080741	8080741	91	5,825	4,586	0.5	0.4	0.9
	80807421	80807421	434	5,825	4,586	2.5	2.0	4.5
	80807423	80807423	302	5,825	4,586	1.8	1.4	3.2
	8080743	8080743	725	5,825	4,586	4.2	3.3	7.5
	8080745	8080745	1,692	5,825	4,586	9.9	7.8	17.7
	808075	808075	536	5,825	4,586	3.1	2.5	5.6
	808077	808077	1,716	5,825	4,586	10.0	7.9	17.9
	Total		**32,283**			**188.0**	**148.3**	**336.3**

Grand Total		**196,000**			**424.5**	**984.1**	**1408.6**

(2) Surface Water Demand of Existing Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
1	101	101	I	3920	8,116	3,670	31.8	14.3	46.1
			Swashi Valley	2900	8,116	3,670	23.5	10.6	34.1
			Wara	200	8,116	3,670	1.6	0.7	2.3
			Gafara	500	8,116	3,670	4.1	1.8	5.9
			Dongongari	320	8,116	3,670	2.6	1.2	3.8
	102	102	I	300			2.4	1.1	3.5
			Nasko	200	8,116	3,670	1.6	0.7	2.3
			Rijau	100	8,116	3,670	0.8	0.4	1.2
	103	103	I	1500			12.2	5.5	17.7
			2009 Kasanu	1500	8,116	3,670	12.2	5.5	17.7
	104	104	I	0			0.0	0.0	0.0
	105	105	I	0			0.0	0.0	0.0
	10601	10601	I	0			0.0	0.0	0.0
	10602	10602	I	0			0.0	0.0	0.0
	10603	10603	I	0			0.0	0.0	0.0
	10604	10604	I	0			0.0	0.0	0.0
	10605	10605	I	200			1.6	0.8	2.4
			Zauro Polder	100	8,116	3,670	0.8	0.4	1.2
			Argungu/ Tabarau	100	8,116	3,670	0.8	0.4	1.2
	10606	10606	I	470			3.8	1.7	5.5
			Shagari	220	8,116	3,670	1.8	0.8	2.6
			Kwakwazo	250	8,116	3,670	2.0	0.9	2.9
	10607	10607	I	0					
	106081	106081_e	O						
		106081_i	I	3100			25.2	11.3	36.5
			Wurno	1500	8,116	3,670	12.2	5.5	17.7
			Kware	800	8,116	3,670	6.5	2.9	9.4
			Kalmalo	800	8,116	3,670	6.5	2.9	9.4
	106082	106082_e	O						
		106082_i1	I	0					
		106082_i2	I	405			3.3	1.5	4.8
			Sabke	130	8,116	3,670	1.1	0.5	1.6
			Ajiwa	0	8,116	3,670	0.0	0.0	0.0
			Mashigi	35	8,116	3,670	0.3	0.1	0.4
			Mangwal	0	8,116	3,670	0.0	0.0	0.0
			Deberam	240	8,116	3,670	1.9	0.9	2.8
	106083	106083	I	5120			41.6	18.8	60.4
			Goronyo	120	8,116	3,670	1.0	0.4	1.4
			Middle Rima Valley	5000	8,116	3,670	40.6	18.4	59.0
	106085	106085_e	O						
		106085_i	I	0					
	1060861	1060861_e	O						
		1060861_i1	I	0					0.0
		1060861_i2	I	2300			18.7	8.4	27.1
			Jibiya	2300	8,116	3,670	18.7	8.4	27.1
	1060863	1060863	I	50			0.4	0.2	0.6
			Raddewa	50	8,116	3,670	0.4	0.2	0.6

	106087	106087_e	O						
		106087_i	I	0			0.0	0.0	0.0
	1060881	1060881	I	2100			17	7.7	24.7
			Zobe	2000	8,116	3,670	16.2	7.3	23.5
			Makere	100	8,116	3,670	0.8	0.4	1.2
	1060883	1060883	I	0			0	0	0
	106089	106089	I	0					
			Gagere	0	8,116	3,670	0.0	0.0	0.0
	106091	106091	I	23000			186.7	84.4	271.1
			Bakolori	23000	8,116	3,670	186.7	84.4	271.1
			Bakura		8,116	3,670	0.0	0.0	0.0
	106093	106093	I	76			0.6	0.3	0.9
			Mairuwa	76	8,116	3,670	0.6	0.3	0.9
	107	107_e	O						
		107_i	I	0			0	0	0
			Illo	0	8,116	3,670	0.0	0.0	0.0
	108	108_e	O						
		108_i	I	0			0.0	0.0	0.0
	109	109	O						
	Total			**42,541**			**345.3**	**156.0**	**501.3**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
2	201	201	I	23	3,312	8,080	0.1	0.2	0.3
			Otibe	3	3,312	8,080	0.0	0.0	0.0
			Serki Noma	20	3,312	8,080	0.1	0.2	0.3
	20201	20201	I	400			1.3	3.2	4.5
			Gerinyan	400	3,312	8,080	1.3	3.2	4.5
	202021	202021	I	0			0.0	0.0	0.0
	202023	202023	I	0			0.0	0.0	0.0
	20203	20203	I	415			1.4	3.4	4.8
			Tafa/ Jere	355	3,312	8,080	1.2	2.9	4.1
			Pambegua	60	3,312	8,080	0.2	0.5	0.7
	20205	20205	I	44			0.1	0.3	0.4
			Hunkuyi	40	3,312	8,080	0.1	0.3	0.4
			Tadanni	4	3,312	8,080	0.0	0.0	0.0
	203	203	I	0			0.0	0.0	0.0
	20401	20401	I	4803			15.9	38.7	54.6
			Kampe/Omi	4000	3,312	8,080	13.2	32.3	45.5
			Kpada	150	3,312	8,080	0.5	1.2	1.7
			Ikale	420	3,312	8,080	1.4	3.4	4.8
			Adorun	80	3,312	8,080	0.3	0.6	0.9
			Odugbo	150	3,312	8,080	0.5	1.2	1.7
			Aiyetoro	3	3,312	8,080	0.0	0.0	0.0
	20403	20403	I	0					0.0
	205	205	I	0					0.0
	206	206	I	6273			20.7	50.7	71.4
			Agaie/ Lapai	1000	3,312	8,080	3.3	8.1	11.4
			E.Lapai	2000	3,312	8,080	6.6	16.2	22.8
			Bakogi	2000	3,312	8,080	6.6	16.2	22.8
			Badeggi	830	3,312	8,080	2.7	6.7	9.4
			Pandegi	25	3,312	8,080	0.1	0.2	0.3
			Chanchanga	302	3,312	8,080	1.0	2.4	3.4
			Agaie	76	3,312	8,080	0.3	0.6	0.9
			Lioji	40	3,312	8,080	0.1	0.3	0.4
			Zara	0	3,312	8,080	0.0	0.0	0.0
	207	207	I	90			0.3	0.7	1
			Duro-Gakpan	90	3,312	8,080	0.3	0.7	1.0
	20801	20801	I	624			2.1	5	7.1
			Guzan	0	3,312	8,080	0.0	0.0	0.0
			Wuya	25	3,312	8,080	0.1	0.2	0.3
			Doko	400	3,312	8,080	1.3	3.2	4.5
			Bangi	50	3,312	8,080	0.2	0.4	0.6
			Edozhigi	100	3,312	8,080	0.3	0.8	1.1
			Baratsu	49	3,312	8,080	0.2	0.4	0.6
	20802	20802	I	0			0.0	0.0	0.0
	20803	20803	I	0			0.0	0.0	0.0
	20804	20804	I	8440			28	68.1	96.1
			Bagoma	500	3,312	8,080	1.7	4.0	5.7
			Zara	0	3,312	8,080	0.0	0.0	0.0
			Birnin Gwari	430	3,312	8,080	1.4	3.5	4.9
			Kuta	30	3,312	8,080	0.1	0.2	0.3
			Toroko	80	3,312	8,080	0.3	0.6	0.9
			2039 Ukusu	1400	3,312	8,080	4.6	11.3	15.9
			3008 Bajagira	6000	3,312	8,080	19.9	48.5	68.4
	20805	20805	I	800			2.6	6.5	9.1
			Tungan Kowa	800	3,312	8,080	2.6	6.5	9.1
			Manta	0	3,312	8,080	0.0	0.0	0.0

	20806	20806	I	400			1.3	3.2	4.5
			Kogun	400	3,312	8,080	1.3	3.2	4.5
	20807	20807	I	0			0.0	0.0	0.0
	20809	20809	I	0			0.0	0.0	0.0
	20810	20810	I	485			1.6	3.9	5.5
			Loguma	125	3,312	8,080	0.4	1.0	1.4
			Gurama/ Sarkin Fawa	60	3,312	8,080	0.2	0.5	0.7
			Galama	300	3,312	8,080	1.0	2.4	3.4
	20811	20811	I	0			0.0	0.0	0.0
	20812	20812	I	780			2.5	6.2	8.7
			Kidandan	40	3,312	8,080	0.1	0.3	0.4
			Tubo	600	3,312	8,080	2.0	4.8	6.8
			Kerawa	100	3,312	8,080	0.3	0.8	1.1
			S.Birni	40	3,312	8,080	0.1	0.3	0.4
			Gongara	0	3,312	8,080	0.0	0.0	0.0
	20813	20813	I	1720			5.7	13.9	19.6
			Kangimi	1600	3,312	8,080	5.3	12.9	18.2
			Igabi	120	3,312	8,080	0.4	1.0	1.4
	20814	20814	I	795			2.6	6.3	8.9
			Galma	610	3,312	8,080	2.0	4.9	6.9
			Shika	80	3,312	8,080	0.3	0.6	0.9
			Kazuntu	65	3,312	8,080	0.2	0.5	0.7
			Dawanta	40	3,312	8,080	0.1	0.3	0.4
	20815	20815	I	310			0.9	2.4	3.3
			Zangon-Kataf	30	3,312	8,080	0.1	0.2	0.3
			Lere	40	3,312	8,080	0.1	0.3	0.4
			G.Kurama	40	3,312	8,080	0.1	0.3	0.4
			Jagindi	100	3,312	8,080	0.3	0.8	1.1
			Kagoro	100	3,312	8,080	0.3	0.8	1.1
	209	209	I	14720			48.8	118.9	167.7
			Omu-Aran	0	3,312	8,080	0.0	0.0	0.0
			Tada Shonga	4100	3,312	8,080	13.6	33.1	46.7
			Oke Oyi	60	3,312	8,080	0.2	0.5	0.7
			Oro-Ago	10	3,312	8,080	0.0	0.1	0.1
			Duku-Lade	1200	3,312	8,080	4.0	9.7	13.7
			Rabba	110	3,312	8,080	0.4	0.9	1.3
			Bacita	9000	3,312	8,080	29.8	72.7	102.5
			Jebba North	20	3,312	8,080	0.1	0.2	0.3
			Lafiagi	5	3,312	8,080	0.0	0.0	0.0
			Ajasse-Ipo	3	3,312	8,080	0.0	0.0	0.0
			Shao	3	3,312	8,080	0.0	0.0	0.0
			Ero	200	3,420	8,080	0.7	1.6	2.3
			Bussamu	9	3,312	8,080	0.0	0.1	0.1
	211	211	I	0			0.0	0.0	0.0
	212	212	I	29			0.1	0.2	0.3
			Oloru	0	3,312	8,080	0.0	0.0	0.0
			Obbo-Ile	12	3,312	8,080	0.0	0.1	0.1
			Passa Elepo	17	3,312	8,080	0.1	0.1	0.2
	213	213	I	10			0	0.1	0.1
			Tamani	10	3,312	8,080	0.0	0.1	0.1
	214	214_e	O						
		214_i	I	5			0	0	0
			Moshi	5	3,312	8,080	0.0	0.0	0.0
	215	215	I	0			0.0	0.0	0.0
	216	216_e	O						
		216_i	I	0			0.0	0.0	0.0
	217	217	I	0			0.0	0.0	0.0
	218	218	I	2180			7.2	17.6	24.8
			Kontagora	2000	3,312	8,080	6.6	16.2	22.8
			Nasarawa	100	3,312	8,080	0.3	0.8	1.1
			Papiri	80	3,312	8,080	0.3	0.6	0.9
	219	219	I	0	3,312	8,080	0.0	0.0	0.0
	Total			**43,346**			**143.2**	**349.5**	**492.7**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
3	30201	30201	I	35000	3,012	7,872	105.4	275.5	380.9
			Donga-Int.2	35000	3,012	7,872	105.4	275.5	380.9
	30202	30202	I	0			0.0	0.0	0.0
	30203	30203_e	O						
		30203_i	I	60			0.2	0.5	0.7
			Donga	60	3,012	7,872	0.2	0.5	0.7
	303	303	I	10000			30.1	78.7	108.8
			Taraba-Int.3	10000	3,012	7,872	30.1	78.7	108.8
	304	304	I	2290			6.9	18	24.9
			Wase	90	3,012	7,872	0.3	0.7	1.0
			2112 Bada	2200	3,012	7,872	6.6	17.3	23.9
	305	305	I	7500			22.6	59	81.6

			Taraba-Int.3	7500	3,012	7,872	22.6	59.0	81.6
	30601	30601	I	18000			54.2	141.7	195.9
			Lower Taraba (Gassol)	3000	3,012	7,872	9.0	23.6	32.6
			Taraba-Int.2	15000	3,012	7,872	45.2	118.1	163.3
	30602	30602	I	5000			15.1	39.4	54.5
			Taraba-Int.1	5000	3,012	7,872	15.1	39.4	54.5
	30603	30603_e	O						
		30603_i	I	0			0.0	0.0	0.0
	307	307	I	0					0.0
	308	308	I	0					0.0
	309	309	I	0			0.0	0.0	0.0
	310	310	I	0			0.0	0.0	0.0
	311	311	I	12315			37	96.9	133.9
			Savannah Sugar	12200	3,012	7,872	36.7	96.0	132.7
			Cham	115	3,012	7,872	0.3	0.9	1.2
	312	312	I	18000			54.2	141.7	195.9
			2091 Mayo Belwa	18000	3,012	7,872	54.2	141.7	195.9
	313	313	I	0			0.0	0.0	0.0
	31401	31401	I	0			0.0	0.0	0.0
	31403	31403	I	160			0.5	1.3	1.8
			Tallum	160	3,012	7,872	0.5	1.3	1.8
	31404	31404	I	20			0.1	0.2	0.3
			Jaffi	20	3,012	7,872	0.1	0.2	0.3
	31405	31405	I	14710			44.3	115.8	160.1
			Dadin Kowa	6660	3,012	7,872	20.1	52.4	72.5
			Kushimaga	200	3,012	7,872	0.6	1.6	2.2
			Gora	50	3,012	7,872	0.2	0.4	0.6
			Balanga	3800	3,012	7,872	11.4	29.9	41.3
			Kaititingo	0	3,012	7,872	0.0	0.0	0.0
			Savannah Integrated Farm	4000	3,012	7,872	12.0	31.5	43.5
	31407	31407	I	300			0.9	2.4	3.3
			Gari Abudullahi	0	3,012	7,872	0.0	0.0	0.0
			Vegetablefru	300	3,012	7,872	0.9	2.4	3.3
	31408	31408	I	0			0.0	0.0	0.0
	31409	31409	I	460			1.4	3.7	5.1
			Waya	250	3,012	7,872	0.8	2.0	2.8
			Ngalda	200	3,012	7,872	0.6	1.6	2.2
			Bagal	10	3,012	7,872	0.0	0.1	0.1
	315	315	I	0			0.0	0.0	0.0
	316	316	I	9050			27.3	71.2	98.5
			Mayo	50	3,012	7,872	0.2	0.4	0.6
			2089 Mayo Ine	9000	3,012	7,872	27.1	70.8	97.9
	317	317	I	5400			16.2	42.5	58.7
			Lake Geriyo	4000	3,012	7,872	12.0	31.5	43.5
			Chouchi	1200	3,012	7,872	3.6	9.4	13.0
			Dasin Hausa	200	3,012	7,872	0.6	1.6	2.2
	318	318	I	10200			30.7	80.3	111
			Dwan	200	3,012	7,872	0.6	1.6	2.2
			3012 Mulemg	10000	3,012	7,872	30.1	78.7	108.8
	319	319_e	O						
		319_i	I	0			0.0	0.0	0.0
	320	320_e	O						
		320_i	I	0			0.0	0.0	0.0
	321	321	O						
	Total			**148,465**			**447.1**	**1,168.8**	1,615.9

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
4	401	401	I	1000	1,908	7,764	1.9	7.8	9.7
			Oguma	1000	1,908	7,764	1.9	7.8	9.7
	402	402	I	4000			7.6	31.1	38.7
			3011 Ragwa	4000	1,908	7,764	7.6	31.1	38.7
	403	403	I	15050			28.7	116.9	145.6
			Loko	50	1,908	7,764	0.1	0.4	0.5
			Nasarawa-Int.	15000	1,908	7,764	28.6	116.5	145.1
	404	404	I	2467			4.7	19.2	23.9
			Doma	2037	1,908	7,764	3.9	15.8	19.7
			Rutu	50	1,908	7,764	0.1	0.4	0.5
			Sabon Gida	200	1,908	7,764	0.4	1.6	2.0
			Bassa	50	1,908	7,764	0.1	0.4	0.5
			Ganauri	130	1,908	7,764	0.2	1.0	1.2
	405	405	I	3145			5.9	24.5	30.4
			Makurdi	1000	1,908	7,764	1.9	7.8	9.7
			Umogidi	0	1,908	7,764	0.0	0.0	0.0
			Kiroki	15	1,908	7,764	0.0	0.1	0.1
			Naka	20	1,908	7,764	0.0	0.2	0.2

			Mu	60	1,908	7,764	0.1	0.5	0.6
			2142 Kereke	2000	1,908	7,764	3.8	15.5	19.3
			Allam	50	1,908	7,764	0.1	0.4	0.5
	406	406_e	O						
		406_i	I	5034			9.5	39.1	48.6
			Katsina-Ala	2000	1,908	7,764	3.8	15.5	19.3
			Jato-Aka	1000	1,908	7,764	1.9	7.8	9.7
			Adi	24	1,908	7,764	0.0	0.2	0.2
			Akata	10	1,908	7,764	0.0	0.1	0.1
			2148 Dula	2000	1,908	7,764	3.8	15.5	19.3
	407	407	I	2100			4.1	16.3	20.4
			Obagaji	500	1,908	7,764	1.0	3.9	4.9
			Awe	80	1,908	7,764	0.2	0.6	0.8
			Awuma	20	1,908	7,764	0.0	0.2	0.2
			2139 Aneri	1500	1,908	7,764	2.9	11.6	14.5
	408	408	I	2098			4	16.2	20.2
			Dep	2000	1,908	7,764	3.8	15.5	19.3
			Bokkos	18	1,908	7,764	0.0	0.1	0.1
			Wuse	50	1,908	7,764	0.1	0.4	0.5
			Gidan Adamu	30	1,908	7,764	0.1	0.2	0.3
	409	409	I	0			0.0	0.0	0.0
	410	410	I	18100			34.5	140.5	175
			Shendam(1)	1000	1,908	7,764	1.9	7.8	9.7
			Longkat	1100	1,908	7,764	2.1	8.5	10.6
			2124 Shemankar	16000	1,908	7,764	30.5	124.2	154.7
	411	411	I	7,500			14	58	73
			Taraba-Int.3	7500	1,908	7,764	14.3	58.2	72.5
	Total			**60,494**			**115.2**	**469.8**	**585.0**

5	500	500	I	4,390	662	9,192	3	40	43
			Ewu	100	662	9,192	0.1	0.9	1.0
			Isampou Rice	1280	662	9,192	0.8	11.8	12.6
			Peremabiri Rice	1280	662	9,192	0.8	11.8	12.6
			Kolo Rice	1300	662	9,192	0.9	11.9	12.8
			Anyama-Ogbia	180	662	9,192	0.1	1.7	1.8
			Ewulu	50	662	9,192	0.0	0.5	0.5
			Kpong	100	662	9,276	0.1	0.9	1.0
			Otuokpoti	100	662	9,192	0.1	0.9	1.0
	502	502	I	1,800			1	0	1
			Land Reclam.	1800	662	0	1.2	0.0	1.2
	50401	50401	I	0			0.0	0.0	0.0
	50402	50402	I	16,060			11	73	84
			Lower Anambra	5000	662	9,192	3.3	46.0	49.3
			Adoru	100	662	9,192	0.1	0.9	1.0
			Ejule Ojebe	1100	662	9,192	0.7	10.1	10.8
			Ofarachi	10	662	9,192	0.0	0.1	0.1
			Ada-Rice	1000	662	9,192	0.7	9.2	9.9
			Uzo Uwani	50	662	9,192	0.0	0.5	0.5
			Egume	100	662	9,192	0.1	0.9	1.0
			Ifite Ogwari	120	662	9,192	0.1	1.1	1.2
			Enugu abor Ufuwa	350	662	9,192	0.2	3.2	3.4
			Ogboji	130	662	9,192	0.1	1.2	1.3
			Land Reclam.	8100	662	0	5.4	0.0	5.4
	50403	50403	I	16150			10.7	86.9	97.6
			Ilush-Ega	5000	662	9,192	3.3	46.0	49.3
			Illahi Ebuh	100	662	9,192	0.1	0.9	1.0
			Ukhun/ Erah	250	662	9,192	0.2	2.3	2.5
			2175 Obe	4100	662	9,192	2.7	37.7	40.4
			Land Reclam.	6700	662	0	4.4	0.0	4.4
	506	506	I	2,400			2	0	2
			Land Reclam.	2400	662	0	1.6	0.0	1.6
	Total			**40,800**			**27.1**	**200.5**	**227.6**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
6	60001	60001	I		3,420	8,608			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250			0.9	2.2	3.1
			Oke-Odan	250	3,420	8,608	0.9	2.2	3.1
	603	603	I	0			0	0	0
			Otta	0	3,420	8,608	0.0	0.0	0.0
	60401	60401	I	12,302			42	106	148
			Owiwi	302	3,420	8,608	1.0	2.6	3.6
			Mokoloki	12000	3,420	8,608	41.0	103.3	144.3
	604021	604021	I	0			0	0	0
			Lower Ogun		3,420	8,608	0.0	0.0	0.0

	604023	604023_e	O						
		604023_i	I	114			0.3	1.0	0.5
			Upper Ogun	10	3,420	8,608	0.0	0.1	0.1
			Ofiki(A)	24	3,420	8,608	0.1	0.2	0.3
			Ofiki(B)	10	3,420	8,608	0.0	0.1	0.1
			Ilero	70	3,420	8,608	0.2	0.6	0.8
	60403	60403	I	12000			41	103.3	144.3
			Middle Ogun (I.G)	12000	3,420	8,608	41.0	103.3	144.3
	60405	60405	I	30			0.1	0.3	0.4
			Sepeteri(A)	30	3,420	8,608	0.1	0.3	0.4
			Sepeteri(B)	0	3,420	8,608	0.0	0.0	0.0
	605	605	I	0					0.0
	606	606	I	335			1.1	2.9	4
			Eyinwa	10	3,420	8,608	0.0	0.1	0.1
			Itokin	315	3,420	8,608	1.1	2.7	3.8
			Eniosa	10	3,420	8,608	0.0	0.1	0.1
	607	607	I	0			0.0	0.0	0.0
	608	608	I	2210			7.4	19.1	26.5
			Esa Oke Dam	800	3,420	8,608	2.7	6.9	9.6
			Igbonla	130	3,420	8,608	0.4	1.1	1.5
			New Erinle	500	3,420	8,608	1.7	4.3	6.0
			Asa	500	3,420	8,608	1.7	4.3	6.0
			Okuku	30	3,420	8,608	0.1	0.3	0.4
			Iwo	0	3,420	8,608	0.0	0.0	0.0
			Osun Ekiti	100	3,420	8,608	0.3	0.9	1.2
			Old Erinle Dam	150	3,420	8,608	0.5	1.3	1.8
	609	609	I	0			0.0	0.0	0.0
	610	610	I	750			2.6	6.5	9.1
			Oogi	400	3,420	8,608	1.4	3.4	4.8
			Ipetu-Ijesha	250	3,420	8,608	0.9	2.2	3.1
			Orile Owu	100	3,420	8,608	0.3	0.9	1.2
	611	611	I	0			0.0	0.0	0.0
	612	612	I	500			1.7	4.3	6
			Owena	500	3,420	8,608	1.7	4.3	6.0
			Iju-Itaogbolu	0	3,420	8,608	0.0	0.0	0.0
	614	614	I	2282			7.7	19.8	27.5
			Ikere-Ogbese	32	3,420	8,608	0.1	0.3	0.4
			Oye	0	3,420	8,608	0.0	0.0	0.0
			Obayantor	100	3,420	8,608	0.3	0.9	1.2
			Erusu	0	3,420	8,608	0.0	0.0	0.0
			Ayo-Kudun	300	3,420	8,608	1.0	2.6	3.6
			Apariko	250	3,420	8,608	0.9	2.2	3.1
			Ado-Ekiti (Osin)	0	3,420	8,608	0.0	0.0	0.0
			Ijero	100	3,420	8,608	0.3	0.9	1.2
			2224 Okhuo	1500	3,420	8,608	5.1	12.9	18.0
	616	616	I	25			0.1	0.2	0.3
			Ukpok	25	3,420	8,608	0.1	0.2	0.3
	617	617	I	100			0.4	0.8	1.2
			Ilah-Ebu	50	3,420	8,608	0.2	0.4	0.6
			Elule	50	3,420	8,608	0.2	0.4	0.6
	699	699	I	0			0.0	0.0	0.0
	Total			**30,898**			**105.3**	**266.3**	**371.6**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	702	702	I	6420	0	9,276	0	4.8	4.8
			Imo (Igwu and Ibu)	0	662	9,192	0.0	0.0	0.0
			Ihitti-Uboma	310	0	9,276	0.0	2.9	2.9
			Umlopara	210	0	9,276	0.0	1.9	1.9
			Land Reclam.	5900	0	0	0.0	0.0	0.0
	703	703	I	3662			0	4.3	4.3
			Abak	62	0	9,276	0.0	0.6	0.6
			Oniong Nung Nden	400	0	9,276	0.0	3.7	3.7
			Land Reclam.	3200	0	0	0.0	0.0	0.0
7	70401	70401	I	3500			0	32.5	32.5
			Utuma	200	0	9,276	0.0	1.9	1.9
			Nkari	0	0	9,276	0.0	0.0	0.0
			Itu	100	0	9,276	0.0	0.9	0.9
			Igbere	440	0	9,276	0.0	4.1	4.1
			Ekoi	500	0	9,276	0.0	4.6	4.6
			Adim Rice	340	0	9,276	0.0	3.2	3.2
			Idomi	100	0	9,276	0.0	0.9	0.9
			Mbiabet	500	0	9,276	0.0	4.6	4.6
			Bende	300	0	9,276	0.0	2.8	2.8
			Igwu-Ohafia	300	0	9,276	0.0	2.8	2.8
			Igwu-Ndiojo	150	0	9,276	0.0	1.4	1.4

			Oguwo						
			Igwu-Ndiebe	100	0	9,276	0.0	0.9	0.9
			Nung Obong	200	0	9,276	0.0	1.9	1.9
			Uzu Abam	70	0	9,276	0.0	0.6	0.6
			Idim Abam	200	0	9,276	0.0	1.9	1.9
	70402	70402	I	7316			0	19.9	19.9
			Isi-Uzo	71	0	9,276	0.0	0.7	0.7
			Owutu	480	0	9,276	0.0	4.5	4.5
			Akaeze	200	0	9,276	0.0	1.9	1.9
			Umuhu	200	0	9,276	0.0	1.9	1.9
			Ofiawu	115	0	9,276	0.0	1.1	1.1
			Ezamgbe	100	0	9,276	0.0	0.9	0.9
			Ezeiyieku Esu	200	0	9,276	0.0	1.9	1.9
			Ezillo Farm	150	0	9,276	0.0	1.4	1.4
			Ozara Okangwu	300	0	9,276	0.0	2.8	2.8
			Item-Ikwo	300	0	9,276	0.0	2.8	2.8
			Land Reclam.	5200	0	0	0.0	0.0	0.0
	70403	70403	I	4015			0	12.2	12.2
			Obubra	315	0	9,276	0.0	2.9	2.9
			Abakaliki/ Iwa	1000	0	9,276	0.0	9.3	9.3
			Ofodun	0	0	9,276	0.0	0.0	0.0
			Land Reclam.	2700	0	0	0.0	0.0	0.0
	704041	704041	I	900			0	0	0
			Land Reclam.	900	0	0	0.0	0.0	0.0
	704042	704042	I	7435			0	16.1	16.1
			Ijegu Yala	80	0	9,276	0.0	0.7	0.7
			Bausara	0	0	9,276	0.0	0.0	0.0
			Ukum	0	0	9,276	0.0	0.0	0.0
			Ogoja	125	0	9,276	0.0	1.2	1.2
			Obudu	30	0	9,276	0.0	0.3	0.3
			2240 Koshisha	1500	0	9,276	0.0	13.9	13.9
			Land Reclam.	5700	0	0	0.0	0.0	0.0
	704043	704043	I	9750			0	40.4	40.4
			Iboko	150	0	9,276	0.0	1.4	1.4
			2229 Ombi	2000	0	9,276	0.0	18.6	18.6
			2231 Ogege	1000	0	9,276	0.0	9.3	9.3
			2237 Abe	1200	0	9,276	0.0	11.1	11.1
			Land Reclam.	5400	0	0	0.0	0.0	0.0
	70405	70405_e	O				0.0	0.0	
		70405_i	I	62			0	0.6	0.6
			Amaeki Abam	62	0	9,276	0.0	0.6	0.6
	705	705	I	50			0	0.5	0.5
			Uwet	50	0	9,276	0.0	0.5	0.5
			Itogodi	0	0	9,276	0.0	0.0	0.0
Total				**43,110**			**0**	**131.3**	**131.3**

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	800	800	I	0	10,750	3,440	0.0	0.0	0.0
	802	802_e	O						
		802_i	I	0			0.0	0.0	0.0
	80401	80401	I	23540			253.1	81.1	334.2
			South Chad	22000	10,750	3,440	236.5	75.7	312.2
			South Chad Pilot	800	10,750	3,440	8.6	2.8	11.4
			Ebeji	140	10,750	3,440	1.5	0.5	2.0
			Gamboru	400	10,750	3,440	4.3	1.4	5.7
			Ngabu	200	10,750	3,440	2.2	0.7	2.9
	80402	80402_e	O						
		80402_i	I	0	10,750	3,440	0	0	0.0
	80403	80403_e	O						
		80403_i	I	680			7.3	2.3	9.6
			Yau	420	10,750	3,440	4.5	1.4	5.9
8			Michika	0	10,750	3,440	0.0	0.0	0.0
			Abadam	260	10,750	3,440	2.8	0.9	3.7
	806	806	I	0			0	0	0
			Jere Bowl Rice	0	10,750	3,440	0.0	0.0	0.0
	807	807	I	2000			21.5	6.9	28.4
			Baga Polder	2000	10,750	3,440	21.5	6.9	28.4
	80801	80801_e	O						
		80801_i	I	2880			30.9	9.9	40.8
			Yobe	2820	10,750	3,440	30.3	9.7	40.0
			Jaffi	30	10,750	3,440	0.3	0.1	0.4
			Damasak	30	10,750	3,440	0.3	0.1	0.4
	80802	80802	I	0			0.0	0.0	0.0
	80803	80803_e	O						
		80803_i	I	0			0.0	0.0	0.0
	80804	80804_e	O						
		80804_i	I	0			0.0	0.0	0.0

	80805	80805	I	2028			21.8	7	28.8
			Gashua	2000	10,750	3,440	21.5	6.9	28.4
			Mugura	28	10,750	3,440	0.3	0.1	0.4
	808061	808061	I	1830			19.6	6.2	25.8
			Abir	130	10,750	3,440	1.4	0.4	1.8
			Katagum	700	10,750	3,440	7.5	2.4	9.9
			Daya	960	10,750	3,440	10.3	3.3	13.6
			Warwada	40	10,750	3,440	0.4	0.1	0.5
			Yamidi	0	10,750	3,440	0.0	0.0	0.0
	808062	808062	I	40			0.4	0.1	0.5
			K.Gana	40	10,750	3,440	0.4	0.1	0.5
	808063	808063	I	200			2.1	0.7	2.8
			Jamaare(Sewa Pilot)	20	10,750	3,440	0.2	0.1	0.3
			Galala	130	10,750	3,440	1.4	0.4	1.8
			Diya	30	10,750	3,440	0.3	0.1	0.4
			Maladumba	20	10,750	3,440	0.2	0.1	0.3
	808071	808071	I	0			0.0	0.0	0.0
	8080721	8080721_e	O						
		8080721_i	I	1230			13.2	4.2	17.4
			Gari	300	10,750	3,440	3.2	1.0	4.2
			Tomas	400	10,750	3,440	4.3	1.4	5.7
			Jakara	430	10,750	3,440	4.6	1.5	6.1
			Jakarade	100	10,750	3,440	1.1	0.3	1.4
			Dambo	0	10,750	3,440	0.0	0.0	0.0
	8080723	8080723	I	0			0	0	0
			Dembo	0	10,750	3,440	0.0	0.0	0.0
	808073	808073	I	42800			460.1	147.2	607.3
			Kano River Phase II	15000	10,750	3,440	161.3	51.6	212.9
			Hadejia Valley	12500	10,750	3,440	134.4	43.0	177.4
			Kafin Chiri	0	10,750	3,440	0.0	0.0	0.0
			Aguja	120	10,750	3,440	1.3	0.4	1.7
			Jahun	100	10,750	3,440	1.1	0.3	1.4
			Gunuar Kukaf	0	10,750	3,440	0.0	0.0	0.0
			Mai-alkama	0	10,750	3,440	0.0	0.0	0.0
			Arawa	0	10,750	3,440	0.0	0.0	0.0
			Hantsu	30	10,750	3,440	0.3	0.1	0.4
			Walu	50	10,750	3,440	0.5	0.2	0.7
			Tsuwa	0	10,750	3,440	0.0	0.0	0.0
			Joda	0	10,750	3,440	0.0	0.0	0.0
	8080741	8080741	I	0			0.0	0.0	0.0
	80807421	80807421	I	0			0	0	0
			Baguwai (Watari)	0	10,750	3,440	0.0	0.0	0.0
	80807423	80807423	I	0					0.0
	8080743	8080743	I	70			0.8	0.2	1
			Guzuguzu	0	10,750	3,440	0.0	0.0	0.0
			Magaga	70	10,750	3,440	0.8	0.2	1.0
	8080745	8080745	I	0			0	0	0
			Gwarzo	0	10,750	3,440	0.0	0.0	0.0
	808075	808075	I	22300			239.7	76.7	316.4
			Kano River Phase I	22000	10,750	3,440	236.5	75.7	312.2
			Bagauda	300	10,750	3,440	3.2	1.0	4.2
	808077	808077	I	0			0	0	0
			Tudun Wada	0	10,750	3,440	0.0	0.0	0.0
	Total			**84,598**			**909.3**	**290.9**	**1,200.2**

Grand Total			**494,252**			**2,092.5**	**3,033.1**	**5,125.6**

(3) Diversion Water Requirement of Irrigation Project (Climate Change)

Water Resirces: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	662	282	13,240	5,640	40	50	8,116
	Dry	0	367	0	7,340	0	50	3,670
2	Wet	259	34	5,180	680	60	30	3,312
	Dry	781	413	15,620	8,260	20	60	8,080
3	Wet	237	28	4,740	560	60	30	3,012
	Dry	762	402	15,240	8,040	20	60	7,872
4	Wet	156	6	3,120	120	60	30	1,908
	Dry	729	404	14,580	8,080	20	60	7,764
5	Wet	41	3	820	60	80	10	662
	Dry	648	354	12,960	7,080	60	20	9,192
6	Wet	250	70	5,000	1,400	60	30	3,420
	Dry	700	376	14,000	7,520	40	40	8,608

7	Wet	0	0	0	0	80	10	0
	Dry	654	357	13,080	7,140	60	20	9,276
8	Wet	639	263	12,780	5,260	80	10	10,750
	Dry	0	344	0	6,880	0	50	3,440

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
1	Wet	662	282	11,033	4,700	20	70	5,497
	Dry	0	367	0	6,117	0	80	4,894
2	Wet	259	34	4,317	567	10	80	885
	Dry	781	413	13,017	6,883	0	80	5,506
3	Wet	237	28	3,950	467	10	80	769
	Dry	762	402	12,700	6,700	0	80	5,360
4	Wet	156	6	2,600	100	10	80	340
	Dry	729	404	12,150	6,733	0	80	5,386
5	Wet	41	3	683	50	30	60	235
	Dry	648	354	10,800	5,900	0	80	4,720
6	Wet	250	70	4,167	1,167	20	70	1,650
	Dry	700	376	11,667	6,267	0	80	5,014
7	Wet	0	0	0	0	30	60	0
	Dry	654	357	10,900	5,950	0	80	4,760
8	Wet	639	263	10,650	4,383	30	60	5,825
	Dry	0	344	0	5,733	0	80	4,586

(4) Net Irrigation Requirement (for Climate Change)

Hydrological Area: **HA-1** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice		81	92	133	161	175	155	137	123	118	120	96	82	
ETo (Potential Evapotranspiration)	mm	95	107	155	188	204	181	160	144	138	140	112	96	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					35	125	166	143	84	21			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					140	230	226	203	114	51			964
⑤ Effective rainfall	mm	0	0	2	4	18	40	82	100	56	6	0	0	
⑥ Net Irrigation Requirement	mm					122	190	144	103	58	45			662
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	95	107	155	188	204	181	160	144	138	140	112	96	
Kc						0.11	0.41	0.75	0.85	0.54	0.14			
① Etcrop (ETo×Kc)	mm					22	74	120	122	75	20			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					52	104	120	122	75	20			493
④ Effective rainfall	mm					13	28	57	70	39	4			
⑤ Net Irrigation Requirement	mm					39	76	63	52	36	16			282

Hydrological Area: **HA-1** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm													
Kc														
① Etcrop (ETo×Kc)	mm													
② Percoration	mm													
③ Land Preparation	mm													
④ =①+②+③	mm													
⑤ Effective rainfall	mm													
⑥ Net Irrigation Requirement	mm													
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	95	107	155	188	204	181	160	144	138	140	112	96	
Kc		0.88	0.85	0.39	0.05							0.15	0.52	
① Etcrop (ETo×Kc)	mm	84	91	60	9							17	50	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	84	91	60	9							47	80	371
④ Effective rainfall	mm	0	0	1	3							0	0	
⑤ Net Irrigation Requirement	mm	84	91	59	6							47	80	367

Hydrological Area: **HA-2** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			96	103	129	134	132	115	111	104	99	104	98	94	
	ETo (Potential Evapotranspiration)	mm	111	119	150	155	153	133	129	121	115	121	114	109	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					26	92	134	120	70	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					131	197	194	180	100	48			850
⑤	Effective rainfall	mm	1	0	9	29	76	105	122	146	150	42	2	1	
⑥	Net Irrigation Requirement	mm					55	92	72	34	0	6			259
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	111	119	150	155	153	133	129	121	115	121	114	109	
	Kc						0.13	0.45	0.78	0.86	0.54	0.14			
①	Etcrop (ETo×Kc)	mm					20	60	101	104	62	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					50	90	101	104	62	17			424
④	Effective rainfall	mm					53	74	85	102	105	29			
⑤	Net Irrigation Requirement	mm					0	16	16	2	0	0			34

Hydrological Area: **HA-2** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	111	119	150	155	153	133	129	121	115	121	114	109	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	Etcrop (ETo×Kc)	mm	122	79	24							21	79	121	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	182	109	54							126	184	181	836
⑤	Effective rainfall	mm	1	0	9							42	2	1	
⑥	Net Irrigation Requirement	mm	181	109	45							84	182	180	781
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	111	119	150	155	153	133	129	121	115	121	114	109	
	Kc		0.84	0.91	0.57	0.15							0.15	0.5	
①	Etcrop (ETo×Kc)	mm	93	108	86	23							17	55	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	93	108	86	23							47	85	442
④	Effective rainfall	mm	1	0	6	20							1	1	
⑤	Net Irrigation Requirement	mm	92	108	80	3							46	84	413

Hydrological Area: **HA-3** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			88	96	129	136	133	115	110	104	98	104	95	88	
	ETo (Potential Evapotranspiration)	mm	102	111	150	158	154	133	128	121	114	121	110	102	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					26	92	133	120	70	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					131	197	193	180	100	48			849
⑤	Effective rainfall	mm	0	0	5	26	67	93	145	167	122	40	2	0	
⑥	Net Irrigation Requirement	mm			0	0	64	104	48	13	0	8			237
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	102	111	150	158	154	133	128	121	114	121	110	102	
	Kc						0.13	0.45	0.78	0.86	0.54	0.14			
①	Etcrop (ETo×Kc)	mm					20	60	100	104	62	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					50	90	100	104	62	17			423
④	Effective rainfall	mm					47	65	102	117	85	28			
⑤	Net Irrigation Requirement	mm					3	25	0	0	0	0			28

Hydrological Area: **HA-3** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	102	111	150	158	154	133	128	121	114	121	110	102	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	Etcrop (ETo×Kc)	mm	112	73	24							21	76	113	

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	172	103	54							126	181	173	809
⑤	Effective rainfall	mm	0	0	5							40	2	0	
⑥	Net Irrigation Requirement	mm	172	103	49							86	179	173	762
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	102	111	150	158	154	133	128	121	114	121	110	102	
	Kc		0.84	0.91	0.57	0.15							0.15	0.5	
①	Etcrop (ETo×Kc)	mm	86	101	86	24							17	51	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	86	101	86	24							47	81	425
④	Effective rainfall	mm	0	0	4	18							1	0	
⑤	Net Irrigation Requirement	mm	86	101	82	6							46	81	402

Hydrological Area: **HA-4** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			99	104	128	126	124	111	109	105	100	104	100	95	
	ETo (Potential Evapotranspiration)	mm	114	120	148	145	143	128	126	121	115	120	115	110	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					24	88	131	120	70	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					129	193	191	180	100	48			841
⑤	Effective rainfall	mm	1	0	15	46	106	123	139	169	174	88	6	0	
⑥	Net Irrigation Requirement	mm					23	70	52	11	0	0			156
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	114	120	148	145	143	128	126	121	115	120	115	110	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					19	59	100	104	62	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					49	89	100	104	62	17			421
④	Effective rainfall	mm					74	86	97	118	122	62			
⑤	Net Irrigation Requirement	mm					0	3	3	0	0	0			6

Hydrological Area: **HA-4** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	114	120	148	145	143	128	126	121	115	120	115	110	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	125	79	24							20	79	122	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	185	109	54							125	184	182	839
⑤	Effective rainfall	mm	1	0	15							88	6	0	
⑥	Net Irrigation Requirement	mm	184	109	39	0						37	178	182	729
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	114	120	148	145	143	128	126	121	115	120	115	110	
	Kc		0.84	0.91	0.57	0.15							0.14	0.5	
①	Etcrop (ETo×Kc)	mm	96	109	84	22							16	55	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	96	109	84	22							46	85	442
④	Effective rainfall	mm	1	0	11	32							4	0	
⑤	Net Irrigation Requirement	mm	95	109	73	0							42	85	404

Hydrological Area: **HA-5** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			107	107	125	122	122	111	108	105	102	106	106	105	
	ETo (Potential Evapotranspiration)	mm	122	122	142	139	139	126	123	120	116	121	121	120	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					24	87	128	119	71	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					129	192	188	179	101	48			837
⑤	Effective rainfall	mm	6	0	46	83	151	206	183	143	225	153	33	6	
⑥	Net Irrigation Requirement	mm					0	0	5	36	0	0			41
2) Other Cereal															

	ETo (Potential Evapotranspiration)	mm	122	122	142	139	139	126	123	120	116	121	121	120	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					18	58	97	103	63	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					48	88	97	103	63	17			416
④	Effective rainfall	mm					106	144	128	100	158	107			
⑤	Net Irrigation Requirement	mm					0	0	0	3	0	0			3

Hydrological Area: **HA-5** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	122	122	142	139	139	126	123	120	116	121	121	120	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	134	81	23							21	83	133	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	194	111	53							126	188	193	865
⑤	Effective rainfall	mm	6	0	46							153	33	6	
⑥	Net Irrigation Requirement	mm	188	111	7							0	155	187	648
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	122	122	142	139	139	126	123	120	116	121	121	120	
	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	99	106	77	19							17	58	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	99	106	77	19							47	88	436
④	Effective rainfall	mm	4	0	32	58							23	4	
⑤	Net Irrigation Requirement	mm	95	106	45	0							24	84	354

Hydrological Area: **HA-6** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			106	107	125	121	122	111	106	102	100	105	105	105	
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					24	88	126	116	70	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					129	193	186	176	100	48			832
⑤	Effective rainfall	mm	3	0	37	71	112	140	116	66	154	105	15	3	
⑥	Net Irrigation Requirement	mm					17	53	70	110	0	0			250
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					18	58	96	101	62	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					48	88	96	101	62	17			412
④	Effective rainfall	mm					78	98	81	46	108	74			
⑤	Net Irrigation Requirement	mm					0	0	15	55	0	0			70

Hydrological Area: **HA-6** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	133	81	23							20	83	133	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	193	111	53							125	188	193	863
⑤	Effective rainfall	mm	3	0	37							105	15	3	
⑥	Net Irrigation Requirement	mm	190	111	16							20	173	190	700
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	98	107	77	19							17	58	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	98	107	77	19							47	88	436
④	Effective rainfall	mm	2	0	26	50							11	2	

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
⑤ Net Irrigation Requirement	mm	96	107	51	0							36	86	376

Hydrological Area: **HA-7** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice		106	107	123	118	120	110	108	104	102	105	105	104	
ETo (Potential Evapotranspiration)	mm	121	123	141	135	138	126	124	119	117	120	120	119	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					23	87	129	118	71	18			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					128	192	189	178	101	48			836
⑤ Effective rainfall	mm	3	0	51	95	158	192	203	200	226	178	26	3	
⑥ Net Irrigation Requirement	mm					0	0	0	0	0	0			0
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	121	123	141	135	138	126	124	119	117	120	120	119	
Kc						0.13	0.46	0.79	0.86	0.54	0.14			
① ETcrop (ETo×Kc)	mm					18	58	98	102	63	17			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					48	88	98	102	63	17			416
④ Effective rainfall	mm					111	134	142	140	158	125			
⑤ Net Irrigation Requirement	mm					0	0	0	0	0	0			0

Hydrological Area: **HA-7** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm	121	123	141	135	138	126	124	119	117	120	120	119	
Kc		1.1	0.66	0.16							0.17	0.69	1.11	
① ETcrop (ETo×Kc)	mm	133	81	23							20	83	132	
② Percoration	mm	60	30	30							30	30	60	
③ Land Preparation	mm										75	75		
④ =①+②+③	mm	193	111	53							125	188	192	862
⑤ Effective rainfall	mm	3	0	51							178	26	3	
⑥ Net Irrigation Requirement	mm	190	111	2							0	162	189	654
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	121	123	141	135	138	126	124	119	117	120	120	119	
Kc		0.81	0.87	0.54	0.14							0.14	0.48	
① Etcrop (ETo×Kc)	mm	98	107	76	19							17	57	
② Pre-Irrigation	mm											30	30	
③ =①+②	mm	98	107	76	19							47	87	434
④ Effective rainfall	mm	2	0	36	67							18	2	
⑤ Net Irrigation Requirement	mm	96	107	40	0							29	85	357

Hydrological Area: **HA-8** **Wet Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice		74	83	122	150	164	147	129	115	112	114	90	76	
ETo (Potential Evapotranspiration)	mm	86	97	142	175	192	172	151	134	131	133	105	89	
Kc						0.17	0.69	1.04	0.99	0.61	0.15			
① Etcrop (ETo×Kc)	mm					33	119	157	133	80	20			
② Percoration	mm					30	30	60	60	30	30			
③ Land Preparation	mm					75	75							
④ =①+②+③	mm					138	224	217	193	110	50			932
⑤ Effective rainfall	mm	0	0	0	4	15	32	88	111	43	4	0	0	
⑥ Net Irrigation Requirement	mm					123	192	129	82	67	46			639
2) Other Cereal														
ETo (Potential Evapotranspiration)	mm	86	97	142	175	192	172	151	134	131	133	105	89	
Kc						0.11	0.41	0.75	0.85	0.54	0.14			
① ETcrop (ETo×Kc)	mm					21	71	113	114	71	19			
② Pre-Irrigation	mm					30	30							
③ =①+②	mm					51	101	113	114	71	19			469
④ Effective rainfall	mm					11	22	62	78	30	3			
⑤ Net Irrigation Requirement	mm					40	79	51	36	41	16			263

Hydrological Area: **HA-8** **Dry Season**

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice														
ETo (Potential Evapotranspiration)	mm													

	Kc														
①	ETcrop (ETo×Kc)	mm													
②	Percoration	mm													
③	Land Preparation	mm													
④	=①+②+③	mm													
⑤	Effective rainfall	mm													
⑥	Net Irrigation Requirement	mm													
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	86	97	142	175	192	172	151	134	131	133	105	89	
	Kc		0.89	0.85	0.39	0.05							0.16	0.53	
①	Etcrop (ETo×Kc)	mm	77	82	55	9							17	47	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	77	82	55	9							47	77	347
④	Effective rainfall	mm	0	0	0	3							0	0	
⑤	Net Irrigation Requirement	mm	77	82	55	6							47	77	344

SR1.4 Other Sectors

SR1.4.1 Livestock

Number of livestock heads is by far larger in the north of the country than in the south because northern inhabitants too often suffer from droughts to rely on crop farming, naturally depending too heavily on livestock production. Due to scanty annual precipitation, surface water availability is particularly low during dry season, and even during rainy season sufficient water seldom runs in the streams. Thus, livestock ought to rely on well water as its last resort. Water consumption of livestock is a function of atmospheric temperature, live weight and availability of grazing grass. Because 80% of the weight of grazing grass is nothing but water, and if a cattle graze and browse 20 kg/day, it is equivalent to drink 16 liter of water that can maintain a day of an adult cow with her live weight of 240 kg (0.15 l / kg live weight). In an extreme drought year, with an annual rainfall of 400mm or less, grass cover becomes so thinner over grazing field that adult cattle cannot graze more than 5kg a day. In such a case it should drink at least 11 liter of water at watering spots a day to maintain its body. Moreover, moving/ walking livestock require more water, about double as much as the staying one. That the reason why adult cattle needs 25-35 liter of water per day on average depending on its live weight and its activities. As to other ruminants like goats and sheep. The situations are similar to the case of cattle. The following table shows a standard of livestock water requirement in the tropical zone shown in one of livestock guidebook published by FAO in 1960s. Of course domestically kept livestock and nomadic one have different standard in a strict sense:

Table SR1.4-1 Case of Water Requirement per Head of Livestock

Livestock specie	Live Weight (kg)	Maintaining* need (L/day)	Uptake from grazing Grass/ feeds (L/day)	Gross water Drink (L/day)	Annual (m^3) requirement
Cattle	250	60	38.4	21.6	7.88
Goat	30	6.6	4.3	2.3	0.84
Sheep	40	8.8	6.8	2.0	0.73
Pig	90	20	16.7	3.3	1.20
Donkey	110	24	15.6	8.4	3.07
Camel	350	80	55.4	24.6	8.98
Horse	300	70	47.8	22.2	8.10
Fowl	2	0.4	0.292	0.108	0.039

Source: FAO Livestock Guide-book in Tropical African Countries, 1960

Table SR1.4-2 Recent Trend of Livestock Herd Size in Nigeria

Specie	1995	1999	2000 ~2005	2006 / 07	07/ 08	08/ 09	2009/ 10
Cattle	16,577,962	15,071,237	n.a	16,278,946	16,537,748	16,488,085	17,893,219
Goat	56,524,075	43,079,529	n.a	51,208,000	52,489,243	54,200,434	52,085,270
Sheep	35,519,759	27,363,427	n.a	32,300,000	33,090,000	33,674,000	32,178,027
Pig	7,471, 730	2,426,747	n.a	9,298,275	9,554,900	9,808,289	10,108,258
Donkey	1,084,770	-	n.a	-	-	-	370,988
Camel	49,810	-	n.a	-	-	-	147,084
Horse	-	-	n.a	-	-	-	789,074
Fowl	192,13,325	112,441,618	n.a	92,035,038	84,781,229	86,600,907	92,133,918

Source: Water Resource Master Plan 1995, NBS abstract and Funso Agricultual Data

Table SR1.4-3 Number of Livestock Heads / Fowls in 2009 / 2010

Livestock Heads	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses
Abia	90,000	197,589	58,544	18,914	594,027	0	0	0
Adamawa	1,494,892	2,582,605	1,039,670	704,285	86,421	9,073	0	0
Akwa-Ibom	54,048	561,277	32,637	196,724	1,480,707	1,706	1,706	1,706
Anambra	5,613	587,655	456,088	975,000	2,056,215	0	0	0
Bauchi	1,000,000	3,443,403	1,928,872	108,135	4,198,632	0	37	0
Bayelsa	22,500	152,079	8,900	247,574	475,235	0	0	0
Benue	40,279	154,212	33,957	130,420	1,245,597	3,175	872	872
Borno	2,200,000	4,899,501	3,764,829	0	317,072	11,428	0	5,904
Cross River	8,000	319,966	21,674	22,800	1,017,489	907	907	907
Delta	299,141	411,290	14,278	6,000	1,320,138	1,671	0	0
Ebonyi	111,000	410,026	108,589	840,000	2,868,961	26,046	0	0
Edo	52,000	348,409	38,654	13,300	772,148	20,837	0	0
Ekiti	10,900	76,499	6,529	50,081	316,391	0	0	0
Enugu	34,000	780,564	15,667	40,832	1,978,609	5,870	0	0
Gombe	1,018,276	2,824,799	1,165,624	487,288	4,806,553	0	0	0
Imo	27,778	775,798	53,293	30,500	4,761,662	0	0	0
Jigawa	608,885	3,820,953	3,126,028	0	2,892,781	63,869	10,245	651,213
Kaduna	520,983	2,175,857	971,336	351,506	3,920,317	2,542	0	0
Kano	1,709,047	5,605,546	5,874,921	0	6,495,021	0	0	0
Katsina	1,109,728	3,998,276	2,398,963	0	5,204,109	6,108	0	0
Kebbi	440,469	1,974,189	1,063,894	140,500	3,598,760	14,726	18,057	4,174
Kogi	242,296	941,451	209,877	8,975	3,023,382	1,151	2,722	1,151
Kwara	43,700	427,112	153,827	164,240	1,084,437	0	1,844	0
Lagos	3,300	203,814	230,111	584,908	3,320,472	0	0	0
Nasarawa	58,329	617,583	125,878	567,961	1,950,636	0	2,646	0
Niger	529,067	2,290,808	843,860	64,000	4,734,575	2,572	0	0
Ogun	41,828	301,002	251,109	78,500	568,613	2,551	2,551	2,551
Ondo	8,861	272,983	81,723	73,688	666,623	640	640	640
Osun	9,073	408,555	98,368	103,300	1,222,429	0	0	0
Oyo	446,320	1,246,587	674,891	256,274	6,175,998	0	0	0
Plateau	643,059	1,421,192	362,633	2,197,599	2,889,871	0	0	0
Rivers	47,221	287,680	42,116	615,000	1,480,609	0	0	0
Sokoto	2,578,403	1,791,659	2,662525	35,000	3,919,385	103,390	59,917	60,682
Taraba	224,104	1,226,332	232,746	935,817	3,435,021	0	0	1,065
Yobe	1,056,524	3,214,055	1,855,173	0	4,510,760	17,366	2,611	16,786
Zamfara	1,075,973	1,129,270	2,076,802	12,975	2,397,355	73,360	42,329	41,284
FCT Abuja	27,622	204,694	93,441	46,162	346,907	0	0	139
National	**17,893,219**	**52,085,270**	**32,178,027**	**10,108,258**	**92,133,918**	**370,988**	**147,084**	**789,074**

Source: 1) NBS abstract and Funso Agricultual Data.
2) Ministry of Agriculture, Ministry of Animal Health in Katsia, Sokoto and Zamfara State

Table SR1.4-4 Corresponding Livestock Water Requirement in 2009 / 2010

Livestock Heads	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses
Abia	709,200	165,975	42,737	22,697	23,167	0	0	0
Adamawa	11,779,749	2,169,388	758,959	845,142	3,370	27,854	0	0
Akwa-Ibom	425,898	471,473	23,825	236,069	57,748	5,237	15,320	13,819
Anambra	44,230	493,630	332,944	1,170,000	80,192	0	0	0
Bauchi	7,880,000	2,892,459	1,408,077	129,762	163,747	0	332	0
Bayelsa	177,300	127,746	6,497	297,089	18,534	0	0	0
Benue	317,399	129,538	24,789	156,504	48,578	9,747	7,831	7,063
Borno	17,336,000	4,115,581	2,748,325	0	12,366	35,084	0	47,822
Cross River	63,040	268,771	15,822	27,360	39,682	2,784	8,145	7,347
Delta	2,357,231	345,484	10,423	7,200	51,485	5,130	0	0
Ebonyi	874,680	344,422	79,270	1,008,000	111,889	79,961	0	0
Edo	409,760	292,664	28,217	15,960	30,114	63,970	0	0
Ekiti	85,892	64,259	4,766	60,097	12,339	0	0	0
Enugu	267,920	655,674	11,437	48,998	77,166	18,021	0	0
Gombe	8,024,015	2,372,831	850,906	584,746	187,456	0	0	0
Imo	218,891	651,670	38,904	36,600	185,705	0	0	0
Jigawa	4,798,014	3,209,601	2,282,000	0	112,818	196,078	92,000	5,274,825
Kaduna	4,105,346	1,827,720	709,075	421,807	152,892	7,804	0	0
Kano	13,467,290	4,708,659	4,288,692	0	253,306	0	0	0
Katsina	8,744,657	3,358,552	1,751,243	0	202,960	18,752	0	0
Kebbi	3,470,896	1,658,319	776,643	168,600	140,352	45,209	162,152	33,809
Kogi	1,909,292	790,819	153,210	10,770	117,912	3,534	24,444	9,323
Kwara	344,356	358,774	112,294	197,088	42,293	0	16,559	0
Lagos	26,004	171,204	167,981	701,890	129,498	0	0	0
Nasarawa	459,633	518,770	91,891	681,553	76,075	0	23,761	0
Niger	4,169,048	1,924,279	616,018	76,800	184,648	7,896	0	0
Ogun	329,605	252,842	183,310	94,200	22,176	7,832	22,908	20,663
Ondo	69,825	229,306	59,658	88,426	25,998	1,965	5,747	5,184
Osun	71,495	343,186	71,809	123,960	47,675	0	0	0
Oyo	3,517,002	1,047,133	492,670	307,529	240,864	0	0	0
Plateau	5,067,305	1,193,801	264,722	2,637,119	112,705	0	0	0
Rivers	372,101	241,651	30,745	738,000	57,744	0	0	0
Sokoto	20,317,816	1,504,994	1,943,643	42,000	152,856	317,407	538,055	491,524
Taraba	1,765,940	1,030,119	169,905	1,122,980	133,966	0	0	8,627
Yobe	8,325,409	2,699,806	1,354,276	0	175,920	53,314	23,447	135,967
Zamfara	8,478,667	948,587	1,516,065	15,570	93,497	231,355	380,114	334,400
FCT Abuja	217,661	171,943	68,212	55,394	13,529	0	0	1,126
National	**140,998,566**	**43,751,627**	**23,489,960**	**12,129,910**	**3,593,223**	**1,138,933**	**1,320,814**	**6,391,499**

Table SR1.4-5 Estimated Growth Rate of Livestock Heads during the period of 2010-2030

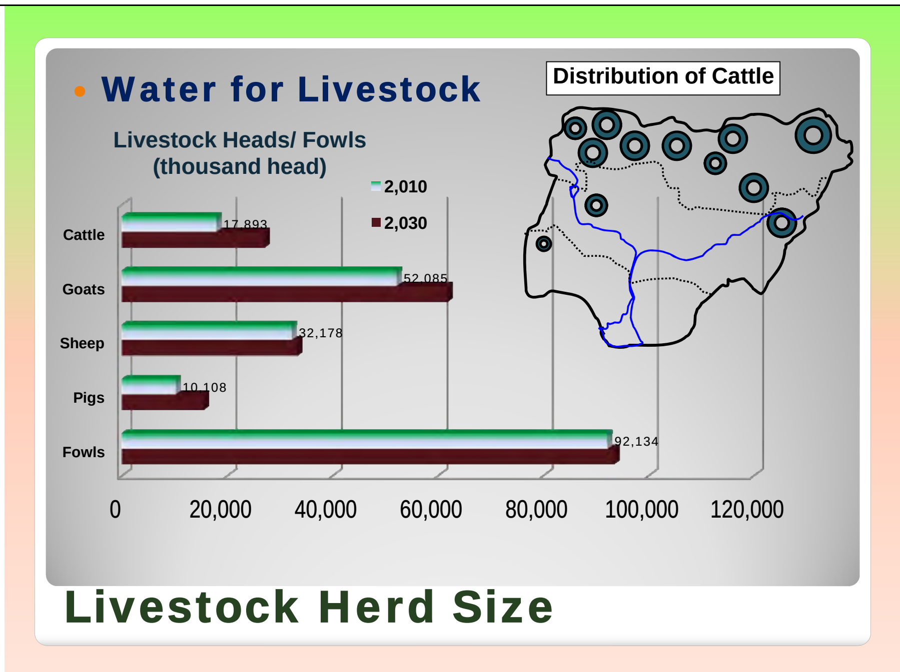
Specie	Formula of linear regression	Annual growth rate
Cattle:	Y= 479.2 X + 12,726.3	2.10%/year
Goats:	Y= 434.2 X + 48,804.8	0.86%/year
Sheep:	Y= 21.8 X + 32,625.2	0.17%/year
Pigs:	Y= 268.3 X + 7,411.7	2.15%/year
Fowls:	Y= 211.7 X + 87,088.3	0.07%/year

Table SR1.4-6 Number of Livestock Heads / Fowls projected in 2030

Livestock Heads	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses
Abia	136,319	234,560	60,547	28,930	602,441	0	0	0
Adamawa	2,264,241	3,065,839	1,075,242	1,077,233	87,645	9,073	0	0
Akwa-Ibom	81,864	666,298	33,754	300,898	1,501,681	1,706	1,706	1,706
Anambra	8,502	697,612	471,693	1,491,303	2,085,341	0	0	0
Bauchi	1,514,652	4,087,702	1,994,869	165,397	4,258,106	0	37	0
Bayelsa	34,080	180,535	9,205	378,675	481,967	0	0	0
Benue	61,009	183,067	35,119	199,483	1,263,241	3,175	872	872
Borno	3,332,234	5,816,252	3,893,643	0	321,563	11,428	0	5,904
Cross River	12,117	379,835	22,416	34,874	1,031,902	907	907	907
Delta	453,095	488,247	14,767	9,177	1,338,838	1,671	0	0
Ebonyi	168,126	486,746	112,304	1,284,815	2,909,600	26,046	0	0
Edo	78,762	413,600	39,977	20,343	783,086	20,837	0	0
Ekiti	16,510	90,813	6,752	76,601	320,873	0	0	0
Enugu	51,498	926,616	16,203	62,454	2,006,636	5,870	0	0
Gombe	1,542,334	3,353,350	1,205,506	745,327	4,874,638	0	0	0
Imo	42,074	920,958	55,116	46,651	4,829,111	0	0	0
Jigawa	922,249	4,535,896	3,232,985	0	2,933,758	63,869	10,245	651,213
Kaduna	789,108	2,582,984	1,004,570	537,643	3,975,849	2,542	0	0
Kano	2,588,611	6,654,406	6,075,932	0	6,587,024	0	0	0
Katsina	1,680,852	4,746,398	2,481,044	0	5,277,826	6,108	0	0
Kebbi	667,157	2,343,582	1,100,295	214,901	3,649,737	14,726	18,057	4,174
Kogi	366,994	1,117,607	217,058	13,728	3,066,209	1,151	2,722	1,151
Kwara	66,190	507,029	159,090	251,212	1,099,798	0	1,844	0
Lagos	4,998	241,950	237,984	894,641	3,367,507	0	0	0
Nasarawa	88,348	733,140	130,185	868,720	1,978,267	0	2,646	0
Niger	801,352	2,719,444	872,733	97,891	4,801,641	2,572	0	0
Ogun	63,355	357,323	259,701	120,069	576,667	2,551	2,551	2,551
Ondo	13,421	324,061	84,519	112,709	676,066	640	640	640
Osun	13,742	485,000	101,734	158,002	1,239,745	0	0	0
Oyo	676,019	1,479,837	697,982	391,982	6,263,482	0	0	0
Plateau	974,011	1,687,113	375,041	3,361,319	2,930,806	0	0	0
Rivers	71,523	341,508	43,557	940,668	1,501,582	0	0	0
Sokoto	3,905,383	2,126,898	2,753,624	53,534	3,974,903	103,390	59,917	60,682
Taraba	339,440	1,455,792	240,709	1,431,371	3,483,678	0	0	1,065
Yobe	1,600,266	3,815,440	1,918,648	0	4,574,655	17,366	2,611	16,786
Zamfara	1,629,725	1,340,569	2,147,860	19,846	2,431,314	75,360	42,329	41,284
FCT Abuja	41,838	242,995	96,638	70,607	351,821	0	0	139
National	**27,102,000**	**61,831,002**	**33,279,001**	**15,461,000**	**93,439,004**	**370,988**	**147,084**	**789,074**

Table SR1.4-7 Corresponding Livestock Water Requirement projected in 2030

Livestock Water	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses
Abia	1,074,191	197,030	44,199	34,716	23,495	0	0	0
Adamawa	17,842,220	2,575,305	784,927	1,292,680	3,418	27,854	0	0
Akwa-Ibom	645,088	559,690	24,640	361,077	58,566	5,237	15,320	13,819
Anambra	66,994	585,994	344,336	1,789,564	81,328	0	0	0
Bauchi	11,935,458	3,433,670	1,456,254	198,476	166,066	0	332	0
Bayelsa	268,548	151,649	6,719	454,410	18,797	0	0	0
Benue	480,748	153,776	25,637	239,379	49,266	9,747	7,831	7,063
Borno	26,258,007	4,885,652	2,842,359	0	12,541	35,084	0	47,822
Cross River	95,484	319,062	16,363	41,848	40,244	2,784	8,145	7,347
Delta	3,570,385	410,127	10,780	11,013	52,215	5,130	0	0
Ebonyi	1,324,836	408,867	81,982	1,541,778	113,474	79,961	0	0
Edo	620,644	347,424	29,183	24,411	30,540	63,970	0	0
Ekiti	130,096	76,283	4,929	91,921	12,514	0	0	0
Enugu	405,806	778,358	11,828	74,945	78,259	18,021	0	0
Gombe	12,153,590	2,816,814	880,019	894,393	190,111	0	0	0
Imo	331,543	773,605	40,235	55,981	188,335	0	0	0
Jigawa	7,267,321	3,810,152	2,360,079	0	114,417	196,078	92,000	5,274,825
Kaduna	6,218,171	2,169,707	733,336	645,172	155,058	7,804	0	0
Kano	20,398,258	5,589,701	4,435,430	0	256,894	0	0	0
Katsina	13,245,112	3,986,974	1,811,162	0	205,835	18,752	0	0
Kebbi	5,257,199	1,968,609	803,216	257,881	142,340	45,209	162,152	33,809
Kogi	2,891,914	938,790	158,452	16,473	119,582	3,534	24,444	9,323
Kwara	521,580	425,905	116,136	301,454	42,892	0	16,559	0
Lagos	39,387	203,238	173,729	1,073,569	131,333	0	0	0
Nasarawa	696,183	615,837	95,035	1,042,464	77,152	0	23,761	0
Niger	6,314,657	2,284,333	637,095	117,469	187,264	7,896	0	0
Ogun	499,236	300,151	189,582	144,083	22,490	7,832	22,908	20,663
Ondo	105,760	272,211	61,699	135,251	26,367	1,965	5,747	5,184
Osun	108,290	407,400	74,266	189,602	48,350	0	0	0
Oyo	5,327,034	1,243,063	509,527	470,378	244,276	0	0	0
Plateau	7,675,204	1,417,175	273,780	4,033,583	114,301	0	0	0
Rivers	563,604	286,867	31,797	1,128,802	58,562	0	0	0
Sokoto	30,774,420	1,786,595	2,010,145	64,241	155,021	317,407	538,055	491,524
Taraba	2,674,784	1,222,866	175,718	1,717,645	135,863	0	0	8,627
Yobe	12,610,098	3,204,970	1,400,613	0	178,412	53,314	23,447	135,967
Zamfara	12,842,230	1,126,078	1,567,938	23,815	94,821	231,355	380,114	334,400
FCT Abuja	329,681	204,115	70,546	84,728	13,721	0	0	1,126
National	**213,563,760**	**51,938,042**	**24,293,671**	**18,553,200**	**3,644,121**	**1,138,933**	**1,320,814**	**6,391,499**



Source: JICA Project team

Figure SR1.4-1 Corresponding Livestock Water Requirement

Table SR1.4-8 Breakdown of Water Requirement into Hydrological Area (HA)

HA	Water Demand (MCM)	
	2010	2030
1	55.7	77.7
2	18.2	25.0
3	46.0	65.1
4	7.7	11.0
5	7.6	10.6
6	10.7	14.6
7	6.8	9.3
8	80.1	107.5
Total	232.8	320.8

The following figures illustrate distribution of major states with large herds by species in 2009/ 2010.

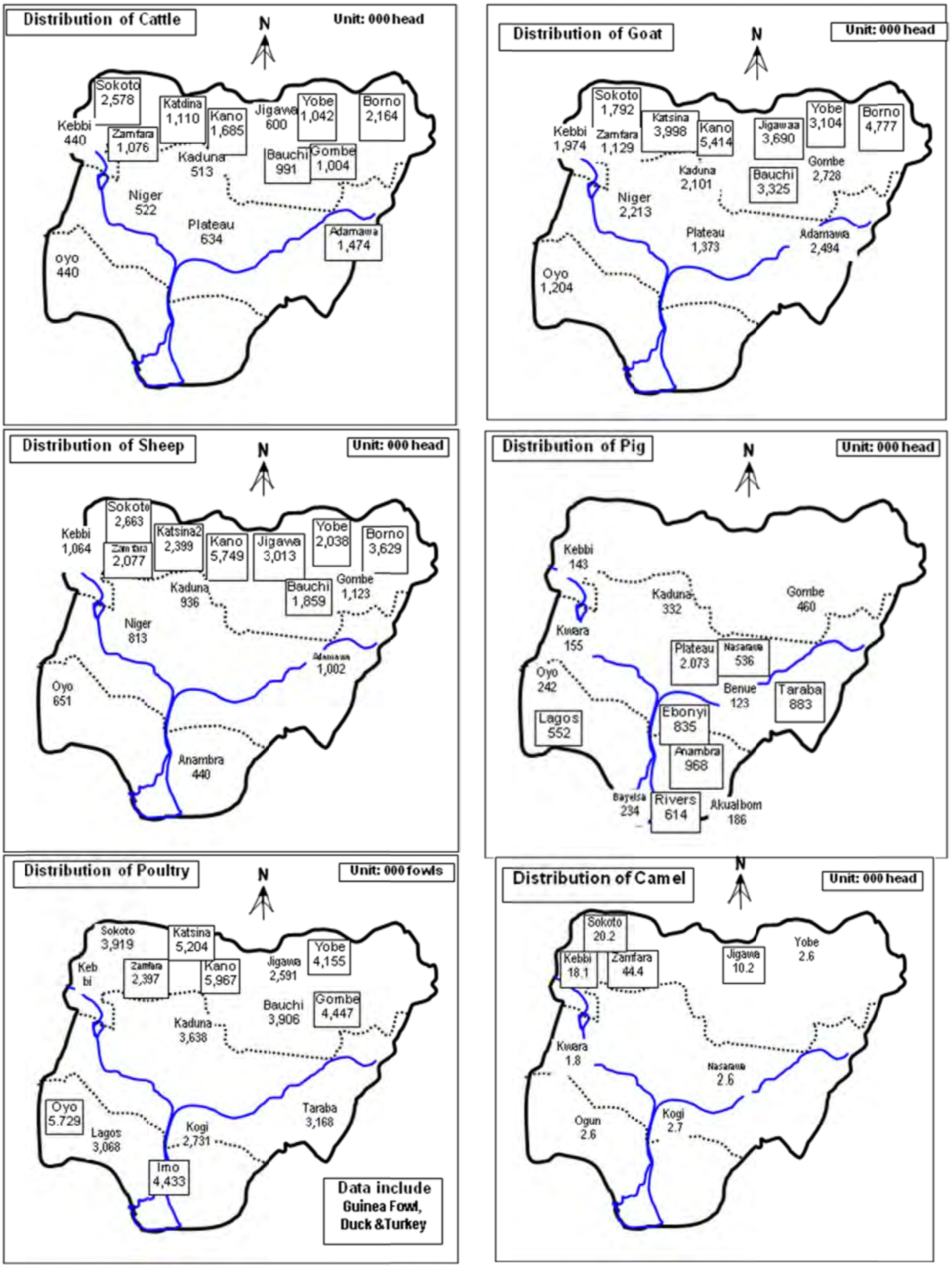


Figure SR1.4-2 Distribution of Livestock

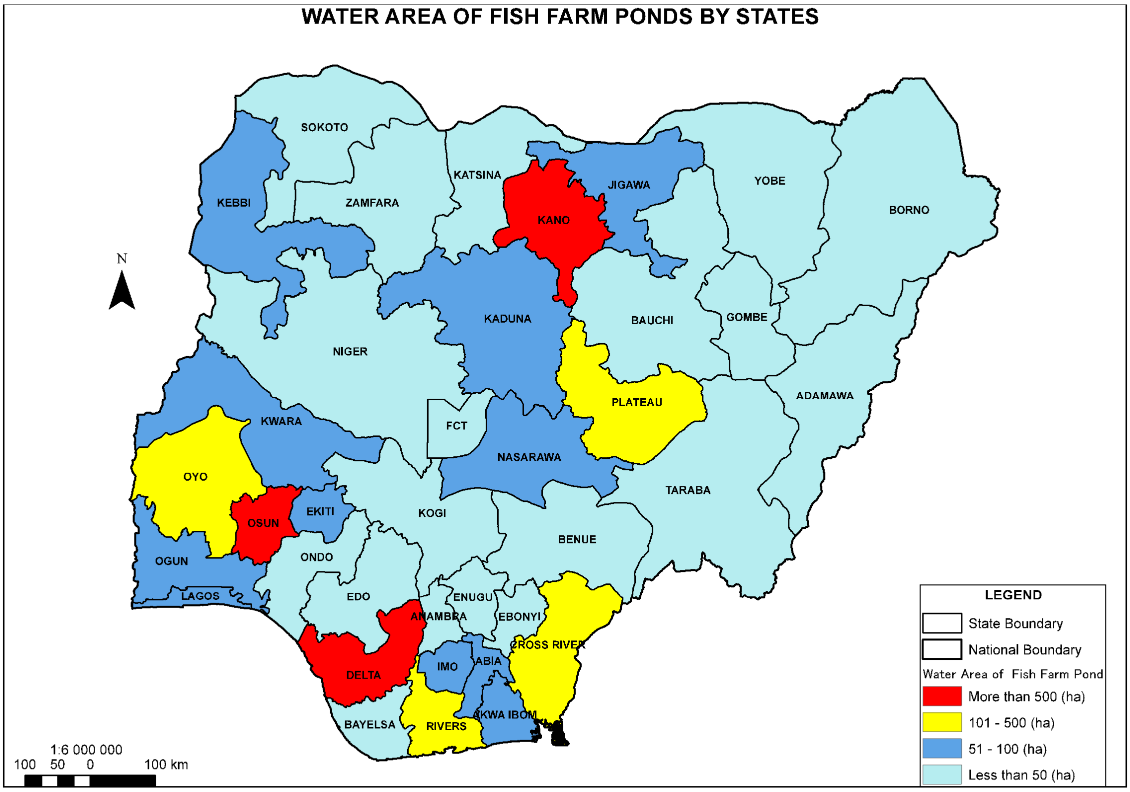
SR1.4.2 Freshwater Aquaculture

Basic Data for 2030 projection: Area of farm ponds by Fishery Statistics of Nigeria, Inventory of Private and Government Fish Farm and Hatcheries published in 2007

Table SR1.4-9 Fish Farm Pond as of 2007

State	Number of Fish Farm	Water Area of Farm Pond (ha)	Brackish Water Area of Farm Pond (ha)
ABIA	40	50.7	0.0
ADAMAWA	4	30.2	0.0
AKUA IBOM	98	59.1	0.0
ANAMBRA	18	34.7	0.0
BAUCHI	16	21.9	0.0
BAYELSA	86	13.8	0.1
BENUE	198	19.3	0.0
BORNO	12	12.1	0.0
CROSS RIVER	191	386.2	0.0
DELTA	420	2,410.0	0.0
EDO	138	2.7	0.0
EBONYI	12	14.9	0.0
RKITI	31	74.5	0.0
ENUGU	4	4.0	0.0
FCT	29	12.3	0.0
GOMBE	15	10.0	0.0
IMO	40	61.5	0.0
JIGAWA	4	63.0	0.0
KADUNA	10	59.2	0.0
KANO	10	711.6	0.0
KATSINA	7	29.0	0.0
KEBBI	56	57.7	0.0
KOGI	32	37.1	0.0
KWARA	121	83.2	0.0
LAGOS	153	70.5	0.0
NASSARAWA	39	78.5	0.0
NIGER	29	29.0	0.0
OGUN	173	92.9	5.0
ONDO	15	27.9	5.2
OYO	234	474.0	0.0
OSUN	293	568.6	0.0
PLATEAU	18	186.7	0.0
RIVERS	89	274.7	9.9
SOKOTO	9	14.2	0.0
TARABA	8	2.8	0.0
YOBE	13	9.9	0.0
ZAMFARA	9	37.5	0.0
TOTAL NIGERIA	2,674	6,126	20.2

Source: Inventory of Fish Farm in Nigeria, FMARD



Source: JICA Project team

Figure SR1.4-3 Distribution of Fish Farm Pond

Table SR1.4-10 Water Sources of Fish Ponds

Water source	Tube-well	Shallow well	Stream	Fountain
proportion	32%	40%	18%	10%

Source: Abbas, Idowu Innocent and J. A. Ukoje, Department of Geography, Ahmadu Bello University, Zaria, Nigeria

Current production level of aqua-culture including brackish water ponds: 60,000 ha, 85,087t in 2007 according to Fishery Statistics of Nigeria, fourth edition 1995-2007 by Fishery Department, FMARD.

Table SR1.4-11 Trend of Inland Fish Farming (IFF):

Year	1995	1996	1997	1998	1999	2000	2001	2002
IFF (t)	16,619	19,490	25,265	20,458	21,738	25,720	24,398	30,664
Year	2003	2004	2005	2006	2007	2008	2009	2010
IFF (t)	30,677	43,950	56,355	84,533	85,087	143,207	152,796	200,535
						16.3 % / y	Annual growth	

Source: Fishery Department, FMARD, Challenges and Investment Opportunities for Large-Scale Aquaculture Farmers in Nigeria

Example of Current Productivity of Cultured Fish in Freshwater Fish-Ponds (as of 2010)
Place: Ondo State,
Culture Type: Semi-intensive type of water recirculation in concrete lined ponds,
Fish Density: 6 - 7 adult catfish / m^2,
Live-weight growth rate; 3.22 g/day = 0.6kg / 6months, or 6.6 ton/ha/year
Cultured Fish Specie: Catfish (= Clarias spp & Heterobranchus spp.), Farm-gate price: 600 N/kg
Type of fish-farmers: 80% from small-scale farmers & urban inhabitants, 20% from enterprises

Intensive type of freshwater fish farms reached the annual rate 10 t/ha in 2007. This is employed as the target yield of fish farming in 2030 by feeding 2.5 t of fish feeds per annum per ha

Projecting conditions: fish farm yield increases in linear way up to 10 t / ha in 2030. Projected fish farm production should meet at least current level of current per capita consumption level. The mean of 2 growth rates during the period of 1995-2007 (14.6%) and that of 1995-2010 (18.1%), 16.3% was used for the initial annual growth rate of fish yield.

Under the afore-mentioned assumption, the following projection is resulted using negative exponential function; $y = pe^{-qt}$ was applied to this projection where p = 0.163, q = -0.06434.

Table SR1.4-12 Projection of Freshwater Fish Farms

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
$Y=0.163e^{-0.06433 \cdot t}$	0.163	0.153	0.143	0.134	0.126	0.118	0.111	0.104	0.097	0.091	0.086	0.080
Fish Yield (ton/ha)	1.418	1.635	1.869	2.120	2.387	2.669	2.965	3.273	3.592	3.920	4.256	4.598
Production (ton)	8,687	22,937	37,187	51,437	65,687	79,937	94,187	108,437	122,687	136,937	151,187	165,437
Water-pond Area (ha)	6,126	14,031	19,897	24,261	27,515	29,945	31,764	33,128	34,155	34,931	35,523	35,981
Water Need (MCM)	184	421	597	728	825	898	953	994	1,025	1,048	1,066	1,079
of which Ground W	147	337	478	582	660	719	762	795	820	838	853	864
of which others	37	84	119	146	165	180	191	199	205	210	213	216

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
$Y=0.163e^{-0.06433 \cdot t}$	0.075	0.071	0.066	0.062	0.058	0.055	0.051	0.048	0.045	0.042	0.040	0.037
Fish Yield (ton/ha)	4.944	5.293	5.644	5.994	6.343	6.689	7.032	7.369	7.701	8.026	8.344	8.653
Production (ton)	179,687	193,937	208,187	222,437	236,687	250,937	265,187	279,437	293,687	307,937	322,187	336,437
Water-pond Area (ha)	36,344	36,639	36,888	37,109	37,314	37,513	37,712	37,919	38,136	38,367	38,615	38,880
Water Need (MCM)	1,090	1,099	1,107	1,113	1,119	1,125	1,131	1,138	1,144	1,151	1,158	1,166
of which Ground W	872	879	885	891	896	900	905	910	915	921	927	933
of which others	218	220	221	223	224	225	226	228	229	230	232	233

Note: t= (Xth year - 2007)

Target as of 2030: Fish Yield 8.6 ton/ha (Maximum record as of 2007, it is expeted to be able to achieve this record normally in future)
Production 336,408 ton (256.8million persons x 1.31kg (comsuption per person)
Production increase growth per year (336,408 - 8,687) / 23 = 14,250 ton/year

Example in case of 2010:

$Y=0.163e^{-0.06433 \cdot t}$ $=0.163e^{-0.06433 \cdot (2010-2007)} = 0.134$

Fish Yield 1.869 (Yield of previous year) x (1+0.134) = 2.120 ton/ha

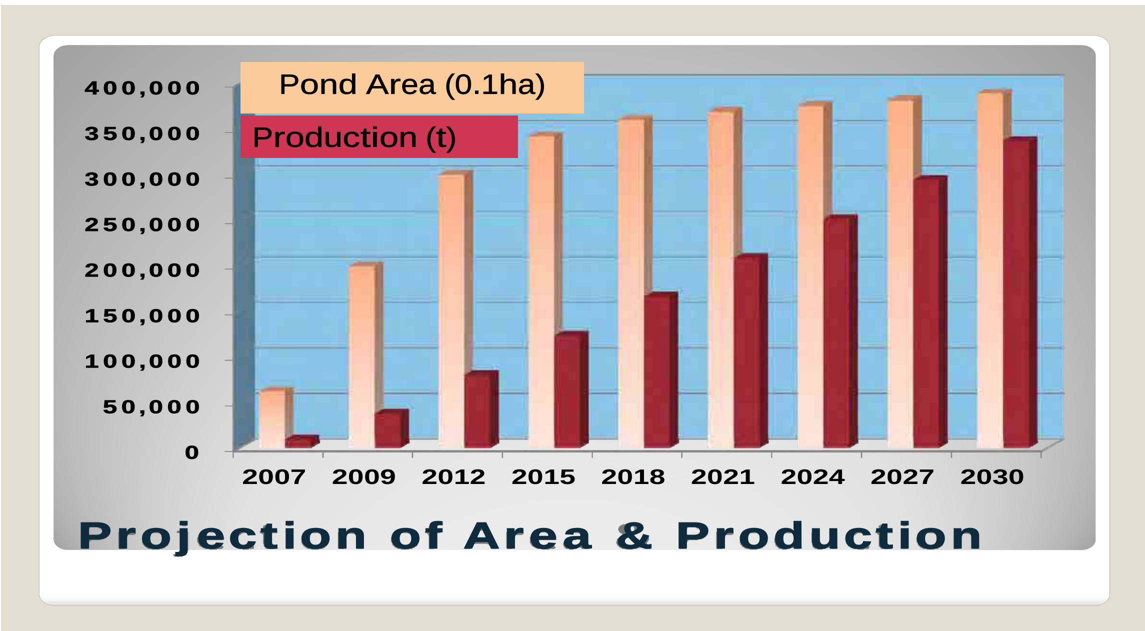
Production 37,187 (Production of previous year) + 14,250ton/year = 51,437 ton

Water Pond Area 51,437 / 2.120 = 24,262 ha

Water Need 24,261 x 0.03MCM/ha = 728 MCM

of which Ground Water 728 x 0.8 = 582 MCM

of which others 728 x 0.2 = 146 MCM



Source: JICA Project Team

Figure SR1.4-4 Projection of Area and Production

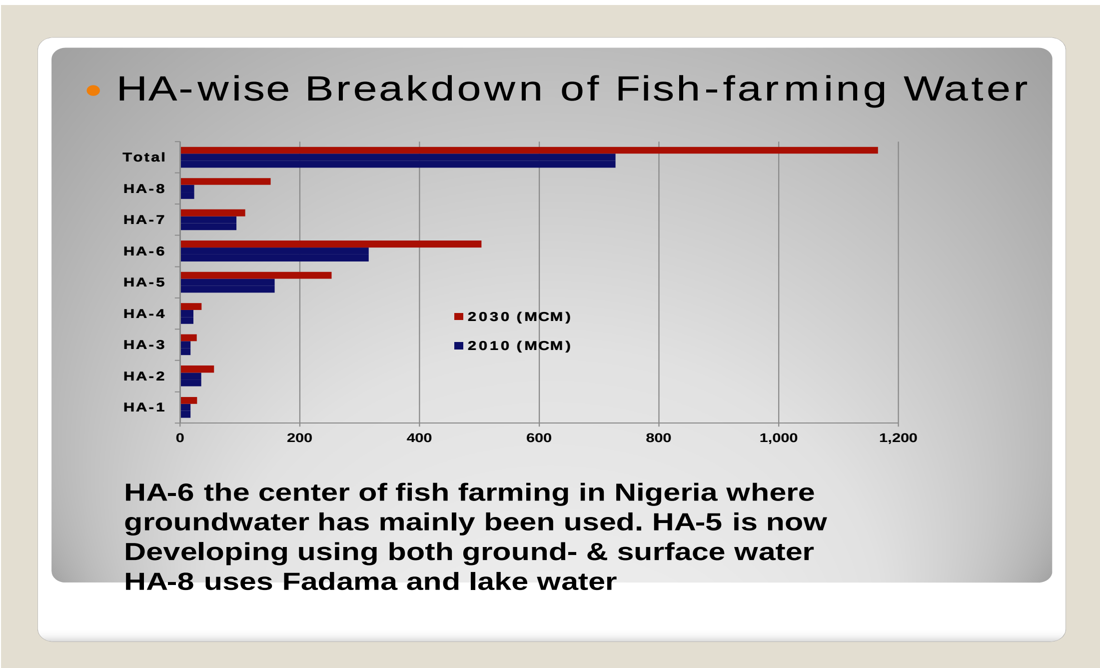
Annual water supply per hectare of water surface is calculated as groundwater replacing bottom 50cm of spoiled water with fish excretes (ammonia) and remained feed every 2 months or 6 times a year per 1-2 batches of fish culture. Totaled 0.03 MCM per ha per year. 75-85% of the pond water is supplied from shallow wells and the rest is filled by surface runoff, running water, stagnant water in lakes/ Fadama etc. Only if water quality satisfies quality requirement, water from any source can be used for partial water replacement. The requirement is free from detergent and agricultural chemicals, neutral pH and dissolved oxygen above 4 ppm. The colder the water temperature, the more oxygen content can be realized, and this is the reason why groundwater is preferred for water replacement.

The above table implies that the envisaged freshwater fish farming supplies 1.73 kg/year /person assuming that national population in 2030 will be 257 million, slightly higher than the current level of per capita consumption of sweet water fish (1.62 kg) and the growth rate expected in 2030 is positive 0.75%. The target yield, 10 t/ha in 2030 is evidently higher than rice yield per ha, but fish farming is just as a manufacturing factory where such fish feeds as offal from slaughterhouses and low-grade fish meal can be converted into raw fish meat in a short period. Initial investment is also much higher than the cases observed in ordinary irrigation projects, higher return should be expected from crop farming. It is often referred to that 1.4 million ha of water surface in Nigeria is suitable for developing fish culture from where 2.5 million ton of cultured fish harvest is possible, this projection suggests only less than 40 thousand ha and less than 500 thousand ton/year of fish-farm output. This divergence comes from two limitations, high level of initial investment and marketing convenience of the place where fish farming is developed.

Table SR1.4-13 Projected Water Demand for Freshwater Aquaculture

HA	Water Demand (MCM)	
	2010	2030
1	17.9	28.6
2	35.6	57.0
3	17.5	27.9
4	22.4	35.8
5	158.3	253.7
6	315.4	505.2
7	94.2	106.8
8	23.8	151.1
Total	727.8	1,166.1

Source: JICA Project Team



Source: JICA Project team

Figure SR1.4-5 HA-wise Breakdown of Fish-Farming Water

Table SR1.4-14 Projected FishPond Area for Freshwater Aquaculture (1/3) **(ha)**

State	2007	2008	2009	2010	2011	2012	2013	2014
ABIA	51	116	165	201	228	248	263	274
ADAMAWA	30	69	98	120	136	148	157	163
AKUA IBOM	59	135	192	234	266	289	307	320
ANAMBRA	35	79	113	137	156	169	180	187
BAUCHI	22	50	71	87	98	107	114	118
BAYELSA	14	32	45	55	63	68	72	75
BENUE	19	44	63	77	87	95	100	105
BORNO	12	28	39	48	54	59	63	65
CROSS RIVER	366	839	1,189	1,450	1,645	1,790	1,899	1,980
DELTA	2,410	5,520	7,827	9,544	10,824	11,780	12,496	13,032
EDO	2.7	6.2	8.8	10.7	12.1	13.2	14	14.6
EBONYI	14.9	34.1	48.4	59	66.9	72.8	77.3	80.6
RKITI	74.5	170.6	242	295	334.6	364.2	386.3	402.9
ENUGU	4	9.2	13	15.8	18	19.6	20.7	21.6
FCT	12.3	28.2	39.9	48.7	55.2	60.1	63.8	66.5
GOMBE	10	22.9	32.5	39.6	44.9	48.9	51.8	54.1
IMO	61.5	140.9	199.7	243.5	276.2	300.6	318.9	332.6
JIGAWA	63	144.3	204.6	249.5	283	307.9	326.7	340.7
KADUNA	59.2	135.6	192.3	234.4	265.9	289.4	306.9	320.1
KANO	711.6	1629.8	2311.1	2818	3196	3478.3	3689.6	3848.1
KATSINA	29	66.4	94.2	114.8	130.2	141.8	150.4	156.8
KEBBI	57.7	132.2	187.4	228.5	259.1	282	299.2	312
KOGI	37.1	85	120.5	146.9	166.6	181.3	192.4	200.6
KWARA	83.2	190.6	270.2	329.5	373.7	406.7	431.4	449.9
LAGOS	70.5	161.5	229	279.2	316.6	344.6	365.5	381.2
NASSARAWA	78.5	179.8	254.9	310.9	352.6	383.7	407	424.5
NIGER	29	66.4	94.2	114.8	130.2	141.8	150.4	156.8
OGUN	97.9	224.2	318	387.7	439.7	478.5	507.6	529.4
ONDO	33.1	75.8	107.5	131.1	148.7	161.8	171.6	179
OYO	474	1085.6	1539.4	1877.1	2128.9	2316.9	2457.7	2563.2
OSUN	568.6	1302.3	1846.7	2251.7	2553.7	2779.3	2948.2	3074.8
PLATEAU	186.7	427.6	606.4	739.4	838.5	912.6	968	1009.6
RIVERS	284.6	651.8	924.3	1127.1	1278.2	1391.1	1475.6	1539
SOKOTO	14.2	32.5	46.1	56.2	63.8	69.4	73.6	76.8
TARABA	2.8	6.4	9.1	11.1	12.6	13.7	14.5	15.1
YOBE	9.9	22.7	32.2	39.2	44.5	48.4	51.3	53.5
ZAMFARA	37.5	85.9	121.8	148.5	168.4	183.3	194.4	202.8
TOTAL	**6,126.2**	**14,030.9**	**19,896.3**	**24,260.3**	**27,514.3**	**29,944.9**	**31,763.8**	**33,127.8**

Source: JICA Project Team

Table SR1.4-14 Projected Fish Pond Area for Freshwater Aquaculture (2/3) **(ha)**

State	2015	2016	2017	2018	2019	2020	2021	2022
ABIA	283	289	294	298	301	303	306	307
ADAMAWA	168	172	175	177	179	181	182	183
AKUA IBOM	330	337	343	347	351	354	356	358
ANAMBRA	193	198	201	204	206	207	209	210
BAUCHI	122	125	127	129	130	131	132	133
BAYELSA	78	79	81	82	83	83	84	84
BENUE	108	110	112	114	115	116	116	117
BORNO	68	69	70	71	72	72	73	73
CROSS RIVER	2,042	2,088	2,123	2,151	2,173	2,190	2,205	2,218
DELTA	13,436	13,741	13,974	14,155	14,297	14,413	14,512	14,598
EDO	15.1	15.4	15.7	15.9	16	16.1	16.3	16.4
EBONYI	83.1	85	86.4	87.5	88.4	89.1	89.7	90.3
RKITI	415.3	424.8	432	437.6	442	445.6	448.6	451.3
ENUGU	22.3	22.8	23.2	23.5	23.7	23.9	24.1	24.2
FCT	68.6	70.1	71.3	72.2	73	73.6	74.1	74.5
GOMBE	55.8	57	58	58.7	59.3	59.8	60.2	60.6
IMO	342.9	350.7	356.6	361.2	364.8	367.8	370.3	372.5
JIGAWA	351.2	359.2	365.3	370	373.7	376.8	379.3	381.6
KADUNA	330	337.5	343.3	347.7	351.2	354.1	356.5	358.6
KANO	3967.3	4057.4	4126.2	4179.5	4221.5	4255.8	4284.8	4310.4
KATSINA	161.7	165.4	168.2	170.3	172	173.4	174.6	175.7
KEBBI	321.7	329	334.6	338.9	342.3	345.1	347.4	349.5
KOGI	206.8	211.5	215.1	217.9	220.1	221.9	223.4	224.7
KWARA	463.9	474.4	482.4	488.7	493.6	497.6	501	504
LAGOS	393	402	408.8	414.1	418.2	421.6	424.5	427
NASSARAWA	437.6	447.6	455.2	461.1	465.7	469.5	472.7	475.5
NIGER	161.7	165.4	168.2	170.3	172	173.4	174.6	175.7
OGUN	545.8	558.2	567.7	575	580.8	585.5	589.5	593
ONDO	184.5	188.7	191.9	194.4	196.4	198	199.3	200.5
OYO	2642.6	2702.7	2748.5	2784	2812	2834.8	2854.1	2871.2
OSUN	3170	3242.1	3297	3339.6	3373.2	3400.6	3423.7	3444.2
PLATEAU	1040.9	1064.5	1082.6	1096.6	1107.6	1116.6	1124.2	1130.9
RIVERS	1586.7	1622.7	1650.3	1671.6	1688.4	1702.1	1713.7	1723.9
SOKOTO	79.2	81	82.3	83.4	84.2	84.9	85.5	86
TARABA	15.6	16	16.2	16.4	16.6	16.7	16.9	17
YOBE	55.2	56.4	57.4	58.1	58.7	59.2	59.6	60
ZAMFARA	209.1	213.8	217.4	220.3	222.5	224.3	225.8	227.2
TOTAL	**34,154.1**	**34,930.4**	**35,522.7**	**35,981**	**36,343.3**	**36,638.2**	**36,887.7**	**37,108.6**

Source: JICA Project Team

Table SR1.4-14 Projected Fish Pond Area for Freshwater Aquaculture (3/3) (ha)

State	2023	2024	2025	2026	2027	2028	2029	2030
ABIA	309	310.7	312.3	314	315.8	317.7	319.8	322
ADAMAWA	183.9	184.9	185.9	186.9	188	189.1	190.4	191.7
AKUA IBOM	360.1	362.1	364	366	368.1	370.3	372.7	375.2
ANAMBRA	211	212.2	213.3	214.5	215.7	217	218.4	219.9
BAUCHI	133.4	134.1	134.8	135.6	136.3	137.2	138	139
BAYELSA	84.8	85.2	85.7	86.1	86.6	87.2	87.7	88.3
BENUE	117.7	118.4	119	119.6	120.3	121.1	121.8	122.7
BORNO	73.7	74.1	74.5	74.9	75.3	75.8	76.3	76.8
CROSS RIVER	2230.5	2242.3	2254.3	2266.6	2279.6	2293.4	2308.2	2324.1
DELTA	14678.9	14757.1	14835.7	14916.9	15002.3	15093.3	15190.6	15294.9
EDO	16.4	16.5	16.6	16.7	16.8	16.9	17	17.1
EBONYI	90.8	91.2	91.7	92.2	92.8	93.3	93.9	94.6
RKITI	453.8	456.2	458.6	461.1	463.8	466.6	469.6	472.8
ENUGU	24.4	24.5	24.6	24.8	24.9	25.1	25.2	25.4
FCT	74.9	75.3	75.7	76.1	76.6	77	77.5	78.1
GOMBE	60.9	61.2	61.6	61.9	62.3	62.6	63	63.5
IMO	374.6	376.6	378.6	380.7	382.8	385.2	387.6	390.3
JIGAWA	383.7	385.8	387.8	389.9	392.2	394.6	397.1	399.8
KADUNA	360.6	362.5	364.4	366.4	368.5	370.8	373.1	375.7
KANO	4334.2	4357.3	4380.5	4404.5	4429.7	4456.6	4485.3	4516.1
KATSINA	176.6	177.6	178.5	179.5	180.5	181.6	182.8	184
KEBBI	351.4	353.3	355.2	357.1	359.2	361.4	363.7	366.2
KOGI	226	227.2	228.4	229.6	230.9	232.3	233.8	235.5
KWARA	506.8	509.5	512.2	515	517.9	521.1	524.4	528
LAGOS	429.4	431.7	434	436.4	438.9	441.5	444.4	447.4
NASSARAWA	478.1	480.7	483.2	485.9	488.7	491.6	494.8	498.2
NIGER	176.6	177.6	178.5	179.5	180.5	181.6	182.8	184
OGUN	596.3	599.5	602.7	606	609.4	613.1	617.1	621.3
ONDO	201.6	202.7	203.8	204.9	206	207.3	208.6	210.1
OYO	2887.1	2902.4	2917.9	2933.9	2950.7	2968.6	2987.7	3008.2
OSUN	3463.3	3481.7	3500.2	3519.4	3539.6	3561	3584	3608.6
PLATEAU	1137.2	1143.2	1149.3	1155.6	1162.2	1169.3	1176.8	1184.9
RIVERS	1733.5	1742.7	1752	1761.6	1771.6	1782.4	1793.9	1806.2
SOKOTO	86.5	87	87.4	87.9	88.4	88.9	89.5	90.1
TARABA	17.1	17.1	17.2	17.3	17.4	17.5	17.6	17.8
YOBE	60.3	60.6	60.9	61.3	61.6	62	62.4	62.8
ZAMFARA	228.4	229.6	230.8	232.1	233.4	234.9	236.4	238
TOTAL	**37,313.5**	**37,512.1**	**37,711.9**	**37,918.3**	**38,135.6**	**38,366.7**	**38,614.1**	**38,879.2**

Source: JICA Project Team

Table SR1.4-15 Projected Water Demand for Freshwater Aquaculture (1/3) (MCM)

State	2007	2008	2009	2010	2011	2012	2013	2014
ABIA	1.5	3.5	4.9	6	6.8	7.4	7.9	8.2
ADAMAWA	0.9	2.1	2.9	3.6	4.1	4.4	4.7	4.9
AKUA IBOM	1.8	4.1	5.8	7	8	8.7	9.2	9.6
ANAMBRA	1	2.4	3.4	4.1	4.7	5.1	5.4	5.6
BAUCHI	0.7	1.5	2.1	2.6	3	3.2	3.4	3.6
BAYELSA	0.4	1	1.4	1.7	1.9	2	2.2	2.3
BENUE	0.6	1.3	1.9	2.3	2.6	2.8	3	3.1
BORNO	0.4	0.8	1.2	1.4	1.6	1.8	1.9	2
CROSS RIVER	11	25.2	35.7	43.5	49.3	53.7	57	59.4
DELTA	72.3	165.6	234.8	286.3	324.7	353.4	374.9	391
EDO	0.1	0.2	0.3	0.3	0.4	0.4	0.4	0.4
EBONYI	0.4	1	1.5	1.8	2	2.2	2.3	2.4
RKITI	2.2	5.1	7.3	8.9	10	10.9	11.6	12.1
ENUGU	0.1	0.3	0.4	0.5	0.5	0.6	0.6	0.6
FCT	0.4	0.8	1.2	1.5	1.7	1.8	1.9	2
GOMBE	0.3	0.7	1	1.2	1.3	1.5	1.6	1.6
IMO	1.8	4.2	6	7.3	8.3	9	9.6	10
JIGAWA	1.9	4.3	6.1	7.5	8.5	9.2	9.8	10.2
KADUNA	1.8	4.1	5.8	7	8	8.7	9.2	9.6
KANO	21.3	48.9	69.3	84.5	95.9	104.3	110.7	115.4
KATSINA	0.9	2	2.8	3.4	3.9	4.3	4.5	4.7
KEBBI	1.7	4	5.6	6.9	7.8	8.5	9	9.4
KOGI	1.1	2.5	3.6	4.4	5	5.4	5.8	6
KWARA	2.5	5.7	8.1	9.9	11.2	12.2	12.9	13.5
LAGOS	2.1	4.8	6.9	8.4	9.5	10.3	11	11.4
NASSARAWA	2.4	5.4	7.6	9.3	10.6	11.5	12.2	12.7
NIGER	0.9	2	2.8	3.4	3.9	4.3	4.5	4.7
OGUN	2.9	6.7	9.5	11.6	13.2	14.4	15.2	15.9
ONDO	1	2.3	3.2	3.9	4.5	4.9	5.1	5.4
OYO	14.2	32.6	46.2	56.3	63.9	69.5	73.7	76.9
OSUN	17.1	39.1	55.4	67.6	76.6	83.4	88.4	92.2
PLATEAU	5.6	12.8	18.2	22.2	25.2	27.4	29	30.3
RIVERS	8.5	19.6	27.7	33.8	38.3	41.7	44.3	46.2
SOKOTO	0.4	1	1.4	1.7	1.9	2.1	2.2	2.3
TARABA	0.1	0.2	0.3	0.3	0.4	0.4	0.4	0.5
YOBE	0.3	0.7	1	1.2	1.3	1.5	1.5	1.6
ZAMFARA	1.1	2.6	3.7	4.5	5.1	5.5	5.8	6.1
TOTAL	**184**	**421**	**597**	**728**	**825**	**898**	**953**	**994**

Source: JICA Project Team

Table SR1.4-15 Projected Water Demand for Freshwater Aquaculture (2/3) (MCM)

State	2015	2016	2017	2018	2019	2020	2021	2022
ABIA	8.5	8.7	8.8	8.9	9	9.1	9.2	9.2
ADAMAWA	5.1	5.2	5.3	5.3	5.4	5.4	5.5	5.5
AKUA IBOM	9.9	10.1	10.3	10.4	10.5	10.6	10.7	10.7
ANAMBRA	5.8	5.9	6	6.1	6.2	6.2	6.3	6.3
BAUCHI	3.7	3.7	3.8	3.9	3.9	3.9	4	4
BAYELSA	2.3	2.4	2.4	2.5	2.5	2.5	2.5	2.5
BENUE	3.2	3.3	3.4	3.4	3.4	3.5	3.5	3.5
BORNO	2	2.1	2.1	2.1	2.2	2.2	2.2	2.2
CROSS RIVER	61.2	62.6	63.7	64.5	65.2	65.7	66.2	66.5
DELTA	403.1	412.2	419.2	424.6	428.9	432.4	435.3	438
EDO	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
EBONYI	2.5	2.5	2.6	2.6	2.7	2.7	2.7	2.7
RKITI	12.5	12.7	13	13.1	13.3	13.4	13.5	13.5
ENUGU	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FCT	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2
GOMBE	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8
IMO	10.3	10.5	10.7	10.8	10.9	11	11.1	11.2
JIGAWA	10.5	10.8	11	11.1	11.2	11.3	11.4	11.4
KADUNA	9.9	10.1	10.3	10.4	10.5	10.6	10.7	10.8
KANO	119	121.7	123.8	125.4	126.6	127.7	128.5	129.3
KATSINA	4.9	5	5	5.1	5.2	5.2	5.2	5.3
KEBBI	9.7	9.9	10	10.2	10.3	10.4	10.4	10.5
KOGI	6.2	6.3	6.5	6.5	6.6	6.7	6.7	6.7
KWARA	13.9	14.2	14.5	14.7	14.8	14.9	15	15.1
LAGOS	11.8	12.1	12.3	12.4	12.5	12.6	12.7	12.8
NASSARAWA	13.1	13.4	13.7	13.8	14	14.1	14.2	14.3
NIGER	4.9	5	5	5.1	5.2	5.2	5.2	5.3
OGUN	16.4	16.7	17	17.3	17.4	17.6	17.7	17.8
ONDO	5.5	5.7	5.8	5.8	5.9	5.9	6	6
OYO	79.3	81.1	82.5	83.5	84.4	85	85.6	86.1
OSUN	95.1	97.3	98.9	100.2	101.2	102	102.7	103.3
PLATEAU	31.2	31.9	32.5	32.9	33.2	33.5	33.7	33.9
RIVERS	47.6	48.7	49.5	50.1	50.7	51.1	51.4	51.7
SOKOTO	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6
TARABA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
YOBE	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8
ZAMFARA	6.3	6.4	6.5	6.6	6.7	6.7	6.8	6.8
TOTAL	**1,025**	**1,048**	**1,066**	**1,079**	**1,090**	**1,099**	**1,107**	**1,113**

Source: JICA Project Team

Table SR1.4-15 Projected Water Demand for Freshwater Aquaculture (3/3) (MCM)

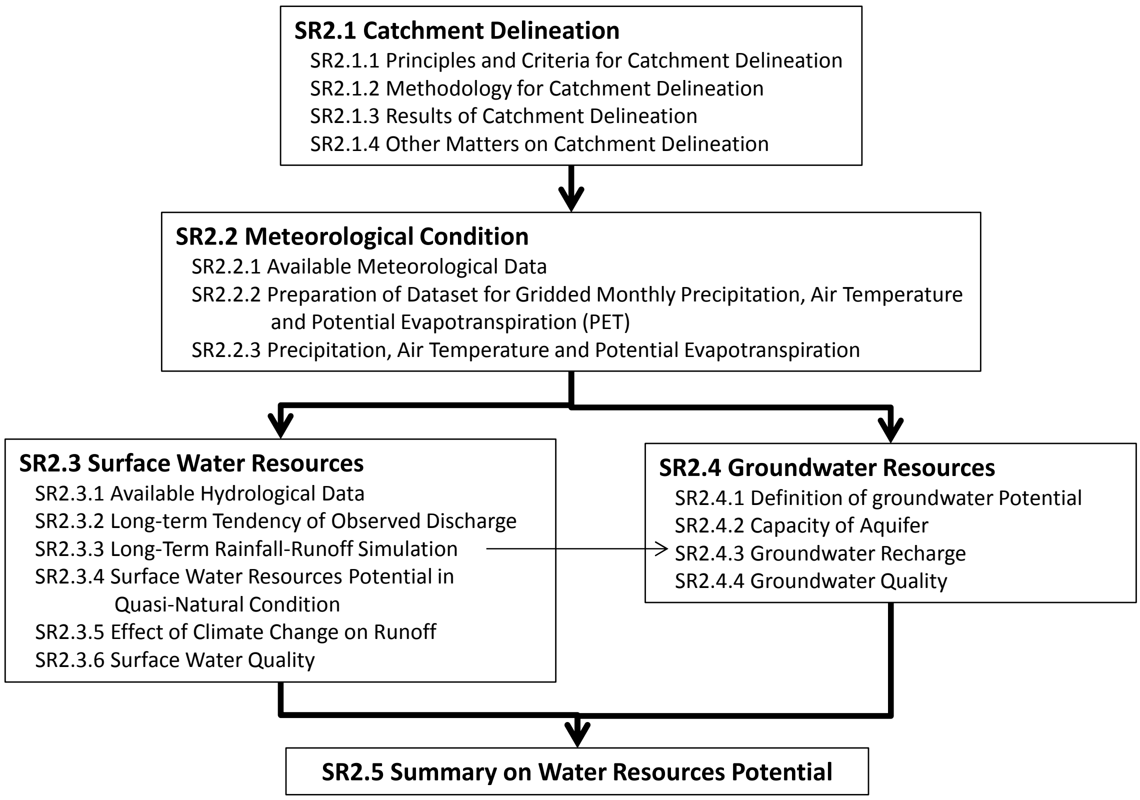
State	2023	2024	2025	2026	2027	2028	2029	2030
ABIA	9.3	9.3	9.4	9.4	9.5	9.5	9.6	9.7
ADAMAWA	5.5	5.5	5.6	5.6	5.6	5.7	5.7	5.7
AKUA IBOM	10.8	10.9	10.9	11	11	11.1	11.2	11.3
ANAMBRA	6.3	6.4	6.4	6.4	6.5	6.5	6.6	6.6
BAUCHI	4	4	4	4.1	4.1	4.1	4.1	4.2
BAYELSA	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
BENUE	3.5	3.6	3.6	3.6	3.6	3.6	3.7	3.7
BORNO	2.2	2.2	2.2	2.2	2.3	2.3	2.3	2.3
CROSS RIVER	66.9	67.3	67.6	68	68.4	68.8	69.2	69.7
DELTA	440.4	442.7	445.1	447.5	450.1	452.8	455.7	458.8
EDO	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
EBONYI	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8
RKITI	13.6	13.7	13.8	13.8	13.9	14	14.1	14.2
ENUGU	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8
FCT	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3
GOMBE	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9
IMO	11.2	11.3	11.4	11.4	11.5	11.6	11.6	11.7
JIGAWA	11.5	11.6	11.6	11.7	11.8	11.8	11.9	12
KADUNA	10.8	10.9	10.9	11	11.1	11.1	11.2	11.3
KANO	130	130.7	131.4	132.1	132.9	133.7	134.6	135.5
KATSINA	5.3	5.3	5.4	5.4	5.4	5.4	5.5	5.5
KEBBI	10.5	10.6	10.7	10.7	10.8	10.8	10.9	11
KOGI	6.8	6.8	6.9	6.9	6.9	7	7	7.1
KWARA	15.2	15.3	15.4	15.4	15.5	15.6	15.7	15.8
LAGOS	12.9	13	13	13.1	13.2	13.2	13.3	13.4
NASSARAWA	14.3	14.4	14.5	14.6	14.7	14.7	14.8	14.9
NIGER	5.3	5.3	5.4	5.4	5.4	5.4	5.5	5.5
OGUN	17.9	18	18.1	18.2	18.3	18.4	18.5	18.6
ONDO	6	6.1	6.1	6.1	6.2	6.2	6.3	6.3
OYO	86.6	87.1	87.5	88	88.5	89.1	89.6	90.2
OSUN	103.9	104.5	105	105.6	106.2	106.8	107.5	108.3
PLATEAU	34.1	34.3	34.5	34.7	34.9	35.1	35.3	35.5
RIVERS	52	52.3	52.6	52.8	53.1	53.5	53.8	54.2
SOKOTO	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.7
TARABA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
YOBE	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9
ZAMFARA	6.9	6.9	6.9	7	7	7	7.1	7.1
TOTAL	**1,119**	**1,125**	**1,131**	**1,138**	**1,144**	**1,151**	**1,158**	**1,166**

Source: JICA Project Team

SUPPORTING REPORT 2

EVALUATION OF WATER RESOURCES POTENTIAL

EVALUATION OF WATER RESOURCES POTENTIAL



Contents

SR2 EVALUATION OF WATER RESOURCES POTENTIAL

In this supporting report, water resources potential in Nigeria is discussed. Firstly, the updated catchment delineation which will be a basis for discussing the water resources is presented. Secondly, meteorological condition as an input condition for water resources is shown. Thirdly, surface water resources potential in quasi-natural condition[1] is discussed on the basis of results of the rainfall-runoff model introduced in the project as well as the available observed discharge in Nigeria. The aspect of water quality is also discussed using currently available data. Fourthly, groundwater resources potential is evaluated, considering hydrogeological conditions as well as the runoff conditions. Finally, overall water resources potential is summarized. It should be noted that the water resources potential with water resources development facilities such as storage dams is discussed in Supporting Report 3, together with the balance between water supply capacity and demand. The present chapter concentrates more on discussing the water resource potential in quasi-natural condition, which does not include the effect of regime change due to significant storage dams in Nigeria.

SR2.1 Catchment Delineation

SR2.1.1 Principles and Criteria for Catchment Delineation

The Joint effort of NIHSA and JICA Project Team on the review of the catchment delineation has been made through the course of the project. The following principles are agreed and applied for the updated catchment delineation.

<u>Principle for Delineation of Hydrological Area (HA)</u>

- The delineation point on Niger River between HA-1 and HA-2 shall be Kainji dam (downstream end of the Kainji dam reservoir).
- The delineation point on Benue River between HA-3 and HA-4 shall be just downstream of the confluence point with Donga River.

<u>Principle for Delineation of Sub Hydrological Area (SHA)</u>

- SHA should be basically delineated at the confluence point of the tributary.
- SHA should not be separated by the center line of the river.

SHA can be a basic unit of discussing water resources in nationwide scale. The criteria of delineation of SHA have also been discussed with the working group in NIHSA and set as follows.

<u>Criteria for Delineation of SHA</u>

- Basically, the catchment of the tributary rivers listed in the table of water balance in M/P1995 are delineated as SHA boundaries, if the river in the SHA in M/P1995 is represented by only one river (sometimes with its tributary)
- The catchment of the significant storage dam whose total storage capacity is more than 100MCM is also delineated as a boundary of SHA.
- For coastal low-lying areas, basically follow previous delineation

The catchment delineation covers the whole drainage area of Benue River and its tributaries, the drainage area downstream portion of Malanville in Benin for Niger River and its tributaries. The other catchment areas surrounding Nigeria whose generated runoff comes into Nigeria are also delineated.

SR2.1.2 Methodology for Catchment Delineation

The catchment delineation has been conducted utilizing the following data and information.

<u>Primary Data and Information</u>

- SRTM 3[2](Digital Elevation Model with grid size of three (3) seconds)
- Landsat Images as of 2000
- GIS data (ESRI shape file with polygons) for ‘waterbodies’ prepared by FME

[1] It is not possible for us to know actual natural condition which has no influence of human activity. The quasi-natural condition is defined as the condition without influence of significant storage dams and abstraction in the Project.
[2] Digital Elevation Model prepared by Shuttle Radar Topography Mission. It covers the entire world with 3minite grids.

- GIS data (ESRI shape file with lines) for 'rivers' prepared by FME

<u>Reference Data and Information</u>

- Scanned map for catchment delineation by M/P1995
- GIS data (ESRI shape file with polygons) for watersheds in Africa based on Hydroshed[3]
- GIS data (ESRI shape file with lines) for rivers in Africa based on Hydroshed
- Google Earth

The procedure of the delineation is as follows. All procedures are implemented in a GIS software.

<u>Preparation of Counter Lines</u>

- DEM with the grid size of nine (9) seconds is prepared.
- Using the DEM with the grid size of nine (9) seconds, the contour lines with 10m interval in elevation are generated.

<u>Main Rivers and Significant Reservoirs</u>

- The main rivers and significant reservoirs to be referred for delineating the catchment are extracted from the GIS data for water bodies and rivers prepared by FME.
- Among the GIS data for 'waterbodies', the polygons specified as reservoirs are extracted. The significant reservoirs with the storage volume of more than about 100MCM are then extracted among the reservoirs.
- The main rivers to be referred for delineating SHA are firstly selected. At least one river segment is chosen for each SHA. The GIS data for the main rivers are then prepared as follows.
  - At the place where the 'waterbodies' for river channels exists, the center line of the polygon is traced to make line segments for the target rivers.
  - At the place where the 'rivers' for river channels exists, the appropriate line segments for the target rivers are extracted from 'rivers'.
  - At the place where neither "water bodies" nor "rivers" are available for the target rivers, the target rivers are traced referring the Landsat images.
  - When preparing the GIS data for the main rivers, the GIS data for rivers in Africa based on Hydroshed are referred as a guide.

<u>Catchment Delineation</u>

- The delineation point along the main river for the target catchment is specified.
- Starting the specified delineation point, the places with highest elevation are traced and connected manually referring the contour lines, in order to delineate the boundary of the target catchment. By this, GIS data for the catchment boundary is prepared.
- When preparing the GIS data for the catchment boundary, the GIS data for watersheds in Africa based on Hydroshed are referred as a guide.

SR2.1.3 Results of Catchment Delineation

The delineated eight (8) HAs are shown in Figure SR2-1. Major change from the one prepared in the M/P1995 appears in Katsina area. There are only minor changes for other areas.

Totally, 168 related SHAs have been delineated, three (3) of which are located completely outside of Nigeria. Some SHAs extend their areas to outside Nigeria. These SHAs are further sub-divided by national boundary of Nigeria, which results in 194 sub-divided SHAs in total. The aggregation of the portion of SHAs inside Nigeria for specific HA coincides with the HA boundary. The delineated SHAs are shown in Figure SR2-2. The HA and SHA are summarized in Table SR2-1 and the list of SHAs is shown in Annex-T SR2-1.

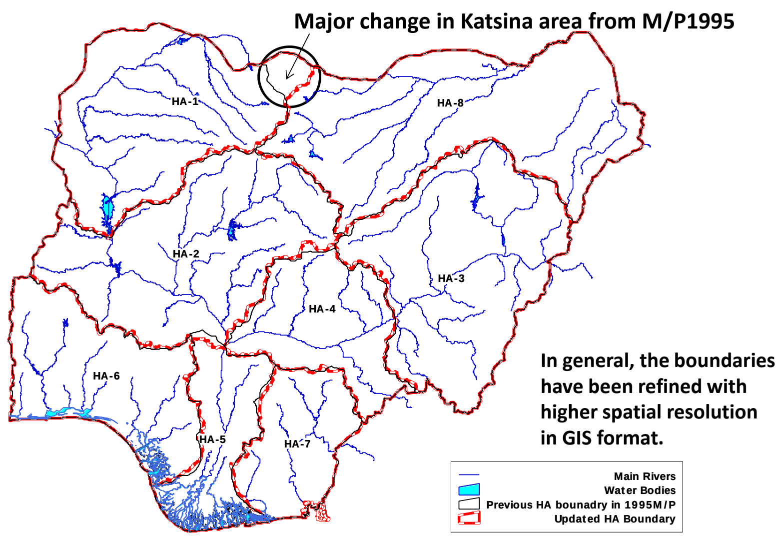
The comparison table between the previous SHAs in the M/P1995 and those in the Project, and the SHA delineation for each HA are presented in Annex-T SR2-2 and Annex-F SR2-1, respectively.

[3] Hydroshed (Hydrological data and maps based on Shuttle Elevation Derivatives at multiple Scales) is the GIS dataset of rivers and watershed for the entire world, which was derived from SRTM. It was developed by the Conservation Science Program of World Wildlife Fund (WWF).

Table SR2-1 Summary of HAs and SHAs

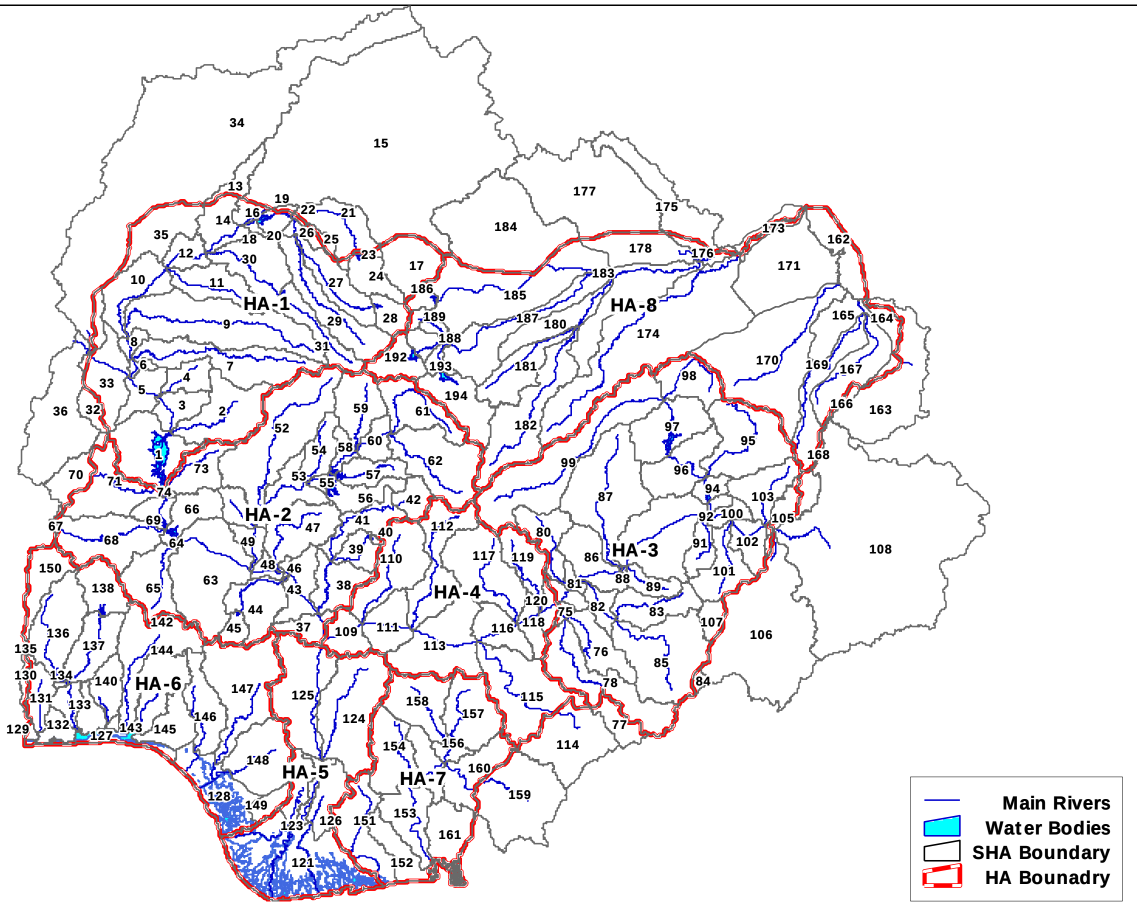
HA		1	2	3	4	5	6	7	8	Total
Area (km^2)		135,128	154,616	156,546	74,519	53,914	99,333	57,440	178,483	909,979
Num. of related SHAs		27	36	30	11	6	22	10	26	168
Num. of SHAs divided by National Boundary	Total	36	38	34	12	6	24	11	33	194
	Inside Nigeria	28	36	29	11	6	22	10	26	168

Source: JICA Project Team



Source: JICA Project Team

Figure SR2-1 Delineated Boundary of Hydrological Areas (HAs)



Source: JICA Project Team Note: The number in the map is not the code number of SHAs. The corresponding code number is presented in Annex-T SR2-1.

Figure SR2-2 Delineated Boundary of Sub Hydrological Areas (SHAs)

SR2.1.4 Other Matters on Catchment Delineation

(1) Limitation

The delineation of catchment (HA and SHA) was mainly based on the desk research working on available information and data which have certain limitation of accuracy and spatial resolution. Considering the data source utilized, the spatial resolution of delineation could be as good as the order of 1/100,000 scale maps. The field verification was also limited for this work because of the limited resources and current security condition in Nigeria. Therefore, in the future, it could be modified by NIHSA when verified by field work or more accurate information and data. To do so in future, the GIS data and related data will be provided to NIHSA.

(2) Proposed Principle for Dealing with HA, SHA and SSHA Data

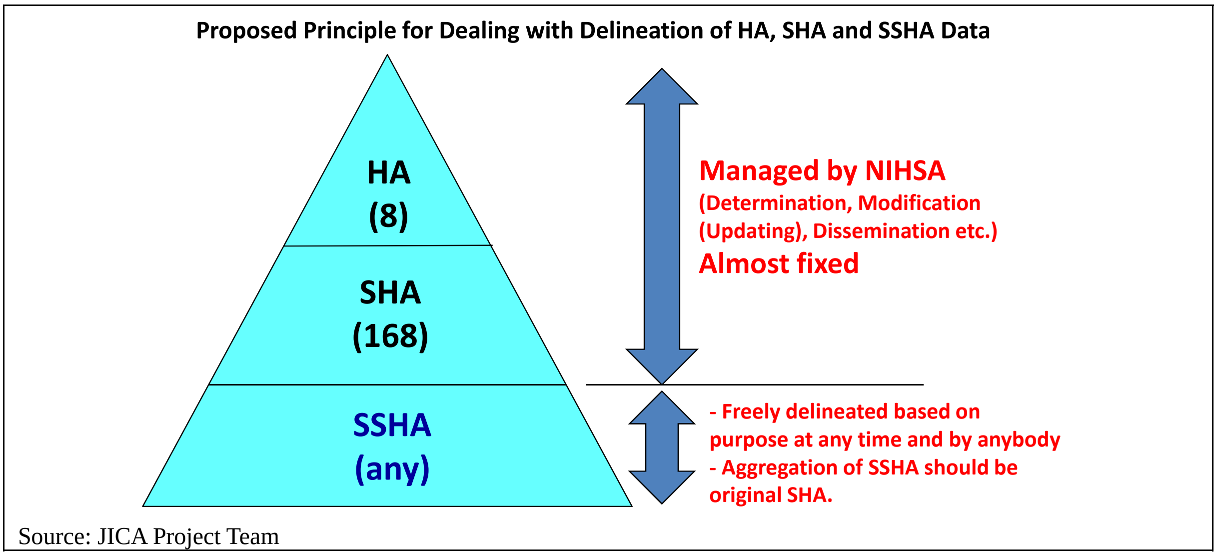
In the M/P1995, Small Sub Hydrological Area (SSHA) was further delineated to support water resources assessment. In the Project, SSHA may be delineated later for some specific purposes. The principle for dealing with HA, SHA and SSHA are proposed as follows.

<u>HA and SHA</u>

- HA and SHA data shall be managed by NIHSA.
- They should be almost fixed. NIHSA shall have responsibility for determination, modification (updating), dissemination etc. for HA and SHA data

<u>SSHA</u>

- It can be freely delineated based on purpose at any time and by anybody.
- The aggregation of the delineated SSHA within specific SHA must coincide with the original SHA managed by NIHSA.



Source: JICA Project Team

Figure SR2-3 Proposed Principle for Dealing with HA, SHA and SSHA Data

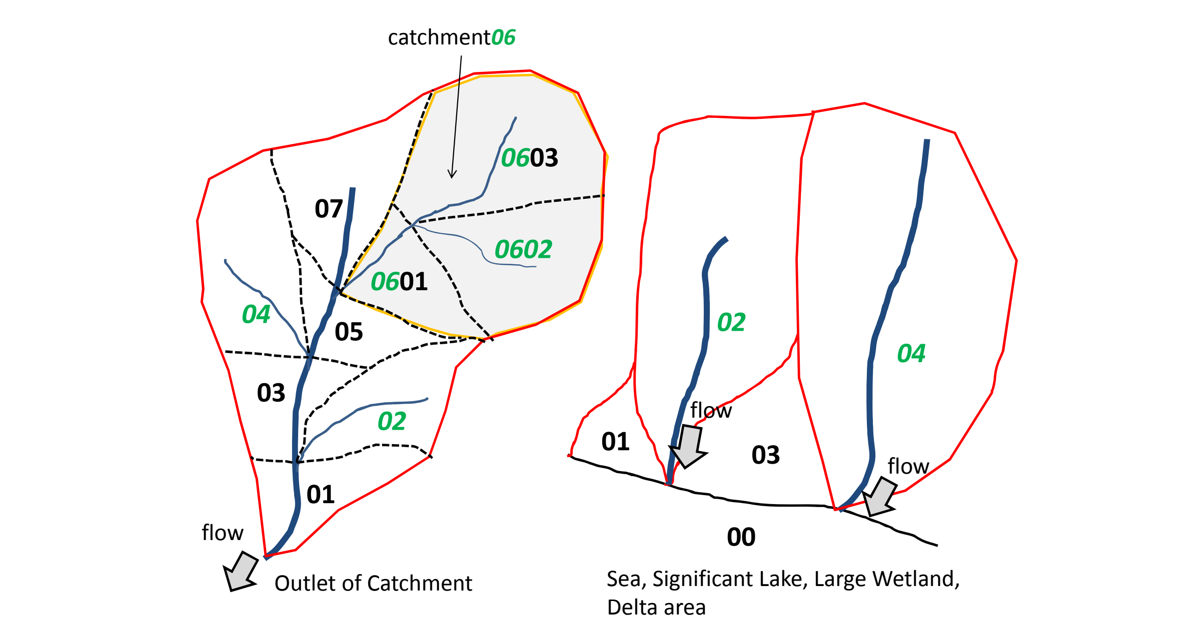
(3) On Coding of SHA

For coding of the SHAs, the modified ERICA[4] (European Rivers and Catchment) coding system has been introduced in the Project. The ERICA is the nested coding system, which utilizes series of two digit numbers to represent one river segment/catchment. The fundamental coding rule is as follows (see also schematic figures presented in Figure SR2-4).

- Use odd number for residual catchment along main channel, whereas use even number for catchment of tributary channel
- For the catchment of tributary channel, second level two digit are assigned, following the same manner applied for the catchment of main channel and tributaries, i.e odd number is used for residual catchment of main tributary and even number is applied for catchment of sub-tributary.

[4] WFD GIS Working Group: Review of Existing River Coding Systems for River Basin Management and Reporting, 2002.

- The catchment that directly flows into large water body such as sea, significant lake, large wetland and delta area (with diffused drainage or small rivers) will have odd number, whereas the catchment flowing into such water body through major rivers will have even number.



Source: JICA Project Team

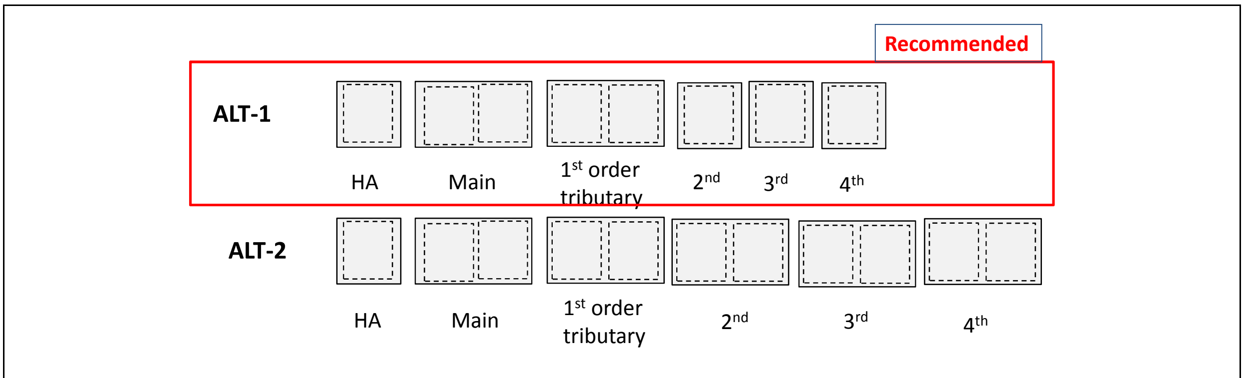
Figure SR2-4 Fundamental Rule of Numbering in ERICA Coding System

The advantage of the ERICA coding system is that it enables easy assessment of relationship between sub-catchment and reaches based on simple numeric comparison, which will be beneficial for water resources assessment. The disadvantage is that the numbering becomes sometimes very long.

The working group member in NIHSA discussed on the coding and some modifications were proposed with alternatives as follows.

- Start from one digit ID number to represent HA
- Alternatives for number of digit to avoid too long code number (see Figure SR2-5)
  - ALT-1: For smaller catchment than 2nd order tributary, use one digit for identifying catchments
  - ALT-2: Always use two digits (like original ERICA)

Among the working group members, the ALT-1 was recommended. The coding in the Project currently follows the ALT-1.



Source: JICA Project Team

Figure SR2-5 Alternatives for Modification of ERICA Coding System

SR2.2 Meteorological Condition

SR2.2.1 Available Meteorological Data

There are two available sources of meteorological data. One is the internal dataset available in Nigeria, and another is the global dataset. The former is mainly managed by NIMET, that is, the agency responsible for meteorological observation in Nigeria. The latter is available on relevant web-sites.

NIMET operates 48 synoptic stations covering the entire Nigeria (see also Annex-T SR2-3). JICA Project Team discussed with the representative of NIMET on the available meteorological data for the project. The representative of NIMET suggested 27 priority synoptic stations among the 48 stations, considering the locations, uniqueness of climate condition and duration of observation. The suggested priority synoptic stations are indicated in Annex-T SR2-3.

The following three global meteorological dataset could be useful for the project.

- CRU-TS3.1[5]
- Worldclim[6]
- GSMaP[7]

These dataset may have both advantages and disadvantages when utilizing them for water resources assessment. The following table summarizes the advantage and disadvantages of these data.

Table SR2-2 Advantage and Disadvantage of Available Meteorological Data

Data Source	Data Manager	Summary	Advantage	Disadvantage
NIMET Synoptic Stations	NIMET	- Long-term observed data with reliable observation system - Require cost for obtaining the data. NIMET recommended 27 priority synoptic stations with important parameters including daily precipitation for last 30years	- Most reliable and official information - Daily precipitation available	- Only point observation data with 27 points are offered. - Costly for obtaining full dataset
CRU-TS 3.1	BADC	- Gridded monthly data based on observed data by meteorological agencies in each country. - Often used for climate-related study - Grid size = 0.5degree - Duration= 1901-2009 - Freely available from web-site	- Monthly time series data with medium spatial resolution - Data outside Nigeria are also available - No cost	- Effect of altitude not considered
Worldclim	Robert J. Hijiman	- Gridded long-term averaged (1950-2000) monthly precipitation and air temperature based on observed data with correction for altitude - Grid size = 0.5, 2.5, 5.0 and 10 minutes - Freely available from web-site	- High spatial resolution with consideration of effect of altitude - Data outside Nigeria are also available - No cost	- Only long-term averaged value available
GSMaP	JAXA	- Gridded daily/hourly precipitation data based on satellite information such as TRMM - Grid size = 0.25 degree - Duration =1998-2006 - Freely available from web-site	- High resolution in time and medium resolution in space - Data outside Nigeria are also available - No cost	- Bias correction could be required before using them - Only recent data are available

NIMET:Nigerian Meteorological Agency
BADC: British Atmospheric Data Centre
JAXA: Japan Aerospace Exploration Agency
Source: JICA Project Team

[5] University of East Anglia Climatic Research Unit (CRU). [Phil Jones, Ian Harris]. CRU Time Series (TS) high resolution gridded datasets, [Internet]. NCAS British Atmospheric Data Centre, 2008. Available from http://badc.nerc.ac.uk/view/badc.nerc.ac.uk__ATOM__dataent_1256223773328276

[6] Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Available from http://www.worldclim.org/

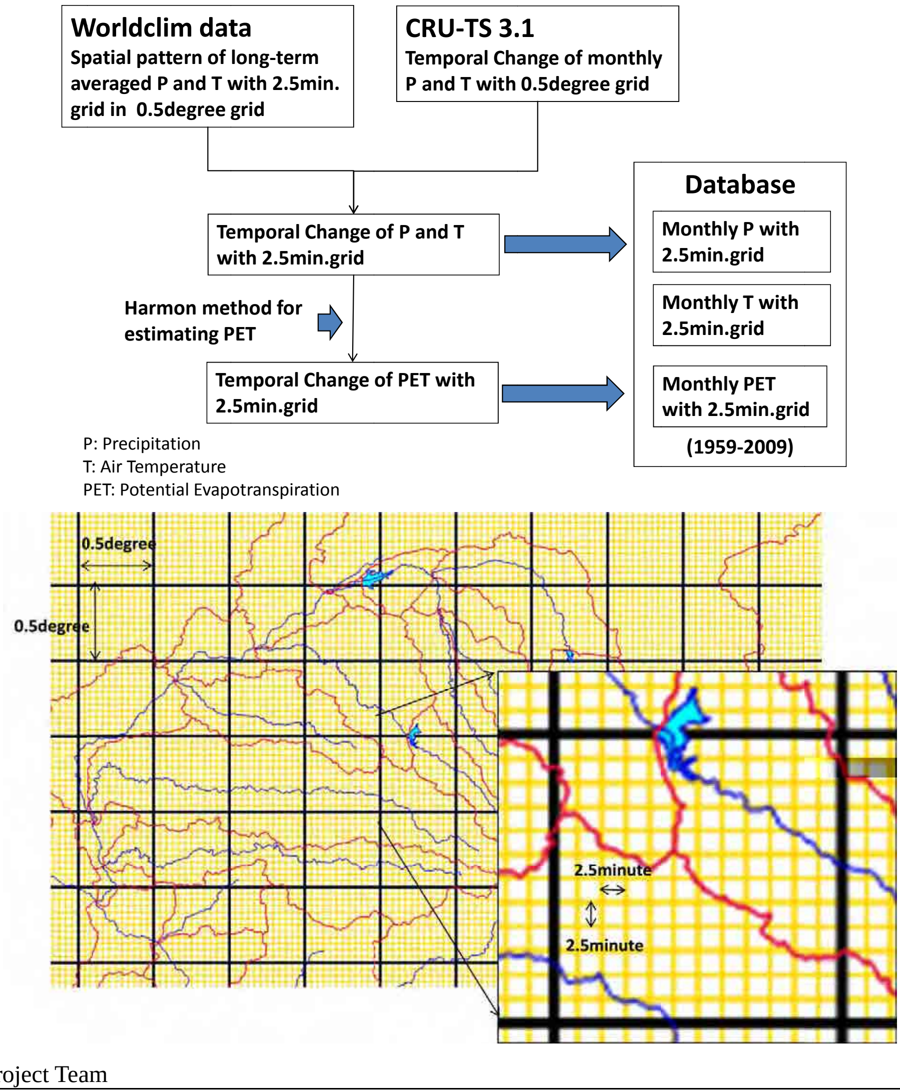
[7] http://sharaku.eorc.jaxa.jp/GSMaP_crest/index.html

Considering the advantage and disadvantage of meteorological data from these sources, the following strategies on the usage of these data are set in the Project.

- For the long-term analysis on assessment of availability of water resources covering entire country and the related surrounding catchment areas, the gridded (2.5minites) monthly precipitation, air temperature and potential evapotranspiration (PET) are prepared based on CRU-TS3.1 and Worldclim. The duration of dataset prepared is 51years from 1959 to 2009.
- Point observation data for daily precipitation by NIMET may be used for checking precipitation pattern within a month as well as frequency analysis for short-term heavy precipitation events for assessing overall flood condition.
- The data from GSMaP could be used for flood analysis for limited and specific pilot areas where the necessary information is available aside from precipitation data for the flood analysis, if necessary. It should be noted that GSMaP is available only after 1998.

SR2.2.2 Preparation of Dataset for Gridded Monthly Precipitation, Air Temperature and Potential Evapotranspiration (PET)

The gridded monthly precipitation and air-temperature with 0.5 degree provided by CRU-TS3.1 are used as a key dataset. However, it does not include the effect of altitude in general and the spatial resolution is low. In order to take the effect of altitude into account as well as to prepare higher resolution data, the CRU-TS3.1 has been modified using the correction factor based on the gridded data with 2.5minutes provided by Worldclim (see Figure SR2-6).



Source: JICA Project Team

Figure SR2-6 Preparation of Dataset for Gridded Monthly Precipitation, Air Temperature and Potential Evapotranspiration

The correction factor is introduced to interpolate the spatial pattern within the grid of 0.5degree and calculated by the following equation.

$$C_{m,i,j} = \frac{\varphi_{m,i,j}}{\frac{1}{N}\sum_{n=1}^{N}\theta_{n,m,i}}$$

where $C_{m,i,j}$ = correction factor for m-th month, i-th grid for 0.5 degree by CRU-TS3.1 and j-th grid for 2.5minutes by Worldclim within i-th grid, $\varphi_{m,i,j}$ = Value given by Worldclim for m-th month, i-th grid and j-th grid within i-th grid, $\theta_{m,i,j}$ = Value given by CRU-TS3.1 for n-th year, m-th month, i-th grid, N = total number of year for obtaining the correction factor (50 years from 1951 to 2000). The corrected grid value is given as follows.

$$\omega_{n,m,i,j} = C_{m,i,j} \cdot \theta_{n,m,i}$$

where $\omega_{n,m,i,j}$ = Corrected value for n-th year, m-th month, i-th grid for 0.5 degree by CRU-TS3.1 and j-th grid for 2.5minutes by Worldclim within i-th grid.

The monthly precipitation and air temperature with 2.5minutes grid were prepared firstly using the above-mentioned correction, and then potential evapotranspiration with 2.5minutes grid was calculated by the Hamon[8] method as shown in the following equation.

$$PET = 13.97 d D^2 W_t$$

$$W_t = \frac{4.95 exp(0.062T)}{100}$$

where PET = potential evapotranspiration in mm/month, d = number of days in a month, D = mean monthly hours of daylight in units of 12hrs, W_t = a saturated water vapor density term in grams/m^3, T = mean monthly air temperature in degree Celsius.

The gridded data have been prepared for 1959 to 2009 (51years) for further analysis.

SR2.2.3 Precipitation, Air Temperature and Potential Evapotranspiration

The precipitation, air temperature and evapotranspiration based on the dataset prepared in the previous section are shown and discussed below.

(1) General Spatial Pattern

The annual precipitation and annual mean air temperature in Nigeria in the last 40years (1970-2009)[9] are estimated at 1,150mm/year and 26.6degree Celsius on average, respectively. Figure SR2-7 shows the spatial pattern of annual precipitation and PET[10] over the county. The annual precipitation varies from over 3,000mm in Niger delta area to about 400mm in the most northern part of the country. The annual PET is affected by altitude. In the high elevation areas along the country border in the south-east as well as around Jos, the annual PET becomes small. The following table summarizes the spatially averaged annual precipitation, annual mean air temperature and annual PET for each HA.

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8 Hamon, W.R.: Estimating potential evapotranspiration, Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, v. 87, p. 107–120, 1961.
There are several methods to estimate PET. Some methods require only mean air temperature and others require more climatic parameters. Considering the necessity of the estimation of spatial distribution of PET for evaluating water resources in wider scale, the method that requires less parameter is preferable in general. In the Project, some different methods for estimating PET were examined by trial and error, and it was found that the Hamon method gave better results for rainfall-runoff model for covering the wide range of meteorological conditions (from Arid to Tropical rainfall) in Nigeria.
There are some variations to express the Hamon equation. In the Project, the equation and coefficient shown in the following paper are utilized; G.J. McCabe and S.L. Markstrom: A Monthly Water-Balance Model Driven by a Graphical User Interface, USGS Open-File Report 2007-1088, 2007.

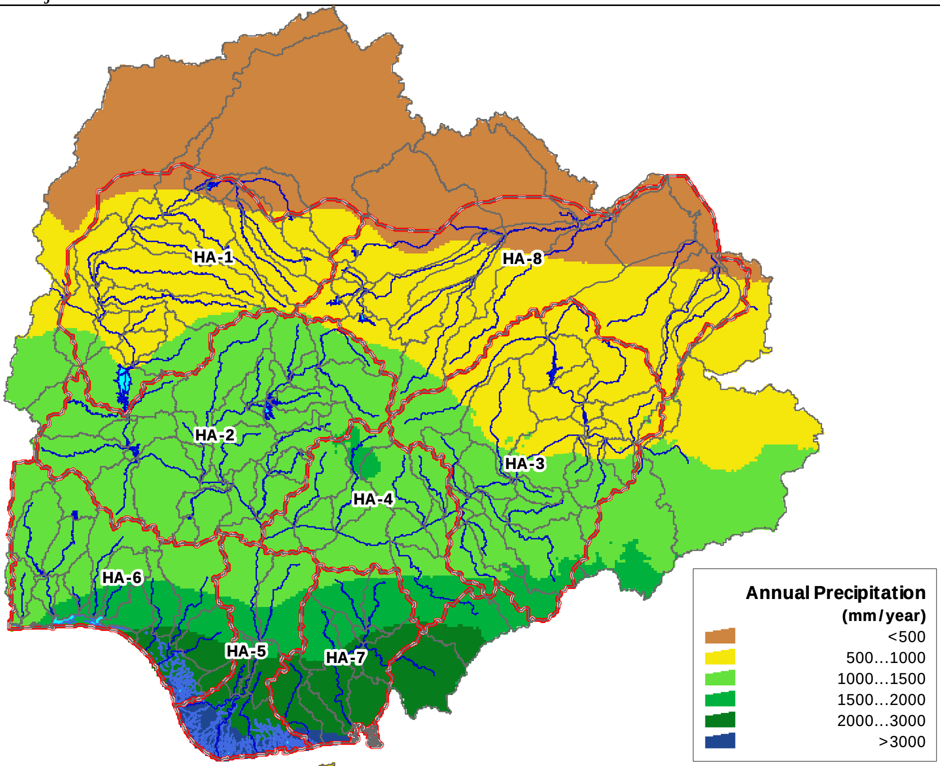
9 The average values for 1970-2009 were shown, because the water resources potential is estimated using 1970-2009 data in the later section. Since the inflow from Niger-Nigeria border can be estimated only after 1970 due to availability of the observed discharge, it is decided to assess the water resources potential using 1970-2009.

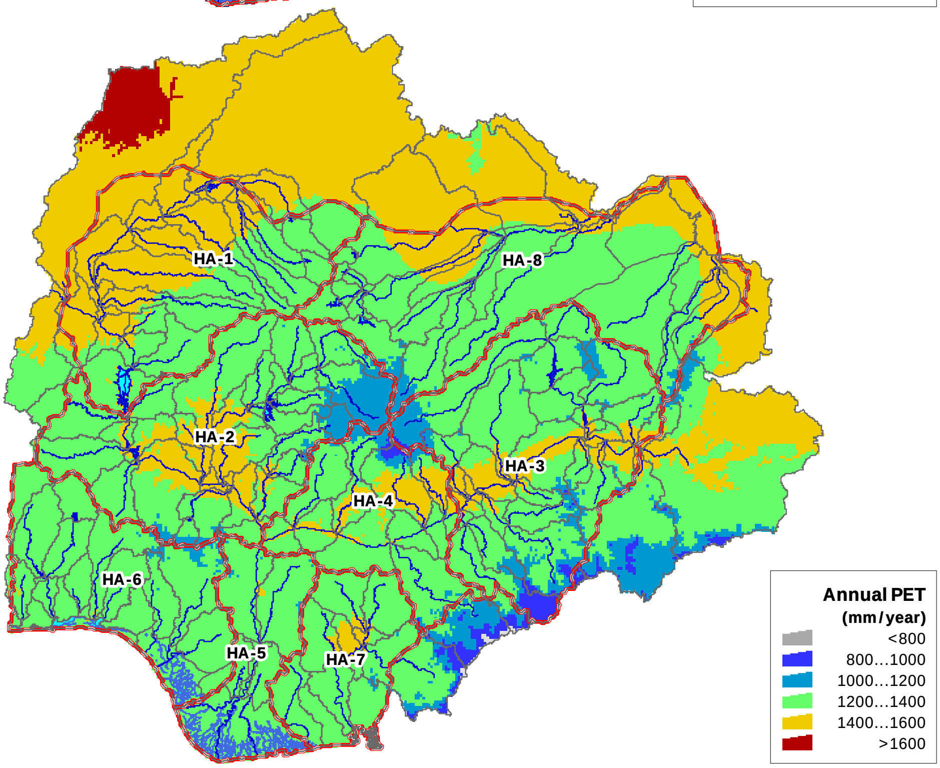
10 According to "J. Ayoade: Water Resources and Their Development in Nigeria, Hydrological Sciences-Bulletin, XX,4 12, 1975", the PET in Nigeria is estimated at 900 – 1,700mm, which is almost same range with that estimated in the Project.

Table SR2-3 Spatially Averaged Annual Precipitation, Annual Mean Air Temperature and Annual PET for Each HA

	Entire country	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8
Annual P (mm/year)	1,148	767	1,170	1,055	1,341	2,132	1,541	2,106	610
Annual Mean T (degree Celsius)	26.6	27.4	26.5	26.0	26.8	26.7	26.5	26.9	26.5
Annual PET (mm/year)	1,337	1,419	1,318	1,290	1,338	1,325	1,314	1,338	1,347

P:Precipitation, T:Air Temperature, PET: Potential Evapotranspiration
Source: JICA Project Team



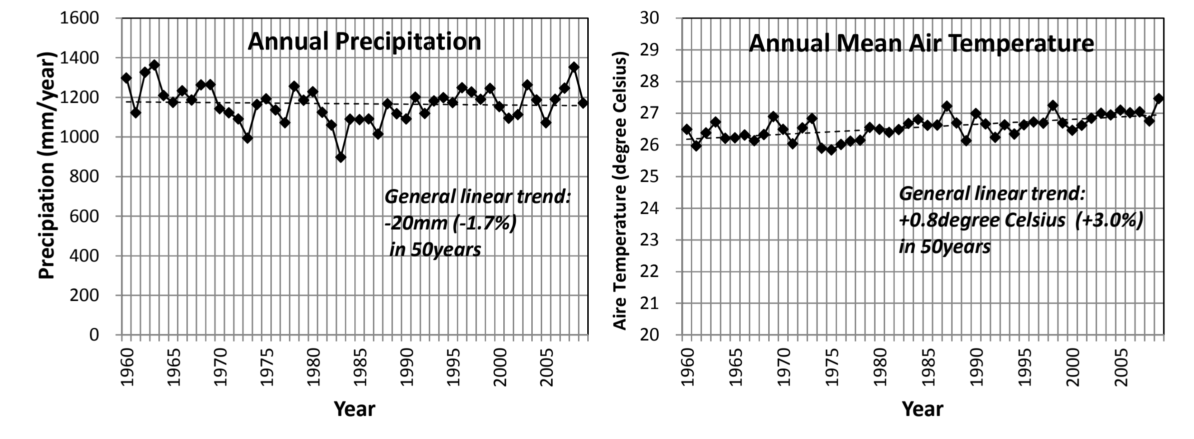


Source: JICA Project Team
Note: Average in 1970-2009 (40years)

Figure SR2-7 Spatial Patterns of Annual Precipitation and Annual PET

(2) Long-term Trend

Based on the gridded data, annual precipitation and annual mean air temperature for the entire country of Nigeria and for each HA is computed. Figure SR2-8 shows the long-term trend of annual precipitation and annual mean air temperature for the entire country.



Source: JICA Project Team

Figure SR2-8 Long-term Trends of Precipitation and Air Temperature for Entire Nigeria

The annual precipitation tends to slightly decrease in the last 50years, and the rate is -1.7% in 50years. The annual mean air temperature tends to increase with +3.0% in 50years.

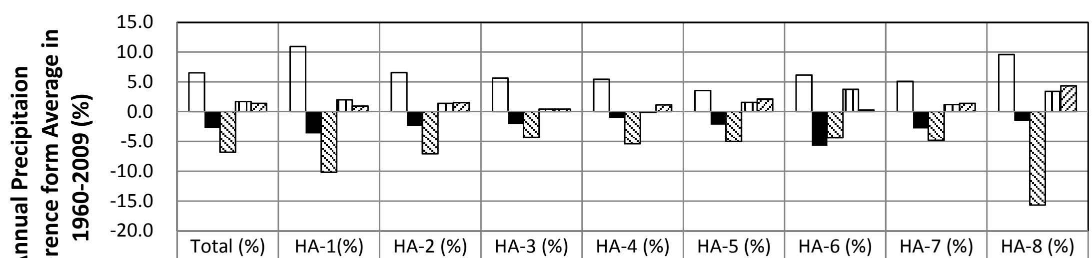
Table SR2-4 shows the linear change rates during 1960-2009 for each HA. For the annual precipitation, the rate differs by HAs. The largest decrease appeared in HA-1, whereas in HA-5 the annual precipitation tends to increase slightly. As for the annual mean temperature, the rate of increase for each HA is almost same at about 3.0% in 50years.

Table SR2-4 Linear Change Rate of Annual Precipitation and Annual Mean Air Temperature during 1960-2009

	Entire Country	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8
Annual Precipitation (%)	-1.7	-6.4	-1.6	-3.4	-2.8	1.3	0.5	-1.2	-0.6
Annual Mean Air Temperature (%)	3.0	3.1	2.8	2.8	2.8	2.9	2.8	2.9	3.4

Source: JICA Project Team

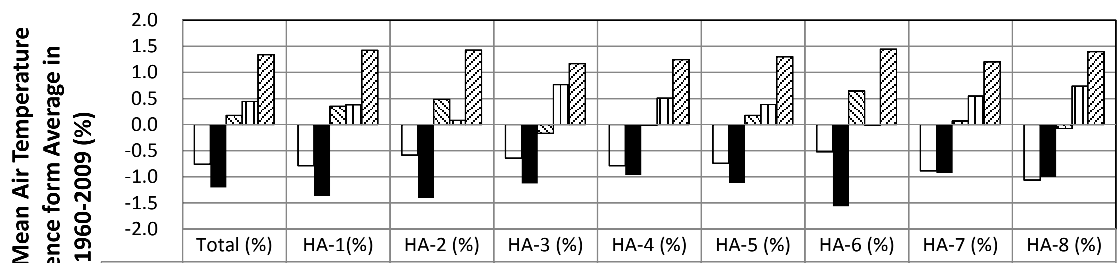
Figures SR2-9 and SR2-10 show the variation of annual precipitation and annual mean air temperature by decades, respectively. One can see that 1960s was relatively wet (more precipitation) and 1970s-1980s was dry (less precipitation). 1990s-2000s became wet periods again. The magnitude of the fluctuation is much larger than the linear change rate of annual precipitation in 50years. On the other hand, annual mean air temperature has been increasing almost constantly without large fluctuation over five (5) decades.



	Total (%)	HA-1(%)	HA-2 (%)	HA-3 (%)	HA-4 (%)	HA-5 (%)	HA-6 (%)	HA-7 (%)	HA-8 (%)
1960s	6.5	10.9	6.6	5.7	5.4	3.5	6.2	5.1	9.6
1970s	-2.8	-3.6	-2.4	-2.1	-1.0	-2.2	-5.7	-2.8	-1.6
1980s	-6.8	-10.2	-7.1	-4.4	-5.4	-5.0	-4.4	-4.8	-15.7
1990s	1.7	2.0	1.4	0.4	-0.1	1.6	3.7	1.2	3.4
2000s	1.4	0.9	1.5	0.4	1.1	2.1	0.2	1.4	4.3

Source: JICA Project Team

Figure SR2-9 Variation of Annual Precipitation by Decades



	Total (%)	HA-1(%)	HA-2 (%)	HA-3 (%)	HA-4 (%)	HA-5 (%)	HA-6 (%)	HA-7 (%)	HA-8 (%)
1960s	-0.8	-0.8	-0.6	-0.6	-0.8	-0.7	-0.5	-0.9	-1.1
1970s	-1.2	-1.4	-1.4	-1.1	-1.0	-1.1	-1.6	-0.9	-1.0
1980s	0.2	0.3	0.5	-0.2	0.0	0.2	0.6	0.1	-0.1
1990s	0.4	0.4	0.1	0.8	0.5	0.4	0.0	0.5	0.7
2000s	1.3	1.4	1.4	1.2	1.2	1.3	1.4	1.2	1.4

Source: JICA Project Team

Figure SR2-10 Variation of Annual Mean Air Temperature by Decades

(3) Seasonal Pattern

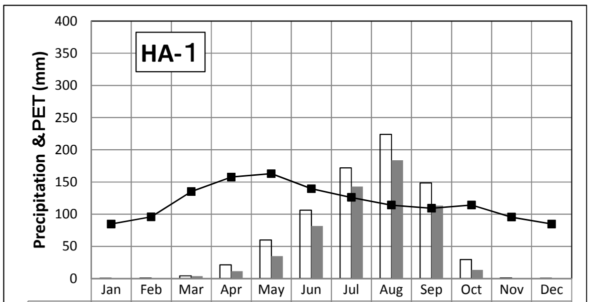
The seasonal variation of precipitation and PET for each HA is presented in Figure SR2-11[11]. In the figure, 80% yearly dependable precipitation for each month as well as average monthly precipitation and PET are presented. Table SR2-5 summarizes the characteristics of seasonal pattern of precipitation and PET for each HA.

Table SR2-5 Characteristics of Seasonal Pattern of Precipitation and PET for Each HA

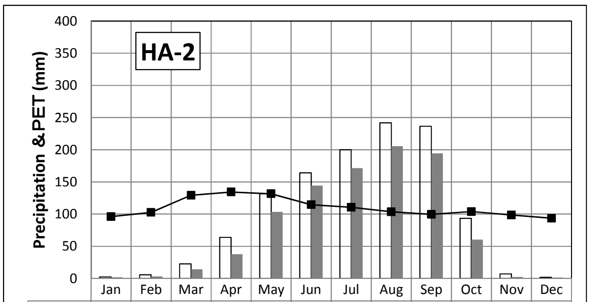
HA	Characteristics of Seasonal Pattern of Precipitation and PET
HA-1	The peak of precipitation appears in August. The average precipitation exceeds the average PET in only three months, which means that there is hydrological deficit for about nine months in a year.
HA-2	The peak of precipitation appears in August to September. There is hydrological deficit for about six months in a year.
HA-3	The peak of precipitation appears in July to August. There is hydrological deficit for about six months in a year. Compared to HA-2, the peak precipitation tends to be higher.
HA-4	It is like transit condition between HA-2 and HA-3.
HA-5	The peak of precipitation appears twice in June to July and September. There is hydrological deficit for about four months in a year.
HA-6	It is almost same pattern to HA-5. The overall precipitation is less than HA-5.
HA-7	It is almost same pattern to HA-5. The two peaks become unclear.
HA-8	It is almost same pattern to HA-1. The overall precipitation is less than HA-1.

Source: JICA Project Team

The 80% yearly dependable precipitation for each month as well as average monthly precipitation and PET for each SHA are presented in Annex-T SR2-4.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	0.0	0.5	4.4	21.4	60.0	106.2	171.9	224.0	148.4	29.6	1.0	0.0
P80	0.0	0.2	3.6	11.4	34.9	81.7	142.8	183.9	113.4	13.4	0.7	0.0
PET	84.6	95.7	135.0	157.6	162.9	139.5	126.0	114.0	109.2	114.2	95.3	84.7

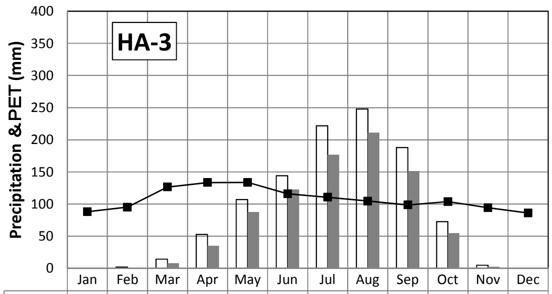


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	2.3	5.6	22.5	63.8	131.5	164.0	200.0	241.8	236.5	93.3	7.1	1.9
P80	1.7	3.1	14.2	37.8	103.4	144.4	171.3	205.7	194.5	60.2	2.2	1.1
PET	96.1	102.6	129.2	134.3	131.5	114.5	110.5	103.6	99.5	103.9	98.5	93.6

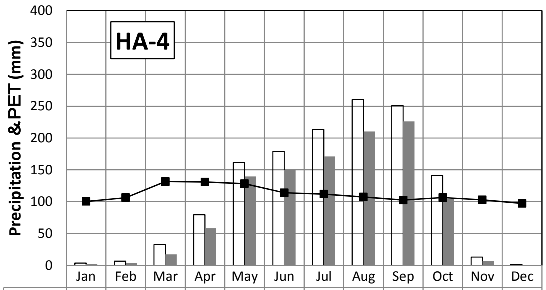
Source: JICA Project Team
Note: P80=80% yearly dependable monthly precipitation, Duration of date used =1970-2009 (40years)

Figure SR2-11 Seasonal Variation of Precipitation and PET (1/2)

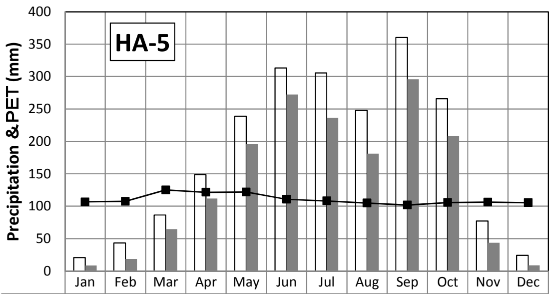
[11] The average values for 1970-2009 were shown, because the water resources potential is estimated using 1970-2009 data in the later section, in the same way in section "(1) General Spatial Pattern".



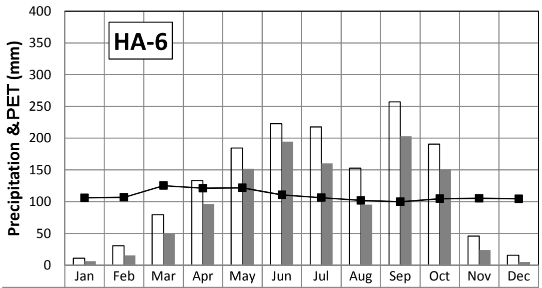
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	0.3	1.8	14.2	52.8	106.9	144.0	221.6	248.0	188.0	72.7	4.6	0.2
P80	0.2	0.8	8.0	35.2	87.7	122.8	176.8	211.1	151.4	54.7	2.5	0.1
PET	87.9	95.1	126.5	133.5	133.6	115.9	110.6	104.6	98.5	103.7	94.3	86.0



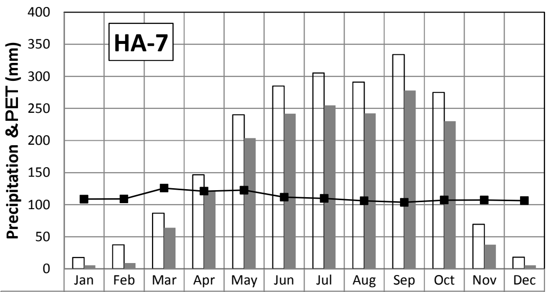
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	3.2	6.3	32.4	79.2	161.5	178.9	213.3	260.1	251.1	140.9	12.9	1.4
P80	1.6	3.3	17.0	58.0	139.6	150.0	170.9	210.3	226.3	104.6	6.7	0.5
PET	100.2	106.2	131.4	130.9	128.1	113.8	111.8	107.2	102.3	106.3	102.8	97.1



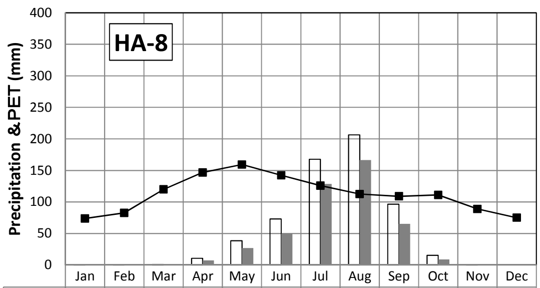
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	20.7	43.2	86.5	148.7	238.7	313.3	305.8	247.7	360.2	265.8	77.3	24.4
P80	8.3	18.6	64.5	111.8	195.6	272.2	236.6	181.2	295.9	208.2	43.6	8.7
PET	106.7	107.4	125.1	121.5	121.8	110.8	108.1	104.9	101.8	105.6	106.2	105.4



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	10.8	30.5	79.4	133.1	184.4	222.5	217.6	152.8	257.2	190.6	45.8	15.6
P80	6.0	15.3	50.2	96.5	151.8	194.5	160.3	95.3	203.0	150.9	23.9	5.1
PET	106.1	106.7	125.3	121.2	121.8	110.7	106.3	101.9	99.8	104.6	105.3	104.5



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	17.6	37.5	86.8	146.6	240.2	284.8	305.1	290.9	333.8	274.9	69.3	18.2
P80	5.7	9.0	64.1	121.5	203.7	241.9	254.8	242.4	277.9	230.0	37.6	5.6
PET	108.6	108.9	125.7	121.0	122.5	111.7	109.7	106.0	103.6	107.1	107.2	106.3



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	0.0	0.1	0.9	10.5	38.6	73.1	167.8	206.4	96.5	15.5	0.0	0.0
P80	0.0	0.1	0.5	7.3	26.8	50.0	128.8	166.6	65.2	9.1	0.0	0.0
PET	73.8	82.7	119.9	146.7	159.3	142.2	125.8	112.5	109.1	111.2	88.8	75.0

Source: JICA Project Team
Note: P80=80% yearly dependable monthly precipitation, Duration of date used =1970-2009 (40years)

Figure SR2-11 Seasonal Variation of Precipitation and PET (2/2)

SR2.3 Surface Water Resources

SR2.3.1 Available Hydrological Data

Nigeria Hydrological Service Agency (NIHSA) is the responsible agency for hydrological monitoring in Nigeria. In the Project, the following hydrological data have been collected in collaboration mainly with NIHSA.

- Data available in NIHSA
  - Daily, monthly discharge
  - Daily water level for last a few years for selected stations
- Data from Niger Basin Authority (NBA) (via. NIHSA)
  - Daily, monthly discharge for some of Niger-HYCOS stations
- Data from NBA (via. World Bank Report for Hydrology in Niger Basin[12])
  - Monthly Discharge for Niger-HYCOS stations in other countries
- Data in M/P1995[13]
  - Monthly discharge
- Database prepared by WSSSRP[14] (EU supported project) for HA-8
  - Daily, monthly discharge in HY-8
- Hydrological Yearbook in BORBDA
  - Daily, monthly water level and discharge in BORBDA
- Reservoir operation data for selected large storage dams
  - Daily, monthly release, reservoir water level, etc. (only limited dams)

JICA Project Team carefully assessed the collected hydrological data. The following problems and issues have been identified on the data.

- Incomplete inventory of hydrological station
  - Information of location of stations is sometimes not accurate. It may make the water resources assessment confused. JICA Project Team and NIHSA C/P have been working together to clarify the location as much as possible so as not to mistake the estimation of catchment area.
- No rating curve for many stations
  - Many stations do not have rating curve, especially for the newly established stations with data logger.
  - Rating curve for the station at low lying area may have influence of backwater. It causes strange discharge in low water condition. If such strange data are identified, they are not used for the assessment of water resources in the Project.
  - It is necessary to establish good rating curve for future usage of these data.
- Duplicated Information
  - Different data sources sometimes show different discharge.
  - In the Project, priority has been set for the case that there are more than two data at same stations. NIHSA data have been given high priority.
- Lack of long-term observation data
  - Duration of available observation data is short in many stations (less than 10years).
  - Additional analysis and rainfall-runoff modeling would be necessary in order to obtain supplementary information on runoff condition.
- Inconsistency of discharge data
  - Discharges observed in neighboring stations are sometimes inconsistent each other (For example, discharge in downstream station is too much lower than that in upstream station).
  - In the Project, the stations which show better consistency with other stations have been selected for further analysis and calibration of rainfall-runoff modeling.

By integrating the collected hydrological data, the data for monthly discharge at 101 stations are arranged. The procedure of preparing the data is as follows.

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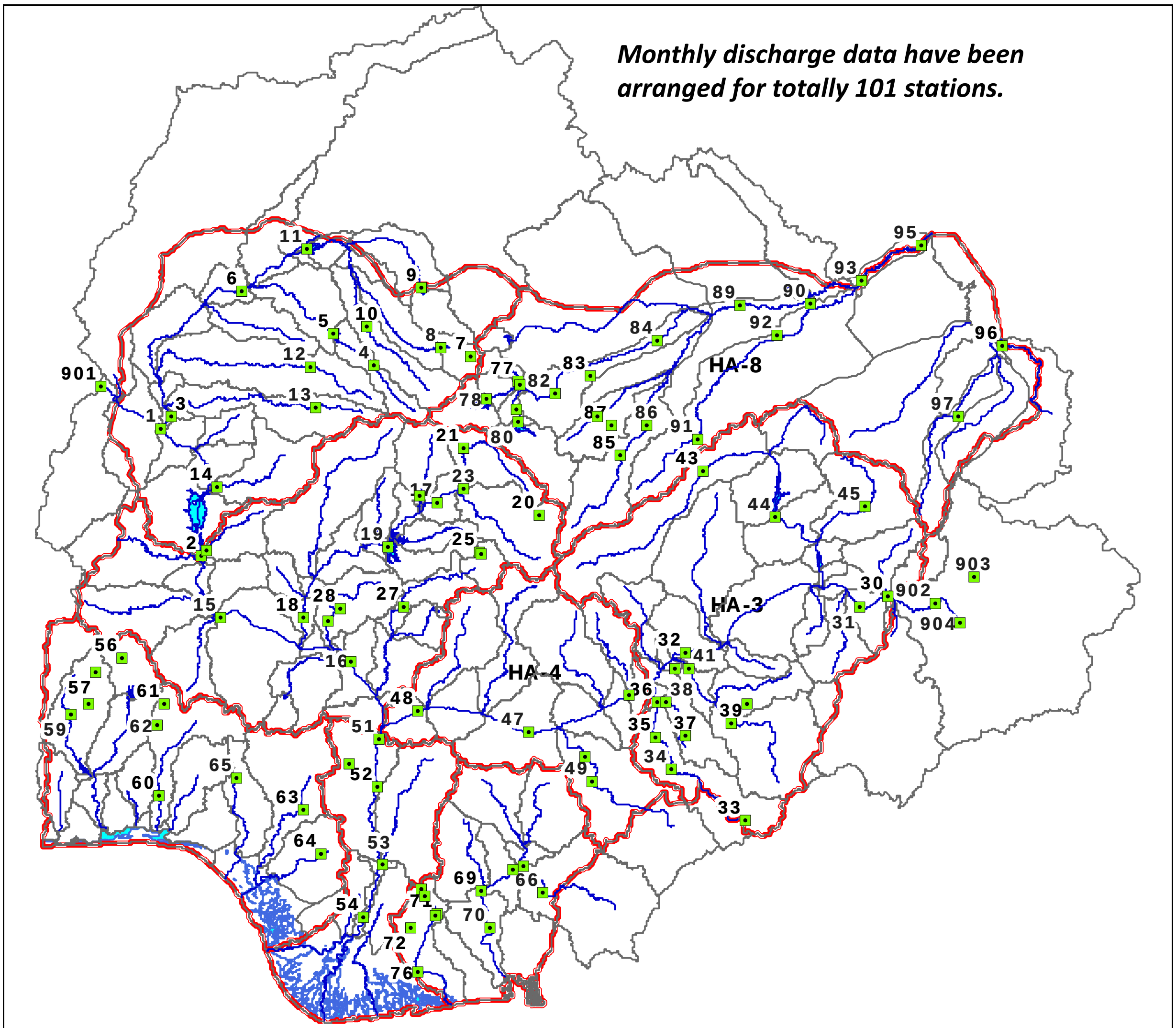
[12] World Bank: The Niger River Basin, A Vision for Sustainable Management, 2005.
[13] FMWR, JICA: National Water Resources Master Plan, 1995.
[14] WSSSRP: River Flow Database Hadejia-Jammare-Komadugu-Yobe Basin, Integrated Water Resources Management Project, 2010.

- All available daily and monthly discharge data are firstly arranged as an original dataset and their inventory was prepared (see Annex-T SR2-5).
- The daily data sometimes have many gaps. The gaps were interpolated, when they are within two months, in order to prepare seamless monthly data series as much as possible.
- When there are more than two different data source at one station, the priority was set as follows.
  - 1st priority: Data in NIHSA (daily data available)
  - 2nd priority: Data in NIHSA (only monthly data available)
  - 3rd priority: Other data sources
- For the data provided by WSSSRP database for HA-8, the arranged monthly data by WSSSRP were used as they are, because the quality check of the data has almost been done in WSSSRP.

The inventory list of the arranged monthly data for each station is presented in Annex-T SR2-6. The locations of the hydrological stations are presented in Figure SR2-12. The followings can be observed on the availability of the data through the inventory list of the hydrological data.

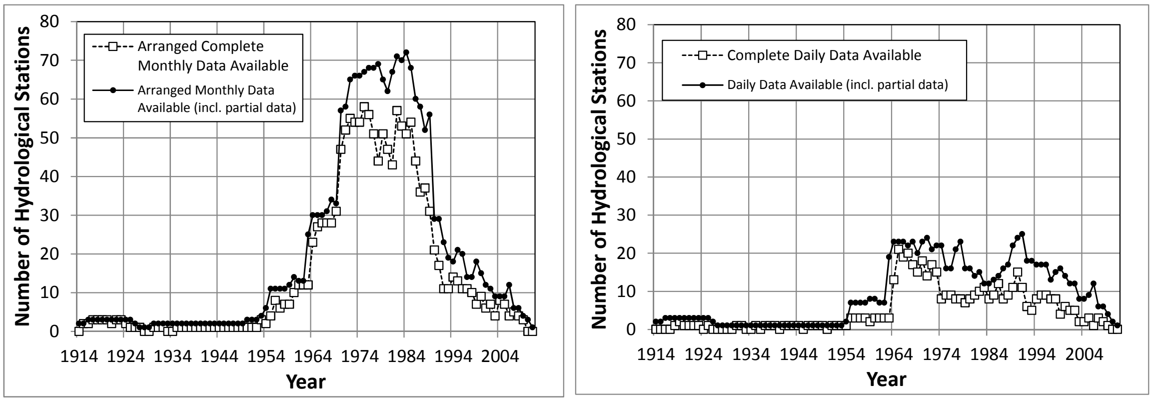
- Along the Niger River and Benue River as well as Hadejia-Jammare-Komadugu-Yobe River system, long-term daily discharge data are available in general. However, many of them are strongly affected by operation of significant storage dams.
- For other areas, only monthly data for limited time periods are available in general.
- For the stations along Niger River and Benue River outside Nigeria, only monthly data are available.
- For HA-6, available discharge data are very limited.



Source: JICA Project Team

Figure SR2-12 Location of Hydrological Stations with Available Data

Figure SR2-13 shows the change in number of hydrological stations with available monthly and daily data. The numbers of stations with available hydrological data becomes maximum from 1970s to 1980s. However, after 1980s the numbers gradually decreases.

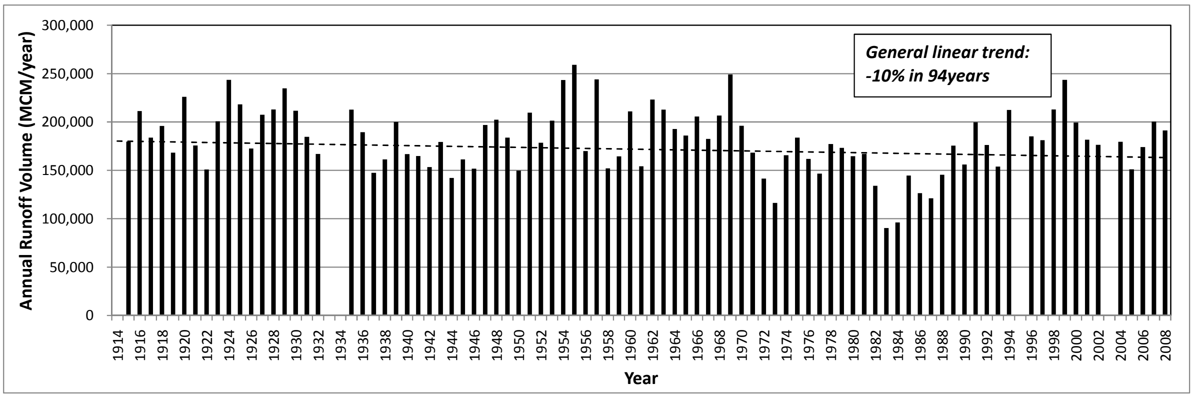


Source: JICA Project Team

Figure SR2-13 Change in Number of Hydrological Stations with Available Monthly and Daily Data

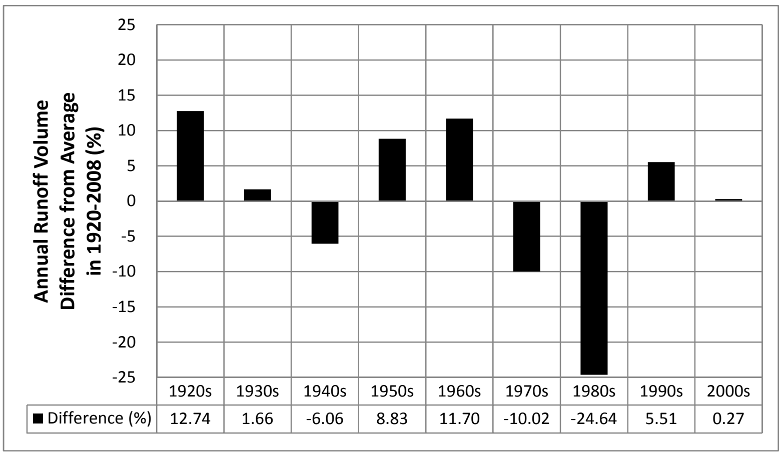
SR2.3.2 Long-term Tendency of Observed Discharge

In Lokoja station, which is located at just downstream of the confluence of Niger and Benue Rivers, there are continuous long-term observed discharge data from 1914 till now. Figure SR2-14 shows the long-term change in annual runoff volume at Lokoja station. It can be seen that there is general linear trend with -10% of average during 94years. The fluctuation of the annual runoff volume by decades is presented in Figure SR2-15. Reflecting the dry and wet sequences in precipitation, the runoff volume in 1970s-1980s is much smaller than the other decades.



Source: JICA Project Team

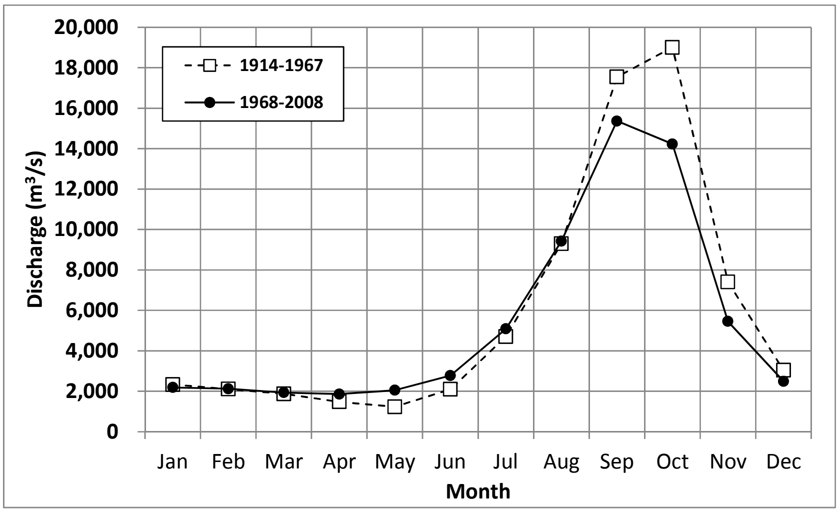
Figure SR2-14 Long-term Change in Annual Runoff Volume at Lokoja Station



Source: JICA Project Team

Figure SR2-15 Fluctuation of Runoff Volume by Decades at Lokoja Station

The construction and operation of large storage dams in Nigeria affects the flow regime in Niger River. Figure SR2-16 shows the seasonal flow patterns at Lokoja station before and after the construction of Kaiji dam in 1968. The discharge in April, May and June increased after the construction of the Kaiji dam, presumably because of regulation of flow for hydropower generation.



Source: JICA Project Team

Figure SR2-16 Seasonal Flow Pattern before and After 1968 at Lokoja Station

SR2.3.3 Long-Term Rainfall-Runoff Simulation

(1) Necessity of Long-Term Rainfall-Runoff Simulation Model

It is always better to use directly observed data, if they are available and their quality is good. However, in the Project there are not enough discharge data in terms of space and time for proper assessment of water resources, as shown in Section SR2.3.1. Furthermore, the observed data at many stations are disturbed by operation of large dams. A long-term rainfall-runoff model has been introduced in order to obtain supplemental information on runoff condition in space and time, especially for the quasi-natural condition without effect of the large storage dams. The model can also be used for exploring the effect of climate change on runoff.

(2) Long-Term Rainfall-Runoff Simulation Model

The primary purposes for introducing the rainfall-runoff model in the Project are as follows.

- To obtain long-term information on runoff conditions, especially for quasi-natural condition.
- To grasp overall water balance in wider scale across Nigeria under the condition with limited available data

To achieve the above purposes, the key requirements for the model would be as follows.

- Be as simple as possible, but can capture fundamental hydrological process
- Requires less input data
- Can consider spatial distribution of climate and other parameters which affect runoff condition

Considering the requirements, a monthly-basis soil-moisture accounted model, which is called the Thornthwaite monthly water balance model [15] has been selected and were applied with semi-distributed manner[16,17,18] in a catchment. It is a rather simple model, which can be implemented

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[15] G.J. McCabe and S.L. Markstrom: A Monthly Water-Balance Model Driven by a Graphical User Interface, USGS Open-File Report 2007-1088, 2007.

[16] Moore, J.W. Trubilowicw and J.M. Buttle: Prediction of Streamflow Regime and Annual Runoff for Ungauged Basins using a Distributed Monthly Water Balance Model, J. of the American Water Resources Association, Vol.48, No.1, pp.32-42, 2012.

[17] C. Gregory Knight, Heejun Chang, Marieta P. Staneva & DeyanKostov : A Simplified Basin Model For Simulating Runoff: The Struma River GIS,The Professional Geographer, 53:4, 533-545, 2001

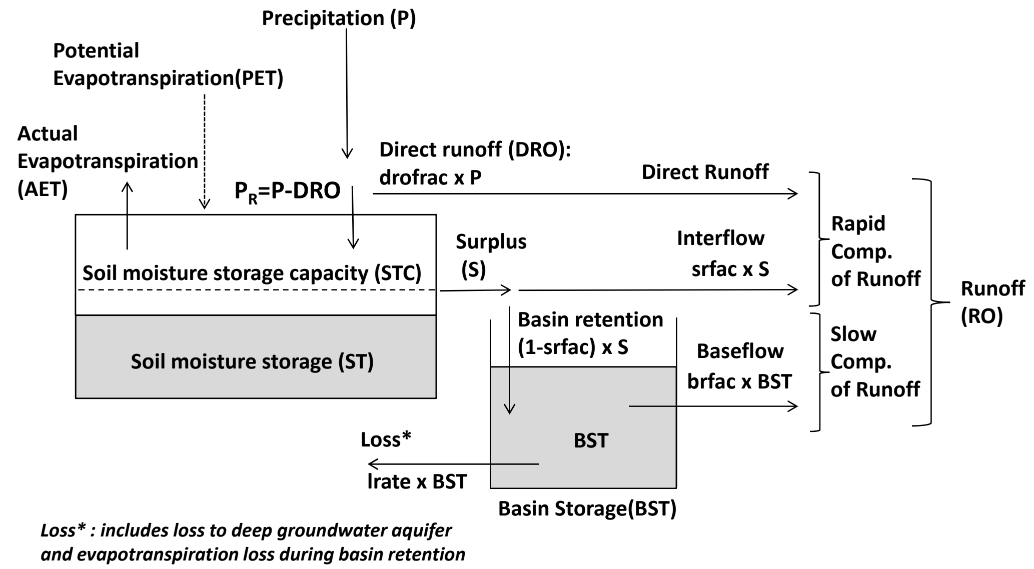
[18] FAO: Water Resources and irrigation in Africa, available from http://www.fao.org/nr/water/aquastat/watresafrica/index4.stm

in a spread sheet and does not require complicated software. However, it can usually capture the essential and important hydrological cycle on a land surface.

In the Project, the original Thornthwaite monthly water balance model has been modified as follows.

- Snow process has not been incorporated, because snow never falls in the project area.
- Basin runoff process has been modified, considering basin retention and loss.

The basic concept of the modified Thornthwaite monthly water balance model is presented in Figure SR2-17.



Source: JICA Project Team

Figure SR2-17 Basic Concept of Modified Thornthwaite Monthly Water Balance Model

There are several hydrological components considered in the model as described below.

Direct Runoff

- Direct runoff (*DRO*) is runoff from impervious surfaces or runoff resulting from infiltration-excess overflow. The fraction (*drofrac*) of precipitation (*P*) is directly runoff without infiltrating into a surface soil. The expression for *DRO* is as follows.

$$DRO = P \cdot drofrac$$

- Direct runoff (*DRO*) is subtracted from *P* to compute the amount of remaining precipitation (P_R).

$$P_R = P - DRO$$

Evapotranspiration and Soil Moisture Storage

- Actual evapotranspiration (*AET*) is derived from potential evapotranspiration (*PET*), P_R, soil-moisture storage (*ST*) and soil-moisture storage withdraw (*STW*).
- When P_R is more than *PET*, *AET* is equal to be *PET*. The excess water is assumed to infiltrate into the surface soil to increase soil-moisture (*ST*). When *ST* is greater than the soil-moisture storage capacity (*STC*), the excess water becomes surplus (*S*).
- When P_R is less than *PET*, *AET* is equal to P_R plus the amount of soil moisture that can be withdrawn from storage in the surface soil (*STW*). Accordingly, the soil-moisture in the surface soil decreases with *STW*.
- *STW* decreases with decreasing *ST*, because water in the surface soil becomes difficult to be removed when the soil becomes drier. This nature is modeled as the following equation in the Project.

$$STW = ST_{i-1}\left[1 - exp\left(\frac{P_R - PET}{STEA}\right)\right] \quad (when\ ST_{i-1} < STEA)$$

$$STW = P_R - PET$$

$$(when\ ST_{i-1} \geq STEA\ and\ ST_{i-1} + P_R - PET \geq STEA)$$

$$STW = ST_{i-1} - STEA\left[1 - exp\left(\frac{P_R - PET}{STEA}\right)\right]$$

$$(when\ ST_{i-1} \geq STEA\ and\ ST_{i-1} + P_R - PET < STEA)$$

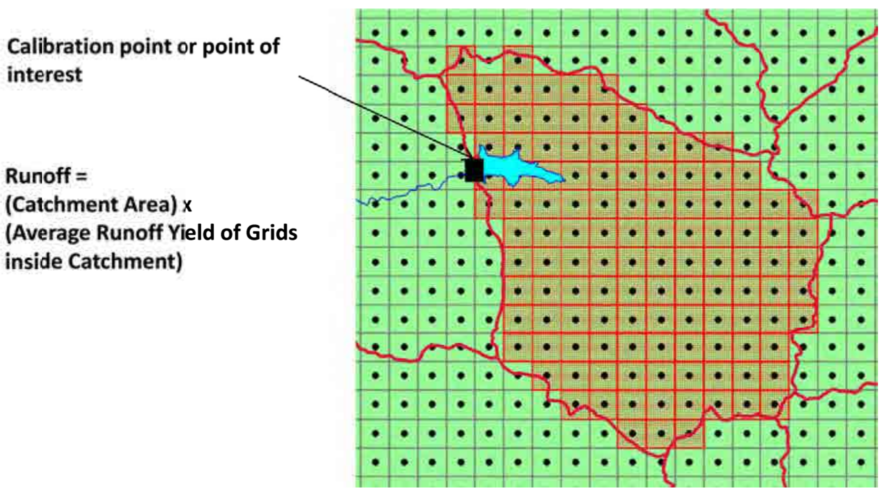
where ST_{i-1} = the soil moisture storage for the previous month, *STEA* = Easily available soil moisture (=αSTC, referring to FAO: Water Resources and irrigation in Africa[19] , it is assumed that α=0.4).

Basin Storage and Runoff Generation

- It is assumed that the runoff is generated from the surplus (*S*) at a specified rate (*srfac*). The *srfac* parameter determines the fraction of surplus that becomes runoff in a month. The remaining surplus is carried over to the following month and is accumulated as basin storage (*BST*).
- The total rapid component of runoff is the sum of the direct runoff and the fraction of surplus that becomes runoff in a month.
- The accumulated basin storage is to be released as a slow component of runoff with the rate (*brfac*).
- The loss during the basin storage has been considered with a specific rate (*lfactor*) against *BST*. The loss may include the loss to deep groundwater aquifer and evapotranspiration loss during basin storage.
- The total runoff (*RO*) is the sum of the rapid component and slow component of runoff.

Semi-Distributed Computation

- The modified Thornthwait Monthly Water Balance Model is applied for each grid cell with 2.5minutes in the Project, in order to reflect local precipitation, potential evapotranspiration and surface soil condition.
- As shown in Figure SR2-18, the average runoff yield in the target catchment is computed based on the computed runoff in the grid cells, and the total runoff is obtained by multiplying the catchment area.



Source: JICA Project Team

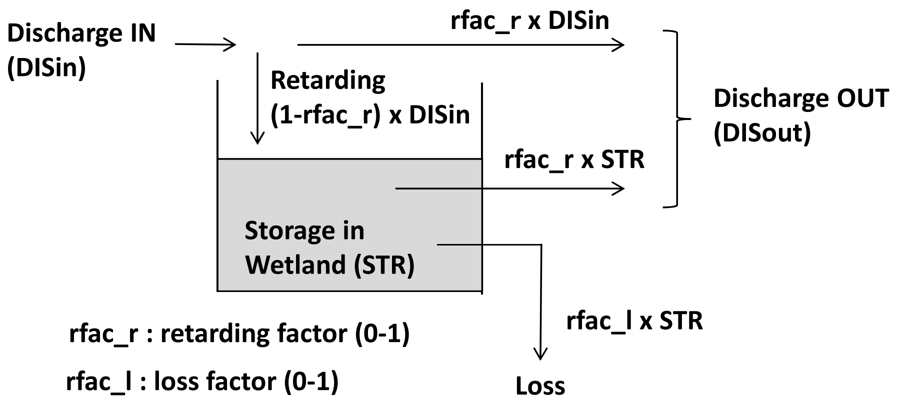
Figure SR2-18 Semi-Distributed Computation of Monthly Water Balance

Retarding and Loss in Large Wetland Area

- In the place where discharge is significantly retarded and lost continuously due to an existence of large wetland area, the retarding and additional loss is considered as shown in Figure SR2-19. The following two empirical parameters are introduced.

[19] FAO: Water Resources and irrigation in Africa, available from http://www.fao.org/nr/water/aquastat/watresafrica/index4.stm

  - Retarding factor in a large wetland area (*rfac_r*)
  - Loss factor in a large wetland area (*rfac_l*)
- This is applied only for the main channel of Hadejia–Jammare-Komadugu-Yobe Rivers in HA-8.



Source: JICA Project Team

Figure SR2-19 Retarding and Loss in a Large Wetland Area

Input Data

- Monthly precipitation (*P*)
  - Monthly precipitation for each grid with 2.5minutes prepared in Section SR2.2.2 is given.
- Monthly PET (*PET*)
  - Monthly PET for each grid with 2.5minutes prepared in Section SR2.2.2 is given.
- Soil moisture storage capacity (*STC*)
  - Maximum available soil moisture for 5minutes grid prepared by FAO[20] based on Digital Soil Map of the World is applied.

Model Parameters

- After some trial calculations, it has been decided to express the model parameter related to direct runoff (*drofrac*) as a function of *P* and *PET* s follows.

$$drofrac = \begin{cases} drofrac0 & (P(1 - drofrac0\ ) \geq PET) \\ 0 & (P(1 - drofrac0\ ) < PET) \end{cases}$$

  where *drofrac0* = direct runoff rate when precipitation is larger than *PET*.

- In order to obtain the satisfied mass balance, it has been necessary to introduce adjustment factors for *STC* and *PET* in the Project. These factors are multiplied to the input data for *STC* and *PET*.
- In summary, there are the following five (5) model parameters for soil water balance and two (2) parameters for the retarding and loss in a wetland area. The range of the parameters has also been set in the Project as follows.
  - Direct runoff rate (*drofrac0*): 0 - 0.1 (mostly 0.05)
  - Adjustment factor for *STC* (*afstc*) : 1 - 3 (mostly 1 - 1.5)
  - Adjustment factor for *PET* (*afep*) : 0.35 – 1 (mostly 1)
  - Surplus runoff factor (*srfac*) : 0.0 – 1.0
  - Basin storage runoff factor (*brfac*) : 0.0 – 1.0 (mostly same as *srfac*)
  - Loss factor (*lfactor*) : 0.0 – 1.0
  - Retarding factor in a wetland area (*rfac_r*) (used for only large wet land area): 0 - 1
  - Loss factor in a wetland area (*rfac_l*) (used for only large wet land area): 0 - 1

Model Implementation

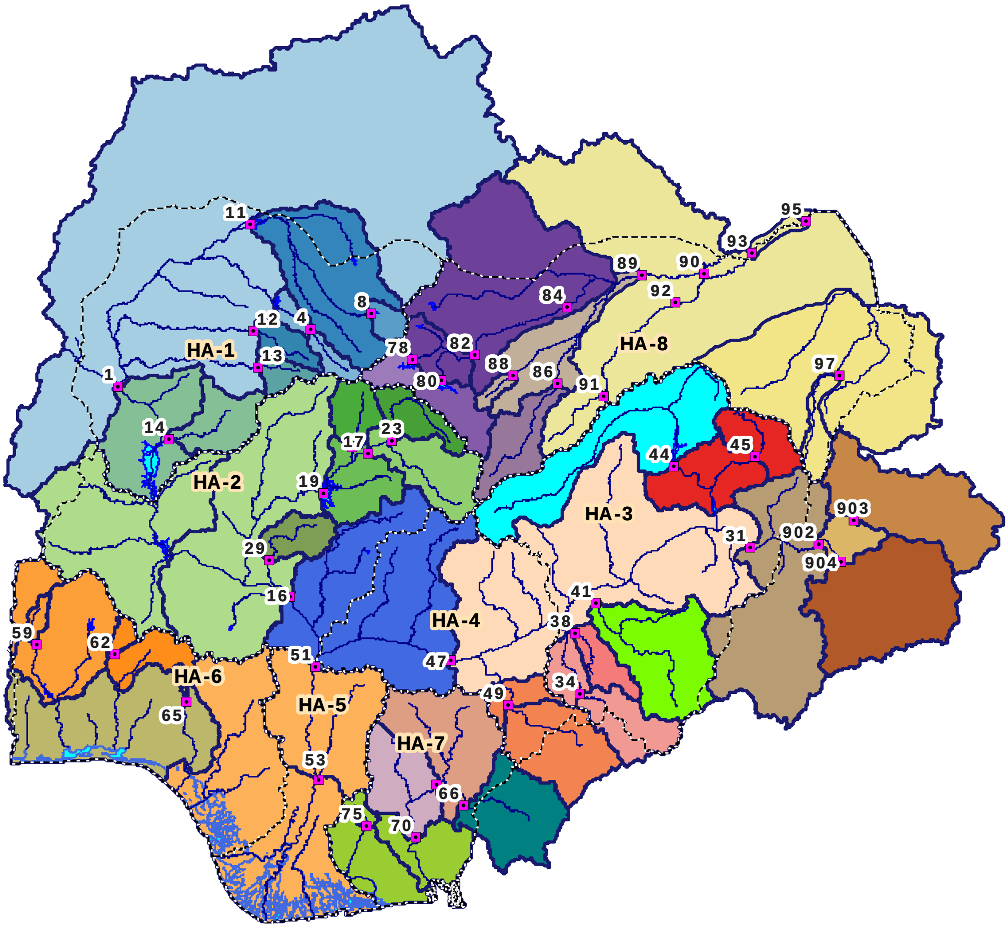
- The model is developed in MS-Excel with VBA (Macro). The input data such as precipitation, PET and soil condition have been prepared using GIS software and MS-Excel.

[20] FAO GeoNetwork, available from http://geonetwork3.fao.org/geonetwork/srv/en/main.home

(3) Calibration of Model Parameters

The model parameters are calibrated at the selected hydrological stations. The stations which have longer discharge records without gaps are basically selected. However, the selection process was somehow trial and error. When the calibrated model parameters are too different from that in neighboring catchment and/or the simulated and observed discharge seems to be too strange compared to that in the surrounding stations, such stations were not selected for the calibration. Finally, 45 stations are selected for the calibration of the model parameters as shown in Figure SR2-20.

For the calibration, the corresponding target catchment for each selected hydrological station was firstly identified. By giving the upstream discharge based on either observed or simulated discharge, the model parameters were optimized in order that the simulated total discharge at the calibration point would fit best to the observed one.



Source: JICA Project Team

Figure SR2-20 Selected Hydrological Stations for Calibration of Model Parameters

The following criteria have been considered for the calibration.

- 1st priority: Total mass during the calibration period
  - The calibration has been conducted so that the total mass error between observed and simulated discharges is less than 3%.
- 2nd priority: Overall shape of runoff pattern, especially for runoff pattern in dry season
  - The best fit parameters are explored so that either $RMSE_L$ is minimized or NS is maximized with keeping the condition that the total mass error is less than 3%. The $RMSE_L$ and NS are expressed as follows.

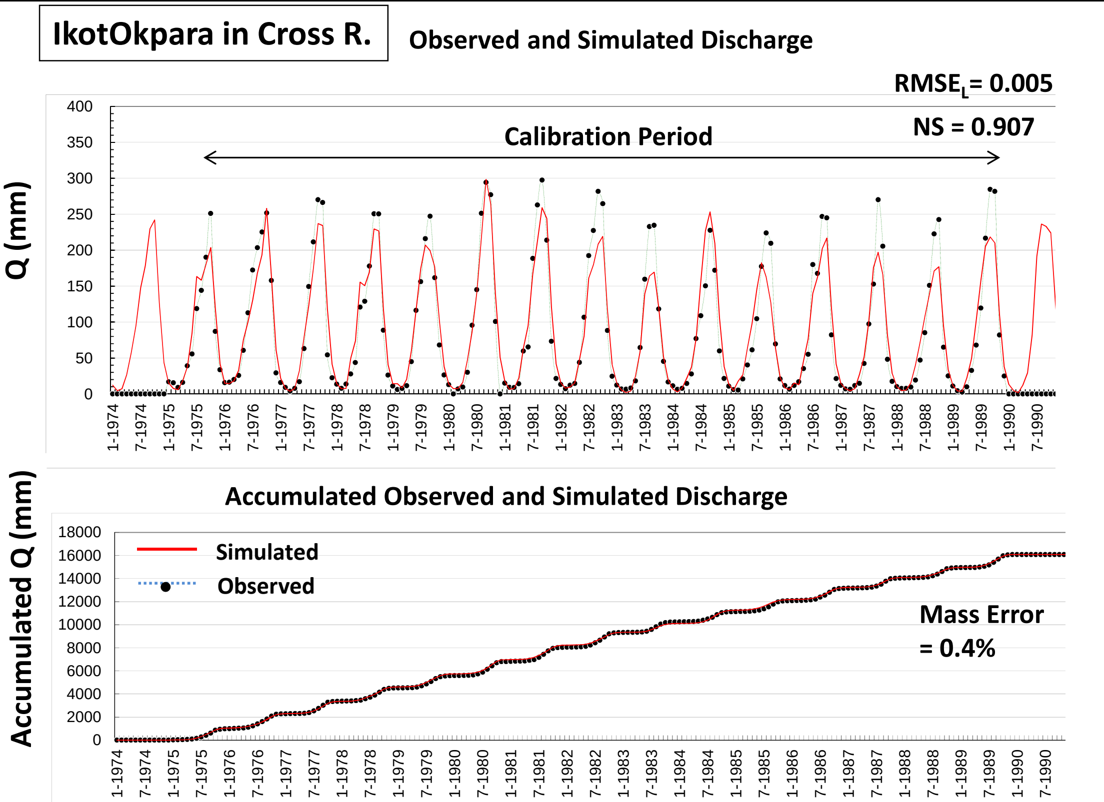
$$RMSE_L = \frac{\sqrt{\overline{\left(RO_{obs}^{1/3} - RO_{sim}^{1/3}\right)^2}}}{\overline{RO_{obs}}}$$

$$NS = 1 - \frac{\int (RO_{obs} - RO_{sim})^2}{\int (RO_{obs} - \overline{RO_{obs}})^2}$$

where $RMSE_L$ = root mean square error which emphasizes low flow condition, NS = Nash-Sutcliffe coefficient, RO = runoff, $*_{obs}$ = observed value, $*_{sim}$ = simulated value, and top bar represents mean value.

- Finally, the parameter for Basin storage runoff factor (*brfac*) is slightly modified to obtain better fitting between the flow duration curve prepared by observed discharge and that prepared by the simulated discharge.

The examples of the calibration are presented in Figure SR2-21.

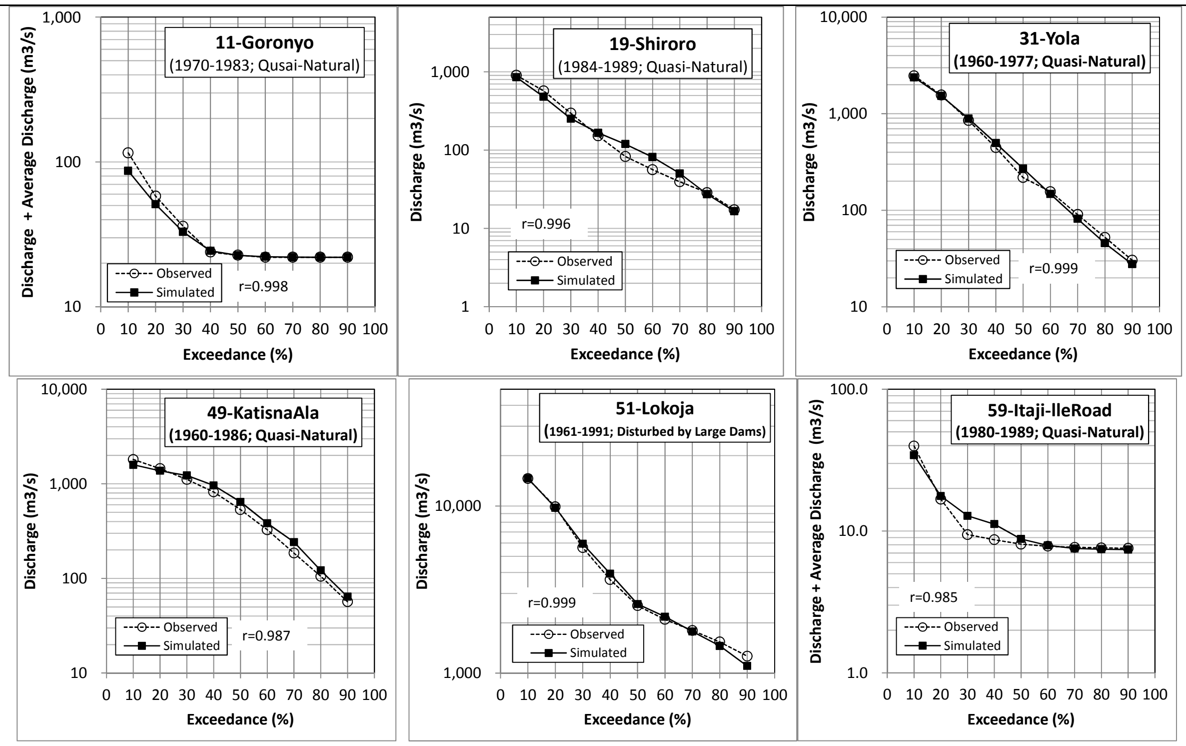


Source: JICA Project Team

Figure SR2-21 Examples of Calibration of Model Parameters

The optimized model parameters as well as conditions for calibration such as duration of calibration and given upstream discharge are presented in Annex-T SR2-7.

Figure SR2-22 shows examples of comparison between the flow duration curve prepared by observed discharge and that prepared by the simulated discharge (see Annex-F SR2-2 for the results for all calibrated stations). One can see that the simulated results reasonably agree with the observed ones for the range of 10-90% in the probability of exceedance in the level of overall shape of the flow duration curve in many calibrated stations. It can be said in general that the results of the simulation is acceptable for assessing the availability of surface water resources through the generated time series of the flow and its monthly flow duration curves.



Source: JICA Project Team

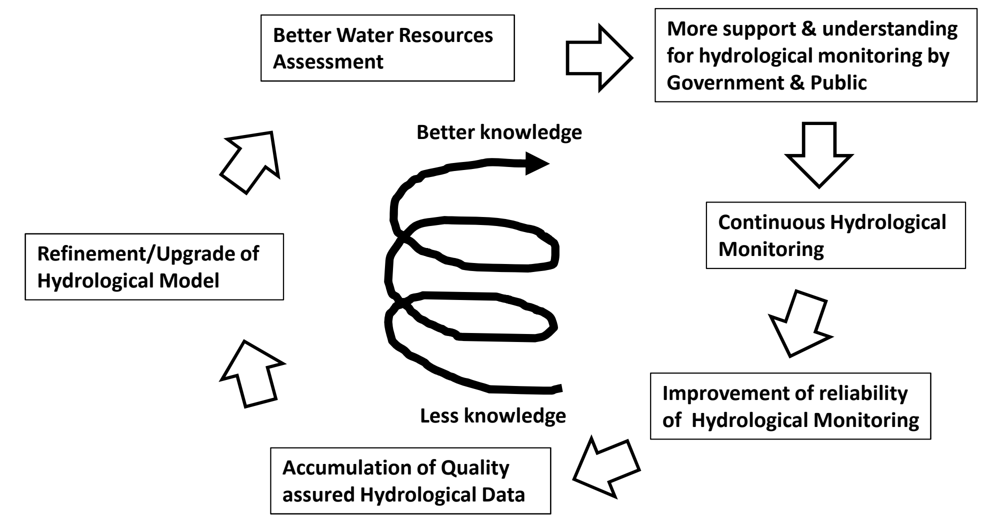
Figure SR2-22 Comparison between Monthly Flow Duration Curve prepared by Observed Discharge and That prepared by Simulated Discharge

(4) Limitation and Improvement of the Model

<u>Limitation of the Model</u>

The results of the simulation model are the best efforts in the project with utilizing currently available data, information and resources. It was confirmed that the model output reasonably agree with the observed discharge in the range of 10-90% in the probability of exceedance for the monthly flow duration curve. However, it should be careful to apply the model output to the outside of the range.

In HA-6 as well as the delta area, there are less hydrological stations with good hydrological data. Especially, there are almost no hydrological stations in the southern plain area. At this moment, the model parameters calibrated in the mountainous area in HA-6 are applied for this area, and the flow was estimated based on it. This assumption should be noted. It is recommended to study further when the observed data will be accumulated in future.



Source: JICA Project Team

Figure SR2-23 Improvement of the Model by Accumulation of Quality Assured Hydrological Observation Data

Improvement of the Model by Accumulation of Quality Assured Hydrological Observation Data

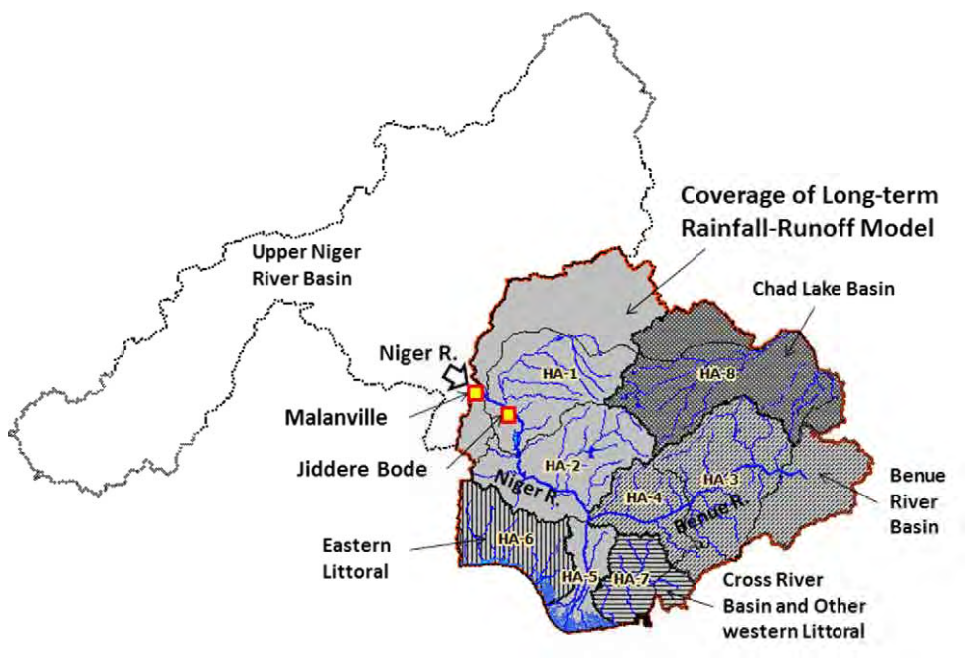
For better assessment of water resources, it would be required to refine and/or upgrade the model based on the accumulated quality assured hydrological observation data in future. In order to improve the understanding for the wide variety of hydrological system in Nigeria, it is important to continue i) continuous hydrological monitoring, ii) improvement of reliability of hydrological monitoring, iii) accumulation of quality assured data and iv) refinement/upgrade of hydrological model, as a cycle, and consequently improve the entire system, as shown in Figure SR2-23.

SR2.3.4 Surface Water Resources Potential in Quasi-Natural Condition

(1) Basis for Estimation of Surface Water Resources Potential

In the Project, the simulated results by long-term rainfall-runoff simulation model are used for estimation of surface water resources potential in quasi-natural condition. The simulated results cover the entire Benue river basin, the Niger river basin in the downstream catchment from Malanville in Benin, and other catchment areas whose generated runoff come into Nigeria, as shown in Figure SR2-24. To estimate surface water resources potential comprehensively, it is necessary to give the discharge at Malanville as a boundary condition. The observed discharge at Malanville is available after 1970s. Therefore, it is decided to analyze the simulated runoff from 1970 to 2009 (40years), although the rainfall-runoff simulation was conducted from 1960 to 2009 (50years).

There are sometimes gaps in the observed discharge at Malanville. To prepare the seamless boundary condition of discharge from 1970 to 2009, the gaps have been filled by the correlation between the observed discharge at Malanville and that at Jiddere Bode in Nigeria. These stations (Malanville and Jiddere Bode) are the main observation stations along the main channel of the Niger River. The distance between them is about 100km. There is inflow from Sokoto-Rima River between these stations, and the Niger River increases its average discharge with 20% by this inflow. Considering the difference between the seasonal runoff condition in the Niger River and the Sokoto-Rima River, the correlation was examined month by month. The correlation was reasonably good with the correlation coefficients ranges from 0.765 to 0.986. The correlations by each month are presented in Annex-F SR2-3.



Source: JICA Project Team

Figure SR2-24 Coverage Area of Long-term Rainfall-Runoff Model

(2) Runoff Yield

Figures SR2-25 and SR2-26 show spatial distribution of the average annual runoff yield and average runoff rate (runoff yield / precipitation), respectively. The average annual runoff yield (height) varies significantly across the county. In the most northern part of the county, the runoff yield is less than

20mm/year, whereas it becomes more than 1,000mm/year in the southern end. The runoff rate also changes from less than 5% to more than 50%. Such a wide variety of hydrological condition itself would be a key characteristic of Nigeria's hydrology.

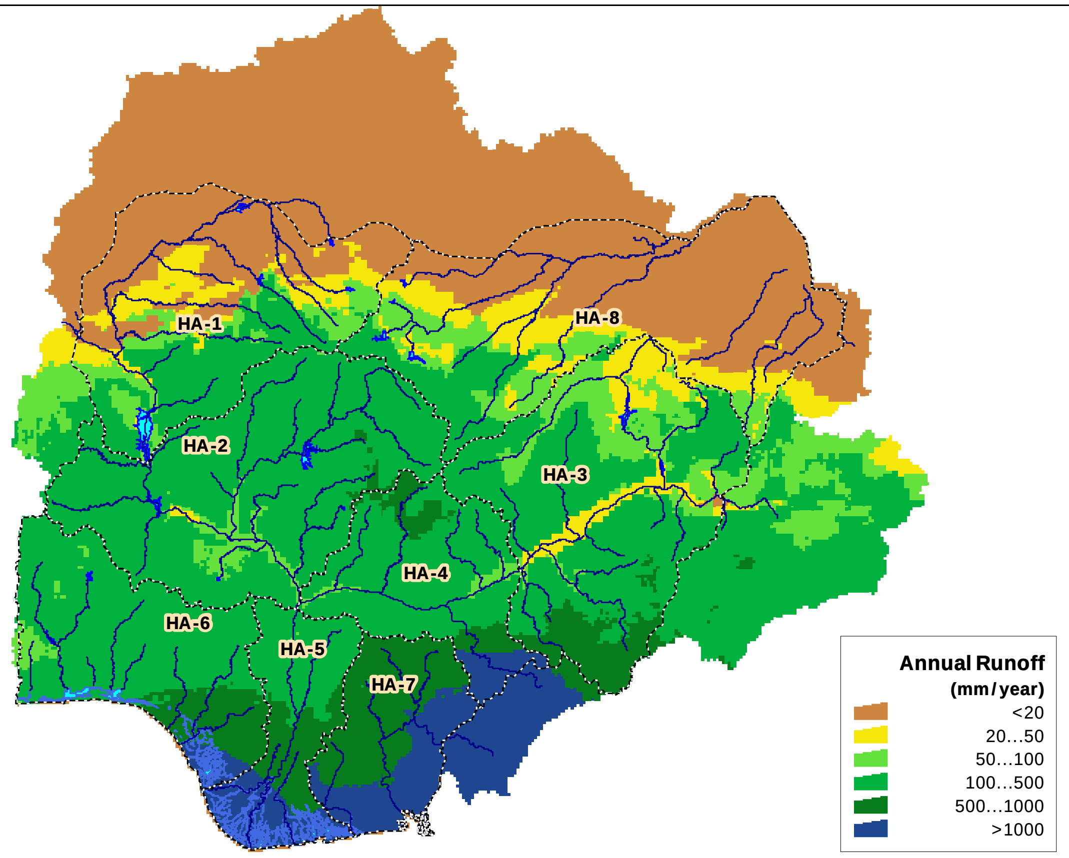
Table SR2-6 summarizes the average annual runoff yields and so on by HAs. In the table, not only the average runoff volume but also 80% and 90% dependable annual runoff volume is also shown. The runoff yields and so on by SHAs are presented in Annex-T SR2-8.

Table SR2-6 Annual Runoff Yields by HAs

	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8*	Entire Country
Area (km^2)	135,128	154,616	156,546	74,519	53,914	99,333	57,440	178,483	909,979
Average Annual Precipitation (mm/year)	767	1,170	1,055	1,341	2,132	1,541	2,106	610	1,148
Average Annual Runoff Yield (Height) (mm/year)	62	205	218	415	744	359	978	40	268
Average Specific Discharge (liter/s/km^2)	2.0	6.5	6.9	13.2	23.6	11.4	31.0	1.3	8.5
Average Runoff Rate (%)	8.1	17.5	20.7	30.9	34.9	23.3	46.4	6.6	23.4
Average Annual Runoff Volume (BCM/year)	8.4	31.7	34.2	30.8	40.1	35.6	56.3	7.2	244.3
80% Dependable Annual Runoff Volume (BCM/year)	4.7	25.6	27.7	26.2	35.3	24.8	48.3	4.0	215.5
90% Dependable Annual Runoff Volume (BCM/year)	3.9	21.4	22.1	22.0	32.9	20.3	46.6	3.0	199.1

Source: JICA Project Team

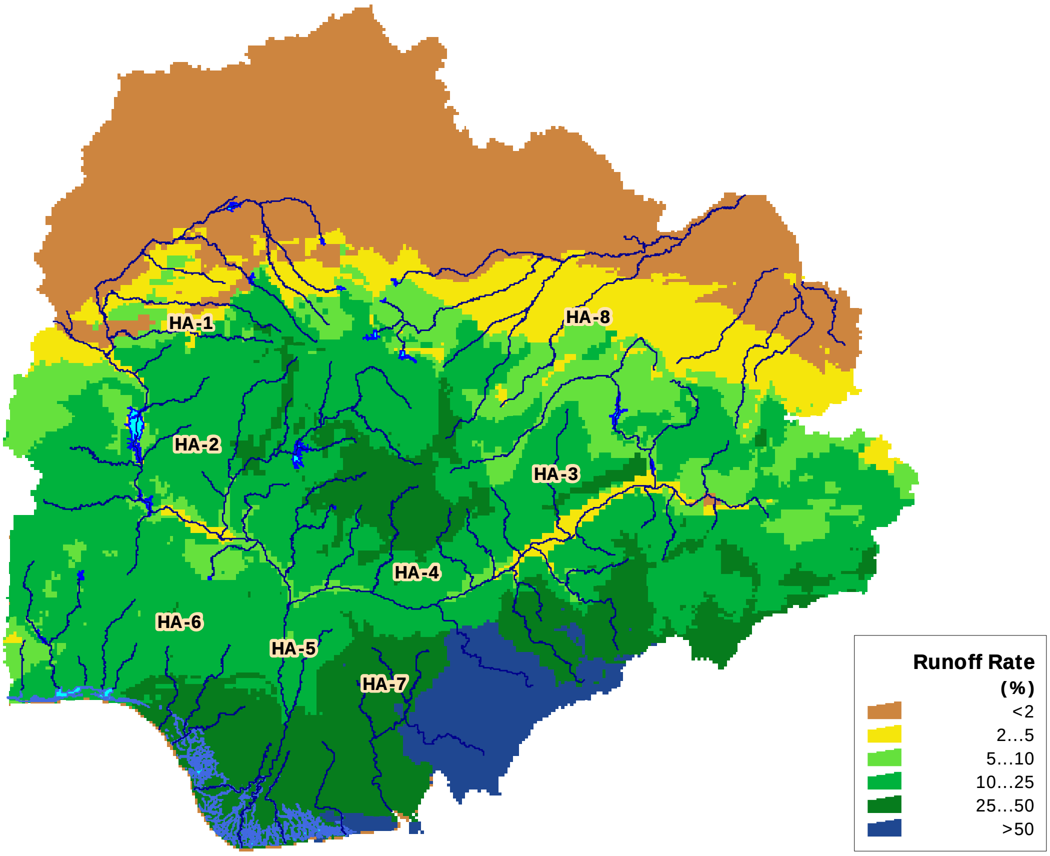
Remarks: 1) The values in the table show the internal production of runoff from the territory of Nigeria. 2) Duration of data used =1970-2009 (40years), 3)*- Loss along major rivers is not taken into account.



Source: JICA Project Team

Note: Duration of data used =1970-2009 (40years)

Figure SR2-25 Spatial Distribution of Average Annual Runoff Yield



Source: JICA Project Team
Note: Duration of data used =1970-2009 (40years)

Figure SR2-26 Spatial Distribution of Average Runoff Rate

(3) Water Balance in terms of Annual Total Runoff Volume

Figure SR2-27 shows the water balance in terms of long-term average annual total runoff volume across Nigeria.

At the Niger-Nigeria border along Niger River., the average inflow volume is estimated at 26,500MCM/year. The total annual runoff volume at the HA-1 and HA-2 border becomes 35,100MCM/year by adding the runoff from HA-1. At the outlet of HA-2, it increases to 67,400MCM/year, and after merging with Benue River the total runoff reaches to 169,690MCM/year.

The Benue River and its tributaries provide larger runoff volume than that in Niger River itself, which is 102,300MCM/year at the confluence with Niger River. The inflow from Cameroon in the Benue River system is also large; 19,790MCM/year through the main channel of Benue River, 2,870MCM/year from upper Donga River, 15,040MCM/year from upper Katsina-Ala River.

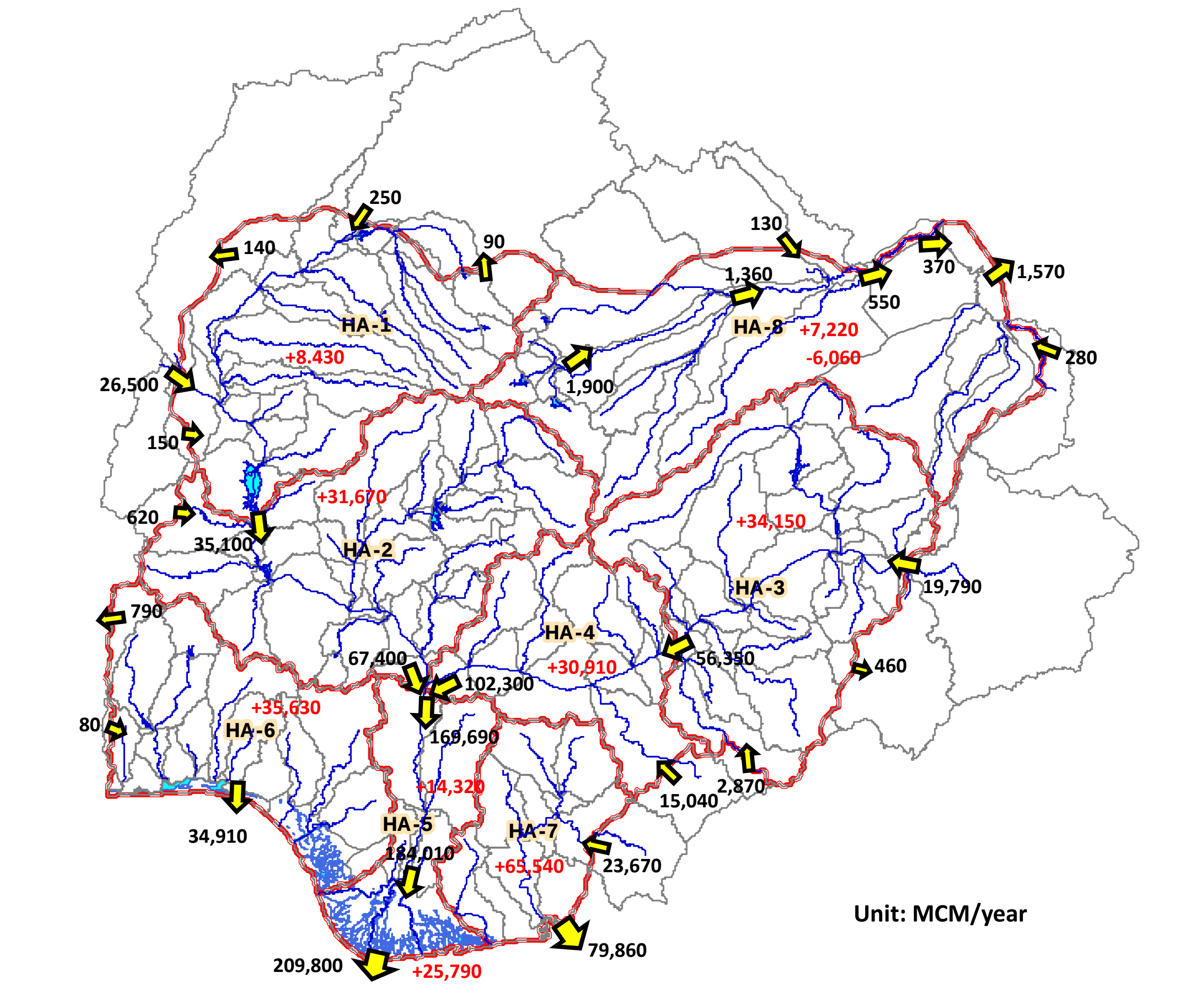
The total annual runoff volume from Cross River and other catchment in HA-7 reaches to 79,860MCM/year, 23,670MCM/year of which is provided from the territory of Cameroon.

In the delta areas in HA-5, the total annual runoff volume is estimated at 25,790MCM/year, which is considerably large volume.

In HA-8, the total generated runoff is estimated at 7,220MCM/year. However, only 1,570MCM/year reaches to the outlet of HA-8 that is Lake Chad, due to large amount of loss in the large wetland area along river system.

(4) Comparison with Estimation of M/P1995

Table SR2-7 summarizes the comparison between the estimation of surface water resources potential in the M/P1995 and that in the Project. The total water resource potential in the Project is evaluated slightly higher than that in the M/P1995. This difference may be caused by the difference in the basis for the estimations as shown below.



Source: JICA Project Team
Note: Duration of data used =1970-2009 (40years)

Figure SR2-27 Water Balance across Nigeria in terms of Long-term Average Annual Total Runoff Volume

- M/P1995: Observed discharge data during 1970s to 1980s (20years at most)
- The Project: Simulated discharge during 1970-2009 (40years), on the basis of the calibration using the observed discharge

Considering that 1990s-2000s are relatively wet periods, the slight increase of the evaluated surface water resources potential is understandable.

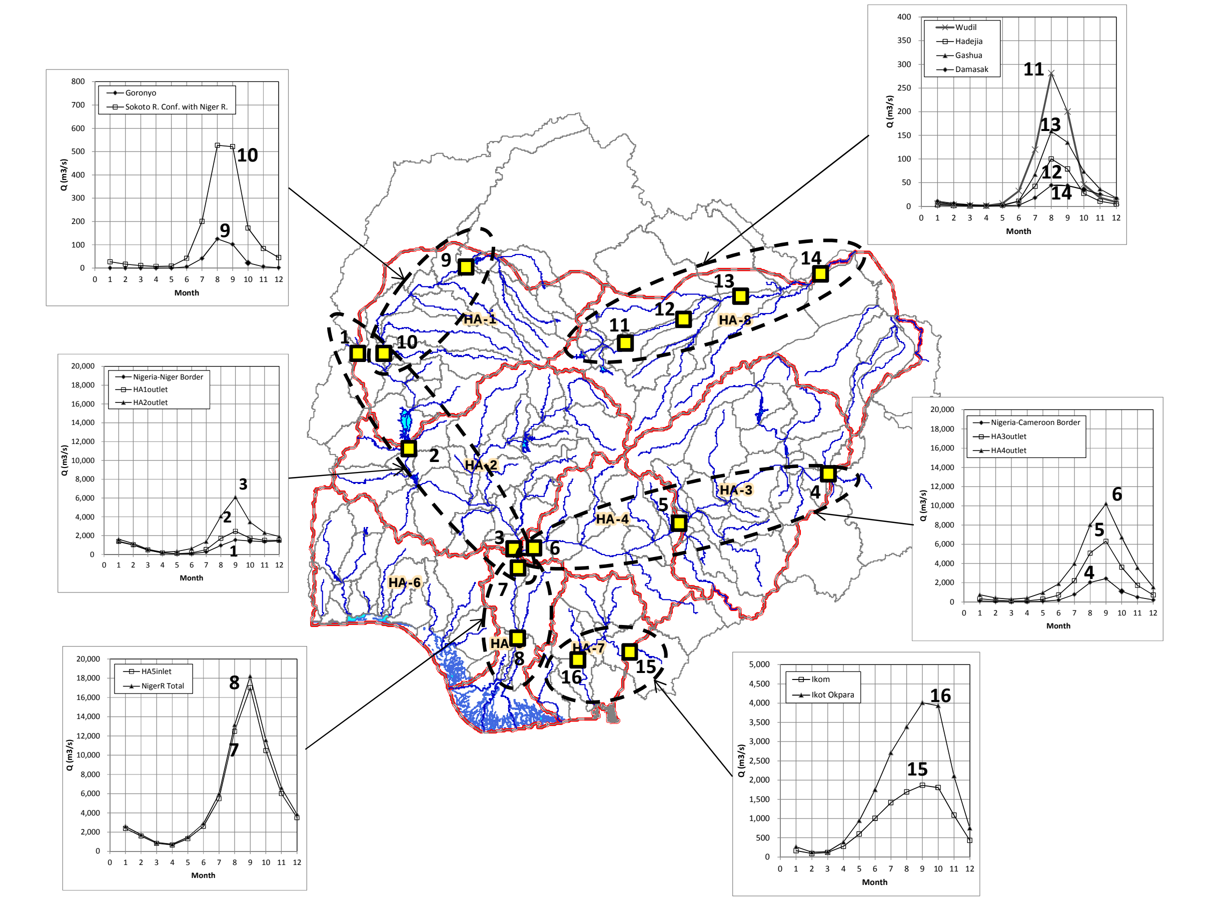
Table SR2-7 Comparison between Surface Water Resources Potential Evaluated in M/P1995 and that in the Project

Hydrological Area	Estimated Potential		Remarks
	M/P1995 (MCM/year)	The Project (MCM/year)	
HA-1	22,400	35,100	Outlet of HA-1, including water from outside of Nigeria
HA-2	32,600	32,300	Outlet of HA-2, including water from outside of Nigeria
HA-3 & 4	83,000	102,300	Outlet of HA4,including water from outside of Nigeria
HA-5 & 7	85,700*	94,180*	Including water from outside of Nigeria *Delta area in HA-5 (25,800MCM/year) is excluded.
HA-6	35,400	35,700	
HA-8	8,200*	7,200** (1,600)***	*Not outlet of HA-8, but the sum of available water at key stations **Sum of runoff yield excluding loss along rivers ***Outlet of HA-8
Total	267,300	306,780* (301,180)**	*Excluding delta area in HA-5 (25,800MCM/year) **In case that water resources potential in HA-8 is 1,600MCM/year.

Source: M/P1995 and JICA Project Team

(5) Seasonal Flow Pattern

The seasonal flow patterns in average year at representative points are shown in Figure SR2-28. There are clear dry and wet seasons. It can be understood that the usable water in dry season with stable manner is much smaller than the annual average discharge in quasi-natural condition.



Source: JICA Project Team
Note: Duration of data used =1970-2009 (40years)

Figure SR2-28 Seasonal Flow Pattern at Representative Points in Quasi-Natural Condition

(6) Available Surface Water Resources in Quasi-Natural Condition

The actually usable water with stable manner is not represented by annual average flow. For example, the discharge with more than average flow can be obtained only 50% of total duration, which means that water shortage can happen once a twice. For water supply system, much higher reliability would be required. In order to evaluate the stably usable surface water in quasi-natural condition, the following indicators were computed at the representative points (mainly at the downstream end of SHAs).

- Q_{80M}
  - 80 percentile monthly discharge for 40years [suffix M represents monthly], which may represent low flow condition.
  - This has been estimated by directly utilizing the simulated monthly discharge.
- Q_{97DS}90%Y
  - 90% yearly dependable Q_{97DS} (Q_{97DS}: 97 percentile daily discharge for a single year, which is usually called as drought discharge, [suffix D represents daily, suffix S represents single year])
  - This indicator may represent available surface water almost throughout a year (available during 97% time of a year) with 90% reliability.

- In the Project, the Q_{97DS}90%Y was estimated by the following equation as a first order approximation[21].

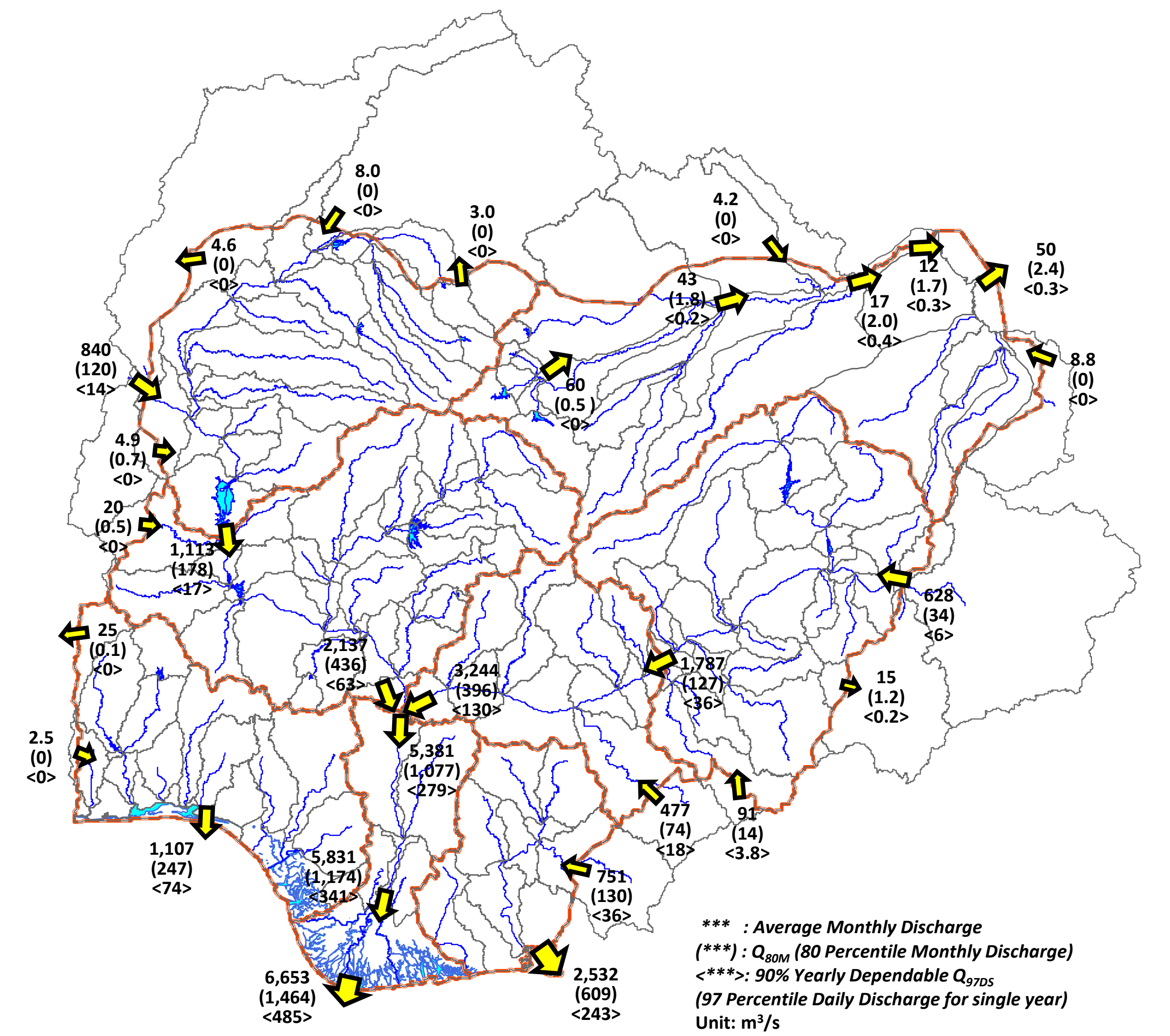
$$Q_{97DS}90\%Y = \alpha Q_{90MS}90\%Y$$

where α = empirical coefficient, and Q_{90MS}*90%Y* = 90% yearly dependable 90 percentile discharge based on the simulated monthly discharge in a single year. The empirical parameter α was set at 0.82 by using the available observed daily and monthly discharge data in the Project. The stations and duration used for the comparison between Q_{97DS}90%Y and Q_{90MS}90%Y were selected by the following criteria.

  - The complete daily data are available.
  - Observed discharge is not affected by operation of significant storage dams.
  - There seems to be no effects of backwater in rating curve.

The result of the comparison between Q_{97DS}90%Y and Q_{90MS}90%Y is presented in Annex-F 5-4.

The estimated Q_{80M} and Q_{97DS}90%Y as well as average discharge are presented in Figure SR2-29.



Source: JICA Project Team
Note: Duration of data used =1970-2009 (40years)

Figure SR2-29 Average Discharge, Q_{80M} and Q_{97DS}90%Y

The Q_{80M} is large in the central and southern areas such as Benue River and its tributaries, Cross River, which means that there is relatively high flow in low flow condition. In the northern area, the Q_{80M} is almost zero, which shows much less flow in low flow condition.

[21] The similar method to estimate the daily flow duration curve from monthly flow data has been successfully applied in South Africa in which monthly streamflow volume time series data have been traditionally used for management and development of water resources. The detail is described in "Smakhtin: Estimating daily flow duration curves from monthly streamflow data, Water SA, Vol.26 No.1, 2000. Available on website http://www.wrc.org.za"

The Q_{97DS}90%Y is 2-5% of average discharge in the central and southern areas in general. However, in the northern part of the country, it is almost zero in many places, which means that there is almost no stably usable water throughout the year in quasi-natural condition. In the northern area, it is inevitable to install storage dams for stable use of surface water throughout the year.

The Q_{80M} and Q_{97DS}90%Y at the downstream end of SHAs are shown in Annex-T-SR2-9, and those at representative points in each SHA are graphically demonstrated in Annex-F SR2-5.

SR2.3.5 Effect of Climate Change on Runoff

(1) Tendency of Observed Climate Conditions in the Past

The long-term tendency of precipitation and air temperature in the past in the entire Nigeria has been discussed in Section SR2.2, which can be summarized as follows.

- There is a linear tendency of increase in air temperature in the last 50years.
- There is a linear tendency of decrease in precipitation in the last 50years. However, the variation by decades is much larger than the linear decreasing rate.

In addition to this, according to the Bulletin issued by NIMET in 2007[22], the following tendency of climate condition in Nigeria has been observed based on the long-term meteorological data.

- Over the country, duration of rainy season during 1971-2000 becomes shorter than that during 1941-1970. The start of rainy season becomes late and the end becomes earlier.
- Annual precipitation showed a decrease of 2-8mm/year across many parts of the country. However, some places like Lokoja, Kano, Ibadan and Ondo had increase of 2-4mm/year from 1941 to 2000.
- Generally, most parts of the country showed evidence of long-term temperature increase except Jos area that is slightly cooling. The highest increase of about 1.4-1.9 degree Celsius during 1941-2000 is observed in the most south-west, the most north-west and the most north-east areas.
- Occurrence of hail has been significantly reduced or completely disappeared nowadays in many places. It indicates general warming across the country.

(2) Climate Change Scenarios

For the possible future climate conditions, climate change scenarios in Nigeria have been discussed as shown below.

<u>**4th IPCC Report**</u>

According to the 4th IPCC report (2007)[23], it is expected that the increase of air temperature in West Africa area in 2100 would be about 3-5 degree Celsius in the case of A1B scenario, which is about 1.5 times higher than the average in the world.

As for the precipitation, the predictions of precipitation by different GCM models vary very much. It is difficult to conclude the general tendency for the change in precipitation.

<u>**Nigeria’s First National Communication on Climate Change**</u>

In the Nigeria’s First National Communication (2003)[24], the climate change scenarios in Nigeria have been discussed based on several GCM model output. The following findings were noted.

- The most significant changes are with respect to temperature and temperature related parameters.
- There has been an observed trend towards aridity in Sub Saharan West Africa. This trend will be put on hold or reversed as the century progresses. There are possibilities, however, that the additional water need created by higher temperatures may not be met by the increases in precipitation.
- The difference of climate condition from coastal area to the northern part of the country could become more significant.

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[22] NIMET: Nigeria Climate Review Bulletin, 2007.
[23] IPCC-IV, Regional Climate Projections, 2007.
[24] FME: Nigeria’s First National Communication, 2003.

Others

According to Special Climate Change Unit under Federal Ministry of Environment, the Second National Communication on Climate Change is now under review for its finalization. It is expected that more detail climate change scenarios would be discussed in the Nigeria's Second Commutation, based on the results of RCM and so on. As soon as the review will be completed, the Second Communication will be opened to the public.

The World Bank has been conducted the Climate Risk Analysis in Nigeria[25]. It utilizes the output of GCMs for setting climate change scenarios.

Analysis of Downscaled Output of GCMs

In order to explore the possible change in climate conditions in future, the statistically downscaled output of GCMs, which is provided by CCAFS[26], are analyzed. The statistical downscaling as well as bias correction was conducted utilizing the spatial distribution of parameters provided by Worldclim[27] dataset. The available dataset by CCAFS includes the average monthly precipitation and air temperature with 30 year running averages from 2020s to 2080s. As for the emission scenarios, the followings are available.

- A1B:High economic growth with globalization utilizing balanced energy sources
- A2: High economic growth with regionalization
- B1: Low economic growth with globalization

At this moment, the downscaled output of the following seven (7) GCMs are available for download.

- CCCMA-GCM3.1
- CRIRO-MK3.0
- IPSL-CM4
- MPI-ECHAM5
- MRI-CCSM3.0
- UKMO-HADCM3
- UKMO-HADGEM1

The downscaled data for A1B scenario with grid scale of 10 minute are spatially averaged for each HA and other related catchment areas outside Nigeria for further analysis.

Although the outputs of the GCMs for precipitation are scattered (see Annex-F SR2-6), their average and standard deviation are computed and presented in Figure SR2-30. The following is noted from the figure.

- In general, the average change among the different outputs from the GCMs is much smaller than the standard deviation. This indicates that there is a lot of uncertainty on the change in precipitation.
- For all HAs, the precipitation tends to decrease during MAM (March, April, May) and increase during JJA (June, July, August) and SON (September, October, November).
- For the southern areas such as HA-5,-6 and-7, the precipitation tends to decrease during DJF (December, January, February), whereas it tends to increase in the central and northern areas.
- These tendencies could bring about drier dry season and wetter wet season, especially in the southern area.
- The rate of change increases gradually with time in general, which amplifies the initial direction of change.

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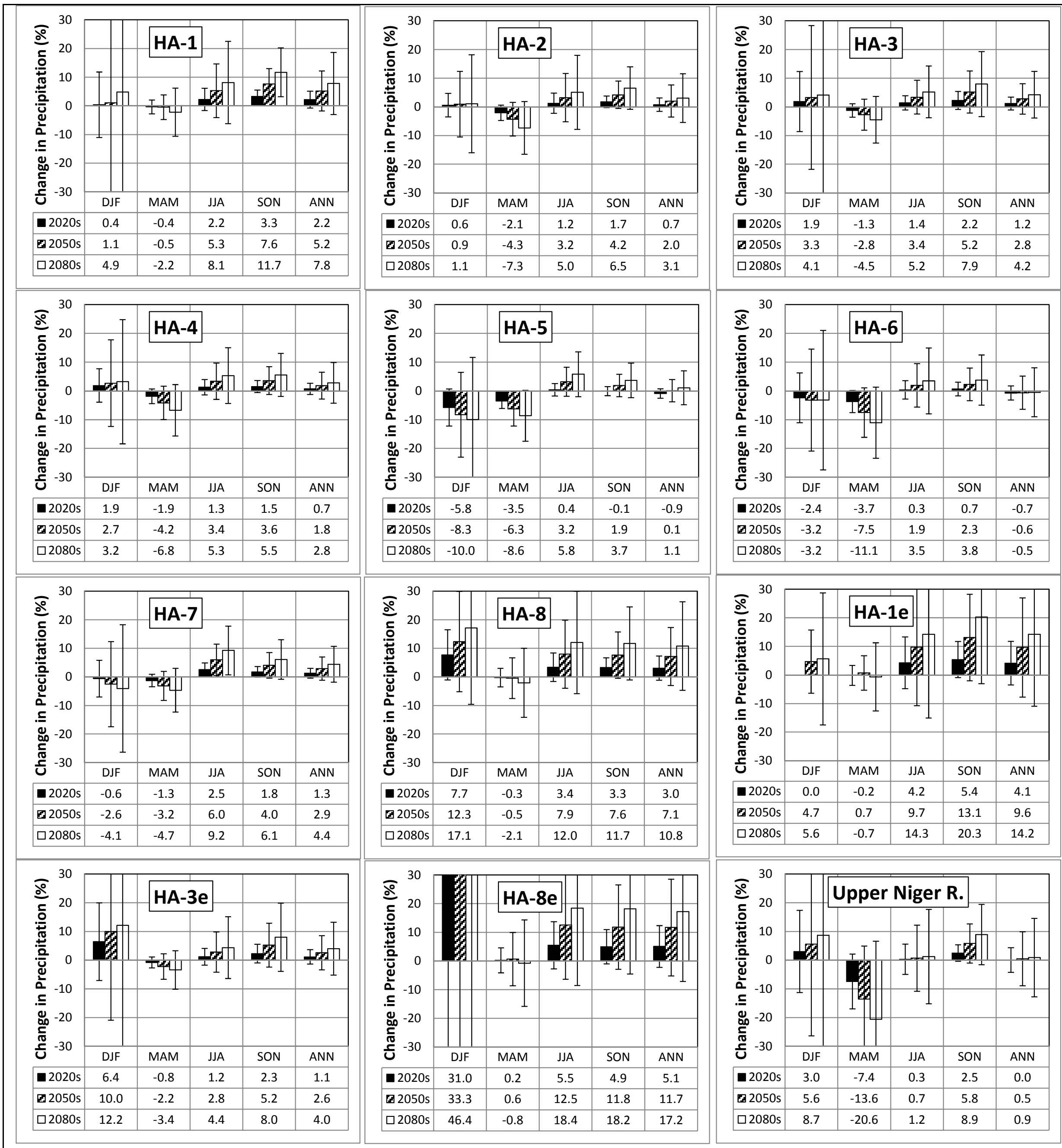
[25] World Bank: Inception Report, Climate Risk Analysis, 2011.

[26] Ramirez, J.; Jarvis, A. 2008. High Resolution Statistically Downscaled Future Climate Surfaces. International Center for Tropical Agriculture (CIAT); CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Cali, Colombia. Data are available from web-site of CCAFS http://www.ccafs-climate.org/

[27] Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Available from http://www.worldclim.org/



HA-1

	DJF	MAM	JJA	SON	ANN
2020s	0.4	-0.4	2.2	3.3	2.2
2050s	1.1	-0.5	5.3	7.6	5.2
2080s	4.9	-2.2	8.1	11.7	7.8

HA-2

	DJF	MAM	JJA	SON	ANN
2020s	0.6	-2.1	1.2	1.7	0.7
2050s	0.9	-4.3	3.2	4.2	2.0
2080s	1.1	-7.3	5.0	6.5	3.1

HA-3

	DJF	MAM	JJA	SON	ANN
2020s	1.9	-1.3	1.4	2.2	1.2
2050s	3.3	-2.8	3.4	5.2	2.8
2080s	4.1	-4.5	5.2	7.9	4.2

HA-4

	DJF	MAM	JJA	SON	ANN
2020s	1.9	-1.9	1.3	1.5	0.7
2050s	2.7	-4.2	3.4	3.6	1.8
2080s	3.2	-6.8	5.3	5.5	2.8

HA-5

	DJF	MAM	JJA	SON	ANN
2020s	-5.8	-3.5	0.4	-0.1	-0.9
2050s	-8.3	-6.3	3.2	1.9	0.1
2080s	-10.0	-8.6	5.8	3.7	1.1

HA-6

	DJF	MAM	JJA	SON	ANN
2020s	-2.4	-3.7	0.3	0.7	-0.7
2050s	-3.2	-7.5	1.9	2.3	-0.6
2080s	-3.2	-11.1	3.5	3.8	-0.5

HA-7

	DJF	MAM	JJA	SON	ANN
2020s	-0.6	-1.3	2.5	1.8	1.3
2050s	-2.6	-3.2	6.0	4.0	2.9
2080s	-4.1	-4.7	9.2	6.1	4.4

HA-8

	DJF	MAM	JJA	SON	ANN
2020s	7.7	-0.3	3.4	3.3	3.0
2050s	12.3	-0.5	7.9	7.6	7.1
2080s	17.1	-2.1	12.0	11.7	10.8

HA-1e

	DJF	MAM	JJA	SON	ANN
2020s	0.0	-0.2	4.2	5.4	4.1
2050s	4.7	0.7	9.7	13.1	9.6
2080s	5.6	-0.7	14.3	20.3	14.2

HA-3e

	DJF	MAM	JJA	SON	ANN
2020s	6.4	-0.8	1.2	2.3	1.1
2050s	10.0	-2.2	2.8	5.2	2.6
2080s	12.2	-3.4	4.4	8.0	4.0

HA-8e

	DJF	MAM	JJA	SON	ANN
2020s	31.0	0.2	5.5	4.9	5.1
2050s	33.3	0.6	12.5	11.8	11.7
2080s	46.4	-0.8	18.4	18.2	17.2

Upper Niger R.

	DJF	MAM	JJA	SON	ANN
2020s	3.0	-7.4	0.3	2.5	0.0
2050s	5.6	-13.6	0.7	5.8	0.5
2080s	8.7	-20.6	1.2	8.9	0.9

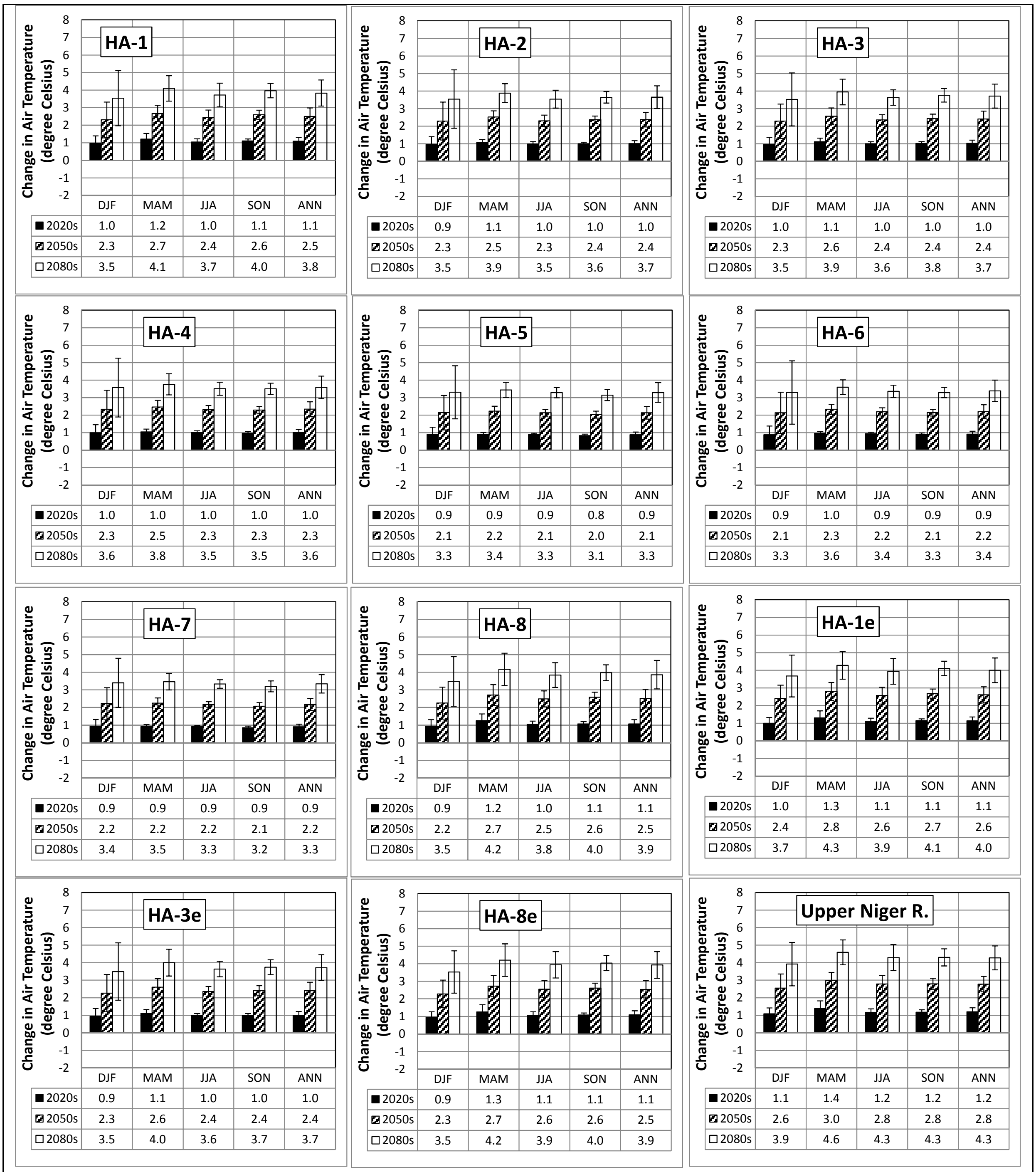
Remarks: 1) Bar and values in table show the average of different outputs from GSMs. Error bar shows the standard deviation of different outputs from GSMs.
2) HA-1e: Catchment area outside Nigeria whose runoff comes into HA-1, HA-3e: Catchment area outside Nigeria whose runoff comes into HA-3, HA-8e: Catchment area outside Nigeria whose runoff comes into HA-8, Upper-Niger R: Entire upstream catchment area of Niger R. from Malanville in Benin
3) DJF= December, January, February, MAM=March, April, May, JJA=June, July, August, SON= September, October, November, ANN=Annual
4) Scenario=A1B

Source: JICA Project Team based on CCAFS

Figure SR2-30 Changes in Precipitation derived from Outputs of GCMs

Figure SR2-31 shows the changes in air temperature derived from outputs of the GCMs. The following is noted from the figure.

- In general, the average change among the different outputs from the GCMs is much larger than the standard deviation. This indicates that there is certain change in air temperature.
- The changes are almost same for all HAs and all seasons.
- The rate of change increases gradually with time.



HA-1

	DJF	MAM	JJA	SON	ANN
2020s	1.0	1.2	1.0	1.1	1.1
2050s	2.3	2.7	2.4	2.6	2.5
2080s	3.5	4.1	3.7	4.0	3.8

HA-2

	DJF	MAM	JJA	SON	ANN
2020s	0.9	1.1	1.0	1.0	1.0
2050s	2.3	2.5	2.3	2.4	2.4
2080s	3.5	3.9	3.5	3.6	3.7

HA-3

	DJF	MAM	JJA	SON	ANN
2020s	1.0	1.1	1.0	1.0	1.0
2050s	2.3	2.6	2.4	2.4	2.4
2080s	3.5	3.9	3.6	3.8	3.7

HA-4

	DJF	MAM	JJA	SON	ANN
2020s	1.0	1.0	1.0	1.0	1.0
2050s	2.3	2.5	2.3	2.3	2.3
2080s	3.6	3.8	3.5	3.5	3.6

HA-5

	DJF	MAM	JJA	SON	ANN
2020s	0.9	0.9	0.9	0.8	0.9
2050s	2.1	2.2	2.1	2.0	2.1
2080s	3.3	3.4	3.3	3.1	3.3

HA-6

	DJF	MAM	JJA	SON	ANN
2020s	0.9	1.0	0.9	0.9	0.9
2050s	2.1	2.3	2.2	2.1	2.2
2080s	3.3	3.6	3.4	3.3	3.4

HA-7

	DJF	MAM	JJA	SON	ANN
2020s	0.9	0.9	0.9	0.9	0.9
2050s	2.2	2.2	2.2	2.1	2.2
2080s	3.4	3.5	3.3	3.2	3.3

HA-8

	DJF	MAM	JJA	SON	ANN
2020s	0.9	1.2	1.0	1.1	1.1
2050s	2.2	2.7	2.5	2.6	2.5
2080s	3.5	4.2	3.8	4.0	3.9

HA-1e

	DJF	MAM	JJA	SON	ANN
2020s	1.0	1.3	1.1	1.1	1.1
2050s	2.4	2.8	2.6	2.7	2.6
2080s	3.7	4.3	3.9	4.1	4.0

HA-3e

	DJF	MAM	JJA	SON	ANN
2020s	0.9	1.1	1.0	1.0	1.0
2050s	2.3	2.6	2.4	2.4	2.4
2080s	3.5	4.0	3.6	3.7	3.7

HA-8e

	DJF	MAM	JJA	SON	ANN
2020s	0.9	1.3	1.1	1.1	1.1
2050s	2.3	2.7	2.6	2.6	2.5
2080s	3.5	4.2	3.9	4.0	3.9

Upper Niger R.

	DJF	MAM	JJA	SON	ANN
2020s	1.1	1.4	1.2	1.2	1.2
2050s	2.6	3.0	2.8	2.8	2.8
2080s	3.9	4.6	4.3	4.3	4.3

Remarks: 1) Bar and values in table show the average of different outputs from GSMs. Error bar shows the standard deviation of different outputs from GSMs.
2) HA-1e: Catchment area outside Nigeria whose runoff comes into HA-1, HA-3e: Catchment area outside Nigeria whose runoff comes into HA-3, HA-8e: Catchment area outside Nigeria whose runoff comes into HA-8, Upper-Niger R: Entire upstream catchment area of Niger R. from Malanville in Benin
3) DJF= December, January, February, MAM=March, April, May, JJA=June, July, August, SON= September, October, November, ANN=Annual
4) Scenario=A1B

Source: JICA Project Team based on CCAFS

Figure SR2-31 Changes in Air Temperature Derived from Outputs of GCMs

(3) Scenarios for Change in Precipitation and Air Temperature

In order to assess the effect of climate change on runoff, the scenarios for change in precipitation and air temperature are set as follows.

- The scenarios refer the analysis of the statistically downscaled output of GCMs shown in the above Item (2).
- The target year of the master plan is 2030. Considering the project life time is usually 50 years for civil works, the 2030 plus 50 years should be the longest time frame to be considered. As the average condition from around 2015 to 2080(=2030+50), the results for 2050s from the output of the GSMs are referred.
- For the emission scenario, A1B scenario is adopted.
- Considering a lot of uncertainty on the precipitation, the following two cases are taken as the scenarios.
    - Case-1
        - The change in precipitation is assumed to be zero, because the output of the GCMs are too scattered and may not give any accurate prediction, especially for direction of change.
        - The change in annual mean air temperature is set at the average value of the output of the GCMs for each HA.
    - Case-2
        - The change in precipitation for each season is set at the average value of the output of the GCMs for each HA.
        - The change in annual mean air temperature is set at the annual average value of output of GCMs for each HA.
- Table SR2-8 shows the change rate for precipitation and the absolute change in air temperature for each case.

Table SR2-8 Scenarios for Change in Precipitation and Air Temperature

Case	Item	Season	HA-1	HA-2	H-3	HA-4	HA-5	HA-6	HA-7	HA-8	HA-1e	HA-3e	HA-8e
1	P (%)	ANN	0	0	0	0	0	0	0	0	0	0	0
	T (^oC)	ANN	+2.5	+2.4	+2.4	+2.3	+2.1	+2.2	+2.2	+2.5	+2.6	+2.4	+2.5
2	P (%)	DJF	+1.1	+0.9	+3.3	+2.7	-8.3	-3.2	-2.6	+12.3	+4.7	+10.0	+33.3
		MAM	-0.5	-4.3	-2.8	-4.2	-6.3	-7.5	-3.2	-0.5	+0.7	-2.2	+0.6
		JJA	+5.3	+3.2	+3.4	+3.4	+3.2	+1.9	+6.0	+7.9	+9.7	+2.8	+12.5
		SON	+7.6	+4.2	+5.2	+1.8	+1.9	+2.3	+4.0	+7.6	+13.1	+5.2	+11.8
	T (^oC)	ANN	+2.5	+2.4	+2.4	+2.3	+2.1	+2.2	+2.2	+2.5	+2.6	+2.4	+2.5

Remarks:
1) P = Precipitation, T=Air Temperature
2) HA-1e: Catchment area outside Nigeria whose runoff comes into HA-1, HA-3e: Catchment area outside Nigeria whose runoff comes into HA-3, HA-8e: Catchment area outside Nigeria whose runoff comes into HA-8
3) DJF= December, January, February, MAM=March, April, May, JJA=June, July, August, SON= September, October, November, ANN=Annual

Source: JICA Project Team

(4) Simulated Runoff under the Scenarios for Change in Precipitation and Air Temperature

The long-term rainfall-runoff simulation model was utilized for estimating the effect of the change in precipitation and air temperature on runoff. In the simulation, only the precipitation and PET were modified, based on the scenarios shown in Table SR2-8. The time-series data of precipitation and PET during 1959-2009 have been modified for each scenario by multiplying the change rate. The change rate of PET was computed by the following equation, assuming the Hamon equation to estimate PET.

$$\frac{PET}{PET_0} = exp(0.062\Delta T)$$

where PET = potential evapotranspiration with changed air temperature, PET_0 = original potential evapotranspiration, ΔT = absolute change in air temperature.

Table SR2-9 summarizes the response of internal annual runoff volume, which is generated in the territory of Nigeria, to the change in precipitation and air temperature, on the basis of the simulated results (see also Figure SR3-32 for seasonal variation).

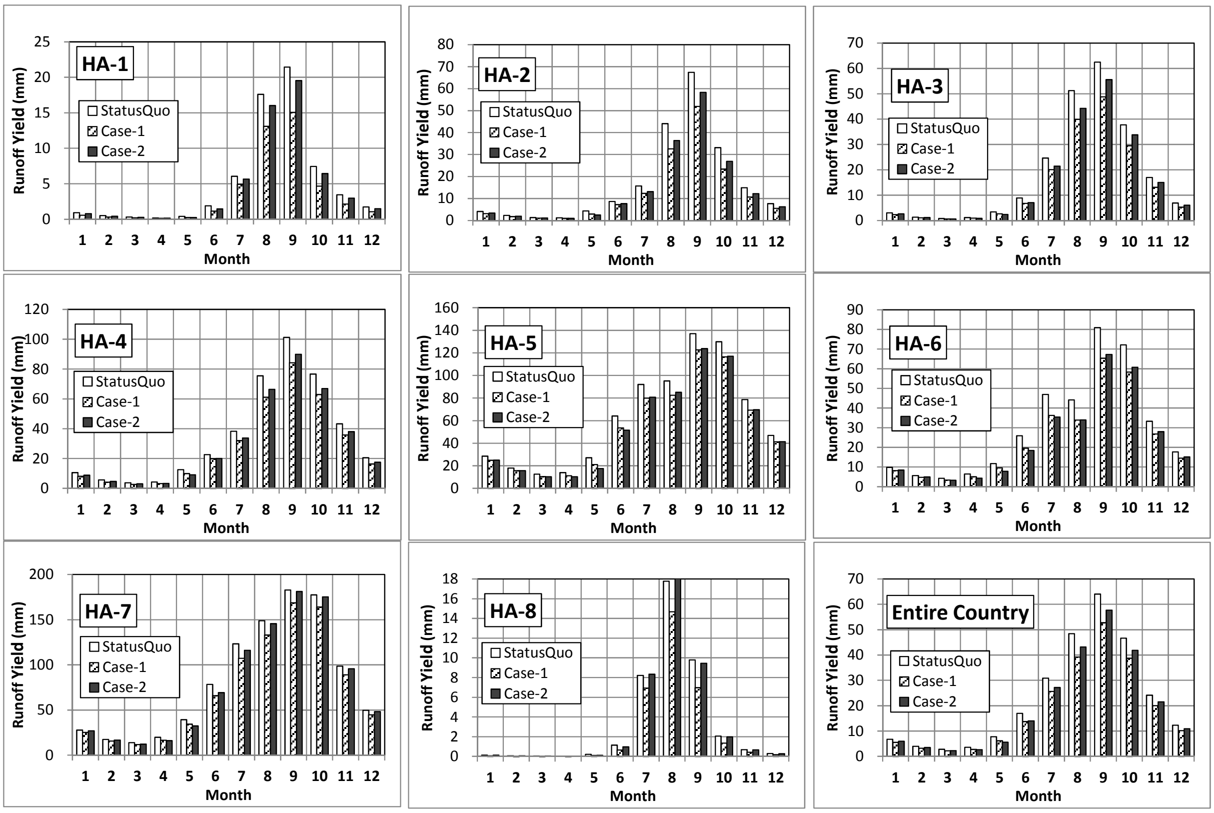
The followings are noted.

- The expected change in air temperature could bring about the reduction of annual runoff with about 20% (Case-1).
- The response of runoff against the expected change in precipitation is more sensitive in the area with less precipitation. It could mitigate the impact of the expected change in air temperature in the northern area (Case-2).
- The decreasing rate of 80, 90% dependable annul runoff volume is larger than that of the average runoff volume in general, which indicates that drought condition would become severer.

Table SR2-9 Response of Internal Runoff Volume to Change in Precipitation and Air Temperature

Case	Item	Entire Country	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8
1	Ave. ARV (%)	-18	-30	-26	-22	-18	-13	-20	-11	-22
	80% Dep. ARV (%)	-19	-38	-31	-25	-20	-14	-26	-12	-21
	90% Dep. ARV (%)	-20	-42	-33	-26	-21	-15	-20	-13	-21
2	Ave. ARV (%)	-12	-10	-17	-13	-13	-13	-20	-4	0
	80% Dep. ARV (%)	-14	-18	-20	-15	-14	-15	-22	-6	-1
	90% Dep. ARV (%)	-13	-22	-23	-16	-16	-16	-20	-7	-2

Remarks: Ave. ARV=Average Annual Runoff Volume, 80% Dep. ARV = 80% Dependable Annual Runoff Volume, 90% Dep. ARV=90% Dependable Annual Runoff Volume
Source: JICA Project Team



Source: JICA Project Team

Figure SR3-32 Response of Seasonal Variation of Internal Runoff Height

SR2.3.6 Surface Water Quality

(1) General Condition of Surface Water Quality

It is difficult to assess the general condition of surface water quality in Nigeria, because no systematic water quality monitoring and analysis is implemented. The current water quality being monitoring implemented by the Water Quality Laboratories of FMWR is conducted poorly for proper water quality assessment of watercourses in Nigeria, due to financial constraints. A few studies performed were conducted on ad-hoc basis or on the request of some governmental institutions or in the frame of EIA of some projects.

(1-1) Study on the Status of Water Resources Management in Nigeria

This Study was conducted in 2011, on the request of NIWRMC. The Study summarized the general condition of water quality based on some available data on water quality at various locations all over Nigeria as indicated in the bellow table:

Table SR2-10 Summary of General Condition of Water Quality Based on Available Water Quality Data at Various Locations all over Nigeria

Parameters	Unit	Average	Standard[1]
Temperature	degree Celsius	20-29.5	(2)
pH		5.5-9.0	6.5-8.5
Conductivity	uS/cm	< 100	-
Turbidity	NTU	2-94	Not exceed 10 over natural condition
TDS	mg/l	12-3005	-
N03	mg/l	20-70	9.1
Total hardness	mg/l	18-89	-
Phosphate	mg/l	0.04-0.9	3.5
Dissolved oxygen	mg/l	3-10	Min 6.0

Source: NIWRMC: Draft Final Report on the Status of Water Resources Management in Nigeria, 2011.
(1) National Environmental (Surface and Ground Water Quality Control) Regulations, 2011, for fishery and recreational water use.
(2) Except in designated thermal mixing zones, temperature increase by a 7-Day Average of the Daily Maximum temperatures of surface waters shall not be more than 0.3ºC above natural background conditions

This study said that the surface water quality is of good to moderate quality near its source and is degraded when passing through urban centers, industrial and agricultural areas, in general. It should be noted that there is no information on the location of the sampling and the number of sampling in the report of this study. This summary should thereby be representing only general tendency.

(1-2) Data Gathering for Development of Baseline Data for Water Quality Laboratory and Monitoring

This Study was started in 2011, on the request of the FMWR, Department of Water Quality and Sanitation. The draft result of the Study was presented in March 2012 to the FMWR and it is under revision. The Study consisted in the analysis of surface and underground water. The Study was divided for two Zones: The Northern zone of the Country and the Southern zone of the Country.

This study is the first comprehensive water quality survey to cover the entire Nigeria. However, the samplings are limited to only two times (one in wet season and another in dry season). It is necessary to continue the survey and accumulate the water quality data.

The JICA Project Team had access to the draft report of this Study and made a preliminary evaluation by comparing the results of the water analysis with the following Standards:

- National Environmental (Surface and Ground Water Quality Control) Regulations,2011(for fishery/recreational water use and for irrigation &reuse water use)
- Standard for Drinking Water (Nigerian Industrial Standard, NIS 554, 2007)

In general, the followings can be said for these Standards.

<u>**Drinking Water Quality Standard**</u>

The Federal Ministry of Health (FMH) in collaboration with the Standards Organization of Nigeria (SON) had developed the present Standard in 2007 known as Nigerian Industrial Standard NIS 554:2007 on Drinking Water Quality. According to this Document, the FMH shall be responsible for Drinking Water Quality Surveillance in Nigeria and shall be the lead institution enforcing Nigerian Standard for Drinking Water Quality, while the FMWR shall develop procedures for the sitting of new water sources for drinking water supply and the construction guidelines for water facilities. The Document also states that the FMWR shall compile data on quality of surface and ground water and provide such data to FMH and other relevant agencies while the Federal Ministry of Environment (FME) (in consultation with relevant institutions) shall be responsible among others for the development of procedures for the establishment of protection zone around water sources intended for human consumption and the protection, restoration and preservation of watershed.

When comparing the Nigerian Drinking Water Quality Standard with WHO Guidelines, the value of Cu (1mg/l) is higher than the WHO value (0.05 mg/l). Cu is an essential element for humans. However, very large single or long-term intakes of copper may harm the health. Other element is Mg (0.2 mg/l) that is too low in the Nigerian Standard than the WHO value (50 mg/l). The JICA Project Team had confirmed that this value was wrong and that the right value is 20 mg/l.

Annex-T SR2-10 shows the comparison of some parameters for the both Nigerian Standard and WHO Guidelines.

Surface Water Quality Standard

The National Environmental Policy states the necessity of specification of water quality criteria for different water uses. So far, the surface water quality criteria was developed for recreational and fishery and for irrigation uses, lacking the criteria for other uses such as for domestic and industrial uses.

The parameters used by JICA Project Team as indicators to evaluate the status of the water environmental quality of the rivers are BOD and DO values. The content of dissolved oxygen in the river is essential for the aquatic living environment while the BOD gives an indication of the state of pollution. BOD and DO values were assessed by comparing with the National Environmental (Surface and Ground Water Quality Control) Regulations, 2011.

Additionally, the found values of metals were compared with the Standard for Drinking Water (Nigerian Industrial Standard, NIS 554, 2007) in order to assess their current levels.

Preliminary Evaluation for Northern Zone

Table SR2-11 presents the preliminary evaluation on water quality for the Northern Zone.

The major points to be highlighted in terms of water quality in the northern zone are as follows:

- Generally the water quality of rivers is good in the wet season judging from the fact that the concentration of BOD and DO are maintained within the standards to support aquatic living environment.
- Generally the water quality of rivers tends to be diminished in the dry season which is attributable, among others reasons, to the lower self-purification efficiency due to the low flow of the water courses.
- Presence of heavy metals had been detected in some rivers that call for further water monitoring research in order to understand their causes and to promote a sound management of the water quality of those affected rivers.
- Since the samplings were limited to only two times, the trends of the found values cannot be assessed and they should be considered as preliminary results only. It is recommended strongly to continue on sustainable manner the monitoring of these watercourses to arrive to a solid conclusion about the water quality.

Preliminary Evaluation for Southern Zone

Table SR2-12 presents the preliminary evaluations on water quality for the Southern Zone:

The major points to be highlighted in terms of water quality in the southern zone are as follows:

- Generally the water quality of rivers is good both in the wet season and dry season judging from the fact that the concentration of BOD and DO are maintained within the standards to support aquatic living environment. This is attributable, among others reasons, to the higher rain pattern in the zone that helps to maintain the self-purification efficiency of the water courses.
- Presence of heavy metals had been detected in some rivers that call for further water monitoring research in order to understand their causes and to promote a sound management of the water quality of those affected rivers.
- Since the samplings were limited to only two times, the trends of the all found values can not be assessed and they should be considered as preliminary results only. It is recommended strongly to continue on sustainable manner the monitoring of these watercourses to arrive to a solid conclusion about the water quality.

Table SR2-11 Preliminary Evaluation of Water Quality Status of Some Rivers in the Northern States of Nigeria

N	State	River Name	Code	Wet Season		Dry Season		NFA
				BOD	DO	BOD	DO	
1	Katsina	River Sokoto at Ajiwa Dam	SW/001	1.9	6.7	3.1	3.4	Ni
2	Kano	River Challawa at Chalawa WTP	SW/001	1.9	8.1	3.8	3.5	-
3		River Challawa at Challawa George Dam	SW/004	13.0	1.8	4.8	3.2	Cu, Ni, Cd
4		River Kano at Tiga Dam	SW/003	3.9	9.9	3.5	3.3	-
5	Zamfara	River Sokoto at Gusau WTP	SW/002	2.6	8.8	8.2	3.1	Ni
6		River Gagre at intake Kaura Namoda WTP	SW/003	2.6	6.6	8.2	3.2	Ni, Zn
7	Jigawa	River Ogwala at Birnin Kudu	SW/001	2.9	9.4	6.8	2.6	Cu
8	Niger	River Kaduna at oulet of Shiroro Dam	SW/001	0.3	12.4	4.8	3.4	Cd
9		River Chanchaga at Mina	SW/003	0.1	12.5	3.1	2.4	-
10		River Gurara at Izon	SW/004	0.2	13.0	3.2	2.4	Ni
11		River Gbako at Bida WTP	SW/006	0.4	12.5	7.5	3.3	Cd
12		River Kaduna at Wuya	SW/005	0.8	12.0	4.9	3.1	Zn, Pb, Cd
13		River Niger at Jebba Bridge	SW/007	0.4	12.5	5.0	2.8	Cd
14		River Niger at New Bussa WTP	SW/002	0.2	12.2	3.4	2.8	-
15	Sokoto	River Rima at Sokoto WTP	SW/001	2.0	10.2	3.8	3.1	-
16		River Sokoto at Sokoto WTP	SW/002	3.0	10.2	3.5	2.7	Fe, Ni
17	Kebbi	River Sokoto at Kebbi WTP	SW/001	2.8	9.7	4.2	3.2	-
18		River Zamfara at Bunza	SW/003	1.8	8.8	3.4	3.1	-
19		River Ka at Fokku	SW/005	0.8	7.9	7.5	2.5	-
20	Nassarawa	River Mada at Mada WTP	SW/005	0.0	14.0	0.3	11.0	Zn, Pb
21	Kaduna	River Galma at Chika Dam	SW/001	0.5	11.2	1.0	7.9	Zn, Pb, Cd
22		River Kaduna at intake to Kaduna North WTP	SW/002	0.4	11.4	1.0	3.0	Ni, Pb
23	Plateu	Lamingo Dam at JOS WTP	SW/002	0.3	6.3	0.3	3.3	Ni, Pb, As,Cd
24	F.C.T.	River Usman at Jabi Dam	SW/001	0.5	12.4	1.0	12.5	Cu, As
25		River Usman at Usman WTP	SW/002	1.1	11.1	2.5	20.0	Cu
26	Kogi	River Niger at Koton Karfi	SW/001	0.0	3.0	7.5	3.0	Fe, Ni
27	Benue	Yandev Dam	SW/002	0.0	8.5	3.5	5.9	Cu,Ni,Pb,Cd
28		River Benue at Makurdi	SW/001	0.0	8.6	0.0	3.7	Fe,As,Cd
29		River Katsina Ala at Katsina Ala	SW/003	0.0	8.1	3.1	5.9	Ni, As,Cd
30	Gombe	River Dindima at Nafada Bridge	SW/001	0.9	4.7	1.0	3.1	As,Pb,Cd
31		River Gongola at Dadin- Kowa WTP	SW/003	0.0	4.6	0.0	3.3	As
32	Bauchi	River Gaidan Maiwa at the Bridge	SW/001	0.4	7.0	1.0	3.1	As, Pb,Cd
33		Wikki spring at Yankari Game Reserve	SW/002	0.2	3.7	0.0	4.0	Fe, As
34		Gubi Dam at intake to Bauchi WTP	SW/003	0.9	5.6	0.8	4.2	As,Cu,Ni
35	Adamawa	River Benue at intake to Yola WTP	SW/003	1.2	3.9	0.0	3.3	Fe,As,Cd
36		River Gongola at Kiri Dam	SW/001	2.8	4.3	2.8	4.3	Cd,Pb
37	Taraba	River Ibi at intake to Ibi WTP	SW/004	1.2	3.6	1.3	3.5	Pb
38		River Donga at Donga Bridge	SW/003	0.0	4.0	0.0	4.0	-
39		River Taraba at A4 Bridge, Tella	SW/001	1.0	3.6	1.2	3.4	Pb
40	Borno	River Ngadda at Alau Dam intake to Maiduguri WTP	SW/001	0.0	8.7	0.0	8.6	-
41		River Banki at Banki town	SW/002	0.0	8.8	0.0	6.5	Ni,Zn
42	Yobe	River Komadugu-Gana at Gashua	SW/002	0.9	4.7	0.7	3.6	Fe,Ni, As

Note: The number of sampling of water quality is only two times (one in wet season and another in dry season). This table shows only preliminary evaluation based on the results of these limited samples.
Unit: mg/l
Criteria:
Good quality : BOD = < 3 and 6=<DO (based on Nigeria Standard Values for surface water- recreation & fisheries)
Moderate : 3<BOD = <6 and 4=<DO < 6 (based on Nigeria Standard Values for surface water- irrigation & reuse)
Poor : BOD > 6 or DO < 4 (proposed by JICA Project Team)

NFA: need further assessment because of the presence of higher values in the samples than the standard

Table SR2-12 Preliminary Evaluation of Water Quality Status of Some Rivers in the Southern States of Nigeria

N	State	River Name	Code	Wet Season		Dry Season		NFA
				BOD	DO	BOD	DO	
1	Lagos	River Ogun at intake to Iju WTP	SW/002	0.3	12.5	0.2	13.5	Cu, Fe, Pb
2		River Ogun at intake to Adiyan WTP	SW/003	1.2	29.5	1.2	3.0	Cu, Fe, Pb
3	Ogun	River Oyan	SW/006	0.9	28.0	0.9	15.0	Cu, Fe, Ni
4		Surface water at Igbo-Ora Road by the Bridge	SW/009	0.7	33.0	0.6	5.6	Cu, Fe, Ni
5		Oyan Dam	SW/007	27.9	n.a.	27.4	n.a.	Cu, Fe, Ni, Pb
6		River Ogun at intake to Abeokuta WTP	SW/012	0.6	27.3	0.3	15.0	Cu, Ni
7	Oyo	River Osun at intake to Asejire WTP	SW/001	1.4	9.7	1.3	9.6	Fe, Pb, Cd
8		River Ona at intake to Eleyele WTP	SW/003	1.2	6.2	1.1	6.1	Fe Pb Cd, Ni
9	Ondo	Owena Coffa Dam	SW/003	0.0	3.9	0.0	3.9	Fe, Ni
10		River Owena	SW/004	0.0	5.5	0.0	5.5	Ni
11		River Ogbese	SW/008	0.0	6.3	0.0	6.5	Ni
12		Awara Dam at Ikare	SW/016	0.0	7.5	0.0	7.3	Fe
13		River Osse at Isua-Akoko	SW/017	0.0	7.2	0.0	7.3	Ni
14	Ekiti	River Osun at Ikere	SW/001	0.0	3.8	0.0	3.7	Fe, Cu, Ni, As
15		Ureje Dam	SW/004	0.0	7.3	0.0	7.3	Fe, Cu, Ni
16		River Ureje at Sije Road intake	SW/005	0.0	5.9	0.0	5.8	Fe, Cu, Ni
17	Osun	Esa-Odo Dam	SW/004	0.0	6.2	0.0	6.2	Fe, Cu, Ni
18		River Osun at Gbodofon Bridge	SW/006	0.1	6.5	0.1	6.6	Ni
19	Edo	River Ekpeshi	SW/002	n.a.	4.9	0.0	4.9	Cu, Ni, Cd
20		Ojiramin Dam at Ojiramin	SW/004	1.9	6.7	1.9	6.9	Fe, Ni, Cd
21		River Osse	SW/007	1.8	6.8	0.9	6.3	Fe, Ni, Pb
22		Ikpoba River	SW/014	0.0	7.4	0.0	5.4	Fe, Ni, Cd
23	Delta	River Niger at the Bridge at Asaba	SW/001	1.3	7.2	1.3	7.2	Zn, Pb, Cd
24		River Ase at Kwale	SW/003	n.a.	4.5	0.0	4.4	Ni
25		River Ethiope	SW/004	n.a.	4.9	0.0	4.6	Fe, Ni, Zn
26		River Warri at Ekpan	SW/008	0.3	4.3	0.3	4.3	Fe, Pb, Cd
27		River Niger at Sapele	SW/012	0.6	4.7	0.6	4.7	Fe, Ni, Zn
28	Bayelsa	River Niger at Yenagoa	SW/004	0.9	6.0	0.9	6.0	-
29	Rivers	River Nember	SW/003	0.1	6.3	0.1	6.3	As
30		River Choba	SW/009	0.1	6.1	0.1	6.1	-
31		River Mbiama	SW/012	0.8	8.4	0.8	8.4	-
32	Akwa-Ibom	River Nyanwudo-Nkwo	SW/002	1.0	8.3	1.0	8.3	Cu, Ni, Cd
33		River Afaha Nsit	SW/007	1.2	6.4	1.2	6.5	Cd
34	Enugu	Lake Nike	SW/007	0.3	5.4	0.3	5.4	Cd
35		Oji River	SW/001	0.5	6.7	0.5	6.8	Ni, Cd
36	Imo	Otamiri River intake to Otamiri WTP	SW/008	2.8	12.8	0.0	5.4	-
37	Abia	River Imo	SW/001	7.1	21.8	0.0	4.4	Pb
38		River Aba	SW/012	4.2	6.4	1.0	4.8	Pb
39	Anambra	River Nkissi at intake to greater Onitsha WTP	SW/002	0.0	6.2	0.0	6.9	-
40		River Ufuma	SW/005	0.2	6.5	0.2	6.5	-
41		Agulu Lake	SW/007	0.0	7.9	0.0	7.2	Pb, As
42		River Ezu-Amansea	SW/012	0.3	6.2	0.3	6.2	Pb
43	Ebonyi	Ebonyi Ezillo River*	SW/001	0.0	6.5	0.0	6.9	As
44	Cross River	River Itu	SW/001	0.2	6.0	0.2	6.0	-
45		Cross River at Obubra	SW/002	0.2	6.7	0.2	6.7	Ni, Cd

Note: The number of sampling of water quality is only two times (one in wet season and another in dry season). This table shows only preliminary evaluation based on the results of these limited samples.
Unit: mg/l

Criteria:
Good quality : BOD = < 3 and 6=<DO (based on Nigeria Standard Values for surface water- recreation & fisheries)
Moderate : 3<BOD = <6 and 4=<DO < 6 (based on Nigeria Standard Values for surface water- irrigation & reuse)
Poor : BOD > 6 or DO < 4 (proposed by JICA Project Team)

NFA: need further assessment because of the presence of higher values in the samples than the standard

(2) Pollution Source and Threat to Water Quality

Water pollution sources are categorized as point and non-point sources. Point sources are wastewater coming from the households, industries and solid waste landfill sites, while, the non-point sources are those originated from the agriculture field, livestock , etc.

In Nigeria, the treatment of wastewater is poorly managed and most of them reach watercourses without any treatment. The water quality of rivers is strongly influenced by human activities especially when passing urban, industrial and agricultural areas due to poor wastewater treatment or management systems. As pollution rises, it will be more costly for the necessary treatment to make usable the water.

(2-1) Domestic Wastewater

General

Domestic wastewater in Nigeria is mainly disposed by means of flush toilets and pit latrines. The nation faces serious health threats from the inadequate sanitary facilities. According to the 2004 NDHS (Nigeria Demographic and Health Survey), 15 percent of households use flush toilet, 57 percent use traditional pit latrines and 28 percent have no facility. Majority of the rural dwellers in many parts of the country still use open defecation or direct disposal into water courses.

In Nigeria, the provider of the service for wastewater collection, transportation and disposal is the local government of each state.   So far, Abuja is the only city that is partially covered with sewerage system with wastewater treatment plant.

The JICA Project Team made a joint site observation of Abuja city with officers of Abuja Environmental Protection Board (AEPB), to check the current condition on sewage management which result is presented in the following subsection.

Current Status of Domestic Wastewater Management in Abuja City

The Abuja Environmental Protection Board (AEPB) is the Regulatory Body statutorily charged with the responsibility for the protection and management of the Federal Capital Territory (FCT) Environment. Among its functions as specified by the enabling act Nº 10, 1997, exist the control of removal and disposal of wastewaters. Among the achievements of AEPB is the efficient treatment of wastewater with the commissioning of a wastewater treatment plant.   The treated wastewater quality is as follows:

Table SR2-13 Treated Wastewater Quality in Abuja City

Parameters	pH	TSS (mg/l)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)	P04 (mg/l)	N03 (mg/l)	Cd (mg/l)	Pb (mg/l)
Values	6.97	17.5	154.5	11	26	1.2	7.7	Nill	< 0.01
Standard*	6-9	30	2000	30	-	5	20	< 1.0	< 1.0

*National Environmental Protection (Effluent Limitation) Regulation, 1991, FEPA

Among the main problems that face AEPB with regard to wastewater management are:

- Indiscriminate discharge of wastewater into the environment without treatment. People are reluctant to be connected to the sewerage system, they prefer to discharge on open drainage channels that finally pollutes nearby water courses.
- Blockage of sewers by solid waste permitting overflowing of the sewage on the road that finally reach watercourses
- Weak/ poor monitoring of illegal discharges
- Lack of enforcement of environmental regulations
- Little awareness of the people on environmental issues

Impact of Domestic Wastewater in the Water Environment

The JICA Project Team could observe in important cities of the country, how people discharge their domestic wastewater (sewage) into open drain channels which connects finally to water courses. This fact bring about the pollution of water courses degrading its quality and besides put in danger the public health of the people that may be in contact with these wastewaters. The JICA Project Team also noted that open defecation and urination in open spaces are common practices in Nigeria, even in Abuja city. These insanitary methods of excreta and sewage management have important negative effects on the public health and the water environment.

(2-2) Industrial Wastewater

General

The National Environmental Standards and Regulations Enforcement Agency (NESREA), parastatal organization from the FME, is the institution responsible in Nigeria for the elaboration of Environmental Standards and Regulations and its enforcement at country level. NESREA has promulgated the National Environmental (Surface and Groundwater Quality Control) Regulation, 2011. According to this Regulations, a person shall not release any substance into, or conduct any activity which will likely cause or contribute to pollution or adversely affect species of, the water of the nation (surface water and groundwater); without having obtained all required approvals and permits from NESREA. The application for permits shall be submitted and processed in accordance with the National Environmental (Permitting and Licensing System).

Among the type of industries in the country, the following are relevant: Oil factory, Agro-processing and manufacturing, Farming, Iron and Steel processing, Plastics, Textiles and Pharmaceuticals.

By 1992, a Study on industrial effluents from industries located near the tributaries of River Niger along its lower reaches was conducted which results are presented in the next table.

Table SR2-14 Quality of Effluents of Some Industries near River Niger and its Tributaries along its Lower Reaches in Anambra State

Industries	Effluent Discharge (m^3/day)	pH	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	TP (mg/l)	TN (mg/l)	Chloride (mg/l)	Oil & Grease (mg/l)
Breweries 1	180	7.6	406	5,849	1,770	15.4	-	165	-
Breweries 2	120	8.0	232	1,047	1,584	17.5	-	163	-
Breweries 3	200	6.8	850	1,867	-	11.7	17.2	-	-
Soft drink 1	180	9.3	375	1,366	215	7.3	-	105	-
Soft drink 2	90	9.5	178	406	364	5.8	-	81	-
Soft drink 3	80	6.3	90	345	36	3.2	-	120	-
Paint 1	1	7.3	98	5,321	679	10.5	16	108	161.4
Paint 2	0.9	7.6	59	2,256	2,558	1.8	20	112	102.2
Textile	250	10.0	400	807	-	27.6	-	-	-
Vegetable oil	150	4.8	417	-	2,096	8.6	29.9	146	1,019
Standard*	-	6-9	30	-	30	5	20	600	10

*: Permissible Limits for discharge as per FEPA 1991

From the table, all samples do not conform to the standard for wastewater discharges into the river.

FME Studies for Industrial Effluent Treatment

The most recent studies for industrial effluent treatment for four (4) cities in Nigeria were conducted by the FME through local consultants. These studies were carried out for four (4) cities including Kano, Aba, Lagos and Kaduna. The FME had provided to the JICA Project Team the related studies reports on Kano, Aba and Lagos. These studies showed that most of the industries located in these cities are polluting the watercourses. The results are summarized in Table SR2-15.

(2-3) Solid Waste

Solid waste if no properly managed may pollutes also surface water and under groundwater. The management of solid waste includes collection, transportation and disposal. The JICA Project Team could observe in important cities of the country, many illegal dumping sites along the roads, public spaces and near banks of water courses. When it rains, these solid wastes are transported to the watercourses degrading its quality.

The other important issue on solid waste management is its final disposal that must be done on sanitary landfill sites which is equipped with facilities to impede the pollution of water. In Nigeria, no sanitary landfill sites exist so far.

(2-4) Non-Point Sources

Pollution coming from fixed places belong to point pollution sources, meanwhile, such land areas as agricultural lands, urban areas, etc., which discharge sorts of pollutants belong to non-point pollution sources. In Nigeria the pollution derived from non-point sources is significant, because the country has vast lands for agricultural and livestock activities. Therefore, this could become major issues in water quality management. Nevertheless, there is not information or studies and measures for controlling pollution from non-point sources.

Table SR2-15 Summaries of FME Studies for Industrial Effluent Treatment

City	City and Industry	Waste water	Impact on Water and Social Environment
Kano	Kano is considered as a tannery center till today. The Study conducted by 2002 reported the existence of 111 industries comprising of 66 wet and 45 dry industries established in three Industrial Areas (Bompai, Sharada and Challawa). Among the wet industries, the dominant industries were tanneries, textiles and oil mills.	Only 17 % of the industries in Kano city treat their wastewater before discharging into water bodies. Almost no parameters fulfill the standard of FEPA for their discharging into watercourses.	In Kano area, the Study indicated that fishing was done at subsistence and active level. Fishing was avoided in the reach close to outfalls because the fish caught from such area contained high levels of heavy metals. The top soil of the Study Area (0-15 cm) also was significantly impacted through higher electrical conductivity, higher levels of exchangeable Na, K, Mg and Ca, and the heavy metals, particularly Pb, Ni, Zn, Cu and Cr. Excessive salts hinder crop growth. The dump heaps of waste leather around the discharge point on the receiving stream was an additional source of pollution load in Challawa. All these pollutants found in the soil may affect the agriculture and the quality of groundwater. There were many villages along the rivers that suffer from industrial wastewater impacts. Water from shallow and deep wells has changed colour to dark and the taste similar to that of potash. The children played and bathed through the polluted rivers because they have no alternative. Animals also drink from the polluted rivers during grazing. There was a big concern among the people affected by the industrial wastewater; this was as a result of the decrease of production capacity of the land or total crop failure caused by polluted rivers overflowing their banks.
Aba	Aba is a leading economic city of Abia State and one of the cities in Nigeria where the growth of both industrial and residential areas is unplanned, unstructured and unzoned. 121 industries were operating in the city and were classified into Cosmetics, pharmaceuticals, paint and chemicals, plastic products, electrical products, steel products, shoes and accessories, textiles, confectionaries, building materials, household products, garments, beverages, agro and allied products, food and beverages.	Most of the industries in Aba dispose of their wastewater untreated since they lack pollution abatement facility of any kind. Almost all samples values of BOD do not meet the Standard for their discharge into surface water.	Industries dispose of their effluents through 3 main ways: (a) discharge into Aba River, (b) direct discharge on top soil and, (c) discharge in burrow pits from where contractors are paid for routine evacuation, however, the industrialists did not know the final discharge point used by the contractors. Most of effluents generated are discharged into Aba River. Some industries discharge their effluents into Aba River very close to the water intake for potable water. Some of the industries were reported to spill large quantity of unused oil into the Aba River.
Lagos	Lagos city is the most prosperous city of Nigeria with high economic activity and holding one of the highest standards of living as compared with other cities of Nigeria. Lagos State has the greatest concentration of industry in the country. A study made in 1997 indicated that there were about 2,000 industries in Lagos State. The major polluting industries are in plastics, rubber, dyes, textiles, foods, metallurgical, chemicals and pharmaceutical sectors.	Lagos State has many water courses that receive these industrial wastewaters and ultimately drain to the Lagos lagoon Almost all samples values of BOD do not meet the Standard for their discharge into surface water.	The impact of untreated effluent was very serious on the receiving rivers in terms of chemical & organic loads. Many streams and big rivers from the hinterland flow into the ocean. Many monitoring studies of the aquatic system in the City of Lagos have been carried out which had shown that the water bodies are contaminated with a variety of pollutants. Research made on the Lagos lagoon detected the presence of heavy metals such as mercury, cadmium, nickel, lead, chromium, copper and zinc as well as hydrocarbons in the water and sediment.

Source:
FME: Studies for Industrial Effluent Treatment Facilities in Kano, Volume 1,
FME: Studies for the construction of industrial effluent waste treatment facilities in Aba, Report Nº1
FME: Studies for the construction of industrial effluent waste treatment facilities in Aba, Report Nº2
FME:Study of Industrial Effluent Treatment Facilities in Lagos City, 2002

(2-5) Deterioration of Surface Water Quality in Urban/Industrial Areas

Available data and information from some hydrological areas (HAs) that shows the current situation on deterioration of surface water quality in urban/industrial areas are presented as follows.

Niger Central Hydrological Area (HA-2)

This HA covers Kwara, Niger, Kaduna and Kogi States and the Federal Capital Territory. Major rivers in the Basin are: Kaduna, Gurara and the Niger and the major urban centers includes Abuja, Kaduna and Ilorin. The Asa River is the major river that goes through Ilorin town. Some studies made by 1994 and 2007 on this river indicated that within Ilorin it was highly polluted with bacteria (including pathogens and free-living saprophytes) and trace metals[28].

By October 5, 2011, on the request of JICA Project Team, officers of Abuja Environmental Protection Board (AEPB) took water samples from three (3) streams located in Abuja city in order to overview the current conditions of water courses crossing the city. The samples were analyzed in the Laboratory of the Wastewater Treatment Plant of Abuja City, and the results are summarized in the following table.

Table SR2-16 Water Quality of Some Streams in Abuja City

Location	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Pb (mg/l)	Cr (mg/l)	Cd (mg/l)	Salmonella (Count/l)	Shigella (Count/l)
Stream (area 8)	6.2	7.6	20	693	0.1	0.07	8.11	present	present
Stream (area Dome)	6.9	8.1	30	204	<0.1	0.003	1.81	present	present
Stream (area Modern Market Garki)	6.8	9.1	100	311	0.01	0.05	1.26	present	present
Standard*	6.5-8.5	6	3	30	0.01	0.001 as Cr^{+6}	0.005	-	-

Note:* National Environmental (Surface and Ground Water Quality Control) Regulations, 2011, for fishery and recreational water use

From the table, it is concluded that streams crossing the City of Abuja receives a high load of pollution representing these watercourses a high potential risk for the public health of the people. Since the water samples were taken on the rainy season, it is assume that the quality of these water courses will be worse in the dry season.

Niger South Hydrological Area (HA-5)

This HA consists of all rivers that drain into Niger River after its confluence with Benue River at Lokoja. The HA covers the States of Bayelsa, Rivers, Delta and parts of Anambra, Edo and Kogi. Main economic activities in the HA are industrial and petroleum exploration/processing activities, where discharge of industrial effluents, petroleum related wastes and episodic oil spill occur[29]. By 1992, a study on industrial effluents from industries located near the tributaries of Niger River along its lower reaches was conducted which results showed a high pollution load that the water bodies received from breweries, soft drinks, paint, textile and vegetable oil industries[30].

Western Littoral Hydrological Area (HA-6)

This HA covers the States of Ogun, Oyo, Osun, Ondo, Ekiti, Lagos and part of Edo. Some urban centers in the HA are: Ibadan, Lagos, Abeokuta, Ijebo-Ode, Shagamu, Akure, Ondo, Oyo, Benin, etc. Studies made on Ogun River[31] indicated that its quality deteriorates when passing through urban centers such as Abeokuta and Lagos where receives industrial and domestic wastewater. Its water quality at the intake for water supply to Abeokuta city showed a value of echerichia coli of 113 on average which may be attributable to the discharge of untreated sewage into the river. The quality of this river also was degraded by cattle market and slaughterhouse wastes located along the Ibadan-Lagos express road.

Similarly, it was reported that Ikpoba River had a high fecal and total bacterial quantity, low DO, high BOD, nitrate and phosphate attributed to the discharges of wastes from slaughterhouses. In Benin City, this River also is influenced by: (a) discharges of industrial breweries with BOD of 422 mg/l, COD of 753 mg/l and E.coli of 193 MPN/100 ml; (b) discharges of sewage and solid wastes dumped into the

[28] NIWRMC: Water Quality Control and Management, 2009, pages 47-49.
[29] NIWRMC: Water Quality Control and Management, 2009, page 35.
[30] NIWRMC: Water Quality Control and Management, 2009, page2 36-38.
[31] NIWRMC: Water Quality Control and Management, 2009, pages 6, 20, 24, 26.

river and its valley by individuals and waste management agencies altering its microbiological and physic-chemical quality.

Other researcher indicated that Benin River is negatively impacted by sawmill wood wastes at Sapele[32]. Other studies showed the evidence of continuous interaction between surface water and groundwater within Ehiope River watershed[33], thus the contamination of one commonly affects the other. Finally, a study conducted for Lagos City in 2002 indicated a strong pollution of rivers with industrial wastewater discharges. These rivers are Lashore-Ibeshe River, Shasha River, Odo Iya-Alaro River, Awosika/Aromire River, Marine Beach, Ijora Creek, Apapa Creek (Lagos State). Table SR2-17 shows some characteristics of these rivers on 2002 year[34].

From the table it can be concluded, that many Rivers of Lagos State present signal of pollution and do not meet the current standards on surface water for fishery and recreational use.

Table SR2-17 Water Quality of Some Rivers in Lagos State

Location	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Oil & Grease (mg/l)	Fe (mg/l)	Pb (mg/l)	Cr (mg/l)
Odo Iya-Alaro River	-	1,818	3,800	18.70	10.10	0.80	0.24
Shasha River	0.7	200	880	0.94	12.10	0.26	2.97
Lashore-Ibeshe River	-	250	960	0.42	10.15	2.65	0.76
Awosika/Aromire River	1.8	35.3	160	10.09	10.84	0.25	0.16
Standard*	6	3	30	0.01		0.01	-

Note:* National Environmental (Surface and Ground Water Quality Control) Regulations, 2011, for fishery and recreational water use

Eastern Littoral Hydrological Area (HA-7)

This HA covers Abia, Anambra, Imo, Enugu, Ebonyi, Cross River, Akwa Ibom and Rivers States. Major rivers in the HA are: Cross River, Imo River and its tributary, Aba River, etc. A study conducted for Aba city in 2002 indicated a strong pollution of Aba River with industrial wastewater discharges. The following table shows some characteristics of Aba River[35].

Table SR2-18 Water Quality of Aba River in Aba City

Location	Colour	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Oil & Grease (mg/l)	Fe (mg/l)	Pb (mg/l)	Cr (mg/l)
Aba River, Upstream of industrial area	Colorless	5.2	0.4	14.8	99	0.1	0.53	<0.03	0.005
Aba River, AWW Intake	Light brown	5.0	0.5	10.0	80	ND	0.25	<0.03	<0.004
Aba River, Dow stream	Brown	5.2	NA	NA	119	ND	0.61	<0.03	<0.004
Standard*	-	6.5-8.5	6	3	30	0.01			

Note:* National Environmental (Surface and Ground Water Quality Control) Regulations, 2011, for fishery and recreational water use

Lake Chad Hydrological Area (HA-8)

The Lake Chad river basin covers seven countries (Nigeria, Niger, Algeria, Sudan, Central Africa, Chad and Cameroon), although only four (Nigeria, Niger, Chad and Cameroon) are in direct contact with the lake. In Nigeria, the area that drains into the Lake lies in the northeastern part of the country and covers Kano, Yobe, Jigawa, Borno, Adamawa and Bauchi States. In this HA are located small and large-scale irrigation projects in which insecticides and fertilizers are used.

A research made by 2005 on 24 surface water samples from various locations in the HA has revealed that all samples, except one sample of a small tributary of Hadejia River, the nitrate concentrations exceeded the current standard on water quality of 9.1 mg/l. These results indicates that irrigation projects as well as urban waste and discharges from industries, especially tanneries, textile mills and abattoirs in Kano and other urban areas, are contributing to the deterioration of the water quality in the

32 NIWRMC: Water Quality Control and Management, 2009, pages 25, 27-29.
33 NIWRMC: Water Quality Control and Management, 2009, pages 7, 33.
34 Study of Industrial Effluent Treatment Facilities in Lagos City, 2002, pages 49-53.
35 Studies for the construction of industrial effluent waste treatment facilities in Aba, Report No2, pages 26, 33.

basin[36]. JICA Project Team made a field visit to Challawa Dam on September 23, 2011 and the major findings were: (a) the water in the dam presented a high turbidity. This may be attributable to the sediments that are transported into the dam in the rainy season; (b) the presence of algae was noted in the coastal parts of the Dam. This may be attributable to the entrance of nutrients coming from agriculture lands and untreated domestic and industrial wastewater; (c) the presence of weeds was noted also in the coastal part of the Dam and in the outlet of the spillway.

(3) Pollution Load

(3-1) General

In the Project, the pollution load is defined as the amount of pollutant that enters a water body taking into account its level of reduction by on-site, off-site treatment facilities. The pollution load is estimated in order to assess its impact on the surface water quality under the present and future condition. The future condition is presented for the year 2030 which is the target year of the Master Plan. The parameter BOD is selected as the indicator of organic pollution for the estimation of the pollution load. The pollution load entering the water body is estimated from domestic, industrial and livestock sources, in order to give us an understanding of its distribution and the magnitude of their impacts.

Nigeria has few researches in the field of pollution and lacks some parameters for the estimation of the generated load and reduction factors. Under this circumstance the following parameters are used:

- For unit domestic BOD pollution generation, the WHO Guideline[37] is applied considering local condition.
- As for reduction factors by on-site facilities, the WHO Guideline is taking into account by the JICA Project Team to estimate the final value to be used in this Study considering the local conditions.
- As for reduction factor by off-site treatment facilities, the Nigeria's experience is applied[38].
- As for industrial pollution generation, JICA Project Team estimated the ratio of industrial to domestic using available information in Nigeria.
- For unit livestock pollution generation, the pollution factors inserted in the Guidelines of WHO are used.

(3-2) Domestic Pollution Load

The following factors are used for estimation:

- Unit BOD Pollution Generation = 54 grams-BOD/person/day
- Reduction through on-site treatment facility
  - Septic tank = 10% BOD reduction (Tentative estimate by JICA Project Team)
  - Septic tank covered by septage treatment plant or septage treatment and disposal facility = 30% BOD reduction (Tentative estimate by JICA Project Team)
  - Latrine = 10% BOD reduction (Tentative estimate by JICA Project Team)
- Reduction through off-site treatment facility (Sewerage treatment plant)
  - Population covered by STP = 95% BOD reduction

The present and future population is given by socio-economic frame work applied in the present study. The domestic BOD pollution load is estimated by the following equation.

- Domestic BOD pollution load (kg-BOD/day) =
  Population (person) x 0.054 (kg-BOD/person/day) x Reduction factor (facilities)

(3-3) Industrial Pollution Load

The Study conducted for Kano industrial areas in 2002 by request of FME[39], estimated the pollution BOD discharge at 23,071 kg/day, which is estimated to be the same as for the year 2006 considering that in the period 2002-2005, the industrial sector had no significant change in the quantity of

36 NIWRMC: Water Quality Control and Management, 2009, page 43, 45.
37 Guidelines of WHO on Rapid Assessment of Sources of Pollution (Rapid Assessment of Sources of Air, Water, and Land Pollution, 1982, publication No.62)
38 Estimated based on Effluent Monitoring Report by Abuja Environmental Protection Agency
39 FME: Studies for Industrial Effluent Treatment Facilities in Kano, 2002.

production[40]. It is assumed that this pollution BOD discharge value is the same to the pollution BOD generation since only 17 % of the studied industries treat their wastewater, and no accurate information exists about the removal efficiency of their treatment plants, in addition, many industries even having treatment plants discharges their wastewater through by-pass directly to watercourses without any treatment.

From the above, the ratio of the industrial BOD pollution generation load to the domestic BOD pollution generation load considering the Kano industrial area population by the year 2006 becomes 0.33 as follows:

- Industrial pollution BOD generation= 23,071 kg/day
- Domestic BOD pollution generation in the industrial area (Nasarawa, Dala and Kumbotsu) = 70,716 kg/day (Population =1,309,561 and unit BOD generation= 0.054 kg/person/day)
- Ratio of Domestic pollution generation and Industrial pollution generation = 0.33

On the other hand, from the Study conducted for industries in Lagos State in 2002 by request of FME[41] and considering the same assumptions as in Kano case, the same ratio becomes 0.22. Then for this project, the average value of 0.27 is applied.

Then, the industrial BOD pollution load is estimated as follows.

- Industrial BOD pollution load (kg-BOD/day) =
  0.27 x Domestic BOD pollution generation (kg-BOD/day) =
  0.27 x 0.054 (kg-BOD/person/day) x Population (person)

The present estimation of industrial pollution load is made on preliminary base and should be revised when enough data is available in the future.

(3-4) Fishpond Pollution Load

The following unit load is applied for fishpond pollution load.

- Unit BOD pollution load = 2.74 (kg-BOD/ha/day)

The fishpond BOD pollution load is estimated by the following equation.

- Fishpond BOD pollution load (kg-BOD/year) = Fishpond area (ha) x 2.74 (kg-BOD/ha/day)

(3-5) Livestock Pollution Load

The following unit BOD pollution generation is applied. For commercial farms, there is no data showing availability of treatment facilities, therefore, the reduction of BOD through treatment facilities is not considered. Because almost all of the agricultural pollution source can be regarded as non-point source, the runoff rate is considered.

- Unit BOD pollution generation:
  - Cattle/Donkey/Camels/Horse = 250.0 (kg-BOD/head/year)
  - Goat/sheep = 36.6 (kg-BOD/head/year)
  - Pig = 28.4 (kg-BOD/head/year)
  - Poultry = 1.4 (kg-BOD/head/year)
- Runoff rate =0.10

The livestock BOD pollution load is estimated by the following equation.

- Livestock BOD pollution load (kg-BOD/year) = Number of Livestock (head) x
  Unit BOD pollution generation (kg-BOD/head/year) x 0.10 (Runoff rate)

(3-5) Preliminary Estimation of Pollution Load

Based on the limited available information, the pollution load is preliminary estimated. The followings are assumed.

- The population for each LGA in 2010 and 2030 is given by the socio-economic framework shown in Supporting Report 1.

[40] NBS: Abstract 2009, Table 297.1: ESTIMATED QUANTUM OF PRODUCTION OF SELECTED ITEMS, 2001 – 2005.

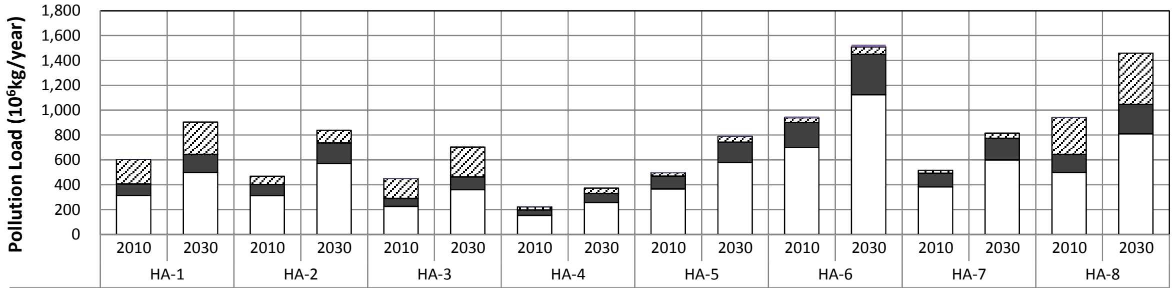
[41] FME: Studies for Industrial Effluent Treatment Facilities in Lagos, 2002.

- The number of livestock for 2010 and 2030 is given by those shown in Supporting Report 1.
- As for the condition of the sanitation facilities, the census data in 2006 are used as the current condition (2010). The cover ratio of the waste water treatment plant is set at 0.7% and 10.1% for Lagos and Abuja, respectively, based on the interview in the preset project. For other cities, the cover ratio is assumed to be zero.
- For future condition of the sanitation facilities, the development scenario for sanitation shown in Chapter 8 is applied.

The estimated total pollution load is 4,668x10^6kg/year for 2010 and 7,436x10^6kg/year for 2030.

Figure SR2-33 shows the change in pollution load by HAs. High pollution load in HA-6 and 8 in which population is concentrated is observed. There is not much difference by HAs in the increasing rate from 2010 to 2030. The domestic pollution load occupies more than 50% in general and exceeds 70% in the southern area such as HA-5, 6, 7 in which the number of livestock is small.

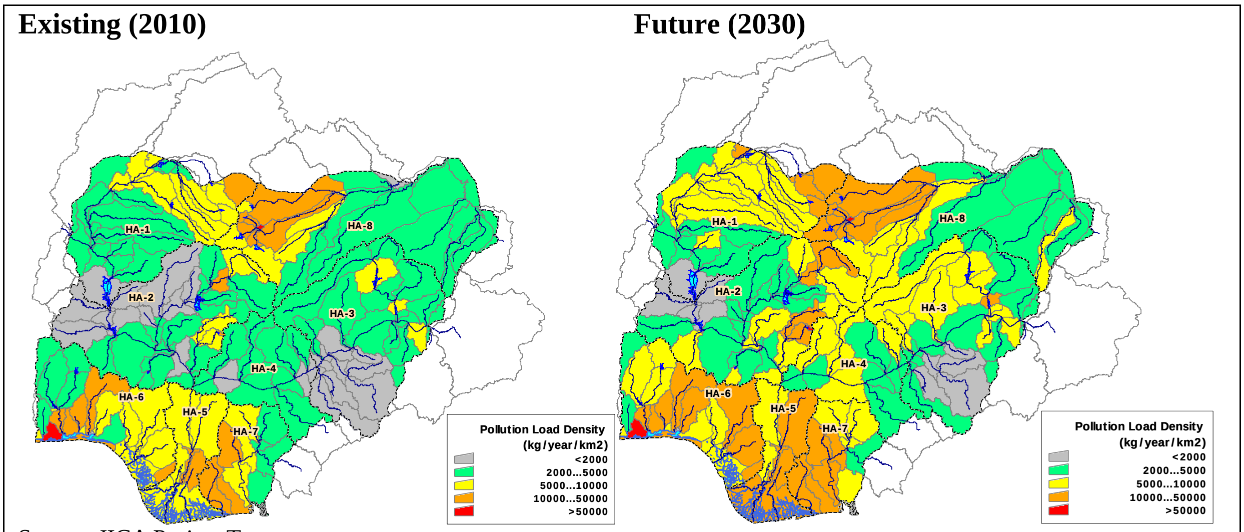
Figure SR2-34 shows the distribution of total pollution load density. Much higher pollution load density can be observed around the large cities such as Lagos and Kano. It is expected that the area with higher pollution load density extend to wider area in HA-5, 6, 7, 8 in 2030.



	HA-1 2010	HA-1 2030	HA-2 2010	HA-2 2030	HA-3 2010	HA-3 2030	HA-4 2010	HA-4 2030	HA-5 2010	HA-5 2030	HA-6 2010	HA-6 2030	HA-7 2010	HA-7 2030	HA-8 2010	HA-8 2030
Fishpond	1	1	1	2	1	1	1	1	5	8	11	17	2	4	3	5
Livestock	198	260	66	101	159	241	25	42	26	44	38	59	24	41	294	412
Industrial	91	145	91	167	65	103	44	74	105	165	203	327	111	173	146	236
Domestic	315	501	313	571	227	361	154	258	366	580	699	1,125	383	601	501	812

Source: JICA Project Team

Figure SR2-33 Change in Pollution Load by HAs



Source: JICA Project Team

Figure SR2-34 Distribution of Total Pollution Load Density

SR2.4 Groundwater Resources

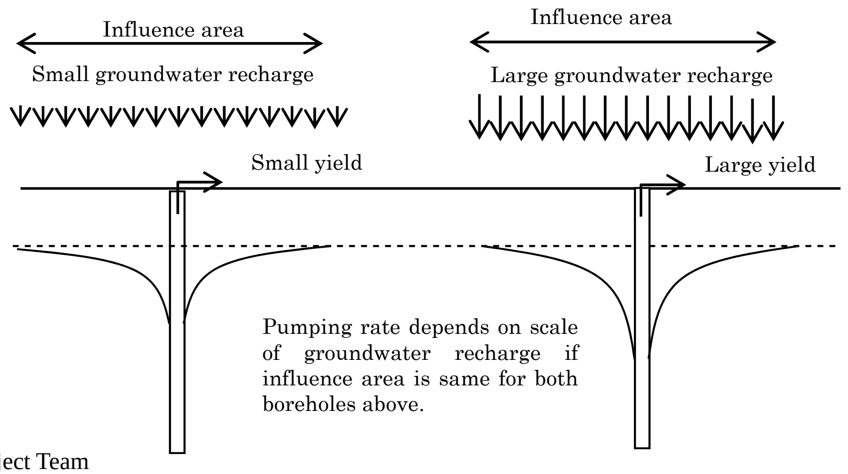
SR2.4.1 Definition of Groundwater Potential

Groundwater resource should be classified into two types as shown below for definition of groundwater potential:

- Renewable groundwater resources
- Nonrenewable groundwater resources

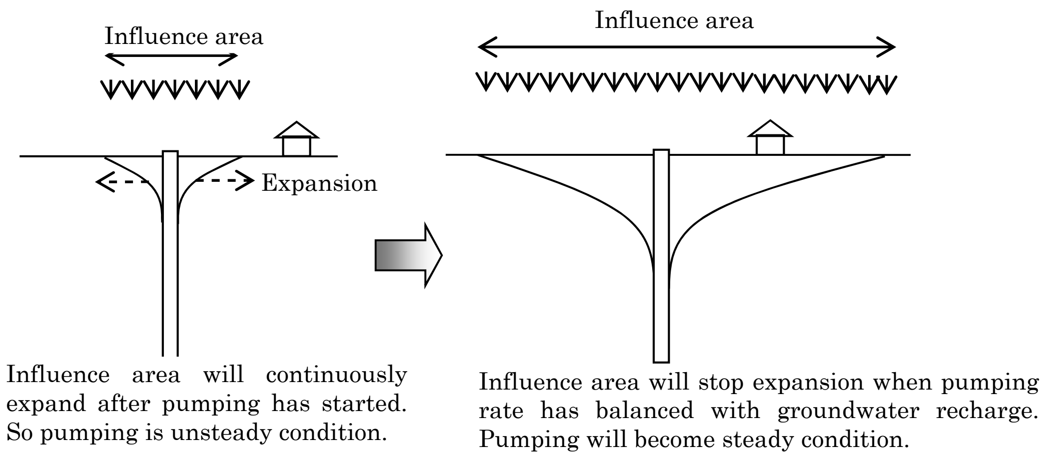
Groundwater of the aquifer will be recharged by rainfall in Nigeria where there is much rainfall. Amount of groundwater to be developed should be less than amount of groundwater recharge for sustainable development. Therefore, amount of groundwater recharge can be defined as the maximum amount of groundwater to be developed.

Groundwater will be extracted form boreholes. How much groundwater can be extracted from an individual borehole is limited. The area where groundwater level will lower by pumping and from which boreholes can collect groundwater is called as influence area (see Figure SR2-35). Influence area will be formed and continuously expanded as time after groundwater pumping has started. Expansion of the influence area will stop when pumping rate has balanced with groundwater recharge within the influence area, and pumping will reach equilibrium condition (see Figure SR2-36).



Source: JICA Project Team

Figure SR2-35 Borehole Pumping Rate with Different Groundwater Recharge



Source: JICA Project Team

Figure SR2-36 Unsteady Pumping and Steady Pumping

Dynamic groundwater level inside borehole will go down with pumping and stop going down when pumping reach steady condition. However, if pumping rate is too large, groundwater level will reach bottom of borehole before pumping reach steady condition, and pumping cannot be continued any more.

Therefore, amount of groundwater available from boreholes depends on 2 factors below.

- Groundwater recharge within influence area
- Size of influence area

As mentioned later, size of influence area depends on permeability and scale of aquifer. Hence, 2 factors above can be replaced with 2 factors below:

- Groundwater recharge
- Permeability and scale of aquifer

Above 2 factors are explained below:

(1) Groundwater recharge

Rainfall reaches the ground and infiltrate into the ground, and evapotranspiration occurs. Soil will be saturated when enough rainfall is given to the soil. If further rainfall is given to the soil, part of surplus water will flow away from soil as surface runoff, and the other surplus water will infiltrate toward aquifer to reach groundwater table as groundwater recharge. Groundwater, which flows out into the ground surface again before reaching the groundwater table, can be called as intermediate flow. Groundwater recharge can be considered as maximum amount of groundwater to be extracted. Groundwater recharge depends on amount of rainfall and type of soil. Groundwater recharge was analyzed water balance analysis including both surface water and groundwater in.

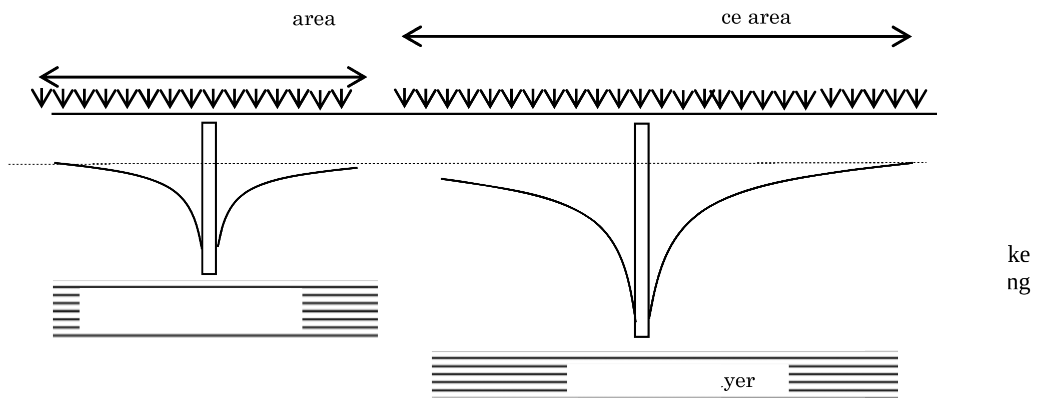
(2) Permeability and scale of aquifer

It is well known that much groundwater can be extracted in the area where there is high permeability aquifer such as sandstone. On the other hand, only little groundwater can be extracted in the area where there is poor aquifer such as shale. This example means that groundwater potential depends on permeability of aquifer in spite of amount of rainfall. This fact can be explained below:

Groundwater will finally flow into rivers so that groundwater recharge is equal to amount of base-flow. According to the analysis theory, groundwater recharge is calculated not by permeability and scale of aquifer but by rainfall and soil characteristics. However, it is true that groundwater potential depends on permeability and scale of aquifer. This means that groundwater recharge is one factor but not all for groundwater potential. Available yield from a borehole is decided by 2 factors below.

- Aquifer thickness (D)
- Permeability of aquifer (k)

Influence area is decided by thickness of aquifer as shown in Figure SR2-37.

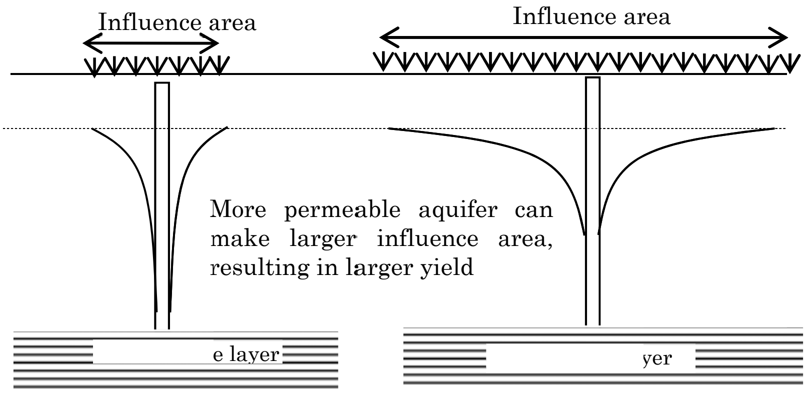


(a) Thin aquifer **(b) Thick aquifer**

Source: JICA Project Team

Figure SR2-37 Relation between Aquifer Thickness and Influence Area

Furthermore, influence area is different depending on permeability (k) of aquifer as shown in Figure SR2-38.



Source: JICA Project Team

Figure SR2-38 Relation between Aquifer Permeability and Influence Area

Available yield of borehole is function of groundwater recharge, thickness and permeability of aquifer as shown below.

$$Y = f(p, D, k) = f(p, T)$$

where f=Yield function, Y=Yield of borehole, p=Groundwater recharge, D=Thickness of aquifer, k= Permeability of aquifer, T =Transmissivity of aquifer (T=k×D).

Groundwater flow can be analyzed as steady or unsteady condition. In this analysis, groundwater flow will be analyzed as steady condition in terms of sustainable groundwater development (see Figure SR2-37 and SR2-38). Therefore, strativity parameter, which is used for unsteady condition analysis, will not be used in this analysis. Aquifer capacity and groundwater recharge is explained in this part.

(3) Important Point in Evaluation of Groundwater Potential

Groundwater recharge is evaluated as mm/year for unit area ($1\times1m^2$). Amount of groundwater recharge can be obtained from: groundwater recharge (mm/year) × area of interest (km^2). It means that amount of groundwater recharge will simply increase as area of interest is increased. However, it is difficult to take adequate area of interest beforehand. Groundwater is extracted from an individual borehole, which has its own influence area. The borehole can extract groundwater only within its influence area. Number of borehole will increase as population grows, extending influence area as shown in Figure SR2-39.

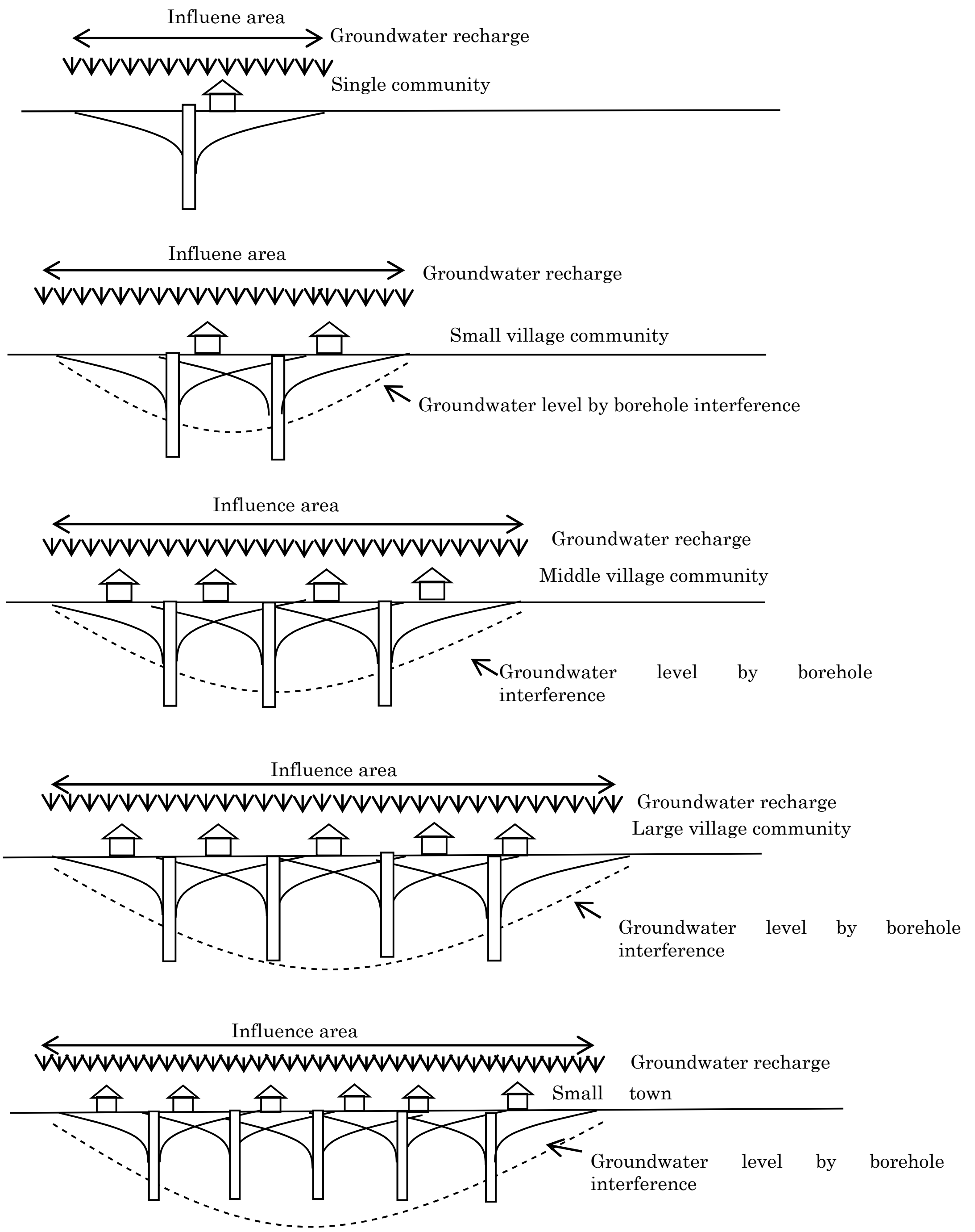
Therefore, it is important to design yield of each borehole to make borehole interference smallest for maximum extraction of groundwater in borehole field. For effective use of groundwater recharge, boreholes must be located covering adequate area, considering borehole interference and aquifer thickness.

(4) Borehole Interference

Generally, radius of influence of single borehole is widely ranging as 10m to several kilometers. It is same even in case of multiple borehole system like borehole field. Influence area will not so expand as expected if many boreholes are located within the narrow area. Then total yield from boreholes will not increase so much. On the other hand, there will be higher possibility of borehole to dry up due to borehole interference. Borehole interference is defined as groundwater level draw down of a borehole affected by pumping of the other boreholes as shown in Figure SR2-40.

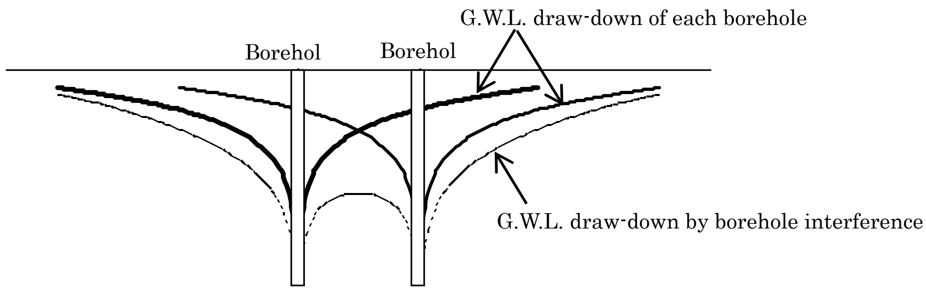
Matters below must be taken into account in groundwater development.

If boreholes are distributed in a line, draw-down of groundwater level is the maximum in the center of the line as shown in Figure SR2-41. Borehole will dry up around the center.



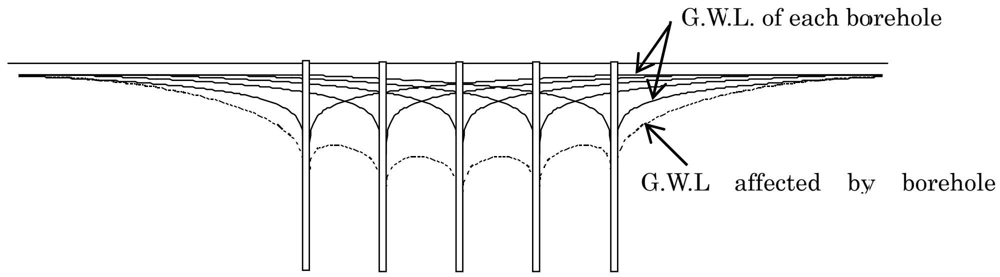
Source: JICA Project Team

Figure SR2-39 Concept of Population Growth and Expansion of Influence Area of Boreholes



Source: JICA Project Team

Figure SR2-40 Borehole Interference



Source: JICA Project Team

Figure SR2-41 Borehole Interference by 5 Boreholes

(5) Optimum Groundwater Development

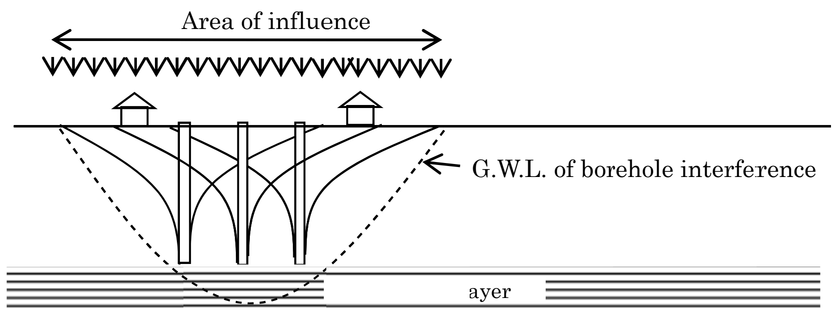
Groundwater will finally flow into rivers as base flow unless it is pumped up from boreholes. In case of the coastal area, groundwater will flow into the sea without any use. Accordingly, it can be suggested:

- Groundwater recharge is defined as maximum amount of groundwater to be developed.
- How much groundwater can be developed within groundwater recharge depends on i) permeability and thickness of aquifer, ii) borehole distribution (i.e. distance among boreholes) and yield of each borehole.

Groundwater recharge must be efficiently pumped up from boreholes for effective groundwater development. For this purpose, influence area of a borehole must be expanded. Among factors that will decide influence area, permeability and thickness of aquifer is impossible to be controlled by human being but factors below are possible to be controlled (se Figure SR2-42).

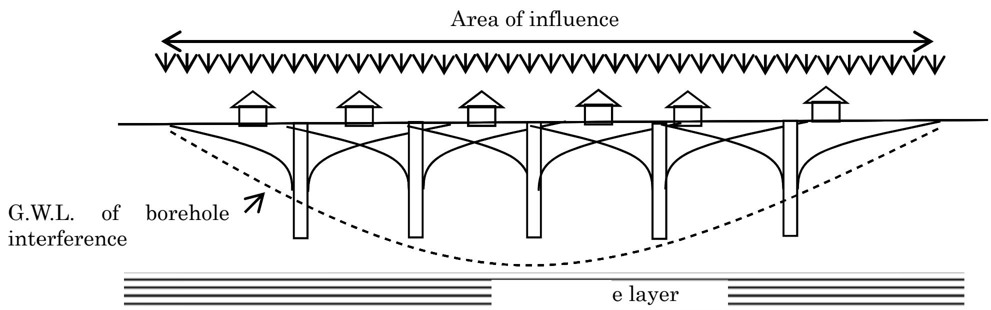
- Distance among boreholes
- Yield of each boreholes

As explained above, groundwater development potential depends on aquifer capacity and groundwater recharge. Based on discussion above, in this Chapter, aquifer capacity of Nigeria will be explained at first, then groundwater recharge will be explained.



Source: JICA Project Team

(a) Ineffective Borehole Development



Source: JICA Project Team

(b)Effective Borehole Development

Figure SR2-42 Concept of Effective Borehole Development

SR2.4.2 Capacity of Aquifer

Aquifer capacity of Nigeria has strong relation with topography and geology. Topography and geology of Nigeria is explained below.

(1) Topography

Nigeria is located in African shield in terms of geomorphology with characteristic of wide plateaus and few steep mountains. The country is classified into two large geomorphological categories below.

- Plateau
- Lowland

Plateau has altitude of 300m to 900m, and lowland less than 300m. There is close relationship between land classification and geological setting. The Basement Complex constitutes plateau, and sedimentary rocks constitute lowland.

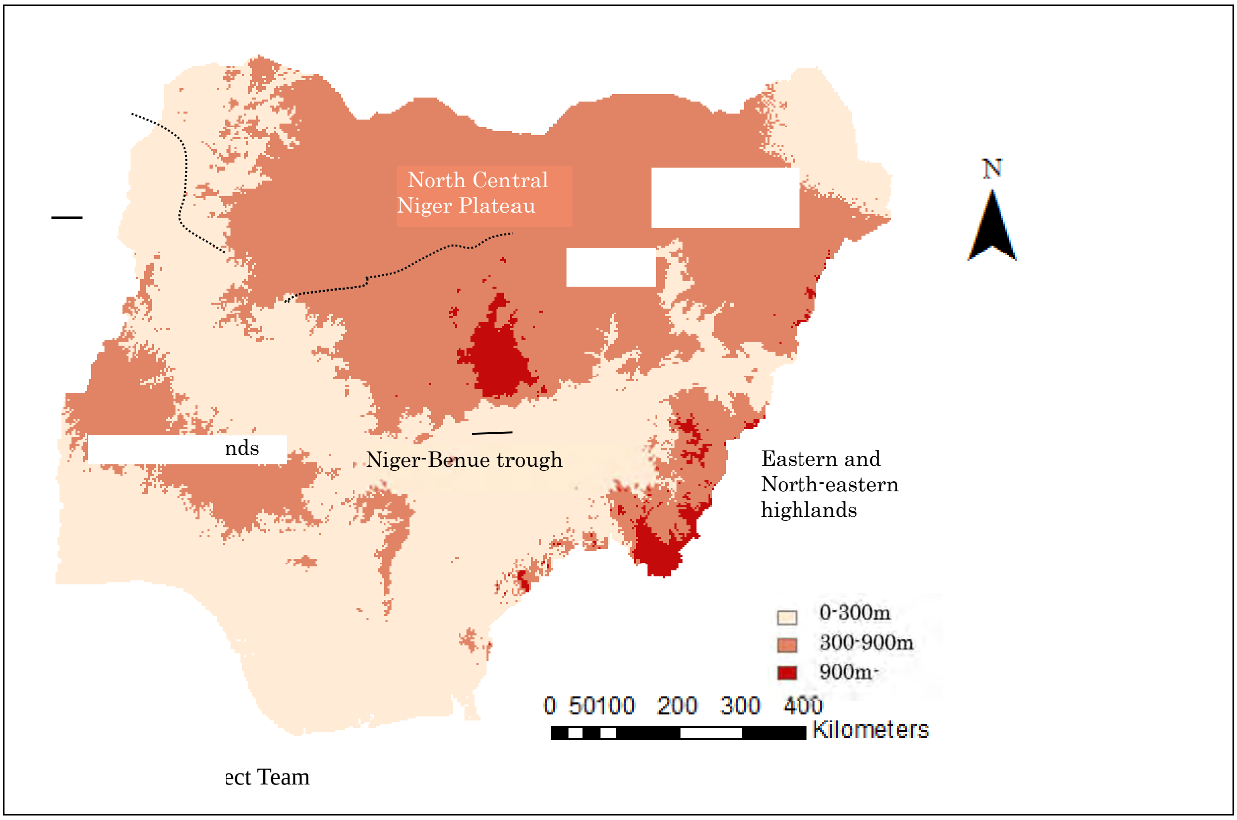


Figure SR2-43 Altitude of Nigeria

Niger River and Benue River flow in lowland, which is called as Niger-Benue Trough. Plateau of Nigeria is divided into three areas by Niger River and Benue River as below:

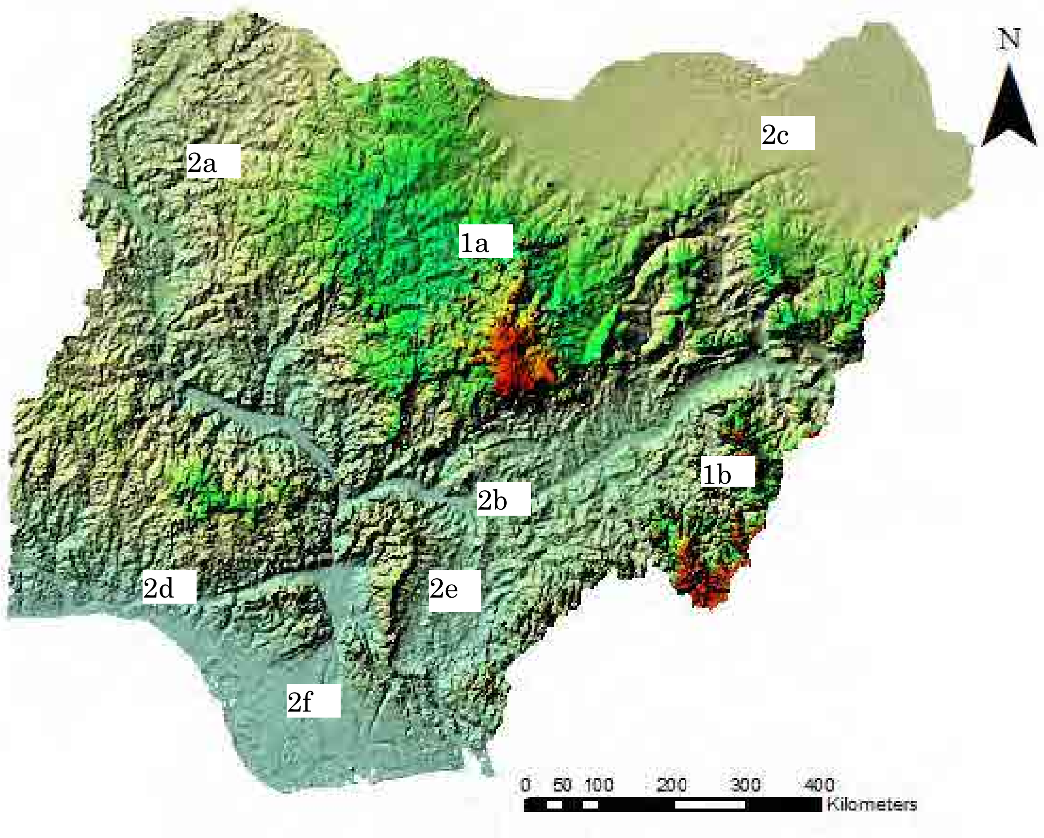
a. North Central Niger Plateau
b. Eastern and North-eastern highlands
c. Western Uplands

Jos plateau (around 1,800m) and high mountains bordering on Cameroon including Adamawa plateau (around 2,400m) show altitude of more than 900m. Erosion made flat surface of the Plateau. Special landscape is created by isolated steep hills of different size rising from flat plain called as Inserberg.

Lowlands are classified into six areas below:

a. Sokoto plains
b. Niger-Benue trough
c. Chad basin
d. Interior coastal lowlands of western Nigeria
e. Lowlands and scarp lands of south-eastern Nigeria.
f. Coastlands

Lowlands is located along large rivers and the coastal line with altitude of less than 300m. However, it is characteristic that lowland is located even interior areas such as Sokoto plain and Chad Based as listed above. Geomorphological classification of Nigeria is shown in Figure SR2-44.



1: High Plateaux
- a. North Central Plateau
- b. Eastern and North-eastern highlands
- c. Western Uplands

2: Lowlands
- a. Sokoto Plain
- b. Niger-Benue trough
- c. Chad basin
- d. Interior lowlands in Western Nigeria
- e. Lowlands and scarp lands in Nigeria
- f. Coastlands

Source: Geography of Nigeria, 1980

Figure SR2-44 Geomorphological Classification of Nigeria

(2) Geology

Geology of Nigeria can be classified in two categories below.

- Basement rock
- Sedimentary rock

Stratigraphy of eight (8) hydrological areas is shown in Table SR2-19. Characteristics of Basement rock and sedimentary rock are explained below (see Figure SR2-45).

Table SR2-19 Stratigraphy of Hydrological Area

Age		HA-1	HA-2	HA-3	HA-4
Quaternary		Alluvium	Alluvium	Chad Formation	Alluvium
Tertiary	Eocene	Gwandu Formation	Patti Formation		
	Paleocene	Kalambaina Formation（Sokoto group ） Dange Formation（Sokoto group ） Wurno Formation（Rima Group）		Kerri-Kerri Formation	Volcanics
Cretaceous	Maestrichtian	Dukamaje Formation（Rima group） Taloka Formation（Rima group） Illo Formation Gundumi Formation	Lokoja Sandstone/ Nupe Sandstone	Lamja Sandstone/Gombe Sandstone	Lafia Formation
	Campanian			Numanha shale/gulani sandstone/Pindiga Formation	Awe Formation
	Santonian			Sekule Formation/Pindiga Formation	
	Turonian			Jessu Formation/ Pindiga Formation Dukul Formation/Pindiga Formation Yolde Formation	
	Cenomanian			Bima sandstone	
	Albian				Asu River Formation
Jurrasic					
Pre-Cambrian		Basement Complex	Basement Complex	Basement Complex	Basement Complex
Age		HA-5	HA-6	HA-7	HA-8
Quaternary		Upper deltaic Lower deltaic	Alluvium Deltaic Benin Formation	Benin Formation	Chad Formation
Tertiary	Eocene	Benin Formation Ogwashi Asaba Formation Ameki Formation/ Nanka sandstone Imo shale Nsukka Formation	Ilaro Formation/Ameki Formation Ewekoro/Imo Shale /Oshuosun Formation	Ameki Formation Imo Formation Nsukka Formation	
	Paleocene				Kerri-Kerri Formation
Cretaceous	Maestrichtian	Ajali Formation Mamu Formation Nkporo Formation	Abeokuta Formation	Ajali Formation Mamu Formation Nkporo shale	Gundumi Formation
	Campanian				
	Santonian			Awgu Formation	
	Turonian			Ezeaku Formation	
	Cenomanian				
	Albian			Asu Formation	
Jurassic					Younger Granite Complex
Pre-Cambrian		Basement Complex	Basement Complex	Basement Complex	Basement Complex

Note) Formation of bold letter consists of sand and gravels, which is expected medium to large scale groundwater development.
Source: JICA Project Team

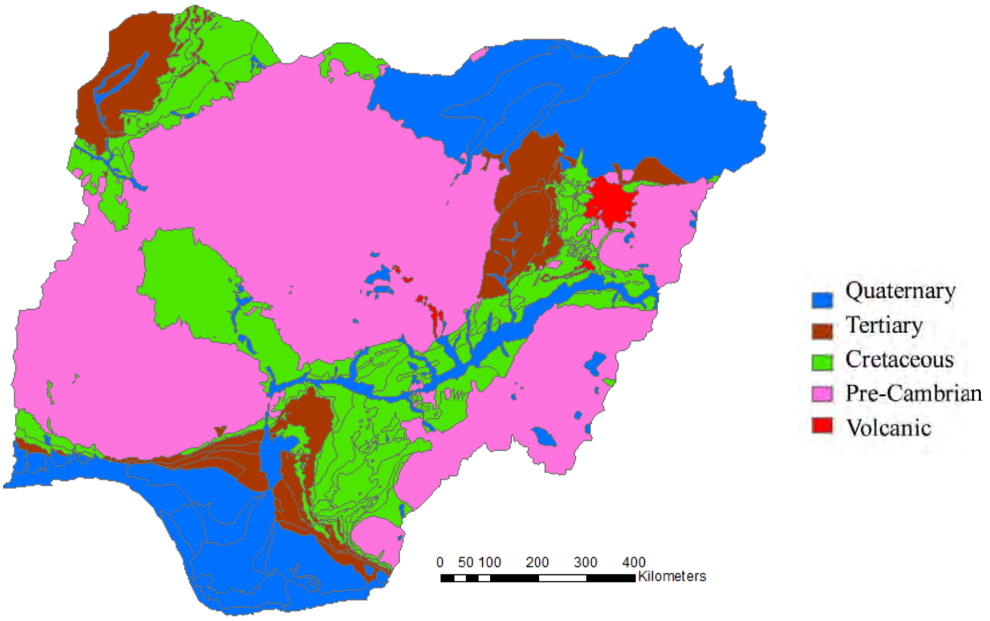


Figure SR2-45 Geological Outline of Nigeria

Basement Rock

Geology of Nigeria is roughly classified into Basement Complex and sedimentary rocks. Stratigraphy of Nigeria is shown in Table SR2-19 by each hydrological area. The Basement Complex is subdivided into three types below:

- Gneiss and Migmatite Complex
- Schist belts
- Younger Granite

Gneiss and Migmatite Complex consist of those of pre-Cambrian era. The Schist Belts consist of metamorphic sedimentary rocks such as schist, phyllite, marble, dolomites and amphibolite. They are enclosed with the Gneiss and Migmatite Complex in the western half of Nigeria.

The Younger Granite consists of rhyolite, quart-diorite and granite of Jurassic period and is distributed in SSW-NNE direction in the central part of Nigeria. They are ring-dike intrusion into the older Basement Complex. The Basement Complex forms plateaux and highlands covering almost a half of Nigeria.

Sedimentary rock

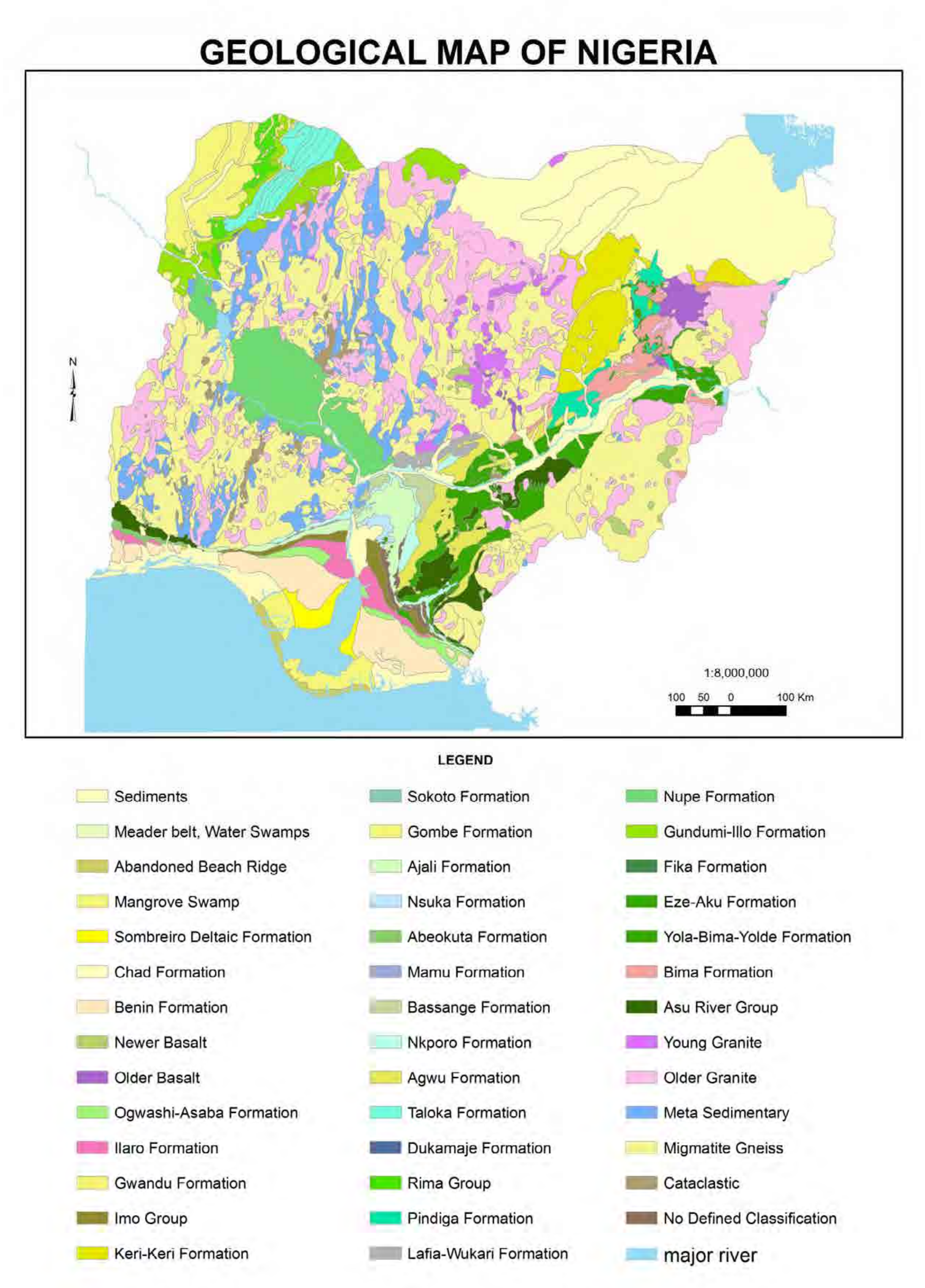
Sedimentary rocks overlie Basement Complex in unconformity and are distributed in lowlands, making clear contrast with Basement Complex. Sedimentary basin is identified into five areas below.

a) Benue –Niger Trough
  - Benue Basin (Upper, Middle, Lower Benue Basin)
  - Anambra Basin

b) Middle-Niger/Bida Basin
c) Sokoto Basin
d) Chad Basin
e) Niger Delta
f) Dahomey Basin

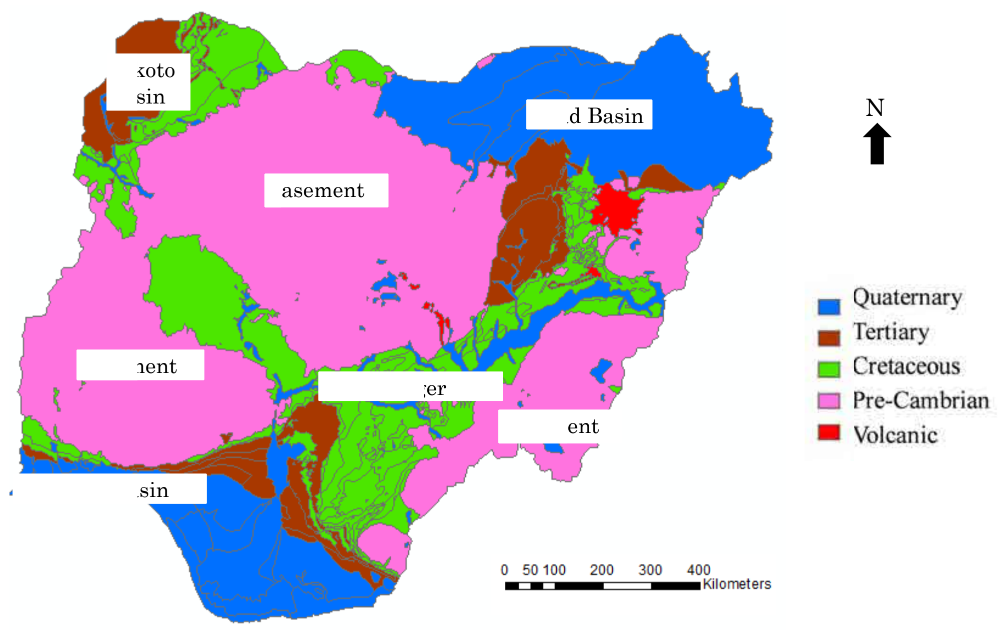
Geological Process

Marine and continental sediments were deposited with large thickness in the Cretaceous period. They are marine shale/limestone and continental sandstone of Cretaceous period. Thick sediments were deposited especially in Benue Trough, which is said as "Graben structure" that developed when African Continent and South American Continent begun separation each other. Sedimentation aslo began at this period in Niger Delta.



Source: JICA Project Team

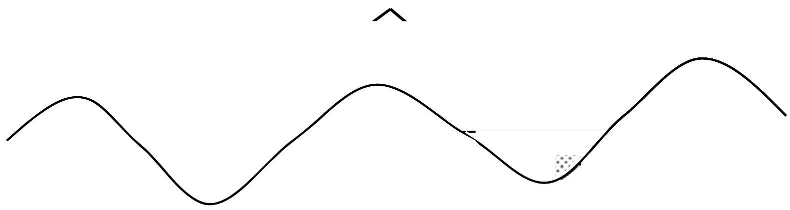
Figure SR2-46 Geological Map of Nigeria



Source: Geography of Nigeria, 1980

Figure SR2-47 Main Sedimentary Basin of Nigeria

Cretaceous, Tertiary and Quaternary sediments deposited on lowlands in Basement Complex



Source : JICA Project Team

Figure SR2-48 Relationship between Basement Complex and Sedimentary Rocks

Cretaceous rocks in each basin were covered widely with Tertiary sediments such as sandstone, claystone and limestone. Tertiary sediment was deposited in Niger Delta following the Cretaceous period. On the other hand, there were volcanic activities in Jos Plateau and Benue Trough areas including basaltic lava eruption.

Thick clay and sand formation were deposited in Chad Basin and Sokoto Basin in Quaternary period as well as in Niger Delta.

(3) Geological Characteristics in Groundwater Development

Multiple aquifer system by aquifer and aquitard

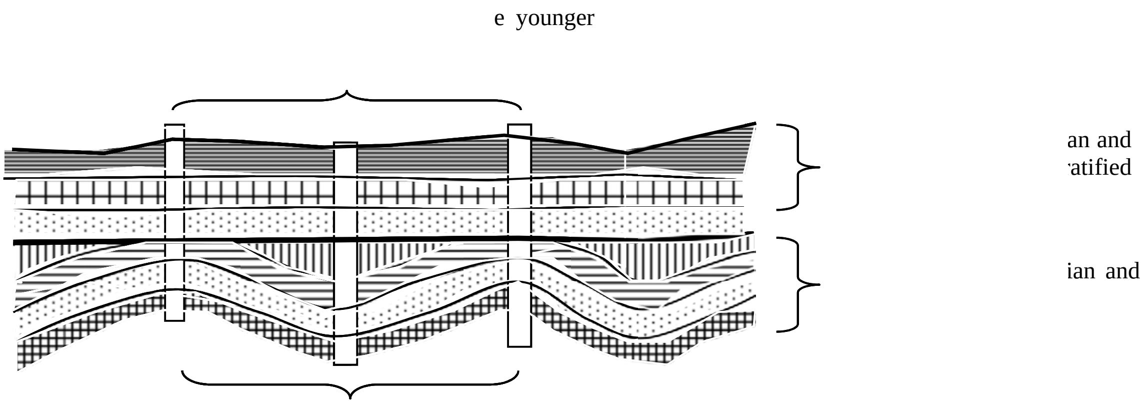
Coastline transgression and regression occurred repeatedly after the Cretaceous period in large scale. Marine sedimentary rocks such as shale and claystone, which is impermeable to form aquiclude, were deposited during transgression. On the other hand, continental sedimentary rock such as sandstones, which is permeable to form aquifer, was deposited during regression. As mentioned above, lowlands were experienced repeated transgressions and regressions, which have made unique sedimentary structure of alternating sand and clay formation.

Aquifer thickness

The Cretaceous overlies Basement Complex in unconformity. Sedimentary rocks before Santonian Age of the Cretaceous were deformed with fold activities and fault movements during Santonian Age. Therefore, the sedimentary rocks before Santonian Age were distributed at different depth at place by place due to fold structure. On the other hand, sedimentary rocks after Campanian Age of the

Cretaceous are almost horizontally stratified (see Figure SR2-49). On the other hand, there was no large geological structural event after Capanian Age that followed Santonian Age. It is why formation from Capanian Age was almost horizontally stratified without folding (see Figure SR2-49).

Therefore, depth of aquifer is different at place by place where the Santonian and the older formations are distributed, so it seems more complicated to do groundwater survey and make drilling plan in such area. On the other hand, depth of aquifer is almost constant in area where the Capanian and the younger formations are distributed, and it seems easier to do the groundwater survey and make the drilling plan in such area.

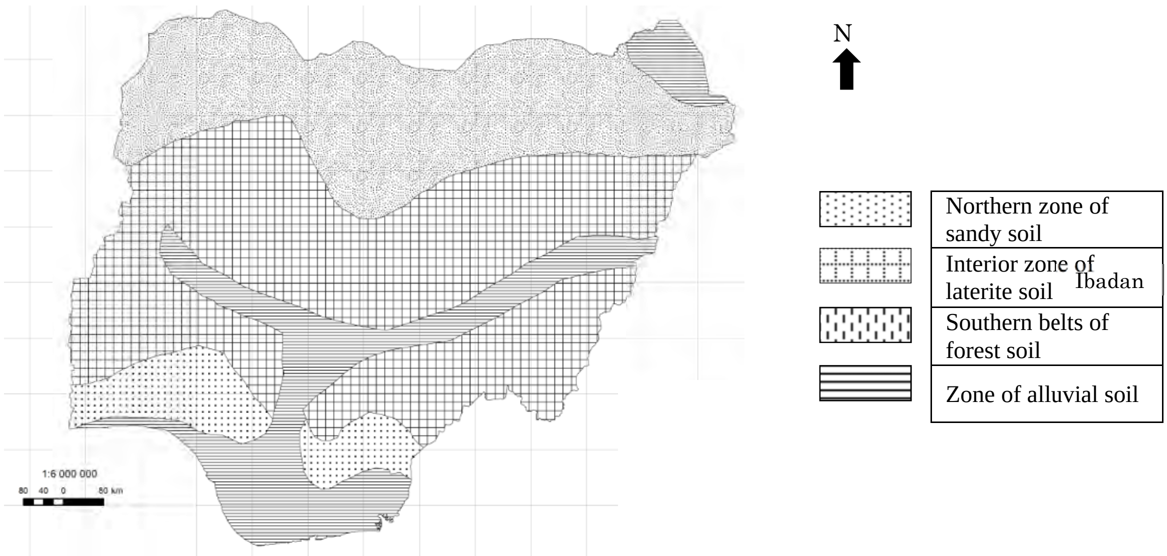


Source: JICA Project Team

Figure SR2-49 Concept of Stratification

(4) Soil

Type of soil is dominated with type of parent rock, vegetation and climate. Soil type distribution is simplified as shown in Figure SR2-50.



Source: Geography of Nigeria

Figure S2-50 Soil Zone

<u>**Northern zone of sandy soil**</u>

Sandy soil is developed in the northern part of Nigeria due to long dry season and sandy dust from the Sahara Desert. Much rain fall will infiltrate into ground of sandy soil because of high permeability. However, such soil has lower capacity to keep water within them.

Interior zone of laterite soil

The soil is accumulated with iron and aluminium after leaching of the other chemical elements form the upper-most part of ground. Such soil is typical in the area where dry and rainy season is clearly divided and repeated. Such a situation is seen in the wide areas of the central Nigeria. Laterite soil shows lower permeability for rainfall infiltration because this soil becomes consolidated hard around ground surface.

Southern belts of forest soil

The Forest soil is distributed between alluvial soil in the south and laterite soil in the north. This soil is covered with rich vegetation throughout a year thanks to long rainy season and short dry season. The forest soil changes its properties from sandy roam to clayey roam following type of their parent rocks. The forest soil shows high permeability for rainfall infiltration because this soil contains organic matters that develop unique soil structure.

Zone of alluvial soil

There is enough rainfall in Niger Delta area, and alluvial soil can be seen in many places in delta plain consisting of sand, silt and clay which were deposited after flood. As well as Niger Delta, alluvial soil is deposited in flood plains of large river such as Niger and Benue River.

Importance of soil in water resources management is that soil properties has strong relationship with capacity of moisture content within soil, which dominate evaporation from soil and transpiration from vegetation. Alluvial soil shows wide range of grain size distribution containing sand, silt and clay, showing different permeability and water holding capacity at place by place. Generally, it shows high permeability and high water holding capacity where the soil is distributed thick.

(5) Hydrogeology

Aquifer of Nigeria is classified into two types as shown below in terms of hydrogeology:

- Basement Complex
- Sedimentary Rock/layesr

There is big difference in hydrological characteristics between Basement Complex and Sedimentary rocks.

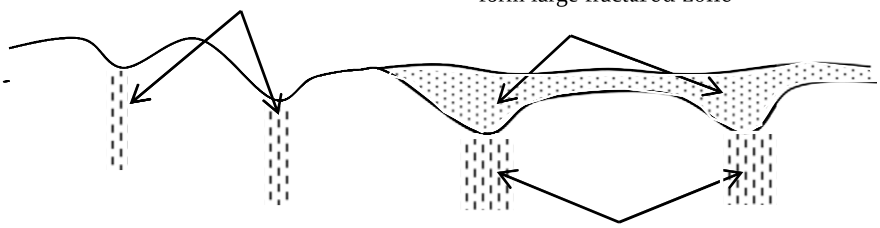
Basement Complex

Basement Complex consists of granite, gneiss and schist of the Pre-Cambrian, which constitutes plateau in Nigeria. Generally, the Basement Complex is weathered in the depth from 30m to 100m below ground level, showing sand and gravel like materials, called as regolith, forming unconfined aquifer.

In addition to above, fractured zone of Basement Complex also forms aquifer. Such zones are limited in its extent compared with the weathered zone that has large extent. However, large fault makes large fractured zone that can form large aquifer. Moreover, large fractured zone can be easily disintegrated into weathered zone in large scale, which will form excellent aquifer as shown in Figure SR2-51.

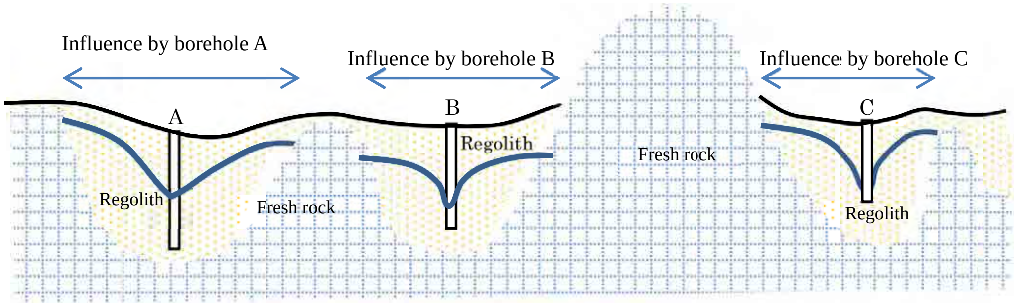
Thickness of weathered zone of the Basement Complex is heterogeneous and its extension is limited both in vertical and horizontal direction (see Figure SR2-51). Consequently, it can be said that groups of small isolated aquifers constitute aquifer system of Basement Complex. Groundwater storage within small aquifer is always small throughout a year, though there is some difference between dry and rainy season. As a result of size of aquifer and low permeability, potential pumping yield of a well/borehole of the aquifer is small.

Therefore, groundwater development potential in Basement Complex area depends on not amount of water recharge but aquifer capacity, namely size and permeability of each isolated aquifer. Weathered aquifer of Basement Complex is commonly distributed in Nigeria though its scale is small. Those aquifers are suitable for rural water supply. It is necessary for groundwater development and management to raise successful rate of borehole and manage properly pumping operation suitable for aquifer capacity in Basement Complex area.



Source: JICA Project Team

Figure SR2-51 Weathered Zone and Fractured Zone



Source: JICA Project Team

Figure SR2-51 Radius of Influence by Borehole in Basement Complex Area

Rock Type of Basement Complex and Hydrogeological Characteristics

Basement Rock is classified into three types, namely a) Gneiss and Migmatite Complex, b) Schist Belts, c) Younger Granite. There is not large difference among them. However, items below should be taken into account.

- Crystalline and coarse-grain rocks such as gneiss and migmatite will become sandy and form aquifer when they are weathered.
- Argillaceous meta-sediment rocks will become clayey and impermeable when they are weathered, and they are classified as aquiclude.
- Old granite is intruded by Younger Granite, which is usually fractured to be promising as aquifer.

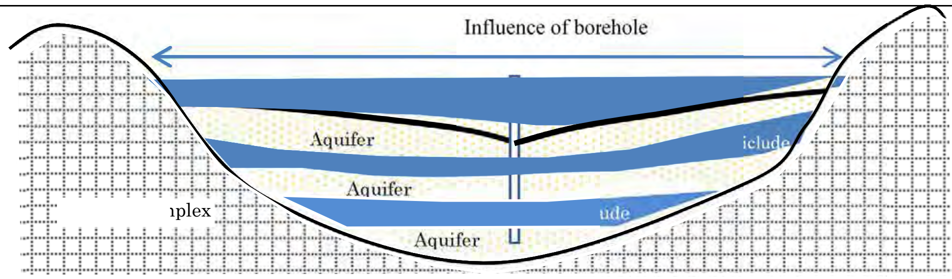
Sedimentary rocks (layer)

Sedimentary rock consists of sandstone and shale (claystone) of the Cretaceous, the Tertiary and the Quaternary (unconsolidated sand, silt and clay). Sedimentary rocks constitute lowlands in contrast with the Basement Complex that constitutes plateau. As a result, large river such as Niger River and Benue River flow in sedimentary rock areas. Weathered and fractured sandstone form goods aquifer. Usually sandstone and shale alternate in sedimentary sequence making sandstone confined aquifer. Groundwater level of sandstone aquifer is sometimes deep. For example, it is reported that groundwater level of Sokoto Basin is deeper than 50m to 100m below ground level.

Sandstone with good lateral continuity and large thickness usually forms aquifer of large scale (see Figure SR2-52). Large amount of groundwater can be extracted from sandstone aquifer with large scale and high permeability. More groundwater can be extracted from aquifer than amount of groundwater recharge. As a result, groundwater in aquifer, which has been accumulated during long period of time, will be rapidly consumed, causing continuous lowering of groundwater level year by year. Amount of groundwater extraction must be less than amount of groundwater recharge for sustainable groundwater usage. Groundwater management and development in Chad Basin and Sokoto Basin must be taken into account above situation.

Aquifer other than sandstones

Argillaceous rock such as shale, claystone and siltstone is also distributed in many places in sedimentary rock area as well as sandstone. The argillaceous rocks usually intercalate thin sandstone layer/lens, which can form aquifer of small scale. Hence, it is possible to develop groundwater even in argillaceous rock. Available yield from such aquifer may be the same as that of Basement Complex.



Source: JICA Project Team

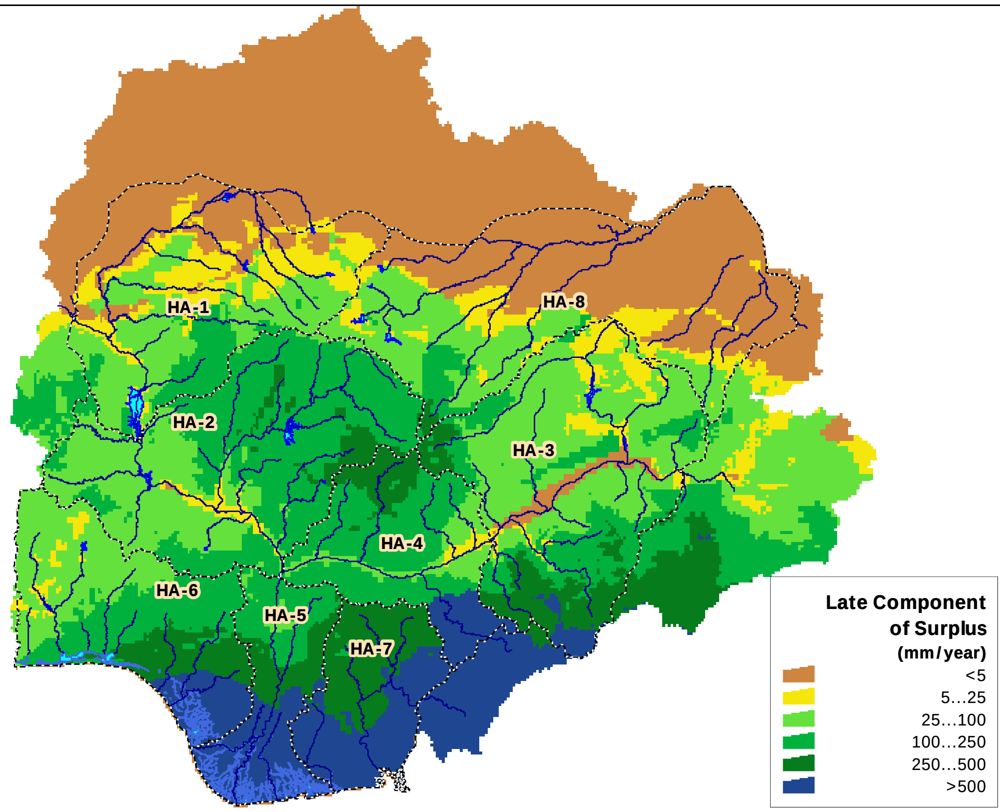
Figure SR2-52 Area of Influence by Borehole in Sedimentary Rock Area

SR2.4.3 Groundwater Recharge

(1) Groundwater Recharge

Groundwater recharge was analysed as the late component of Surplus (S) of the model explained in this Report. Result of analysis is shown in Figure SR2-53 and Table SR2-20. Result should be interpreted as explained below:

- The Surplus is classified into two parts. The first part is those that flow into rivers within one month, and the second part is those that will flow into river after next month. For example, groundwater flowing in weathered basement rock will flow into river earlier within one month after rainfall. On the other hand, some groundwater flowing in sedimentary rock will take more than several months to flow into river, depending on hydrological structure of aquifer.
- Groundwater will finally flow into rivers, so it is considered that groundwater recharge is part of river runoff.



Source: JICA Project Team

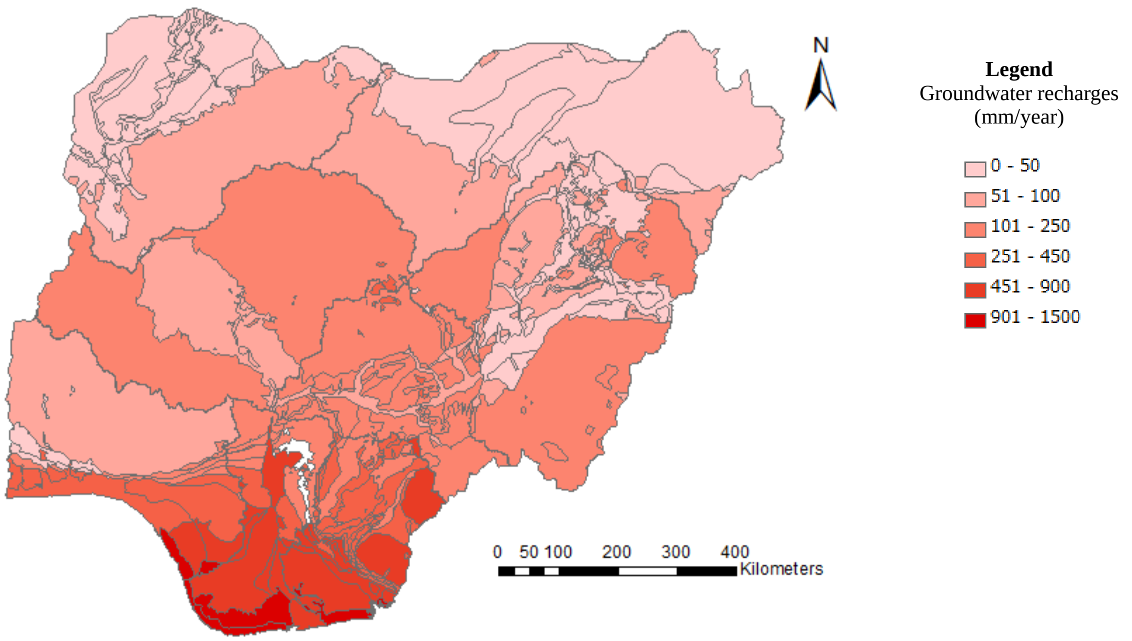
Figure SR2-53 Groundwater Recharge

Table SR2-20 Groundwater Recharge by Hydrological Area

Item	Nation wide	Hydrological area							
		HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8
Area(km2)	909,979	135,128	154,616	156,546	74,519	53,914	99,333	57,440	178,483
Average precipitation (mm/year)	1,148	768	1,170	1,055	1,341	2,132	1,541	2,106	610
Average groundwater recharge (mm/year)	171	37	132	123	250	592	236	570	24
Same (%)	14.9	4.8	11.3	11.7	18.7	27.7	15.3	27.1	3.9
Same (BCM/year)	155.8	5.0	20.5	19.3	18.6	31.9	23.4	32.8	4.3

Source：JICA Project Team

The analysed result of groundwater recharge by SHA is rearranged by aquifer as shown in Table SR2-21 and Figure SR2-54.



Source: JICA Project Team

Figure SR2-54 Groundwater Recharge by Aquifer

Table SR2-21 Groundwater Recharge by Aquifer

Age	Formation	Groundwater Recharge (mm/year)
HA-1		
Eocene	Gwandu Formation	24
Paleocene	Kalambaina Formation（Sokoto group ）	1
	Dange Formation（Sokoto group ）	1
	Wurno Formation（Rima Group）	18
Maestrichitian	Dukamaje Formation（Rima Group）	34
	Taloka Formation（Rima）¥ Group）	6
	Ill Formation	10
	Gundumi Formation	10
Pre-Cambria	Basement complex	40
HA-2		
Quaternary	Sand and gravel	18
Tertiary	Patti Formation	51
cretaceous	Lokoja Sandstone/Nupe Sandstone	37
Pre-Cambria	Basement complex	51
HA-3		
Holocene	Alluvium	7
Pleistocene	Chad Formation	9
Paleocene	Kerri-Kerri Formation	32
Maestrichtian	Lamja Sandstone/Gombe Sandstone	19
Campanian	Numanha shale/gulani sandstone/Pindiga Formation	20
Santonian	Sekule Formation/Pindiga Formation	20
Turonian	Jessu Formation/Pindiga Formation	20
	Dukul Formation/Pindiga Formation	20
	Yolde Formation	17
Cenomanian	Bima sandstone	43
Pre-Cambria	Basement complex	132
HA-4		
Paleocene	Volcanic	301
Maestrichtian	Lafia Formation	176
Senonian	Awgu Formation	128
Turonian	Ezeaku/makurdi Formation	59
	Keana Formation	128
Cenomanian	Awe Formation	128
Mid-late Albian	Asu River Formation	59
Pre-Cambria	Basement complex	277
HA-5		
Quaternary	Upper deltaic	590
	Lower deltaic	458
Tertiary	Benin Formation	450
	Ogwashi Asaba Formation	331
	Ameki Formation/Nanka sandstone	189
	Imo shale	51
	Nsukka Formation	83
Cretaceous	Ajali Formation	122
Maestrichtian	Mamu Formation	91
	Nkporo Formation	63
Pre-Cambria	Basement complex	62
HA-6		
Quaternary	Alluvium	792
	Deltaic Formation	532
	Benin Fo`rmation	291
Tertiary	Ilaro Formation/Ameki Formation	124
	Ewekoro/Imo Shale /Oshuosun Formation	180
Cretaceous	Abeokuta Formation	86
Pre-Cambria	Basement complex	93
HA-7		
Quaternary	Benin Formation	743
Tertiary	Ameki Formation	440

Age	Formation	Groundwater Recharge (mm/year)
	Imo Formation	322
	Nsukka Formation	322
	Ajali Formation	251
	Mamu Formation	251
	Nkporo shale	189
Cretaceous	Awgu Formation	147
	Ezeaku Formation	177
	Asu Formation	228
Pre-Cambrian	Basement complex	354
HA-8		
Pleistocene	Chad Formation	7
Paleocene	Kerri-Kerri Formation	7
Cretaceous	Gundumi Formation	1
Jurrassic	Younger Granite Complex	103
Pre-Cambria	Basement complex	61

Source: JICA Project Team

(2) Water Balance by Groundwater Monitoring

As explained above, groundwater recharge was analysed by the method that dealt both surface and groundwater at the same time. As a result of the analysis, groundwater recharge was calculated nationwide with the unified method, and it is easy to compare groundwater recharge of each area with the same accuracy. On the other hand, single method has limitation to analyse those of the large country such as Nigeria with various natural conditions. To compensate above disadvantage, groundwater monitoring is implemented to analyse groundwater recharge in two hydrological areas (HA-1 and HA-6) where Catchment Management Plan will be formulated in this Project.

Analysis method

Rainfall will fall on the ground and infiltrate into the soil. Then surplus soil water will drain into shallow aquifer as a result of soil water balance. Groundwater recharge, which was drained from the saturated soil, can be directly observed as the fluctuation of groundwater table of shallow aquifer. So this can be observed in shallow wells. For this purpose, shallow hand-dug wells were constructed as monitoring wells in this Project. Groundwater monitoring is currently on going in two Hydrological areas, for which Catchment Management Plan will be formulated.

Installation of groundwater monitoring wells

Outline of monitoring wells is shown in Table SR2-22. Monitoring wells were selected at 30 sites by the JICA Project Team and NIHSA, considering representative geological condition of the target areas and accessibility by observers. Groundwater level will be monitored by the JICA Project Team during Phase-1 of the Project. Then, NIHSA will take over the monitoring work from the JICA Project Team and continue. Detail of monitoring wells is shown in Table SR2-23. Location of monitoring wells is shown in Figure SR2-55, and structure of monitoring wells is shown in Figure SR2-56.

Table SR2-22 Outline of Monitoring Wells

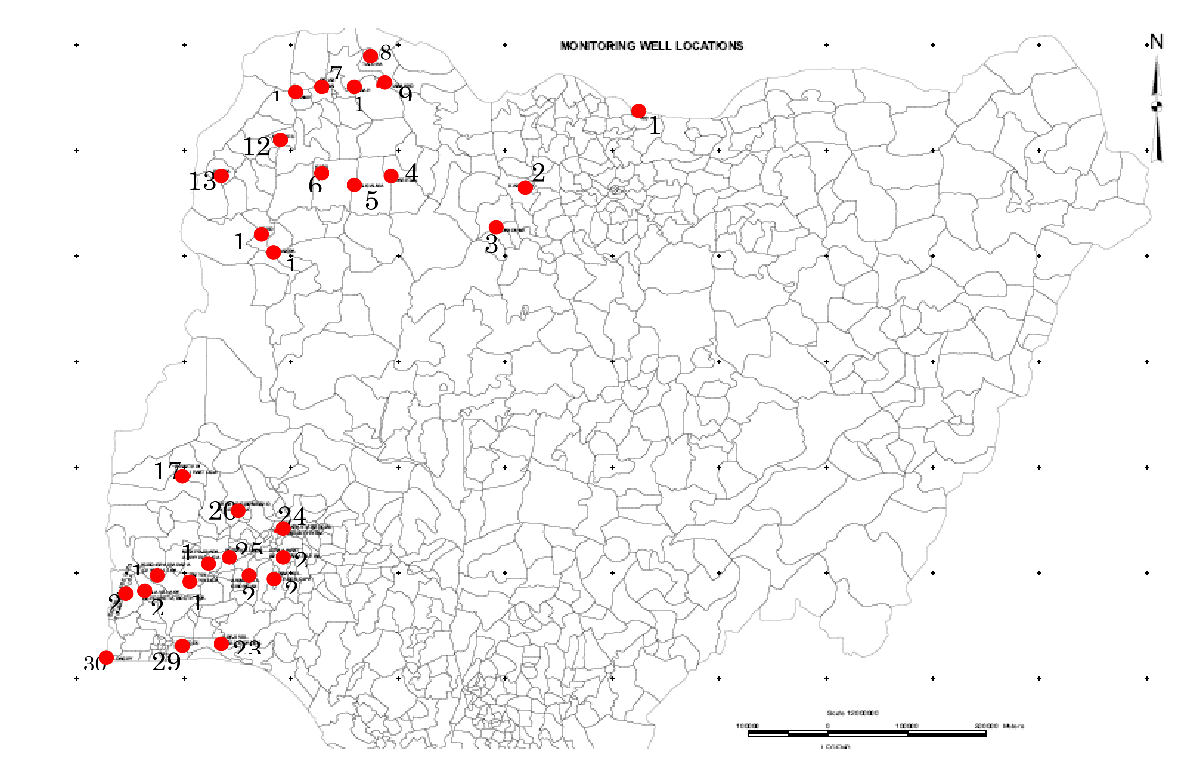
Catchment area	No. of monitoring wells	Observation		
		Method	Period	Frequency
Niger North	15	Manual by surveyor	From December 2011 to June 2012	More than twice a month
Western Littoral	15			
Total	30	-	-	-

Source: JICA Project Team

Table SR2-23 Detail of Monitoring Wells

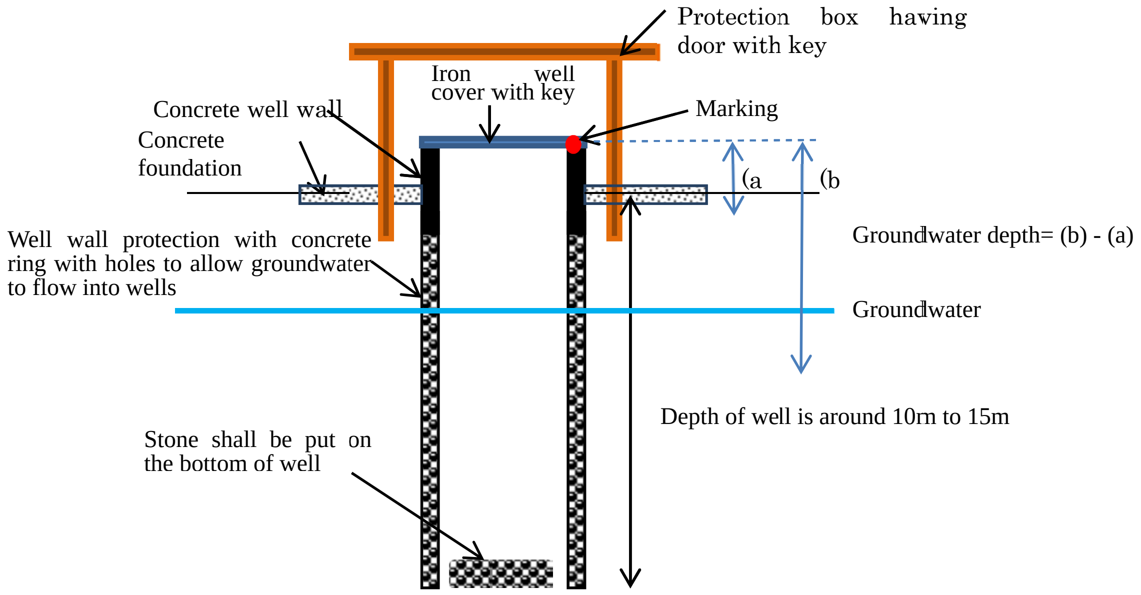
Niger North					Western Littoral				
No.	Site	State	Geology	Well depth (m)	No.	site	State	geology	Well depth (m)
1	BAURE	KATSINA	Sedimentary	26	16	IBADAN	OYO	Basement	13
2	KANKARA	KATSINA	Basement	12	17	SHEPETERI	OYO	Basement	12
3	DANDUME	KATSINA	Basement	12	18	ISEYIN	OYO	Basement	15
4	DARETA	ZAMFARA	Basement	12	19	IGBO ORA	OYO	Basement	10
5	YALGALMA	ZAMFARA	Basement	12	20	OGBOMOSO	OYO	Basement	12
6	GUMI	ZAMFARA	Sedimentary	12	21	ABEOKUTA	OGUN	Basement	8
7	GIDAN IGWAI	SOKOTO	Sedimentary	12	22	ILARO	OGUN	Basement	10
8	TALOKA	SOKOTO	Sedimentary	16	23	IJEBU ODE	OGUN	Basement	10
9	DANTASAKKO	SOKOTO	Sedimentary	22	24	INISA	OSUN	Basement	10
10	RABAH	SOKOTO	Sedimentary	12	25	IWO	OSUN	Basement	15
11	SILAME	SOKOTO	Sedimentary	30	26	ILE IFE	OSUN	Basement	12
12	GWANDU	KEBBI	Sedimentary	10	27	GBONGAN	OSUN	Basement	15
13	BUNZA	KEBBI	Sedimentary	15	28	ILESA	OSUN	Basement	15
14	KOKO/BESE	KEBBI	Sedimentary	15	29	IKORODU	LAGOS	Sedimentary	15
15	SHANGA	KEBBI	Sedimentary	15	30	BADAGRY	LAGOS	Sedimentary	15

Source: JICA Project Team



Source: JICA Project Team

Figure SR2-55 Location of Monitoring Well



Source: JICA Project Team

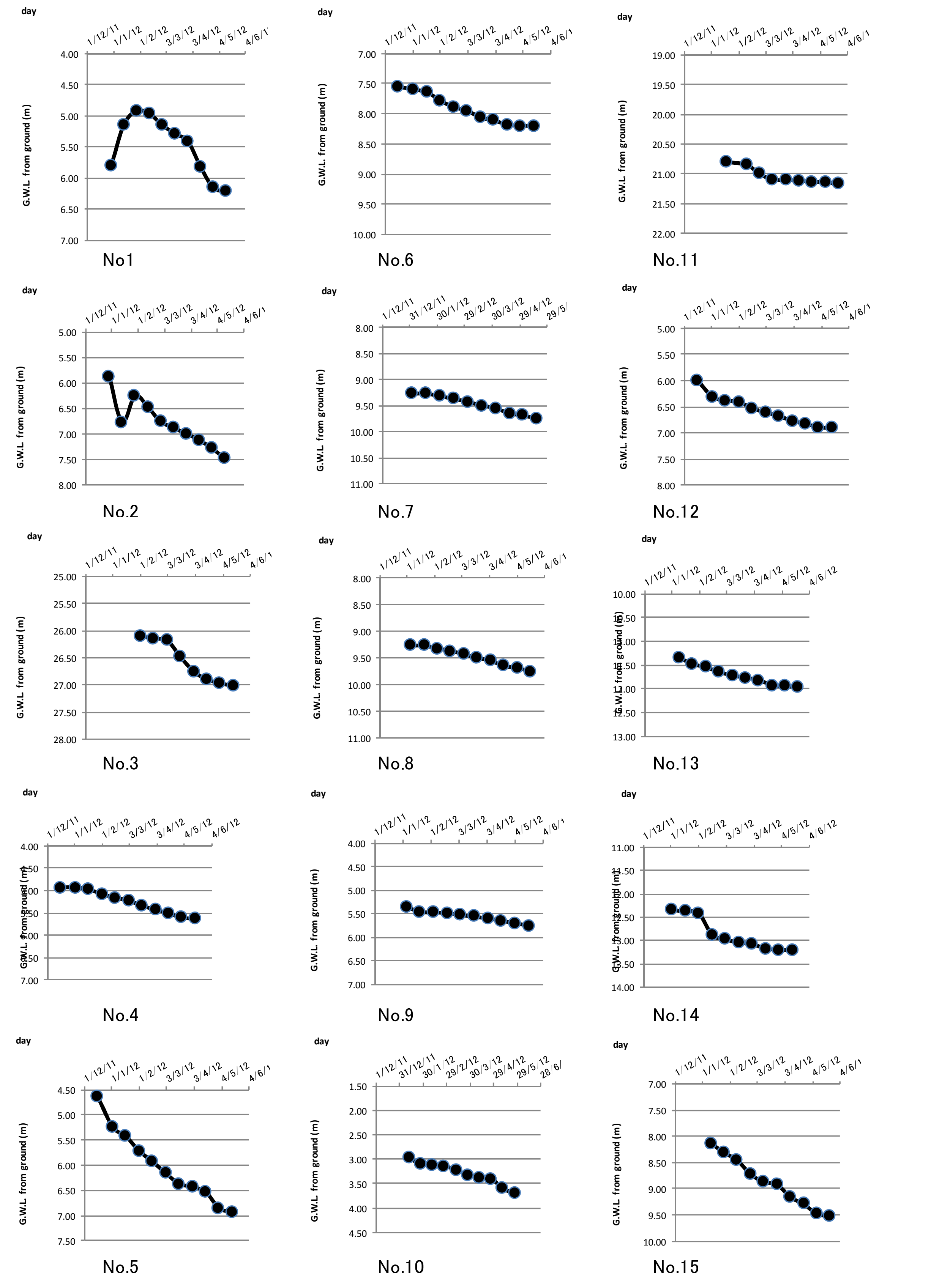
Figure SR2-56 Structure of Monitoring Well

Result of Monitoring

Result of monitoring is shown in Figure SR2-57 to Figure SR2-58 There was little rain between December 2011 and May 2012 due to dry season. So groundwater level was going down at almost all the monitoring sites. Average groundwater decline is 0.92m in Niger North area and 0.88m in Western Littoral area during the observation period. There was almost no groundwater recharge during this period.

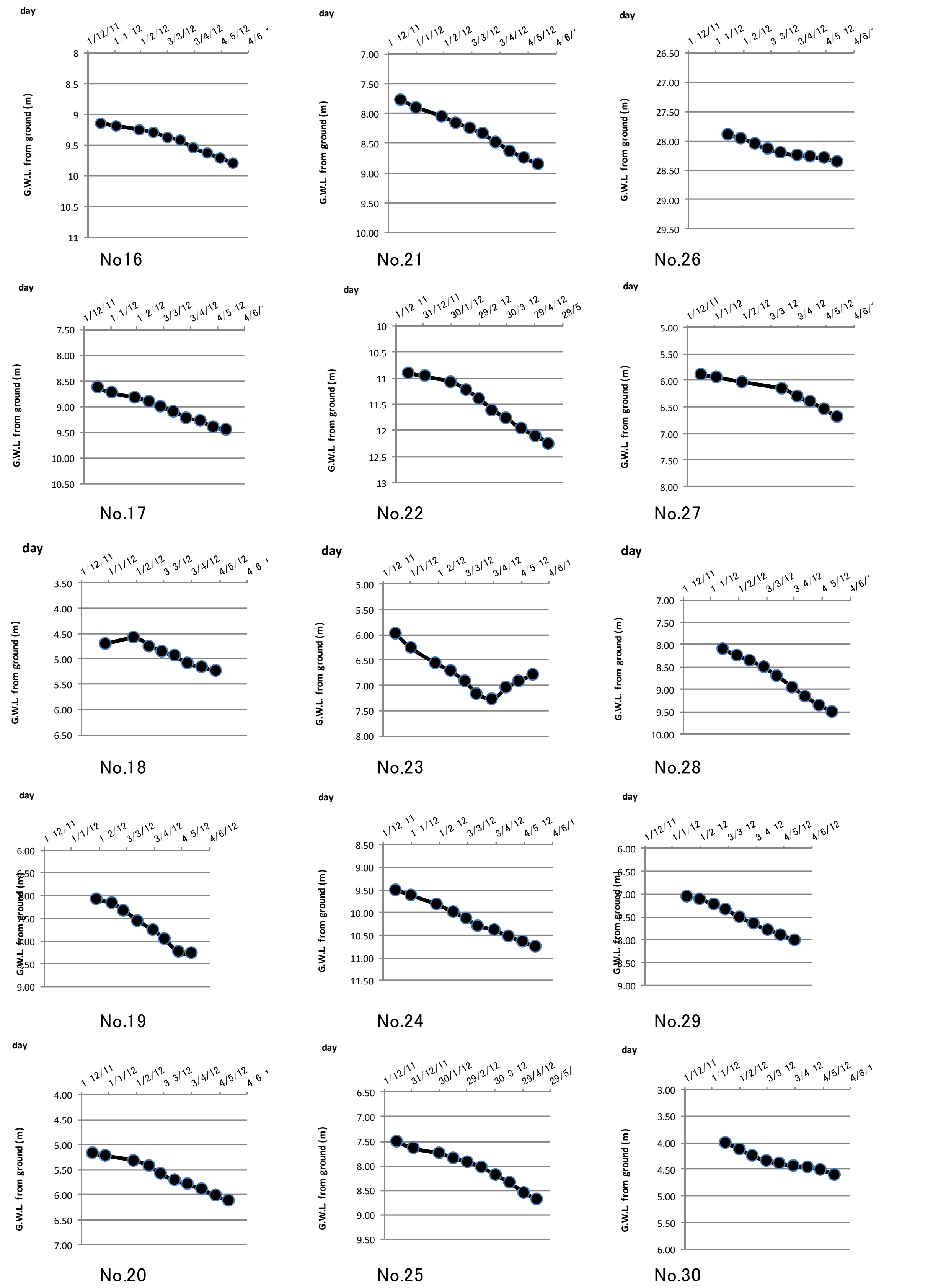
Analysis of Monitoring Result

Observation result of 30 monitoring wells will be analysed for every monitoring sites using groundwater recharge model shown in Figure SR2-59 with precipitation data. Method of analysis is as follows:



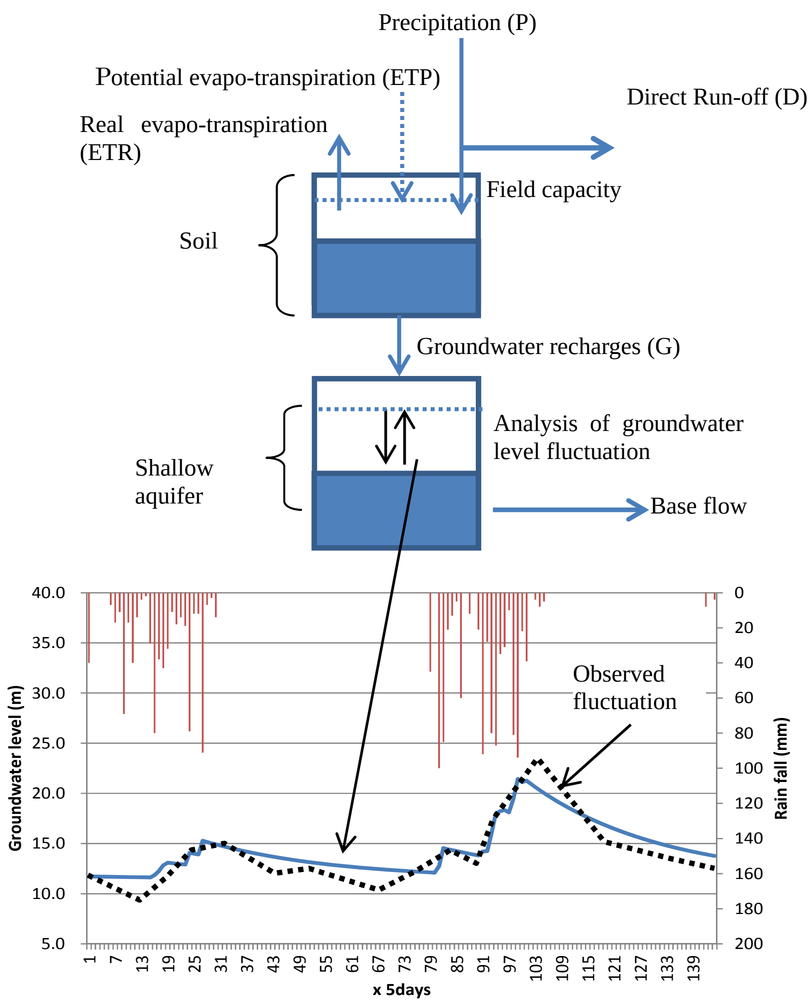
Source: JICA Project Team

Figure SR2-57 Result of Monitoring (Niger North Area)



Source: JICA Project Team

Figure SR2-58 Result of Monitoring (Western Littoral Area)



Source: JICA Project Team

Figure SR2-59 Groundwater Recharge Model

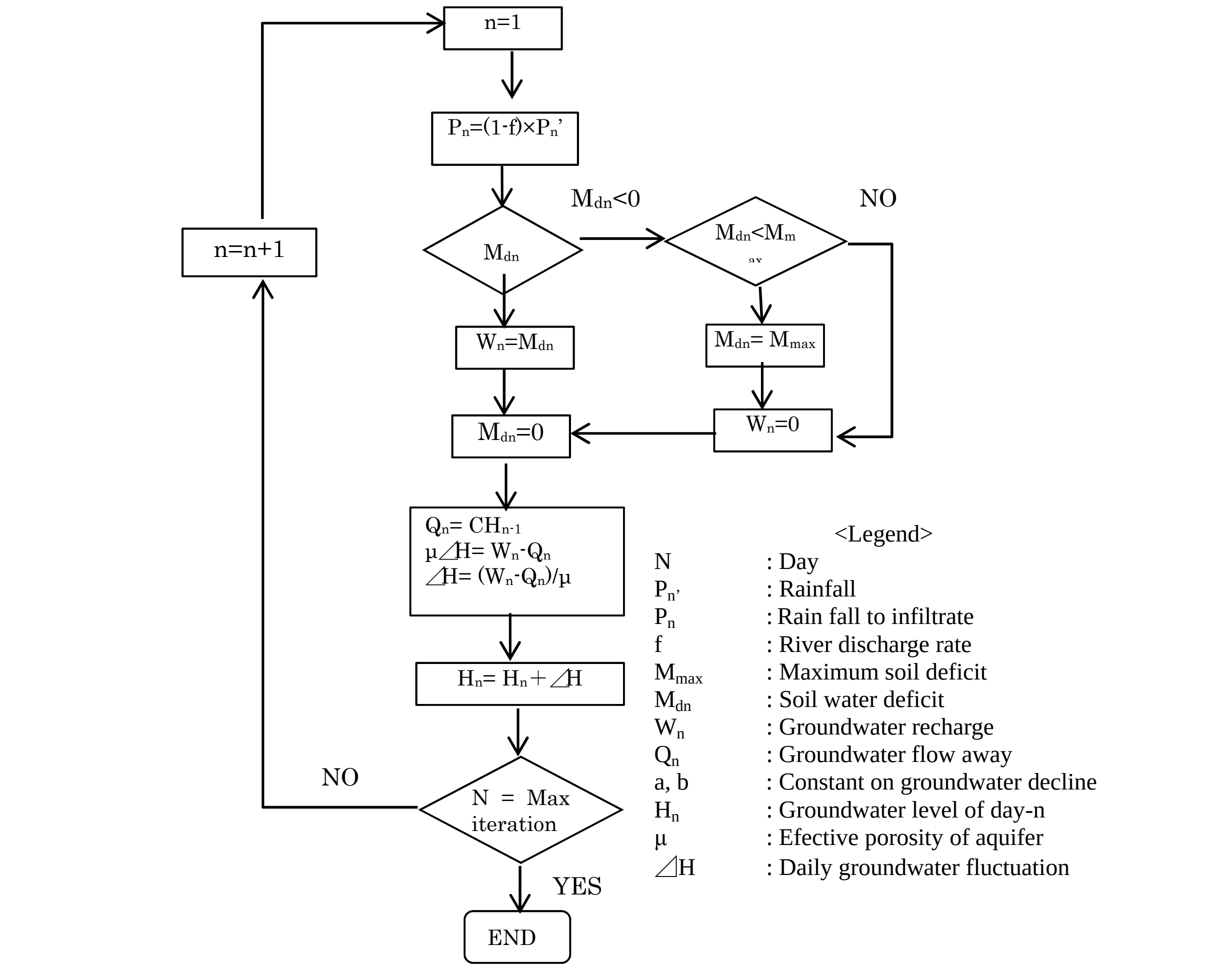
Theory of Analysis

Theory of analysis is explained below:

- Soil moisture will be analyzed on daily base.
- Groundwater recharge will happen when soil water deficit is recovered.
- Potentials evapotranspiration will be calculated using Hamon equation.
- Maximum evapotranspiration (ETPR) will occur when soil moisture deficit is recovered. In case where soil deficit is not recovered, evapotranspiration will occur following the relation below.

Soil moisture > Total Available Moisture in the soil	: ETR of the day = Actual maximum Potential Evapo - Transpiration (ETP_R)
Soil moisture < Total Available Moisture in the soil	: ETR of the day = ETP_R ×Soil water of the day /Total Available Moisture in the soil

Calculation method is shown in Figure SR2-60.



Source: Study of Groundwater Resource, Water Balance Study Group, Japan, 1970

Figure SR2-60 Calculation Method for Groundwater Recharge and Groundwater Level

Groundwater level of well will be expressed as below.

$$\mu \frac{\Delta Hn}{\Delta t} = W_n - Q_n$$

where, Wn : groundwater recharge in day-n, Qn: (Groundwater flow out — Groundwater flow in) of day-n, Wn=0 in dry season, then relation below will be satisfied:

$$\mu \frac{\Delta Hn}{\Delta t} = -Q_n$$

Qn will be approximated as below:

$$Q_n = a \times H_{n-1} + b$$

From above 2 equations, relation below will be obtained.

$$\mu \triangle H_n / \triangle t = -a \times H_{n-1} - b$$

Moreover, by changing constant : -a/μ→a、-b/μ→b, then relation below will be finally obtained.

$$\triangle H_n / \triangle t = a \times H_n + b$$

Relation below will be obtained by solving above equation.

$$H = (1/a) \times [\exp(a \times (t-c)) - b]$$

Constant "a" and "b" above were obtained for each monitoring site and shown in Table SR2-24. Groundwater flow (Qn) can be calculated form relation of ⊿Hn/⊿t =aHn-1 + b.

Table SR2-24 Parameter of Groundwater Level Decline

Well No		Maximum G.W.L. Fluctuation (m)	Constant		Well No		Maximum G.W.L. Fluctuation (m)	Constant	
			a	b				a	b
Niger North	1	-1.29	-0.0009	0.0178	Western Littoral	16	-1.29	-0.00043	0.0081
	2	-1.59	-0.0014	0.0182		17	-1.59	-0.00073	0.0119
	3	-0.92	-0.0061	0.1726		18	-0.92	-0.00108	0.0122
	4	-0.70	-0.0010	0.0102		19	-0.5	-0.00075	0.0174
	5	-2.30	-0.0080	0.0616		20	-2.21	-0.00089	0.0111
	6	-0.65	-0.0061	0.0531		21	-0.65	-0.00067	0.0123
	7	-0.48	-0.0035	0.0370		22	-0.48	-0.00054	0.0152
	8	-0.48	-0.0033	0.0352		23	-0.48	-0.00048	0.0144
	9	-0.41	-0.0034	0.0215		24	-0.41	-0.00043	0.0122
	10	-0.74	-0.0033	0.0155		25	-0.74	-0.00058	0.0118
	11	-0.36	-0.0176	0.3729		26	-0.36	-0.01104	0.3146
	12	-0.92	-0.0089	0.0640		27	-0.78	-0.00061	0.0085
	13	-0.63	-0.0106	0.1284		28	-0.59	-0.00151	0.0244
	14	-0.87	-0.0110	0.1486		29	-0.85	-0.00178	0.0214
	15	-1.39	-0.0050	0.0546		30	-1.35	-0.01290	0.0605
Average		-0.9153	-	-	Average		-0.88	-	-

Source: JICA project Team

Monitoring survey from now on

Monitoring result so far is representing typical groundwater fluctuation during dry season, which give information on behaviour of groundwater decline (see Figure SR2-61). It seems that groundwater level will soon turn rising from the begging of the rainy season, and ground water recharge can be calculated using monitoring data of rainy season. Local Contractor will finish their monitoring work by the middle of July 2012. Then, it is scheduled that NIHSA will take over monitoring work from the Contractor at middle of July 2012.

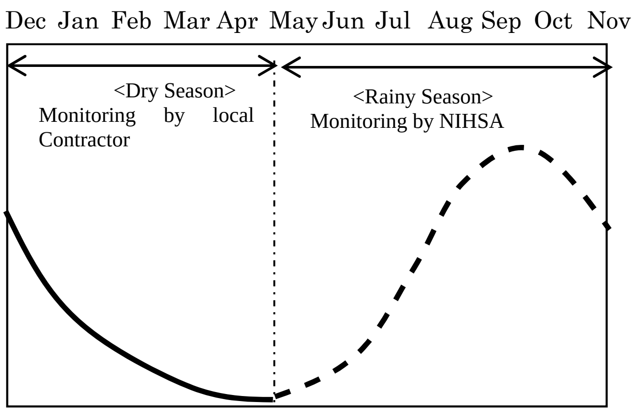


Figure SR2-61 Responsibility of Monitoring Work

(3) Influence of Climate Change

Influence of climate change to precipitation and temperature is explained in Item (2) of Section SR2.3.5 of this Supporting Report. Groundwater recharge, which will be affected by Climate Change, is evaluated as late component of the Surplus by the discharge analysis based on tentative scenarios (see Item (2) of Section SR2.3.5). The result of analysis is shown in Table SR2-25.

As shown in Table SR2-7, groundwater recharge seems to reduce due to influence of the Climate Change. Groundwater recharge will decrease by 16% in case -1, 10% in case-2 in average nationwide. Amount of decrease in groundwater recharge is different in area by area. It should be noticed that area with smaller groundwater recharge will have lager influence than the area with higher groundwater recharge even though amount of the decrease in groundwater recharge is the same. For example, in Niger North (HA-1) and Chad Basin (HA-8), the amount of the decrease in groundwater recharge is not as large as the other areas. However, they will receive more serious influence by the Climate

Change because their current groundwater recharge is much smaller than the other areas. This result is tentative and will be examined again in the next step of the Project.

Table SR2-25 Groundwater Recharge Affected by Change of Precipitation and Temperature due to the Climate Change

Area (HA)	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Nation-wide
Current estimation (mm/year)	37	132	123	250	592	236	570	24	171
Case-1(mm/year)	22	91	92	204	509	186	499	17	136
Case-2(mm/year)	31	105	105	217	508	188	538	24	147

Source: JICA project Team

<u>Lowering of Groundwater Level due to Decrease in Groundwater Recharge</u>

Decrease in groundwater recharge will be recognized as lowering of groundwater level. It will be reflected quickly in groundwater level of shallows wells. Then, it will be gradually reflected in groundwater level of deeper boreholes, such as 50m depth and deeper. Relation between groundwater level of shallow well and groundwater recharge is expressed below:

$$S \times dh/dt = W + Q$$

where, S=Effective porosity of aquifer, H=Groundwater level, W=Groundwater recharge, =Groundwater flow in - groundwater flow out

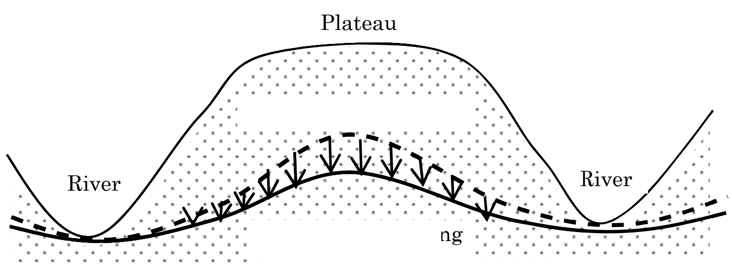
Groundwater lowering by decrease in groundwater recharge can be calculated as decrease in groundwater recharge multiplied by effective porosity of aquifer. If decrease in groundwater recharge is 10mm/year and effective porosity is 0.10, then groundwater lowering can be calculated as 10mm/year / 0.1=100mm/year. However, actual lowering of the groundwater level is not as simple as way mentioned above because there is an effect of groundwater flow in.

<u>Prediction of Groundwater level lowering from the result of groundwater monitoring</u>

Groundwater level has been observed in 30 monitoring shallow wells of HA-1 and HA-6 in this Project. Groundwater level lowering in dry season was observed so far. From now on groundwater level rising will be observed as rainy season begins. As a result of the monitoring, relation between groundwater recharge and groundwater level will be analysed. Based on this relation, model for groundwater recharge can be established to predict groundwater level lowering due to Climate Change.

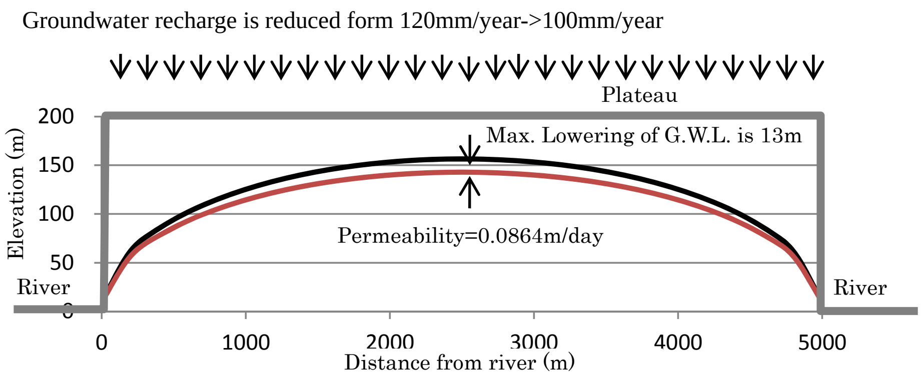
<u>Difference in lowering of groundwater level at place by place</u>

Lowering of groundwater level due to reduce in groundwater recharge is small around river because groundwater level will be almost constant at river beds. However, decrease in groundwater level will become larger in place far from river (see Figure SR2-62). Therefore, inland area in plateau far form river will affect more influence by decrease in groundwater recharge. Countermeasures against Climate Change will take account on such a condition above. Figure SR2-63 shows example of lowering of groundwater level by decrease in groundwater recharge. This is calculated result of groundwater lowering in case where groundwater recharge is deduced form 120mm/year to 100mm/year in plateau of 50km width with both side bordered with rivers. As shown in the result, groundwater lowering in the centre of plateau is larger than the other part.



Source: JICA Project Team

Figure SR2-62 Groundwater Level Lowering after Decrease in Groundwater Recharge



Note) Groundwater level was calculated using well formula
Source: JICA Project Team

Figure SR2-63 Example of Calculation of Groundwater Level Lowering by Reduce in Groundwater Recharge

SR2.4.4 Groundwater Quality

Groundwater quality can be classified following aspects below.

- Geochemical aspect
- Hygienic aspect

(1) Geochemical Aspect

Main chemical elements of groundwater are: Na+, K+, Ca2+, Mg2+, SO32-, HCO3-, and Cl-. Groundwater can be classified based on elements above as listed below.

a) Calcium bicarbonate type
b) Magnesium sulphate, sodium chloride calcium bicarbonate type
c) Sodium chloride type
d) Magnesium sulphate type

- Calcium bicarbonate type is most common in both Basement Complex and sedimentary rock area. Groundwater of this type is stored in unconfined aquifer in the shallow part of the ground.
- Magnesium sulphate, sodium chloride calcium bicarbonate type is common next to calcium bicarbonate type in sedimentary rock area. This type is gradually changed from calcium bicarbonate type during flowing through unconfined and confined aquifers of sedimentary rock area.
- Sodium chloride type is found in aquifers in part of Benue Basin and coastal aquifer. Formation with high salt concentration is cause of salty groundwater in Benue Basin. On the hand, sea-water intrusion is cause of salty groundwater in the coastal aquifer.
- Magnesium sulphate type is not so common. It is reported that this type is found in Benue Basin. Formation with high concentration of MgSO4 may be cause of this groundwater.

Relation between water quality and geology

When groundwater is flowing within aquifer, some chemical substances will be dissolved into groundwater from minerals by chemical reaction with groundwater. Therefore, groundwater is rich in dissolved chemical substances in aquifer which consist of rocks with soluble minerals. It can be said that groundwater in sedimentary rock area is richer in dissolved chemical substances than groundwater in the Basement rock area. Groundwater in the Basement rock area is flowing within weathered zone near the ground surface for short period of time, showing unconfined condition. On the other hand, groundwater of the sedimentary rock area is flowing within deep aquifer for long period of time, showing confined condition. Such a difference in groundwater environment makes difference in groundwater quality of both aquifers.

(2) Hygienic Aspect

Water quality of groundwater of boreholes and shallow wells is summarized in Table SR2-26.

Table SR2-26 Water Quality of Groundwater

Items	Borehole (%)		Protected dug well (%)	
	No. of samples	Ratio out of requirement*) (%)	No. of sample	Ratio out of requirement*) (%)
Fecal streptococci	525	6	424	44
Thermotolerant coliforms	60	25	47	15
nitrate	215	17	159	18
arsenic	525	0	424	0
fluoride	502	6	410	4
iron	522	14	424	8
turbidity	524	13	424	65
pH	525	58	424	50
conductivity	525	2	424	5

Note: * Compared with WHO Guideline
Sources: Rapid Assessment of Drinking Water Quality in the Federal Republic of Nigeria, Unicef, 2010

Matters below are concluded form Table SR2-26.

- There are many cases where groundwater of both shallow wells and boreholes are contaminated with coliforms. More than half of groundwater is contaminated in shallow wells, and more than 30% in boreholes. Shallow hand dug-well will be easily contaminated by dirty surface water compared with borehole in terms of facilities structure. It is generally said that coliform cannot survive in borehole deeper than 30m if sealing of borehole is perfect. Borehole with coliform means that sealing is not perfect.
- Contamination by nitrate is detected in groundwater of boreholes and shallow wells to the same degree.
- Arsenic contamination is not detected.
- Contamination originated form geology such as fluoride and iron was detected more from boreholes than shallow wells. Those chemical substances are dissolved from minerals of rocks comprising aquifer. Groundwater of deep aquifer flows for longer period of time within the aquifer than groundwater of shallow aquifer, which makes deep groundwater richer in chemical substance. As a result, groundwater of boreholes has more chemical substances than groundwater of shallow hand-dug wells.
- Groundwater of shallow wells is of high turbidity. This is caused by muddy surface water which infiltrates into the ground when heavy rainfall.
- More than half of groundwater of shallow wells and boreholes do not comply with requirement in pH by quality standard. Lower and higher pH value than requirement is detected. Other than health hazard, groundwater with low pH will cause corrosion of metallic materials of pipes and pumps of boreholes. Therefore, it is recommended that PVC and stainless materials, which show high resistance against corrosion, should be used for borehole construction in the area of low pH. Such areas have already been identified, and it should be taken into account for new groundwater development.

Generally speaking, groundwater is better than surface water in raw water quality. However, it is recognized from Table SR2-26 that even groundwater is contaminated by coliform and does not comply with water quality standard. Cause of groundwater contamination is as follows:

- Shallow wells will collect groundwater near the ground surface which is subject to contamination by dirty/muddy surface water around the wells.
- Borehole is not completely sealed to prevent surface water from entering into borehole, so that dirty surface water will easily infiltrate into borehole along casing pipe of borehole.
- Borehole is located in the center of community and subject to contamination by domestic waste water around boreholes.

Measures against groundwater contamination are as follows:

- Surface water can easily infiltrate into shallow hand–dug wells. Even shallow hand-dug well with protection lining are subject to contamination compared with boreholes. It is desirable that groundwater of borehole should be used for drinking, and groundwater of shallow hand-dug wells should be used for the other domestic purpose.
- According to JICA Guideline, coliform cannot survive within aquifer deeper than 30m below ground. Consequently, coliform detected in borehole means direct connection of aquifer and

dirty surface water, which was caused by imperfect borehole sealing. Such a contamination can be prevented by perfect sealing in borehole construction.

- Boreholes for public water supply should be located in the center of community. However, boreholes in such place are subject to groundwater contamination by domestic dirty water. In this context, boreholes should be located as far from the center of community as possible. However, public borehole located far from community center is not practical. Then it should be resolved by perfect sealing in borehole construction.

(3) Other groundwater problems

There is local groundwater contamination for further examination in Nigeria as mentioned below:

- There is a high possibility of groundwater contamination by activity for oil production in Niger Delta area. It is reported that groundwater shows higher concentration of Pb, Hg and Cd than those stipulated in water quality standard.
- It is reported that groundwater is contamination by Pb due to mining activity in communities of Bukkuyum LGA and Anka LGA of Zamfara State. Water quality test was implemented for samples from 18 wells, and higher concentration of Pb than drinking water standard was detected from water samples of 15 wells (83%) out of 18 wells.

SR2.5 Summary on Water Resources Potential

In this section, the water resources potential in Nigeria is summarized based on the results shown in the previous sections.

Basis for Estimating Water Resources Potential

The followings are the basis of estimating the water resources potential.

- The output of long-term rainfall-runoff model with the input data of precipitation and air temperature for 40years from 1970 to 2009 is used.
- The long-term rainfall-runoff model is set up based on the available observed discharge data at main hydrological stations, which covers the catchment area of rivers flowing into Nigeria except the upper Niger River as well as the territory of Nigeria.

Estimated Water Resources Potential

Table SR2-27 shows the estimated water resources potential.

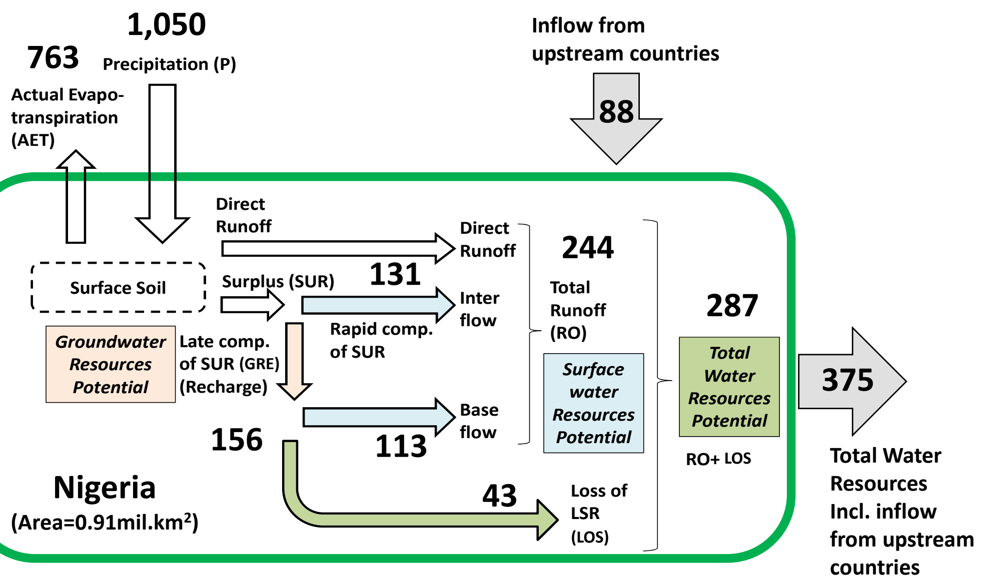
The average precipitation over the country is about 1,150mm. Only 24% of the precipitation becomes runoff and the rest are lost as evapotranspiration and/or others. Total internal generation of the runoff is 244BCM/year and the surface water resources potential is estimated at 333BCM/year. The total water resources potential can be evaluated by adding the component that is lost without becoming surface runoff among recharge. The internal generation of total water resources potential is estimated at 287BCM/year and the total water resources potential with inflow from neighboring countries is estimated at 375BCM/year. 88BCM/year of water comes from neighboring countries, which roughly indicates that almost 24% of surface water resources in Nigeria relies on neighboring countries. The total groundwater resources potential is estimated at156BCM/year as a renewable source on the basis of the estimated groundwater recharge.

Table SR2-27 Estimated Water Resources Potential

		HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
Water Resources Potential										
Total Water Resources Potential [1)]										
Including inflow from outside Nigeria	(BCM /year)	37.4	40.9	60.2	47.9	50.7	43.7	84.0	10.3	375.1
Only internal generation in Nigeria	(BCM /year)	10.7	40.3	37.9	32.8	50.7	43.6	60.3	10.3	286.6
Surface Water Resources Potential										
Including inflow from outside Nigeria	(BCM /year)	35.1	32.3	56.4	46.0	40.1	35.7	79.9	7.2	332.7
Only internal generation in Nigeria	(BCM /year)	8.4	31.7	34.1	30.9	40.1	35.6	56.2	7.2	244.2
Groundwater Resources Potential										
Groundwater Recharge	(BCM /year)	5.0	20.5	19.3	18.6	31.9	23.4	32.8	4.3	155.8
Runoff Condition (Only internal generation in Nigeria)										
Precipitation (P)	(mm/ year)	767	1,170	1,055	1,341	2,132	1,540	2,106	609	1,148
Total Runoff (RO)	(mm/ year)	62	205	218	415	744	359	978	40	268
Groundwater Recharge (GRE)	(mm/ year)	37	132	123	250	592	236	570	24	171
Loss of Recharge (LOS)	(mm/ year)	18	56	24	25	197	80	72	17	47
Runoff Rate (RO/P)	(%)	8.1	17.5	20.7	30.9	34.9	23.3	46.4	6.6	23.4
Recharge Rate (GRE/P)	(%)	4.8	11.3	11.7	18.7	27.7	15.3	27.1	3.9	14.9
Loss Rate (LOS/P)	(%)	2.3	4.8	2.3	1.9	9.2	5.2	3.4	2.9	4.1
Total Water Res. Rate ((RO+LOS)/P)	(%)	10.4	22.3	22.9	32.8	44.1	28.5	49.8	9.5	27.4

Note:

1) **Total Water Resources Potential**
   = Surface Water Resource Potential + Groundwater Recharge – Base Flow Runoff
   = Surface Water Resource Potential + Loss of Groundwater Recharge
2) Water Resources Potential in HA-5, 6 include the runoff in the delta area
3) Water Resources Potential in HA-8 shows the total runoff generation without the loss in the large wet land area



Unit: BCM/year (Billion m³/year)

Source: JICA Project Team

Annex-T SR2-1 List of SHA (1/3)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Inside (I) or Outside (O) Nigeria	SN
1	135,128.3	101	101	9,355.4	I	1
		102	102	9,127.2	I	2
		103	103	3,387.3	I	3
		104	104	2,933.6	I	4
		105	105	3,456.6	I	5
		10601	10601	689.1	I	6
		10602	10602	10,960.3	I	7
		10603	10603	1,084.9	I	8
		10604	10604	17,476.6	I	9
		10605	10605	6,335.9	I	10
		10606	10606	5,817.2	I	11
		10607	10607	2,706.1	I	12
		106081	106081_e	2,220.3	O	13
			106081_i	4,132.3	I	14
		106082	106082_e	80,006.8	O	15
			106082_i1	1,322.2	I	16
			106082_i2	6,043.4	I	17
		106083	106083	412.5	I	18
		106085	106085_e	290.3	O	19
			106085_i	1,499.6	I	20
		1060861	1060861_e	6,067.9	O	21
			1060861_i1	164.7	I	22
			1060861_i2	548.0	I	23
		1060863	1060863	3,509.3	I	24
		106087	106087_e	632.3	O	25
			106087_i	1,216.5	I	26
		1060881	1060881	5,750.6	I	27
		1060883	1060883	2,513.8	I	28
		106089	106089	8,354.1	I	29
		106091	106091	7,636.2	I	30
		106093	106093	4,746.6	I	31
		107	107_e	1,924.1	O	32
			107_i	6,223.4	I	33
		108	108_e	63,517.4	O	34
			108_i	7,724.9	I	35
		109	109	14,037.5	O	36
2	154,615.9	201	201	2,646.9	I	37
		20201	20201	5,088.0	I	38
		202021	202021	2,739.0	I	39
		202023	202023	190.7	I	40
		20203	20203	4,599.3	I	41
		20205	20205	2,636.8	I	42
		203	203	4,436.7	I	43
		20401	20401	5,985.0	I	44
		20403	20403	1,596.0	I	45
		205	205	375.0	I	46
		206	206	7,358.0	I	47
		207	207	1,056.1	I	48
		20801	20801	1,936.8	I	49
		20802	20802	2,240.6	I	50
		20803	20803	725.1	I	51
		20804	20804	17,359.5	I	52
		20805	20805	4,325.9	I	53
		20806	20806	3,503.9	I	54
		20807	20807	557.0	I	55
		20809	20809	3,692.3	I	56
		20810	20810	3,449.6	I	57
		20811	20811	1,561.0	I	58
		20812	20812	5,919.2	I	59
		20813	20813	2,483.4	I	60
		20814	20814	6,713.9	I	61
		20815	20815	10,882.2	I	62
		209	209	15,015.3	I	63
		211	211	6.2	I	64
		212	212	6,740.8	I	65
		213	213	4,145.9	I	66
		214	214_e	257.9	O	67
			214_i	9,792.7	I	68
		215	215	2,109.7	I	69
		216	216_e	3,698.9	O	70
			216_i	7,957.2	I	71
		217	217	127.2	I	72
		218	218	4,644.4	I	73
		219	219	19.0	I	74

Annex-T SR2-1 List of SHA (2/3)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Inside (I) or Outside (O) Nigeria	SN
3	156,546.0	30201	30201	587.0	I	75
		30202	30202	5,145.8	I	76
		30203	30203_e	2,826.1	O	77
			30203_i	11,384.8	I	78
		303	303	1,463.0	I	79
		304	304	4,997.2	I	80
		305	305	808.7	I	81
		30601	30601	2,266.4	I	82
		30602	30602	5,395.0	I	83
		30603	30603_e	559.0	O	84
			30603_i	13,799.2	I	85
		307	307	5,737.4	I	86
		308	308	15,173.5	I	87
		309	309	87.1	I	88
		310	310	2,512.7	I	89
		311	311	11,883.8	I	90
		312	312	2,748.4	I	91
		313	313	48.5	I	92
		31401	31401	717.6	I	93
		31403	31403	1,658.9	I	94
		31404	31404	11,229.0	I	95
		31405	31405	6,890.1	I	96
		31407	31407	7,702.1	I	97
		31408	31408	5,303.7	I	98
		31409	31409	19,178.0	I	99
		315	315	1,616.6	I	100
		316	316	5,536.5	I	101
		317	317	3,400.3	I	102
		318	318	5,441.5	I	103
		319	319_e	2,088.9	O	104
			319_i	1,726.6	I	105
		320	320_e	25,211.5	O	106
			320_i	2,106.7	I	107
		321	321	65,499.3	O	108
4	74,518.7	401	401	3,642.9	I	109
		402	402	9,075.9	I	110
		403	403	4,906.6	I	111
		404	404	9,347.8	I	112
		405	405	11,303.0	I	113
		406	406_e	10,331.5	O	114
			406_i	12,618.8	I	115
		407	407	4,277.1	I	116
		408	408	10,587.4	I	117
		409	409	2,471.0	I	118
		410	410	4,839.1	I	119
		411	411	1,449.1	I	120
5	53,913.6	500	500	19,112.1	I	121
		502	502	3,156.9	I	122
		50401	50401	1,580.8	I	123
		50402	50402	14,104.9	I	124
		50403	50403	11,821.3	I	125
		506	506	4,137.6	I	126
6	99,333.2	60001	60001	2,701.1	I	127
		60002	60002	8,252.4	I	128
		601	601	391.8	I	129
		602	602_e	844.5	O	130
			602_i	3,311.6	I	131
		603	603	1,965.7	I	132
		60401	60401	2,034.9	I	133
		604021	604021	168.9	I	134
		604023	604023_e	72.9	O	135
			604023_i	9,040.6	I	136
		60403	60403	6,011.7	I	137
		60405	60405	4,704.2	I	138
		605	605	1,102.3	I	139
		606	606	4,398.1	I	140
		607	607	417.6	I	141
		608	608	9,764.4	I	142
		609	609	113.5	I	143
		610	610	6,462.0	I	144
		611	611	4,227.7	I	145
		612	612	5,869.5	I	146
		614	614	13,271.7	I	147
		616	616	8,417.4	I	148
		617	617	1,896.8	I	149
		699	699	4,809.4	I	150

Annex-T SR2-1 List of SHA (3/3)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Inside (I) or Outside (O) Nigeria	SN
7	57,440.2	702	702	8,146.5	I	151
		703	703	4,318.8	I	152
		70401	70401	6,054.6	I	153
		70402	70402	7,090.9	I	154
		70403	70403	3,625.5	I	155
		704041	704041	1,236.3	I	156
		704042	704042	7,702.7	I	157
		704043	704043	7,382.6	I	158
		70405	70405_e	13,407.4	O	159
			70405_i	6,028.1	I	160
		705	705	5,854.2	I	161
8	178,483.2	800	800	5,221.9	I	162
		802	802_e	13,857.3	O	163
			802_i	2,422.8	I	164
		80401	80401	4,647.6	I	165
		80402	80402_e	626.1	O	166
			80402_i	7,171.8	I	167
		80403	80403_e	253.1	O	168
			80403_i	6,656.5	I	169
		806	806	21,903.0	I	170
		807	807	14,280.8	I	171
		80801	80801_e	1,438.6	O	172
			80801_i	946.1	I	173
		80802	80802	30,141.6	I	174
		80803	80803_e	8,391.9	O	175
			80803_i	1,528.3	I	176
		80804	80804_e	21,200.9	O	177
			80804_i	6,230.7	I	178
		80805	80805	9,381.6	I	179
		808061	808061	5,200.0	I	180
		808062	808062	6,129.6	I	181
		808063	808063	12,632.1	I	182
		808071	808071	274.9	I	183
		8080721	8080721_e	19,574.1	O	184
			8080721_i	18,041.8	I	185
		8080723	8080723	1,145.5	I	186
		808073	808073	9,609.9	I	187
		8080741	8080741	244.3	I	188
		80807421	80807421	861.8	I	189
		80807423	80807423	653.9	I	190
		8080743	8080743	1,581.2	I	191
		8080745	8080745	3,841.5	I	192
		808075	808075	1,196.2	I	193
		808077	808077	6,537.9	I	194

Annex-T SR2-2 Comparison between Previous SHAs in M/P1995 and those in Present Project (1/3)

HA	MP1995		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
1	101	Gada	1060861	Gada	d.s. of Jibiya dam
			1060863	Gada	u.s. of Jibiya dam
	102	Bunshur	1060881	Bunshur	d.s. of Zobe dam
			1060883	Bunshur	u.s. of Zobe dam
	103	Gagare	106089	Gagare	
	104	Sokoto	106091	Sokoto	d.s. of Bakolori dam
			106093	Sokoto	u.s. of Bakolori dam
	105	Rima	106081	Rima	
			106082	Tributary of Rima	Mainly from Niger
			106083	Rima	d.s. of Goronyo dam
			106085	Rima	u.s. of Goronyo dam
			106087	Rima	
	106	Gawon Gubil	10606	Gawon Gubil	
	107	Along Sokoto River	10601	Sokoto	
			10603	Sokoto	
			10605	Sokoto	
			10607	Sokoto	
	108	Zamfara	10604	Zamfara	
	109	Gulbinka	10602	Gulbinka	
	110	Damzaki	104	Damzaki	
	111	Malendo	102	Malendo	
	112	Along Border	108	Tributary of Niger	Mainly from NIger
			109	Niger	Mainly from Benin
	113	Oura and Maiel	103	Niger	
			105	Niger	
			107	Niger	
	114	Swashi and Dore	101	NIger	

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
2	201	Oli (incl.Wuruma)	215	Niger	
			216	Oli	
	202	Moshi	214	Moshi	
	203	Kontagora	213	Niger	
			217	Niger	
			218	Kontagora	
			219	Niger	
	204	Awun (incl. Oshun)	211	Niger	u.s of Jebba dam
			212	Awun	
	205	Oshun, Oi and Ove	209	Niger	d.s of Jebba dam
	206	Kojin Maringo	20804	Kojin Maringo	
	207	Eba	20801	Kaduna	
			20802	Eba	
			20803	Kaduna	
	208	Kampe	201	Niger	
			20401	Kampe	d.s. of Omi dam
			20403	Kampe	u.s. of Omi dam
	209	Tubo	20811	Kaduna	
			20812	Tubo	
	210	Koringa	20805	Kaduna	
			20806	Koringa	
			20807	Kaduna	d.s. of Shiroro dam
	211	Galma	20814	Galma	
	212	Upper Kaduna	20813	Kaduna	
			20815	Kaduna	
	213	Sarikin Powa	20809	Kaduna	u.s. of Shiroro dam
			20810	Sarikin Powa	
	214	Gbako	205	Niger	
			206	Gbako	
			207	Niger	
	215	Small Tributaries	203	Niger	
	216	Gurara	20201	Gurrara	
			202023	Usman	u.s. of Usman dam
			202021	Usman	d.s. of Usman dam
			20203	Gurara	d.s. of Gurara dam
			20205	Gurara	u.s. of Gurara dam

Annex-T SR2-2 Comparison between Previous SHAs in M/P1995 and those in Present Project (2/3)

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
3			321	Benue	Cameroon
			320	Benue	Cameroon
	301	Kiriange and Others	315	Benue	
			318	Kiriange	
			319	Benue	
	302	Mayo Ine and Others	316	Mayo Ine	
			317	Benue	
	303	Hawal and Others	31401	Gongola	d.s. of Kiri dam
			31403	Gongola	u.s. o f Kiri dam
			31404	Hawal	
	304	Upper Gongola	31407	Gongola	u.s. of Dadin Kowa dam
			31408	Tributary of Gongola	
			31409	Gongola	
	305	Middle Gongola	31405	Gongola	d.s. of Dadin Kowa dam
	306	Small Tributaries	311	Benue	
	307	Mayo Belwa	312	Mayo Belwa	
			313	Benue	
	308	Pai	308	Pai	
	309	Fan	309	Benue	
			310	Fan	
	310	Duchi	304	Duchi	
			305	Benue	
			307	Benue	
	311	Taraba and Lower Donga	30201	Donga	
			303	Benue	
			30601	Taraba	
			30602	Taraba	
	312	Suntai	30202	Suntai	
	313	Uppet Taraba	30603	Taraba	
	314	Upper Donga	30203	Donga	

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
4	401	Shemankar	410	Shemankar	
			411	Benue	
	402	Rity and Fiyu	407	Benue	
			409	Benue	
	403	Ankwe and Others	408	Ankwe	
	404	Asku and Guma	405	Benue	
	405	Katsina-Ala	406	Katsina-Ala	
	406	Small Tributaries			included in 405
	407	Mada	404	Mada	
	408	Akini	402	Akini	
	409	Small Tributaries	401	Benue	
			403	Benue	

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
5	501	Osordo, Udo and Oril	50403	Niger	
	502	Anambra	50402	Anambra	
	503	Asa and Others	502	Asa	
	504	Arong River Niger	50401	Niger	
			506		
	505	Forcados	500	Coastal area	

Annex-T SR2-2 Comparison between Previous SHAs in M/P1995 and those in Present Project (3/3)

HA	MP1995		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
6	601	Wuru, Kobo and Ove	699		
	602	Ogun and Oyan	60401	Ogun	
			604021	Oyan	d.s. of Oyan dam
			604023	Oyan	u.s. of Oyan dam
			60403	Ogun	d.s. of Ikere Gorge dam
			60405	Ogun	u.s. of Ikere Gorge dam
	603	Yewa	601		
			602	Yewa	
			603		
	604	Oni	605		
			606	Oni	
	605	Oshun	607		
			608	Oshun	
	606	Sasa	609		
			610	Sasa	
			611		
	607	Silko	612	Silko	
	608	Osse	614	Osse	
	609	Lagoon	60001	Coastal area	
			60002	Coastal area	
	610	Ossimo	616	Ossimo	
			617		

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
7	701	Upper Cross	704043	Aya	
	702	Okpanku	704042	Okpanku	
			704041	Aya	
	703	Middle Cross	70402	Aboine	
			70403	Cross	
	704	Middle Cross	70405	Cross	
	705	Lower Cross and Imo	702	Imo	
			703		
	706	Lower Cross	70401	Cross	
	707	Small Tributaries	705		

HA	1995M/P		This Project		
	SHA	Rivers	SHA	Rivers	Remarks
8	801	Tagwai			included in HA1
	802	Gari	8080721	Gari	d.s. of Gari dam
			8080723	Gari	u.s of Gari dam
	803	Challawa (incl. Watari)	8080741	Challawa	
			80807421	Watari	d.s. of Watari dam
			80807423	Watari	u.s of Watari dam
			8080743	Challawa	d.s. of Challawa dam
			8080745	Challawa	u.s. of Challawa dam
	804	Kano	808075	Kano	d.s. of Tiga dam
			808077	Kano	u.s. of Tiga dam
	805	Jama'are (incl. Bunga)	808063	Jama'are	
	806	Iggi	808062	Iggi	
	807	Hadejia (incl. Gaya)	808071	Hadejia	
			808073	Hadejia	
	808	Along Border	80804		Mainly from Niger
	809	Katagan	80805	Katagan	
			808061	Katagan	
	810	Dingaiya (incl. Misau)	80802	Dingaiya	
	811	Yobe	80801	Yobe	
			80803	Yobe	
	812	Along Chad Lake	807		
	813	Ngaddo	806	Ngaddo	
	814	Yedseram	80401	Yedseram	
			80403	Yedseram	
	815	Komadugu Gama	80402	Komadugu Gama	
			802		Mainly from Cameroon
			800		Lake Chad

Annex-T SR2-3 List of Meteorological Stations operated by NIMET

No	Station	State	Year of Establishment	Year of Existence	Priority
1	Umuahia	Abia	2005	6	
2	Uyo	Akwa Ibom	1981	30	
3	**Yola**	**Adamawa**	**1942**	**69**	**x**
4	Awka	Anambra	2005	6	
5	**Bauchi**	**Bauchi**	**1941**	**70**	**x**
6	Yenegoa	Bayelsa	1998	13	
7	**Makurdi**	**Benue**	**1942**	**69**	**x**
8	**Maiduguri**	**Borno**	**1951**	**60**	**x**
9	**Calbar**	**Cross River**	**1941**	**70**	**x**
10	**Ikom**	**Cross River**	**1972**	**39**	**x**
11	**Ogoja**	**Cross River**	**1976**	**35**	**x**
12	Asaba	Delta	1996	15	
13	**Warri**	**Delta**	**1949**	**62**	**x**
14	Abakaliki	Ebonyi	2003	8	
15	**Benin**	**Edo**	**1942**	**69**	**x**
16	Ado-Ekiti	Ekiti	2011	0	
17	**Enugu**	**Enugu**	**1941**	**70**	**x**
18	**Abuja**	**FCT**	**1982**	**29**	**x**
19	Gombe	Gombe	2000	11	
20	**Ikeja**	**Lagos**	**1955**	**56**	**x**
21	**Owerri**	**Imo**	**1974**	**37**	**x**
22	Airport	Imo	1995	16	
23	**Kaduna**	**Kaduna**	**1941**	**70**	**x**
24	Zaria	Kaduna	1969	42	
25	**Katsina**	**Katsina**	**1941**	**70**	**x**
26	Kano	Kano	1941	70	
27	**Yelwa**	**Kebbi**	**1943**	**68**	**x**
28	**Lokoja**	**Kogi**	**1942**	**69**	**x**
29	**Ilorin**	**Kwara**	**1946**	**65**	**x**
30	Roof	Lagos	1964	47	
31	**Minna**	**Niger**	**1936**	**75**	**x**
32	Bida	Niger	1941	70	
33	Lafia	Nasarawa	2000	11	
34	**Abeokuta**	**Ogun**	**1981**	**30**	**x**
35	Ijebu-Ode	Ogun	1974	37	
36	**Akure**	**Ondo**	**1979**	**32**	**x**
37	Ondo	Ondo	1941	70	
38	Osogbo	Osun	1956	55	
39	**Ibadan**	**Oyo**	**1907**	**104**	**x**
40	Iseyin	Oyo	1981	30	
41	Shaki	Oyo	1984	27	
42	**Jos**	**Plateau**	**1979**	**32**	**x**
43	**PHC**	**Rivers**	**1941**	**70**	**x**
44	**Sokoto**	**Sokoto**	**1943**	**68**	**x**
45	**Ibi**	**Taraba**	**1948**	**63**	**x**
46	**Nguru**	**Yobe**	**1969**	**42**	**x**
47	Potiskum	Yobe	1941	70	
48	Gusau	Zamfara	1952	59	

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (1/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average Precipitation (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
1	101	101	1	9,355.4	0	3	11	43	103	152	190	248	207	61	4	0	1,023
	102	102	2	9,127.2	0	1	7	32	89	140	197	266	225	63	2	0	1,021
	103	103	3	3,387.3	0	1	6	30	84	136	191	252	192	47	2	0	940
	104	104	4	2,933.6	0	0	6	29	73	123	181	256	194	45	3	0	909
	105	105	5	3,456.6	0	1	6	31	84	139	190	269	182	41	3	0	945
	10601	10601	6	689.1	0	1	5	28	79	129	183	255	170	36	2	0	887
	10602	10602	7	10,960.3	0	0	6	30	75	124	186	258	198	43	1	0	922
	10603	10603	8	1,084.9	0	1	6	25	73	120	177	237	156	31	2	0	828
	10604	10604	9	17,476.6	0	0	6	26	64	111	178	240	166	32	1	0	825
	10605	10605	10	6,335.9	0	1	9	21	54	94	157	187	116	26	2	0	666
	10606	10606	11	5,817.2	0	0	2	16	49	92	165	221	129	21	0	0	695
	10607	10607	12	2,706.1	0	0	2	11	40	79	150	186	96	16	0	0	581
	106081	106081_e	13	2,220.3	0	0	0	5	26	57	122	130	56	5	0	0	401
		106081_i	14	4,132.3	0	0	0	5	31	72	139	158	75	9	0	0	489
	106082	106082_e	15	80,006.8	0	0	0	1	9	27	83	98	36	2	0	0	256
		106082_i1	16	1,322.2	0	0	0	5	25	63	134	145	67	6	0	0	446
		106082_i2	17	6,043.4	0	0	0	5	29	66	150	194	84	9	0	0	536
	106083	106083	18	412.5	0	0	0	5	23	67	137	158	76	8	0	0	473
	106085	106085_e	19	290.3	0	0	0	2	14	49	121	135	62	3	0	0	386
		106085_i	20	1,499.6	0	0	0	3	18	58	130	146	70	5	0	0	429
	1060861	1060861_e	21	6,067.9	0	0	0	2	18	50	125	142	65	5	0	0	408
		1060861_i1	22	164.7	0	0	0	1	14	50	120	134	66	3	0	0	389
		1060861_i2	23	548.0	0	0	0	5	26	65	151	178	87	9	0	0	521
	1060863	1060863	24	3,509.3	0	0	1	7	34	77	166	205	102	11	0	0	605
	106087	106087_e	25	632.3	0	0	0	3	20	58	129	152	75	7	0	0	444
		106087_i	26	1,216.5	0	0	0	2	18	57	127	148	74	6	0	0	432
	1060881	1060881	27	5,750.6	0	0	1	12	39	85	166	205	118	14	0	0	641
	1060883	1060883	28	2,513.8	0	0	2	15	51	100	187	242	132	15	0	0	745
	106089	106089	29	8,354.1	0	0	3	20	54	102	180	229	144	19	0	0	751
	106091	106091	30	7,636.2	0	0	1	9	36	83	155	193	107	14	0	0	597
	106093	106093	31	4,746.6	0	0	4	29	68	118	192	250	175	27	0	0	863
	107	107_e	32	1,924.1	0	2	8	39	95	153	194	298	191	44	4	0	1,028
		107_i	33	6,223.4	0	1	5	29	85	139	187	271	173	36	3	0	930
	108	108_e	34	63,517.4	0	0	0	3	19	48	99	110	53	5	0	0	337
		108_i	35	7,724.9	0	0	1	9	37	75	139	157	82	14	0	0	514
	109	109	36	14,037.5	0	2	12	40	109	150	195	257	190	48	3	0	1,006
2	201	201	37	2,646.9	5	11	38	95	159	164	179	185	233	124	11	5	1,208
	20201	20201	38	5,088.0	3	9	28	77	153	163	202	239	240	115	8	0	1,236
	202021	202021	39	2,739.0	2	8	27	70	151	167	222	287	255	116	8	0	1,315
	202023	202023	40	190.7	3	10	33	75	156	175	234	315	271	121	10	0	1,402
	20203	20203	41	4,599.3	2	7	25	67	148	172	228	308	261	111	7	0	1,338
	20205	20205	42	2,636.8	1	6	31	70	149	185	249	349	274	108	4	0	1,425
	203	203	43	4,436.7	3	9	29	80	150	163	195	209	231	111	8	2	1,189
	20401	20401	44	5,985.0	5	12	41	92	151	165	177	172	233	121	12	6	1,189
	20403	20403	45	1,596.0	8	19	59	108	158	167	163	150	245	145	21	14	1,256
	205	205	46	375.0	3	7	22	73	144	165	209	213	232	103	6	0	1,177
	206	206	47	7,358.0	2	5	17	62	139	166	214	254	242	101	5	0	1,208
	207	207	48	1,056.1	3	7	25	75	143	166	203	200	229	101	6	0	1,158
	20801	20801	49	1,936.8	3	5	19	68	135	169	211	212	237	95	5	0	1,159
	20802	20802	50	2,240.6	2	3	14	57	127	170	203	228	250	94	6	0	1,154
	20803	20803	51	725.1	1	2	13	60	130	173	209	231	251	94	5	0	1,170
	20804	20804	52	17,359.5	0	1	8	42	105	157	206	272	245	73	2	0	1,112
	20805	20805	53	4,325.9	0	2	11	52	128	172	203	268	259	95	5	0	1,196
	20806	20806	54	3,503.9	0	2	10	47	117	166	214	289	252	80	3	0	1,179
	20807	20807	55	557.0	0	3	11	51	129	168	210	287	252	94	5	0	1,212
	20809	20809	56	3,692.3	1	5	19	61	140	172	225	312	259	101	6	0	1,301
	20810	20810	57	3,449.6	0	4	16	57	131	174	230	314	256	90	3	0	1,274
	20811	20811	58	1,561.0	0	2	11	51	121	168	218	299	253	81	4	0	1,208
	20812	20812	59	5,919.2	0	1	8	47	106	155	217	290	225	51	1	0	1,100
	20813	20813	60	2,483.4	0	2	11	52	120	164	224	304	238	71	2	0	1,187
	20814	20814	61	6,713.9	0	0	8	37	108	143	232	293	188	39	0	0	1,049
	20815	20815	62	10,882.2	0	1	18	56	138	172	259	318	225	66	1	0	1,255
	209	209	63	15,015.3	6	10	38	83	144	168	168	167	234	118	14	5	1,155
	211	211	64	6.2	5	6	26	71	129	167	164	175	225	99	10	3	1,082
	212	212	65	6,740.8	7	13	47	91	148	168	143	140	231	130	22	10	1,151
	213	213	66	4,145.9	3	4	19	59	124	165	183	208	234	92	7	1	1,100
	214	214_e	67	257.9	3	8	31	70	131	156	171	199	226	97	10	5	1,108
		214_i	68	9,792.7	4	9	34	76	136	160	159	175	229	107	13	5	1,106
	215	215	69	2,109.7	2	5	21	62	123	163	171	200	226	90	8	1	1,073
	216	216_e	70	3,698.9	1	5	21	61	123	158	181	239	229	74	6	1	1,098
		216_i	71	7,957.2	1	5	21	61	121	159	174	221	227	82	7	1	1,081
	217	217	72	127.2	2	4	17	54	118	160	180	216	225	82	6	1	1,065
	218	218	73	4,644.4	1	3	12	43	112	156	199	244	235	81	5	0	1,089
	219	219	74	19.0	2	3	16	53	115	159	179	217	220	78	6	1	1,050

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (2/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average Precipitation (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
3	30201	30201	75	587.0	0	1	21	63	131	163	179	215	211	112	6	0	1,103
	30202	30202	76	5,145.8	1	5	34	85	151	186	215	239	242	138	12	0	1,307
	30203	30203_e	77	2,826.1	4	19	73	125	177	206	269	281	300	201	32	6	1,693
		30203_i	78	11,384.8	3	11	51	104	168	198	231	251	265	170	21	3	1,476
	303	303	79	1,463.0	0	1	17	59	125	161	184	222	210	103	5	0	1,086
	304	304	80	4,997.2	0	0	13	48	114	155	214	256	208	78	3	0	1,088
	305	305	81	808.7	0	0	15	56	120	157	190	226	205	94	4	0	1,067
	30601	30601	82	2,266.4	0	2	20	66	129	165	200	229	214	105	6	0	1,135
	30602	30602	83	5,395.0	0	1	21	76	135	170	227	247	219	100	7	0	1,203
	30603	30603_e	84	559.0	3	12	57	132	183	207	284	278	264	151	21	0	1,592
		30603_i	85	13,799.2	1	6	38	103	162	193	249	258	248	136	14	0	1,408
	307	307	86	5,737.4	0	0	12	51	112	152	203	236	199	81	3	0	1,048
	308	308	87	15,173.5	0	0	5	34	85	130	224	252	168	48	0	0	945
	309	309	88	87.1	0	0	12	54	113	152	207	236	198	79	3	0	1,054
	310	310	89	2,512.7	0	0	16	64	122	157	221	243	206	84	5	0	1,118
	311	311	90	11,883.8	0	0	8	49	101	139	215	240	183	61	3	0	998
	312	312	91	2,748.4	0	0	10	57	109	142	221	242	190	62	4	0	1,038
	313	313	92	48.5	0	0	4	43	91	126	205	231	166	46	2	0	915
	31401	31401	93	717.6	0	0	3	41	87	122	205	230	161	44	2	0	894
	31403	31403	94	1,658.9	0	0	3	37	83	121	211	238	157	41	2	0	894
	31404	31404	95	11,229.0	0	0	2	26	72	111	207	245	144	34	0	0	841
	31405	31405	96	6,890.1	0	0	3	31	74	116	215	242	150	38	0	0	869
	31407	31407	97	7,702.1	0	0	1	22	59	104	216	242	133	30	0	0	807
	31408	31408	98	5,303.7	0	0	0	15	41	86	198	224	112	22	0	0	699
	31409	31409	99	19,178.0	0	1	7	33	89	130	240	271	165	42	1	0	979
	315	315	100	1,616.6	0	0	4	43	92	124	202	229	166	46	2	0	907
	316	316	101	5,536.5	0	1	13	67	124	153	233	249	204	72	4	0	1,121
	317	317	102	3,400.3	0	0	7	52	111	137	212	236	189	58	3	0	1,005
	318	318	103	5,441.5	0	0	3	37	93	125	206	245	165	46	0	0	922
	319	319_e	104	2,088.9	0	0	4	37	103	129	203	253	172	55	0	0	956
		319_i	105	1,726.6	0	0	3	40	102	129	200	245	175	54	0	0	949
	320	320_e	106	25,211.5	0	2	25	97	163	196	271	275	246	113	8	0	1,396
		320_i	107	2,106.7	0	2	21	86	147	177	249	259	227	99	7	0	1,273
	321	321	108	65,499.3	0	0	6	44	105	138	221	264	188	64	2	0	1,032
4	401	401	109	3,642.9	5	12	36	90	163	165	185	200	244	131	14	3	1,246
	402	402	110	9,075.9	2	7	31	74	154	170	232	299	262	124	10	0	1,366
	403	403	111	4,906.6	4	11	34	83	165	166	196	228	250	135	13	1	1,286
	404	404	112	9,347.8	2	4	31	73	156	174	245	315	257	120	9	0	1,385
	405	405	113	11,303.0	5	8	34	86	176	178	197	231	245	148	14	2	1,323
	406	406_e	114	10,331.5	8	26	90	141	187	230	294	316	341	235	38	10	1,915
		406_i	115	12,618.8	7	11	48	103	193	218	210	243	276	212	27	5	1,553
	407	407	116	4,277.1	3	2	28	74	158	174	188	230	230	137	10	0	1,233
	408	408	117	10,587.4	1	2	25	67	144	170	235	295	248	116	9	0	1,312
	409	409	118	2,471.0	1	2	25	68	144	171	173	215	221	130	8	0	1,159
	410	410	119	4,839.1	0	1	17	57	128	164	205	256	227	101	5	0	1,161
	411	411	120	1,449.1	0	1	20	60	129	162	172	214	211	113	5	0	1,088
5	500	500	121	19,112.1	37	77	130	202	312	474	447	318	468	370	152	50	3,055
	502	502	122	3,156.9	19	40	87	148	239	299	313	249	373	278	63	17	2,125
	50401	50401	123	1,580.8	18	37	81	143	233	296	305	259	362	273	60	16	2,083
	50402	50402	124	14,104.9	10	21	55	110	194	205	213	201	292	196	30	9	1,536
	50403	50403	125	11,821.3	9	20	56	110	177	192	187	173	268	172	26	9	1,398
	506	506	126	4,137.6	17	38	84	149	235	315	306	291	351	279	60	16	2,142
6	60001	60001	127	2,701.1	18	37	86	132	232	333	259	103	224	207	68	18	1,712
	60002	60002	128	8,252.4	23	53	114	189	280	388	440	270	417	324	100	31	2,635
	601	601	129	391.8	13	31	82	115	195	258	153	54	145	162	46	19	1,271
	602	602_e	130	844.5	4	26	63	134	153	148	125	91	179	124	21	14	1,083
		602_i	131	3,311.6	7	27	73	131	162	173	136	79	171	138	30	15	1,140
	603	603	132	1,965.7	15	30	80	129	206	278	181	70	163	166	53	14	1,385
	60401	60401	133	2,034.9	13	26	78	139	177	223	172	84	172	156	45	12	1,294
	604021	604021	134	168.9	9	25	78	140	156	178	150	84	170	143	34	12	1,179
	604023	604023_e	135	72.9	4	20	47	114	134	158	159	144	207	116	16	10	1,128
		604023_i	136	9,040.6	5	19	58	111	143	154	146	120	199	129	21	10	1,115
	60403	60403	137	6,011.7	6	22	72	127	154	165	138	101	194	150	33	10	1,174
	60405	60405	138	4,704.2	6	16	52	96	149	157	141	133	219	129	24	9	1,130
	605	605	139	1,102.3	19	31	78	136	216	299	218	91	189	180	58	12	1,477
	606	606	140	4,398.1	10	27	75	139	179	221	189	109	198	186	47	9	1,380
	607	607	141	417.6	16	32	79	125	212	287	242	98	219	205	65	13	1,601
	608	608	142	9,764.4	8	25	71	119	163	182	157	118	225	180	41	12	1,302
	609	609	143	113.5	16	36	86	128	215	300	259	108	238	208	65	17	1,674
	610	610	144	6,462.0	9	30	83	132	171	211	201	132	237	194	46	14	1,462
	611	611	145	4,227.7	12	38	93	144	199	267	269	156	277	217	60	20	1,753
	612	612	146	5,869.5	9	37	93	142	181	221	241	175	285	198	49	21	1,652
	614	614	147	13,271.7	8	29	79	127	171	190	198	165	271	171	34	19	1,463
	616	616	148	8,417.4	15	43	97	156	221	270	298	232	359	256	59	17	2,023
	617	617	149	1,896.8	25	50	103	171	268	343	393	287	424	324	87	23	2,498
	699	699	150	4,809.4	6	14	47	90	140	150	160	151	207	119	14	7	1,105

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (3/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average Precipitation (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
7	702	702	151	8,146.5	21	54	106	164	252	345	356	338	376	292	94	26	2,424
	703	703	152	4,318.8	26	64	127	188	263	344	395	345	403	314	133	37	2,638
	70401	70401	153	6,054.6	23	48	110	168	256	295	344	296	346	284	96	20	2,286
	70402	70402	154	7,090.9	14	26	70	132	234	248	270	251	309	238	38	10	1,840
	70403	70403	155	3,625.5	17	28	78	137	238	265	299	277	312	282	49	11	1,992
	704041	704041	156	1,236.3	15	27	70	131	235	274	279	282	310	301	48	13	1,986
	704042	704042	157	7,702.7	11	17	50	110	214	244	216	248	280	255	39	10	1,693
	704043	704043	158	7,382.6	10	17	51	105	202	216	216	226	282	213	30	8	1,576
	70405	70405_e	159	13,407.4	16	58	116	179	237	299	370	387	403	331	58	21	2,474
		70405_i	160	6,028.1	17	40	87	153	246	294	318	319	349	322	57	17	2,219
	705	705	161	5,854.2	27	57	133	194	281	340	401	353	384	305	122	34	2,629
8	800	800	162	5,221.9	0	0	0	1	10	24	91	119	49	7	0	0	302
	802	802_e	163	13,857.3	0	0	0	11	46	82	174	217	112	23	0	0	666
		802_i	164	2,422.8	0	0	0	7	29	56	146	172	88	19	0	0	517
	80401	80401	165	4,647.6	0	0	0	6	27	57	143	180	89	16	0	0	517
	80402	80402_e	166	626.1	0	0	1	15	61	102	191	254	129	28	0	0	782
		80402_i	167	7,171.8	0	0	0	10	45	82	170	220	113	23	0	0	664
	80403	80403_e	168	253.1	0	1	4	29	94	127	217	283	153	42	0	0	951
		80403_i	169	6,656.5	0	0	1	16	59	96	182	236	127	29	0	0	747
	806	806	170	21,903.0	0	0	0	12	37	76	167	208	104	19	0	0	623
	807	807	171	14,280.8	0	0	0	3	12	31	106	141	54	8	0	0	355
	80801	80801_e	172	1,438.6	0	0	0	0	6	18	78	108	33	5	0	0	248
		80801_i	173	946.1	0	0	0	1	7	20	83	117	36	5	0	0	269
	80802	80802	174	30,141.6	0	0	0	10	34	69	178	208	93	16	0	0	609
	80803	80803_e	175	8,391.9	0	0	0	0	5	17	72	84	26	2	0	0	208
		80803_i	176	1,528.3	0	0	0	1	9	28	100	119	43	6	0	0	305
	80804	80804_e	177	21,200.9	0	0	0	1	8	22	87	102	35	2	0	0	257
		80804_i	178	6,230.7	0	0	0	2	9	31	110	118	45	5	0	0	320
	80805	80805	179	9,381.6	0	0	0	5	23	53	155	182	72	10	0	0	500
	808061	808061	180	5,200.0	0	0	0	7	34	68	176	227	88	9	0	0	610
	808062	808062	181	6,129.6	0	0	1	14	61	99	210	264	123	18	0	0	790
	808063	808063	182	12,632.1	0	1	4	25	84	121	237	278	149	29	0	0	928
	808071	808071	183	274.9	0	0	0	4	14	45	139	154	57	7	0	0	420
	8080721	8080721_e	184	19,574.1	0	0	0	2	12	35	114	125	50	4	0	0	342
		8080721_i	185	18,041.8	0	0	0	5	22	61	150	184	72	7	0	0	500
	8080723	8080723	186	1,145.5	0	0	1	8	41	87	175	231	107	11	0	0	661
	808073	808073	187	9,609.9	0	0	1	10	42	85	182	233	100	11	0	0	665
	8080741	8080741	188	244.3	0	0	2	11	52	105	192	255	113	12	0	0	743
	80807421	80807421	189	861.8	0	0	1	11	50	101	187	246	114	12	0	0	723
	80807423	80807423	190	653.9	0	0	1	12	50	99	186	244	121	13	0	0	726
	8080743	8080743	191	1,581.2	0	0	2	16	62	112	199	264	132	16	0	0	803
	8080745	8080745	192	3,841.5	0	0	4	28	82	125	209	273	164	24	0	0	908
	808075	808075	193	1,196.2	0	0	3	18	69	118	207	271	137	18	0	0	842
	808077	808077	194	6,537.9	0	0	6	29	92	135	235	287	164	29	0	0	976

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (4/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	80 % Dependable Precipitatin (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
1	101	101	1	9,355.4	0	1	7	19	69	119	153	183	162	39	2	0	755
	102	102	2	9,127.2	0	0	5	17	52	105	154	207	176	33	1	0	750
	103	103	3	3,387.3	0	0	4	14	46	98	146	171	142	21	1	0	644
	104	104	4	2,933.6	0	0	5	13	39	87	141	186	143	21	2	0	637
	105	105	5	3,456.6	0	1	5	14	52	104	147	198	142	21	2	0	685
	10601	10601	6	689.1	0	0	4	14	49	93	147	202	134	19	2	0	664
	10602	10602	7	10,960.3	0	0	5	14	42	97	150	208	152	19	1	0	688
	10603	10603	8	1,084.9	0	0	5	10	45	83	143	187	123	15	2	0	613
	10604	10604	9	17,476.6	0	0	5	8	39	80	150	191	125	16	1	0	616
	10605	10605	10	6,335.9	0	1	7	7	35	69	132	145	82	10	1	0	490
	10606	10606	11	5,817.2	0	0	2	5	27	53	139	162	91	9	0	0	488
	10607	10607	12	2,706.1	0	0	2	4	21	48	122	139	69	7	0	0	411
	106081	106081_e	13	2,220.3	0	0	0	3	9	28	87	93	39	2	0	0	261
		106081_i	14	4,132.3	0	0	0	2	12	39	103	116	52	4	0	0	328
	106082	106082_e	15	80,006.8	0	0	0	0	6	15	63	74	21	0	0	0	179
		106082_i1	16	1,322.2	0	0	0	3	8	33	94	102	44	2	0	0	287
		106082_i2	17	6,043.4	0	0	0	2	10	46	101	143	54	1	0	0	357
	106083	106083	18	412.5	0	0	0	2	11	33	102	115	47	2	0	0	313
	106085	106085_e	19	290.3	0	0	0	1	5	23	93	95	47	1	0	0	264
		106085_i	20	1,499.6	0	0	0	1	7	31	97	107	47	1	0	0	292
	1060861	1060861_e	21	6,067.9	0	0	0	1	6	28	93	109	42	0	0	0	279
		1060861_i1	22	164.7	0	0	0	0	5	25	91	98	49	1	0	0	269
		1060861_i2	23	548.0	0	0	0	1	10	41	111	135	63	1	0	0	363
	1060863	1060863	24	3,509.3	0	0	1	2	13	48	123	154	74	1	0	0	416
	106087	106087_e	25	632.3	0	0	0	1	7	31	95	119	42	1	0	0	296
		106087_i	26	1,216.5	0	0	0	1	7	31	97	121	43	1	0	0	302
	1060881	1060881	27	5,750.6	0	0	1	2	19	64	136	160	83	2	0	0	467
	1060883	1060883	28	2,513.8	0	0	1	5	21	71	131	187	96	3	0	0	514
	106089	106089	29	8,354.1	0	0	2	4	31	77	148	176	110	3	0	0	552
	106091	106091	30	7,636.2	0	0	1	3	20	48	128	147	76	4	0	0	426
	106093	106093	31	4,746.6	0	0	3	7	39	96	157	199	141	5	0	0	647
	107	107_e	32	1,924.1	0	1	6	18	66	119	161	240	159	18	2	0	789
		107_i	33	6,223.4	0	1	4	16	58	107	154	221	140	19	2	0	720
	108	108_e	34	63,517.4	0	0	0	2	12	35	80	84	39	3	0	0	254
		108_i	35	7,724.9	0	0	1	4	18	52	118	112	58	6	0	0	369
	109	109	36	14,037.5	0	1	8	22	79	115	156	214	159	18	1	0	773
2	201	201	37	2,646.9	3	5	13	62	121	131	126	119	188	86	2	3	860
	20201	20201	38	5,088.0	2	4	13	55	118	138	165	176	195	77	3	0	947
	202021	202021	39	2,739.0	2	5	13	40	117	135	171	222	212	75	4	0	995
	202023	202023	40	190.7	2	6	17	42	119	140	185	253	217	80	5	0	1,067
	20203	20203	41	4,599.3	2	4	14	37	111	141	182	245	211	66	4	0	1,018
	20205	20205	42	2,636.8	1	4	18	46	112	159	210	275	204	54	2	0	1,084
	203	203	43	4,436.7	2	5	12	54	118	132	154	157	180	74	2	1	892
	20401	20401	44	5,985.0	4	6	21	59	125	134	132	116	187	94	2	4	884
	20403	20403	45	1,596.0	5	7	36	79	133	134	115	89	197	109	4	7	916
	205	205	46	375.0	2	4	10	47	114	130	155	150	183	59	2	0	854
	206	206	47	7,358.0	1	3	7	35	99	134	177	199	193	59	3	0	911
	207	207	48	1,056.1	3	4	13	45	113	133	154	139	178	65	2	0	849
	20801	20801	49	1,936.8	2	3	7	36	100	131	159	155	192	58	2	0	845
	20802	20802	50	2,240.6	2	1	7	33	93	140	160	188	203	55	3	0	884
	20803	20803	51	725.1	1	1	6	34	94	137	166	188	203	53	2	0	885
	20804	20804	52	17,359.5	0	1	6	22	70	132	176	217	185	44	1	0	855
	20805	20805	53	4,325.9	0	1	6	22	82	137	160	192	198	60	3	0	862
	20806	20806	54	3,503.9	0	1	7	23	70	142	180	230	184	46	2	0	884
	20807	20807	55	557.0	0	2	7	24	85	134	163	220	191	58	3	0	887
	20809	20809	56	3,692.3	1	3	12	34	103	142	180	260	197	54	4	0	989
	20810	20810	57	3,449.6	0	3	9	30	92	142	185	271	184	48	2	0	966
	20811	20811	58	1,561.0	0	2	7	23	79	139	177	247	184	47	3	0	909
	20812	20812	59	5,919.2	0	1	5	20	73	127	160	231	184	21	1	0	824
	20813	20813	60	2,483.4	0	1	6	25	88	134	171	248	176	36	1	0	886
	20814	20814	61	6,713.9	0	0	4	10	73	113	177	241	150	15	0	0	784
	20815	20815	62	10,882.2	0	1	7	31	103	150	211	277	178	30	1	0	988
	209	209	63	15,015.3	4	4	21	54	114	140	128	111	204	72	2	3	858
	211	211	64	6.2	3	2	12	45	102	133	115	113	198	55	3	2	784
	212	212	65	6,740.8	4	3	25	55	116	134	98	86	192	72	2	5	794
	213	213	66	4,145.9	2	2	10	36	91	139	134	148	200	60	3	1	824
	214	214_e	67	257.9	2	2	13	47	95	120	128	140	180	43	0	2	774
		214_i	68	9,792.7	3	3	17	50	105	129	115	122	197	55	2	3	800
	215	215	69	2,109.7	2	2	12	39	93	129	124	144	194	50	3	1	792
	216	216_e	70	3,698.9	0	1	12	41	82	116	134	182	182	38	2	0	792
		216_i	71	7,957.2	1	2	12	42	79	122	130	165	187	46	2	1	789
	217	217	72	127.2	1	2	8	29	84	130	130	146	186	47	3	1	767
	218	218	73	4,644.4	1	1	7	24	79	131	163	180	186	51	2	0	825
	219	219	74	19.0	1	1	8	28	82	129	129	147	183	45	2	1	757

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (5/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	80 % Dependable Precipitatin (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
3	30201	30201	75	587.0	0	1	6	32	99	127	132	173	178	74	4	0	825
	30202	30202	76	5,145.8	0	3	14	48	118	150	167	206	215	101	7	0	1,030
	30203	30203_e	77	2,826.1	2	6	43	95	137	178	227	255	270	160	13	2	1,387
		30203_i	78	11,384.8	1	4	31	65	141	167	188	221	239	134	10	1	1,203
	303	303	79	1,463.0	0	1	5	36	98	126	140	179	173	68	4	0	830
	304	304	80	4,997.2	0	0	7	33	86	129	171	208	180	50	2	0	867
	305	305	81	808.7	0	0	4	37	98	122	149	182	159	67	3	0	822
	30601	30601	82	2,266.4	0	1	6	40	99	128	152	186	185	73	4	0	874
	30602	30602	83	5,395.0	0	1	8	46	111	133	184	203	183	72	4	0	945
	30603	30603_e	84	559.0	2	3	25	84	136	181	246	236	226	118	4	0	1,260
		30603_i	85	13,799.2	0	2	17	61	136	167	206	224	220	107	5	0	1,145
	307	307	86	5,737.4	0	0	5	35	96	121	160	199	162	59	2	0	841
	308	308	87	15,173.5	0	0	3	20	60	106	181	201	132	34	0	0	738
	309	309	88	87.1	0	0	4	37	89	115	159	189	167	55	3	0	818
	310	310	89	2,512.7	0	0	6	41	103	119	180	189	168	55	3	0	865
	311	311	90	11,883.8	0	0	4	28	83	111	165	191	142	35	2	0	760
	312	312	91	2,748.4	0	0	4	30	86	103	168	202	143	30	2	0	769
	313	313	92	48.5	0	0	2	20	71	87	154	189	122	19	1	0	665
	31401	31401	93	717.6	0	0	2	20	65	87	162	181	114	20	2	0	652
	31403	31403	94	1,658.9	0	0	2	18	64	87	168	191	110	23	1	0	664
	31404	31404	95	11,229.0	0	0	1	15	48	80	156	201	102	21	0	0	624
	31405	31405	96	6,890.1	0	0	2	18	57	92	162	198	105	25	0	0	659
	31407	31407	97	7,702.1	0	0	1	14	40	72	173	196	95	18	0	0	609
	31408	31408	98	5,303.7	0	0	0	10	24	53	147	177	75	12	0	0	499
	31409	31409	99	19,178.0	0	1	3	18	68	107	201	224	136	24	0	0	781
	315	315	100	1,616.6	0	0	2	20	69	86	152	180	118	20	2	0	649
	316	316	101	5,536.5	0	1	5	37	92	104	185	202	161	35	3	0	824
	317	317	102	3,400.3	0	0	2	27	84	98	161	203	142	31	2	0	750
	318	318	103	5,441.5	0	0	2	18	67	93	175	201	116	29	0	0	700
	319	319_e	104	2,088.9	0	0	2	15	66	92	154	214	122	32	0	0	697
		319_i	105	1,726.6	0	0	1	16	68	93	161	205	127	35	0	0	707
	320	320_e	106	25,211.5	0	1	10	68	134	176	234	235	204	83	3	0	1,148
		320_i	107	2,106.7	0	1	8	56	115	136	212	221	182	60	3	0	995
	321	321	108	65,499.3	0	0	3	26	75	117	193	214	144	49	1	0	823
4	401	401	109	3,642.9	3	4	15	56	128	139	136	128	191	86	3	1	889
	402	402	110	9,075.9	2	4	14	48	121	143	189	233	217	83	5	0	1,059
	403	403	111	4,906.6	2	5	16	56	134	145	150	161	206	92	4	1	972
	404	404	112	9,347.8	1	2	16	50	126	149	201	248	210	86	5	0	1,094
	405	405	113	11,303.0	2	3	13	56	141	147	143	170	202	109	5	1	993
	406	406_e	114	10,331.5	2	9	56	109	148	191	243	275	303	186	17	2	1,541
		406_i	115	12,618.8	3	5	23	68	165	179	167	201	236	164	15	2	1,226
	407	407	116	4,277.1	1	1	8	42	136	137	139	177	194	101	6	0	943
	408	408	117	10,587.4	0	1	12	48	121	141	184	242	220	82	6	0	1,056
	409	409	118	2,471.0	1	1	9	36	114	137	130	166	189	82	6	0	871
	410	410	119	4,839.1	0	1	8	37	106	135	162	216	198	69	4	0	936
	411	411	120	1,449.1	0	1	6	33	96	128	126	166	176	70	4	0	808
5	500	500	121	19,112.1	16	33	93	151	240	383	345	257	369	275	95	17	2,274
	502	502	122	3,156.9	5	18	63	105	197	265	248	174	301	206	32	4	1,618
	50401	50401	123	1,580.8	5	13	57	106	192	260	235	189	294	208	29	5	1,593
	50402	50402	124	14,104.9	2	5	40	83	154	179	161	131	237	140	6	2	1,142
	50403	50403	125	11,821.3	3	7	35	76	142	175	138	112	224	124	6	3	1,046
	506	506	126	4,137.6	5	13	57	110	194	270	235	222	272	211	28	4	1,622
6	60001	60001	127	2,701.1	6	14	44	87	180	262	155	40	134	141	39	3	1,105
	60002	60002	128	8,252.4	7	25	78	123	217	298	336	172	312	235	61	6	1,871
	601	601	129	391.8	2	7	40	72	153	197	70	19	89	111	26	3	789
	602	602_e	130	844.5	1	8	25	94	105	112	69	42	134	81	7	1	678
		602_i	131	3,311.6	2	10	33	97	116	137	83	33	116	93	11	1	733
	603	603	132	1,965.7	3	8	42	83	153	200	93	24	98	119	29	1	853
	60401	60401	133	2,034.9	4	9	38	96	128	171	96	31	116	111	17	1	819
	604021	604021	134	168.9	3	9	36	94	112	141	91	37	116	100	12	2	754
	604023	604023_e	135	72.9	1	5	21	78	84	115	101	70	155	74	3	1	707
		604023_i	136	9,040.6	2	4	29	75	102	119	95	68	160	95	5	3	758
	60403	60403	137	6,011.7	3	5	38	86	121	130	95	55	149	110	12	3	807
	60405	60405	138	4,704.2	3	3	28	64	112	129	110	87	184	81	2	4	807
	605	605	139	1,102.3	6	8	39	88	163	213	112	27	116	126	29	1	928
	606	606	140	4,398.1	4	11	41	95	136	169	108	39	130	140	19	2	894
	607	607	141	417.6	5	7	36	82	161	203	130	28	118	140	32	1	941
	608	608	142	9,764.4	5	9	43	80	135	154	106	61	185	138	17	5	941
	609	609	143	113.5	7	8	48	87	168	233	151	43	144	153	28	2	1,071
	610	610	144	6,462.0	5	10	51	96	132	170	135	59	169	142	21	4	993
	611	611	145	4,227.7	6	13	59	102	157	223	170	71	200	160	27	4	1,192
	612	612	146	5,869.5	5	18	61	102	143	181	160	95	218	134	20	5	1,144
	614	614	147	13,271.7	4	14	51	91	138	160	143	105	225	133	13	7	1,082
	616	616	148	8,417.4	4	19	67	104	179	229	228	140	280	177	29	3	1,458
	617	617	149	1,896.8	7	23	75	115	218	294	299	196	340	233	51	6	1,858
	699	699	150	4,809.4	3	2	21	58	106	119	110	99	168	82	2	2	773

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (6/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	80 % Dependable Precipitatin (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
7	702	702	151	8,146.5	9	15	73	122	196	277	266	275	299	226	58	7	1,823
	703	703	152	4,318.8	10	19	95	145	216	280	310	295	339	244	82	10	2,046
	70401	70401	153	6,054.6	5	9	84	137	206	245	273	238	292	230	50	4	1,773
	70402	70402	154	7,090.9	2	4	43	98	186	210	213	191	243	179	9	2	1,379
	70403	70403	155	3,625.5	3	4	57	107	195	227	241	218	252	214	15	1	1,534
	704041	704041	156	1,236.3	1	7	51	100	194	238	229	222	248	242	13	2	1,547
	704042	704042	157	7,702.7	3	5	27	78	185	208	159	198	238	203	16	3	1,323
	704043	704043	158	7,382.6	3	4	31	74	165	182	166	175	227	161	7	3	1,196
	70405	70405_e	159	13,407.4	4	12	89	149	204	266	323	332	352	265	29	2	2,027
		70405_i	160	6,028.1	3	10	66	122	214	265	274	279	299	273	22	2	1,829
	705	705	161	5,854.2	5	12	101	152	237	286	339	303	314	252	73	9	2,085
8	800	800	162	5,221.9	0	0	0	1	6	15	64	79	26	3	0	0	195
	802	802_e	163	13,857.3	0	0	0	8	28	52	138	174	73	8	0	0	481
		802_i	164	2,422.8	0	0	0	5	14	37	104	128	53	7	0	0	348
	80401	80401	165	4,647.6	0	0	0	5	16	34	103	128	59	6	0	0	351
	80402	80402_e	166	626.1	0	0	1	10	38	63	150	197	85	10	0	0	552
		80402_i	167	7,171.8	0	0	0	7	29	50	132	170	77	7	0	0	472
	80403	80403_e	168	253.1	0	1	3	16	66	85	175	232	103	22	0	0	702
		80403_i	169	6,656.5	0	0	1	10	36	61	135	185	84	19	0	0	531
	806	806	170	21,903.0	0	0	0	8	23	45	119	154	73	7	0	0	429
	807	807	171	14,280.8	0	0	0	2	8	19	71	98	32	4	0	0	234
	80801	80801_e	172	1,438.6	0	0	0	0	4	11	45	73	20	2	0	0	155
		80801_i	173	946.1	0	0	0	1	4	12	49	78	22	2	0	0	168
	80802	80802	174	30,141.6	0	0	0	6	20	49	128	162	67	7	0	0	439
	80803	80803_e	175	8,391.9	0	0	0	0	3	11	50	58	15	1	0	0	138
		80803_i	176	1,528.3	0	0	0	0	5	14	55	79	23	2	0	0	178
	80804	80804_e	177	21,200.9	0	0	0	1	4	9	58	72	20	0	0	0	165
		80804_i	178	6,230.7	0	0	0	1	6	17	71	93	31	1	0	0	219
	80805	80805	179	9,381.6	0	0	0	3	11	31	113	136	45	3	0	0	342
	808061	808061	180	5,200.0	0	0	0	4	15	45	127	166	49	4	0	0	411
	808062	808062	181	6,129.6	0	0	1	6	37	67	160	195	77	9	0	0	552
	808063	808063	182	12,632.1	0	1	1	10	63	90	186	222	108	16	0	0	697
	808071	808071	183	274.9	0	0	0	2	6	24	88	120	33	2	0	0	276
	8080721	8080721_e	184	19,574.1	0	0	0	1	7	19	90	92	26	1	0	0	235
		8080721_i	185	18,041.8	0	0	0	3	9	34	108	131	40	2	0	0	328
	8080723	8080723	186	1,145.5	0	0	1	3	16	59	131	167	65	3	0	0	445
	808073	808073	187	9,609.9	0	0	1	4	22	52	135	163	59	5	0	0	440
	8080741	8080741	188	244.3	0	0	1	4	28	65	138	166	67	4	0	0	473
	80807421	80807421	189	861.8	0	0	1	4	23	65	137	174	71	3	0	0	478
	80807423	80807423	190	653.9	0	0	1	5	21	65	135	174	77	3	0	0	482
	8080743	8080743	191	1,581.2	0	0	2	5	32	75	142	187	77	5	0	0	523
	8080745	8080745	192	3,841.5	0	0	3	7	47	96	158	223	118	7	0	0	659
	808075	808075	193	1,196.2	0	0	2	5	37	77	150	192	79	6	0	0	548
	808077	808077	194	6,537.9	0	0	2	11	58	100	180	216	110	11	0	0	689

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (7/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average PET (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
1	101	101	1	9,355.4	95	107	140	147	142	123	117	109	103	108	98	92	1,381
	102	102	2	9,127.2	89	99	132	146	143	121	114	106	100	105	93	86	1,334
	103	103	3	3,387.3	90	103	140	152	147	126	119	110	103	109	94	87	1,381
	104	104	4	2,933.6	88	100	138	154	152	129	120	110	104	110	94	86	1,385
	105	105	5	3,456.6	91	106	145	158	154	132	122	113	106	112	97	90	1,425
	10601	10601	6	689.1	92	107	148	164	162	139	127	116	110	117	100	91	1,472
	10602	10602	7	10,960.3	85	96	133	152	153	129	119	109	104	108	93	85	1,364
	10603	10603	8	1,084.9	91	106	148	167	168	144	130	118	112	119	102	91	1,495
	10604	10604	9	17,476.6	86	97	136	160	165	140	126	114	109	115	96	86	1,429
	10605	10605	10	6,335.9	90	102	145	171	179	155	137	122	117	125	105	90	1,540
	10606	10606	11	5,817.2	86	96	138	168	175	150	133	118	114	121	100	87	1,487
	10607	10607	12	2,706.1	87	97	141	173	184	160	141	124	119	128	104	88	1,548
	106081	106081_e	13	2,220.3	80	92	135	166	186	165	144	127	123	127	98	82	1,524
		106081_i	14	4,132.3	84	95	139	171	184	161	143	126	121	129	101	85	1,539
	106082	106082_e	15	80,006.8	73	84	126	161	185	170	146	130	125	123	93	75	1,492
		106082_i1	16	1,322.2	82	93	136	168	183	161	141	125	120	126	99	83	1,518
		106082_i2	17	6,043.4	72	81	122	149	163	145	125	112	108	111	88	72	1,347
	106083	106083	18	412.5	82	93	136	167	180	157	139	123	118	124	98	83	1,503
	106085	106085_e	19	290.3	79	90	134	165	182	160	139	124	119	122	96	81	1,493
		106085_i	20	1,499.6	81	91	135	167	181	159	139	123	119	123	97	82	1,496
	1060861	1060861_e	21	6,067.9	73	85	126	160	178	157	136	122	118	118	89	75	1,438
		1060861_i1	22	164.7	78	89	132	164	181	159	139	123	119	121	94	80	1,478
		1060861_i2	23	548.0	72	82	123	153	166	145	126	113	110	111	86	73	1,361
	1060863	1060863	24	3,509.3	72	82	122	149	161	139	122	110	106	108	86	72	1,328
	106087	106087_e	25	632.3	74	85	126	159	174	153	133	120	116	116	89	76	1,420
		106087_i	26	1,216.5	77	88	130	162	177	155	136	121	117	119	92	79	1,455
	1060881	1060881	27	5,750.6	75	86	125	153	164	139	124	112	109	110	87	77	1,362
	1060883	1060883	28	2,513.8	73	82	120	144	154	130	117	106	102	104	85	73	1,290
	106089	106089	29	8,354.1	77	87	125	150	159	133	120	109	106	107	87	78	1,339
	106091	106091	30	7,636.2	83	93	136	167	176	150	134	119	115	121	97	84	1,478
	106093	106093	31	4,746.6	78	88	124	146	154	126	116	106	103	104	86	79	1,311
	107	107_e	32	1,924.1	92	107	146	156	152	131	120	111	105	111	97	92	1,421
		107_i	33	6,223.4	93	109	150	163	160	137	125	115	109	116	101	93	1,471
	108	108_e	34	63,517.4	79	93	136	172	194	174	153	136	131	132	99	83	1,581
		108_i	35	7,724.9	87	99	143	172	185	162	143	126	121	129	104	88	1,560
	109	109	36	14,037.5	94	108	143	151	147	129	119	109	104	110	98	95	1,407
2	201	201	37	2,646.9	98	106	130	126	125	112	110	106	100	104	103	96	1,315
	20201	20201	38	5,088.0	102	111	136	135	131	116	114	109	104	108	106	100	1,372
	202021	202021	39	2,739.0	98	104	130	131	127	111	109	104	99	104	100	95	1,314
	202023	202023	40	190.7	88	93	116	119	116	102	99	94	90	95	90	86	1,188
	20203	20203	41	4,599.3	94	100	125	129	125	109	106	100	96	101	96	91	1,272
	20205	20205	42	2,636.8	83	88	112	120	118	104	99	93	91	95	88	82	1,172
	203	203	43	4,436.7	105	113	139	137	133	118	116	110	105	109	109	103	1,396
	20401	20401	44	5,985.0	102	107	130	130	126	112	109	103	99	103	104	99	1,323
	20403	20403	45	1,596.0	95	98	119	118	115	104	100	94	92	95	96	94	1,220
	205	205	46	375.0	111	119	145	146	139	122	120	114	108	113	114	108	1,459
	206	206	47	7,358.0	108	115	142	144	136	118	117	110	105	110	109	105	1,420
	207	207	48	1,056.1	111	119	145	146	139	123	120	113	108	113	114	108	1,460
	20801	20801	49	1,936.8	110	118	144	147	139	122	119	112	106	111	112	107	1,448
	20802	20802	50	2,240.6	106	114	141	146	139	122	117	110	105	109	107	102	1,417
	20803	20803	51	725.1	111	119	146	151	143	124	121	113	108	113	112	108	1,468
	20804	20804	52	17,359.5	92	100	130	142	141	118	113	105	101	104	95	90	1,332
	20805	20805	53	4,325.9	106	113	140	146	140	119	117	110	105	110	105	102	1,413
	20806	20806	54	3,503.9	93	98	128	138	136	115	111	103	100	104	94	90	1,310
	20807	20807	55	557.0	103	109	138	142	137	117	115	109	104	109	102	99	1,385
	20809	20809	56	3,692.3	92	98	124	130	126	109	107	100	97	102	95	90	1,271
	20810	20810	57	3,449.6	88	93	121	130	126	110	107	99	97	101	92	86	1,250
	20811	20811	58	1,561.0	89	94	122	132	130	111	108	100	97	101	91	87	1,263
	20812	20812	59	5,919.2	80	86	117	131	138	112	106	98	96	97	85	79	1,227
	20813	20813	60	2,483.4	84	88	116	129	127	111	107	98	96	100	88	82	1,226
	20814	20814	61	6,713.9	78	85	113	129	132	113	106	98	95	99	86	78	1,213
	20815	20815	62	10,882.2	80	85	110	122	121	106	101	94	92	96	86	79	1,171
	209	209	63	15,015.3	105	110	135	135	131	116	112	106	102	106	106	102	1,365
	211	211	64	6.2	108	115	143	144	139	124	119	112	108	112	110	104	1,440
	212	212	65	6,740.8	103	106	130	127	125	112	108	102	99	104	102	99	1,316
	213	213	66	4,145.9	104	112	139	143	138	121	116	109	104	109	105	100	1,400
	214	214_e	67	257.9	99	106	126	126	123	111	107	100	96	101	98	96	1,289
		214_i	68	9,792.7	101	106	129	129	126	113	109	102	98	103	100	96	1,312
	215	215	69	2,109.7	103	111	138	141	137	121	116	109	103	109	104	98	1,389
	216	216_e	70	3,698.9	97	105	130	134	131	116	110	103	98	103	97	94	1,319
		216_i	71	7,957.2	98	107	133	137	133	118	112	105	100	105	99	95	1,343
	217	217	72	127.2	101	110	139	144	138	121	117	109	104	109	103	97	1,394
	218	218	73	4,644.4	96	105	135	143	138	119	114	106	101	105	98	92	1,352
	219	219	74	19.0	103	112	143	147	141	124	119	111	105	111	104	99	1,418

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (8/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average PET (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
3	30201	30201	75	587.0	103	110	141	135	134	119	118	114	106	111	104	98	1,393
	30202	30202	76	5,145.8	98	103	129	123	124	111	110	106	100	104	99	95	1,301
	30203	30203_e	77	2,826.1	88	89	105	97	102	92	92	90	86	88	86	86	1,101
		30203_i	78	11,384.8	95	98	119	111	114	102	102	99	94	97	94	91	1,215
	303	303	79	1,463.0	102	110	142	139	138	121	119	115	108	112	105	99	1,409
	304	304	80	4,997.2	91	99	128	135	135	117	112	106	101	106	97	89	1,314
	305	305	81	808.7	102	110	142	142	141	124	121	116	109	114	105	98	1,422
	30601	30601	82	2,266.4	102	109	140	137	136	120	118	114	106	111	104	98	1,395
	30602	30602	83	5,395.0	95	101	130	129	128	113	111	107	100	105	98	91	1,306
	30603	30603_e	84	559.0	73	74	91	85	89	81	81	78	74	76	73	70	944
		30603_i	85	13,799.2	91	95	119	114	116	104	103	100	94	98	93	88	1,214
	307	307	86	5,737.4	99	107	140	143	142	124	120	114	107	113	104	96	1,408
	308	308	87	15,173.5	86	95	128	140	141	121	114	107	101	106	94	84	1,315
	309	309	88	87.1	101	109	143	145	144	125	121	116	108	114	105	97	1,427
	310	310	89	2,512.7	97	104	136	137	136	118	115	111	103	109	101	93	1,361
	311	311	90	11,883.8	94	102	136	144	141	121	116	111	103	110	100	91	1,370
	312	312	91	2,748.4	93	101	134	140	136	116	113	108	100	107	98	90	1,334
	313	313	92	48.5	99	108	145	157	150	127	121	116	108	116	105	95	1,447
	31401	31401	93	717.6	94	104	141	152	146	124	118	112	104	112	102	92	1,399
	31403	31403	94	1,658.9	88	97	133	145	141	120	113	107	100	107	97	86	1,335
	31404	31404	95	11,229.0	79	87	122	136	136	117	108	100	95	101	90	79	1,250
	31405	31405	96	6,890.1	83	91	127	140	140	120	112	105	98	104	92	81	1,294
	31407	31407	97	7,702.1	77	85	121	138	142	122	112	103	98	102	88	77	1,267
	31408	31408	98	5,303.7	71	78	115	136	145	126	113	102	98	101	85	71	1,241
	31409	31409	99	19,178.0	77	85	115	130	133	115	107	99	95	99	86	77	1,219
	315	315	100	1,616.6	97	106	144	154	147	124	118	113	105	113	104	94	1,417
	316	316	101	5,536.5	91	98	130	137	131	113	110	106	98	104	96	88	1,304
	317	317	102	3,400.3	97	106	143	152	142	120	117	112	103	111	103	94	1,401
	318	318	103	5,441.5	88	97	133	143	137	115	110	104	97	104	97	87	1,313
	319	319_e	104	2,088.9	90	100	137	145	135	114	110	103	96	104	99	90	1,324
		319_i	105	1,726.6	94	104	142	151	141	117	114	107	100	108	102	93	1,371
	320	320_e	106	25,211.5	83	88	114	118	116	104	102	98	91	96	88	83	1,182
		320_i	107	2,106.7	89	95	124	127	124	109	107	103	96	101	94	87	1,257
	321	321	108	65,499.3	91	102	140	149	138	119	113	107	100	109	102	93	1,363
4	401	401	109	3,642.9	100	108	132	128	127	113	113	108	102	106	105	98	1,342
	402	402	110	9,075.9	97	104	129	132	128	113	110	105	100	105	101	95	1,320
	403	403	111	4,906.6	103	110	135	133	129	115	114	109	104	108	106	100	1,366
	404	404	112	9,347.8	94	101	126	130	128	112	109	103	99	104	99	93	1,298
	405	405	113	11,303.0	105	111	135	133	127	114	114	109	104	108	107	100	1,368
	406	406_e	114	10,331.5	86	86	100	94	97	88	87	85	82	85	84	83	1,057
		406_i	115	12,618.8	104	107	128	123	122	110	109	106	102	105	103	100	1,318
	407	407	116	4,277.1	105	111	138	134	130	116	116	111	106	109	105	100	1,381
	408	408	117	10,587.4	96	103	130	133	131	115	112	106	102	106	101	94	1,331
	409	409	118	2,471.0	104	110	139	133	130	116	116	112	105	109	104	99	1,377
	410	410	119	4,839.1	95	102	131	135	135	118	113	108	103	108	101	94	1,343
	411	411	120	1,449.1	103	110	141	135	133	119	118	114	106	111	104	98	1,393
5	500	500	121	19,112.1	110	108	122	118	121	112	108	107	104	108	108	109	1,333
	502	502	122	3,156.9	108	108	125	121	122	112	108	106	103	107	108	108	1,337
	50401	50401	123	1,580.8	110	110	127	123	124	113	110	107	104	108	109	109	1,354
	50402	50402	124	14,104.9	105	107	127	124	122	109	108	103	100	104	105	103	1,316
	50403	50403	125	11,821.3	102	106	127	125	123	111	108	104	100	104	104	101	1,315
	506	506	126	4,137.6	109	109	125	120	121	111	108	106	103	106	107	108	1,333
6	60001	60001	127	2,701.1	113	112	129	125	127	115	112	108	106	110	112	113	1,381
	60002	60002	128	8,252.4	109	108	124	121	123	112	108	106	103	108	109	109	1,341
	601	601	129	391.8	114	114	130	126	128	114	112	107	106	110	113	114	1,387
	602	602_e	130	844.5	114	115	131	125	126	113	111	105	103	109	111	111	1,373
		602_i	131	3,311.6	114	114	131	125	127	114	111	106	104	109	111	111	1,376
	603	603	132	1,965.7	111	110	126	122	124	112	109	105	103	108	110	111	1,352
	60401	60401	133	2,034.9	112	111	129	123	125	113	110	105	104	108	110	110	1,359
	604021	604021	134	168.9	113	113	131	125	126	114	111	106	104	109	110	110	1,371
	604023	604023_e	135	72.9	112	115	132	125	125	114	110	105	101	108	110	107	1,364
		604023_i	136	9,040.6	108	111	130	124	124	113	108	103	100	105	106	104	1,335
	60403	60403	137	6,011.7	108	108	129	124	123	112	107	103	101	105	105	105	1,330
	60405	60405	138	4,704.2	102	104	126	122	121	109	105	100	96	101	100	98	1,284
	605	605	139	1,102.3	111	111	128	123	125	114	110	106	104	108	110	111	1,360
	606	606	140	4,398.1	110	110	129	124	124	113	109	104	103	108	108	109	1,349
	607	607	141	417.6	114	113	132	127	128	116	112	108	106	111	112	113	1,394
	608	608	142	9,764.4	103	103	125	121	121	110	104	99	98	103	103	102	1,292
	609	609	143	113.5	114	114	132	127	129	117	113	108	107	111	113	114	1,398
	610	610	144	6,462.0	106	106	126	121	122	112	106	101	101	105	106	106	1,318
	611	611	145	4,227.7	110	109	127	122	124	113	108	105	103	108	110	110	1,349
	612	612	146	5,869.5	104	104	121	118	119	109	104	100	98	103	104	104	1,287
	614	614	147	13,271.7	99	101	119	117	117	105	101	97	95	99	100	98	1,247
	616	616	148	8,417.4	105	105	121	118	120	109	105	102	99	104	105	104	1,295
	617	617	149	1,896.8	108	108	124	120	122	112	108	107	103	108	109	108	1,337
	699	699	150	4,809.4	105	110	130	125	124	113	108	102	98	104	102	100	1,321

Annex-T SR2-4 Monthly Average Precipitation, 80% Dependable Monthly Precipitation, Average Monthly PET by SHAs (9/9)

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average PET (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
7	702	702	151	8,146.5	108	107	121	117	119	110	107	105	102	105	106	107	1,313
	703	703	152	4,318.8	109	107	121	116	120	111	108	105	103	106	106	107	1,318
	70401	70401	153	6,054.6	110	109	124	119	123	113	110	107	105	108	108	108	1,343
	70402	70402	154	7,090.9	111	111	129	124	124	112	110	105	104	108	109	108	1,358
	70403	70403	155	3,625.5	114	114	132	127	128	116	114	110	108	112	112	111	1,398
	704041	704041	156	1,236.3	113	114	132	127	129	116	115	111	108	112	112	111	1,399
	704042	704042	157	7,702.7	109	110	130	126	125	113	111	108	104	107	107	105	1,355
	704043	704043	158	7,382.6	109	111	131	127	125	112	111	106	103	107	108	105	1,354
	70405	70405_e	159	13,407.4	96	96	110	106	111	101	99	96	95	98	96	94	1,199
		70405_i	160	6,028.1	105	106	122	118	121	110	108	104	102	106	105	103	1,309
	705	705	161	5,854.2	104	104	119	113	118	109	109	104	102	106	105	103	1,295
8	800	800	162	5,221.9	72	83	122	157	175	164	145	127	123	124	91	75	1,458
	802	802_e	163	13,857.3	88	98	138	163	163	143	126	113	110	119	104	91	1,455
		802_i	164	2,422.8	82	93	134	165	171	153	133	118	115	122	99	85	1,468
	80401	80401	165	4,647.6	77	86	124	153	163	148	130	115	113	117	92	79	1,396
	80402	80402_e	166	626.1	83	91	126	145	144	127	115	104	100	107	96	85	1,324
		80402_i	167	7,171.8	84	93	130	154	157	140	124	112	108	115	98	86	1,400
	80403	80403_e	168	253.1	75	82	111	122	118	103	96	89	84	90	84	76	1,129
		80403_i	169	6,656.5	81	89	124	143	145	129	116	106	102	107	93	82	1,317
	806	806	170	21,903.0	73	81	117	141	151	134	119	107	104	107	87	73	1,294
	807	807	171	14,280.8	70	80	119	152	172	158	139	122	119	119	89	72	1,412
	80801	80801_e	172	1,438.6	70	80	121	155	180	168	149	131	126	124	90	72	1,467
		80801_i	173	946.1	70	81	121	154	179	166	147	129	125	123	90	72	1,457
	80802	80802	174	30,141.6	71	79	117	142	156	138	121	109	105	107	86	72	1,303
	80803	80803_e	175	8,391.9	71	81	123	157	182	168	146	128	124	123	91	73	1,468
		80803_i	176	1,528.3	72	82	125	159	183	165	142	126	123	123	91	74	1,464
	80804	80804_e	177	21,200.9	72	82	122	155	176	163	140	123	119	120	92	74	1,438
		80804_i	178	6,230.7	72	82	124	154	176	160	137	121	118	119	92	74	1,428
	80805	80805	179	9,381.6	72	80	120	149	167	150	129	115	111	113	90	73	1,369
	808061	808061	180	5,200.0	75	84	122	153	168	152	132	117	113	114	90	75	1,396
	808062	808062	181	6,129.6	77	86	120	146	154	137	124	111	107	109	89	77	1,336
	808063	808063	182	12,632.1	78	86	117	137	142	125	115	104	101	104	88	78	1,275
	808071	808071	183	274.9	72	81	123	150	171	156	133	117	113	115	93	74	1,398
	8080721	8080721_e	184	19,574.1	72	83	124	159	182	166	141	127	123	124	92	74	1,467
		8080721_i	185	18,041.8	71	81	121	154	173	155	135	121	116	116	88	73	1,404
	8080723	8080723	186	1,145.5	71	80	119	146	158	137	122	109	105	107	86	72	1,313
	808073	808073	187	9,609.9	75	84	122	151	163	145	129	115	111	112	89	76	1,371
	8080741	8080741	188	244.3	74	83	121	149	157	136	124	110	107	108	88	75	1,332
	80807421	80807421	189	861.8	73	82	120	148	157	135	123	109	106	106	87	74	1,318
	80807423	80807423	190	653.9	72	81	119	144	155	133	119	107	103	105	85	73	1,296
	8080743	8080743	191	1,581.2	75	83	120	144	153	130	119	106	103	105	87	75	1,299
	8080745	8080745	192	3,841.5	76	83	117	137	147	120	111	102	99	100	85	76	1,253
	808075	808075	193	1,196.2	76	85	120	144	150	129	119	107	103	105	88	77	1,302
	808077	808077	194	6,537.9	77	84	115	133	136	119	111	101	98	101	86	77	1,237

Annex-T SR2-5 Inventory List of Hydrological Data (1/3)

NO	Name	River	HA	DA (km2)	DA (km2) (GIS by JST)	Lat	Lon	Source for location	Source of Data	Type	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11
1	Jiddere Bode	Niger	1	563,500	1,561,691	11.38048	4.11880	NIHSA-GPS	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																						
									NBA	D																																																							p	p	p	p	p	p	p	p	c	p	p	p	p	p	c	c	p	c	c	p	p	p	c	p	p	p	p	c	c	p	c	c	c	c	p	p	p	p	p	c	c	p		
									NBA	M_int																																																							p	c	c	c	c	p	c	c	c	c	c	c	c	c	c	c	c	c	c	p	c	c	c	p	p	p	c	c	c	c	c	c	c	c	c	p	c	p	p	c	c	p		
									NIHSA	M																																																								p	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	p	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	p	
2	Kainji	Niger	1	569,800	1,589,938	10.35000	4.60000	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																						
3	Kende	Sokoto	1		181,927	11.51847	4.25003	NIHSA-GPS	NBA	D																																																																													p	p	p	p	p	p	c	c	c	p												
									NBA	M_int																																																																													p	p	p	p	p	p	c	c	c	p												
									NIHSA	D																																																																															p	c	c	c	c	c	c	c	c	c	c	c	c	p	p	c	p	p	p	p	p	
									NIHSA	M_int																																																																															p	c	c	c	c	c	c	c	c	c	c	c	c	p	c	c	c	c	p	p	p	
4	Gusau	Sokola	1	2,570	2,570	12.14723	6.66995	JPT-GIS	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																										
5	Bakolori Dam	Sokolo	1	4,800	4,747	12.51007	6.18216	JPT-GIS	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																										
6	Wamako	Sokolo	1	40,160	137,219	13.03333	5.10000	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c		c	c	c	c																										
7	Funlua-Yashi Road	Karaduwa	1	425	440	12.23333	7.83333	MP1995	MP1995	M																																																											c	c	c	c	c	c																																		
8	Zobe	Karaduwa	1	2,380	2,514	12.35838	7.46547	JPT-GIS	MP1995	M																																																									c	c	c	c	c	c	c	p																																		
9	Jibiya Dam	Maradi	1	3,200	3,522	13.07097	7.25199	JPT-GIS	MP1995	M																																																									p	c	c	c	c	c	c	c																																		
10	Kaura Namoda	Gagere	1	6,500	5,802	12.60000	6.58333	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	p																																		
11	GoronyoDam	Rima	1	21,450	30,547	13.53124	5.88033	JPT-GIS	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c		c	c	c	c																										
12	Anka	Zamfara	1	4,140	4,389	12.11667	5.91667	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																											
13	Banaga Dam	Gulbinka	1	3,170	2,967	11.65000	5.96667	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c	c	c	c	c																											
14	Malendo Bridge	Malendo	1	9,954	8,751	10.70000	4.80000	MP1995	MP1995	M																																																																			c	c	c	c	c	c	c	c																						
15	Jebba	Niger	2	631,800	1,629,481	9.12876	4.83278	NIHSA-GPS	MP1995	M																																																																					p	c	c	c	c	c																						
									NBA	D	p	p	p	p	p	p	p	p	p	p	p	p																												c	c	c	c	c	c	c	c	c	c	c	c	c	c	p	c	p	c	c	p	c	p	c	p	c	p	p	p				p	p	p	p	p	p	p	p	p	p	c	p												
									NBA	M_int	p	c	c	c	c	c	c	p	c	c	c	p																										p	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	p	p	c				p	c	p	p	p	p	p	c	c	c	c	p												
16	Baro	Niger	2	730,300	1,726,856	8.60664	6.41699	NIHSA-GPS	MP1995	M																																															c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c		c	c	c	c	c	c	c	c	c																						
									NBA	D																																																																			p	p	p	c	c	p	c	p	p	p	c	c				p	p			p	p											
									NBA	M_int																																																																			c	c	c	c	c	p	c	p	p	p	c	c				p	p			p	p											
17	Kaduna Saulh	Kaduna	2	18,420	18,789	10.48333	7.43333	MP1995	MP1995	M																																																											p	c	c	c	c	c	p	c																																
18	Wuya	Kaduna	2	59,180	64,726	9.11667	5.83333	NIHSA	MP1995	M																																																									p	p	p	p	p	c	p	p	p	p	c	p	p	c	p	c	p	p	p	c																						
19	Shiroro	Kaduna	2	36,100	34,702	9.97404	6.83337	JPT-GIS	MP1995	M																																																																					p	c	c	c	c	c																						
									ShiroroHP	D																																																																													c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c		
20	Saminaka	Karami	2	630	577	10.36667	8.66667	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	p	c																																
21	Zaria-Kano Bridge	Shika	2	845	879	11.15000	7.75000	MP1995	MP1995	M																																																											p	c	c	c	c	p	p	c	c																														
22	Malando Road	Tubo	2	5,900	5,683	10.58333	7.21667	MP1995	MP1995	M																																																											p	c	c	c	c	c	c																																		
23	Ribako	Galma	2	6,650	6,663	10.66667	7.75000	MP1995	MP1995	M																																																											p	c	c	c	c	c	p	c	c																														
24	Komi	Kontagora	2	2,250	2,326	9.88333	4.66667	MP1995	MP1995	M																																																																					c	c	c	c	c	c																						
25	Kachia	Shaho	2	128	124	9.90000	7.93333	MP1995	MP1995	M																																																											p	c	c	c	c	c	p	c	c																														
26	Kaeia	Gurara	2	562	559	9.86667	7.98333	MP1995	MP1995	M																																																											p	c	c	c	c	c	p	c	p																														
27	Izom	Gurara	2	7,650	6,203	9.25000	7.03333	MP1995	MP1995	M																																																							c	c	p	c	c	c	c	c	p		p	c	c	p																														
28	Ebba	Jatau	2	1,890	1,896	9.25000	6.56667	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c	c																														
29	Badeggi	Gbako	2	5,480	5,850	9.08333	6.11667	MP1995	MP1995	M																																																									c	c	c	c	c	c	c	c	c	c																																
30	WuroBoki	Benue	3	103,680	96,608	9.36667	12.83333	NIHSA	MP1995	M																																															c	c	c	c	c	c	c	c	c	c	c	p	c	p	p	p	c	c	c	c			p	p	p																										
									NBA	D																																								p	p	p	p	p	p	p	p	p	c	p	c	c	c	p	p	c	p	p	p	p	p	c	c	c	p	p		p	p				p	p	p		p	p	p			p										p					
									NBA	M_int																																								p	p	p	p	p	p	c	c	p	c	p	c	c	c	p	c	c	c	c	p	p	p	c	c	c	c	p		c	p				p	c	p		p	p	p			p										p					
31	Yola	Benue	3	108,400	104,797	9.23333	12.46667	MP1995	MP1995	M																																															c	c	c	c	c	c	p	c	c	c	c	c	p	p	c	p	c	p	c	c	p	c	c	c	c	c	c	c	p	c																						
									NIHSA	D																																																																								p	p	p	p	p	p	p	p																	
									NIHSA	M_int																																																																								p	c	c	c	c	c	p	p																	
									UBRBDA	M																																										c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	p	c	c	c		
32	Agwan Taru	Benue	3	206,700	200,716	8.66667	10.41667	MP1995	MP1995	M																																																									c	c	c	c	p	p	c	c	c	c																																
33	Mbu/Tepkwar	Donga	3	2,120	1,975	6.70000	11.13333	MP1995	MP1995	M																																																																				c	c	c	c	c	c	c	c	p																						
34	Manya	Donga	3	6,350	9,513	7.31667	10.25000	MP1995	MP1995	M																																																																				c	c	c	c	c	p	p	c	p																						
35	Donga	Donga	3	11,910	12,523	7.71667	10.08333	MP1995	MP1995	M																																																									c	p	p	p	c	c	c	p	p	p																																
36	Gindin Dorowa	Donga	3	18,800	19,360	8.08333	10.05000	MP1995	MP1995	M																																																																				c	c	c	c	c																											
37	Suntai Bakundi	Sunlai	3	2,600	2,509	7.68333	10.45000	MP1995	MP1995	M																																																																				c	c	c	c	c																											

Annex-T SR2-5 Inventory List of Hydrological Data (2/3)

N0	Name	River	HA	DA (km2)	DA (km2) (GIS by JST)	Lat	Lon	Source for location
38	Banlaji	Suntai	3	5,350	5,056	8.10000	10.16667	1995MP
39	Bali	Taraba	3	10,850	12,017	7.86667	10.96667	1995MP
40	Tela	Taraba	3		N/A	8.51667	10.28333	1995MP
41	Gassol	Taraba	3	20,700	21,792	8.51667	10.45000	NIHSA
42	Maisamari	Jigwal	3	562	N/A	8.10000	11.13333	1995MP
43	GombeAbba	Gongola	3	17,650	13,914	10.83333	10.66667	1995MP
44	DadinKowa	Gongola	3	30,460	32,184	10.32040	11.47946	JPT-GIS
45	Garkida	Hawal	3		7,381	10.46667	12.55000	1995MP
46	Ibi	Benue	4	258,700	253,876	8.18333	9.75000	NIHSA
47	Makurdi	Benue	4	305,500	303,341	7.75000	8.53333	NIHSA
48	Umaisha	Benue	4	335,000	334,206	7.98333	7.20000	NIHSA
49	Katsina-Ala	Katsina Ala	4	16,770	16,789	7.15144	9.28886	NIHSA-GPS
50	Sevav	Katsina Ala	4	22,100	20,786	7.46667	9.21667	1995MP
51	Lokoja	Niger	5	1,089,500	2,086,277	7.66667	6.73333	1995MP
52	Idah	Niger	5	1,095,100	2,091,497	7.10000	6.71667	1995MP
53	OniIsha	Niger	5	1,100,800	2,112,018	6.16250	6.77556	NIHSA-GPS
54	Aboh	Niger	5	1,112,800	2,113,160	5.53333	6.51667	1995MP
55	Ughideda	Ojo	5	406	406	7.36667	6.38333	BORBDA
56	Sepoleri	Ogun	6	1,060	1,096	8.63333	3.65000	1995MP
57	OfikiTown	Ofiki	6	438	694	8.46667	3.31667	1995MP
58	Iganna	Ofiki	6	2,780	2,451	8.10000	3.23333	1995MP
59	Ilaji-Ile Road	Oyan	6	1,460	1,569	7.96667	3.03333	1995MP
60	Apoje	Oshun	6	8,170	8,517	6.98333	4.11667	1995MP
61	Awe-Ife Odan	Oba	6	930	459	8.10000	4.15000	1995MP
62	Oyo-Ogbomosho Road	Oba	6	1,580	1,434	7.83333	4.06667	1995MP
63	Owan Village	Owan	6	1,257	1,257	6.76667	5.76667	BORBDA
64	Abudu	Ossiomo	6	1,231	1,178	6.30000	6.03333	BORBDA
65	Owena Village	Owena	6	783	775	7.20000	5.01667	BORBDA

N0	Source of Data	Type	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
38	1995MP	M																																	
39	1995MP	M																																	
40	1995MP	M																																	
41	1995MP	M																																	
41	NBA	D																																	
41	NBA	M_int																																	
42	1995MP	M																																	
43	1995MP	M																																	
44	1995MP	M																																	
45	1995MP	M																																	
46	1995MP	M																																	
46	NBA	D			p	p	p	C	C	p	p	p	p	p	p																				
46	NBA	M_int			p	C	C	C	C	C	C	C	p	p	p																				
47	1995MP	M																																	
47	NBA	D																																	
47	NBA	M_int																																	
47	NIHSA	D																																	
47	NIHSA	M_int																																	
48	1995MP	M																																	
48	NBA	D																																	
48	NBA	M_int																																	
49	1995MP	M																																	
49	NBA	D																																	
49	NBA	M_int																																	
50	1995MP	M																																	
51	1995MP	M																																	
51	NBA	D	p	p	p	p	C	C	p	C	C	C	p	C	p	p	p	p	p	C	C	p	p	C	p	C	C	C	p	C	C	C	C	p	C
51	NBA	M_int	p	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	C	C	C	p	p	C	C	C	C	C	C	C	C	C	C	C	C
51	NIHSA	D																																	
51	NIHSA	M_int																																	
52	1995MP	M																																	
53	1995MP	M																																	
53	NBA	D																																	
53	NBA	M_int																																	
54	1995MP	M																																	
55	BORBDA	D																																	
55	BORBDA	M_int																																	
56	1995MP	M																																	
57	1995MP	M																																	
58	1995MP	M																																	
59	1995MP	M																																	
60	1995MP	M																																	
61	1995MP	M																																	
62	1995MP	M																																	
63	BORBDA	D																																	
63	BORBDA	M_int																																	
64	BORBDA	D																																	
64	BORBDA	M_int																																	
65	BORBDA	D																																	
65	BORBDA	M_int																																	

N0	Source of Data	Type	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
38	1995MP	M																																	
39	1995MP	M																																	
40	1995MP	M																																	
41	1995MP	M																								C	p	C	C	C	C	C	p	C	C
41	NBA	D																																	
41	NBA	M_int																																	
42	1995MP	M																																	
43	1995MP	M																																	
44	1995MP	M																						p	C	C	C	C	C	C					
45	1995MP	M																								C	C	C	p	C	C	C	C	C	C
46	1995MP	M																																	
46	NBA	D									p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p		p	p	p	p	p	p	p
46	NBA	M_int									p	C	C	C	C	C	C	C	p	p	p	C	p	p	p	p	p		p	p	p	p	p	p	C
47	1995MP	M														C	C	p	C	C	C	C	C	p	C	p	C	C	C	C	C	C	C	C	C
47	NBA	D																																	
47	NBA	M_int																																	
47	NIHSA	D																																	
47	NIHSA	M_int																																	
48	1995MP	M																								C	p	p	p	p	p	p	p	p	p
48	NBA	D									p	p	p	p	p	C	p	p	p	p	C	C	C	C	C	C	p	p	p	p	p	p	p	p	p
48	NBA	M_int									p	C	p	p	p	C	C	C	C	C	C	C	C	C	C	C	C	p	p	C	p	C	p	p	C
49	1995MP	M																								C	C	C	p	C	C	C	C	C	C
49	NBA	D									p	p	p	p	p	p	p	p	p	p	p	p	p	p		p	p	p	p	p	p	p		p	p
49	NBA	M_int									p	C	p	p	p	p	p	C	C	C	p	p	C	p		p	p	p	p	p	p	p		p	C
50	1995MP	M																																	
51	1995MP	M														C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
51	NBA	D	C	C	C	p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	C	C	p	C	C
51	NBA	M_int	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
51	NIHSA	D																																	
51	NIHSA	M_int																																	
52	1995MP	M																								C	C	C	p	p	p	C	C	p	p
53	1995MP	M																													C	C	C	C	C
53	NBA	D									C	C	C	C	p	p	C	C	p	p	C	p				p	p	C	p	C	C	p	p	p	p
53	NBA	M_int									C	C	C	C	C	C	C	C	C	C	C	C				p	C	C	C	C	C	p	p	C	p
54	1995MP	M																													C	C	C	C	C
55	BORBDA	D																																	
55	BORBDA	M_int																																	
56	1995MP	M																																	
57	1995MP	M																																	
58	1995MP	M																																	
59	1995MP	M																																	
60	1995MP	M																																	
61	1995MP	M																																	
62	1995MP	M																																	
63	BORBDA	D																																	
63	BORBDA	M_int																																	
64	BORBDA	D																																	
64	BORBDA	M_int																																	
65	BORBDA	D																																	
65	BORBDA	M_int																																	

N0	Source of Data	Type	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11
38	1995MP	M		C	C	C	C	C																										
39	1995MP	M	p	C	p	C	C	C	p	C	p	C																						
40	1995MP	M		C	C	C	C	C	C	p	p																							
41	1995MP	M	C	p	p	C	C	p	p	p																								
41	NBA	D									p	p	p	C	p	p	p	p	p	p	p	p	p	p										
41	NBA	M_int									p	p	p	C	p	p	p	p	p	p	p	C	p	p										
42	1995MP	M		p	C	C	C	C	C	p	C																							
43	1995MP	M						p	C	p	C	p																						
44	1995MP	M		C	C	C	C	C	C	C	C	C																						
45	1995MP	M																																
46	1995MP	M	C	p	C	C	p	C	C	p	p	p																						
46	NBA	D	p	p	C	C	p	p	C	p	p	p	C	p				p				p	p	p	p	p								
46	NBA	M_int	C	p	C	C	C	C	C	C	p	p	C	p				p				p	p	p	p	p								
47	1995MP	M	C	C	C	p	C	C	C	C	C	C																						
47	NBA	D	p	C	C	C	C	C	C	C	C	C	C	p		p	p	p	p		p	p	p		p				p	p	p			
47	NBA	M_int	C	C	C	C	C	C	C	C	C	C	C	p		p	p	p	p		p	p	p		p				p	p	p			
47	NIHSA	D											p	p																				
47	NIHSA	M_int											C	p																				
48	1995MP	M	p	C	p	C	C	C	C	C	p	C																						
48	NBA	D	C	C	C	C	C	C	C	p	C	C	C	C																				
48	NBA	M_int	C	C	C	C	C	C	C	C	C	C	C	C																				
49	1995MP	M	C	C	C	C	C	p	p																									
49	NBA	D	p	p	p																													
49	NBA	M_int	p	p	C																													
50	1995MP	M		p	C	C	C	C	C	C	C	C																						
51	1995MP	M	C	C	C	C	C	C	C	C	C	C																						
51	NBA	D	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p	p		p	p	C	C	C	p	p	C	p	C	p			
51	NBA	M_int	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p	p		p	C	C	C	C	p	C	C	C	C	p			
51	NIHSA	D											p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
51	NIHSA	M_int											C	C	C	C	C	p	C	C	C	C	C	C	p	p	p	p	p	p	C	p	p	p
52	1995MP	M	p	p	C	C	p	C	C	C	p	p																						
53	1995MP	M	C	C	C	C	C	C	C																									
53	NBA	D	C	C	C	C	C	C	C	C	C	C	p	C	p			p				p	C	C	p				p					
53	NBA	M_int	C	C	C	C	C	C	C	C	C	C	p	C	p			p				p	C	C	p				p					
54	1995MP	M	C	C	C	C	C	C	C	p																								
55	BORBDA	D										C	C	C	p	C	C																	
55	BORBDA	M_int										C	C	C	C	C	C																	
56	1995MP	M	p	p	p	p	p	p	p	p	p	p																						
57	1995MP	M	p	p	p	p	p	p	p	p																								
58	1995MP	M		p	C	p	p	p	p	p	p	p																						
59	1995MP	M	C	p	C	p	p	p	p	p	p	C																						
60	1995MP	M			C	C	p	p	p	p																								
61	1995MP	M		C	C	p	p	p				p																						
62	1995MP	M		p	p	p	p	p	p	p	p	p																						
63	BORBDA	D										p	C	C	C	C	C	C	C	C	C	C												
63	BORBDA	M_int										C	C	C	C	C	C	C	C	C	C	C												
64	BORBDA	D										p	C	C	C	C	C																	
64	BORBDA	M_int										p	C	C	C	C	C																	
65	BORBDA	D										p	p	C	C	p	p	C	C	C	C		C											
65	BORBDA	M_int										p	p	C	C	p	p	C	C	C	C		C											

Annex-T SR2-5 Inventory List of Hydrological Data (3/3)

N0	Name	River	HA	DA (km2)	DA (km2) (GIS by JST)	Lat	Lon	Source for location	Source of Data	Type
66	Ikom	Cross	7	16,900	16,112	5.83333	8.71667	1995MP	1995MP	M
67	Adonatarn	Cross	7	18,900	19,422	6.15000	8.46667	1995MP	1995MP	M
68	Obubra	Cross	7	35,800	35,968	6.10000	8.33333	1995MP	1995MP	M
69	Afikpo	Cross	7	46,200	46,509	5.85000	7.95000	1995MP	1995MP	M
70	Ikot Okpara	Cross	7	48,300	48,582	5.40000	8.06667	1995MP	1995MP	M
71	Ugwu NKPA	Erne	7	230	N/A	5.58333	7.43333	1995MP	1995MP	M
72	Ulakwo	Oramiriukwa	7	795	535	5.41667	7.11667	1995MP	1995MP	M
73	Ndirnoko	Imo	7	160	N/A	5.86667	7.25000	1995MP	1995MP	M
74	Urnuna	Irno	7	490	620	5.78333	7.30000	1995MP	1995MP	M
75	Umuopara	Imo	7	1,450	1,518	5.55000	7.41667	1995MP	1995MP	M
76	Obigbo	Imo	7	5,600	4,974	4.86667	7.18333	1995MP	1995MP	M
77	Gwarzo	Watari	8	1,450	1,466	11.95000	8.40000	WRECA	WSSSRP	D
									WSSSRP	M
78	Challawa Gorge	Challawa	8	3,859	3,842	11.73272	8.03266	JPT-GIS	WSSSRP	D
									WSSSRP	M
79	Challawa Bridge	Challawa	8	6,889	6,940	11.90600	8.41342	JPT-GIS	WSSSRP	D
									WSSSRP	M
80	Tiga Dam	Kano	8	6,553	6,538	11.46232	8.40858	JPT-GIS	WSSSRP	D
									WSSSRP	M
81	Chiromawa	Kano	8	6,975	7,026	11.61667	8.38333	WRECA	WSSSRP	D
									WSSSRP	M
82	Wudil	Hadejia	8	16,380	16,781	11.81667	8.83333	WRECA	WSSSRP	D
									WSSSRP	M
83	Chai Chai	Gaya	8	1,710	1,864	12.01667	9.25000	WRECA	WSSSRP	D
									WSSSRP	M
84	Hadejia	Hadejia	8	25,900	22,393	12.43333	10.06667	WRECA	WSSSRP	D
									WSSSRP	M
85	Bunga Bridge	Jama'are	8	73,800	8,031	11.06667	9.63333	WRECA	WSSSRP	D
									WSSSRP	M
86	Foggo	Jama'are	8	9,660	9,771	11.41667	9.96667	WRECA	WSSSRP	D
									WSSSRP	M
87	Birnin Kudu	Dogwala	8	1,891	1,772	11.43333	9.46667	WRECA	WSSSRP	D
									WSSSRP	M
88	Iggi Bridge	Iggi	8	1,334	1,474	11.53333	9.33333	WRECA	WSSSRP	D
									WSSSRP	M
89	Gashua	Yobe	8	55,700	88,298	12.86667	11.05000	WRECA	WSSSRP	D
									WSSSRP	M
90	Geidam	Yobe	8	58,500	96,765	12.88333	11.91667	WRECA	WSSSRP	D
									WSSSRP	M
91	Kari	Komadugu Gana	8	5,865	6,015	11.25000	10.55000	WRECA	WSSSRP	D
									WSSSRP	M
92	Dapchi	Komadugu Gana	8	18,090	16,373	12.50000	11.50000	WRECA	WSSSRP	D
									WSSSRP	M
93	Damasak	Yobe	8	82,560	164,624	13.13333	12.51667	1995MP	WSSSRP	D
									WSSSRP	M
94	Bagada Diffa	Yobe	8		N/A				WSSSRP	M
95	Yau	Yobe	8	84,140	166,343	13.56667	13.25000	1995MP	WSSSRP	D
									WSSSRP	M
96	Gamboru Bridge	Ebeji	8	16,220	16,149	12.36667	14.20000	1995MP	WSSSRP	D
									WSSSRP	M
97	Bama Bridge	Yedseram	8		N/A	11.53333	13.68333	1995MP	WSSSRP	M
901	Malanville	Niger	B	440,000	1,286,116	11.86667	3.38333	WB	WB	M
902	Garoua	Benue	C	64,000	61,636	9.28333	13.40000	WB	WB	M
903	Cossi	Benue	C	26,000	26,177	9.60000	13.86667	WB	WB	M
904	Riao	Benue	C	27,600	30,782	9.05000	13.70000	WB	WB	M

N0	Type	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
66	M																																			
67	M																																			
68	M																																			
69	M																																			
70	M																																			
71	M																																			
72	M																																			
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94	M																																			
95	D																																			
95	M																																			
96	D																																			
96	M																																			
97	M																																			
901	M																																			
902	M																p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
903	M																																			
904	M																																			

N0	Type	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11
66	M																					p	C	C	C	C	C	p	p	p	p	C	C	C	C	p		C	C	C	C																						
67	M																										C	p	p	p	p	C	p	p	C	C	p	p	p																								
68	M																					p	C	C	C	C	C	C	p			p	p	p	p	p	p	p	C	C	p																						
69	M																							C	p	p	C	p	p	C	C	p	C	C	p	C	p	C	p		p																						
70	M																										C	C	C	C	C	p	C	C	C	C	C	C	C	C	C																						
71	M																														p	C	C	C	C	C	C	C	p																								
72	M																													p	C	C	C	C	p	C	C	C	C	C	p																						
73	M																													p	C	C	C	C	C	p	C	p																										
74	M																													p	C	C	C	C	C	C	C	C	p	C	p																						
75	M																													p	C	p			p	C	C	C	p	p	p																						
76	M																													p	C	C	p	p	p	p	C	C	C	C	p																						
77	D														p	C	C	C	C	C	C	C	C	C	C	p																																						
77	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	C	p	C	C	C	C	C	p																						
78	D																						p	C	C	p	p	p	p	p										p	C	C	p							p	p	p	p	p	p	p	p	p					
78	M																						p	C	C	p	p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p											p	C	C	p					
79	D														p	p	C	p	C	C	C	C	C	C	p	C	C	C	C	p																																
79	M														p	C	C	p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																		
80	D																					p	C	C	C	p																			C	C	C	C	C	p												
80	M															p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C											C	C	C	C	C	p				p	C	C	p					
81	D														p	C	C	C	C	C	C	C	C	C	C	p	p	C	C	C	p					p	p	p	p					p																				
81	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p																			
82	D														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p																					
82	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																						
83	D														p	C	C	C	C	C	C	C	C	C	C	p			p	p	p	p					p	C	C	C	C	C	p																				
83	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																				
84	D															p	C	C	C	C	C	C	C	C	C	C	C	p	p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p		p	p									
84	M															p	C	C	C	C	C	C	C	C	C	C	C	p	p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p		p	p									
85	D															p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	C	p	p	p	C	C	C	C	C	p												
85	M															p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	C	p	p	p	C	C	C	C	C	p												
86	D														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																												
86	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																												
87	D															p	C	C	C	C	C	C	C	C	C	p			p	p																																
87	M															p	C	C	C	C	C	C	C	C	C	p			p	p			p	C	C	p																										
88	D															p	C	C	C	C	C	C	C	C	C	p			p	p																																
88	M															p	C	C	C	C	C	C	C	C	C	C	C	p	p	p			p	C	C																										
89	D														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p	C	C	p	C	p	C	p	p	C		p	p	p					
89	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p	C	C	p	C	p	C	p	p	C		p	p	p					
90	D										p	p			p	C	C	C	C	C	C	C	p																				p												p	p					
90	M										p	p			p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	C	C	C	C	C	C	p																									
91	D														p	C	C	C	C	C	C	C	C	C	C	p				p	p																																
91	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																						
92	D														p	C	C	C	C	C	C	C	p																										p	p	C	p	p	p	C	C	C	p	p					
92	M														p	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	p																			p	p	C	C	p	p	C	C	C	p	p					
93	D														p	C	C	C	C	p										p	p																																
93	M														p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																																
94	M																		p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p																				
95	D														p	C	C	C	C	p										p	p																																
95	M														p	C	C	C	C	C		p	C	C	C	p	p	C	C	C																																
96	D																													p	p																																
96	M																			p	C	C	C	p	p	C	C	p	p	p																																
97	M																											p	C	C	p	p	p	C	C	C	C	C	p	p																						
901	M																					C	C	C	C	C	C	C	C	C	C	C	p	p	p	p	C	C	C	C	p	C	C	C	C	C	p	p														
902	M	p	p	p	C	p	p	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	p	C	C	p	p	p	p	p	p	C	p	p	C	C	C	C	C	p	C	p	C	p	C	C	C	p	p	p	p	p												
903	M					p	p	p	p	C	C	C	C	C	C	p	C	C	C	C	C	C	C	C	p	p	C	C	C	C	p	p	p	p	p	p	p	p	C	p	p	p	p	p			p	p			p	C										
904	M	p	p	p	C	p	p	p	p	p	p	p	C	C	C	C	C	C	C	C	C	p	C	C	p	p	p	p	C	p	p	p	p	p	p	p	p	C	p	p	p	C	p	p			p				p												

Annex-T SR2-6 Inventory List of Hydrological Stations with Arranged Monthly Discharge Available (1/2)

N0	Name	River	HA	DA (km2)	DA (km2) (GIS by JST)	Lat	Lon	Source for location	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11
1	Jiddere Bode	Niger	1	563,500	1,561,691	11.38048	4.11880	NIHSA-GPS																																																				p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	
2	Kainji	Niger	1	569,800	1,589,938	10.35000	4.60000	1995MP																																																					C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																						
3	Kende	Sokoto	1		181,927	11.51847	4.25003	NIHSA-GPS																																																																												p	p	p	p	p	p	C	C	C	p		C	C	C	p	C	C	C	C	p	p	p	
4	Gusau	Sokola	1	2,570	2,570	12.14723	6.66995	JPT-GIS																																																					C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																										
5	Bakolori Dam	Sokolo	1	4,800	4,747	12.51007	6.18216	JPT-GIS																																																					C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																										
6	Wamako	Sokolo	1	40,160	137,219	13.03333	5.10000	1995MP																																																					C	C	C	C	C	C	C	C	C	C	C		C	C	C	C																										
7	Funlua-Yashi Road	Karaduwa	1	425	440	12.23333	7.83333	1995MP																																																							C	C	C	C	C	C																																						
8	Zobe	Karaduwa	1	2,380	2,514	12.35838	7.46547	JPT-GIS																																																					C	C	C	C	C	C	C	p																																						
9	Jibiya Dam	Maradi	1	3,200	3,522	13.07097	7.25199	JPT-GIS																																																					p	C	C	C	C	C	C	C																																						
10	Kaura Namoda	Gagere	1	6,500	5,802	12.60000	6.58333	1995MP																																																					C	C	C	C	C	C	C	p																																						
11	GoronyoDam	Rima	1	21,450	30,547	13.53124	5.88033	JPT-GIS																																																					C	C	C	C	C	C	C	C	C	C	C		C	C	C	C																										
12	Anka	Zamfara	1	4,140	4,389	12.11667	5.91667	1995MP																																																					C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																											
13	Banaga Dam	Gulbinka	1	3,170	2,967	11.65000	5.96667	1995MP																																																					C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																											
14	Malendo Bridge	Malendo	1	9,954	8,751	10.70000	4.80000	1995MP																																																																		C	C	C	C	C	C	C	C																						
15	Jebba	Niger	2	631,800	1,629,481	9.12876	4.83278	NIHSA-GPS	p	C	C	C	C	C	C	p	C	C	C	p																												p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	C		p	C	C	C	C	C	p	p	p	C	C	p	C	p													
16	Baro	Niger	2	730,300	1,726,856	8.60664	6.41699	NIHSA-GPS																																												p	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				p	p			p	p											
17	Kaduna Saulh	Kaduna	2	18,420	18,789	10.48333	7.43333	1995MP																																																						p	C	C	C	C	C	p	C																																								
18	Wuya	Kaduna	2	59,180	64,726	9.11667	5.83333	NIHSA																																																				p	p	p	p	p	C	p	p	p	p	C	p	p	C	p	C	p	p	p	C																						
19	Shiroro	Kaduna	2	36,100	34,702	9.97404	6.83337	JPT-GIS																																																																	p	C	C	C	C	C																						
20	Saminaka	Karami	2	630	577	10.36667	8.66667	1995MP																																																				C	C	C	C	C	C	C	C	p	C																																								
21	Zaria-Kano Bridge	Shika	2	845	879	11.15000	7.75000	1995MP																																																						p	C	C	C	C	p	p	C	C																																							
22	Malando Road	Tubo	2	5,900	5,683	10.58333	7.21667	1995MP																																																						p	C	C	C	C	C	C																																									
23	Ribako	Galma	2	6,650	6,663	10.66667	7.75000	1995MP																																																						p	C	C	C	C	C	p	C	C																																							
24	Komi	Kontagora	2	2,250	2,326	9.88333	4.66667	1995MP																																																																		C	C	C	C	C	C																						
25	Kachia	Shaho	2	128	124	9.90000	7.93333	1995MP																																																						p	C	C	C	C	C	p	C	C																																							
26	Kaeia	Gurara	2	562	559	9.86667	7.98333	1995MP																																																						p	C	C	C	C	C	p	C	p																																							
27	Izom	Gurara	2	7,650	6,203	9.25000	7.03333	1995MP																																																		C	C	p	C	C	C	C	C	p		p	C	C	p																																						
28	Ebba	Jatau	2	1,890	1,896	9.25000	6.56667	1995MP																																																				C	C	C	C	C	C	C	C	C	C	C																																									
29	Badeggi	Gbako	2	5,480	5,850	9.08333	6.11667	1995MP																																																				C	C	C	C	C	C	C	C	C	C																																										
30	WuroBoki	Benue	3	103,680	96,608	9.36667	12.83333	NIHSA																																										p	p	p	p	p	p	C	C	C	C	C	C	C	C	C	C	C	C	C	p	p	p	C	C	C	C	p		C	p	p			p	C	p		p	p	p			p										p					
31	Yola	Benue	3	108,400	104,797	9.23333	12.46667	1995MP																																											C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	C		
32	Agwan Taru	Benue	3	206,700	200,716	8.66667	10.41667	1995MP																																																				C	C	C	C	p	p	C	C	C	C																																										
33	Mbu/Tepkwar	Donga	3	2,120	1,975	6.70000	11.13333	1995MP																																																																C	C	C	C	C	C	C	C	p																						
34	Manya	Donga	3	6,350	9,513	7.31667	10.25000	1995MP																																																																C	C	C	C	C	p	p	C	p																						
35	Donga	Donga	3	11,910	12,523	7.71667	10.08333	1995MP																																																				C	p	p	p	C	C	C	p	p	p																																										
36	Gindin Dorowa	Donga	3	18,800	19,360	8.08333	10.05000	1995MP																																																																C	C	C	C	C																										
37	Suntai Bakundi	Sunlai	3	2,600	2,509	7.68333	10.45000	1995MP																																																																C	C	C	C	C																										
38	Banlaji	Suntai	3	5,350	5,056	8.10000	10.16667	1995MP																																																																C	C	C	C	C																										
39	Bali	Taraba	3	10,850	12,017	7.86667	10.96667	1995MP																																																															p	C	p	C	C	C	p	C	p	C																						
40	Tela	Taraba	3		N/A	8.51667	10.28333	1995MP																																																																C	C	C	C	C	C	p	p																								
41	Gassol	Taraba	3	20,700	21,792	8.51667	10.45000	NIHSA																																																				C	p	C	C	C	C	C	p	C	C	C	p	p	C	C	p	p	p	p	p	p	C	p		p	p				p	C	p										
42	Maisamari	Jigwal	3	562	N/A	8.10000	11.13333	1995MP																																																																p	C	C	C	C	C	p	C																								
43	GombeAbba	Gongola	3	17,650	13,914	10.83333	10.66667	1995MP																																																																				p	C	p	C	p																						
44	DadinKowa	Gongola	3	30,460	32,184	10.32040	11.47946	JPT-GIS																																																	p	C	C	C	C	C	C							C	C	C	C	C	C	C	C	C																						
45	Garkida	Hawal	3		7,381	10.46667	12.55000	1995MP																																																				C	C	C	p	C	C	C	C	C	C																																										
46	Ibi	Benue	4	258,700	253,876	8.18333	9.75000	NIHSA			p	C	C	C	C	C	C	C	p	p	p																															p	C	C	C	C	C	C	C	p	p	p	C	p	p	p	p	p		p	p	p	p	p	p	C	C	p	C	C	C	C	C	p	p	p	C	p				p	p			p	p	p	p	p								
47	Makurdi	Benue	4	305,500	303,341	7.75000	8.53333	NIHSA																																												C	C	p	C	C	C	C	C	p	C	p	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	C	C	C	C	C	p		p	p	C	p		p	p	p	p	p				p	p	p			
48	Umaisha	Benue	4	335,000	334,206	7.98333	7.20000	NIHSA																																											p	C	p	p	p	C	C	C	C	C	C	C	C	C	C	C	C	p	C	C	p	C	p	p	C	C	C	C	C	C	C	C	C	C	C	C	C																				
49	Katsina-Ala	Katsina Ala	4	16,770	16,789	7.15144	9.28886	NIHSA-GPS																																											p	C	p	p	p	p	p	C	C	C	p	p	C	p	p	C	C	C	p	C	C	C	C	C	C	C	C	C	C	C	C	p																										
50	Sevav	Katsina Ala	4	22,100	20,786	7.46667	9.21667	1995MP																																																																p	C	C	C	C	C	C	C	C																						

Annex-T SR2-6 Inventory List of Hydrological Stations with Arranged Monthly Discharge Available (2/2)

N0	Name	River	HA	DA (km2)	DA (km2) (GIS by JST)	Lat	Lon	Source for location	Years 14–11
51	Lokoja	Niger	5	1,089,500	2,086,277	7.66667	6.73333	1995MP	14 p; 15–27 C; 28–29 p; 30–32 C; 33–34 p; 35–2 C; 3 p; 4–8 C; 10–11 p
52	Idah	Niger	5	1,095,100	2,091,497	7.10000	6.71667	1995MP	70–72 C; 73–75 p; 76–77 C; 78–81 p; 82–83 C; 84 p; 85–87 C; 88–89 p
53	Onilsha	Niger	5	1,100,800	2,112,018	6.16250	6.77556	NIHSA-GPS	55–66 C; 67 p; 70 p; 71–78 C; 79 p; 80–89 C; 90 p; 91 C; 92 p; 95 p; 99 p; 0–1 C; 2 p; 6 p
54	Aboh	Niger	5	1,112,800	2,113,160	5.53333	6.51667	1995MP	75–86 C; 87 p
55	Ughideda	Ojo	5	406	N/A	7.36667	6.38333	BORBDA	89–94 C
56	Sepoleri	Ogun	6	1,060	1,096	8.63333	3.65000	1995MP	80–89 p
57	OfikiTown	Ofiki	6	438	694	8.46667	3.31667	1995MP	80–87 p
58	Iganna	Ofiki	6	2,780	2,451	8.10000	3.23333	1995MP	81 p; 82 C; 83–89 p
59	Ilaji-Ile Road	Oyan	6	1,460	1,569	7.96667	3.03333	1995MP	80 C; 81 p; 82 C; 83–88 p; 89 C
60	Apoje	Oshun	6	8,170	8,517	6.98333	4.11667	1995MP	82–83 C; 84–87 p
61	Awe-Ife Odan	Oba	6	930	459	8.10000	4.15000	1995MP	81–82 C; 83–85 p; 89 p
62	Oyo-Ogbomosho Road	Oba	6	1,580	1,434	7.83333	4.06667	1995MP	81–89 p
63	Owan Village	Owan	6	1,257	1,217	6.76667	5.76667	BORBDA	89–99 C
64	Abudu	Ossiomo	6	1,231	1,178	6.30000	6.03333	BORBDA	89 p; 90–94 C
65	Owena Village	Owena	6	783	775	7.20000	5.01667	BORBDA	89–90 p; 91–92 C; 93–94 p; 95–98 C; 0 C
66	Ikom	Cross	7	16,900	16,112	5.83333	8.71667	1995MP	70 p; 71–75 C; 76–79 p; 80–83 C; 84 p; 86–89 C
67	Adonatarn	Cross	7	18,900	19,422	6.15000	8.46667	1995MP	75 C; 76–79 p; 80 C; 81–82 p; 83–84 C; 85–87 p
68	Obubra	Cross	7	35,800	35,968	6.10000	8.33333	1995MP	70 p; 71–76 C; 77 p; 80–86 p; 87–88 C; 89 p
69	Afikpo	Cross	7	46,200	46,509	5.85000	7.95000	1995MP	72 C; 73–74 p; 75 C; 76–77 p; 78–79 C; 80 p; 81–82 C; 83 p; 84 C; 85 p; 86 C; 87 p; 89 p
70	Ikot Okpara	Cross	7	48,300	48,582	5.40000	8.06667	1995MP	75–79 C; 80 p; 81–89 C
71	Ugwu NKPA	Erne	7	230	N/A	5.58333	7.43333	1995MP	79 p; 80–86 C; 87 p
72	Ulakwo	Oramiriukwa	7	795	535	5.41667	7.11667	1995MP	78 p; 79–82 C; 83 p; 84–88 C; 89 p
73	Ndirnoko	Imo	7	160	N/A	5.86667	7.25000	1995MP	78 p; 79–83 C; 84 p; 85 C; 86 p
74	Urnuna	Irno	7	490	620	5.78333	7.30000	1995MP	78 p; 79–86 C; 87 p; 88 C; 89 p
75	Umuopara	Imo	7	1,450	1,518	5.55000	7.41667	1995MP	78 p; 79 C; 80 p; 83 p; 84–86 C; 87–89 p
76	Obigbo	Imo	7	5,600	4,974	4.86667	7.18333	1995MP	78 p; 79–80 C; 81–84 p; 85–88 C; 89 p
77	Gwarzo	Watari	8	1,450	1,466	11.95000	8.40000	WRECA	63 p; 64–79 C; 80–81 p; 82 C; 83 p; 84–88 C; 89 p
78	Challawa Gorge	Challawa	8	3,859	3,842	11.73272	8.03266	JPT-GIS	71 p; 72–73 C; 74–75 p; 76–91 C; 92 p; 3 p; 4–5 C; 6 p
79	Challawa Bridge	Challawa	8	6,889	6,940	11.90600	8.41342	JPT-GIS	63 p; 64–65 C; 66 p; 67–92 C; 93 p
80	Tiga Dam	Kano	8	6,553	6,538	11.46232	8.40858	JPT-GIS	64 p; 65–85 C; 94–98 C; 99 p; 3 p; 4–5 C; 6 p
81	Chiromawa	Kano	8	6,975	7,026	11.61667	8.38333	WRECA	63 p; 64–90 C; 91–93 p
82	Wudil	Hadejia	8	16,380	16,781	11.81667	8.83333	WRECA	63 p; 64–89 C; 90 p
83	Chai Chai	Gaya	8	1,710	1,864	12.01667	9.25000	WRECA	63 p; 64–90 C; 91 p
84	Hadejia	Hadejia	8	25,900	22,393	12.43333	10.06667	WRECA	64 p; 65–77 C; 78–79 p; 80–99 C; 0 p; 2–3 p
85	Bunga Bridge	Jama'are	8	7,380	8,031	11.06667	9.63333	WRECA	64 p; 65–84 C; 85 p; 86–91 C; 92–94 p; 95–99 C; 0 p
86	Foggo	Jama'are	8	9,660	9,771	11.41667	9.96667	WRECA	63 p; 64–81 C; 82 p
87	Birnin Kudu	Dogwala	8	1,891	1,772	11.43333	9.46667	WRECA	64 p; 65–73 C; 74 p; 77–78 p; 82 p; 83–84 C; 85 p
88	Iggi Bridge	Iggi	8	1,334	1,474	11.53333	9.33333	WRECA	64 p; 65–75 C; 76–78 p; 82 p; 83–84 C
89	Gashua	Yobe	8	55,700	88,298	12.86667	11.05000	WRECA	63 p; 64–90 C; 91–93 p; 94–95 C; 96 p; 97 C; 98 p; 99 C; 0–1 p; 2 C; 4–6 p
90	Geidam	Yobe	8	58,500	96,765	12.88333	11.91667	WRECA	59–60 p; 63 p; 64–77 C; 78–79 p; 80–85 C; 86 p
91	Kari	Komadugu Gana	8	5,865	6,015	11.25000	10.55000	WRECA	63 p; 64–88 C; 89 p
92	Dapchi	Komadugu Gana	8	18,090	16,373	12.50000	11.50000	WRECA	63 p; 64–72 C; 73 p; 74–78 C; 79 p; 96–97 p; 98–99 C; 0–1 p; 2–4 C; 5–6 p
93	Damasak	Yobe	8	82,560	164,624	13.13333	12.51667	1995MP	63 p; 64–78 C; 79 p
94	Bagada Diffa	Yobe	8		N/A				67 p; 68–90 C; 91 p
95	Yau	Yobe	8	84,140	166,343	13.56667	13.25000	1995MP	63 p; 64–68 C; 70 p; 71–73 C; 74–75 p; 76–78 C
96	Gamboru Bridge	Ebeji	8	16,220	16,149	12.36667	14.20000	1995MP	68 p; 69–71 C; 72–73 p; 74–75 C; 76–78 p
97	Bama Bridge	Yedseram	8		4,691	11.53333	13.68333	1995MP	77 p; 78–79 C; 80–82 p; 83–87 C; 88–89 p
901	Malanville	Niger	B	440,000	1,286,116	11.86667	3.38333	WB	70–80 C; 81–84 p; 85–88 C; 89 p; 90–94 C; 95–96 p
902	Garoua	Benue	C	64,000	61,636	9.28333	13.40000	WB	30–52 p; 53 C; 54–55 p; 56–64 C; 65 p; 66–70 C; 71 p; 72–73 C; 74–79 p; 80 C; 81–82 p; 83–87 C; 88 p; 89 C; 90 p; 91 C; 92 p; 93–95 C; 96–0 p
903	Cossi	Benue	C	26,000	26,177	9.60000	13.86667	WB	54–57 p; 58–63 C; 64 p; 65–72 C; 73–74 p; 75–78 C; 79–86 p; 87 C; 88–92 p; 95–96 p; 99 p; 0 C
904	Riao	Benue	C	27,600	30,782	9.05000	13.70000	WB	50–52 p; 53 C; 54–60 p; 61–69 C; 70 p; 71–72 C; 73–76 p; 77 C; 78–85 p; 86 C; 87–89 p; 90 C; 91–92 p; 96 p; 99 p

Annex-T SR2-7 Calibrated Model Parameters for Long-Term Rainfall-Runoff Simulation Model (1/2)

No	Calibration Point		Catchment Area (km²)		Given Upstream Discharge		Calibrartion Periods			Calibrated Parameters						Degree of Fitting					
	SN	Name of Hydrological Station	Total Area	Area for Calibration	Hydrological Station	Observed or Simulated	Num. Months	Duration	Remarks	drofrac0	afstc	afep	srfac	brfac	lfactor	Mass Error	$RMSE_L$	NS	R_monthly	R_yearly	RMSE _yearly
1	1	JiddereBode	1,561,691	232,925	901-Malanville 11-Goronyo 5-Bakolori 12-Anka 13-Banga	Observed Simulated Simulated Simulated Simulated	96	1970-1977		0.020	2.00	1.00	0.20	0.20	0.16	0.001	51.000	0.949	0.975	0.982	0.001
2	4	Gusau	2,570	2,570	No		192	1970-1985		0.100	1.13	1.00	0.60	0.60	0.05	0.001	0.085	0.482	0.752	0.655	0.030
3	8	Zobe	2,514	2,514	No		96	1970-1977		0.050	1.43	1.00	0.60	0.60	0.05	0.003	0.151	0.433	0.773	0.739	0.069
4	11	Goronyo	30,547	28,033	8-Zobe	Simulated	156	1970-1983	Gap in '81	0.020	1.50	1.00	0.40	0.40	0.60	-0.005	0.197	0.583	0.848	0.755	0.027
5	12	Anka	4,389	4,389	No		180	1970-1984		0.100	1.18	1.00	0.60	0.60	0.05	0.005	0.091	0.498	0.771	0.542	0.024
6	13	Banga	2,967	2,967	No		180	1970-1984		0.050	1.50	1.00	0.55	0.55	0.20	0.006	0.064	0.727	0.871	0.887	0.022
7	14	Malend Bridge	8,751	8,751	No		96	1981-1988		0.050	2.00	1.00	0.40	0.40	0.28	-0.001	0.091	0.302	0.641	0.447	0.024
8	16	Baro	1,726,856	56,824	15-Jebba 19-Shiroro 29-Badeggi	Observed Simulated Simulated	215	1970-1989	Gaps in '80, '81, '83	0.050	1.50	1.00	0.40	0.40	0.32	-0.002	0.041	0.840	0.917	0.921	0.001
9	17	KadunaSouth	18,789	12,126	23-Ribako	Simulated	96	1972-1980	Gaps in '72, '78	0.050	1.50	1.00	0.45	0.45	0.25	0.002	0.015	0.878	0.939	0.745	0.006
10	19	Shiroro	34,702	10,230	17-KadunaSouth 22-MalendoRd	Simulated Simulated	308	1984-2009	Gap in '84	0.050	1.50	1.00	0.32	0.32	0.06	0.001	0.026	0.805	0.904	0.609	0.005
11	22	MalendoRd	5,683	5,683	No		81	1972-1978	Gap in '72	0.050	1.80	1.00	0.28	0.28	0.34	-0.003	0.056	0.712	0.845	0.637	0.022
12	23	Ribako	6,663	6,663	No		94	1972-1980	Gaps in '72, '78	0.050	1.50	1.00	0.40	0.40	0.40	0.011	0.033	0.835	0.917	0.745	0.015
13	29	Badeggi	5,850	5,850	No		120	1970-1979		0.050	1.50	1.00	0.32	0.32	0.30	0.000	0.026	0.860	0.928	0.768	0.012
14	31	Yola	104,797	43,161	902-Garoua	Simulated	202	1960-1977	Gaps in '66, '72, '73, '75, '77	0.010	1.50	1.00	0.30	0.40	0.21	0.002	0.017	0.888	0.945	0.754	0.002
15	34	Manya	9,513	9,513	No		60	1981-1985		0.100	1.00	0.84	0.30	0.52	0.05	0.017	0.006	0.893	0.952	0.619	0.004
16	38	Bantaji	5,056	5,056	No		60	1981-1985		0.050	1.00	0.72	0.30	0.70	0.05	0.002	0.011	0.824	0.909	0.618	0.008
17	41	Gassol	21,792	21,792	No		267	1970-2000	Gaps in '71, '77, '81, '82, '85-'90, '92-'99	0.050	1.10	1.00	0.40	0.70	0.05	0.000	0.018	0.770	0.855	0.295	0.006
18	44	DadinKowa	32,184	32,184	No		192	1968-1989	Gaps in '68, '70, '76-'80	0.050	1.70	1.00	0.25	0.25	0.33	0.003	0.050	0.745	0.864	0.764	0.009
19	45	Garkida	7,381	7,381	No		118	1970-1979	Gaps in '73	0.050	1.84	1.00	0.50	0.50	0.05	-0.001	0.085	0.687	0.837	0.720	0.022
20	47	Makarudi	303,341	84,643	KiriDam 36-GindinDorowa 41-Gassol 50-Sevav 31-Yola	Simulated Simulated Simulated Simulated Simulated	195	1960-1977	Gaps in '62, '68, '70	0.050	1.40	1.00	0.50	0.50	0.05	-0.003	0.012	0.867	0.931	0.815	0.001
21	49	Katsina-Ala	16,789	16,789	No		285	1960-1986	Gaps in '61, '65, '66, '68, '69, '73, '85	0.100	1.00	0.36	0.20	0.65	0.05	0.001	0.005	0.817	0.905	0.318	0.003
22	51	Lokoja	2,086,277	56,080	16-Baro 47-Makarudi	Observed Observed	347	1961-1991	Gaps in '62, '68, '70	0.050	1.41	1.00	0.33	0.33	0.05	-0.008	0.011	0.984	0.992	0.949	0.001
23	53	Onitsha	2,112,018	25,741	51-Lokoja	Observed	341	1960-1991	Gaps in '67-'70, '79, '90	0.050	1.50	1.00	0.30	0.30	0.13	0.017	0.012	0.984	0.962	0.982	0.000
24	59	Itaji-IleRoad	1,569	1,569	No		79	1980-1989	Gaps in '81, '83, '84-'88	0.050	1.36	1.00	0.70	0.70	0.05	-0.006	0.070	0.511	0.743	0.716	0.046
25	62	Oyo-OgbomoshoRoad	1,434	1,434	No		84	1981-1989	Gaps in every year	0.050	1.35	1.00	0.70	0.70	0.05	0.007	0.046	0.538	0.759	0.575	0.043
26	65	OwenaVillage	775	775	No		115	1989-2000	Gaps in '90, '93, '94, '99	0.050	1.50	1.00	0.40	0.40	0.22	0.001	0.026	0.454	0.699	0.648	0.033
27	66	Ikom	16,112	16,112	No		179	1970-1989	Gaps in '76-'79, '84, '85	0.100	1.00	0.52	0.30	0.62	0.05	0.013	0.004	0.837	0.925	0.685	0.002
28	68	Obubra	35,968	19,856	66-Ikom	Simulated	110	1970-1988	Gaps in '70, '77-'86	0.100	1.00	0.72	0.40	0.62	0.05	0.018	0.004	0.902	0.958	0.811	0.001
29	70	IkotOkpara	48,582	12,614	68-Obubra	Simulated	178	1975-1989	Gap in '80	0.100	1.50	1.00	0.40	0.52	0.07	0.004	0.005	0.907	0.959	0.790	0.001
30	75	Umuopara	1,518	1,518	No		84	1978-1989	Gaps in '80-83, '87-89	0.100	1.00	1.00	0.28	0.28	0.05	0.021	0.009	0.651	0.807	0.404	0.014
31	78	ChallawaGorge	3,842	3,842	No		237	1971-1991	Gaps in '74, '75	0.100	1.70	1.00	0.60	0.60	0.05	-0.010	0.098	0.442	0.723	0.871	0.040
32	80	TigaDam	6,538	6,538	No		120	1964-1973		0.050	1.50	1.00	0.50	0.50	0.66	0.003	0.034	0.759	0.871	0.660	0.016
33	82	Wudil	16,781	6,402	78-ChallawaGorge 80-TigaDam	Simulated Simulated	129	1963-1973	Gap in '63	0.040	2.80	1.00	0.20	0.20	0.22	-0.001	0.062	0.830	0.852	0.663	0.014
34	86	Foggo	9,771	9,771	No		228	1963-1982	Gaps in '63, '82	0.050	1.80	1.00	0.45	0.45	0.60	0.000	0.027	0.776	0.881	0.538	0.012
35	88	IggiBridge	1,474	1,474	No		205	1964-1983	Gaps in '64, '76-'79	0.050	1.70	1.00	0.40	0.40	0.51	-0.006	0.069	0.638	0.806	0.467	0.058
36	91	Kari	6,015	6,015	No		312	1963-1989	Gaps in '63, '89	0.040	2.60	1.00	0.35	0.35	0.55	0.003	0.122	0.555	0.745	0.557	0.045
37	97	BamaBridge	4,696	4,696	No		131	1976-1989	Gaps in '79-'80, '87	0.030	2.00	1.00	0.40	0.40	0.68	-0.003	0.181	0.436	0.702	0.647	0.075
38	902	Garoua	61,636	4,677	903-Cossi 904-Riao	Simulated Simulated	202	1960-1977	Gaps in '65, '71, '75-'77	0.050	1.35	1.00	0.70	0.70	0.05	0.007	0.026	0.854	0.924	0.682	0.005
39	903	Cossi	26,177	26,177	No		335	1960-1990	Gaps in '64, '70, '73-'74, '79-'86, '88-'90	0.050	1.50	1.00	0.50	0.50	0.15	-0.004	0.044	0.678	0.872	0.728	0.012
40	904	Riao	30,782	30,782	No		206	1960-1977	Gaps in '70, '73-'76	0.050	1.50	1.00	0.53	0.53	0.41	0.002	0.026	0.820	0.906	0.507	0.006

Annex-T SR2-7 Calibrated Model Parameters for Long-Term Rainfall-Runoff Simulation Model (2/2)

No	Calibration Point		Calibrated Parameters	
	SN	Name of Hydrological Station	rfac_r	rfac_l
1	84	Hadejia	0.30	0.80
2	89	Gashua	0.20	0.47
3	90	Geidam	0.35	0.38
4	92	Dapchi	0.08	0.45
5	93	Damasak	0.25	0.42
6	95	Yau	0.50	0.49

Annex-T SR2-8 Runoff Yield by SHAs (1/3)

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	AverageMonthly Runoff Yield (Height) (mm/month)												Average Annual Runoff Yield (mm/year)	Average Annual Preci-pitation (mm/year)	Average Runoff Rate (%)
					1	2	3	4	5	6	7	8	9	10	11	12			
1	101	101	1	9,355.4	1.1	0.5	0.2	0.1	1.5	6.8	12.0	26.0	41.3	14.0	5.9	2.5	112	1,023	10.9
	102	102	2	9,127.2	2.1	0.9	0.4	0.2	1.0	5.5	12.5	48.1	68.9	25.9	11.0	4.7	181	1,021	17.8
	103	103	3	3,387.3	1.2	0.5	0.2	0.1	0.7	4.5	10.9	32.7	43.8	14.9	6.4	2.8	119	940	12.6
	104	104	4	2,933.6	1.3	0.5	0.2	0.1	0.3	2.9	9.2	33.1	45.8	15.7	6.8	2.9	119	909	13.1
	105	105	5	3,456.6	0.8	0.3	0.1	0.1	0.4	4.3	9.4	26.7	31.2	9.7	4.2	1.8	89	945	9.4
	10601	10601	6	689.1	2.1	1.4	0.9	0.6	0.5	1.7	3.6	10.7	13.3	6.8	4.5	3.1	49	887	5.6
	10602	10602	7	10,960.3	3.1	2.0	1.3	0.9	0.8	2.4	6.4	24.3	35.6	15.2	8.4	5.0	105	922	11.4
	10603	10603	8	1,084.9	0.9	0.6	0.4	0.3	0.3	1.2	3.3	6.9	7.2	3.0	2.0	1.3	27	828	3.3
	10604	10604	9	17,476.6	1.2	0.7	0.5	0.3	0.3	1.5	7.5	19.2	22.0	7.3	3.7	2.0	66	825	8.0
	10605	10605	10	6,335.9	0.1	0.1	0.1	0.0	0.0	0.1	2.2	3.9	2.0	0.4	0.3	0.2	10	666	1.4
	10606	10606	11	5,817.2	0.8	0.6	0.4	0.3	0.2	0.3	3.0	6.9	5.9	2.8	1.9	1.2	24	695	3.5
	10607	10607	12	2,706.1	0.2	0.1	0.1	0.1	0.0	0.1	1.9	4.1	1.6	0.6	0.4	0.3	10	581	1.7
	106081	106081_e	13	2,220.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.6	0.1	0.0	0.0	0.0	2	401	0.6
		106081_i	14	4,132.3	0.1	0.1	0.1	0.0	0.0	0.0	1.4	3.2	0.9	0.4	0.3	0.2	7	489	1.4
	106082	106082_e	15	80,006.8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	1	256	0.4
		106082_i1	16	1,322.2	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.3	0.2	0.0	0.0	0.0	4	446	0.9
		106082_i2	17	6,043.4	0.2	0.1	0.1	0.1	0.0	0.1	2.1	4.6	1.7	0.7	0.5	0.3	11	536	2.0
	106083	106083	18	412.5	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.7	0.3	0.0	0.0	0.0	4	473	0.9
	106085	106085_e	19	290.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.0	0.0	0.0	3	386	0.8
		106085_i	20	1,499.6	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.5	0.3	0.0	0.0	0.0	4	429	0.9
	1060861	1060861_e	21	6,067.9	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.7	0.4	0.0	0.0	0.0	4	408	1.0
		1060861_i1	22	164.7	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.0	0.0	0.0	3	389	0.8
		1060861_i2	23	548.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	9.7	3.4	0.7	0.2	0.0	17	521	3.2
	1060863	1060863	24	3,509.3	0.0	0.0	0.0	0.0	0.0	0.1	3.2	10.6	5.1	0.9	0.2	0.1	20	605	3.3
	106087	106087_e	25	632.3	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.1	0.7	0.1	0.0	0.0	5	444	1.2
		106087_i	26	1,216.5	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.7	0.5	0.0	0.0	0.0	4	432	1.0
	1060881	1060881	27	5,750.6	0.0	0.0	0.0	0.0	0.0	0.2	2.9	8.2	7.3	1.3	0.3	0.1	20	641	3.2
	1060883	1060883	28	2,513.8	0.4	0.2	0.1	0.0	0.0	1.3	9.5	32.3	25.5	7.6	2.9	1.1	81	745	10.8
	106089	106089	29	8,354.1	0.1	0.0	0.0	0.0	0.1	0.7	3.8	16.0	18.0	3.7	0.9	0.2	44	751	5.8
	106091	106091	30	7,636.2	0.2	0.1	0.1	0.0	0.0	0.2	2.4	4.0	1.9	0.5	0.3	0.2	10	597	1.7
	106093	106093	31	4,746.6	0.8	0.3	0.1	0.0	0.7	4.5	19.2	48.0	53.3	14.2	5.4	2.0	149	863	17.2
	107	107_e	32	1,924.1	3.7	2.5	1.7	1.1	1.1	2.8	4.3	14.4	22.0	12.3	8.3	5.5	80	1,028	7.8
		107_i	33	6,223.4	2.1	1.4	0.9	0.6	0.6	2.0	3.8	10.5	13.6	6.9	4.6	3.1	50	930	5.4
	108	108_e	34	63,517.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.9	0.1	0.0	0.0	0.0	1	337	0.4
		108_i	35	7,724.9	0.1	0.0	0.0	0.0	0.0	0.1	1.3	2.7	0.7	0.2	0.1	0.1	5	514	1.0
	109	109	36	14,037.5	3.6	2.4	1.6	1.1	1.4	3.0	4.7	12.9	21.2	12.0	8.0	5.4	77	1,006	7.7
2	201	201	37	2,646.9	9.4	6.0	3.8	4.0	8.8	10.8	18.0	29.7	57.0	41.3	23.3	14.9	227	1,208	18.8
	20201	20201	38	5,088.0	10.2	6.5	4.1	3.1	6.9	9.3	16.1	38.9	66.2	43.3	25.3	16.1	246	1,236	19.9
	202021	202021	39	2,739.0	13.1	8.4	5.3	3.9	7.2	9.5	16.5	52.4	82.6	54.9	32.4	20.6	307	1,315	23.3
	202023	202023	40	190.7	19.2	12.2	7.8	5.7	9.9	12.3	31.6	88.7	115.0	78.8	47.1	30.0	458	1,402	32.7
	20203	20203	41	4,599.3	15.6	9.9	6.3	4.5	7.5	10.5	22.5	71.0	97.4	63.9	38.3	24.4	372	1,338	27.8
	20205	20205	42	2,636.8	20.0	12.7	8.1	5.8	8.8	11.9	28.1	98.8	121.3	80.2	48.7	31.0	475	1,425	33.3
	203	203	43	4,436.7	7.3	4.6	2.9	2.5	6.3	8.9	15.1	29.1	53.9	33.5	18.6	11.6	194	1,189	16.3
	20401	20401	44	5,985.0	1.6	0.6	0.3	1.4	6.1	8.4	11.8	17.5	45.9	27.3	9.2	3.8	134	1,189	11.3
	20403	20403	45	1,596.0	2.7	1.1	0.7	2.6	7.8	9.7	16.0	23.3	65.9	46.4	16.2	6.6	199	1,256	15.8
	205	205	46	375.0	1.1	0.4	0.2	0.5	4.1	7.3	11.9	20.6	40.9	17.4	6.0	2.4	113	1,177	9.6
	206	206	47	7,358.0	2.6	1.2	0.6	0.5	3.7	8.0	14.6	38.3	60.2	28.1	11.9	5.6	175	1,208	14.5
	207	207	48	1,056.1	0.6	0.3	0.1	0.4	4.1	7.3	10.4	13.8	27.3	10.9	3.4	1.4	80	1,158	6.9
	20801	20801	49	1,936.8	1.2	0.5	0.2	0.4	3.3	7.6	13.2	24.4	47.7	19.2	7.0	2.8	127	1,159	11.0
	20802	20802	50	2,240.6	1.9	0.8	0.3	0.3	2.7	8.0	13.6	34.8	70.8	28.8	10.9	4.5	177	1,154	15.4
	20803	20803	51	725.1	1.6	0.6	0.3	0.3	2.7	8.0	12.8	29.2	61.5	24.4	9.2	3.7	154	1,170	13.2
	20804	20804	52	17,359.5	2.1	0.9	0.4	0.2	1.8	8.6	20.5	66.3	85.3	32.2	12.7	5.2	236	1,112	21.2
	20805	20805	53	4,325.9	2.2	0.9	0.4	0.4	4.1	13.9	25.4	59.2	84.3	34.5	13.3	5.4	244	1,196	20.4
	20806	20806	54	3,503.9	2.2	0.9	0.4	0.3	2.8	11.5	24.1	65.1	87.2	33.6	13.2	5.4	247	1,179	20.9
	20807	20807	55	557.0	2.0	0.8	0.3	0.3	2.9	8.7	14.5	49.3	77.1	31.6	12.1	4.9	205	1,212	16.9
	20809	20809	56	3,692.3	13.7	8.8	5.6	3.9	6.7	9.9	16.3	59.4	87.4	55.3	33.5	21.4	322	1,301	24.8
	20810	20810	57	3,449.6	13.9	8.9	5.7	3.9	6.2	11.3	19.6	63.7	90.0	54.8	33.7	21.6	333	1,274	26.2
	20811	20811	58	1,561.0	12.2	7.8	5.0	3.4	4.9	9.8	15.9	54.0	82.2	48.0	29.8	19.0	292	1,208	24.2
	20812	20812	59	5,919.2	2.5	1.3	0.7	0.5	1.7	7.1	11.7	34.6	52.0	20.7	10.0	5.0	148	1,100	13.4
	20813	20813	60	2,483.4	7.8	4.7	2.9	2.0	4.1	9.0	17.6	67.2	87.6	42.8	23.0	13.2	282	1,187	23.7
	20814	20814	61	6,713.9	0.8	0.3	0.1	0.0	1.9	5.9	15.5	57.2	57.1	17.5	6.3	2.3	165	1,049	15.7
	20815	20815	62	10,882.2	2.8	1.1	0.5	0.4	4.8	9.1	25.6	96.8	98.8	40.0	16.0	6.6	303	1,255	24.1
	209	209	63	15,015.3	1.5	0.6	0.3	1.1	4.9	8.1	10.1	16.1	45.0	26.0	9.0	3.7	126	1,155	10.9
	211	211	64	6.2	1.0	0.4	0.2	0.7	2.8	7.3	7.8	14.4	39.6	16.8	5.9	2.4	99	1,082	9.2
	212	212	65	6,740.8	1.9	0.8	0.3	1.4	6.0	8.5	9.5	14.9	46.6	31.8	10.9	4.4	137	1,151	11.9
	213	213	66	4,145.9	1.3	0.5	0.2	0.3	2.5	7.4	9.7	20.4	51.3	20.6	7.6	3.1	125	1,100	11.4
	214	214_e	67	257.9	1.6	0.7	0.3	0.5	4.0	7.4	12.1	28.3	57.4	27.3	10.0	4.1	154	1,108	13.9
		214_i	68	9,792.7	1.6	0.6	0.3	0.9	4.5	7.5	10.2	21.0	52.1	27.1	9.6	3.9	139	1,106	12.6
	215	215	69	2,109.7	1.2	0.5	0.2	0.3	2.5	7.2	8.9	21.1	49.7	19.9	7.3	3.0	122	1,073	11.4
	216	216_e	70	3,698.9	1.5	0.6	0.2	0.2	2.9	8.1	11.1	34.3	61.6	23.6	9.2	3.7	157	1,098	14.3
		216_i	71	7,957.2	1.4	0.6	0.2	0.2	2.7	7.7	10.3	29.4	58.1	22.8	8.7	3.5	146	1,081	13.5
	217	217	72	127.2	1.3	0.5	0.2	0.2	2.1	7.1	9.7	25.4	53.4	19.9	7.6	3.1	130	1,065	12.2
	218	218	73	4,644.4	1.6	0.7	0.3	0.1	2.0	7.0	12.5	34.7	64.1	24.6	9.5	3.9	161	1,089	14.8
	219	219	74	19.0	0.2	0.1	0.0	0.0	1.9	6.8	8.3	10.9	17.0	4.0	1.2	0.5	51	1,050	4.8

Annex-T SR2-8 Runoff Yield by SHAs (2/3)

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	AverageMonthly Runoff Yield (Height) (mm/month)												Average Annual Runoff Yield (mm/year)	Average Annual Preci-pitation (mm/year)	Average Runoff Rate (%)
					1	2	3	4	5	6	7	8	9	10	11	12			
3	30201	30201	75	587.0	1.8	0.9	0.4	0.3	3.0	7.6	9.7	18.1	34.0	19.7	7.9	3.8	107	1,103	9.7
	30202	30202	76	5,145.8	4.6	1.3	0.5	2.5	8.4	23.9	63.3	111.4	142.8	120.7	54.9	15.7	550	1,307	42.1
	30203	30203_e	77	2,826.1	18.4	8.5	7.1	13.0	26.2	56.1	110.9	153.9	183.6	163.6	88.3	40.3	870	1,693	51.4
		30203_i	78	11,384.8	13.5	6.2	4.2	7.8	19.5	37.1	72.9	111.6	142.2	124.3	64.7	29.5	633	1,476	42.9
	303	303	79	1,463.0	2.1	1.0	0.5	0.2	2.1	7.0	10.4	22.1	41.8	20.7	8.8	4.2	121	1,086	11.1
	304	304	80	4,997.2	3.6	1.7	0.8	0.4	1.7	6.8	16.6	53.8	74.1	33.6	15.5	7.4	216	1,088	19.9
	305	305	81	808.7	1.7	0.8	0.4	0.2	1.3	6.3	10.7	22.8	38.5	16.8	7.3	3.5	110	1,067	10.3
	30601	30601	82	2,266.4	1.1	0.3	0.1	0.1	2.5	7.4	12.0	31.8	57.6	39.0	13.0	3.8	169	1,135	14.9
	30602	30602	83	5,395.0	1.6	0.5	0.1	0.4	3.7	9.1	27.5	69.4	99.0	61.5	19.7	5.6	298	1,203	24.8
	30603	30603_e	84	559.0	4.6	1.3	1.2	5.9	13.0	40.3	113.4	167.8	180.8	133.2	55.6	15.8	733	1,592	46.0
		30603_i	85	13,799.2	3.0	0.9	0.5	2.7	9.1	21.1	63.7	112.7	136.8	96.4	36.6	10.4	494	1,408	35.1
	307	307	86	5,737.4	2.1	1.0	0.5	0.2	0.9	5.9	12.7	31.4	47.8	20.0	9.1	4.3	136	1,048	13.0
	308	308	87	15,173.5	2.3	1.1	0.5	0.2	0.3	4.2	15.7	46.6	51.2	20.9	9.9	4.7	158	945	16.7
	309	309	88	87.1	0.6	0.3	0.1	0.1	0.8	5.4	10.5	15.4	20.6	6.2	2.6	1.2	64	1,054	6.0
	310	310	89	2,512.7	3.2	1.5	0.7	0.5	2.1	6.5	14.9	44.2	66.5	30.5	13.8	6.6	191	1,118	17.1
	311	311	90	11,883.8	2.0	0.9	0.4	0.3	0.9	5.4	18.7	39.5	44.9	18.1	8.4	4.0	144	998	14.4
	312	312	91	2,748.4	2.5	1.2	0.6	0.4	1.7	5.6	12.2	39.6	55.3	23.6	10.9	5.2	159	1,038	15.3
	313	313	92	48.5	0.0	0.0	0.0	0.0	0.3	3.6	9.8	11.6	8.0	0.2	0.1	0.0	34	915	3.7
	31401	31401	93	717.6	1.4	0.7	0.3	0.1	0.4	3.4	11.1	31.5	33.3	12.4	5.9	2.8	103	894	11.5
	31403	31403	94	1,658.9	1.5	0.7	0.3	0.2	0.4	3.6	15.6	34.7	34.8	13.1	6.2	3.0	114	894	12.8
	31404	31404	95	11,229.0	1.4	0.7	0.3	0.1	0.3	2.8	10.9	28.9	32.4	12.4	5.9	2.8	99	841	11.8
	31405	31405	96	6,890.1	1.3	0.6	0.3	0.1	0.1	2.8	13.4	28.3	31.1	11.7	5.5	2.6	98	869	11.3
	31407	31407	97	7,702.1	0.6	0.3	0.2	0.1	0.0	1.8	11.0	18.6	15.1	4.8	2.4	1.2	56	807	7.0
	31408	31408	98	5,303.7	0.3	0.2	0.1	0.0	0.0	1.2	9.8	15.2	9.0	2.5	1.3	0.6	40	699	5.8
	31409	31409	99	19,178.0	1.9	0.9	0.5	0.3	1.8	5.1	17.9	38.7	35.7	14.6	7.2	3.6	128	979	13.1
	315	315	100	1,616.6	0.9	0.4	0.2	0.1	0.6	3.6	9.9	19.6	23.5	7.6	3.6	1.7	71	907	7.9
	316	316	101	5,536.5	3.8	1.8	0.8	0.7	3.0	7.0	21.1	59.3	76.4	35.4	16.2	7.7	233	1,121	20.8
	317	317	102	3,400.3	2.2	1.0	0.5	0.2	0.6	1.8	5.8	21.2	34.0	19.7	9.4	4.5	101	1,005	10.0
	318	318	103	5,441.5	2.3	1.1	0.5	0.2	0.3	0.9	3.6	24.9	35.9	21.0	10.0	4.7	106	922	11.5
	319	319_e	104	2,088.9	2.3	1.1	0.5	0.2	0.5	1.0	2.6	19.8	33.6	20.5	9.7	4.6	96	956	10.1
		319_i	105	1,726.6	2.0	0.9	0.4	0.2	0.4	1.0	2.7	17.1	29.3	17.7	8.4	4.0	84	949	8.9
	320	320_e	106	25,211.5	7.4	3.5	1.7	1.3	2.5	6.8	33.2	72.8	93.7	64.8	32.6	15.5	336	1,396	24.1
		320_i	107	2,106.7	5.3	2.5	1.2	0.8	1.4	2.3	11.2	45.2	68.8	46.6	23.0	10.9	219	1,273	17.2
	321	321	108	65,499.3	0.8	0.3	0.1	0.2	1.9	5.0	18.5	53.1	56.5	18.3	5.9	2.1	163	1,032	15.8
4	401	401	109	3,642.9	9.1	5.8	3.7	3.6	8.2	9.6	14.2	26.8	54.8	40.5	22.6	14.4	213	1,246	17.1
	402	402	110	9,075.9	14.9	9.5	6.0	4.3	7.9	9.9	19.9	63.7	91.6	62.0	36.6	23.3	350	1,366	25.6
	403	403	111	4,906.6	10.6	6.7	4.3	3.5	8.4	9.2	14.2	33.8	62.8	46.2	26.1	16.6	243	1,286	18.9
	404	404	112	9,347.8	17.0	10.8	6.9	4.8	8.6	10.3	28.1	83.7	103.6	69.5	41.6	26.5	411	1,385	29.7
	405	405	113	11,303.0	10.1	6.1	3.7	3.2	9.4	10.0	17.4	44.7	74.4	56.6	28.9	17.0	282	1,323	21.3
	406	406_e	114	10,331.5	19.2	7.9	14.7	37.7	82.3	134.2	187.7	234.4	265.4	255.3	159.9	57.1	1,456	1,915	76.0
		406_i	115	12,618.8	13.5	4.7	4.7	11.5	39.2	88.2	125.3	149.1	179.5	181.2	114.2	39.5	951	1,553	61.2
	407	407	116	4,277.1	4.5	2.2	1.0	0.9	6.8	8.5	13.7	41.2	69.0	47.1	19.8	9.4	224	1,233	18.2
	408	408	117	10,587.4	6.4	3.0	1.4	0.9	4.7	8.4	31.0	97.6	116.1	62.5	27.9	13.2	373	1,312	28.5
	409	409	118	2,471.0	3.5	1.7	0.8	0.6	5.0	8.0	10.3	25.9	52.6	36.7	15.1	7.2	167	1,159	14.4
	410	410	119	4,839.1	4.5	2.2	1.0	0.5	2.8	7.6	18.2	63.3	87.0	43.5	19.6	9.3	260	1,161	22.4
	411	411	120	1,449.1	2.1	1.0	0.5	0.3	2.9	7.3	9.4	19.8	37.9	22.5	9.1	4.3	117	1,088	10.8
5	500	500	121	19,112.1	50.0	32.2	23.5	26.7	53.2	141.0	188.7	175.9	223.2	213.5	139.3	82.4	1,350	3,055	44.2
	502	502	122	3,156.9	27.7	17.0	11.2	11.6	17.6	36.7	79.9	90.5	141.4	136.0	75.9	45.8	691	2,125	32.5
	50401	50401	123	1,580.8	26.5	16.3	10.4	10.9	16.5	33.9	72.5	88.4	135.8	130.8	72.5	43.9	659	2,083	31.6
	50402	50402	124	14,104.9	14.6	8.9	5.6	5.6	12.1	16.6	27.8	40.3	80.0	74.5	39.7	24.1	350	1,536	22.8
	50403	50403	125	11,821.3	10.8	6.6	4.1	4.7	10.0	13.0	19.5	26.4	61.7	56.0	29.3	17.8	260	1,398	18.6
	506	506	126	4,137.6	28.4	17.5	11.2	12.2	18.2	50.1	89.4	110.9	145.5	139.3	77.5	46.9	747	2,142	34.9
6	60001	60001	127	2,701.1	6.0	2.9	2.4	4.6	13.0	52.9	77.3	43.0	64.5	66.3	28.6	13.0	375	1,712	21.9
	60002	60002	128	8,252.4	37.7	23.4	16.9	18.3	31.9	86.3	154.0	139.3	184.9	175.9	104.9	62.4	1,036	2,635	39.3
	601	601	129	391.8	1.8	0.9	1.5	3.2	9.5	34.5	32.4	13.4	18.6	25.2	8.5	4.0	153	1,271	12.1
	602	602_e	130	844.5	1.1	0.5	0.5	4.1	6.0	7.5	7.6	6.2	21.2	15.3	5.1	2.4	78	1,083	7.2
		602_i	131	3,311.6	1.4	0.6	0.9	4.2	6.7	11.9	12.7	7.1	20.6	18.9	6.4	3.0	94	1,140	8.3
	603	603	132	1,965.7	2.8	1.3	1.4	4.5	10.9	47.4	48.3	23.3	31.5	34.8	13.1	6.0	225	1,385	16.3
	60401	60401	133	2,034.9	2.3	1.1	1.1	5.1	7.9	21.4	26.7	14.5	27.9	28.9	10.5	4.9	152	1,294	11.8
	604021	604021	134	168.9	0.4	0.1	0.4	5.1	6.2	10.6	12.7	7.2	25.8	25.2	5.5	1.6	101	1,179	8.6
	604023	604023_e	135	72.9	0.6	0.2	0.0	2.5	4.6	8.4	20.4	31.8	60.3	29.2	7.4	2.1	167	1,128	14.8
		604023_i	136	9,040.6	0.6	0.2	0.2	2.5	5.3	8.0	14.3	16.7	48.2	30.6	7.3	2.1	136	1,115	12.2
	60403	60403	137	6,011.7	0.8	0.2	0.6	4.3	6.7	10.0	15.1	13.5	45.5	39.5	9.4	2.7	148	1,174	12.6
	60405	60405	138	4,704.2	0.8	0.2	0.1	1.6	6.2	9.0	12.4	17.7	61.5	38.5	9.5	2.7	160	1,130	14.2
	605	605	139	1,102.3	4.1	1.9	1.6	4.6	11.4	45.9	58.9	31.9	45.2	47.7	19.6	8.9	282	1,477	19.1
	606	606	140	4,398.1	4.1	1.9	1.5	5.8	9.0	19.0	30.9	22.9	42.9	48.8	19.1	8.9	215	1,380	15.6
	607	607	141	417.6	5.6	2.6	1.9	3.9	10.9	36.8	61.7	34.4	56.3	62.2	26.6	12.1	315	1,601	19.7
	608	608	142	9,764.4	2.2	0.8	0.7	3.5	7.9	13.8	24.1	24.7	71.9	67.3	19.0	6.3	242	1,302	18.6
	609	609	143	113.5	6.2	2.9	2.1	3.8	11.7	43.8	74.5	41.2	69.0	69.5	29.2	13.4	367	1,674	21.9
	610	610	144	6,462.0	5.5	2.6	2.0	4.9	9.1	18.3	37.0	31.5	64.5	63.6	25.7	12.0	277	1,462	18.9
	611	611	145	4,227.7	8.0	3.8	3.1	5.9	12.0	36.7	75.8	57.5	96.6	88.3	37.7	17.4	443	1,753	25.3
	612	612	146	5,869.5	7.8	3.6	3.1	6.3	11.7	24.3	57.2	55.8	101.5	84.7	36.1	16.7	409	1,652	24.7
	614	614	147	13,271.7	12.6	7.7	5.5	6.7	11.0	14.8	28.4	34.1	73.1	63.9	34.2	20.8	313	1,463	21.4
	616	616	148	8,417.4	25.6	15.7	11.4	12.1	17.9	35.3	75.7	83.4	133.4	125.1	70.4	42.4	648	2,023	32.1
	617	617	149	1,896.8	36.3	22.5	15.4	15.8	24.3	63.0	126.8	129.6	181.0	173.6	100.4	60.1	949	2,498	38.0
	699	699	150	4,809.4	0.7	0.2	0.1	1.2	4.8	7.5	15.3	26.1	63.3	34.0	8.4	2.4	164	1,105	14.8

Annex-T SR2-8 Runoff Yield by SHAs (3/3)

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	AverageMonthly Runoff Yield (Height) (mm/month)												Average Annual Runoff Yield (mm/year)	Average Annual Preci-pitation (mm/year)	Average Runoff Rate (%)
					1	2	3	4	5	6	7	8	9	10	11	12			
7	702	702	151	8,146.5	49.3	35.2	27.4	30.4	46.2	96.8	137.6	159.5	189.6	177.1	110.1	72.0	1,131	2,424	46.7
	703	703	152	4,318.8	56.1	40.4	33.3	37.0	55.1	105.7	156.5	171.4	206.1	193.8	128.9	81.8	1,266	2,638	48.0
	70401	70401	153	6,054.6	34.9	23.4	19.0	24.6	37.5	65.7	118.1	137.0	170.4	163.9	95.0	55.2	945	2,286	41.3
	70402	70402	154	7,090.9	12.5	5.6	3.2	8.6	24.5	36.9	72.8	101.8	147.1	137.7	63.1	28.2	642	1,840	34.9
	70403	70403	155	3,625.5	14.8	6.6	3.8	9.1	24.9	39.0	83.8	119.2	157.3	161.8	76.6	33.6	731	1,992	36.7
	704041	704041	156	1,236.3	13.9	5.1	2.8	12.2	30.9	80.4	137.6	172.2	199.9	209.3	106.3	38.4	1,009	1,986	50.8
	704042	704042	157	7,702.7	11.3	4.1	1.7	8.7	30.0	73.3	105.6	136.3	169.3	174.5	86.5	31.2	832	1,693	49.2
	704043	704043	158	7,382.6	9.3	3.4	1.7	7.4	24.0	51.9	90.3	120.4	161.4	152.7	71.6	25.8	720	1,576	45.7
	70405	70405_e	159	13,407.4	25.0	14.2	20.3	48.6	102.3	168.4	237.0	285.8	314.2	301.3	180.2	68.5	1,766	2,474	71.4
		70405_i	160	6,028.1	19.0	8.3	8.3	20.9	60.1	131.7	193.2	223.4	248.1	251.2	141.2	52.2	1,358	2,219	61.2
	705	705	161	5,854.2	54.9	39.2	34.1	38.2	58.6	105.6	159.0	176.1	202.8	190.2	124.3	80.1	1,263	2,629	48.0
8	800	800	162	5,221.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.7	0.1	0.0	0.0	0.0	4	302	1.2
	802	802_e	163	13,857.3	0.0	0.0	0.0	0.0	0.0	0.4	4.4	7.8	4.2	0.4	0.1	0.0	17	666	2.6
		802_i	164	2,422.8	0.0	0.0	0.0	0.0	0.0	0.0	2.9	4.6	1.0	0.0	0.0	0.0	8	517	1.6
	80401	80401	165	4,647.6	0.0	0.0	0.0	0.0	0.0	0.0	2.8	5.1	1.3	0.0	0.0	0.0	9	517	1.8
	80402	80402_e	166	626.1	0.0	0.0	0.0	0.0	0.2	1.2	5.6	11.2	8.5	1.0	0.2	0.0	28	782	3.6
		80402_i	167	7,171.8	0.0	0.0	0.0	0.0	0.0	0.5	4.4	7.3	3.7	0.3	0.1	0.0	16	664	2.4
	80403	80403_e	168	253.1	0.0	0.0	0.0	0.0	0.9	3.0	7.2	24.9	27.3	4.6	0.9	0.2	69	951	7.3
		80403_i	169	6,656.5	0.0	0.0	0.0	0.0	0.2	1.2	5.2	13.9	12.1	1.8	0.3	0.1	35	747	4.7
	806	806	170	21,903.0	0.0	0.0	0.0	0.0	0.0	0.5	4.3	8.7	5.2	0.6	0.1	0.0	19	623	3.1
	807	807	171	14,280.8	0.0	0.0	0.0	0.0	0.0	0.0	1.5	4.0	0.2	0.0	0.0	0.0	6	355	1.6
	80801	80801_e	172	1,438.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.8	0.0	0.0	0.0	0.0	2	248	0.9
		80801_i	173	946.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.5	0.0	0.0	0.0	0.0	3	269	1.1
	80802	80802	174	30,141.6	0.0	0.0	0.0	0.0	0.0	0.4	6.8	14.1	6.7	1.4	0.4	0.1	30	609	4.9
	80803	80803_e	175	8,391.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	1	208	0.4
		80803_i	176	1,528.3	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.7	0.0	0.0	0.0	0.0	4	305	1.2
	80804	80804_e	177	21,200.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.5	0.0	0.0	0.0	0.0	2	257	0.7
		80804_i	178	6,230.7	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.6	0.0	0.0	0.0	0.0	4	320	1.3
	80805	80805	179	9,381.6	0.0	0.0	0.0	0.0	0.0	0.0	4.6	8.0	1.5	0.2	0.1	0.0	14	500	2.9
	808061	808061	180	5,200.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	17.9	4.9	1.0	0.3	0.1	32	610	5.3
	808062	808062	181	6,129.6	0.2	0.0	0.0	0.0	0.1	1.5	18.8	50.3	24.8	6.0	1.8	0.5	104	790	13.2
	808063	808063	182	12,632.1	0.1	0.0	0.0	0.0	1.4	6.1	32.6	65.2	38.7	7.4	1.7	0.4	154	928	16.6
	808071	808071	183	274.9	0.0	0.0	0.0	0.0	0.0	0.0	3.1	5.2	0.0	0.0	0.0	0.0	8	420	2.0
	8080721	8080721_e	184	19,574.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.9	0.0	0.0	0.0	0.0	4	342	1.2
		8080721_i	185	18,041.8	0.2	0.1	0.1	0.0	0.0	0.1	3.9	7.7	1.7	0.6	0.4	0.3	15	500	3.0
	8080723	8080723	186	1,145.5	0.4	0.2	0.1	0.1	0.1	0.4	6.3	11.3	4.9	1.5	0.9	0.6	27	661	4.0
	808073	808073	187	9,609.9	0.8	0.5	0.3	0.2	0.1	0.8	7.1	14.8	7.6	3.5	2.2	1.4	39	665	5.9
	8080741	8080741	188	244.3	1.6	1.0	0.6	0.4	0.2	1.5	9.1	22.2	13.6	6.8	4.2	2.6	64	743	8.6
	80807421	80807421	189	861.8	1.5	0.9	0.6	0.4	0.2	1.3	8.4	20.2	12.7	6.1	3.8	2.4	58	723	8.1
	80807423	80807423	190	653.9	1.4	0.8	0.5	0.3	0.2	1.3	8.1	18.4	12.4	5.6	3.5	2.2	55	726	7.5
	8080743	8080743	191	1,581.2	1.9	1.2	0.7	0.5	0.3	2.1	9.5	22.5	16.5	7.7	4.8	3.0	71	803	8.8
	8080745	8080745	192	3,841.5	0.6	0.2	0.1	0.0	1.2	6.4	21.4	47.6	43.5	10.9	4.1	1.6	138	908	15.2
	808075	808075	193	1,196.2	1.3	0.8	0.5	0.3	0.4	2.6	8.9	18.2	13.1	5.4	3.4	2.1	57	842	6.8
	808077	808077	194	6,537.9	0.0	0.0	0.0	0.0	1.3	6.0	24.9	62.9	44.0	6.2	1.1	0.2	147	976	15.0

Annex-T SR2-9 Available Surface Water Resources in Quasi-Natural Condition at the Downstream End of SHAs (1/3)

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	Average Monthly Discharge (m3/s) 1	2	3	4	5	6	7	8	9	10	11	12	Average Discharge (m3/s)	Q_{80M} (m3/s)	Q_{97DS}90%Y (m3/s)
1	101	101	1	9,355	1,400.1	1,024.1	482.7	167.7	97.0	183.8	572.0	1,872.3	2,672.6	1,813.8	1,543.4	1,519.3	1,112.8	178.4	17.24
	102	102	2	9,127	7.0	3.4	1.3	0.6	3.5	19.2	42.7	163.9	242.7	88.4	38.7	16.2	52.4	1.0	0.09
	103	103	3	3,387	1,389.3	1,019.0	480.7	166.8	88.2	140.0	487.5	1,617.6	2,280.9	1,676.6	1,483.5	1,494.3	1,027.2	162.7	17.00
	104	104	4	2,934	1.4	0.7	0.3	0.1	0.3	3.2	10.1	36.3	51.8	17.2	7.7	3.2	11.0	0.1	0.00
	105	105	5	3,457	1,386.5	1,017.6	480.2	166.6	87.1	131.0	463.6	1,540.0	2,171.9	1,640.5	1,467.5	1,487.6	1,003.4	158.1	16.97
	10601	10601	6	689	27.0	18.5	10.7	7.2	8.2	35.1	182.5	517.5	542.2	172.5	86.8	45.5	138.5	6.5	0.47
	10602	10602	7	10,960	12.8	9.1	5.4	3.7	3.4	10.0	26.3	99.3	150.2	62.2	35.5	20.4	36.6	3.9	0.42
	10603	10603	8	1,085	13.6	9.0	5.1	3.4	4.6	24.6	155.3	415.5	388.5	108.5	50.2	24.4	100.8	2.0	0.06
	10604	10604	9	17,477	7.8	5.3	3.1	2.1	2.2	9.9	48.8	125.2	148.4	47.5	24.8	13.1	36.6	1.1	0.02
	10605	10605	10	6,336	5.5	3.4	1.8	1.2	2.3	14.3	105.1	287.5	237.1	59.8	24.6	10.7	63.2	0.6	0.01
	10606	10606	11	5,817	1.8	1.4	0.8	0.6	0.4	0.8	6.5	15.1	13.2	6.0	4.2	2.7	4.5	0.0	0.00
	10607	10607	12	2,706	3.3	1.8	0.9	0.5	1.8	13.1	93.4	263.3	219.0	52.8	19.7	7.5	56.8	0.3	0.01
	106081	106081_e	13	2,220	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.1	0.0	0.0	0.0	0.2	0.0	0.00
		106081_i	14	4,132	1.3	0.7	0.4	0.2	0.4	4.2	50.5	162.3	113.8	25.5	8.3	3.0	31.1	0.0	0.00
	106082	106082_e	15	80,007	0.5	0.4	0.2	0.2	0.1	0.2	11.1	31.2	4.2	1.6	1.1	0.7	4.3	0.0	0.00
		106082_i1	16	1,322	0.5	0.4	0.2	0.2	0.1	0.2	11.7	32.3	4.3	1.6	1.1	0.7	4.5	0.0	0.00
		106082_i2	17	6,043	0.5	0.4	0.2	0.2	0.1	0.2	4.8	10.4	3.9	1.6	1.1	0.7	2.0	0.0	0.00
	106083	106083	18	412	0.6	0.2	0.1	0.0	0.3	4.0	36.0	123.8	108.1	23.2	6.8	2.0	25.6	0.0	0.00
	106085	106085_e	19	290	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00
		106085_i	20	1,500	0.6	0.2	0.1	0.0	0.3	4.0	35.8	123.4	108.0	23.2	6.8	2.0	25.5	0.0	0.00
	1060861	1060861_e	21	6,068	0.0	0.0	0.0	0.0	0.0	0.2	7.2	21.9	8.5	1.5	0.4	0.1	3.3	0.0	0.00
		1060861_i1	22	165	0.0	0.0	0.0	0.0	0.0	0.2	7.2	22.0	8.5	1.5	0.4	0.1	3.4	0.0	0.00
		1060861_i2	23	548	0.0	0.0	0.0	0.0	0.0	0.2	4.8	15.8	7.6	1.4	0.3	0.1	2.5	0.0	0.00
	1060863	1060863	24	3,509	0.0	0.0	0.0	0.0	0.0	0.1	4.2	13.8	6.9	1.2	0.3	0.1	2.2	0.0	0.00
	106087	106087_e	25	632	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.2	0.0	0.0	0.0	0.1	0.0	0.00
		106087_i	26	1,217	0.6	0.2	0.1	0.0	0.3	3.8	27.9	99.8	99.3	21.7	6.4	1.9	22.0	0.0	0.00
	1060881	1060881	27	5,751	0.4	0.2	0.1	0.0	0.0	1.7	15.2	47.9	40.9	10.1	3.5	1.2	10.2	0.0	0.00
	1060883	1060883	28	2,514	0.4	0.2	0.1	0.0	0.0	1.2	8.9	30.3	24.7	7.2	2.8	1.0	6.4	0.0	0.00
	106089	106089	29	8,354	0.2	0.0	0.0	0.0	0.3	2.2	11.9	49.9	58.1	11.7	2.9	0.7	11.5	0.0	0.00
	106091	106091	30	7,636	1.8	0.9	0.4	0.2	1.3	8.8	40.9	96.8	103.6	26.7	10.9	4.3	24.8	0.2	0.01
	106093	106093	31	4,747	1.4	0.6	0.2	0.1	1.2	8.4	34.1	85.3	98.0	25.3	9.9	3.6	22.5	0.1	0.01
	107	107_e	32	1,924	2.7	2.0	1.2	0.8	0.8	2.1	3.1	10.3	16.3	8.9	6.1	4.0	4.9	0.7	0.02
		107_i	33	6,223	1,358.5	998.6	469.3	159.2	78.4	90.1	269.0	988.0	1,588.0	1,455.5	1,375.0	1,439.7	855.2	127.1	15.40
	108	108_e	34	63,517	0.2	0.2	0.1	0.1	0.1	0.4	13.8	29.7	4.6	0.7	0.5	0.3	4.3	0.0	0.00
		108_i	35	7,725	0.0	0.0	0.0	0.0	0.0	0.2	10.0	22.0	2.6	0.1	0.1	0.1	3.0	0.0	0.00
	109	109	36	14,037	1,350.8	992.9	465.8	156.8	76.2	82.9	243.4	923.6	1,534.4	1,429.9	1,357.3	1,428.1	836.1	113.5	14.31
2	201	201	37	2,647	1,639.4	1,171.8	560.4	243.0	350.3	712.0	1,496.1	4,466.7	6,788.9	3,760.4	2,447.8	1,965.2	2,136.9	435.8	63.21
	20201	20201	38	5,088	80.5	56.8	32.6	24.5	42.7	59.8	116.1	353.1	521.9	332.7	204.9	126.2	163.1	37.9	10.21
	202021	202021	39	2,739	14.8	10.4	6.0	4.5	8.1	10.9	19.1	59.9	95.8	61.7	37.7	23.2	29.4	6.7	1.77
	202023	202023	40	191	1.4	1.0	0.6	0.4	0.7	0.9	2.3	6.3	8.5	5.6	3.5	2.1	2.8	0.6	0.21
	20203	20203	41	4,599	46.4	32.7	18.8	13.8	21.6	30.7	66.4	219.2	296.2	188.7	117.6	72.4	94.0	21.7	6.26
	20205	20205	42	2,637	19.7	13.9	8.0	5.9	8.7	12.1	27.7	97.2	123.4	79.0	49.5	30.5	39.7	9.5	2.64
	203	203	43	4,437	1,549.6	1,108.5	524.0	214.5	299.0	641.2	1,362.2	4,084.3	6,208.8	3,386.9	2,219.0	1,824.3	1,954.7	370.7	49.89
	20401	20401	44	5,985	5.1	2.3	1.0	4.9	18.4	25.3	35.9	52.9	146.7	88.6	31.3	12.4	35.5	2.0	0.08
	20403	20403	45	1,596	1.6	0.7	0.4	1.6	4.6	6.0	9.5	13.9	40.6	27.6	10.0	3.9	10.1	0.7	0.03
	205	205	46	375	1,532.6	1,097.9	518.2	205.3	270.2	600.8	1,301.4	3,983.2	5,970.0	3,243.0	2,156.0	1,792.9	1,892.0	356.9	46.42
	206	206	47	7,358	7.2	3.8	1.6	1.5	10.3	22.6	40.1	105.1	170.8	77.2	33.8	15.3	40.9	2.1	0.27
	207	207	48	1,056	1,525.2	1,094.1	516.6	203.7	259.3	577.1	1,259.6	3,875.2	5,793.3	3,163.3	2,121.4	1,777.3	1,849.8	345.2	46.14
	20801	20801	49	1,937	93.7	55.7	28.3	20.7	79.6	226.7	474.5	1,545.7	2,018.8	826.1	384.0	181.4	496.4	36.3	8.30
	20802	20802	50	2,241	1.6	0.7	0.3	0.3	2.3	6.9	11.4	29.1	61.2	24.1	9.5	3.7	12.6	0.3	0.02
	20803	20803	51	725	91.2	54.6	27.8	20.1	74.9	214.1	453.6	1,499.0	1,922.1	788.1	369.3	175.6	475.9	35.3	8.11
	20804	20804	52	17,359	13.8	6.2	2.3	1.2	11.4	57.5	132.6	429.4	571.1	208.9	85.3	33.7	129.9	2.8	0.30
	20805	20805	53	4,326	77.0	48.2	25.5	18.8	62.8	154.4	317.5	1,061.6	1,333.8	572.6	281.4	140.9	342.5	32.3	7.73
	20806	20806	54	3,504	2.9	1.3	0.5	0.5	3.6	15.6	31.6	85.1	117.8	44.0	17.8	7.0	27.4	0.6	0.05
	20807	20807	55	557	70.5	45.3	24.4	17.8	52.6	115.6	244.8	880.9	1,075.2	473.0	241.5	125.2	281.6	30.6	7.57
	20809	20809	56	3,692	70.1	45.1	24.3	17.7	52.0	113.8	241.8	870.6	1,058.7	466.4	238.9	124.1	278.0	30.5	7.57
	20810	20810	57	3,450	17.9	12.6	7.3	5.1	8.0	15.1	25.3	82.0	119.8	70.6	44.9	27.8	36.5	8.0	1.95
	20811	20811	58	1,561	33.3	19.0	9.3	7.0	34.7	84.5	194.1	706.6	814.3	319.6	146.2	66.8	203.8	12.4	3.10
	20812	20812	59	5,919	5.4	3.1	1.4	1.1	3.8	16.1	25.9	76.2	118.2	45.4	22.5	10.8	27.6	1.6	0.28
	20813	20813	60	2,483	20.7	11.0	5.0	3.9	28.1	62.5	158.9	599.0	646.6	246.2	105.8	44.9	161.8	7.6	1.59
	20814	20814	61	6,714	2.1	0.8	0.3	0.1	4.8	15.4	38.7	143.4	147.7	43.9	16.3	5.7	35.1	0.3	0.01
	20815	20815	62	10,882	11.3	5.2	1.9	1.8	19.5	38.4	103.9	393.3	414.9	162.4	67.2	26.8	104.4	4.0	0.47
	209	209	63	15,015	1,431.3	1,038.2	488.3	182.8	178.2	347.4	781.0	2,324.1	3,763.3	2,333.0	1,736.0	1,595.3	1,350.8	286.0	34.14
	211	211	64	6	1,422.7	1,034.3	486.6	176.7	150.6	300.4	724.5	2,233.9	3,502.8	2,187.2	1,684.2	1,574.9	1,290.6	247.2	29.16
	212	212	65	6,741	4.7	2.1	0.8	3.7	15.2	22.1	24.0	37.6	121.3	79.9	28.4	11.2	29.3	0.9	0.01
	213	213	66	4,146	1,418.0	1,032.2	485.7	173.0	135.4	278.3	700.5	2,196.3	3,381.5	2,107.2	1,655.8	1,563.7	1,261.3	224.5	27.48
	214	214_e	67	258	0.2	0.1	0.0	0.0	0.4	0.7	1.2	2.7	5.7	2.6	1.0	0.4	1.3	0.0	0.00
		214_i	68	9,793	5.9	2.7	1.0	3.3	17.0	28.9	38.4	79.5	202.5	101.7	37.1	14.7	44.5	1.5	0.10
	215	215	69	2,110	1,410.1	1,028.6	484.4	169.2	114.6	237.6	647.1	2,085.2	3,096.9	1,973.6	1,606.4	1,544.2	1,200.4	202.8	22.08
	216	216_e	70	3,699	2.0	0.9	0.3	0.3	4.1	11.5	15.3	47.4	88.0	32.6	13.1	5.2	18.4	0.4	0.01
		216_i	71	7,957	6.2	2.8	1.0	1.1	12.0	35.1	46.0	134.8	266.2	100.5	39.7	15.7	55.2	1.2	0.09
	217	217	72	127	1,402.9	1,025.4	483.2	167.9	100.6	196.6	594.1	1,933.8	2,790.2	1,857.5	1,560.7	1,526.1	1,137.0	178.9	18.04
	218	218	73	4,644	2.8	1.3	0.5	0.2	3.5	12.5	21.6	60.2	114.9	42.7	17.0	6.7	23.7	0.4	0.02
	219	219	74	19	1,400.1	1,024.1	482.7	167.7	97.0	183.8	572.0	1,872.4	2,672.7	1,813.8	1,543.4	1,519.3	1,112.8	178.4	17.24

Annex-T SR2-9 Available Surface Water Resources in Quasi-Natural Condition at the Downstream End of SHAs (2/3)

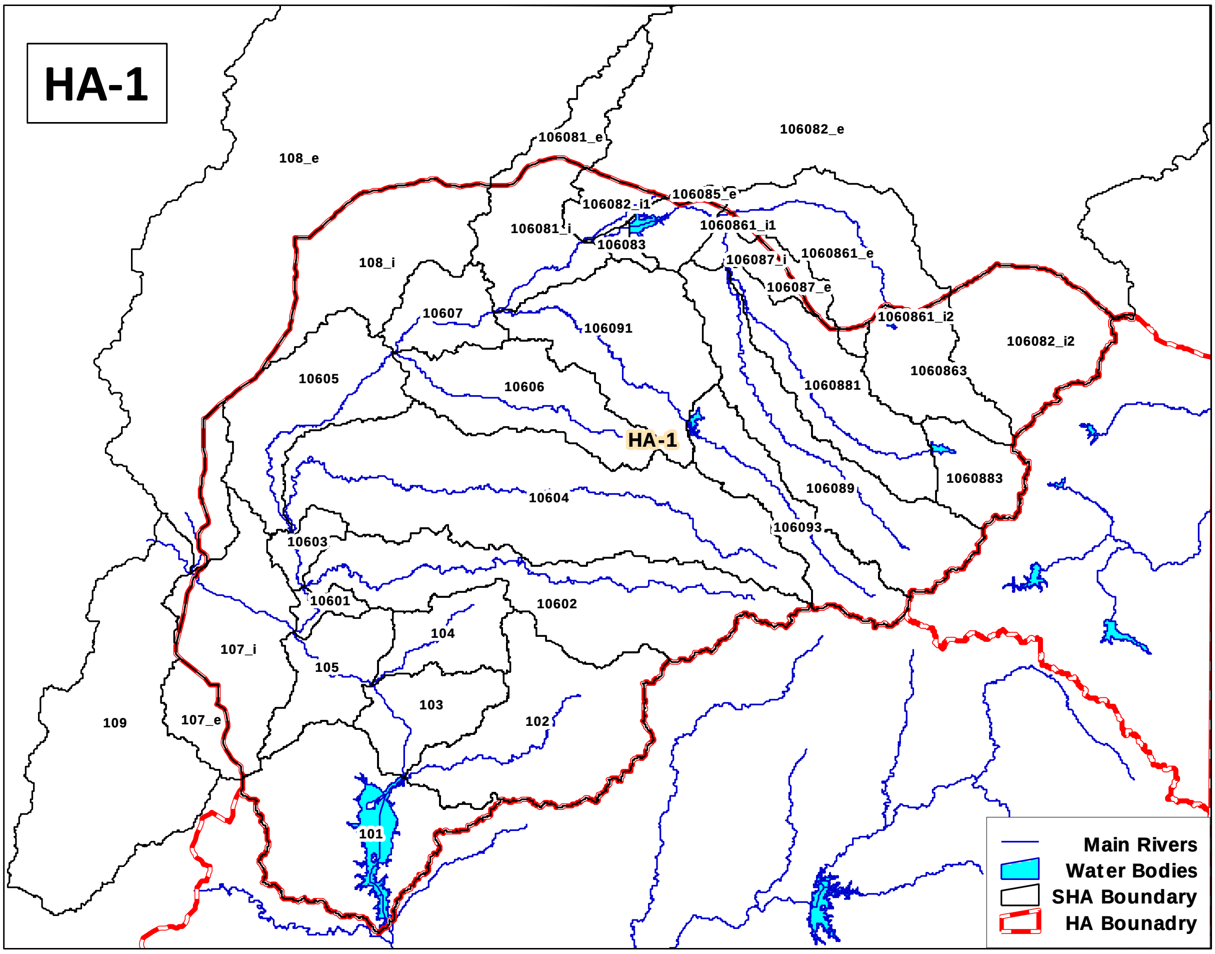
HA	SHA	SHA divided by National Boundary	SN	Area (km2)	Average Monthly Discharge (m3/s)												Average Discharge (m3/s)	Q_{80M} (m3/s)	Q_{97DS}90%Y (m3/s)
					1	2	3	4	5	6	7	8	9	10	11	12			
3	30201	30201	75	587	86.2	42.1	26.3	53.6	127.4	273.6	551.3	855.4	1,116.7	937.7	491.5	199.0	398.7	50.0	14.04
	30202	30202	76	5,146	8.8	2.8	1.0	5.0	16.2	47.5	121.5	213.9	283.3	231.7	108.9	30.2	89.7	4.1	0.33
	30203	30203_e	77	2,826	19.4	10.0	7.5	14.2	27.7	61.2	117.0	162.3	200.2	172.6	96.3	42.5	78.0	13.5	3.62
		30203_i	78	11,385	77.0	39.1	25.2	48.6	110.6	224.5	427.7	637.6	825.7	701.7	380.8	168.0	307.0	45.8	13.53
	303	303	79	1,463	199.4	99.0	42.4	46.5	169.5	525.5	1,797.6	4,332.4	5,261.9	2,539.8	1,115.6	448.8	1,388.2	74.6	16.50
	304	304	80	4,997	6.7	3.5	1.5	0.7	3.2	13.1	31.1	100.4	142.9	62.7	29.9	13.7	34.2	1.5	0.22
	305	305	81	809	191.6	94.9	40.7	45.6	165.1	508.5	1,760.9	4,219.9	5,095.3	2,465.8	1,080.7	432.8	1,348.3	72.3	16.06
	30601	30601	82	2,266	20.8	6.6	3.0	16.5	58.9	146.1	417.2	782.1	1,023.1	680.9	259.3	71.6	292.1	10.4	0.94
	30602	30602	83	5,395	3.3	1.0	0.3	0.9	7.4	18.9	55.4	139.8	206.0	123.9	41.1	11.3	51.0	0.8	0.03
	30603	30603_e	84	559	1.0	0.3	0.3	1.3	2.7	8.7	23.7	35.0	39.0	27.8	12.0	3.3	13.0	0.7	0.06
		30603_i	85	13,799	16.6	5.2	2.7	15.6	49.5	120.8	351.8	615.5	767.0	524.3	207.0	57.1	229.0	9.3	0.78
	307	307	86	5,737	170.3	88.1	37.5	29.0	105.7	360.4	1,340.4	3,430.9	4,060.3	1,779.8	819.1	360.1	1,053.4	53.7	12.21
	308	308	87	15,173	13.0	6.8	2.9	1.4	1.8	24.5	89.2	264.0	299.9	118.5	57.8	26.6	75.9	2.0	0.12
	309	309	88	87	152.7	78.9	33.6	27.0	101.9	322.9	1,224.1	3,099.7	3,654.6	1,618.4	741.0	324.2	952.8	49.0	11.75
	310	310	89	2,513	3.0	1.6	0.7	0.4	2.0	6.3	14.0	41.5	64.5	28.6	13.4	6.2	15.2	0.7	0.12
	311	311	90	11,884	149.7	77.3	32.9	26.6	99.9	316.4	1,209.8	3,057.7	3,589.4	1,589.6	727.5	318.0	937.4	48.4	11.50
	312	312	91	2,748	2.6	1.4	0.6	0.4	1.7	5.9	12.6	40.7	58.7	24.2	11.5	5.3	13.8	0.5	0.07
	313	313	92	48	138.4	71.3	30.4	25.0	94.3	285.6	1,114.1	2,841.9	3,324.7	1,485.0	677.3	294.9	869.4	45.7	10.71
	31401	31401	93	718	26.2	14.2	6.3	3.8	14.5	67.8	271.7	584.7	582.0	217.2	109.2	51.9	163.4	7.7	1.05
	31403	31403	94	1,659	25.8	14.0	6.2	3.8	14.4	66.8	268.7	576.2	572.8	213.9	107.6	51.1	161.0	7.7	1.04
	31404	31404	95	11,229	5.8	3.0	1.3	0.6	1.1	12.0	45.8	121.1	140.5	51.9	25.5	11.7	35.2	0.4	0.00
	31405	31405	96	6,890	19.1	10.5	4.7	3.0	13.1	52.5	213.4	433.7	410.0	153.8	78.1	37.6	119.8	6.6	0.94
	31407	31407	97	7,702	15.8	8.8	4.0	2.6	12.8	45.1	178.8	360.7	327.4	123.8	63.4	30.8	98.4	5.7	0.90
	31408	31408	98	5,304	0.6	0.4	0.2	0.1	0.0	2.4	19.4	30.0	18.5	5.0	2.6	1.3	6.8	0.0	0.00
	31409	31409	99	19,178	13.3	7.4	3.4	2.3	12.6	37.5	127.8	277.2	263.9	104.8	53.5	26.0	77.9	5.2	0.90
	315	315	100	1,617	112.3	57.1	24.0	21.2	79.8	217.8	842.2	2,257.0	2,742.6	1,267.8	568.1	243.1	706.0	38.0	7.34
	316	316	101	5,536	7.8	4.1	1.8	1.6	6.3	15.0	43.6	122.6	163.2	73.1	34.7	15.9	41.0	2.3	0.41
	317	317	102	3,400	104.0	52.7	22.2	19.6	73.2	200.6	792.7	2,122.7	2,564.7	1,190.1	531.2	226.1	661.4	35.1	6.92
	318	318	103	5,441	4.7	2.5	1.1	0.5	0.7	1.9	7.3	50.6	75.3	42.8	20.9	9.6	18.2	0.7	0.06
	319	319_e	104	2,089	1.8	0.9	0.4	0.2	0.4	0.8	2.0	15.4	27.1	16.0	7.9	3.6	6.4	0.2	0.00
		319_i	105	1,727	96.4	48.8	20.5	18.8	71.8	196.4	778.0	2,045.1	2,444.5	1,122.1	497.7	210.8	632.2	33.7	6.44
	320	320_e	106	25,211	74.0	38.8	16.7	13.2	24.8	67.8	321.4	720.4	967.7	646.4	335.8	154.1	283.0	20.8	5.32
		320_i	107	2,107	4.1	2.2	0.9	0.6	1.1	1.9	8.8	35.6	55.9	36.7	18.7	8.6	14.6	1.2	0.24
	321	321	108	65,499	19.4	8.3	3.0	5.2	46.4	127.2	452.9	1,298.3	1,430.2	448.3	148.5	50.5	338.2	6.5	0.66
4	401	401	109	3,643	653.0	351.9	231.0	371.3	962.4	1,983.9	4,139.0	8,189.7	10,346.4	6,594.0	3,488.9	1,440.0	3,244.0	395.6	129.46
	402	402	110	9,076	50.6	35.6	20.5	15.0	26.8	34.6	67.6	215.7	320.8	210.1	128.3	79.0	100.6	23.7	6.59
	403	403	111	4,907	590.1	307.5	205.5	351.3	924.6	1,935.8	4,052.1	7,937.6	9,948.5	6,328.8	3,328.8	1,341.4	3,118.7	361.2	115.24
	404	404	112	9,348	59.4	41.9	24.1	17.4	30.1	37.2	98.0	292.1	373.6	242.7	149.9	92.3	122.0	27.5	9.43
	405	405	113	11,303	511.2	252.0	173.6	327.3	879.0	1,881.2	3,928.1	7,583.5	9,456.1	6,001.5	3,129.5	1,218.6	2,959.0	330.2	98.35
	406	406_e	114	10,331	73.9	33.7	56.7	150.1	317.4	535.0	724.2	904.3	1,057.9	984.9	637.5	220.2	477.0	73.8	17.47
		406_i	115	12,619	137.5	58.4	78.8	206.3	501.9	964.0	1,313.9	1,606.6	1,931.3	1,838.3	1,193.4	406.0	857.1	128.1	27.18
	407	407	116	4,277	330.8	164.9	78.9	106.8	337.5	873.6	2,540.9	5,788.5	7,200.5	3,924.4	1,809.8	741.0	2,000.9	144.5	40.48
	408	408	117	10,587	25.4	13.3	5.7	3.7	18.6	34.5	122.7	385.8	474.3	247.0	113.9	52.4	125.3	7.9	1.58
	409	409	118	2,471	298.2	147.7	71.6	101.7	308.1	825.1	2,396.4	5,336.9	6,612.3	3,602.2	1,663.2	673.6	1,845.2	129.3	37.42
	410	410	119	4,839	8.2	4.3	1.9	0.9	5.1	14.2	32.9	114.4	162.4	78.7	36.6	16.8	39.8	2.2	0.30
	411	411	120	1,449	286.8	141.7	69.0	100.3	298.4	803.3	2,354.0	5,198.5	6,399.8	3,489.7	1,612.2	650.1	1,792.3	127.1	36.17
5	500	500	121	19,112	357.0	254.2	167.6	197.2	379.7	1,039.6	1,346.3	1,254.9	1,645.6	1,523.2	1,027.0	588.1	817.9	216.5	86.28
	502	502	122	3,157	32.6	22.2	13.2	14.1	20.8	44.7	94.2	106.6	172.2	160.3	92.5	54.0	69.2	17.7	6.82
	50401	50401	123	1,581	2,432.6	1,618.3	845.2	672.6	1,430.3	2,866.2	5,910.0	13,037.4	17,935.0	11,070.9	6,330.3	3,637.0	5,667.7	1,132.5	312.94
	50402	50402	124	14,105	76.9	51.9	29.4	30.4	63.5	90.2	146.3	212.2	435.4	392.2	215.9	127.2	156.4	41.2	10.78
	50403	50403	125	11,821	2,340.0	1,555.8	809.6	635.5	1,357.1	2,755.3	5,720.9	12,773.1	17,416.7	10,601.5	6,070.1	3,484.0	5,478.3	1,106.1	290.11
	506	506	126	4,138	43.9	29.9	17.3	19.5	28.1	80.0	138.1	171.3	232.2	215.2	123.7	72.4	98.0	23.4	9.12
6	60001	60001	127	2,701	6.0	3.2	2.4	4.8	13.2	55.1	78.0	43.3	67.2	66.9	29.8	13.1	32.1	3.1	0.35
	60002	60002	128	8,252	116.1	79.9	52.1	58.3	98.4	274.8	474.4	429.2	588.6	542.0	333.8	192.4	271.1	66.4	27.80
	601	601	129	392	0.3	0.1	0.2	0.5	1.4	5.2	4.7	2.0	2.8	3.7	1.3	0.6	1.9	0.0	0.00
	602	602_e	130	844	0.4	0.2	0.1	1.3	1.9	2.4	2.4	2.0	6.9	4.8	1.7	0.8	2.1	0.0	0.00
		602_i	131	3,312	2.1	1.1	1.3	6.6	10.2	17.6	18.1	10.8	33.2	28.3	9.8	4.4	12.0	0.2	0.00
	603	603	132	1,966	2.0	1.1	1.0	3.4	8.0	35.9	35.5	17.1	23.9	25.5	9.9	4.4	14.0	0.7	0.02
	60401	60401	133	2,035	6.9	2.5	2.9	26.0	50.5	85.0	125.3	129.7	410.6	283.7	73.5	21.7	101.8	2.9	0.04
	604021	604021	134	169	2.1	0.7	0.6	9.2	18.6	28.7	49.5	57.5	171.6	105.5	26.1	7.2	39.9	0.4	0.00
	604023	604023_e	135	73	0.0	0.0	0.0	0.1	0.1	0.2	0.6	0.9	1.7	0.8	0.2	0.1	0.4	0.0	0.00
		604023_i	136	9,041	2.0	0.6	0.6	8.8	18.2	28.0	48.6	57.0	169.9	104.0	25.8	7.1	39.3	0.3	0.00
	60403	60403	137	6,012	3.1	1.0	1.5	12.8	25.9	39.4	55.6	61.3	217.1	156.2	39.1	10.8	52.1	1.1	0.03
	60405	60405	138	4,704	1.4	0.4	0.1	2.9	10.9	16.3	21.8	31.1	111.7	67.6	17.3	4.8	23.9	0.2	0.00
	605	605	139	1,102	1.7	0.9	0.6	2.0	4.7	19.5	24.2	13.1	19.2	19.6	8.3	3.7	9.9	0.7	0.02
	606	606	140	4,398	6.7	3.4	2.5	9.8	14.8	32.3	50.7	37.6	72.8	80.1	32.4	14.5	30.0	2.7	0.08
	607	607	141	418	0.9	0.4	0.3	0.6	1.7	5.9	9.6	5.4	9.1	9.7	4.3	1.9	4.2	0.3	0.01
	608	608	142	9,764	8.1	3.4	2.5	13.2	28.8	52.1	87.9	90.0	271.1	245.4	71.5	23.1	75.0	3.8	0.26
	609	609	143	114	0.3	0.1	0.1	0.2	0.5	1.9	3.2	1.7	3.0	2.9	1.3	0.6	1.3	0.1	0.00
	610	610	144	6,462	13.3	6.9	4.7	12.3	22.0	45.6	89.3	76.1	160.7	153.4	64.0	28.8	56.7	6.4	0.33
	611	611	145	4,228	12.7	6.6	5.0	9.6	19.0	59.9	119.6	90.8	157.6	139.4	61.5	27.4	59.4	8.3	1.25
	612	612	146	5,869	17.0	8.8	6.8	14.2	25.7	55.2	125.9	122.7	230.5	186.0	81.9	36.7	76.3	10.9	1.76
	614	614	147	13,272	62.3	42.0	27.4	34.3	54.5	75.5	140.5	168.9	374.3	316.4	175.3	102.9	131.6	36.3	6.81
	616	616	148	8,417	80.6	54.7	35.8	39.3	56.4	114.6	237.9	262.2	433.1	393.1	228.5	133.1	173.1	45.2	14.66
	617	617	149	1,897	25.7	17.6	10.9	11.6	17.2	46.1	89.8	91.8	132.4	122.9	73.5	42.5	57.1	14.0	5.20
	699	699	150	4,809	1.2	0.4	0.1	2.3	8.6	13.9	27.5	46.9	117.5	61.0	15.6	4.3	25.0	0.1	0.00

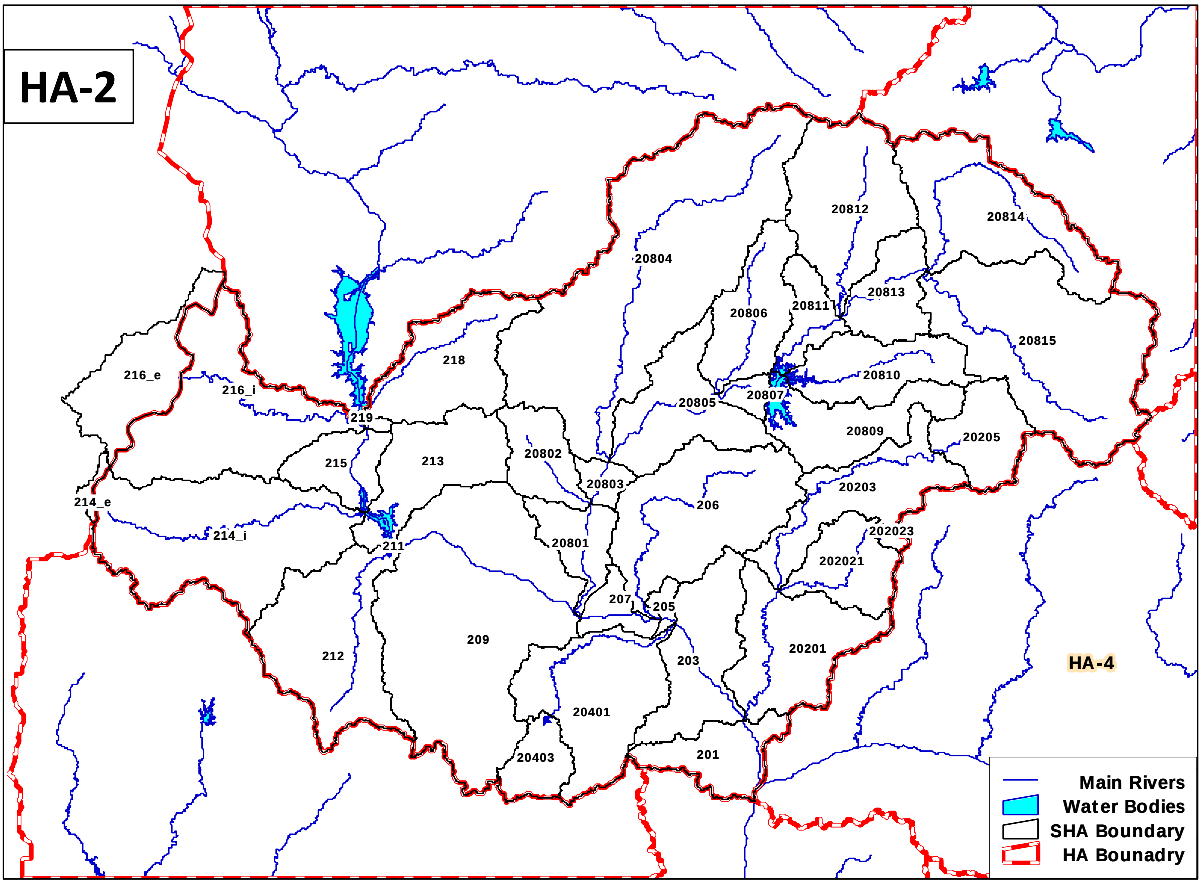
Annex-T SR2-9 Available Surface Water Resources in Quasi-Natural Condition at the Downstream End of SHAs (3/3)

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	Average Monthly Discharge (m3/s)												Average Discharge (m3/s)	Q_{80M} (m3/s)	Q_{97DS}90%Y (m3/s)
					1	2	3	4	5	6	7	8	9	10	11	12			
7	702	702	151	8,147	150.3	118.7	83.4	95.8	140.8	304.6	419.0	485.7	596.8	539.4	346.6	219.4	292.6	109.3	47.08
	703	703	152	4,319	90.5	72.1	53.7	61.7	88.8	176.1	252.4	276.4	343.4	312.5	214.7	131.9	173.4	68.2	29.29
	70401	70401	153	6,055	364.1	209.6	187.7	446.3	998.0	1,891.1	2,811.8	3,479.0	4,281.9	4,048.0	2,274.5	884.0	1,831.9	340.2	94.35
	70402	70402	154	7,091	33.1	16.4	8.5	23.7	64.9	101.0	192.6	269.6	402.3	364.5	172.8	74.6	144.4	18.7	2.81
	70403	70403	155	3,625	252.6	135.0	136.7	365.5	848.7	1,636.9	2,352.3	2,899.6	3,481.3	3,312.8	1,880.3	685.0	1,506.3	244.0	61.33
	704041	704041	156	1,236	64.6	25.9	10.8	52.8	166.8	404.1	616.1	803.5	1,058.0	1,019.3	511.5	178.6	411.4	38.2	5.21
	704042	704042	157	7,703	32.5	13.0	4.8	25.8	86.3	217.9	303.7	392.1	503.0	501.8	256.9	89.7	203.3	19.4	2.36
	704043	704043	158	7,383	25.7	10.3	4.7	21.2	66.2	147.8	248.9	331.9	459.7	420.9	203.9	71.2	168.5	14.0	1.47
	70405	70405_e	159	13,407	125.2	78.5	101.9	251.2	512.0	870.9	1,186.5	1,430.7	1,625.0	1,508.1	932.0	343.0	750.7	130.0	35.99
		70405_i	160	6,028	168.0	99.2	120.7	300.0	648.1	1,178.0	1,622.1	1,934.3	2,202.8	2,074.0	1,261.3	460.9	1,010.7	166.5	45.47
	705	705	161	5,854	120.0	94.9	74.5	86.2	128.1	238.4	347.5	384.8	458.1	415.8	280.7	175.1	234.5	94.1	42.71
8	800	800	162	5,222	0.0	0.0	0.0	0.0	0.0	0.0	1.6	5.3	0.3	0.0	0.0	0.0	0.6	0.0	0.00
	802	802_e	163	13,857	0.0	0.0	0.0	0.0	0.2	2.3	23.0	40.3	22.4	2.1	0.4	0.1	7.7	0.0	0.00
		802_i	164	2,423	0.0	0.0	0.0	0.0	0.2	2.3	25.6	44.5	23.4	2.1	0.4	0.1	8.3	0.0	0.00
	80401	80401	165	4,648	0.0	0.0	0.0	0.0	0.8	5.0	31.6	67.9	48.4	6.0	1.2	0.2	13.5	0.0	0.00
	80402	80402_e	166	626	0.0	0.0	0.0	0.0	0.0	0.3	1.3	2.6	2.1	0.2	0.0	0.0	0.6	0.0	0.00
		80402_i	167	7,172	0.0	0.0	0.0	0.0	0.1	1.6	13.1	22.2	12.2	1.0	0.2	0.0	4.2	0.0	0.00
	80403	80403_e	168	253	0.0	0.0	0.0	0.0	0.1	0.3	0.7	2.4	2.7	0.4	0.1	0.0	0.6	0.0	0.00
		80403_i	169	6,656	0.0	0.0	0.0	0.0	0.7	3.4	13.5	36.9	33.8	4.9	1.0	0.2	7.9	0.0	0.00
	806	806	170	21,903	0.0	0.0	0.0	0.0	0.1	3.9	34.9	70.9	43.8	5.0	1.0	0.2	13.4	0.0	0.00
	807	807	171	14,281	0.0	0.0	0.0	0.0	0.0	0.0	7.8	21.6	0.8	0.0	0.0	0.0	2.6	0.0	0.00
	80801	80801_e	172	1,439	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00
		80801_i	173	946	8.6	5.8	3.1	1.8	1.1	1.1	8.8	24.8	28.7	24.6	19.5	13.2	11.8	1.7	0.31
	80802	80802	174	30,142	1.1	0.6	0.3	0.2	0.1	0.6	26.4	46.9	17.9	7.5	4.2	2.2	9.1	0.1	0.01
	80803	80803_e	175	8,392	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.0	0.0	0.0	0.0	0.2	0.0	0.00
		80803_i	176	1,528	11.4	6.7	3.1	1.7	1.4	4.1	37.1	97.1	81.6	57.8	37.3	20.7	30.2	2.1	0.35
	80804	80804_e	177	21,201	0.0	0.0	0.0	0.0	0.0	0.0	2.9	12.2	0.0	0.0	0.0	0.0	1.3	0.0	0.00
		80804_i	178	6,231	0.0	0.0	0.0	0.0	0.0	0.0	6.6	18.3	0.0	0.0	0.0	0.0	2.1	0.0	0.00
	80805	80805	179	9,382	11.4	6.7	3.1	1.7	1.4	4.1	29.1	75.2	81.6	57.8	37.3	20.7	27.6	2.1	0.35
	808061	808061	180	5,200	0.8	0.2	0.1	0.1	6.9	33.5	213.0	458.3	257.7	50.7	12.9	3.1	87.3	0.2	0.01
	808062	808062	181	6,130	0.4	0.1	0.0	0.0	0.2	3.6	43.0	115.1	58.8	13.8	4.2	1.2	20.2	0.0	0.00
	808063	808063	182	12,632	0.4	0.1	0.0	0.1	6.7	29.8	154.4	308.4	189.2	35.0	8.1	1.8	61.7	0.1	0.00
	808071	808071	183	275	3.9	2.6	1.4	0.9	2.1	10.4	81.7	180.9	96.8	32.4	14.3	7.0	36.5	0.3	0.00
	8080721	8080721_e	184	19,574	0.0	0.0	0.0	0.0	0.0	0.0	9.3	21.3	0.2	0.0	0.0	0.0	2.6	0.0	0.00
		8080721_i	185	18,042	1.2	0.8	0.5	0.3	0.2	0.7	38.1	78.0	14.2	5.0	3.2	1.9	12.2	0.0	0.00
	8080723	8080723	186	1,145	0.2	0.1	0.1	0.0	0.0	0.2	2.7	4.8	2.2	0.6	0.4	0.2	1.0	0.0	0.00
	808073	808073	187	9,610	2.7	1.7	0.9	0.6	1.9	9.6	43.3	102.4	82.7	27.4	11.1	5.0	24.3	0.3	0.00
	8080741	8080741	188	244	2.9	1.8	0.9	0.6	2.1	11.8	41.8	94.5	83.1	24.2	11.6	5.6	23.5	0.2	0.00
	80807421	80807421	189	862	0.8	0.6	0.3	0.2	0.1	0.8	4.7	11.0	7.3	3.3	2.1	1.3	2.7	0.0	0.00
	80807423	80807423	190	654	0.3	0.2	0.1	0.1	0.1	0.3	2.0	4.5	3.1	1.4	0.9	0.5	1.1	0.0	0.00
	8080743	8080743	191	1,581	2.0	1.1	0.6	0.3	2.0	10.8	36.3	81.5	74.5	20.2	9.1	4.0	20.3	0.2	0.00
	8080745	8080745	192	3,842	0.9	0.4	0.1	0.0	1.8	9.5	30.7	68.2	64.4	15.7	6.1	2.3	16.8	0.0	0.00
	808075	808075	193	1,196	0.7	0.4	0.2	0.1	3.5	16.3	64.7	161.8	116.9	17.6	4.2	1.4	32.6	0.1	0.00
	808077	808077	194	6,538	0.1	0.0	0.0	0.0	3.3	15.1	60.7	153.6	110.9	15.2	2.7	0.4	30.4	0.0	0.00

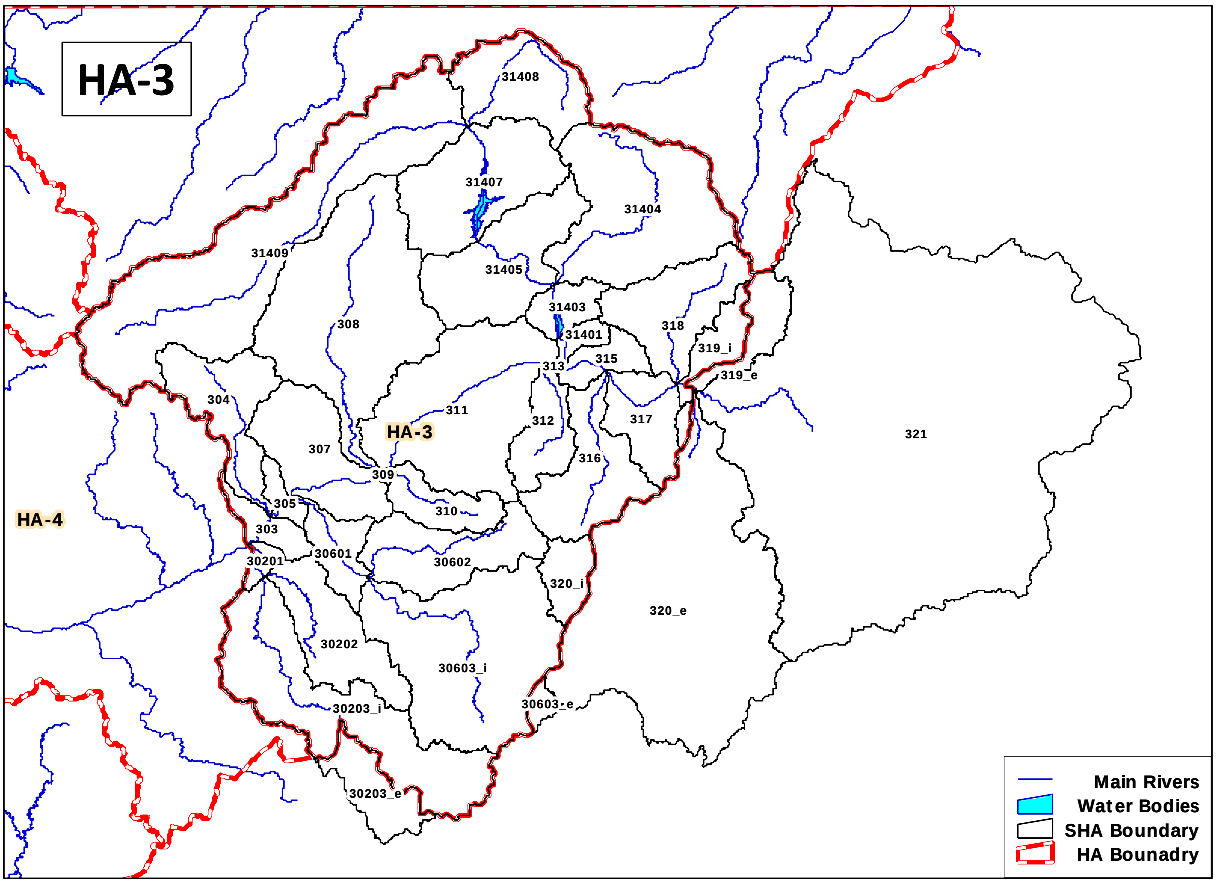
Annex-T SR2-10 Comparison of Nigerian Drinking Water Quality Standard with WHO Standard

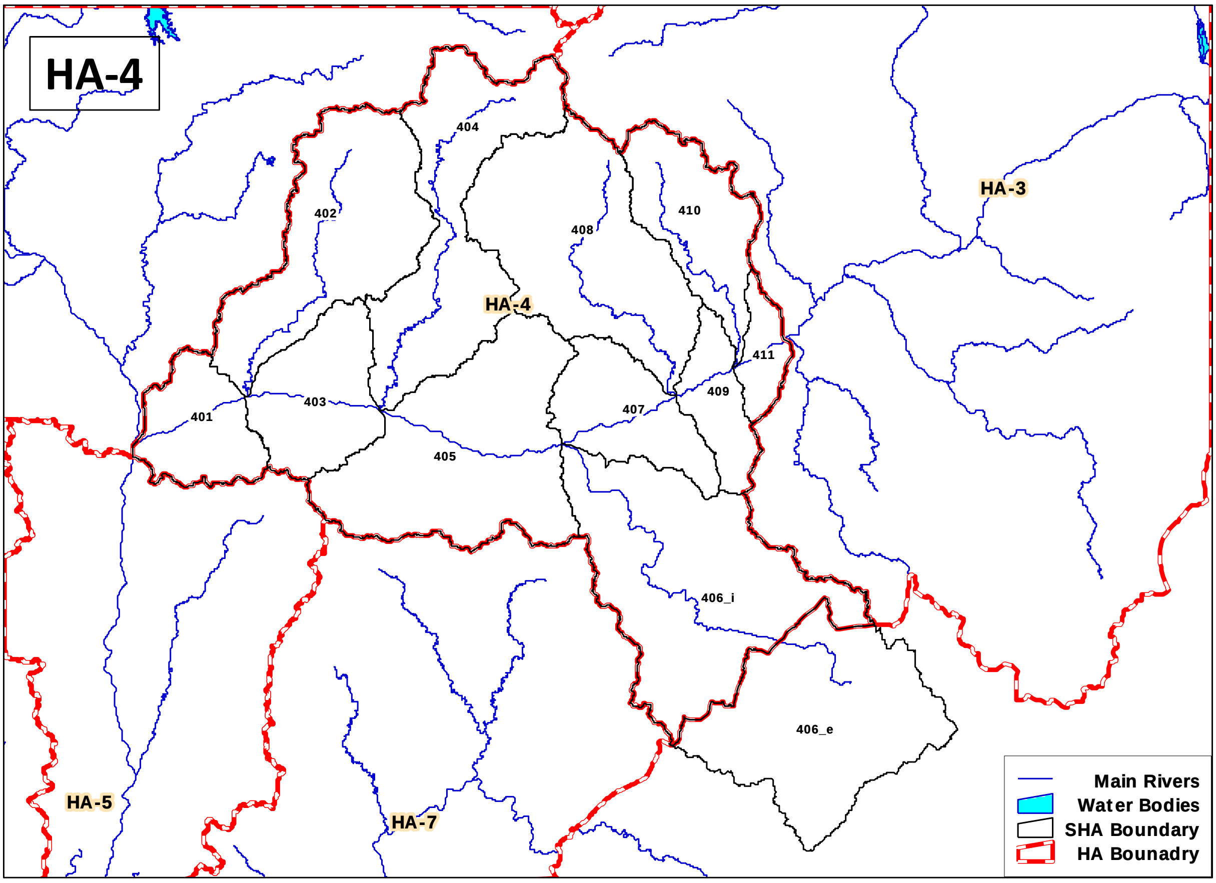
Parameter	Unit	Nigeria Standard (SON)	WHO
Colour	TCU	Colourless	colourless
Temperature	ºC	Ambient	-
pH		6.5-8.5	6.5-8.5
Turbidity	NTU	5	5
Conductivity	µS/cm	1,000	NA
TDS	mg/L	500	500
Calcium	mg/L	NA	NA
Chloride	mg/L	250	250
Sulphate	mg/L	100	400
Nitrite	mg/L	0.2	1.0
Nitrate	mg/L	50	10
Iron	mg/L	0.3	0.3
Magnesium	mg/L	0.2	50
Copper	mg/L	1.0	0.05
Sodium	mg/L	200	200
Manganese	mg/L	NA	0.05
Nickel	mg/L	0.02	NA
Zinc	mg/L	3.0	5.0
Lead	mg/L	0.01	NA
Arsenic	mg/L	0.01	0.05
Cadmium	mg/L	0.003	NA
E.Coli	Cfu/100ml	0	0



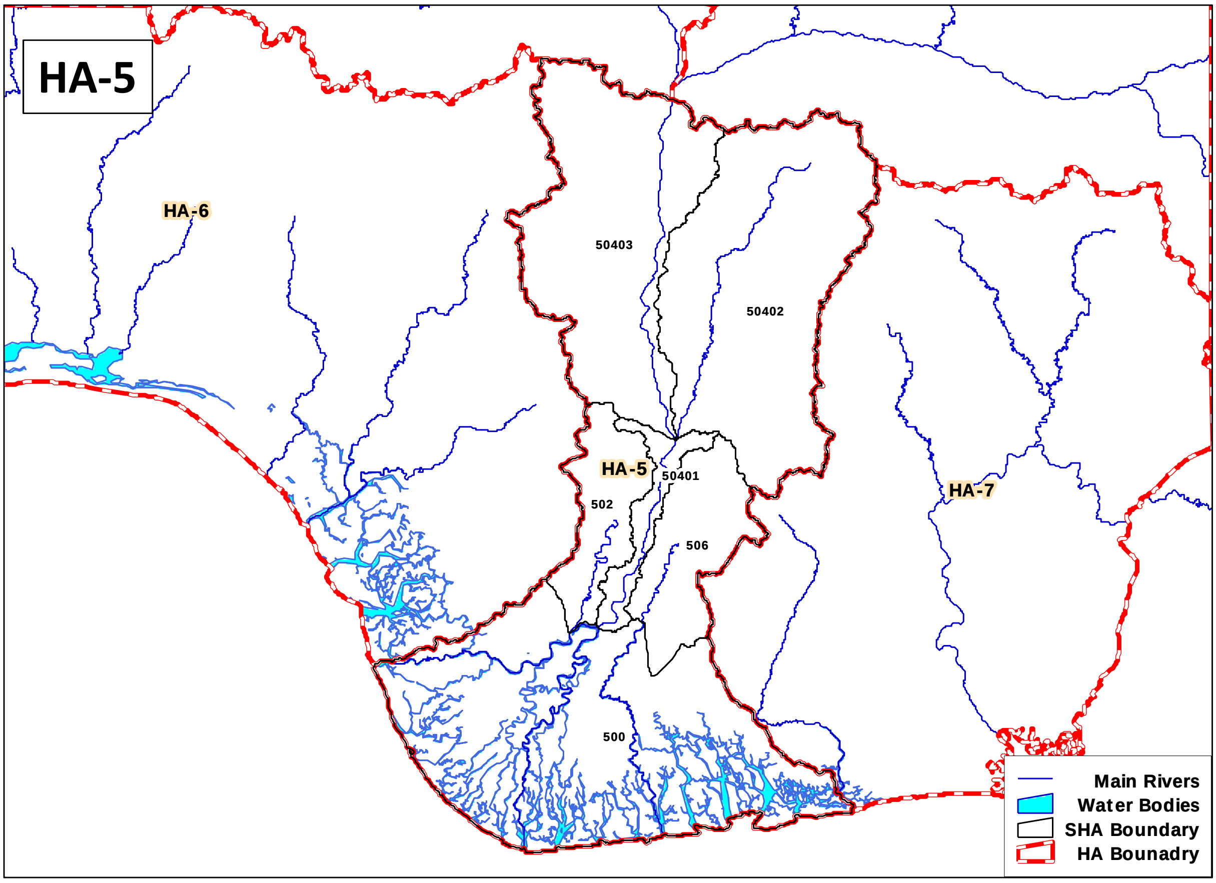


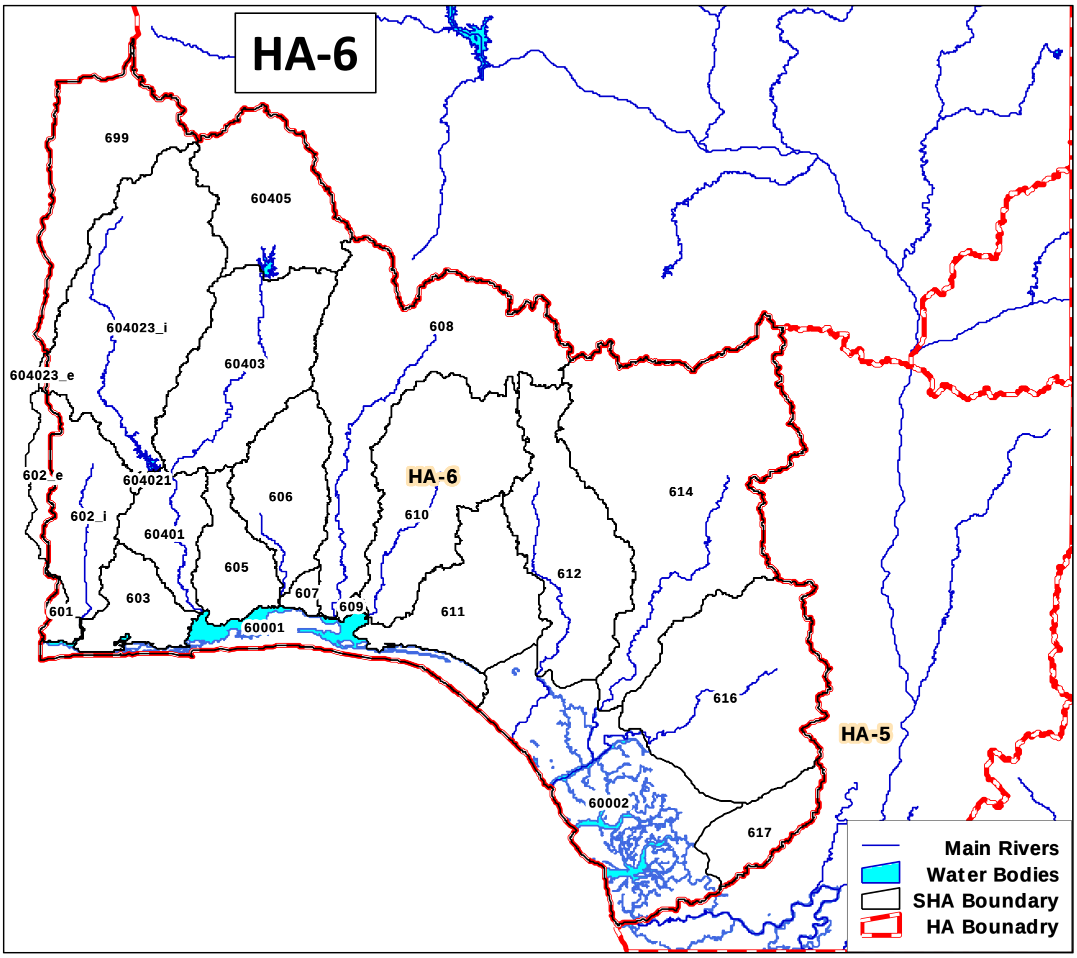
Annex-F SR2-1 SHA Boundary (1/4)



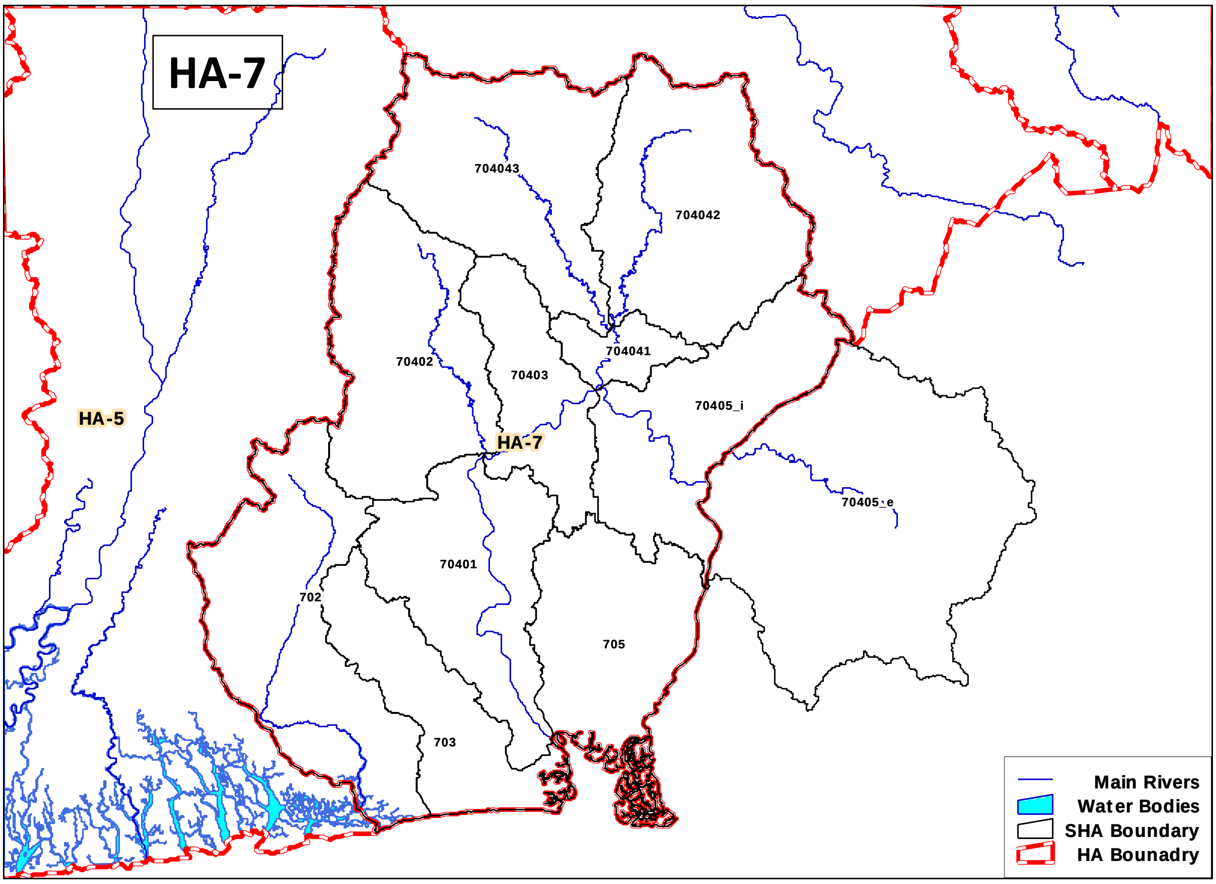


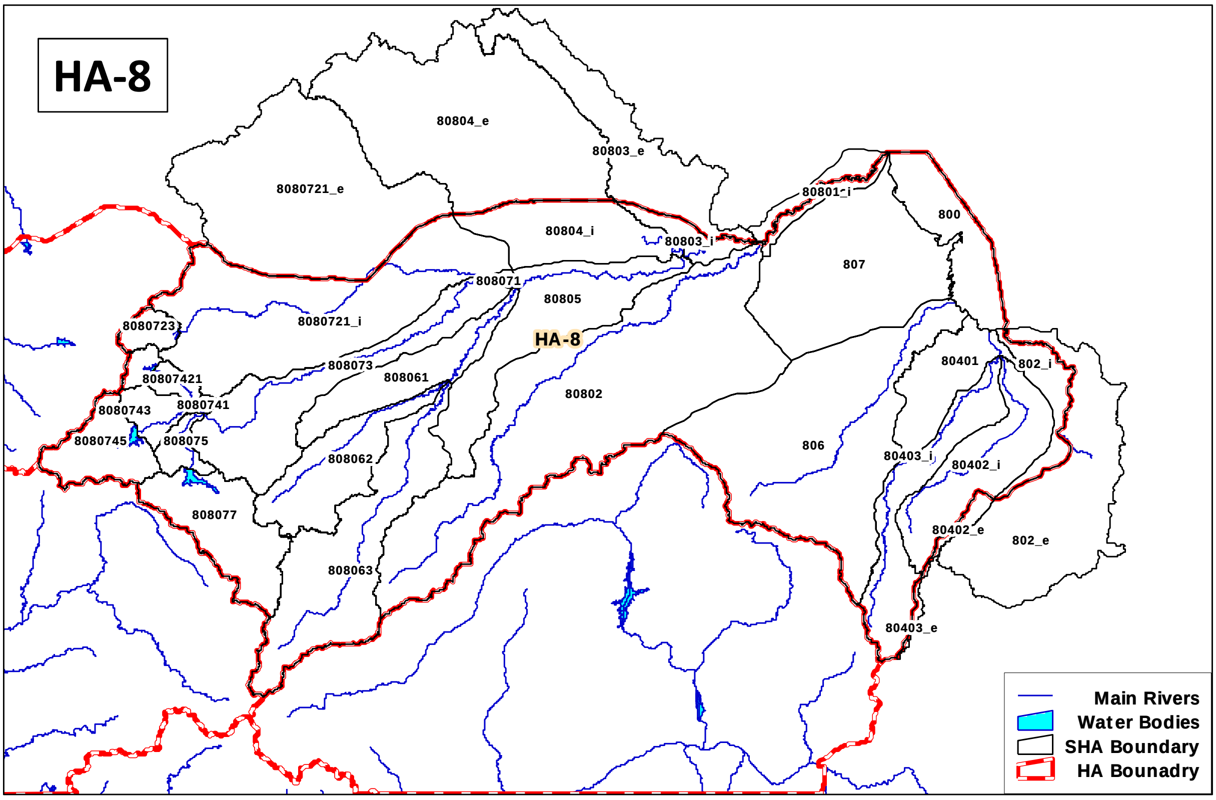
Annex-F SR2-1 SHA Boundary (2/4)



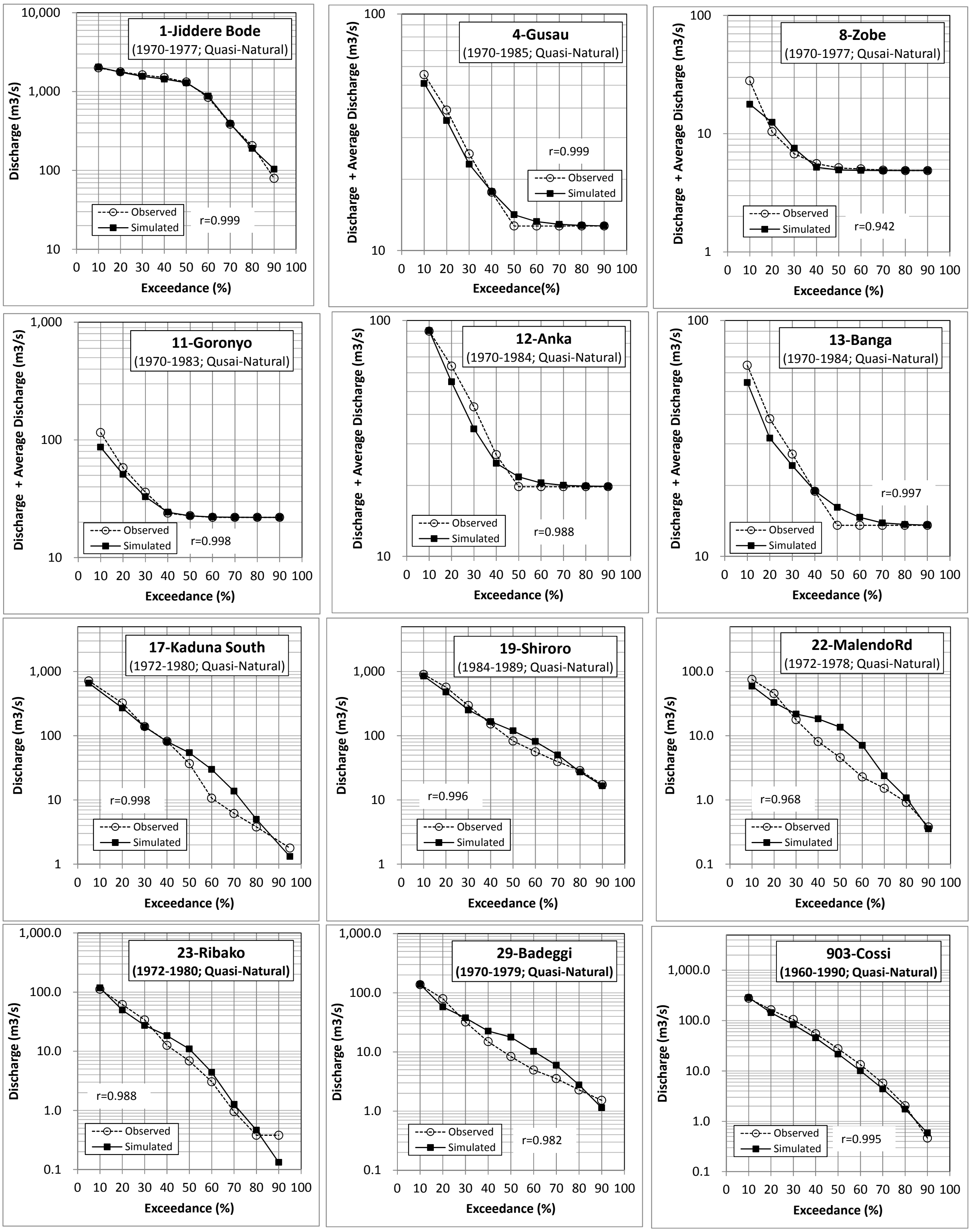


Annex-F SR2-1 SHA Boundary (3/4)

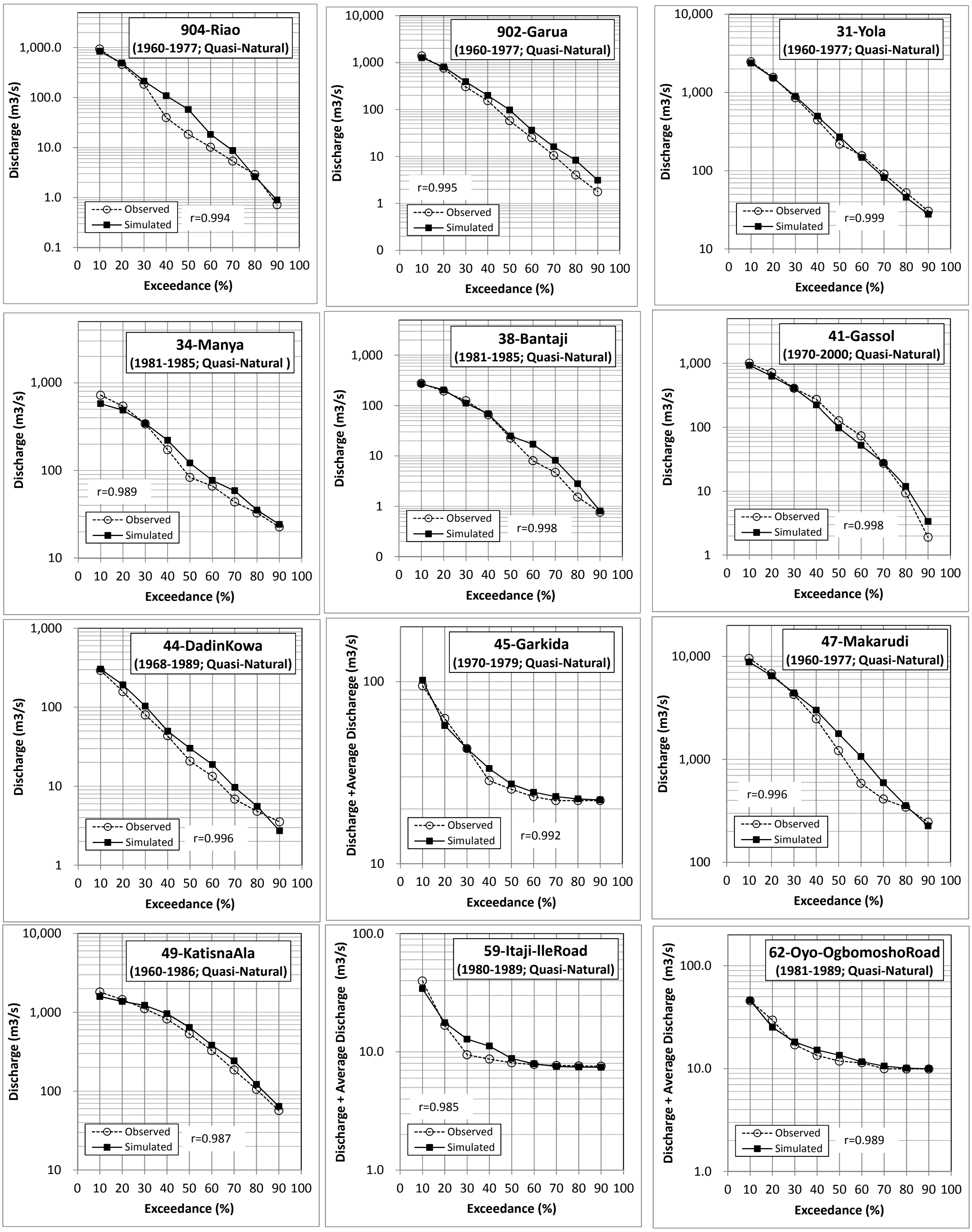




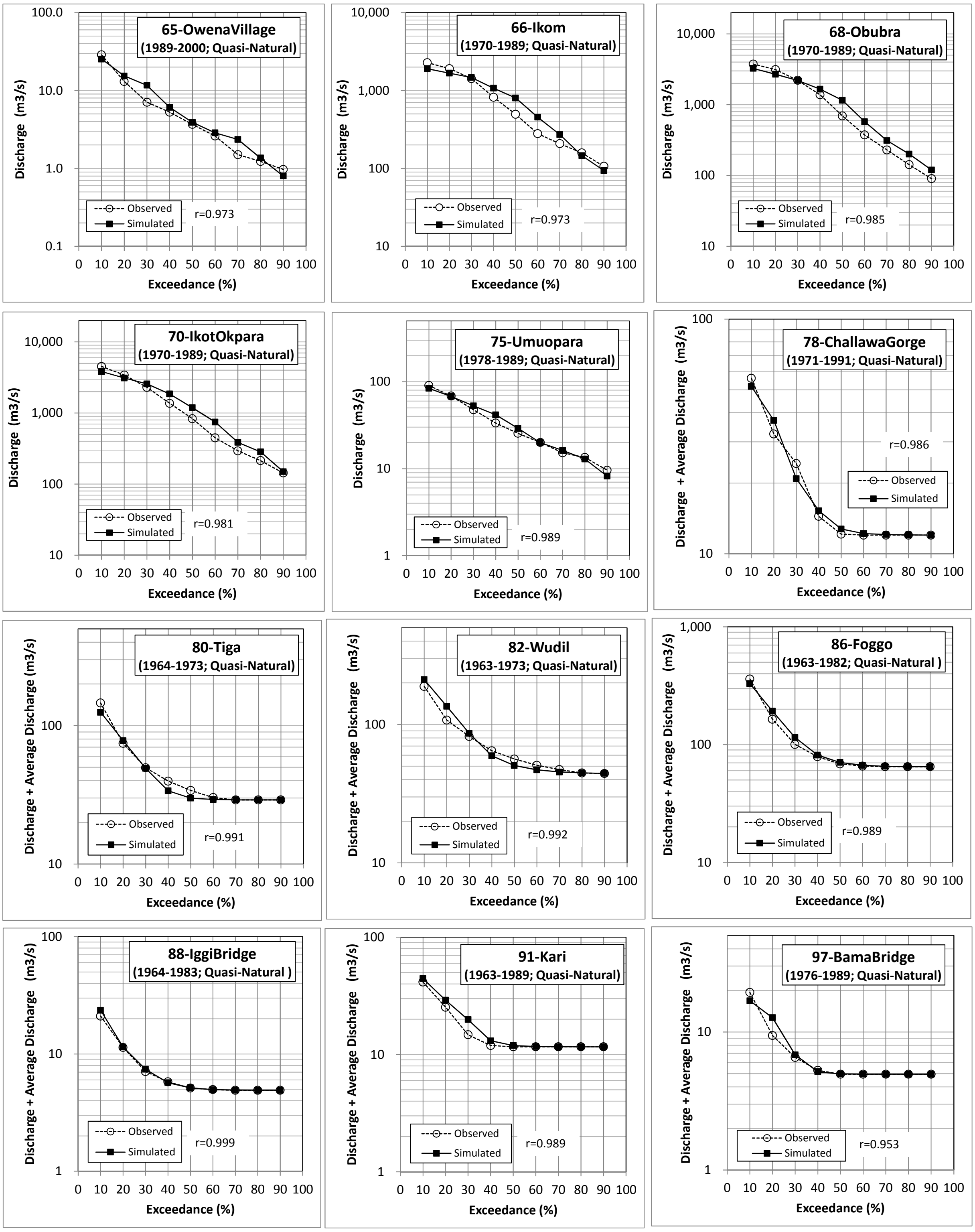
Annex-F SR2-1 SHA Boundary (4/4)



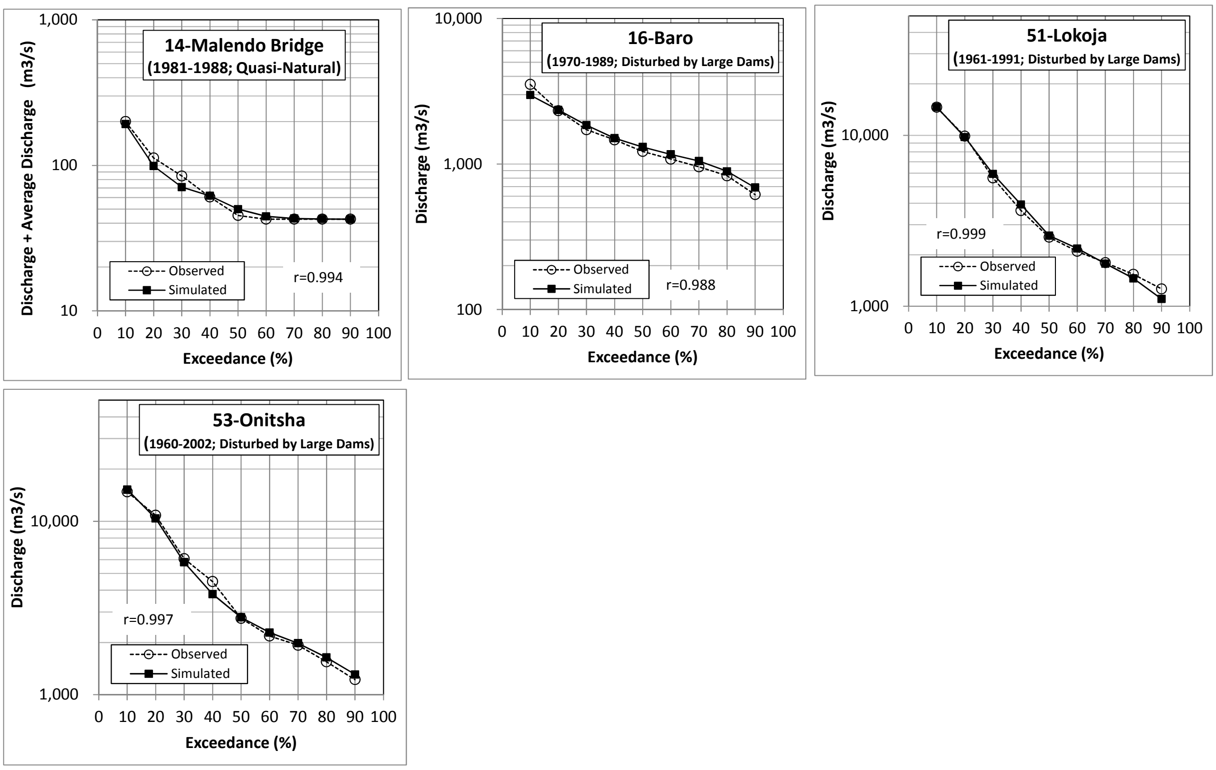
Annex-F SR2-2 Observed and Simulated Monthly Flow Duration Curves (1/4)



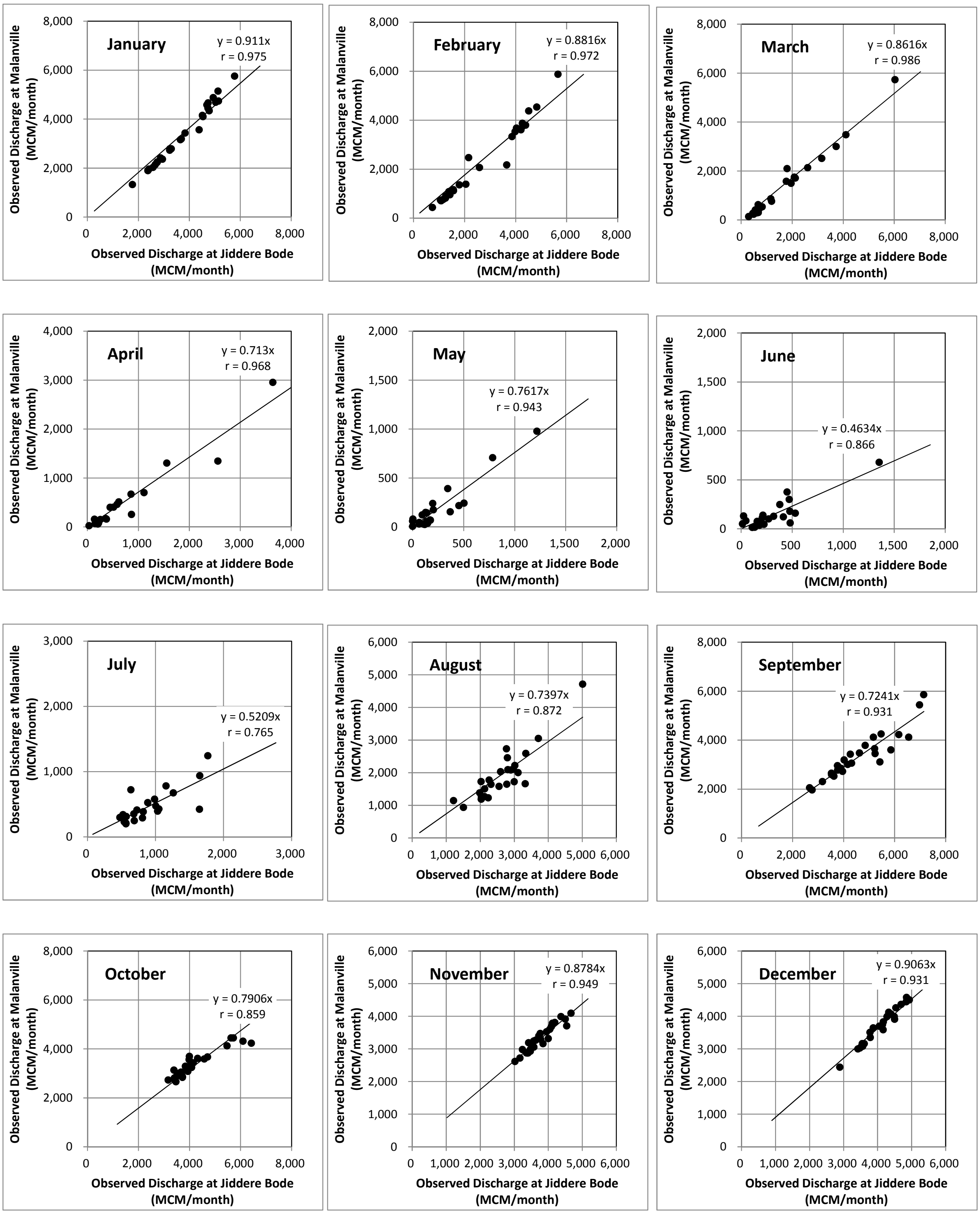
Annex-F SR2-2 Observed and Simulated Monthly Flow Duration Curves (2/4)



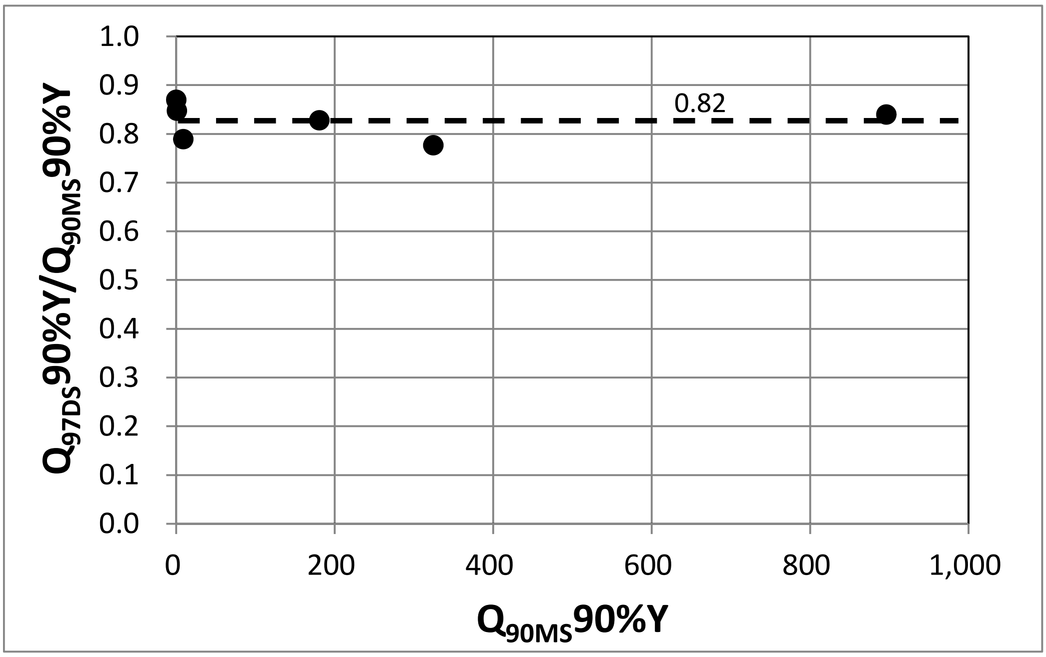
Annex-F SR2-2 Observed and Simulated Monthly Flow Duration Curves (3/4)



Annex-F SR2-2 Observed and Simulated Monthly Flow Duration Curves (4/4)

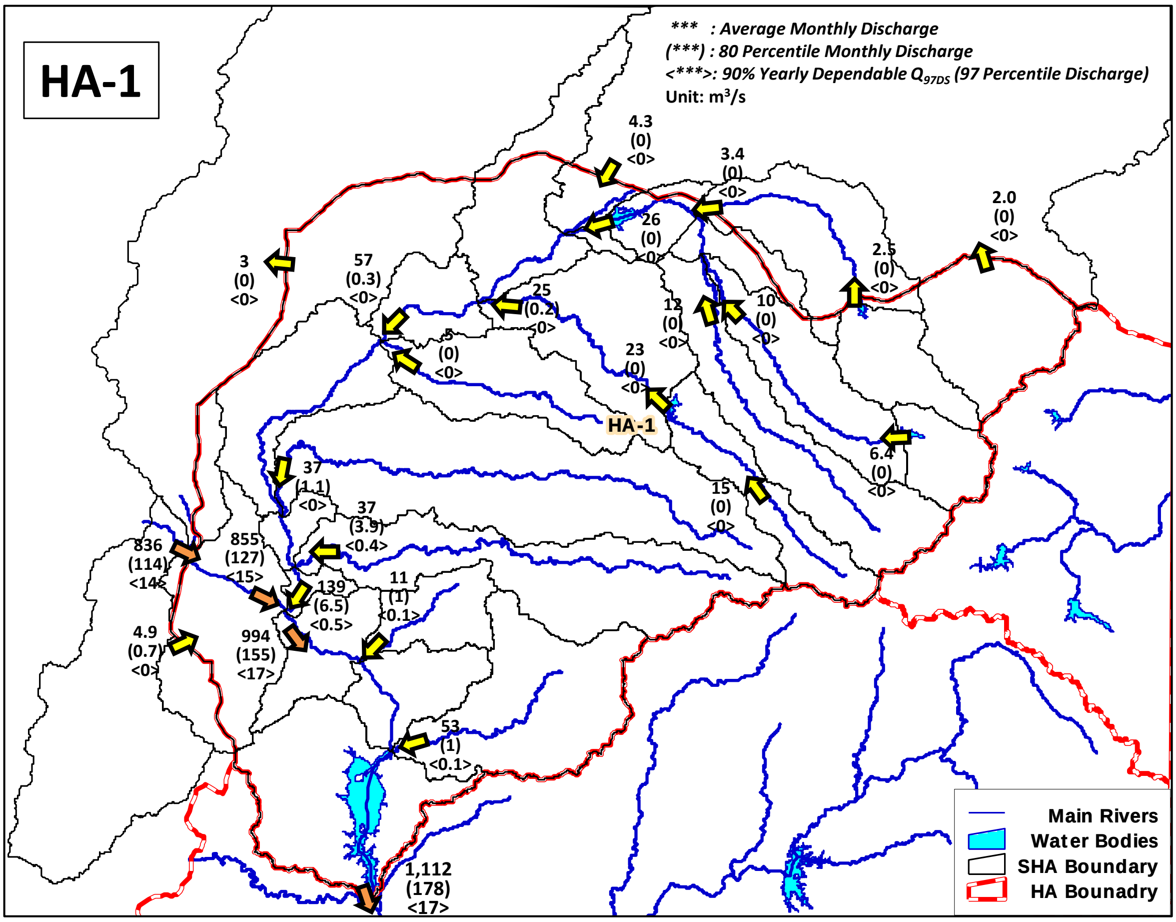


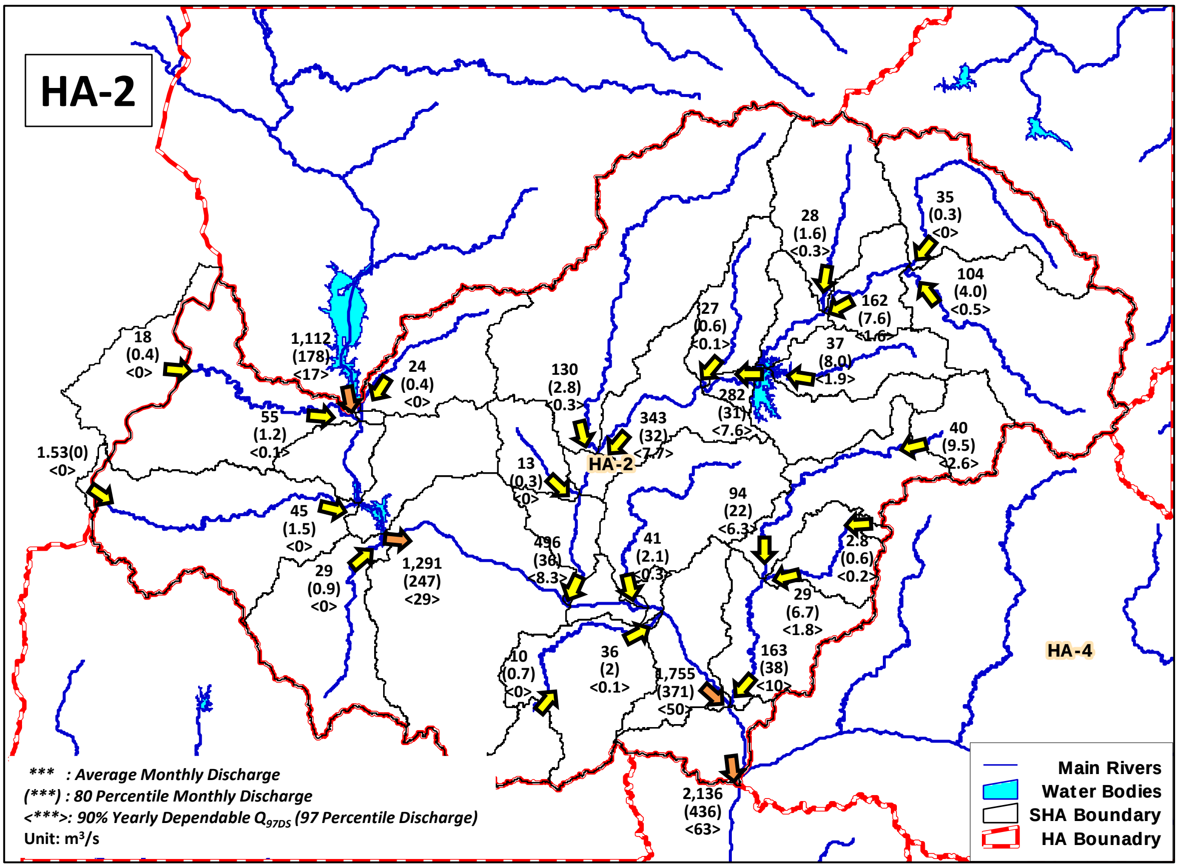
Annex-F SR2-3 Correlation between Observed Discharges in Malanville and Jiddere Bode



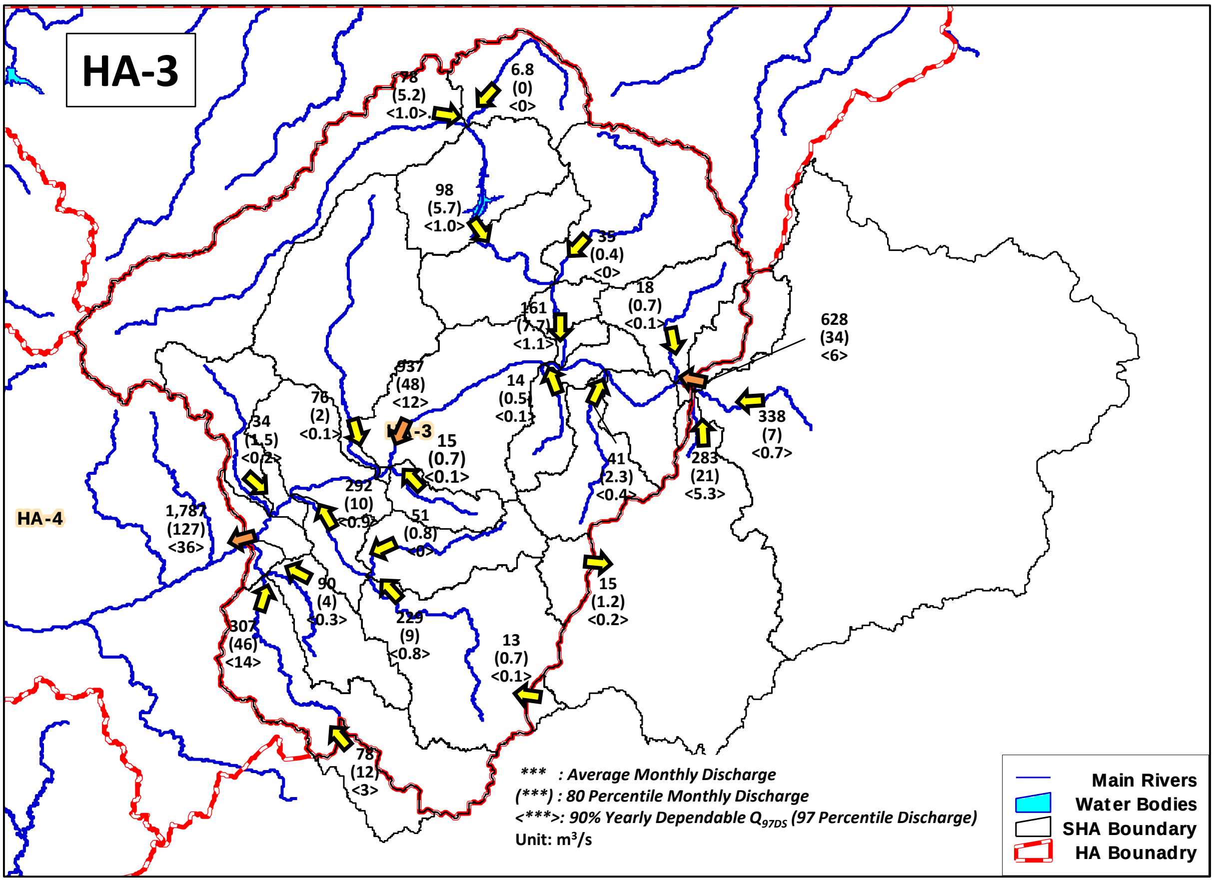
SN	Name of Station	Num Year	Duration
15	Jebba	13	1955 - 1967
30	Wuroboki	4	1963 - 1967
48	Umaisha	7	1969 - 1970
51	Lokoja	37	1918 - 1967
55	Ughideda	5	1989 - 1994
65	Owena Village	7	1991 - 2000

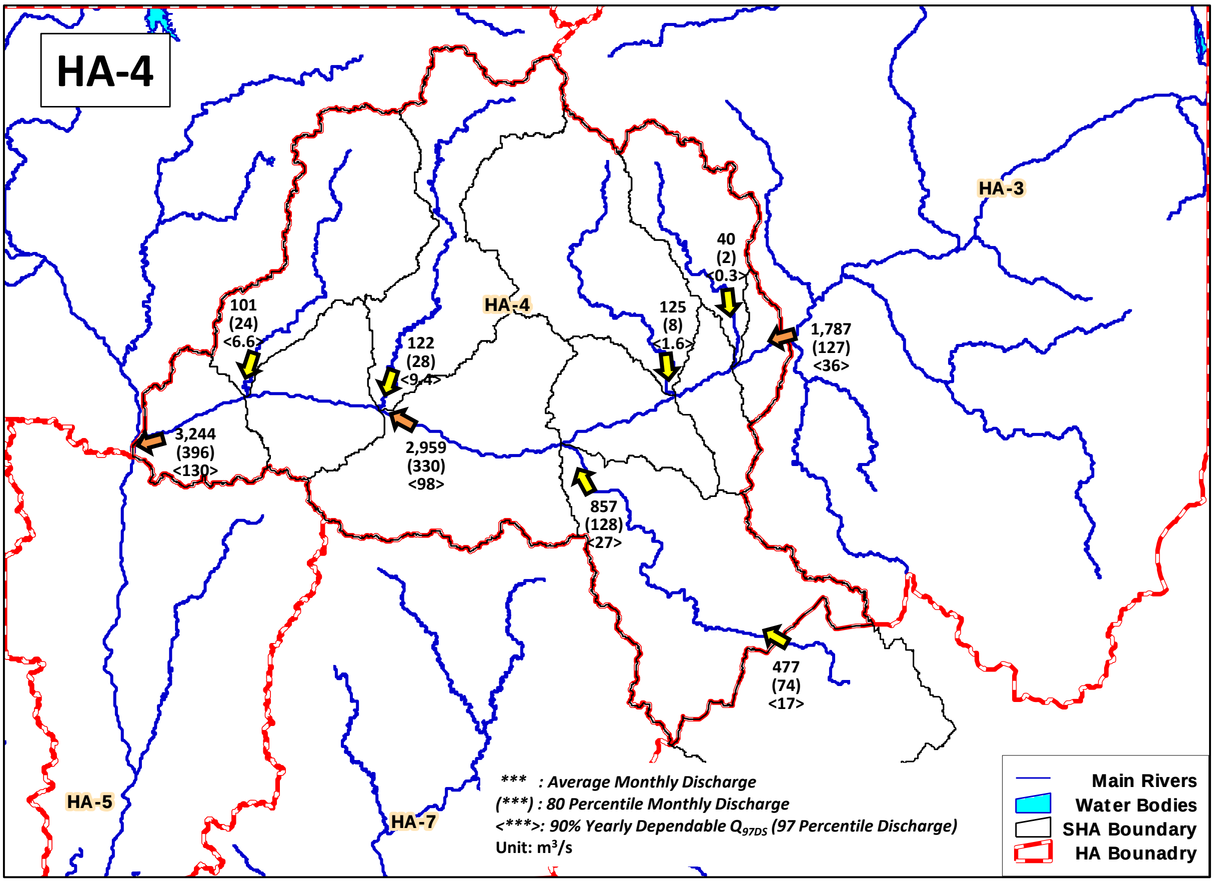
Annex-F SR2-4 Relationship between Q_{90MS}90%Y and Q_{97DS}90%Y/ Q_{90MS}90%Y



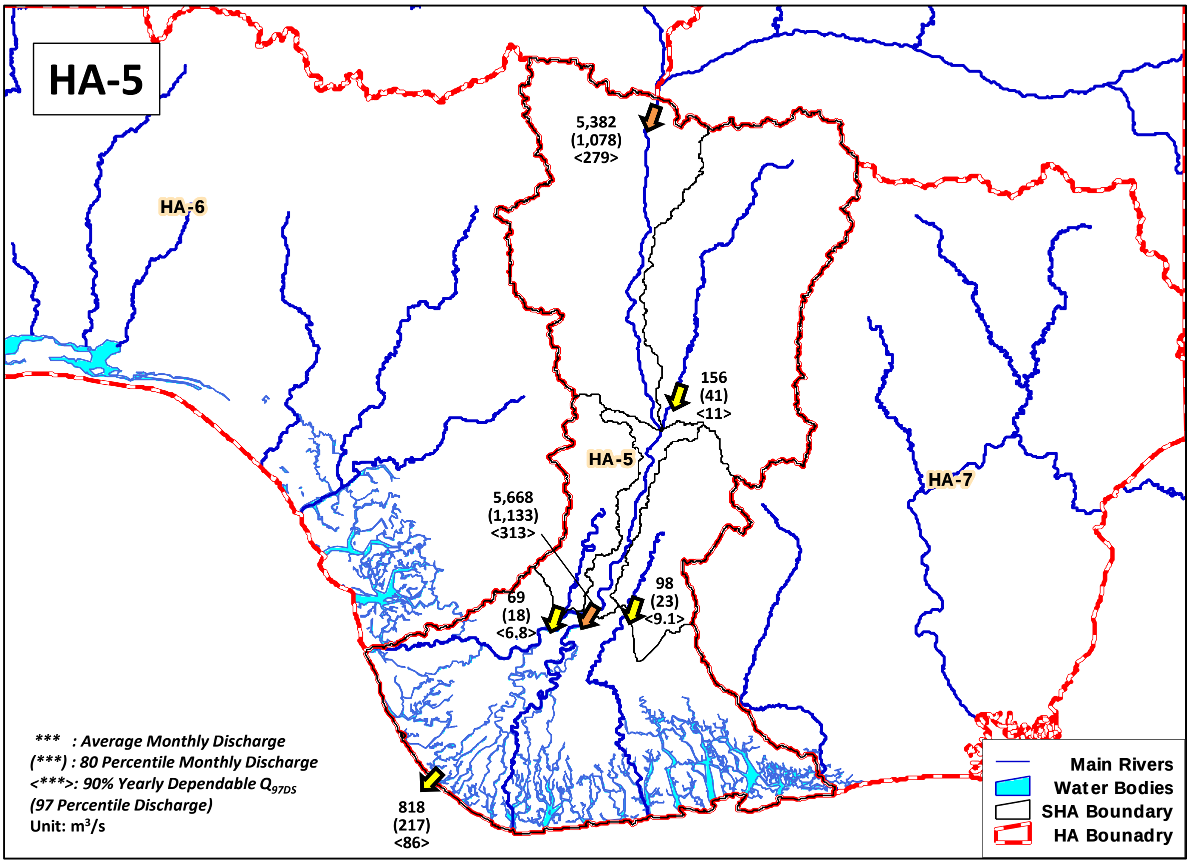


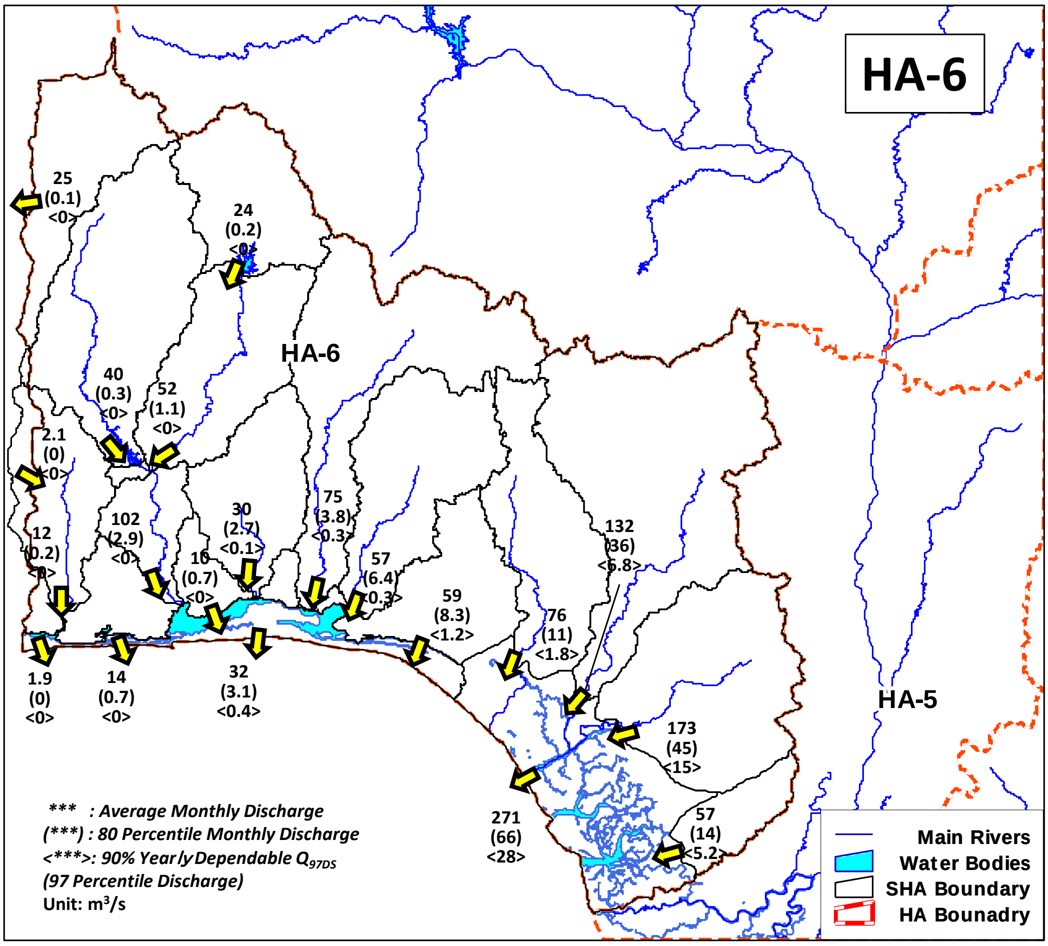
Annex-F SR2-5 Available Surface Water in Quasi-Natural Condition at Representative Points (1/4)



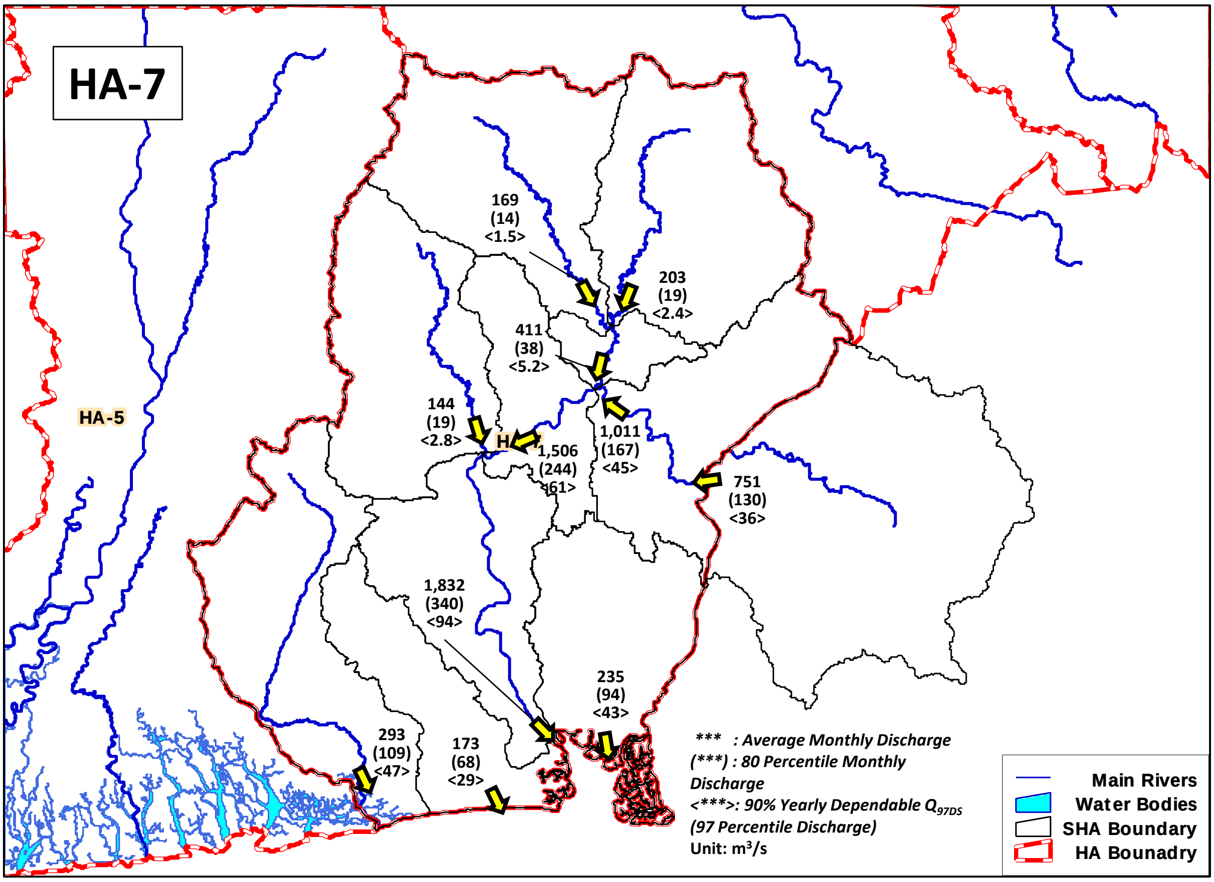


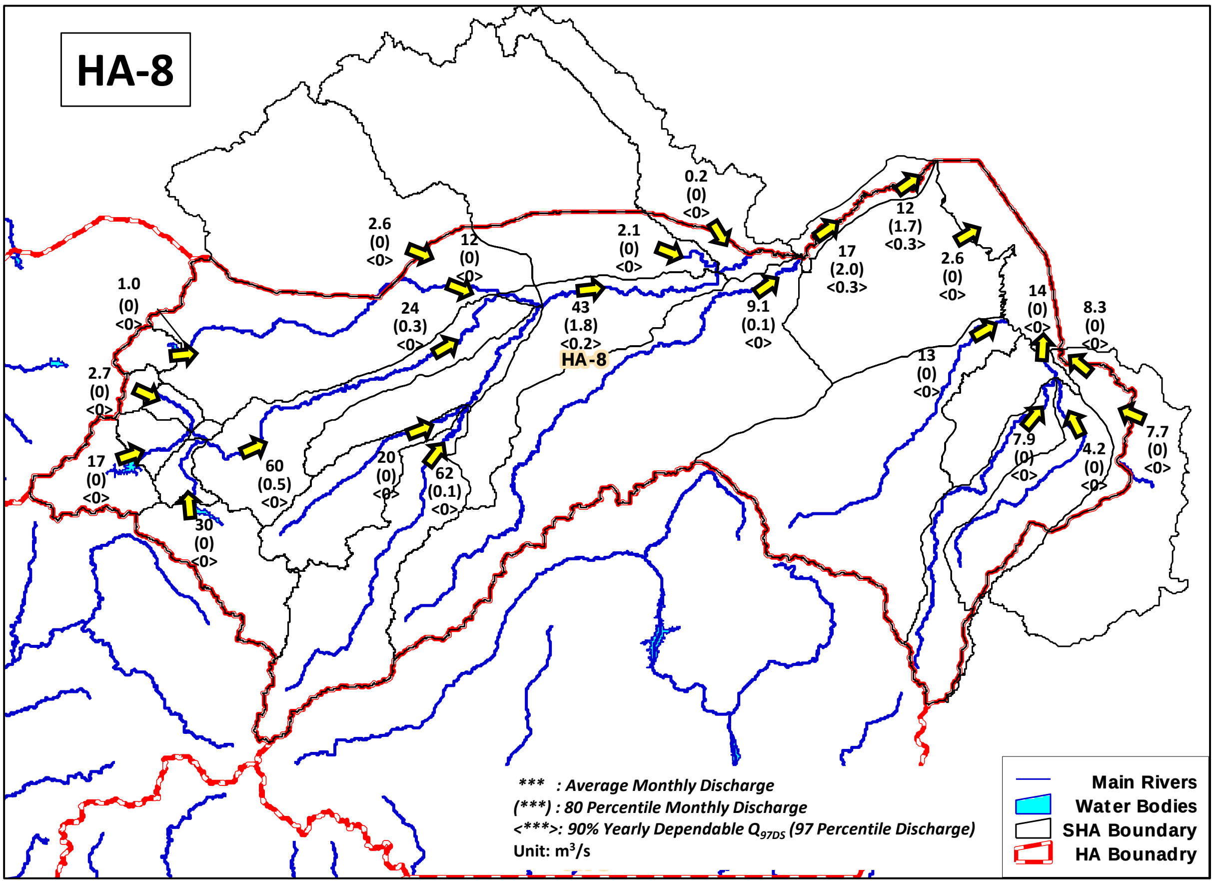
Annex-F SR2-5 Available Surface Water in Quasi-Natural Condition at Representative Points (2/4)



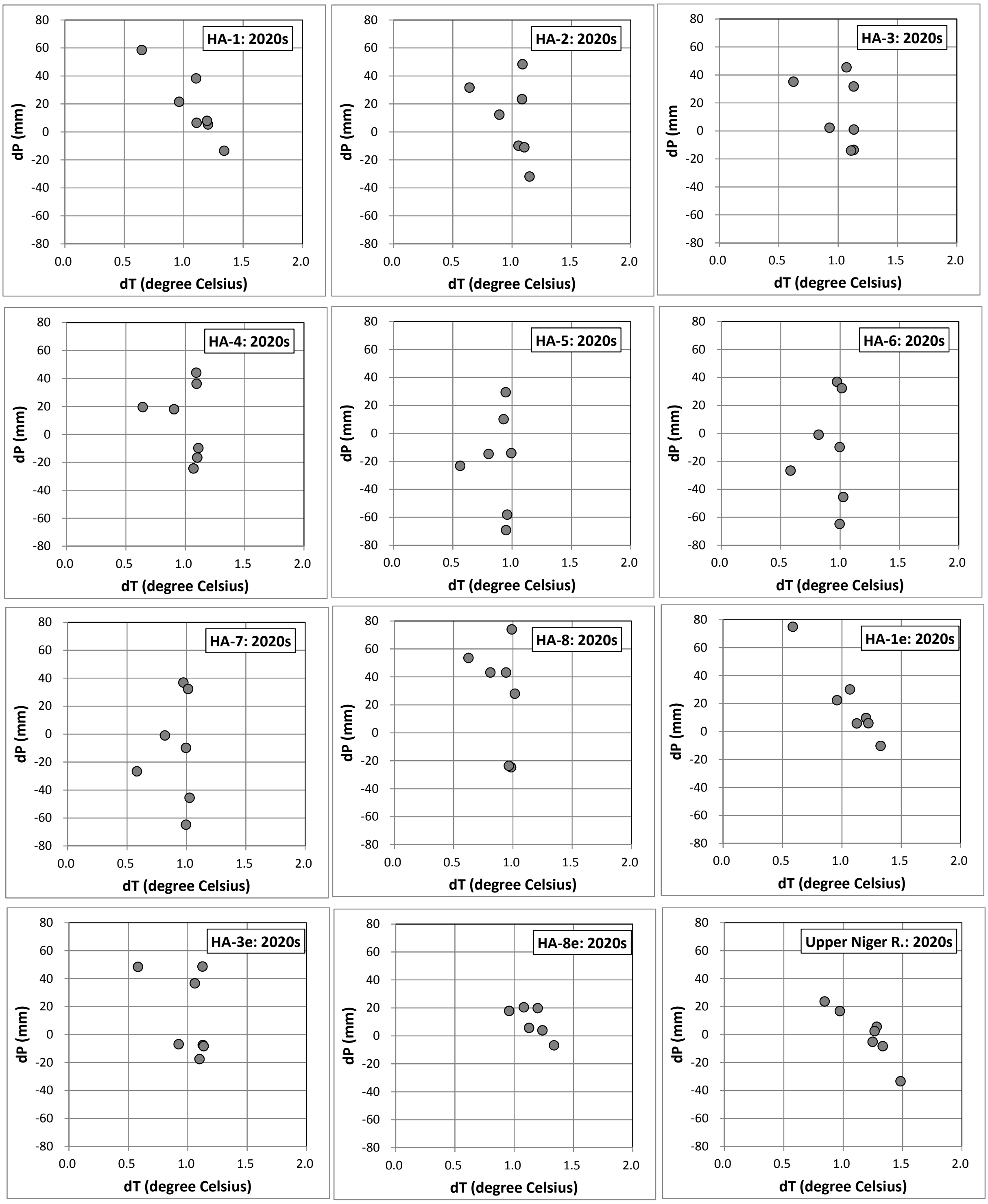


Annex-F SR2-5 Available Surface Water in Quasi-Natural Condition at Representative Points (3/4)





Annex-F SR2-5 Available Surface Water in Quasi-Natural Condition at Representative Points (4/4)

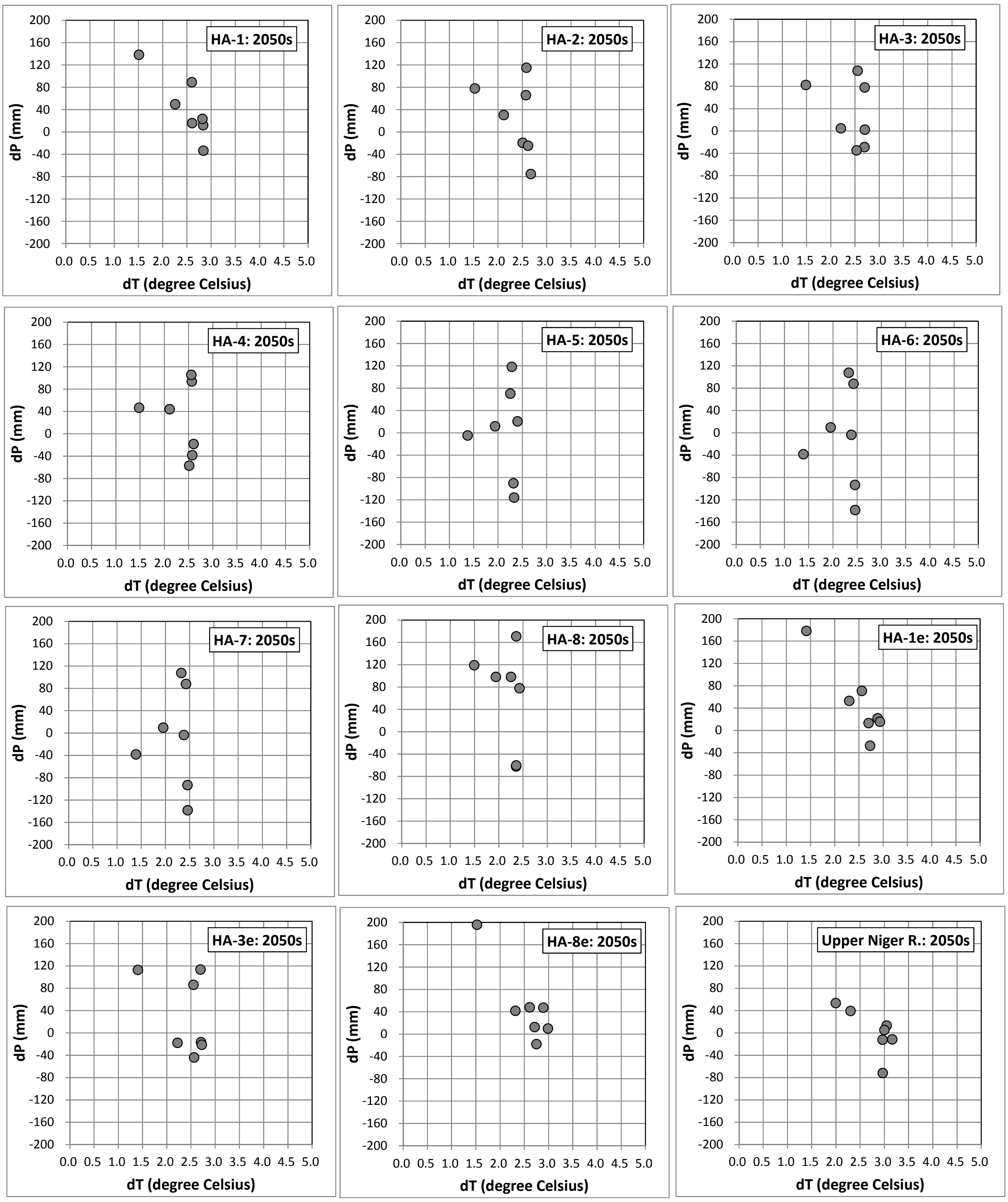


Remarks:

1) dP= change in annual total precipitation from base condition (1970-2000), dT=change in annual average air temperature from base condition (1970-2000).
2) Scenario=A1B

Source: JICA Project Team based on CCAFS

Annex-F SR2-6 Changes in Annual Average Air Temperature and Annual Total Precipitation with Different Outputs from GCMs (1/3)

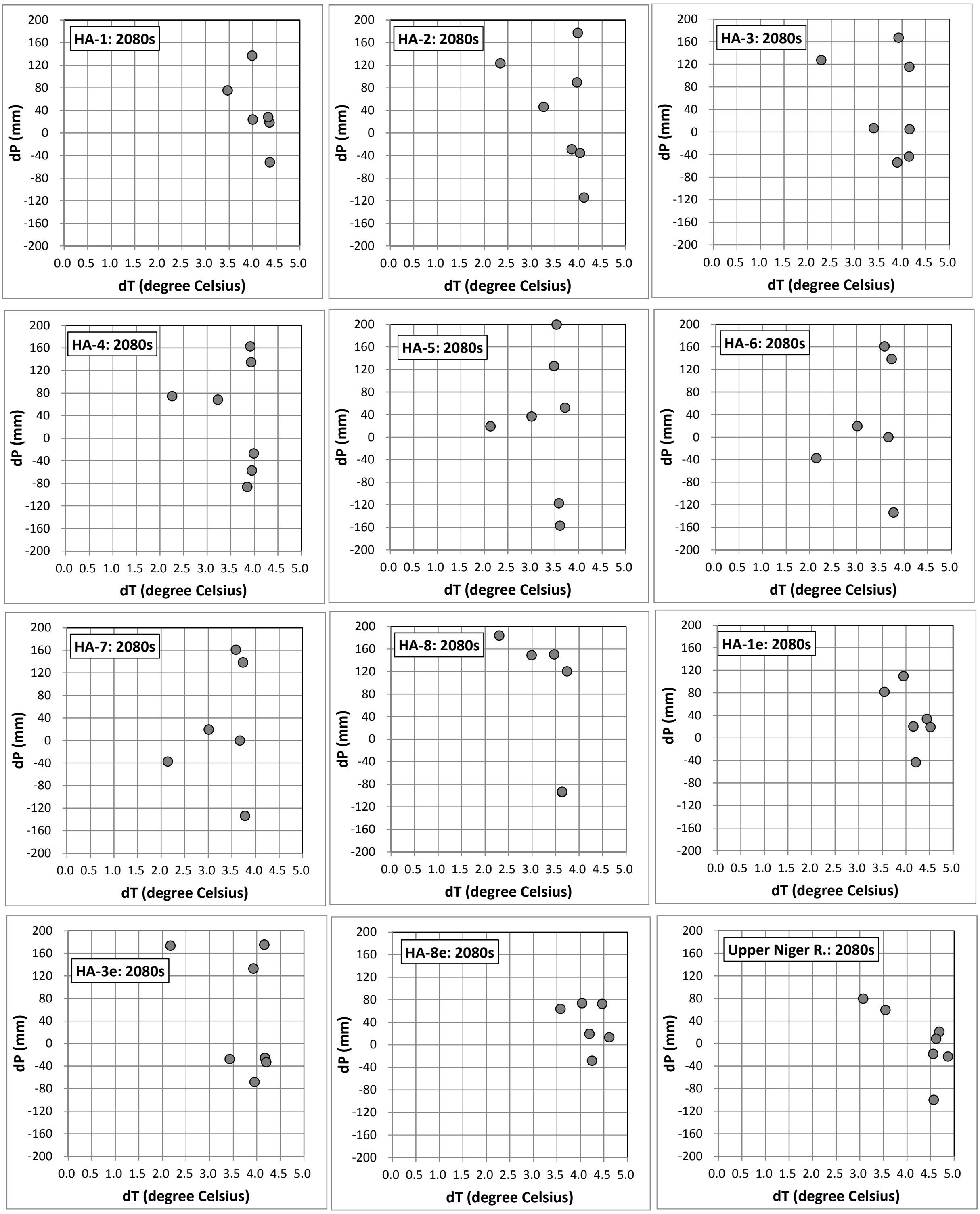


Remarks:

1) dP= change in annual total precipitation from base condition (1970-2000), dT=change in annual average air temperature from base condition (1970-2000).
2) Scenario=A1B

Source: JICA Project Team based on CCAFS

Annex-F SR2-6 Changes in Annual Average Air Temperature and Annual Total Precipitation with Different Outputs from GCMs (2/3)



Remarks:

1) dP= change in annual total precipitation from base condition (1970-2000), dT=change in annual average air temperature from base condition (1970-2000).
2) Scenario=A1B

Source: JICA Project Team based on CCAFS

Annex-F SR2-6 Changes in Annual Average Air Temperature and Annual Total Precipitation with Different Outputs from GCMs (3/3)