केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

AQUIFER MAPPING REPORT

Parts of East Kameng District, Arunachal Pradesh

उत्तरी पूर्वी क्षेत्र, गुवाहाटी

North Eastern Region, Guwahati

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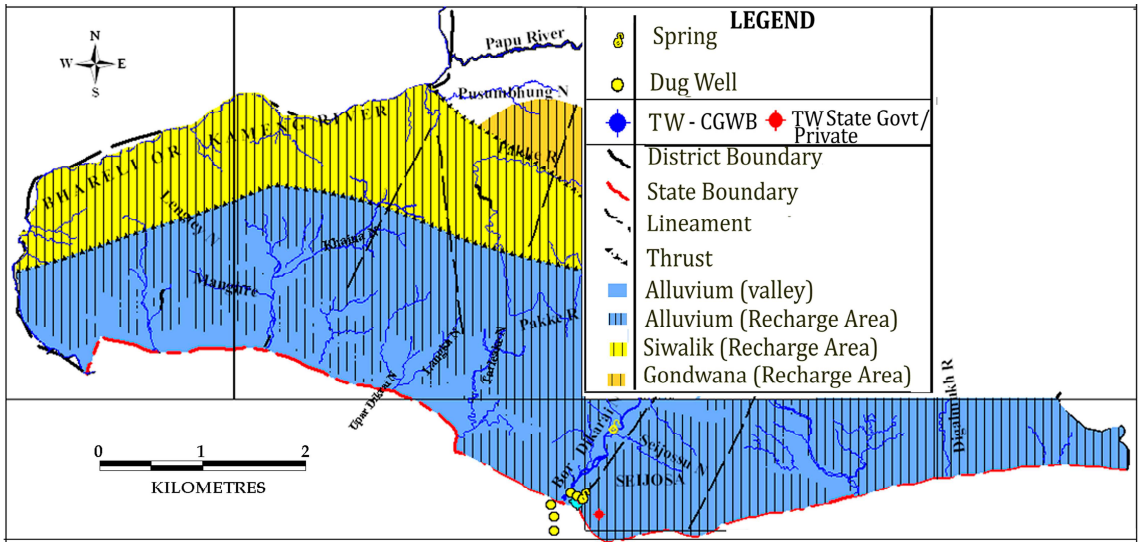
Govt. of India
Central Ground Water Board
Ministry of Water Resources, River Development & Ganga Rejuvenation

AQUIFER MAPPING REPORT OF PART OF EAST KAMENG DISTRICT, ARUNACHAL PRADESH
(AAP 2014-15)



State Unit Office
Naharlagun
March 2015

AQUIFER MAPPING REPORT OF PART OF EAST KAMENG DISTRICT, ARUNACHAL PRADESH

ANNUAL ACTION PLAN 2014-15

CONTENTS

CHAPTER 1.0

1.0 INTRODUCTION

1.1 Objectives: As part of national aquifer mapping programme, part of the Tertiary aquifer and the unconsolidated alluvial aquifer of Seijosa block, East Kameng district of Arunachal Pradesh was taken for study. During AAP 2015-16 the block was surveyed. (Fig. 1)

The objective of the study can be defined as follows:

a) to define the aquifer geometry, type of aquifers, ground water regime behaviours, hydraulic characteristics and geochemistry of aquifer systems on 1:50,000 scale and
b) existing scenario of groundwater regime in shallow/deep aquifer
c) to identify ground water related issues and thereby work out a management plan for sustainable development of ground water.

1.2 Scope of the study

Seijosa block of East Kameng district is situated in the foothills of Arunachal Himalayas. The area is demanding special study to utilize its groundwater resources. East Kameng district has rugged topography and covered by hills with varying heights. The Tertiary Siwalik forms Hills and the unconsolidated alluvium is found in river valleys, intermontane valleys, terrace, etc. The Siwalik area is less inhabited than the alluvial area. The valley or terrace of the district is populated. Therefore, hydrogeological information can be gathered for a very narrow stretch of the area. Similarly scope of exploration and use of geophysical technique to gather subsurface information is restricted only in the valley portion. Poor communication due to rugged terrain condition restricts the scope of the study.

1.3. Approach and methodology: The approach is to identify the principal aquifers and to understand the aquifer system. This will help to formulate an aquifer management plan. Finally the scientific knowledge will be disseminated to farmers, state government and stake holders.

The methodology can be illustrated as follows:

Data compilation and data gap analysis: The preliminary works consisted of collection and review of all existing hydrogeological and exploration data of CGWB, State Groundwater Departments. All data were plotted in the base map on GIS Platform (MapInfo-6.5 using Projection category longitude/latitude (Indian for Pakistan, India, Bangladesh, Nepal projection). On the basis of available data, data Gaps were identified.

Data Generation: Efforts were made to fill the data gaps by multiple activities such as exploratory drilling, geophysical techniques, hydro-geochemical analysis, besides detailed hydrogeological surveys.

Aquifer Map Preparation: On the basis of integration of data generated from various studies of hydrogeology & geophysics, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out Characterization of Aquifers, which can be termed as Aquifer maps providing spatial variation (lateral & vertical) in reference aquifer extremities, quality, water level, potential and vulnerability (quality & quantity).

Aquifer Management Plan Formulation: Based on **a**quifer map and conceptual model a sustainable development plan of the aquifer is formulated

1.4 Area Details: The area lies in the southern part of East Kameng district of Arunachal Pradesh and is bounded by north latitudes $26^0$55’ and $27^0$15’ and east longitude of $92^0$35’ and $93^0$30. The area comes under the Survey of India Toposheets of 83 A/12, 83A/16, 83B/13, 83F/1 & 83F/5 (all in parts) (Fig. 1)

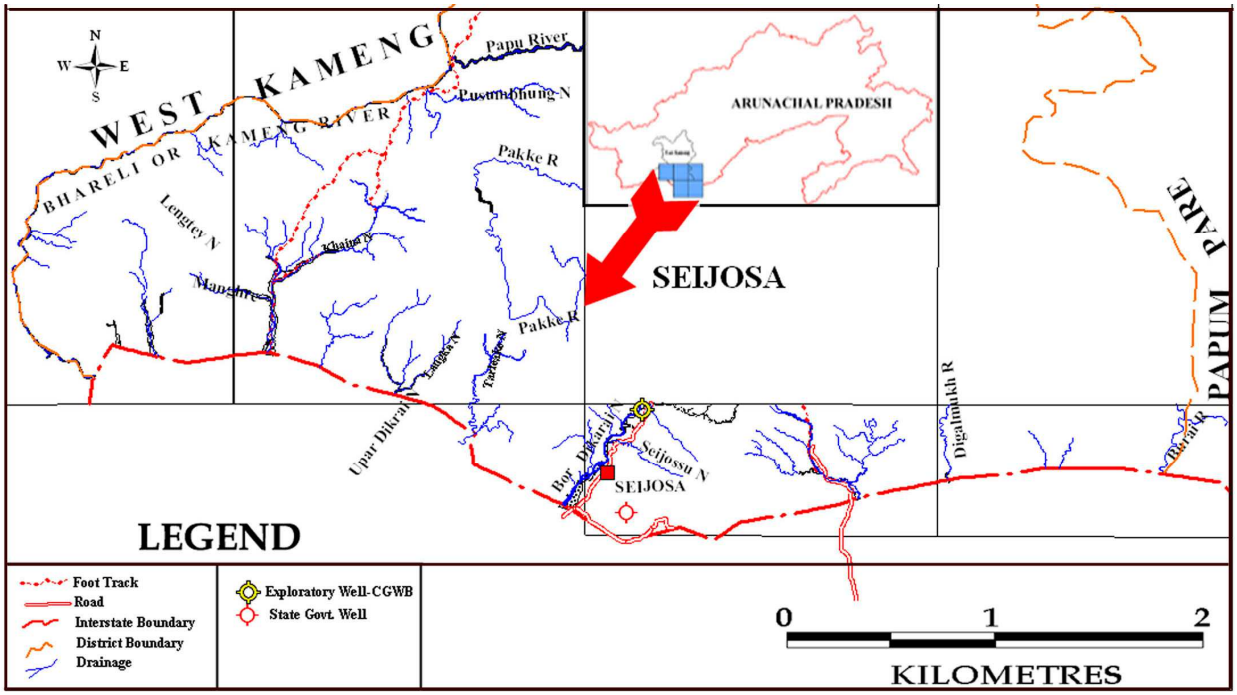


Fig.1.1: Location map of the study area

Table 1.1: Administrative area

District	CD Block	Circle	No. of villages
East Kameng	Seijosa	Seijosa	22
		Dissing Passo	15

Source: Statistical Handbook 2011

Out of 37numbers of villages 3 villages are uninhabited. As per 2011 Census total population of the study area is 5519 persons. Average population of the village is only 149.

Major part of the area has poor communication facility due to rugged terrain condition. Seijosa, the block headquarter is approachable by NH 52 from Saimari and from Biswanath Chariali, Sonitpur District, Assam. The area is not connected by rail service.

1.3 Data availability, data adequacy, data gap analysis and data generation

The preliminary works consisted of collection and review of all existing hydrogeological and exploration data of CGWB, State Groundwater Departments. All data were plotted in base map on GIS Platform (MapInfo-6.5 using Projection category longitude/latitude (Indian for Pakistan, India, Bangladesh, Nepal projection).

The available data, data gap and data generation work is tabulated in Table: 1.2 and shown in Fig.1.2.

Table 1.2: Data availability, data gap and data generation in Seijosa, East Kameng district of Arunachal Pradesh

SN	Theme	Data available	Data gap	Data generation	Total	Remarks
1	Borehole Lithology Data	2	4	1	3	Maximum depth of well is 103mbgl only.
2	Geophysical data	Nil	11	Nil	11	Difficult to obtain spread of 600 or even 500m in hilly terrain with variable slope

SN	Theme	Type	Data available	Data gap	Data generation	Total	Remarks
3	Groundwater level data	Dug well (Aquifer-1)	Nil	7	4	7	GW abstraction structures are not available in hilly area.
		Spring (Aquifer-1)	Nil	-	2	2	
		Piezometer Aquifer-I	Nil		Nil		
4	Groundwater quality data	Dugwell-Aquifer-I	**6**		Nil		GW abstraction structures are not available in hilly area.
		Spring (Aquifer-I)	**2**				
		Piezometer Aquifer-I	Nil		Nil		
5	Specific Yield		Nil		**2**		
6	Soil Infiltration Test		Nil		**7**		

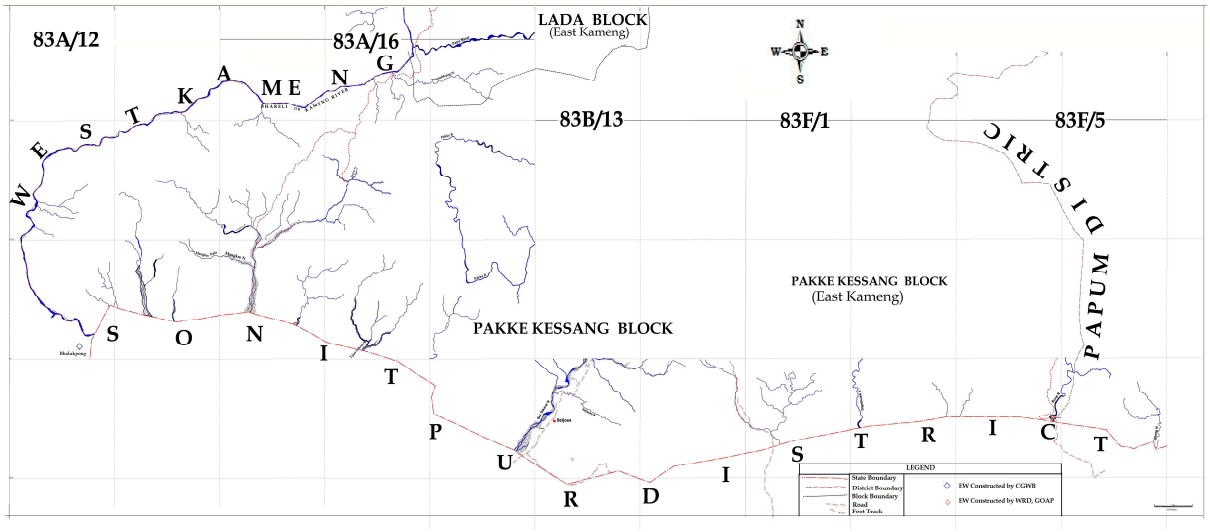


Fig.1.2: EW data availability and data generation

1.4 Rainfall-spatial, temporal and secular distribution: The rainfall distribution of the area is influenced by altitudinal difference. There was only one rain gauge station of Rural Works Department, Govt. of Arunachal Pradesh till 2008. Presently there was no rain gauge station in the area**.**

Here the analysis of rainfall data from 2003 to 2008 is given. The monsoon season starts from May to September. The precipitation graph is generally uni-model in nature.

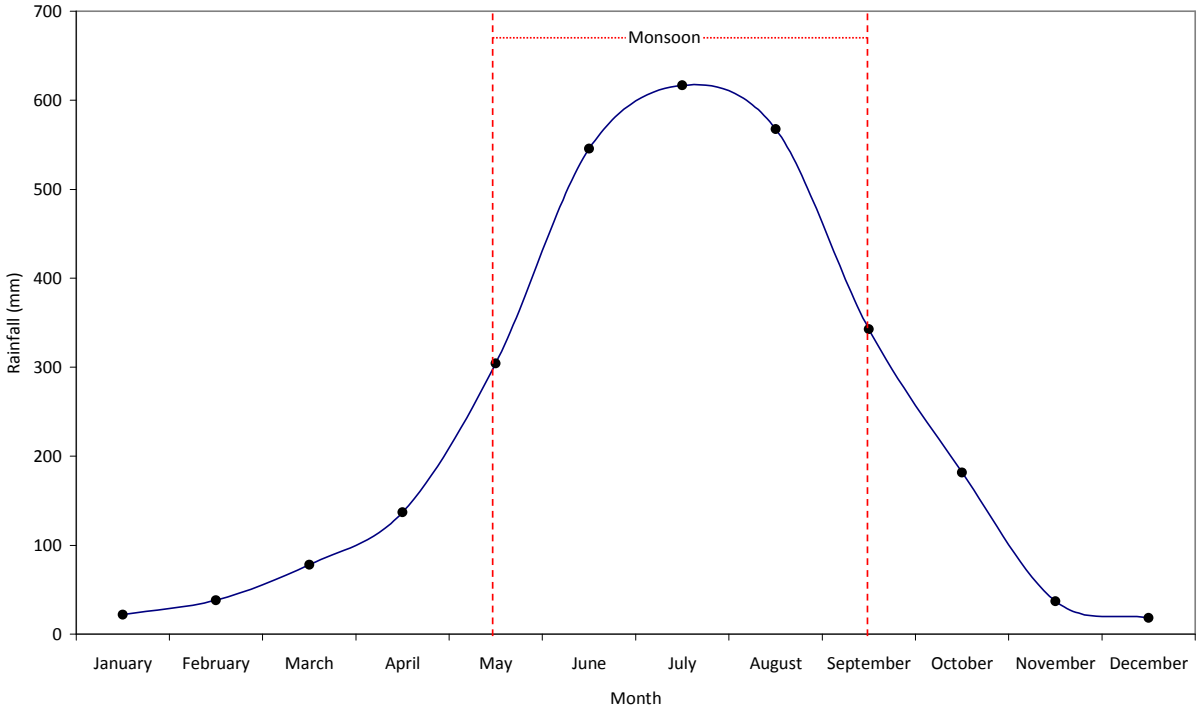


Fig.1.3: Average monthly rainfall at Seijosa, East Kameng District, Arunachal Pradesh

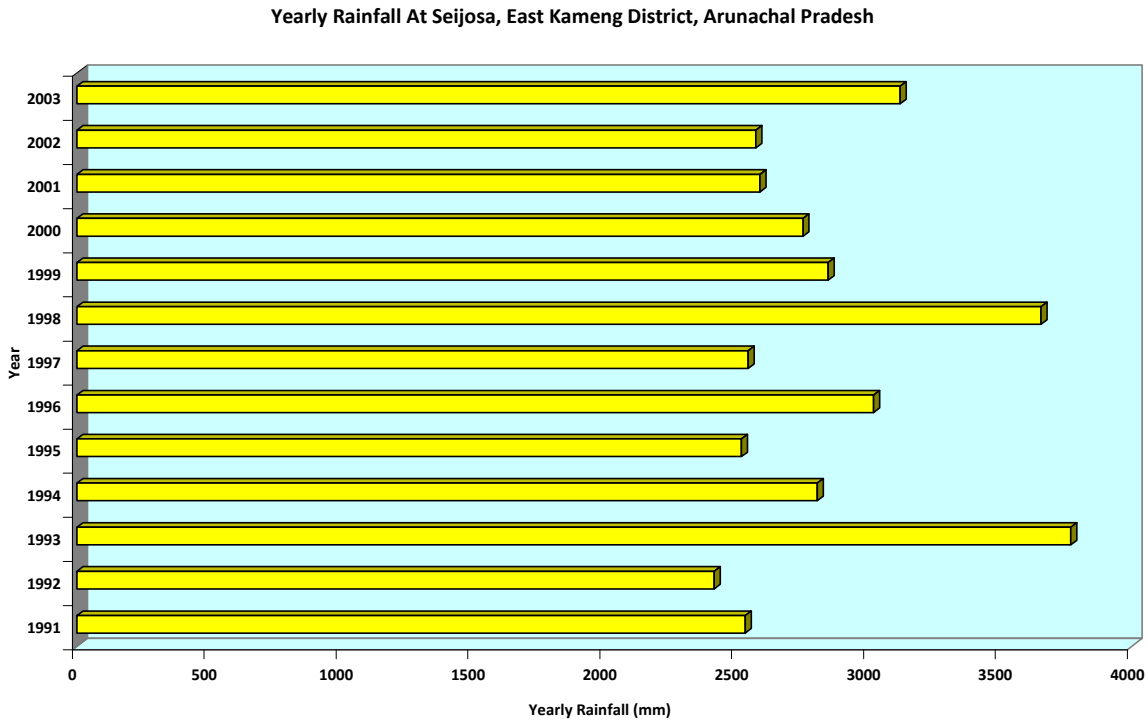


Fig. 1.4: Yearly rainfall distribution at Seijosa

In the area the pre-monsoon season continues from January to March, April witnesses the onset of monsoon and it continues up to September and November-December constitute the post monsoon season.

1.5 Physiographic set up: Phisiographically the area can broadly be divided into three parts, i.e., the hilly tract, the piedmont and the intermontane valley. The hilly tracts are characterized by low to high relief hills and corrugated landform and comprise of Siwalik sediments of lesser

Himalayas. The Himalayan Frontal Fault (HFF) marks the southern limit of the sub-Himalaya where the Siwalik Hills terminate abruptly with steep slope and come in contact with Brahmaputra plain towards south. The slope of the area drops from northern and eastern corners towards south.

1.6. Geomorphology: Geomorphologically the area can be divided into structural hills, piedmont zone and alluvilal plains.

1.**7. Land use Pattern:** Village wise land use data is not available in 2011 census data. A large part of the study area is covered by thick forest which has sub-tropical, deciduous and humid type of vegetation. The low land and valleys are occupied by inhabitations. The land utilization pattern of the block as per Agriculture Census 2010-11 is given in Table: 1.3

Table: 1.3 Land utilization pattern, as per 2010-2011 agricultural census (Area in Hect)

Block	Total Holdings Area		Net Area Sown	Area Under Current Fallows	Net Cultivated Area	Other Uncultivated Land Excluding Fallow Land	Fallow Land Other than Current Fallows	Culturable Waste Land	Total Uncultivated Land	Land Not Available for Cultivation
(1)	(2)	(3)	(4)	(5)	-6	(7)	(8)	(9)	(10)	(11)
Seijosa	460	531	432	14	447	24	28	5	56	28

Note: Total May not Tally Due to Rounding off (Agriculture Census 2010-11)

1.8 Soil: The soil developed in each physiographic unit haS their distinct morphological and other related properties. It indicates a good soil-landform relationship in this region. Taxonomically the soils of the district are divided into various classes. Generally the soil of the area is sandy loamy.

1.9 Hydrology and drainage: The study area is a part of Brahmaputra river basin. The main rivers of the area are Kameng or Jia Bhareli, Pakke or Bor Dikorai, Burigang, etc. However, no hydrological data are availablle in the area.

The drainage pattern is generally sub-dendritic to sub-parallel. Drainage pattern in the high relief structural hills is parallel and trellis. Streams of low relief structural hills are sub-parallel to dendrtitic pattern whereas in the dissected hills the drainage pattern is closely spaced sub-dendritic. In the Piedmont plain the drainage channels are nearly straight.

1.9 Agriculture: Agricultural land is very limited in the area. Compared to district total area of 83743 sq.km the total agriculture land is only 154.89 sq.km. The traditional agricultural practice is Jhumming or shifting cultivation. But now, practice of settled cultivation in foothill plains is increasing in the area. Paddy is the principal crops followed by maize, millet. Vegetables, mustard and fruits like banana are also cultivated in these villages. The paddy area is very limited and confined to the intermontane valleys and in the foothill area. Details of the area and production of food crops in East Kameng district is given in Table: 1.5.

Table 1.5: Area & production of Food crops in East Kameng District

Rice		Maize		Millet		Wheat		Pulses		Total	
Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
8235	9470	4298	3497	485	475	23	47	843	886	13884	14375

Source: The District Agriculture Officer, Papum Pare district, A.P.

As per Agriculture Census of 2010-11, there is no canal, well for irrigation rather there is other sources of irrigation. The net irrigated area of the block is 103hectra.

CHAPTER 2.0

Data Collection and Generation

2.1 Data collection

Data collection includes collection of rainfall data from state government, litholog collection from state groundwater departments, compilation of CGWB's earlier exploration and geophysical data. Population data is collected from Census of India website. Agricultural data is collected from the website of Ministry of Agriculture, Govt. of India.

The accessibility to Seijosa area is difficult due to poor road communication and hilly terrain. The area is less populated. As such there exist very few data. Water Resource Department, Govt. of Arunachal Pradesh had constructed one tube well at Monai village of Seijosa. Central Ground Water Board, North Eastern Region, Guwahati had constructed one tube well at Upper Seijosa. Details of the wells are given in Table 2.5. Rainfall data was collected from Rural Works Department, Govt. of Arunachal Pradesh, Itanagar. CGWB has no groundwater monitoring station at Seijosa due to lack of ground water abstraction structure and also for communication problem.

2.2 Data Generation

The main constraints observed during data generation are:

i) Poor road communication. The remote areas of Seijosa are not connected with all-weather road. Many areas are connected by foot-track only.
ii) The area is hilly and plain area is confined along the river course only.
iii) As stated above the area is sparsely populated and there are few groundwater abstraction structures.

However, efforts were made to collect various data. Groundwater monitoring stations and spring monitoring stations has been established.

2.2.1 Hydrogeological data: As mentioned earlier, major part of the area is covered with hill and communication is very poor. As such habitation is clustered in plain area and ground water abstraction structures are also clustered in the plain area. Due to this reason entire study area could not be covered by establishing new water level monitoring stations. Spring data of earlier study was utilized as well as new spring monitoring stations was also established.

Water level data:

Table 2.1: Water level monitoring stations and spring locations

Unique ID	Name of village/site	Altitude	Longitude	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/ Pz/Spring)	Aquifer group	Measuring point (magl)
EKS-01	Maa Sarda	26.93	92.98	135	4.86	DW	Unconsolidated (I-Aquifer)	1.28
EKS-02	Bordikorai	26.93	92.98	124	17.53	DW		0.83
EKS-03	Bordikorai1	26.92	92.98	122	4.94	DW		0.92
EKS-04	Pakke Forest Office	26.92	92.98	129	9.1	DW		1.17
EKS-05	Niti Darlong	92.99	26.94	136	2.19	DW		0.88

Unique ID	Name of village/site	Altitude	Longitude	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/ Pz/Spring)	Aquifer group	Measuring point (magl)
EKS-06	Lower Seijosa, VKV School	26.93	92.996	133	-	TW	Unconsolidated (I-Aquifer)	0.41
EKS-07	100m north of VKV Girls Hostel	92.996	26.94	131		Spring		
EKS-08	Pakke, Papum	93.02	26.98	162		Spring		

Table 2.2 Water level and spring discharge of monitoring stations

Unique ID	**Date of measurement (dd/mm/yyyy)**	**Depth of water level in mbgl**		**Unique ID**	**Date of measurement (dd/mm/yyyy)**	**Depth of water level in mbgl**
1	**2**	**3**		**4**	**5**	**6**
EKS-01	10/11/2015	2.96		EKS-05	24/03/2016	1.81
	02/03/2016	3.65		EKS-06	10/11/2015	9.51
EKS-02	10/11/2015	15.82			02/03/2016	Could not measure due to installation of pump
	02/03/2016	Dry		**Spring**		**Discharge (lpm)**
EKS-03	10/11/2015	4.57		EKS-07	11/11/2015	34.48
	02/03/2016	Dry			24/03/2016	6.0
EKS-04	10/11/2015	1.36		EKS-08	24/03/2016	5.0
	02/03/2016	2.31				

2.2.2 Water Quality

To understand the chemical quality of groundwater in the study area and its suitability for domestic, drinking and agricultural utilisation, water quality data of spring and existing quality data of CGWB were collected (Table 2.3). Water samples were collected from monitoring wells for detailed, iron, heavy metals and arsenic. However, heavy metal and arsenic analysis data are yet to be received. Chemical analysis results of collected post-monsoon water samples are presented in Table 2.4.

Table 2.3: Location details of water quality sample points

Unique ID	Name of village/site	Altitude	Longitude	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/ Pz/Spring)	Aquifer group	Date of collection of water sample
EKS-01	Maa Sarda	26.93	92.98	135	4.86	DW	Unconsolidated (I-Aquifer)	10/11/2015 02/03/2016
EKS-03	Bordikorai1	26.92	92.98	122	4.94	DW		10/11/2015
EKS-05	Niti Darlong	92.99	26.94	136	2.19	DW		24/03/2016

Unique ID	Name of village/site	Altitude	Longitude	RL (mamsl)	Total depth of Pz/DW (mbgl)	Type (DW/ Pz/Spring)	Aquifer group	Date of collection of water sample
EKS-07	100m north of VKV Girls Hostel, Lr. Seijosa	92.996	26.94	131		Spring		11/11/2015 24/03/2016
EKS-08	Pakke, Papum	93.02	26.98	162		Spring		24/03/2016
EKS-09	Monai					TW		

Table 2.4: Chemical analysis result of collected post-monsoon water samples

Location	Type	pH*	EC*	Turbidity	TDS	CO_3^{-2*}	HCO_3^{-1*}	Cl^{-*}	SO_4^{-2}	NO_3^{-1}	F^-	Ca^{+2*}	Mg^{+2*}	TH*	Na*	K*	Fe
EKS-01	DW	8.03	245.3	0.3	122	BDL	40	5.955	3.8406456	1.1	0.17	20.8	80.582524	384	3.39	2.54	0.1
EKS-03	DW	7.89	123	0.2	63.7	BDL	100	15.88	19.008305	1	0.04	16	60.194175	288	2.94	2.65	0.04
EKS-09	TW	7.88	199	0.1	100	BDL	32	19.85	3.025854	1.3	0.18	9.6	58.252427	264	1.15	1.46	0.12
EKS-07	Spring	8.04	143.3	1.1	73.1	BDL	84	633.215	7.2565027	0.6	0.14	22.4	47.572816	252	3.22	3.77	0.18

2.2.3 Geophysical survey

VES survey was yet to be carried out in the area.

2.2.4 Exploratory Drilling

CGWB has started drilling activities since 2001 at Seijosa. As part of data geration activity one exploratory well was constructed during AAP 2015-16. One observation well is under construction. Water Resources Department, Govt. of Arunachal Pradesh had also constructed one tube well in this area. Following is a list of wells constructed by different agencies, well designs, etc.

Table 2.5: Details of exploratory wells in the study area

Village/ Location	Taluka/ Block	District	Toposheet No.	Lat	Long	Type of well (DW/BW/TW)	Depth (m)	Dia (mm)	Source/ Agency
Upper Seijosa	Seijosa	East Kameng	83	27.14	93.72	TW	72		CGWB
Lower Seijosa				26.93	92.99	TW	70	152.4mmX6m 152.4mmX3m 152.4mmX15m	CGWB
Monai				26.93	93.01	TW	68.3		WRD, Govt. of A.P.

CHAPTER 3.0

Data Interpretation, Integration and Aquifer Mapping

3.1 Data Interpretation

There is total dearth of data in this area due to remoteness of the region and poor communication.

During 2001 one exploratory well was drilled by Central Ground Water Board at Upper Seijosa and during AAP 2015-16 one exploratory well was constructed at Lower Seijosa. One observation well is also under construction. Besides these Water Resource Department had constructed one tube well at Monai, Seijosa. Based on lithological logs of these three wells the subsurface geology is interpreted along with geological map of the area.

Lithological log clearly shows that the subsurface formation is arenaceous and in the piedmont area unconsolidated aquifer is the main water bearing aquifer (Fig. 3.1).

Aquifer 1: **Unconsolidated Quaternary Aquifer**

Unconsolidated Quaternary aquifer consists of older and recent alluvium and flood plain deposits. CGWB constructed two deep tube wells at Seijosa. From the distribution of the grain size of the aquifer it can be inferred that the aquifer is formed by coalescing fan and/or terrace materials. The discharge of the tube wells varies from 16m^3/hr to 34m^3/day. Water level varies between 10 to 33mbgl during pre-monsoon. Details of aquifer parameters are shown in Table 3.1: Available data of tube wells at Seijosa

Village/ Location	Taluka/ Block	Lat	Long	Type of well (DW/BW /TW)	Depth (m)	Date of pumping Test	Draw down (m)	Transmissivity (m^2/day)	Storativity/ S.Yield	Specific Capacity (lpm/m of dd)	Source/ Agency
Upper Seijosa	Seijosa	27.16	93.75	TW	71		26	9.87	-		CGWB
Lower Seijos		27.13	93.77	TW				-	-		CGWB
Monai		27.14	93.75	TW	68.3		-	-	-	-	WRD

Ground water level

The depth to water level at Seijosa 2.31 to 3.65mbgl in pre-monsoon period and 1.36 to 15.82 m bgl in post-monsoon period. Dug well at the right hand side of river bank becomes dry during pre-monsoon. Seasonal fluctuation of water level in shallow aquifers as observed in dug wells is within 5 m.

Ground Water Movement

As the major portion of the area has more than 20% slopes, water table contour was not prepared. Generally the flow of groundwater in this area is from piedmont to flood plain or valley.

Spring Discharge: The discharge of the springs was measured during pre- and post-monsoon time by volumetric method.

Water quality: In total 6 numbers of Ground water samples from dug wells and springs representing Phreatic aquifer were collected and sent for analysis to Chemical Lab, NER, Guwahati. From Table 2.4 it is observed that the water is alkaline in nature and low TDS and EC values indicate juvenile character of the water. All the parameters are within permissible limit,

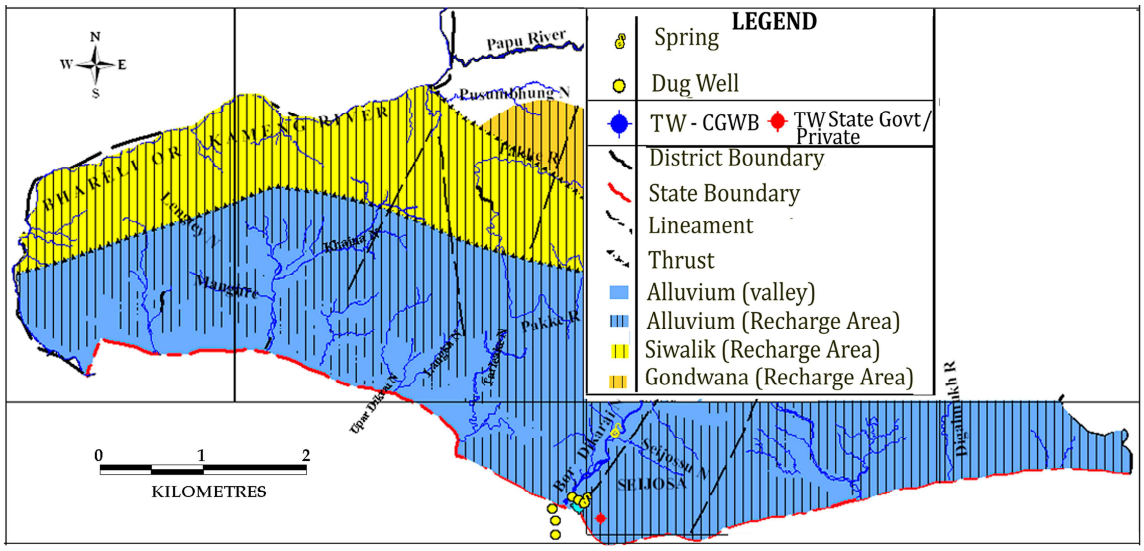


Fig. 3.1: Aquifer units of the Seijosa Block, East Kameng District, Arunachal Pradesh

4.0 Groundwater resources

The boundary of Seijosa block of East Kameng district is not demarcated. Major part of the study area has slopes more than 20%. Rechargable areas are confined within river and intermontane valleys only. Like other part of country, no land survey was conducted in this state. Village, circle or block wise geographical areas are not available. Even in 2011 census data only districtwise geographical areas are provided. Therefore, it was not possible to carry out blockwise resource calculation. Here district wise resource calculation is presented.

The computation of ground water resources available in the district has been done using GEC 1997 methodology. The total replenishable ground water resources available in the study area have been computed using the average water level fluctuations in observation wells and specific yield of aquifers. These have been normalised using normal rainfall data to eliminate variations in recharge due to excess or deficit rainfall. The monsoon recharge arrived at is then compared with the recharge computed using rainfall infiltration method. In cases where the difference between the two is more than 20 percent, the recharge is computed using ad hoc method.

The rechargeable area of the district is 31250ha which is nearly 8% of the total area of the district.

Recharge: The aquifers of the study area are recharged through a) infiltration of rainfall on the outcrop b) seepage from the tanks and ponds c) subsurface inflow across the updip margin. The area experiences south-east monsoon. Monsoon rainfall contributes approximately 87 percent of total rainfall (April, May, June, July, August, September) while share of post and pre monsoon rainfall are approximately 7 percent each.

The rainfall occurs almost in every month of a year. The month November to December has the minimum number of rainy days in any year and the period April to September has maximum number of rainy days. Rain fall infiltration factor is taken as 0.22. Specific yield value is considered to be 0.1.

The monsoon recharge of the 31250hectre of recharge worthy area is 13364 ham while non-monsoon recharge is 3030ham. Thus total ground water recharge is 163494ham.

Draft: The draft of unconsolidated aquifer and also the Siwalik aquifer is created by natural discharge like seepages, spring and draft created by human interference, viz., (a) withdrawals for irrigation and industry and (b) public-supply wells.

Seepages and springs are numerous in the study area. Perrenial springs in the study area are generally topographic. In the district natural discharge is considered to be 10% of the total groundwater recharge, i.e., 1639ham.

Irrigation draft is created by three shallow tube wells and pump fitted ten dug wells as per Water Reources Department data. Total draft created by these wells is 15ham. There is no industry in the area. Draft created by all the groundwater abstraction structure is 15ham. Draft for domestic uses is 2.5ham.

Total groundwater draft for all uses is only 17.5ham.

Allocation of resources up to 2025: The net ground water resource is allocated for domestic and industrial and irrigation sector. 14.0ham of resource is allocated for domestic and industrial purposes while 14726ham resource is allocated for irrigation.

Stage of groundwater development: The area has very little irrigation facilities. Similarly industrial development in the area is practically nil. Groundwater is mainly utilized for domestic purposes. However, Public Health Engineering & Water Supply Department has

supplied water mainly through surface water sources. The stage of groundwater development in the district is mere 0.1%.

Table 4.1: Net groundwater availability, existing draft and stage of development as March on 2013.

District	Recharge worthy area Ha	Total annual GW recharge Ham	Provision for natural discharge Ham	Net GW availability Ham (3-4)	Existing gross GW draft for all uses Ham	Stage of GW development [(6/5)*100 %]
1	2	3	4	5	6	7
East Kameng	31250	16394	1639	14755	17.5	0.119

Static resource: The static groundwater resource of the district has not been calculated for the base year 2009 due to non-availability of water level data.

Extraction from unconfined aquifer/deeper aquifer: As mentioned earlier that groundwater in this area is utilized mainly for drinking or domestic purposes. Dug wells are main groundwater abstraction structure.

As per 2011 census 138 numbers of village populations habituate in using water from untreated source predominantly from open well. Majority of villages use spring water.

5.0 Groundwater Related Issues

Identification of issues:

Groundwater resource utilization of this block is in nascent stage. Paddy is the principal crop of the area which means that the agriculture is mainly sustenance type and is mainly rain fed. The small population of the villages is met by spring or small stream.

Another reason for little utilization of groundwater resource is the bouldery nature of subsurface formation. The cost associated with drilling is high. Moreover, due to high permeability of the bouldery formation drilling or dug well excavation in comparatively higher terrace has to go deeper. Otherwise sustainable yield of groundwater is not possible.

Future demand scenario and stress aspects of the aquifer

Domestic Water Supply Demand: Future demand of water in the area will come from domestic and irrigation sector.

The projected population of Seijosa for 2025 will be 8613. Present public water supply data is not available.

The groundwater resource of this area is yet to develop to its full potentiality. Stage of groundwater development is merely one percent. Ground water occurrences of this area are controlled by geomorphic setting of the area. Ground water rechargeable area is limited to the valley portion of the area.

Table 5.1: Projected population and water demand for domestic purpose of the area

Block	% Decadal population growth	Projected Population			Projected Water Demand considering per person water need of 60litre per day (Ham)		
		2013	2025	2030	2013	2025	2030
Seijosa	37.62	5934	8613	9283	13	19	20

Quality issue: The water quality of the area is generally good for all uses.

Future demand for agriculture: Compared to the district total land area, cultivable land is very limited in the district. As per 2010-11 agriculture census, the net sown area of Seijosa block is 432ha. The net irrigated area is 103ha. Since there is little scope to increase net sown area, a paradigm shift of cropping pattern has to be made to increase agriculture production of the area.

In this area, large or medium surface irrigation scheme is difficult to adopt due to its topography and continuous stretch of cultivable land is not available. Therefore, groundwater based irrigation scheme coupled with small scale surface water irrigation has to be adopted. Paddy is cultivated in 150ha of land.

Table: 5.2: Block wise water requirement for winter paddy cultivation through irrigation

Block	Irrigated Area	Unirrigated Area	Total Area	Δ in m	Water requirement
Seijosa	85	65	150	1.2	78

Table 5.3: Block wise water requirement for rabi crops other than paddy through irrigation

Block	Total Area	Δ in m	Water requirement (Ham)
Seijosa	242	0.3	**72.6**

Stress Aspects of aquifer

Therefore the water requirement for the area can be summed up as follows:

Table 5.4: Total water requirement of the area

Block Name	Drinking water requirement up to 2025 Ham	Water requirement to bring unirrigated paddy field Ham	Water requirement to bring non-paddy cultivation under irrigation for Ham	Water allocated for drinking and domestic purposes up to 2025 Ham	Water allocated for irrigation up to 2025 Ham
Seijosa	19	78	72.6	14	14726

Supply and demand gap: It is observed that drinking water allocation is not sufficient to meet the future demand (Table 5.4). There will be excess of water if the entire un-irrigated area will bring under irrigation (Table 5.5).

Table 5.5: Supply and demand gap in drinking water sector

Block Name	Drinking water demand up to 2025 Ham	Water allocated for drinking and domestic purposes up to 2025 Ham	Gap between supply and demand (+ve indicates supply is above demand and –ve means demand is more than supply) Ham
Seijosa	19	14	(-) 5

Table 5.5: Supply and demand gap in irrigation

Block Name	Total irrigation demand Ham	Water allocated for irrigation up to 2025 Ham	60% of the allocated water for irrigation available for use	Gap between supply and demand (+ve indicates supply is above demand and –ve means demand is more than supply) Ham
Seijosa	150.6	14726	8836	(+) 8685

6.0 Management Strategies

From the available hydrogeological data and geology of the area, it can be inferred that the Quaternary alluvium is recharged mainly by infiltration of rainfall on the outcrop.

Discharge

The discharge from Quaternary aquifer occurs as (a) withdrawals for domestic purpose and (b) seepages and springs. The unconsolidated aquifer discharge occurs as (a) withdrawal for domestic purpose (b) base flow to river and (c) springs.

Present scenario of stress in aquifer: Currently there is no groundwater irrigation in the area as per Agriculture Census report 2010-11 and also 2011 Census data. Groundwater is entirely used for domestic purpose. Dug well census is not available.

Sustainable groundwater development plan: Groundwater has to play an important role in future for economic progress of the area and also for domestic water needs. Here recharge worthy areas is very limited and a narrow stretch of land is available for recharge. Construction of groundwater abstraction structures: Based on available groundwater resource and subsurface condition, the approximate numbers of tube wells that can be constructed in the area is worked out.

Groundwater draft is calculated for well discharge of $15m^3$/hr and $35m^3$/hr. If the well is allowed to run 10hrs a day for 150days of a year then a tube well having discharge of $15m^3$/hr will create a draft of 0.0225MCM while a tube well with $35m^3$/hr discharge will create a draft of 0.0525MCM.

Therefore with available resource of 8836ham and with 0.0225MCM draft 3927 numbers of tube wells and with 0.0525MCM draft 1683 numbers of tube wells can be constructed in the area.

However, based on total net sown area and total unirrigated status of the land is worked out. Therefore, the required numbers of tube wells are worked out and shown in Table 6.1.

Table 6.1: Numbers tube well required for irrigation

Block Name	Total irrigation demand Ham	No. of TW required with Q=$35m^3$/hr for 10 hrs pumping hrs for 150days Draft to be created =0.0525MCM	No. of TW required with Q=$15m^3$/hr for 10 hrs pumping hrs for 150days Draft to be created =0.0225MCM
Seijosa	174.8 or 1.748MCM	33	78

The pump test data of CGWB has indicated that the drawdown of the tube wells is generally high particularly in the area where bouldery formation is dominant. Therefore it is advisable to keep the discharge of tube wells within $15m^3$/hr.

Sustainable management plan should take care to increase recharge of rain water artificially. Increase recharge will fill the aquifer as well as lower surface run-off and soil erosion.

Perennial spring source may be nurtured properly to increase yield by constructing spring box and to take spring shed development programme wherever possible.

Demand side management

Demand side management implies sustainable management of water. In irrigation and in drinking water supply also sufficient quantity of water loss occurs. In the study area there is no groundwater irrigation and the surface water irrigation is provided through

unlined canals. Although cost of preparation of unlined canals is less, there is considerable water loss through unlined canals.

Water loss through supply canals can be minimized by proper lining in the canals. The wet rice cultivation of Apatani tribe in Zero Valley of Lower Subansiri is an example of efficient water management. The Apatanis utilized bamboo pipe or wooden lining in the distribution channel to effectively utilize the water resource for cultivation. Therefore, wooden or locally available materials can be utilized for lining canals.

Stress aspect and future demand

Numerical modelling and aquifer simulation study could not be done due to paucity of various data, it was not possible to test a model under different stress conditions.

However, stress aspects of aquifer are analyized for different situations.

Stress on aquifer due to drinking water supply: The population of the study area has been projected based on 2011 census data up to 2030. Based on this projected population drinking water demand of the area is calculated (Table 6.1).

Table 6.1: Drinking water demand up to 2030

	Projected Water Demand considering per person water need of 60litre per day			Projected Water Demand considering per person water need of 135litre per day		
Block	2013	2025	2030	2013	2025	2030
Seijosa	**5**	**6**	**14**	8.01	11.6	12.5

From the table it is observed that the maximum water demand of the area considering per person water need of 135litre per day is almost 4ham up to 2030. Since available groundwater up to 2025 is 14ham for the entire district, the increased demand may give stress on aquifer in case of sole dependency on groundwater. However, the water supply department is utilizing surface water to the people. The dependency on groundwater is as on today is very less.

Irrigation:

The total water requirement to bring the entire cultivable area is much less than the groundwater available up to 2025. So there will be no stress on aquifer. However, recently there is rubber plantation in the area. It is known that a rubber plant has deep root system to extract soil moisture and for this reason it is termed as water pump. Presently there is no water scarcity problem in the area, however, there is a need to take a sustainable water use policy for irrigation.

Therefore, following strategy is suggested for sustainable groundwater development

1) Conserve and improve traditional irrigation techniques. Traditionally perennial streams are used as source water for irrigation. Wherever irrigation from perennial stream exists they need to be preserved and modified so that cropping intensity can be increased.
2) Ground water abstraction structure for irrigation is feasible only in unconsolidated aquifer.
3) Water distribution mechanism should minimize water loss by using lining distribution canals. Locally available materials are to be preferred as these materials are cheap and eco-friendly.
4) Conservation of rain water in the up dip of cultivated field. During rabi season the conserved water can be drained to paddy field through gravity.