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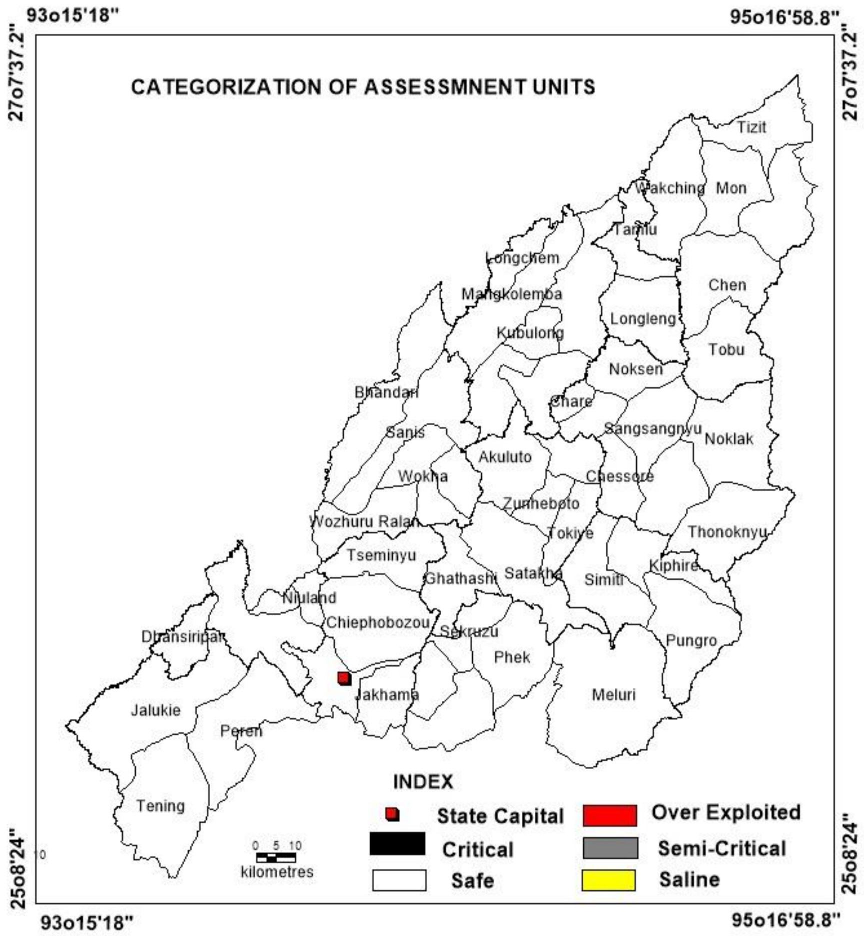
DYNAMIC GROUND WATER RESOURCES OF NAGALAND, 2023



CENTRAL GROUND WATER BOARD
NORTH EASTERN REGION
GUWAHATI
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DYNAMIC GROUND WATER RESOURCES OF NAGALAND, 2023

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PREFACE

The State of Nagaland, situated in the Northeast of India, comprises of hilly terrain bordered in parts of the west by low lying, alluvial tracts adjoining the State of Assam. It has three neighboring states, Arunachal Pradesh on north, Assam on west and Manipur on south. The State is located in the northern extension of the Arakan Yoma ranges representing orogenic upheavals in this part of the country during Cretaceous and Tertiary periods. The state is largely a hilly region and the highest mountain in the state is Saramati which is 3841 m above mean sea level.

Nagaland has large multicolored hilly terrain in the north eastern part of India. The hills are steep and are separated by rivers which flow either to the east or west creating deep gorges between the hill ranges. Inspite of good rainfall in the state, the major part of rainfall is lost as surface run-off except Dimapur valley. Hence, there is acute shortage of water during the summer. The prominent sources of water are streams, small rivers, springs and nallas which also act as main contributors to the ground water storage. There is necessity to assess the ground water resource potential of the state periodically for scientific planning of its development. Keeping this objective in view, the ground water resource potential of Nagaland has been reassessed based on 'Ground Water Resource Estimation Methodology – 2015' (GEC'15).

This report presents the Dynamic Ground Water Resources of Nagaland estimated based on GEC'2015 in web based IN-GRESS software with base year as 2020. The present assessment has been done for eleven districts. The annual extractable groundwater resources is 1.95 BCM, of which annual allocation for domestic needs up to 2025 is 0.02 BCM and 1.93 BCM is available for irrigation and other uses. Present stage of ground water extraction in the state is only 1.04%.

The estimation of dynamic groundwater resources for Nagaland was jointly done by the Directorate of Geology and Mining, Govt. of Nagaland and Central Ground Water Board, North Eastern Region. The efforts made by the scientists of Central Ground Water Board, North Eastern Region, Guwahati and Directorate of Geology and mining; Govt of Nagaland are commendable.

I firmly believe that the report will throw light on the Future Ground Water Availability for various uses including irrigation and domestic sectors and help the planners and policy makers in the ground water sector to formulate future ground water extraction and sustainable management plan for the state of Nagaland.

(Biplab Ray)

Regional Director/HOO

CGWB, NER, GUWAHATI

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CHAPTER: 1

INTRODUCTION

1.1 Background for re estimating the Ground Water Resources of Nagaland State

Groundwater is an important resource for meeting the water requirements for irrigation, domestic and industrial uses. The groundwater is available in the zone of water level fluctuation which is active recharge zone and replenished annually, i.e., dynamic as well as in the deeper zone below the water level fluctuation i.e., in in-storage condition. The dynamic groundwater resources, which are being used regularly, are reflected in the fluctuation of water levels. Apart from this, there are huge groundwater reservoirs in the deeper zones below the active recharge zone and in the confined aquifers in the areas covered by alluvial sediments of river basins, coastal and deltaic tracts constituting the unconsolidated formations and productive fracture zones in hard rock areas. The in-storage groundwater resource can be considered for development only during the period of extreme drought condition, and that too probably only to meet drinking water supply.

The previous assessment of groundwater resources of Nagaland was carried out as on March 2022. The groundwater resource of the state of Nagaland as on March 2023 has been re-assessed based on the new methodology, i.e., 'Ground Water Estimation Methodology', 2015 (GEC 2015) and modified database. Dynamic Ground Water Resource of Nagaland was automated through IN-GRES software (India Groundwater Resources Estimation System), a software/web-based application developed by CGWB in collaboration with Vassar Lab, IIT-Hyderabad.

The Annual extractable ground water resource was worked out as 70,693.74 Ham**.** The current gross ground water extraction for all uses was estimated as 2,044.19 Ham and the Stage of Ground Water Development was 2.89%.

1.2 Constitution of State Level Committee

The State Level Committee for re-estimation ground water resources as on March 2023 has been constituted by the Nagaland State Government vide notification NO. GM-25/CGW-1/2010, dated; 20.01.2022 (Annexure- I).

CHAPTER: 2

HYDROGEOLOGICAL CONDITIONS OF NAGALAND

2.1 Description of rock types

Geologically the state is covered by rocks ranging in age from Pre-Cretaceous to Recent. The rock sequences comprise the geosynclinal facies, represented by the Disang Group, the Barail Group, the Surma Group, the Tipam Group, the Namsang formation and the Dihing Group. While the Disang and Surma Group of rocks are mainly argillaceous, the Barail and Tipam groups are arrenacious. The Girujan clay formation overlying the Tipam sandstones is characterised by typical blue, mottled clay and argillaceous sand stone beds. Older rocks occupy southern parts of the State whereas younger rocks are exposed in the northern parts. Narrow, intermontane and open valleys are found to occur in part bordering Upper reaches of Brahmaputra flood plains of Assam. The valleys are mostly structurally controlled. Rock types found in valley areas comprise clay, sand pebble, cobble and boulder assemblages of unconsolidated nature.

The consolidated formations are confined to the south eastern part of the State along the Burma (Myanmar) border and the unconsolidated alluvial plains in the northern part of the state.

2.2 Hydrometeorological Conditions

The state of Nagaland enjoys sub-tropical humid climate with maximum temperature upto 38^o C and minimum winter temperature goes down to 2.2^o C. Humidity is very high ranging from 74 to 87%. Nagaland experiences the influence of the South West Tropical monsoon which persists from May to September, with occasional winter showers. The average annual rainfall of the state is recorded to be 1738 mm. The average number of rainy days in the state is around 135 days, varying from 60 to 190 days.

2.3 Ground Water conditions

Investigations carried out by CGWB shows that ground water development potentiality in valley fill and alluvial deposits are restricted to construction of open wells having depth of 15 to 20 metres and deep tube well down to 100 m depth which can give yield ranging from 10m^3/day to 45 m^3/day with more than 5 m drawdown. Water bearing formations pertaining to Tertiary deposits are found to have moderate potentials which can sustain deep tube wells having yield prospects varying from 10 to 20 m^3/hr. The valleys underlain by Tipam sandstones form good aquifers with yield prospects varying from 30 to 80 m^3/hr. In the consolidated formations, ground water abstraction structures can be constructed in structurally weak zones.

Ground water at deeper levels is found to occur under semi-confined to confined conditions. Auto flow zones have also been identified in some parts of the state. Ground water emerges as perennial springs which are the main source of water supply for domestic needs in the state.

Exploration carried out by CGWB infers that yield potential of deep tube well in the valley fill and alluvial formations ranges from 3 to 62 m^3/hr for considerable drawdown. The transmissivity ranges from 9 m^2/day to more than 300 m^2/day and permeability range varies from 0.4 m/day to 5 m/day.

Hydrogeological studies conducted by the CGWB infer that the deep tube wells can be constructed in alluvial, valley fill deposits and structurally weak zones of the semi-consolidated and consolidated formations. Development of perennial springs and providing storage for better supply can be adopted in the hilly areas.

2.4 Ground water quality

Ground water in general is good and can be used for irrigation, drinking and other purposes. In valley areas in some localities iron content exceeds drinking water quality permissible limit and needs treatment before use.

CHAPTER 3

GROUND WATER RESOURCES ESTIMATION METHODOLOGY, 2015

Ground water resources assessment of the state was done based on the recommendations of Ground Water Estimation Committee – 2015 (GEC'15) as on March 2023.

The revised methodology GEC 2015 recommends aquifer wise ground water resource assessment. Ground water resources have two components – Replenishable ground water resources or Dynamic ground water resources and In-storage resources or Static resources.GEC 2015 recommends estimation of Replenishable and in-storage ground water resources for both unconfined and confined aquifers. Wherever the aquifer geometry has not been firmly established for the unconfined aquifer, the in-storage ground water resources have to be assessed in the alluvial areas up to the depth of bed rock or 300m whichever is less. In case of hard rock aquifers, the depth of assessment would be limited to 100m. In case of confined aquifers, if it is known that ground water extraction is being taken place from this aquifer, the dynamic as well as in-storage resources are to be estimated. If it is firmly established that there is no ground water extraction from this confined aquifer, then only in-storage resources of that aquifer has to be estimated.

3.1 Periodicity of assessment

Keeping in view of the rapid change in ground water extraction, the GEC 2015 recommends that the resources should be assessed once in every three years. In addition, there will be an estimation of ground water extraction after the second year of each assessment.

3.2 Ground water assessment unit

This methodology recommends aquifer wise ground water resource assessment. An essential requirement for this is to demarcate lateral as well as vertical extent and disposition of different aquifers. A watershed with well-defined hydrological boundaries is an appropriate unit for ground water resource estimation if the principal aquifer is other than 44 alluvium. Ground water resources worked out on watershed as a unit, may be apportioned and presented on administrative units (block/taluka/mandal/ firka). This would facilitate local administration in planning of ground water management programmes. Areas occupied by unconsolidated sediments (alluvial deposits, aeolian deposits, coastal deposits etc.) usually have flat topography and demarcation of watershed boundaries may be difficult in such areas. Even if the demarcation is done, this may lead to trans boundary movement of ground water because of excessive pumping in one of the watersheds. Until Aquifer Geometry is established on appropriate scale, the existing practice of using watershed in hard rock areas and blocks/mandals/ firkas in soft rock areas may be continued.

3.3 Ground water assessment sub-units

It is recommended that ground water recharge may be estimated for the entire assessment unit. Out of the total geographical area of the unit, hilly areas wherever slope is greater than 20% are to be identified and subtracted as these areas have more runoff than infiltration. The hilly areas wherever slope is more than 20% may be demarcated using DEM data and geomorphological maps. This would allow the valleys, terraces, plateaus occurring within >20% slope zone to be considered for recharge computations. It is quite likely that with hilly areas, densely forested area may also be excluded; this may affect to some extent ground water losses caused due to transpiration by deep rooted trees in the area of assessment. Apart from this it is also important that the areas where the quality of ground water is beyond the usable limits (for drinking water in particular) in terms of salinity is to be identified and handled separately. This methodology recommends that after the assessment is done, a quality flag may be added to the assessment unit for parameters salinity, fluoride and arsenic.

In inhabited hilly areas, where surface and sub-surface runoff is high and generally water level data is missing, it is difficult to compute the various components of water balance equation. Hence, it is recommended that wherever spring discharge data is available, the same may be assessed as a proxy for ‘ground water resources’ in hilly areas. The assessment of spring discharge would constitute the ‘replenishable potential ground water resource’ but it will not be accounted for in the categorization of ground water assessment, at least not in the near future.

The ground water resource beyond the permissible quality limits in terms of the salinity has to be computed separately. The remaining area after excluding the area with poor ground water quality is to be delineated as follows:

(a) Non-command areas which do not come under major/medium surface water irrigation schemes. (command area <100 Ha in the assessment unit should be ignored)

(b) Command areas which come under major/medium surface water irrigation schemes which are supplying water (>100 Ha of command area in the assessment unit.)

It is proposed to have all these areas of an assessment unit in integer hectares to make it national database with uniform precision.

3.4 Ground water resources of an assessment unit

The ground water resources of any assessment unit is the sum of the total ground water availability in the principal aquifer (mostly unconfined aquifer) and the total ground water availability of semi-confined and confined aquifers existing in that assessment unit. The total ground water availability of any aquifer is the sum of dynamic ground water resources and the in-storage or static resources of the aquifer.

3.5 Methodology for calculation

3.5.1. Ground water assessment of unconfined aquifer:

As mentioned earlier, assessment of ground water includes assessment of dynamic and in-storage ground water resources. The development planning should mainly depend on dynamic resource only as it gets replenished every year. Changes in static or in-storage resources reflect impacts of ground water mining. Such resources may not be replenishable annually and may be allowed to be extracted only during exigencies with proper recharge planning in the succeeding excess rainfall years.

3.5.2. Assessment of annually replenishable or dynamic ground water resources:

The methodology for ground water resources estimation is based on the principle of water balance as given below –

Inflow – Outflow = Change in Storage (of an aquifer)

Equation 1 can be further elaborated as -

$$\Delta S = R_{RF} + R_{STR} + R_C + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B$$

Where,

ΔS – Change is storage

Inflow:

Recharge from Rainfall (Main source)

R_{RF} – Rainfall recharge

Recharge from other sources (Command and non command area)

R_{STR}- Recharge from stream channels

R_C– Recharge from canals

R_{SWI} – Recharge from surface water irrigation

R_{GWI}- Recharge from ground water irrigation

R_{TP}- Recharge from Tanks& Ponds

R_{WCS} – Recharge from water conservation structures
VF – Vertical inter aquifer flow
LF- Lateral flow along the aquifer system (throughflow)

Outflow:
GE-Ground Water Extraction
T- Transpiration
E- Evaporation
B-Base flow

3.5.3. Rainfall recharge

It is recommended that ground water recharge should be estimated on ground water level fluctuation and specific yield approach since this method takes into account the response of ground water levels to ground water input and output components. This, however, requires adequately spaced representative water level measurement for a sufficiently long period. It is proposed that there should be at least three spatially well distributed observation wells in the assessment unit, or one observation well per 100 sq. Km.

Water level data should also be available for a minimum period of 5 years (preferably 10years), along with corresponding rainfall data. Regarding frequency of water level data, two water level readings, during pre and post monsoon seasons, are the minimum requirement. It would be ideal to have monthly water level measurements to record the peak rise and maximum fall in the ground water levels. In units or subareas where adequate data on ground water level fluctuations are not available as specified above, ground water recharge may be estimated using rainfall infiltration factor method only. The rainfall recharge during non-monsoon season may be estimated using rainfall infiltration factor method only.

3.5.3.1. Ground water level fluctuation method

The ground water level fluctuation method is to be used for assessment of rainfall recharge in the monsoon season. The ground water balance equation in non-command areas is given by

$$\Delta S = R_{RF}+R_{STR}+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS}\pm VF \pm LF - GE - T - E - B$$

Where,

ΔS – Change is storage
R_{RF} – Rainfall recharge
R_{STR} - Recharge from stream channels
R_{SWI} – Recharge from surface water irrigation (Lift Irrigation)
R_{GWI} - Recharge from ground water irrigation

R_{TP} - Recharge from tanks& ponds
R_{WCS} – Recharge from water conservation structures
VF – Vertical inter aquifer flow
LF- Lateral flow along the aquifer system (throughflow)
GE-Ground water Extraction
T- Transpiration
E- Evaporation
B-Base flow
Whereas the water balance equation in command area will have another term i,e,
Recharge due to canals (RC) and the equation will be as follows:
$\Delta S = R_{RF}+R_{STR}+R_{C}+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS}\pm VF \pm LF - GE-T-E-B$
The change in storage can be estimated using the following equation:

$$\mathbf{\Delta S = \Delta h * A * SY}$$

Where
ΔS – Change is storage
$(\Delta S = R_{RF}+R_{STR}+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS}\pm VF \pm LF - GE-T-E-B)$
Δh - rise in water level in the monsoon season
A - area for computation of recharge
Sy - Specific Yield
Hence,
$R_{RF}= h \text{ x } Sy \text{ x } A - R_{STR} - R_{SWI} - R_{GWI} - R_{TP} - R_{WCS} \pm VF \pm LF + GE + T + E + B$
$R_{RF}= h \text{ x } Sy \text{ x } A - R_{STR} - R_{C} - R_{SWI} - R_{GWI} - R_{TP} - R_{WCS} \pm VF \pm LF + GE + T + E + B$
Normalization of Recharge due to rainfall during Monsoon season
Two methods as proposed by GEC 1997 can be employed

- Y=mx
- Y=mx+c equation

3.5.3.2 Rainfall Infiltration Factor method

The rainfall recharge estimation based on Water level fluctuation method reflects actual field conditions since it takes into account the response of ground water level. However, the ground water extraction estimation included in the computation of rainfall recharge using water level fluctuation approach is often subject to uncertainties. Therefore, it is recommended to compare the rainfall recharge obtained from water level fluctuation approach with that estimated using rainfall infiltration factor method. Recharge from rainfall is estimated by using the following relationship –

$R_{rf} = R_{FIF} * A * (R – a)/1000$

Where,

R_{rf}= Rainfall recharge in ham

A = Area in Hectares

R_{FIF} = Rainfall Infiltration Factor

R = Rainfall in mm

a = Minimum threshold value above which rainfall induces ground water recharge in mm.

It is suggested that 10% of Normal annual rainfall may be taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit. While computing the rainfall recharge, 10% of the normal annual rainfall is to be deducted from the monsoon rainfall and balance rainfall would be considered for computation of rainfall recharge. The same recharge factor may be used for both monsoon and non-monsoon rainfall, with the condition that the recharge due to non-monsoon rainfall may be taken as zero, if the normal rainfall during the non-monsoon season is less than 10% of normal annual rainfall. In using the method based on the specified norms, recharge due to both monsoon and non-monsoon rainfall may be estimated for normal rainfall, based on recent 30 to 50 years of data.

3.5.4. Recharge from other Sources

Recharge from other sources constitutes recharges from canals, surface water irrigation, ground water irrigation, tanks & ponds, and water conservation structures in command areas where as in non-command areas it constitutes the recharge due to surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures are possible.

3.5.4.1 Recharge from Canals:

Recharge due to canals is to be estimated based on the following formula:

R_C=WA * SF * Days

Where:

R_C= Recharge from Canals

WA=Wetted Area = Wetted Perimeter X Length of Canal Reach.

SF= Seepage Factor

Days= Number of Canal Running Days.

3.5.4.2 Recharge from Surface Water Irrigation:

Recharge due to applied surface water irrigation, either by means of canal outlets or by lift irrigation schemes is to be estimated based on the following formula:

R_{SWI} =AD*Days*RFF

Where:

R_{SWI} = Recharge due to applied surface water irrigation

AD= Average Discharge

Days=Number of days water is discharged to the Fields

RFF= Return Flow Factor

3.5.4.3 Recharge from Ground Water Irrigation:

Recharge due to applied ground water irrigation is to be estimated based on the following formula:

R_{GWI} =GEIRR*RFF

Where:

R_{GWI} = Recharge due to applied ground water irrigation

GEIRR= Ground Water Extraction for Irrigation

RFF= Return Flow Factor

3.5.4.4 Recharge due to Tanks & Ponds:

Recharge due to Tanks &Ponds is to be estimated based on the following formula:

RTP =AWSA*N *RF

Where:

RTP = Recharge due to Tanks & Ponds

AWSA= Average Water Spread Area

N=Number of days Water is available in the Tank/Pond

RF= Recharge Factor

3.5.4.5 Recharge due to Water Conservation Structures:

Recharge due to Water

Conservation Structures is to be estimated based on the following formula:

RWCS =GS*RF

Where:

RWCS = Recharge due to Water Conservation Structures

GS= Gross Storage = Storage Capacity multiplied by number of fillings.

RF= Recharge Factor

3.6. Evaporation and transpiration

It is recommended to compute the evaporation through field studies. If field studies are not possible, for areas with water levels within 1.0mbgl, evaporation can be estimated using the evaporation rates available for other adjoining areas. If depth to water level is more than 1.0mbgl, the evaporation losses from the aquifer should be taken as zero. Transpiration through vegetation can be estimated if water levels in the aquifer are within the maximum root zone of the local vegetation. Even though it varies from place to place depending on type of soil &vegetation, in the absence of field studies the following estimation can be followed. If water levels are within 3.5m bgl, transpiration can be estimated using the transpiration rates available for other areas. If it is greater than3.5m bgl, the transpiration should be taken as zero.

3.7 Total ground water recharge

The sum of the recharge/ accumulations during monsoon and non-monsoon seasons is the total annual ground water recharge/ accumulations for the sub unit.

3.7.1 Recharge/ Accumulations during Monsoon Season

The sum of normalized monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during monsoon season is the total recharge/ accumulation during monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

3.7.2 Recharge/ Accumulations during Non-Monsoon Season

The rainfall recharge during non-monsoon season is estimated using rainfall infiltration factor Method only when the non-monsoon season rainfall is more than 10% of normal annual rainfall. The sum of non-monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during non-monsoon season is the total recharge/ accumulation during non - monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

3.8 Annual extractable ground water resource (EGR)

The Total Annual Ground Water Recharge cannot be utilised for human consumption, since ecological commitments need to be fulfilled, before the extractable resources is defined. The National Water Policy, 2012 stresses that the ecological flow of rivers should be maintained. Therefore, ground water base flow contribution limited to the ecological flow of the river should be determined which will be deducted from Annual Ground Water Recharge to determine Annual Extractable Ground Water Resources (EGR). The ecological flows of the rivers are to be determined in consultation with Central Water Commission and other concerned river basin agencies.

EGR= TAGWR-B

Where,

ERG= Annual Extractable Ground Water Recharge

TAGWR= Total Annual Ground Water Recharge

B= Base Flow

(5% or 10% of annual recharge)

3.9 Estimation of ground water extraction

Ground water draft or extraction is to be assessed as follows.

$GE_{ALL} = GE_{IRR} + GE_{DOM} + GE_{IND}$

Where,

GE_{ALL}=Ground water extraction for all uses

GE_{IRR}=Ground water extraction for irrigation

GE_{DOM} =Ground water extraction for domestic uses

GE_{IND} = Ground water extraction for industrial uses

3.9.1 Ground Water Extraction for Irrigation (GEIRR)

Unit Draft Method: In this method, season-wise unit draft of each type of well in an assessment unit is estimated. The unit draft of different types (eg. Dug well,Dug cum bore well, shallow tube well, deep tube well, bore well etc.) is multiplied with the number of wells of that particular type to obtain season-wise ground water extraction by that particular structure.

Crop Water Requirement Method: For each crop, the season-wise net irrigation water requirement is determined. This is then multiplied with the area irrigated by ground water abstraction structures.

Power Consumption Method: Ground water extraction for unit power consumption\ (electric) is determined. Extraction per unit power consumption is then multiplied with number of units of power consumed for agricultural pump sets to obtain total ground water extraction for irrigation.

3.9.2 Ground Water Extraction for Domestic Use (GE_{DOM})

Unit Draft Method: In this method, unit draft of each type of well is multiplied by the number of wells used for domestic purpose to obtain the domestic ground water extraction.

Consumptive Use Method: In this method, population is multiplied with per capita consumption usually expressed in litre per capita per day (lpcd). It can be expressed using following equation.

GE_{DOM}= Population X Consumptive Requirement X Lg 24

Where,

Lg = Fractional Load on Ground Water for Domestic Water Supply

The Load on Ground water can be obtained from the Information based on Civic water supply agencies in urban areas.

3.9.3 Ground water Extraction for Industrial use (GEIND):

Unit Draft Method: In this method, unit draft of each type of well is multiplied by the number of wells used for industrial purpose to obtain the industrial ground water extraction.

Consumptive Use Pattern Method: In this method, water consumption of different industrial units is determined. The number of Industrial units which are dependent on ground water are multiplied with unit water consumption to obtain ground water extraction for industrial use.

GE_{IND}= Number of industrial units X Unit Water Consumption X Lg 25

Where,

Lg = Fractional load on ground water for industrial water supply

The load on ground water for industrial water supply can be obtained from water supply agencies in the Industrial belt.

3.10 Stage of ground water extraction

The stage of ground water extraction is defined by,

$$\text{Stage of GW Extraction (\%)} = \frac{\text{Existing gross ground water extraction for all uses}}{\text{Annual Extractable Ground water Resources}} \times 100$$

3.11 Validation of stage of ground water extraction

The estimation of ground water extraction is likely to be associated with considerable uncertainties as it is based on indirect assessment using factors such as electricity consumption, well census and area irrigated from ground water. Annual Extractable Ground Water Resources also has uncertainties due to limitations in the assessment methodology, as well as uncertainties in the data. In view of this, it is desirable to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels.

SOGWE	Ground Water Level Trend	Remarks
≤70%	Significant decline in trend in both pre-monsoon and post-monsoon	Not acceptable and needs reassessment
>100%	No significant decline in both pre-monsoon and post-monsoon long term trend	Not acceptable and needs reassessment

Categorization of Assessment Units

Stage of Ground Water Extraction	Category
≤70%	Safe
>70%and ≤90%	Semi-Critical
>90%and ≤100%	Critical
> 100%	Over Exploited

Categorisation of Assessment Units Based on Quality

Sub unit	Category
Command	Fresh
Non command	Fresh
Poor ground water quality- Salinity	Poor-Salinity hazard
Poor ground water quality- Fluoride	Poor-Flouride hazard
Poor ground water quality- Arsenic	Poor-Arsenic hazard

3.12 Allocation of ground water resource for utilization

Alloc = 22 * N * L_g mm per year

Where

Alloc=Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

Lg = fractional load on ground water for domestic water supply (≤1.0)

3.13 Net annual ground water availability for future use

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge.

3.14 Additional potential resources under specific conditions

3.14.1 Potential Resource Due to Spring Discharge:

The spring discharge is equal to the ground water recharge minus the outflow through evaporation and evapotranspiration and vertical and lateral sub-surface flow. Thus, Spring Discharge is a form of 'Annual Extractable Ground Water Recharge'. It is a renewable resource, though not to be used for Categorization.

Potential ground water resource due to springs (PRS) = Q x No of days

Where

Q= Spring Discharge

No of days= No of days spring yields

3.14.2 Potential Resource in Waterlogged and Shallow Water Table Areas:

In the area where the ground water level is less than 5m below ground level or in waterlogged areas, the resources up to 5m below ground level are potential and would be available for development in addition to the annual recharge in the area. It is therefore recommended that in such areas, ground water resources may be estimated up to 5m bgl only assuming that where water level is less than 5m bgl, the same could be depressed by pumping to create space to receive recharge from natural resources.

Potential ground water resource in shallow water table areas = (5-D) * A * SY

Where,

D = Depth to water table below ground surface in pre-monsoon period in shallow aquifers.

A = Area of shallow water table zone.

S_Y = Specific Yield

3.14.3 Potential Resource in Flood Prone Areas:

Ground water recharge from a flood plain is mainly the function of the following parameters-

- Areal extent of flood plain
- Retention period of flood
- Type of sub-soil strata and silt charge in the river water which gets deposited and controls seepage

Since collection of data on all these factors is time taking and difficult, in the meantime, the potential resource from flood plain may be estimated on the same norms as for ponds, tanks and lakes. This has to be calculated over the water spread area and only for the retention period using the following formula.

Potential ground water resource in Flood Prone Areas = 1.4 *N * A/1000

Where

N = No of Days Water is Retained in the Area

A = Flood Prone Area

CHAPTER: 4

PROCEDURES FOLLOWED IN THE PRESENT ASSESSMENT

4.1 Ground water assessment unit

This methodology recommends aquifer wise ground water resource assessment. An essential requirement for this is to demarcate lateral as well as vertical extent and disposition of different aquifers. Aquifer wise resource assessment of the state of Nagaland is not possible due to unavailability of adequate data.

For the first time as per the recommendations assessment of ground water resources has been carried out block wise. Due to paucity of data for reassessment of ground water resources as on March 2023, only 52 block (as per census 2011) has been considered as assessment units. The areas having a slope of more than 20% are identified and subtracted from the total geographical area (area as per 2011 census) of the district as these areas have more runoff than infiltration. The remaining area of each district is considered as recharge worthy area and accordingly ground water resource for that area in each district is calculated.

4.2 Resource Assessment for Command and Non command area

It is recommended that ground water recharge may be estimated for the entire assessment unit. Out of the total geographical area of the unit, hilly areas wherever slope is greater than 20% are to be identified and subtracted as these areas have more runoff than infiltration. The hilly areas wherever slope is more than 20% may be demarcated using SRTM-DEM data and geomorphological maps.

4.3 Resource Assessment for poor Water Quality Area

No poor ground water quality zone has been demarcated in the state.

4.4 resource assessment for Unconfined and confined aquifer

4.5 Ground water extraction:

As per GEC'15 methodology Ground water draft is renamed as ground water extraction. Gross ground water extraction includes ground water extraction from all existing ground water structures from irrigation and domestic uses and from industrial uses both during monsoon and non monsoon season.

4.5.1 Domestic extraction:

The domestic draft for the state of Nagaland has been calculated as per data and information on drinking water status in rural from 2011 census.

4.5.2 Irrigation extraction:

The total number of irrigation structures is taken from 6th Minor Irrigation Census, Nagaland (2013-2014).

4.5.3 Industrial extraction:

The district wise average unit draft for industries is calculated from ground water extraction demand placed by various industries for issuance of no objection certificate (NOC) from Central Ground Water Authority. The industrial draft has been calculated only for Dimapur and Kohima districts since data is available only for these two districts.

4.6 Ground water Recharge

The resources assessment during monsoon season is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying water level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. During non-Monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-Monsoon recharge. In case of areas receiving less than 10% of the annual rainfall during non-monsoon season, the rainfall recharge is ignored.

4.7 Total annual ground water recharge or accumulation

The total annual ground water recharge of the area is the sum-total of monsoon and non-monsoon recharge. An allowance is kept for natural discharge (as per GEC'97) in the non-monsoon season by deducting 5% of total annual ground water recharge, if WLF method is employed to compute rainfall recharge during monsoon season and 10% of total annual ground water recharge if RIF method is employed before getting the **annual extractable ground water resource**.

4.8 Stage of ground water development & Categorization of units

The stage of Ground water Development is defined by,

$$\text{Stage of Ground water Development (\%)} = \frac{\text{Existing Gross Ground water Draft for all uses}}{\text{Net annual Ground water Availability}} \times 100$$

Water level data is available only for the district Dimapur but the results could not be validated using water level fluctuation method because the data is not continuous.

4.9 Allocation of ground water resource for utilization

The net annual ground water availability is to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, 2012, requirement for domestic water supply is to be accorded priority. The ground water requirement for domestic water supply is to be kept based on projected population to 2025. The GEC' 15 methodology provides following empirical formula for allocation of ground water for domestic requirement

$$\mathbf{A = 22 * N * L_g}$$

Where,

A = Allocation for domestic in mm/year.

N = Projected Population density in assessment unit in thousands per square kilometer.

L_g= Fractional Load on ground water for domestic and industrial water supply (≤ 1.0)

The net ground water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge.

4.9 Additional potential recharge

Additional potential recharge for spring discharge could not be calculated as requisite data like spring discharge/number of days running is not available.

CHAPTER: 5

COMPUTATION OF GROUND WATER RESOURCES ESTIMATION AS ON MARCH 2023

5.1 Total Resources of the state

The total annual ground water recharge in the state of Nagaland is 60,306.63 ham. The Annual extractable ground water resource of the state worked out to be 54,275.97 ham after deducting the natural discharge during non-monsoon season. Current annual gross ground water extraction for all uses is 2,040.12 ham. The Net Ground water availability for future use is estimated to be 52,135.22 ham.

5.2 Spatial variation of resources

The over-all stage of ground water development of the state is 2.89%. All the districts of the state fall under safe category.

5.3 Comparison with the earlier ground water resources estimate and reasons for Significant departure from earlier estimates

A comparison is made between the previous estimate based on GEC'15 as on 2020 and present estimate based on GEC'15 as on March, 2022 and presented in tabular statement given below. The comparison depicts that there is a decrease in total annual net ground water recharge by about 18242 ham in the 2023 estimate. This change in ground water recharge is mainly due paucity of block wise data as compared to district wise data during the previous assessment years.

Comparison between ground water resources estimation for Nagaland for 2022 and 2023 (based on GEC'15)

Sl. No.	ITEM	GEC'15 (2020)	GEC'15 (2022)	COMPARISON
1	Total annual ground water recharge	78,548.63	60,306.63	Decrease by 18242 ham
2	Annual extractable ground water resource (HAM)	70,693.74	54,275.97	Decrease by 16417.77 ham
3	Current annual gross Ground Water extraction for all uses (HAM)	2,044.19	2,040.12	Decreased by 4.07 ham
4	Annual allocation of ground water for domestic water supply as on 2025 (HAM)	1,961.80	1,911.35	Decrease by 50.45 ham

5	Net Ground water availability for future use (HAM)	68,530.17	52,135.22	Decrease by 16394.95 ham
6	Stage of Ground Water extraction (HAM)	2.89%	3.75%	Increase by 0.86%

5.4 Ground water recharge in poor ground water quality zone

No poor ground water quality zone has been demarcated in the state.

5.5 Additional Annual Potential Recharge in Shallow Water and flood prone areas

Additional annual potential recharge in shallow water areas has not been calculated due to non-availability of data.

CHAPTER 6

AUTOMATION OF ESTIMATION OF DYNAMIC GROUND WATER RESOURCES USING GEC-2015 THROUGH IN-GRES

The Automation of dynamic ground water resource estimation of Nagaland for the year 2022-23 has been done through IN-GRES software (India Ground Water Resource Estimation System). IN-GRES is the common portal to input, estimate, analyze, and access static and dynamic groundwater resources. India GEC system will take Data Input through Excel as well as through Forms, compute various Ground water components (recharge, draft, flux, etc.), classify assessment unit into appropriate categories, develop visibility dashboards for each of the components. System allows user to view the data in both MIS as well as GIS view. User can also download the reports in formats like CGWB, etc.

India GEC system is divided into 3 modules – Input, Computation and Output.

i. Input module – Input Module refers to the Data Entry module at an Assessment Unit level. Data Input is done via 2 methods i.e.
a. Excel based input – In this, the user needs to download Block level data sheet template where he/she can fill the data at an Assessment Unit level. User now needs to upload their fully filled excel sheet into the system.
b. Form based input – In this, the user is shown a form and he/she can fill/edit the data in data sheet in an online mode. Once user is done with editing online, he/she can submit the data file.

ii. Computation module – Computation Module refers to the ground water calculations for an assessment unit. These computations are based on GEC 2015 methodology and are used to calculate Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of ground water utilization with respect to recharge (stage of Ground Water Extraction) for an assessment unit. Based on these percentages an assessment unit is categorized into Safe, Semi-critical, Critical and Over-exploited categories.

iii. Output module-Once categorized the data is shown in two views:
a. MIS Dashboard – MIS dashboard shows the results of the assessment for the entire India, and also State wise in tabular form. The MIS dashboard shows all type of recharges, extractions, inflows and outflows computed for both monsoon and non-monsoon periods of the year and then reflect the overall stage of extraction at the selected Geo-Zoom Level.
b. GIS Dashboard – GIS dashboard shows the data in Web Geo-Server format, implemented in interactive GIS platform allowing user to all GEC related information in the map itself. GIS view represents the data on India map and color codes each Block/Assessment unit based on the categorization.

ANNEXURE I

GOVERNMENT OF NAGALAND
GEOLOGY & MINING DEPARTMENT
NAGALAND:KOHIMA

NOTIFICATION

Dated Kohima the, Oct.2020

NO.GM-25/G&M/1/2020: : In supersession of this Department's notification of even number dated 24th August, 2017 , the Governor of Nagaland is pleased to constitute the State Level Committee for Assessment of Dynamic Ground Water Resources, 2020 of Nagaland with the following members :-

1.	Principal Secretary, G&M	-	Chairman
2.	Regional Director, CGWB (NER) Guwahati	-	Member Secy.
3.	Representative, P.H.E. Deptt.	-	Member
4.	Representative, Soil & Water Conservation Deptt.	-	Member
5.	Representative, Water Resource Deptt.	-	Member
6.	Representative, Urban Development Deptt	-	Member
7	Shri Nitovi Chishi, Jt. Director Nodal Officer i/c Ground Water	-	Member

Sd/- **S.RADHAKHRISHNAN,IAS**
Principal Secretary to the Govt. of Nagaland

NO.GM-25/G&M/1/2020 /225
Dated Kohima the, Oct.2020

Copy to:-

1. The OSD to the Chief Secretary, Nagaland, Kohima.
2. All members of the State Level Committee
3. Office copy/Guard File

19/10/2020

(KEKHREIZAVI LEA)
OSD to the Govt. of Nagaland

ANNEXURE II

MINUTES OF THE STATE LEVEL COMMITTEE (SLC) ON DYNAMIC GROUND WATER RESOURCES OF NAGALAND AS ON MARCH 2023

Date: 4th September 2023 **Time: 11.00 hrs.**

(Meeting Platform: Online through Google Meet/ Virtual Mode)

The State Level Committee (SLC) on Ground Water Resources of Nagaland as on March 2023 was convened on 4th September 2023 at 11.00 hrs through virtual mode in google meet.

The meeting was chaired by Sri Kekhriezavi Lea, OSD to Govt. of Nagaland, Geology & Mining on behalf of Principal Secretary to the Govt. of Nagaland, Geology & Mining & Chairman of SLC. The Chairman of the SLC welcomed all the members of SLC present in the meeting. List of members attended in the meeting is enclosed as Annexure-I.

Sri Biplab Ray, Regional Director/HOO, CGWB, NER has extended his warm welcome to all the representative members of the SLC, Nagaland. He also expressed his sincere thanks to all SLC members and chairman for the support and guidance in carrying out the assessment a success.

Dr. S S Singh, Scientist-D(Hg) & OIC, GWRA highlighted that Ground Water Resources of Nagaland 2023 has been carried out jointly by Central Ground Water Board, NER, Guwahati and Directorate of Geology & Mining, Govt. of Nagaland (State Nodal Department) in coordination with other members/state departments of SLC. He briefed about computation of dynamic ground water resources of Nagaland 2023 through IN-GRES software/web-based application developed by CGWB in collaboration with Vassar Lab, IIT-Hyderabad. The Dynamic Ground Water Resource of Nagaland,2023 has been carried out at block level by considering 52 nos. of blocks as assessment unit.

Presentation of the Dynamic Groundwater resources of Nagaland as on March 2023 was made by Ms. Wonjano Mozhui, Scientist-C along with the senior officers of CGWB, NER Guwahati where she explained the methodology of Ground Water Resource Estimation along with findings and comparison between GWRE 2022 and GWRE 2023.

With due permission of the Chair, committee members of SLC discussed in detail on the methodology of resource estimation, various factors utilized /considered as per norm or otherwise, constrains of non-availability of various field data, source of various field data utilized for resource calculation etc.

SLC members agreed upon on sharing of block level well (govt/private) information such as data on tube well, dug well, bore wells, block level population data etc. for the new 16 districts of Nagaland in the Ground Water Resource Assessment of Nagaland,2024.

After thorough discussion all the members of the State Level Committee (SLC) has agreed and accepted upon the figures in the draft report of Dynamic Ground Water Resources of Nagaland for the Assessment Year 2022-23 as on March 2023.

(Sri Biplab Ray)
Regional Director/HOO, CGWB NER
& Member Secretary, SLC

(Sri Kekhriezavi Lea)
OSD to Govt. of Nagaland,
Geology & Mining for Chairman, SLC

ANNEXURE III

ANNEXURE I

LIST OF MEMBERS ATTENDED

1. Sri Kekhriezavi Lea OSD to Govt. of Nagaland, Geology & Mining for Principal Secretary to the Govt. of Nagaland, Geology & Mining & Chairman of SLC
2. Sri Biplab Ray, Regional Director/HOO, CGWB, NER & Member Secretary, SLC, Mizoram
3. Dr. S S Singh, Scientist-D(HG) & OIC, GWRA, Central Ground Water Board, NER, Guwahati
4. Er.L. Leyang Khiamniungan, Superintending Engineer (PT), Public Health Engineering Department, Nagaland, New Capital Complex, Kohima,797004
5. Er. Sobu Angami, Superintending Engineer-III, Water Resource Department, Nagaland, New Capital Complex, Kohima,797004
6. Sri Asingbow Newmai, Joint Director & Nodal Officer GW & GWRA-Nagaland, Directorate of Geology & Mining, Nagaland, Dimapur
7. Sri V Kezo, Scientist-C, Central Ground Water Board, NER, Guwahati
8. Ms Wonjano Mozhui, Scientist-C, Central Ground Water Board, NER, Guwahati
9. Er. Sedevelie Suoho, SDO, Public Health Engineering Department, Nagaland, New Capital Complex, Kohima,797004
10. Er. Sumo T, SDO, Public Health Engineering Department, Nagaland, New Capital Complex, Kohima,797004
11. Er. L. Nokpfo K, SDO, Public Health Engineering Department, Nagaland, New Capital Complex, Kohima,797004
12. Dr.O. Chunchibeni Ezung, Hydrogeologist, Public Health Engineering Department, Nagaland, New Capital Complex, Kohima,797004
13. Myngthungo Jami, Geologist, Directorate of Geology & Mining, Nagaland, Dimapur
14. Tsino Viya, Geologist, Directorate of Geology & Mining, Nagaland, Dimapur
15. Daventhung, Asst. Geologist, Directorate of Geology & Mining, Nagaland, Dimapur
16. Tosang Chang, Asst. Geologist, Directorate of Geology & Mining, Nagaland, Dimapur
17. Lipoklemla Jamir, Asst.Geologist, Directorate of Geology & Mining, Nagaland, Dimapur
18. Subongsenla, Asst. Geologist, Directorate of Geology & Mining, Nagaland, Dimapur

Table 1: Type of Ground Water Assessment Unit and Characteristics of Ground Water Year		
Name of State / Union Territory		NAGALAND
Ground Water Assessment Year		2021-22
1	Predominant type of Aquifer System (Alluvial/ Non-Alluvial)	Non-Alluvial
2	Predominant monsoon (South-west/ North-east/ Both)	South-West
3	If predominant monsoon is, 'South – west', The time when it usually commences (late May or early June/ late June or early July)	Late May or Early June
4	Type of Ground Water Assessment Unit (Block / Taluka / Mandal / Firka/ Watershed)	Block
5	Ground Water Year (June to May / July to June October to September)	June to May
6	Monsoon Season (June to September / July to October / October to December / June to December)	June to September
7	Non – monsoon Season (October to May / November to June / January to September / January to May)	October to May
8	Month of Pre – monsoon Monitoring (May / June / September)	March
9	Month of Post – monsoon Monitoring (October / November / January)	November

TABLE 2: GENERAL DESCRIPTION OF THE GROUND WATER ASSESSMENT UNIT OF NAGALAND (as on March, 2023) (in ham)

District	Name of Ground Water Assessment Unit	Type of rock formation	Areal extent (in hectares)						
			Total Geographical Area	Hilly Area	Ground Water Recharge Worthy Area			Shallow Water Table Area	Flood Prone Area
					Command area	Non-command area	Poor ground water quality area		
Zunheboto	Akuluto	Semi-consolidated (Tertiary)	26974	24270.72	NIL	24270.72	NA	NA	NA
Wokha	Bhandari	Semi-consolidated (Tertiary)	49715	26844.9	NIL	26844.9	NA	NA	NA
Mokokchung	Changtongya	Semi-consolidated (Tertiary)	42289	27987.18	NIL	27987.18	NA	NA	NA
Tuensang	Chare	Semi-consolidated (Tertiary)	8271	7759.96	NIL	7759.96	NA	NA	NA
Mon	Chen	Semi-consolidated (Tertiary)	37708	25240.25	NIL	25240.25	NA	NA	NA
Tuensang	Chessore	Semi-consolidated (Tertiary)	22679	21723.66	NIL	21723.66	NA	NA	NA
Kohima	Chiephobozou	Semi-consolidated (Tertiary)	59656	47075	NIL	47075	NA	NA	NA
Wokha	Chukitong	Semi-consolidated (Tertiary)	14534	9611.22	NIL	9611.22	NA	NA	NA
Dimapur	Dhansiripar	Alluvium/ Semi-consolidated	21215	4612.78	NIL	4612.78	NA	NA	NA
Zunheboto	Ghathashi	Semi-consolidated (Tertiary)	23100	21198.35	NIL	21198.35	NA	NA	NA
Kohima	Jakhama	Semi-consolidated (Tertiary)	24600	20107.27	NIL	20107.27	NA	NA	NA
Peren	Jalukie	Semi-consolidated (Tertiary)	65871	31533.47	NIL	31533.47	NA	NA	NA
Phek	Kikruma	Semi-consolidated	16620.55	15569.25	NIL	15569.25	NA	NA	NA

		(Tertiary)							
Kiphire	Kiphire	Semi-consolidated (Tertiary)	25420	24376.39	NIL	24376.39	NA	NA	NA
Kohima	Kohima	Semi-consolidated (Tertiary)	25655	21948.58	NIL	21948.58	NA	NA	NA
Mokokchung	Kubulong	Semi-consolidated (Tertiary)	12773	8426.06	NIL	8426.06	NA	NA	NA
Dimapur	Kuhoboto	Alluvium/ Semi-consolidated	6976	2971.25	NIL	2971.25	NA	NA	NA
Mokokchung	Longchem	Semi-consolidated (Tertiary)	14100	9088.17	NIL	9088.17	NA	NA	NA
Tuensang	Longkhim	Semi-consolidated (Tertiary)	14989	14375.33	NIL	14375.33	NA	NA	NA
Longleng	Longleng	Semi-consolidated (Tertiary)	34503.56	27159.02	NIL	27159.02	NA	NA	NA
Mokokchung	Mangkolemba	Semi-consolidated (Tertiary)	44812	29712.33	NIL	29712.33	NA	NA	NA
Dimapur	Medziphema	Alluvium/ Semi-consolidated	55165	17984.97	NIL	17984.97	NA	NA	NA
Phek	Meluri	Semi-consolidated (Tertiary)	97649.74	92364.4	NIL	92364.4	NA	NA	NA
Mon	Mon	Semi-consolidated (Tertiary)	25278	14953.48	NIL	14953.48	NA	NA	NA
Dimapur	Niuland	Alluvium/ Semi-consolidated	9344	4085.33	NIL	4085.33	NA	NA	NA
Tuensang	Noklak	Semi-consolidated (Tertiary)	57107	55070.36	NIL	55070.36	NA	NA	NA
Tuensang	Noksen	Semi-consolidated (Tertiary)	28340	27101.94	NIL	27101.94	NA	NA	NA
Mokokchung	Ongpangkong North	Semi-consolidated (Tertiary)	24572	16235.77	NIL	16235.77	NA	NA	NA
Mokokchung	Ongpangkong South	Semi-consolidated (Tertiary)	22954	15007.53	NIL	15007.53	NA	NA	NA
Peren	Peren	Semi-consolidated (Tertiary)	47063	32960.7	NIL	32960.7	NA	NA	NA
Phek	Pfutsero	Semi-consolidated (Tertiary)	30044.41	28155.3	NIL	28155.3	NA	NA	NA
Phek	Phek	Semi-consolidated (Tertiary)	40088.02	39011.05	NIL	39011.05	NA	NA	NA
Mon	Pomching	Semi-consolidated (Tertiary)	26015	16331.73	NIL	16331.73	NA	NA	NA

Kiphire	Pungro	Semi-consolidated (Tertiary)	56500	55128.22	NIL	55128.22	NA	NA	NA
Tuensang	Sangsangnyu	Semi-consolidated (Tertiary)	35307	33823.74	NIL	33823.74	NA	NA	NA
Wokha	Sanis	Semi-consolidated (Tertiary)	44379	25944.28	NIL	25944.28	NA	NA	NA
Zunheboto	Satakha	Semi-consolidated (Tertiary)	38774	36680.75	NIL	36680.75	NA	NA	NA
Phek	Sekruzu	Semi-consolidated (Tertiary)	18197.28	16191	NIL	16191	NA	NA	NA
Tuensang	Shamator	Semi-consolidated (Tertiary)	33609	32326.72	NIL	32326.72	NA	NA	NA
Kiphire	Simiti	Semi-consolidated (Tertiary)	31080	29919.19	NIL	29919.19	NA	NA	NA
Zunheboto	Suruhoto	Semi-consolidated (Tertiary)	12024	11258.74	NIL	11258.74	NA	NA	NA
Longleng	Tamlu	Semi-consolidated (Tertiary)	21696.44	16151.36	NIL	16151.36	NA	NA	NA
Peren	Tening	Semi-consolidated (Tertiary)	52166	36767.39	NIL	36767.39	NA	NA	NA
Tuensang	Thonoknyu	Semi-consolidated (Tertiary)	53298	51294.86	NIL	51294.86	NA	NA	NA
Mon	Tizit	Semi-consolidated (Tertiary)	23861	13493.44	NIL	13493.44	NA	NA	NA
Mon	Tobu	Semi-consolidated (Tertiary)	31288	26588.39	NIL	26588.39	NA	NA	NA
Zunheboto	Tokiye	Semi-consolidated (Tertiary)	14966	14060.06	NIL	14060.06	NA	NA	NA
Kohima	Tseminyu	Semi-consolidated (Tertiary)	36389	28905.58	NIL	28905.58	NA	NA	NA
Mon	Wakching	Semi-consolidated (Tertiary)	34450	20480.27	NIL	20480.27	NA	NA	NA
Wokha	Wokha	Semi-consolidated (Tertiary)	26904	16256.92	NIL	16256.92	NA	NA	NA
Wokha	Wozhuru Ralan	Semi-consolidated (Tertiary)	27268	17222.06	NIL	17222.06	NA	NA	NA
Zunheboto	Zunheboto	Semi-consolidated (Tertiary)	9662	9045.91	NIL	9045.91	NA	NA	NA
			1657900	**1272392.58**		**1272392.6**			

TABLE 3: DATA VARIABLES USED IN DYNAMIC GROUND WATER RESOURCES OF NAGALAND (as on March, 2023)

Sl No	Assessment Unit	Command/Non-command/Poor GW Quality	Rainfall (mm)	Average Pre-monsoon Water level (mbgl)	Average Post-monsoon Water Level (mbgl)	Average Post-monsoon Water Level (mbgl)
1	Akuluto	Command	NA	NA	NA	NA
		Non-Command	24270.72	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
2	Bhandari	Command	NA	NA	NA	NA
		Non-Command	26844.9	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
3	Changtongya	Command	NA	NA	NA	NA
		Non-Command	27987.18	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
4	Chare	Command	NA	NA	NA	NA
		Non-Command	7759.96	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
5	Chen	Command	NA	NA	NA	NA
		Non-Command	25240.25	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
6	Chessore	Command	NA	NA	NA	NA
		Non-Command	21723.66	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
7	Chiephobozou	Command	NA	NA	NA	NA
		Non-Command	47075	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
8	Chukitong	Command	NA	NA	NA	NA
		Non-Command	9611.22	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
9	Dhansiripar	Command	NA	NA	NA	NA
		Non-Command	4612.78	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
10	Ghathashi	Command	NA	NA	NA	NA
		Non-Command	21198.35	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
11	Jakhama	Command	NA	NA	NA	NA
		Non-Command	20107.27	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
12	Jalukie	Command	NA	NA	NA	NA
		Non-Command	31533.47	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
13	Kikruma	Command	NA	NA	NA	NA
		Non-Command	15569.25	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
14	Kiphire	Command	NA	NA	NA	NA
		Non-Command	24376.39	NA	NA	NA

		Poor GW Quality	NA	NA	NA	NA
15	Kohima	Command	NA	NA	NA	NA
		Non-Command	21948.58	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
16	Kubulong	Command	NA	NA	NA	NA
		Non-Command	8426.06	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
17	Kuhoboto	Command	NA	NA	NA	NA
		Non-Command	2971.25	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
18	Longchem	Command	NA	NA	NA	NA
		Non-Command	9088.17	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
19	Longkhim	Command	NA	NA	NA	NA
		Non-Command	14375.33	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
20	Longleng	Command	NA	NA	NA	NA
		Non-Command	27159.02	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
21	Mangkolemba	Command	NA	NA	NA	NA
		Non-Command	29712.33	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
22	Medziphema	Command	NA	NA	NA	NA
		Non-Command	17984.97	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
23	Meluri	Command	NA	NA	NA	NA
		Non-Command	92364.4	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
24	Mon	Command	NA	NA	NA	NA
		Non-Command	14953.48	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
25	Niuland	Command	NA	NA	NA	NA
		Non-Command	4085.33	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
26	Noklak	Command	NA	NA	NA	NA
		Non-Command	55070.36	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
27	Noksen	Command	NA	NA	NA	NA
		Non-Command	27101.94	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
28	Ongpangkong North	Command	NA	NA	NA	NA
		Non-Command	16235.77	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
29	Ongpangkong South	Command	NA	NA	NA	NA
		Non-Command	15007.53	NA	NA	NA

		Poor GW Quality	NA	NA	NA	NA
30	Peren	Command	NA	NA	NA	NA
		Non-Command	32960.7	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
31	Pfutsero	Command	NA	NA	NA	NA
		Non-Command	28155.3	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
32	Phek	Command	NA	NA	NA	NA
		Non-Command	39011.05	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
33	Pomching	Command	NA	NA	NA	NA
		Non-Command	16331.73	NA	NA	NA
		Command	NA	NA	NA	NA
34	Pungro	Command	NA	NA	NA	NA
		Non-Command	55128.22	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
35	Sangsangnyu	Command	NA	NA	NA	NA
		Non-Command	33823.74	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
36	Sanis	Command	NA	NA	NA	NA
		Non-Command	25944.28	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
37	Satakha	Command	NA	NA	NA	NA
		Non-Command	36680.75	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
38	Sekruzu	Command	NA	NA	NA	NA
		Non-Command	16191	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
39	Shamator	Command	NA	NA	NA	NA
		Non-Command	32326.72	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
40	Simiti	Command	NA	NA	NA	NA
		Non-Command	29919.19	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
41	Suruhoto	Command	NA	NA	NA	NA
		Non-Command	11258.74	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
42	Tamlu	Command	NA	NA	NA	NA
		Non-Command	16151.36	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
43	Tening	Command	NA	NA	NA	NA
		Non-Command	36767.39	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
44	Thonoknyu	Command	NA	NA	NA	NA
		Non-Command	51294.86	NA	NA	NA

		Poor GW Quality	NA	NA	NA	NA
45	Tizit	Command	NA	NA	NA	NA
		Non-Command	13493.44	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
46	Tobu	Command	NA	NA	NA	NA
		Non-Command	26588.39	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
47	Tokiye	Command	NA	NA	NA	NA
		Non-Command	14060.06	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
48	Tseminyu	Command	NA	NA	NA	NA
		Non-Command	28905.58	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
49	Wakching	Command	NA	NA	NA	NA
		Non-Command	20480.27	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
50	Wokha	Command	NA	NA	NA	NA
		Non-Command	16256.92	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
51	Wozhuru Ralan	Command	NA	NA	NA	NA
		Non-Command	17222.06	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA
52	Zunheboto	Command	NA	NA	NA	NA
		Non-Command	9045.91	NA	NA	NA
		Poor GW Quality	NA	NA	NA	NA

TABLE 4: POPULATION PROJECTION FOR 2023

Sl no	District	Population 2011	Decadal growth	Projected Population as on 2023
1	Akuluto	23159	-8.95	20672
2	Bhandari	22577	3.18	23439
3	Changtongya	46301	-16.14	37333
4	Chare	11156	5.7	11919
5	Chen	53220	-3.99	50672
6	Chessore	15979	5.7	17072
7	Chiephobozou	28724	21.72	36211
8	Chukitong	15023	3.18	15596
9	Dhansiripar	38690	22.92	49331
10	Ghathashi	16910	-8.95	15094
11	Jakhama	48186	21.72	60745
12	Jalukie	36922	4.91	39097
13	Kikruma	32025	10.27	35972
14	Kiphire	31014	-30.57	19637
15	Kohima	134239	21.72	169227
16	Kubulong	12679	-16.14	10223
17	Kuhoboto	18264	22.92	23287
18	Longchem	8617	-16.14	6948
19	Longkhim	17306	5.7	18490
20	Longleng	31799	-58.48	9484
21	Mangkolemba	43228	-16.14	34856
22	Medziphema	296748	22.92	378366
23	Meluri	22618	10.27	25405
24	Mon	58817	-3.99	56001
25	Niuland	25109	22.92	32015
26	Noklak	40700	5.7	43484
27	Noksen	16160	5.7	17265
28	Ongpangkong North	45510	-16.14	36696
29	Ongpangkong South	38287	-16.14	30872
30	Peren	27233	4.91	28838
31	Pfutsero	48987	10.27	55024
32	Phek	33586	10.27	37725
33	Pomching	34248	-3.99	32608
34	Pungro	24837	-30.57	15726
35	Sangsangnyu	61837	5.7	66067
36	Sanis	45430	3.18	47164
37	Satakha	27558	-8.95	24598
38	Sekruzu	26202	10.27	29431
39	Shamator	14858	5.7	15874
40	Simiti	18153	-30.57	11494
41	Suruhoto	18550	-8.95	16558
42	Tamlu	18685	-58.48	5573
43	Tening	31064	4.91	32894

44	Thonoknyu	18600	5.7	19872
45	Tizit	32803	-3.99	31232
46	Tobu	55527	-3.99	52868
47	Tokiye	21355	-8.95	19061
48	Tseminyu	56839	21.72	71654
49	Wokha	63047	3.18	65453
50	Wakching	15645	-3.99	14896
51	Wozhuru Ralan	20266	3.18	21039
52	Zunheboto	33225	-8.95	29657

TABLE 5: GROUND WATER EXTRACTION FOR ALL USES (AS ON MARCH 2023)

(in ham)

Sl no	Ground Water Assessment Unit	a. Irrigation			b. Domestic Water Supply			c. Industrial Water Supply			d. 'All Uses'		
		Monsoon	Non-Monsoon	Annual	Consumptive Use Method		Annual	Unit Draft Method		Annual	[(1a) + (1b) +(1c)]		Annual
					Monsoon	Non-monsoon		Monsoon	Non-monsoon		Monsoon	Non-monsoon	
1	Akuluto	0	0	0	3.63	5.03	8.651673	0	0	0	3.63	5.03	8.66
2	Bhandari	0	0	0	12.31	17.06	29.3648	0	0	0	12.31	17.06	29.37
3	Changtongya	0	0	0	4.96	6.87	11.82966	0	0	0	4.96	6.87	11.83
4	Chare	0	0	0	1.78	2.46	4.234595	0	0	0	1.78	2.46	4.24
5	Chen	0	0	0	12.07	16.73	28.80393	0	0	0	12.07	16.73	28.8
6	Chessore	0	0	0	2.91	4.03	6.939199	0	0	0	2.91	4.03	6.94
7	Chiephobozou	0	0	0	16.17	22.41	38.58022	0	0	0	16.17	22.41	38.58
8	Chukitong	0	0	0	1.76	2.43	4.191699	0	0	0	1.76	2.43	4.19
9	Dhansiripar	0	0	0	40.1	55.57	95.6702	0	0	0	40.1	55.57	95.67
10	Ghathashi	0	0	0	2.48	3.43	5.913735	0	0	0	2.48	3.43	5.91
11	Jakhama	0	0	0	5.28	7.31	12.59302	0	0	0	5.28	7.31	12.59
12	Jalukie	0	0	0	20.61	28.56	49.17185	0	0	0	20.61	28.56	49.17
13	Kikruma	0	0	0	1.75	2.43	4.18666	0	0	0	1.75	2.43	4.18
14	Kiphire	0	0	0	2.94	4.07	7.002711	0	0	0			7.01
15	Kohima	0	0	0	56.27	77.97	134.2376	0.24	0.36	0.6	56.51	78.33	134.84
16	Kubulong	0	0	0	0.04	0.06	0.10719	0	0	0			0.1
17	Kuhoboto	24.75	56.97	81.72	18.34	25.41	43.75166	0	0	0			125.47
18	Longchem	0	0	0	3.42	4.74	8.157177	0	0	0	3.42	4.74	8.16
19	Longkhim	0	0	0	7.42	10.27	17.69032	0	0	0	7.42	10.27	17.69
20	Longleng	0	0	0	3.39	4.7	8.09117	0	0	0	3.39	4.7	8.09
21	Mangkolemba	0	0	0	8.54	11.83	20.36621	0	0	0	8.54	11.83	20.37
22	Medziphema	19.25	44.3	63.56	280.08	388.08	668.1632	0.49	0.74	1.2312	299.82	433.12	732.95
23	Meluri	0	0	0	6.38	8.84	15.22426	0	0	0	6.38	8.84	15.22
24	Mon	0	0	0	13.7	18.99	32.68838	0	0	0	13.7	18.99	32.69
25	Niuland	24.75	56.97	81.72	24.6	34.09	58.68946	0	0	0	49.35	91.06	140.41
26	Noklak	0	0	0	0.18	0.24	0.419945	0	0	0	0.18	0.24	0.42
27	Noksen	0	0	0	7.25	10.04	17.28863	0	0	0	7.25	10.04	17.29

28	Ongpangkong North	0	0	0	6.89	9.54	16.43219	0	0	0	6.89	9.54	16.43
29	Ongpangkong South	0	0	0	5.79	8.03	13.8182	0	0	0	5.79	8.03	13.82
30	Peren	0	0	0	6.03	8.35	14.38111	0	0	0	6.03	8.35	14.38
31	Pfutsero	0	0	0	4.33	6	10.32317	0	0	0	4.33	6	10.33
32	Phek	0	0	0	2.41	3.34	5.750078	0	0	0	2.41	3.34	5.75
33	Pomching	0	0	0	13.06	18.09	31.14883	0	0	0	13.06	18.09	31.15
34	Pungro	0	0	0	0.2	0.28	0.484416	0	0	0	0.2	0.28	0.48
35	Sangsangnyu	0	0	0	16.78	23.25	40.03636	0	0	0	16.78	23.25	40.03
36	Sanis	0	0	0	25.8	35.75	61.54643	0	0	0	25.8	35.75	61.55
37	Satakha	0	0	0	4.46	6.18	10.63716	0	0	0	4.46	6.18	10.64
38	Sekruzu	0	0	0	2.04	2.83	4.873211	0	0	0	2.04	2.83	4.87
39	Shamator	0	0	0	2.88	3.99	6.872922	0	0	0	2.88	3.99	6.87
40	Simiti	0	0	0	1.5	2.08	3.5809	0	0	0	1.5	2.08	3.58
41	Suruhoto	0	0	0	2.69	3.72	6.412328	0	0	0	2.69	3.72	6.41
42	Tamlu	0	0	0	1.54	2.14	3.676472	0	0	0	1.54	2.14	3.68
43	Tening	0	0	0	9.13	12.65	21.77128	0	0	0	9.13	12.65	21.78
44	Thonoknyu	0	0	0	1.41	1.96	3.370976	0	0	0	1.41	1.96	3.37
45	Tizit	0	0	0	18.43	25.54	43.96456	0	0	0	18.43	25.54	43.97
46	Tobu	0	0	0	2.22	3.08	5.296346	0	0	0	2.22	3.08	5.3
47	Tokiye	0	0	0	4.42	6.12	10.54261	0	0	0	4.42	6.12	10.54
48	Tseminyu	0	0	0	17.74	24.59	42.33074	0	0	0	17.74	24.59	42.33
49	Wakching	0	0	0	4.7	6.51	11.21301	0	0	0	4.7	6.51	11.21
50	Wokha	0	0	0	24.26	33.62	57.88635	0.22	0.32	0.54	24.48	33.94	58.42
51	Wozhuru Ralan	0	0	0	12.6	17.46	30.0692	0	0	0	12.6	17.46	30.06
52	Zunheboto	0	0	0	9.36	12.97	22.32231	0	0	0	9.36	12.97	22.33
				227			**1810.75**			**2.3712**			**2040.12**

TABLE 6: RAINFALL

Sl no	Ground Water Assessment Unit	Rainfall (Normal) 2023			10% of annual normal RF
		Monsoon	Non- Monsoon	Total	
1	Akuluto	1508.5	571.9	2080.4	208.04
2	Bhandari	1601.4	565.36	2166.76	216.676
3	Changtongya	1508.5	571.9	2080.4	208.04
4	Chare	1508.5	571	2079.5	207.95
5	Chen	1112.6	356.5	1469.1	146.91
6	Chessore	1508.5	571	2079.5	207.95
7	Chiephobozou	1400.4	378.9	1779.3	177.93
8	Chukitong	1601.4	565.36	2166.76	216.676
9	Dhansiripar	1400.4	344.56	1744.96	174.496
10	Ghathashi	1508.5	571.9	2080.4	208.04
11	Jakhama	1400.4	378.9	1779.3	177.93
12	Jalukie	1015.3	378.9	1394.2	139.42
13	Kikruma	924.1	371	1295.1	129.51
14	Kiphire	703.1	371	1074.1	107.41
15	Kohima	1400.4	378.9	1779.3	177.93
16	Kubulong	1508.5	571.9	2080.4	208.04
17	Kuhoboto	1400.4	344.56	1744.96	174.496
18	Longchem	1508.5	571.9	2080.4	208.04
19	Longkhim	1508.5	571	2080.4	208.04
20	Longleng	1508.5	371	1879.5	187.95
21	Mangkolemba	1508.5	571.9	2080.4	208.04
22	Medziphema	1400.4	344.56	1744.96	174.496
23	Meluri	924.1	371	1295.1	129.51
24	Mon	1112.6	356.5	1469.1	146.91
25	Niuland	1400.4	344.56	1744.96	174.496
26	Noklak	1508.5	571	2080.4	208.04
27	Noksen	1508.5	571	2080.4	208.04
28	Ongpangkong North	1508.5	571.9	2080.4	208.04
29	Ongpangkong South	1508.5	571.9	2080.4	208.04
30	Peren	1015.3	378.9	1394.2	139.42
31	Pfutsero	924.1	371	1295.1	129.51
32	Phek	924.1	371	1295.1	129.51
33	Pomching	1112.6	356.5	1469.1	146.91
34	Pungro	703.1	371	1074.1	107.41
35	Sangsangnyu	1508.5	571	2079.5	207.95
36	Sanis	1601.4	565.36	2166.76	216.676
37	Satakha	1508.5	571.9	2080.4	208.04
38	Sekruzu	924.1	371	1295.1	129.51
39	Shamator	1508.5	571	2079.5	207.95
40	Simiti	703.1	371	1074.1	107.41
41	Suruhoto	1508.5	571.9	2080.4	208.04
42	Tamlu	1508.5	371	1879.5	187.95
43	Tening	1015.3	378.9	1394.2	139.42

44	Thonoknyu	1508.5	571	2079.5	207.95
45	Tizit	1112.6	356.5	1469.1	146.91
46	Tobu	1112.6	356.5	1469.1	146.91
47	Tokiye	1508.5	571.9	2080.4	208.04
48	Tseminyu	1400.4	378.9	1779.3	177.93
49	Wakching	1112.6	356.5	1469.1	146.91
50	Wokha	1601.4	565.36	2166.76	216.676
51	Wozhuru Ralan	1601.4	565.36	2166.76	216.676
52	Zunheboto	1508.5	571.9	2080.4	208.04

TABLE 7: RAINFALL RECHARGE BY RAINFALL INFILTRATION FACTOR METHOD

Sl No	Ground Water Assessment Unit	Recharge Worthy Area of the Unit (ha)	Normal rainfall during		Minimum Threshold Rainfall in mm	Maximum Threshold Rainfall in mm	Rainfall infiltration factor as a fraction	Rainfall recharge in non-command area by rainfall infiltration factor method in hectare meters during	
			Monsoon season in mm	Non - monsoon season in mm				a) Monsoon season [(1) * {(2d)-2c)} * (3) if (2a)> (2d) (1) * {(2a)-2c)} * (3) if (2a) <=(2d)]	b) Non - monsoon season [= 0 if (2b) <=(2c) = (1) * {2b)-(2c)} * (3) if (2b)> (2c)]
		1	2a	2b	2c	2d	3		
1	Akuluto	24270.72	1508.5	571.9	208.04	2080.4	0.06	210.93	59.02
2	Bhandari	26844.9	1601.4	565.36	216.676	2166.76	0.06	1900.13	478.47
3	Changtongya	27987.18	1508.5	571.9	208.04	2080.4	0.06	1115.94	312.23
4	Chare	7759.96	1508.5	571	207.95	2079.5	0.06	39.88	11.13
5	Chen	25240.25	1112.6	356.5	146.91	1469.1	0.06	722.4	156.79
6	Chessore	21723.66	1508.5	571	207.95	2079.5	0.06	74.55	20.81
7	Chiephobozou	47075	1400.4	378.9	177.93	1779.3	0.06	922.79	151.7
8	Chukitong	9611.22	1601.4	565.36	216.676	2166.76	0.06	409	102.99
9	Dhansiripar	4612.78	1400.4	344.56	174.5	1744.96	0.22	3582.07	621.14
10	Ghathashi	21198.35	1508.5	571.9	208.04	2080.4	0.06	148.38	41.52
11	Jakhama	20107.27	1400.4	378.9	177.93	1779.3	0.06	329.53	54.17
12	Jalukie	31533.47	1015.3	378.9	139.42	1394.2	0.06	1804.53	493.39
13	Kikruma	15569.25	924.1	371	129.51	1295.1	0.06	50.12	15.23
14	Kiphire	24376.39	703.1	371	107.41	1074.1	0.06	37.3	16.51
15	Kohima	21948.58	1400.4	378.9	177.93	1779.3	0.06	271.86	44.69
16	Kubulong	8426.06	1508.5	571.9	208.04	2080.4	0.06	339.18	94.9
17	Kuhoboto	2971.25	1400.4	344.56	174.5	1744.96	0.22	1080.07	149.83
18	Longchem	9088.17	1508.5	571.9	208.04	2080.4	0.06	391.06	109.42
19	Longkhim	14375.33	1508.5	571	207.95	2079.5	0.06	47.89	13.37
20	Longleng	27159.02	1508.5	371	187.95	1879.5	0.06	581.93	80.67
21	Mangkolemba	29712.33	1508.5	571.9	208.04	2080.4	0.06	1178.19	329.65

22	Medziphema	17984.97	1400.4	344.56	174.5	1744.96	0.22	12032.86	1391.02
23	Meluri	92364.4	924.1	371	129.51	1295.1	0.06	251.98	76.58
24	Mon	14953.48	1112.6	356.5	146.91	1469.1	0.06	598.22	129.83
25	Niuland	4085.33	1400.4	344.56	174.5	1744.96	0.22	1418.25	196.74
26	Noklak	55070.36	1508.5	571	207.95	2079.5	0.06	158.93	44.36
27	Noksen	27101.94	1508.5	571	207.95	2079.5	0.06	96.61	26.97
28	Ongpangkong North	16235.77	1508.5	571.9	208.04	2080.4	0.06	650.46	181.99
29	Ongpangkong South	15007.53	1508.5	571.9	208.04	2080.4	0.06	620.04	173.48
30	Peren	32960.7	1015.3	378.9	139.42	1394.2	0.06	741.12	202.63
31	Pfutsero	28155.3	924.1	371	129.51	1295.1	0.06	90.06	27.37
32	Phek	39011.05	924.1	371	129.51	1295.1	0.06	51.34	15.6
33	Pomching	16331.73	1112.6	356.5	146.91	1469.1	0.06	561.06	121.77
34	Pungro	55128.22	703.1	371	107.41	1074.1	0.06	49.03	21.7
35	Sangsangnyu	33823.74	1508.5	571	207.95	2079.5	0.06	115.74	32.31
36	Sanis	25944.28	1601.4	565.36	216.676	2166.76	0.06	1531.62	385.67
37	Satakha	36680.75	1508.5	571.9	208.04	2080.4	0.06	163.33	163.33
38	Sekruzu	16191	924.1	371	129.51	1295.1	0.06	95.65	29.07
39	Shamator	32326.72	1508.5	571	207.95	2079.5	0.06	100.06	27.93
40	Simiti	29919.19	703.1	371	107.41	1074.1	0.06	41	18.36
41	Suruhoto	11258.74	1508.5	571.9	208.04	2080.4	0.06	59.71	16.71
42	Tamlu	16151.36	1508.5	371	187.95	1879.5	0.06	439.35	60.9
43	Tening	36767.39	1015.3	378.9	139.42	1394.2	0.06	809.24	221.26
44	Thonoknyu	51294.86	1508.5	571	207.95	2079.5	0.06	156.31	43.63
45	Tizit	13493.44	1112.6	356.5	146.91	1469.1	0.06	600.71	130.38
46	Tobu	26588.39	1112.6	356.5	146.91	1469.1	0.06	272.3	59.1
47	Tokiye	14060.06	1508.5	571.9	208.04	2080.4	0.06	70.69	19.78
48	Tseminyu	28905.58	1400.4	378.9	177.93	1779.3	0.06	548.9	90.24
49	Wakching	20480.27	1112.6	356.5	146.91	1469.1	0.06	809.43	175.67
50	Wokha	16256.92	1601.4	565.36	216.676	2166.76	0.06	884.6	222.75

51	Wozhuru Ralan	17222.06	1601.4	565.36	216.676	2166.76	0.06	834.65	210.17
52	Zunheboto	9045.91	1508.5	571.9	208.04	2080.4	0.06	48.07	13.45

TABLE 8: ANNUAL EXTRACTABLE GROUND WATER RESOURCE IN NON-COMMAND AREA (AS ON MARCH 2023)

Sl. No	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season	Recharge from Other Sources-Monsoon Season	Recharge from Rainfall-Non Monsoon Season	Recharge from Other Sources-Non Monsoon Season	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
1	Akuluto	26974	24270.72	210.93	86.25	59.02	3.08	359.28	35.93	323.35
2	Bhandari	49715	26844.9	1900.13	798.6	478.47	45.85	2744.58	322.3	2900.75
3	Changtongya	42289	27987.18	1115.94	132.6	312.23	0.27	1561.04	156.1	1404.94
4	Chare	8271	7759.96	39.88	5.37	11.13	0	56.38	5.64	50.74
5	Chen	37708	25240.25	722.4	12.3	156.79	0.25	891.74	89.17	802.57
6	Chessore	22679	21723.66	74.55	468.96	20.81	0	564.32	56.43	507.89
7	Chiephobozou	59656	47075	922.79	143.1	151.7	6.8	301.6	122.44	1101.95
8	Chukitong	14534	9611.22	409	90	102.99	6.64	608.63	60.86	547.77
9	Dhansiripar	21215	4612.78	3582.07	392.1	621.14	21.65	4616.96	461.7	4155.26
10	Ghathashi	23100	21198.35	148.38	53.1	41.52	2	245	24.5	220.5
11	Jakhama	24600	20107.27	329.53	260.1	54.17	20.16	663.96	66.39	597.57
12	Jalukie	65871	31533.47	1804.53	1,220.40	493.39	21.71	3540.03	354	3186.03
13	Kikruma	16620.55	15569.25	50.12	229.31	15.23	2.88	297.54	29.75	267.79
14	Kiphire	25420	24376.39	37.3	80.37	16.51	0	134.18	13.42	120.76
15	Kohima	25655	21948.58	271.86	1,196.74	44.69	52.13	1565.42	156.54	1408.88
16	Kubulong	12773	8426.06	339.18	61.2	94.9	0.38	495.66	49.57	446.09
17	Kuhoboto	6976	2971.25	1080.07	236.64	149.83	8.96	1475.5	149.96	1349.68
18	Longchem	14100	9088.17	391.06	61.2	109.42	0.27	561.95	56.2	505.75
19	Longkhim	14989	14375.33	47.89	136.8	13.37	0	150.17	19.81	178.25
20	Longleng	34503.56	27159.02	581.93	222	80.67	4.1	888.7	88.87	799.83

21	Mangkolemba	44812	29712.33	1178.19	184.8	329.65	0.65	515.1	169.33	1523.96
22	Medziphema	55165	17984.97	12032.86	487.88	1391.02	21.36	13933.12	1395.19	12556.71
23	Meluri	97649.74	92364.4	251.98	174.79	76.58	0.1	503.45	50.35	453.1
24	Mon	25278	14953.48	598.22	38.4	129.83	0.16	766.61	76.66	689.95
25	Niuland	9344	4085.33	1418.25	195.6	196.74	8.37	1818.96	184.32	1658.78
26	Noklak	57107	55070.36	158.93	407.2	44.36	0	610.49	61.05	549.44
27	Noksen	28340	27101.94	96.61	222.93	26.97	0.05	346.56	34.65	311.91
28	Ongpangkong North	24572	16235.77	650.46	283.2	181.99	2.05	1117.7	111.77	1005.93
29	Ongpangkong South	22954	15007.53	620.04	42	173.48	0.05	835.57	83.55	752.02
30	Peren	47063	32960.7	741.12	247.98	202.63	0.97	1192.7	119.27	1073.43
31	Pfutsero	30044.41	28155.3	90.06	236.63	27.37	3.45	357.51	35.75	321.76
32	Phek	40088.02	39011.05	51.34	304.3	15.6	8.18	379.42	37.94	341.48
33	Pomching	26015	16331.73	561.06	72	121.77	1.87	756.7	75.67	681.03
34	Pungro	56500	55128.22	49.03	82.2	21.7	0	131.23	15.29	137.64
35	Sangsangnyu	35307	33823.74	115.74	316.53	32.31	0	464.58	46.46	418.12
36	Sanis	44379	25944.28	1531.62	291	385.67	22.39	2230.68	223.07	2007.61
37	Satakha	38774	36680.75	163.33	168.6	163.33	7.78	503.04	38.54	346.87
38	Sekruzu	18197.28	16191	95.65	195.9	29.07	0.72	321.34	32.14	289.2
39	Shamator	33609	32326.72	100.06	92.4	27.93	0	220.3	22.04	198.35
40	Simiti	31080	29919.19	41	164.52	18.36	0	223.88	22.44	201.93
41	Suruhoto	12024	11258.74	59.71	118.2	16.71	4.91	199.53	19.95	179.58
42	Tamlu	21696.44	16151.36	439.35	111.9	60.9	2.05	614.2	61.43	552.77
43	Tening	52166	36767.39	809.24	210	221.26	3.51	1244.01	124.4	1119.61
44	Thonoknyu	53298	51294.86	156.31	221.1	43.63	0	421.04	42.1	378.94
45	Tizit	23861	13493.44	600.71	60	130.38	0.11	791.2	79.12	712.08
46	Tobu	31288	26588.39	272.3	26.7	59.1	0.49	86.29	35.86	322.73
47	Tokiye	14966	14060.06	70.69	167.1	19.78	7.07	264.64	26.47	238.17
48	Tseminyu	36389	28905.58	548.9	232.74	90.24	16.9	888.78	88.87	799.91
49	Wakching	34450	20480.27	809.43	75.09	175.67	1.17	1061.63	106.13	955.23
50	Wokha	26904	16256.92	884.6	220.2	222.75	7.99	1335.54	133.55	1201.99

51	Wozhuru Ralan	27268	17222.06	834.65	214.78	210.17	16.68	1276.28	127.63	1148.65
52	Zunheboto	9662	9045.91	48.07	219.6	13.45	19.71	300.83	30.09	270.74
									6030.66	**54275.97**

TABLE 9: STAGE OF GROUND WATER DEVELOPMENT (AS ON MARCH 2023)

Sl no	Ground Water Assessment Unit	Recharge Worthy Area of the Unit (ha)	Annual Extractable Ground Water Resource in hectare meters	Current annual gross ground water extraction for all uses in hectare meters	Stage of Ground Water Extraction as a percentage [(5) / (4) * 100]	Poor Ground Water Quality Area	Categorization of the sub-unit (Safe/Semi- critical / Critical / Over-exploited)
1	2	3	4	5	6	7	8
1	Akuluto	24270.72	323.35	8.66	2.678212463	NIL	Safe
2	Bhandari	26844.9	2900.75	29.37	1.012496768	NIL	Safe
3	Changtongya	27987.18	1404.94	11.83	0.842028841	NIL	Safe
4	Chare	7759.96	50.74	4.24	8.35632637	NIL	Safe
5	Chen	25240.25	802.57	28.8	3.588472034	NIL	Safe
6	Chessore	21723.66	507.89	6.94	1.366437614	NIL	Safe
7	Chiephobozou	47075	1101.95	38.58	3.501066292	NIL	Safe
8	Chukitong	9611.22	547.77	4.19	0.764919583	NIL	Safe
9	Dhansiripar	4612.78	4155.26	95.67	2.302383004	NIL	Safe
10	Ghathashi	21198.35	220.5	5.91	2.680272109	NIL	Safe
11	Jakhama	20107.27	597.57	12.59	2.106866141	NIL	Safe
12	Jalukie	31533.47	3186.03	49.17	1.543299969	NIL	Safe
13	Kikruma	15569.25	267.79	4.18	1.560924605	NIL	Safe
14	Kiphire	24376.39	120.76	7.01	5.804902286	NIL	Safe
15	Kohima	21948.58	1408.88	134.84	9.570722844	NIL	Safe
16	Kubulong	8426.06	446.09	0.1	0.022417001	NIL	Safe
17	Kuhoboto	2971.25	1349.68	125.47	9.296277636	NIL	Safe
18	Longchem	9088.17	505.75	8.16	1.613445378	NIL	Safe

19	Longkhim	14375.33	178.25	17.69	9.924263675	NIL	Safe
20	Longleng	27159.02	799.83	8.09	1.011464936	NIL	Safe
21	Mangkolemba	29712.33	1523.96	20.37	1.336649256	NIL	Safe
22	Medziphema	17984.97	12556.71	732.95	5.837118162	NIL	Safe
23	Meluri	92364.4	453.1	15.22	3.35908188	NIL	Safe
24	Mon	14953.48	689.95	32.69	4.738024495	NIL	Safe
25	Niuland	4085.33	1658.78	140.41	8.464654746	NIL	Safe
26	Noklak	55070.36	549.44	0.42	0.076441468	NIL	Safe
27	Noksen	27101.94	311.91	17.29	5.543265686	NIL	Safe
28	Ongpangkong North	16235.77	1005.93	16.43	1.633314445	NIL	Safe
29	Ongpangkong South	15007.53	752.02	13.82	1.837717082	NIL	Safe
30	Peren	32960.7	1073.43	14.38	1.339630903	NIL	Safe
31	Pfutsero	28155.3	321.76	10.33	3.210467429	NIL	Safe
32	Phek	39011.05	341.48	5.75	1.683846785	NIL	Safe
33	Pomching	16331.73	681.03	31.15	4.573954158	NIL	Safe
34	Pungro	55128.22	137.64	0.48	0.348735833	NIL	Safe
35	Sangsangnyu	33823.74	418.12	40.03	9.573806563	NIL	Safe
36	Sanis	25944.28	2007.61	61.55	3.0658345	NIL	Safe
37	Satakha	36680.75	346.87	10.64	3.067431603	NIL	Safe
38	Sekruzu	16191	289.2	4.87	1.68395574	NIL	Safe
39	Shamator	32326.72	198.35	6.87	3.46357449	NIL	Safe
40	Simiti	29919.19	201.93	3.58	1.772891596	NIL	Safe
41	Suruhoto	11258.74	179.58	6.41	3.569439804	NIL	Safe
42	Tamlu	16151.36	552.77	3.68	0.66573801	NIL	Safe
43	Tening	36767.39	1119.61	21.78	1.945320245	NIL	Safe
44	Thonoknyu	51294.86	378.94	3.37	0.889322848	NIL	Safe
45	Tizit	13493.44	712.08	43.97	6.174867992	NIL	Safe
46	Tobu	26588.39	322.73	5.3	1.642239643	NIL	Safe
47	Tokiye	14060.06	238.17	10.54	4.425410421	NIL	Safe
48	Tseminyu	28905.58	799.91	42.33	5.291845333	NIL	Safe
49	Wakching	20480.27	955.23	11.21	1.173539357	NIL	Safe

50	Wokha	16256.92	1201.99	58.42	4.86027338	NIL	Safe
51	Wozhuru Ralan	17222.06	1148.65	30.06	2.616985156	NIL	Safe
52	Zunheboto	9045.91	270.74	22.33	8.247765384	NIL	Safe
			54275.97	**2040.12**	**3.758790492**		

TABLE 10: WATER QUALITY

Sl no	Ground Water Assessment Unit	Recharge Worthy Area of the Unit (ha)	Area effected by Salinity in mappable patches	Area effected by Fluoride in mappable patches	Area effected by Arsenic in mappable patches	Other Hazardous parameters present in the sub unit in mappable areas	Quality tag For the sub unit
1	Akuluto	24270.72	NO	NO	NO	NO	FRESH
2	Bhandari	26844.9	NO	NO	NO	NO	FRESH
3	Changtongya	27987.18	NO	NO	NO	NO	FRESH
4	Chare	7759.96	NO	NO	NO	NO	FRESH
5	Chen	25240.25	NO	NO	NO	NO	FRESH
6	Chessore	21723.66	NO	NO	NO	NO	FRESH
7	Chiephobozou	47075	NO	NO	NO	NO	FRESH
8	Chukitong	9611.22	NO	NO	NO	NO	FRESH
9	Dhansiripar	4612.78	NO	NO	NO	NO	FRESH
10	Ghathashi	21198.35	NO	NO	NO	NO	FRESH
11	Jakhama	20107.27	NO	NO	NO	NO	FRESH
12	Jalukie	31533.47	NO	NO	NO	NO	FRESH
13	Kikruma	15569.25	NO	NO	NO	NO	FRESH
14	Kiphire	24376.39	NO	NO	NO	NO	FRESH
15	Kohima	21948.58	NO	NO	NO	NO	FRESH
16	Kubulong	8426.06	NO	NO	NO	NO	FRESH
17	Kuhoboto	2971.25	NO	NO	NO	NO	FRESH
18	Longchem	9088.17	NO	NO	NO	NO	FRESH
19	Longkhim	14375.33	NO	NO	NO	NO	FRESH
20	Longleng	27159.02	NO	NO	NO	NO	FRESH

21	Mangkolemba	29712.33	NO	NO	NO	NO	FRESH
22	Medziphema	17984.97	NO	NO	NO	NO	FRESH
23	Meluri	92364.4	NO	NO	NO	NO	FRESH
24	Mon	14953.48	NO	NO	NO	NO	FRESH
25	Niuland	4085.33	NO	NO	NO	NO	FRESH
26	Noklak	55070.36	NO	NO	NO	NO	FRESH
27	Noksen	27101.94	NO	NO	NO	NO	FRESH
28	Ongpangkong North	16235.77	NO	NO	NO	NO	FRESH
29	Ongpangkong South	15007.53	NO	NO	NO	NO	FRESH
30	Peren	32960.7	NO	NO	NO	NO	FRESH
31	Pfutsero	28155.3	NO	NO	NO	NO	FRESH
32	Phek	39011.05	NO	NO	NO	NO	FRESH
33	Pomching	16331.73	NO	NO	NO	NO	FRESH
34	Pungro	55128.22	NO	NO	NO	NO	FRESH
35	Sangsangnyu	33823.74	NO	NO	NO	NO	FRESH
36	Sanis	25944.28	NO	NO	NO	NO	FRESH
37	Satakha	36680.75	NO	NO	NO	NO	FRESH
38	Sekruzu	16191	NO	NO	NO	NO	FRESH
39	Shamator	32326.72	NO	NO	NO	NO	FRESH
40	Simiti	29919.19	NO	NO	NO	NO	FRESH
41	Suruhoto	11258.74	NO	NO	NO	NO	FRESH
42	Tamlu	16151.36	NO	NO	NO	NO	FRESH
43	Tening	36767.39	NO	NO	NO	NO	FRESH
44	Thonoknyu	51294.86	NO	NO	NO	NO	FRESH
45	Tizit	13493.44	NO	NO	NO	NO	FRESH
46	Tobu	26588.39	NO	NO	NO	NO	FRESH
47	Tokiye	14060.06	NO	NO	NO	NO	FRESH
48	Tseminyu	28905.58	NO	NO	NO	NO	FRESH
49	Wakching	20480.27	NO	NO	NO	NO	FRESH
50	Wokha	16256.92	NO	NO	NO	NO	FRESH
51	Wozhuru Ralan	17222.06	NO	NO	NO	NO	FRESH
52	Zunheboto	9045.91	NO	NO	NO	NO	FRESH

TABLE 11: ALLOCATION OF GROUND WATER RESOURCES (AS ON MARCH 2023)

Sl No	Ground Water Assessment Unit	Recharge Worthy Area of the Unit (ha)	Census 2011 Population	Decadal growth	Projected population on 2025	Projected population density as on 2025 in thousands per sq. Km	Extent of dependence on ground water to meet domestic water supply as a fraction (less than or equal to 1)	Annual allocation of ground water for domestic water supply per unit area in millimeters [22 * (6) * (7)	Area in hectares	Annual allocation of ground water for domestic water supply in hectare meters [((8) * (9) / 1000]
	1	2	3	4	5	6	7	8	9	10
1	Akuluto	24270.72	23159	-8.95	7893469	32.52259925	0.190847128	136.5505822	24270.72	3314.180947
2	Bhandari	26844.9	22577	3.18	8511927	31.70779925	0.014065539	9.811720611	26844.9	263.3946586
3	Changtongya	27987.18	46301	-16.14	18169669	64.92139973	0.004787743	6.838194034	27987.18	191.3817673
4	Chare	7759.96	11156	5.7	1219742	15.71840576	0.436872528	151.0726726	7759.96	1172.317897
5	Chen	25240.25	53220	-3.99	18831246	74.60800111	0.30221998	496.056629	25240.25	12520.59333
6	Chessore	21723.66	15979	5.7	4881437	22.47060118	0.004409804	2.180000894	21723.66	47.35759822
7	Chiephobozou	47075	28724	21.72	18977627	40.31359958	0.652608484	578.797936	47075	27246.91284
8	Chukitong	9611.22	15023	3.18	2031062	21.13219758	0.642774757	298.8313496	9611.22	2872.133844
9	Dhansiripar	4612.78	38690	22.92	2503171	54.26599578	0.227710546	271.8526694	4612.78	1253.996556
10	Ghathashi	21198.35	16910	-8.95	5039696	23.77400128	0.389561161	203.7514056	21198.35	4319.193609
11	Jakhama	20107.27	48186	21.72	13584552	67.5603998	0.343227767	510.1493131	20107.27	10257.70998
12	Jalukie	31533.47	36922	4.91	16331436	51.79079879	0.252212389	287.3701845	31533.47	9061.77909
13	Kikruma	15569.25	32025	10.27	6996042	44.93499687	0.142258065	140.632045	15569.25	2189.535467
14	Kiphire	24376.39	31014	-30.57	10608507	43.51959827	0.122724909	117.5006522	24376.39	2864.241724
15	Kohima	21948.58	134239	21.72	41270925	188.0346018	0.069598575	287.912688	21948.58	6319.274665
16	Kubulong	8426.06	12679	-16.14	1504102	17.85059684	0.266534579	104.6716288	8426.06	881.9694245
17	Kuhoboto	2971.25	18264	22.92	762708	25.66960034	0.204382022	115.4209063	2971.25	342.9443679
18	Longchem	9088.17	8617	-16.14	1105467	12.16380195	0.273635819	73.22594188	9088.17	665.4898082

19	Longkhim	14375.33	17306	5.7	3497288	24.3284015	0.276710684	148.1024298	14375.33	2129.021302
20	Longleng	27159.02	31799	-58.48	12117974	44.61859817	0.075607712	74.2172223	27159.02	2015.667025
21	Mangkolemba	29712.33	43228	-16.14	18011377	60.61920085	0.362210023	483.051407	29712.33	14352.58281
22	Medziphema	17984.97	296748	22.92	74736039	415.5471986	0.045744553	418.1984567	17984.97	7521.286698
23	Meluri	92364.4	22618	10.27	29339736	31.76519958	0.197196713	137.8078451	92364.4	12728.53892
24	Mon	14953.48	58817	-3.99	12328217	82.44379904	0.144688948	262.4315436	14953.48	3924.264839
25	Niuland	4085.33	25109	22.92	1440185	35.25259893	0.185601225	143.9443624	4085.33	588.0602219
26	Noklak	55070.36	40700	5.7	31434161	57.07999911	0.403833635	507.1181173	55070.36	27927.17728
27	Noksen	27101.94	16160	5.7	6158645	22.72400057	0.457245974	228.5900713	27101.94	6195.234396
28	Ongpangkong North	16235.77	45510	-16.14	10360694	63.81399835	0.302478288	424.6516781	16235.77	6894.546975
29	Ongpangkong South	15007.53	38287	-16.14	8059314	53.7018017	0.806355087	952.6598614	15007.53	14297.07145
30	Peren	32960.7	27233	4.91	12599623	38.22619969	0.094661922	79.60844148	32960.7	2623.949957
31	Pfutsero	28155.3	48987	10.27	19337567	68.68180058	0.574287029	867.7474778	28155.3	24431.69056
32	Phek	39011.05	33586	10.27	18382163	47.1204005	0.25956106	269.0736647	39011.05	10496.84619
33	Pomching	16331.73	34248	-3.99	7846939	48.04720014	0.176598521	186.6714187	16331.73	3048.66721
34	Pungro	55128.22	24837	-30.57	19224203	34.87180069	0.436187732	334.634336	55128.22	18447.7953
35	Sangsangnyu	33823.74	61837	5.7	29315644	86.67179916	0.266801619	508.7318802	33823.74	17207.21485
36	Sanis	25944.28	45430	3.18	16527025	63.70199905	0.572062979	801.7142182	25944.28	20799.89816
37	Satakha	36680.75	27558	-8.95	14188554	38.68119927	0.07745866	65.91626472	36680.75	2417.858027
38	Sekruzu	16191	26202	10.27	5955503	36.78279909	0.085667646	69.32410792	16191	1122.426631
39	Shamator	32326.72	14858	5.7	6756672	20.90119876	0.204471408	94.02134573	32326.72	3039.401718
40	Simiti	29919.19	18153	-30.57	7633642	25.51420008	0.162228797	91.0610356	29919.19	2724.472426
41	Suruhoto	11258.7	18550	-8.95	2935154	26.07000428	0.857900318	492.0402293	11258.7	5539.753011

		4							4	
42	Tamlu	16151.36	18685	-58.48	4241186	26.25900234	0.595865328	344.2302388	16151.36	5559.78651
43	Tening	36767.39	31064	4.91	16026758	43.58959937	0.536087866	514.0928168	36767.39	18901.85109
44	Thonoknyu	51294.86	18600	5.7	13408476	26.13999921	0.162834692	93.64297157	51294.86	4803.403117
45	Tizit	13493.44	32803	-3.99	6210248	46.02420139	0.885549133	896.647216	13493.44	12098.85541
46	Tobu	26588.39	55527	-3.99	20695818	77.83780063	0.837071362	1433.427464	26588.39	38112.52845
47	Tokiye	14060.06	21355	-8.95	4217596	29.99699859	0.343722944	226.8344465	14060.06	3189.305928
48	Tseminyu	28905.58	56839	21.72	23030405	79.67459916	0.269756098	472.8395968	28905.58	13667.70279
49	Wakching	20480.27	63047	3.18	18097554	88.36579791	0.48649684	945.7729912	20480.27	19369.68622
50	Wokha	16256.92	15645	-3.99	3577010	22.00299934	0.053144581	25.72548403	16256.92	418.2171358
51	Wozhuru Ralan	17222.06	20266	3.18	4903534	28.47240109	0.197701926	123.839068	17222.06	2132.763859
52	Zunheboto	9045.91	33225	-8.95	4216751	46.61500059	0.178664528	183.2258355	9045.91	1657.444418

TABLE 12: NET ANNUAL GROUND WATER AVAILABILITY FOR 'FUTURE USE'

Sl No	Ground Water Assessment Unit	Recharge Worthy Area of the Unit (ha)	Annual Extractable Ground Water Resource in hectare meters	Current annual gross ground water extraction for Irrigation in hectare meters	Current annual gross ground water extraction for Industrial use in hectare meters	Annual allocation of ground water for domestic water supply as on 2025 in hectare meters	Net annual ground water availability for 'Future Use' in hectare meters [(2) - ((3) + (4) + (5))]	Net annual ground water availability for 'Future Use' per unit area in millimeters [((6) / (1)) * 1000]
1	Akuluto	24270.72	323.35	0	0	8.65	314.69	0.012965829
2	Bhandari	26844.9	2900.75	0	0	29.71	2871.03	0.106948806
3	Changtongya	27987.18	1404.94	0	0	11.83	1393.11	0.049776719
4	Chare	7759.96	50.74	0	0	4.31	46.42	0.00598199
5	Chen	25240.25	802.57	0	0	28.8	773.77	0.030656194
6	Chessore	21723.66	507.89	0	0	7.06	500.83	0.023054587
7	Chiephobozou	47075	1101.95	0	0	41.53	1060.42	0.022526182
8	Chukitong	9611.22	547.77	0	0	4.24	543.53	0.056551614
9	Dhansiripar	4612.78	4155.26	0	0	103.52	4051.74	0.878372695
10	Ghathashi	21198.35	220.5	0	0	5.91	214.59	0.010122958
11	Jakhama	20107.27	597.57	0	0	13.56	584.01	0.029044719
12	Jalukie	31533.47	3186.03	0	0	49.96	3136.07	0.099452106
13	Kikruma	15569.25	267.79	0	0	4.32	263.48	0.016923102
14	Kiphire	24376.39	120.76	0	0	7.19	113.56	0.004658606
15	Kohima	21948.58	1408.88	0	0.6	144.51	1263.77	0.057578668
16	Kubulong	8426.06	446.09	0	0	0.11	445.99	0.052929839
17	Kuhoboto	2971.25	1349.68	81.72	0	47.34	1220.62	0.410810265
18	Longchem	9088.17	505.75	0	0	8.16	497.59	0.054751397
19	Longkhim	14375.33	178.25	0	0	18.01	160.24	0.011146875
20	Longleng	27159.02	799.83	0	0	11.72	788.11	0.029018352
21	Mangkolemba	29712.33	1523.96	0	0	20.37	1503.59	0.050604917
22	Medziphema	17984.97	12556.71	63.56	1.2312	722.97	11768.95	0.65437696
23	Meluri	92364.4	453.1	0	0	15.71	437.39	0.004735483
24	Mon	14953.48	689.95	0	0	32.69	657.26	0.043953648

25	Niuland	4085.33	1658.78	81.72	0	63.5	1513.56	0.370486595
26	Noklak	55070.36	549.44	0	0	0.43	549.01	0.009969247
27	Noksen	27101.94	311.91	0	0	17.6	294.31	0.01085937
28	Ongpangkong North	16235.77	1005.93	0	0	16.43	989.5	0.060945677
29	Ongpangkong South	15007.53	752.02	0	0	13.82	738.2	0.049188641
30	Peren	32960.7	1073.43	0	0	14.61	1058.82	0.032123711
31	Pfutsero	28155.3	321.76	0	0	10.65	311.1	0.011049429
32	Phek	39011.05	341.48	0	0	5.93	335.55	0.008601409
33	Pomching	16331.73	681.03	0	0	31.15	649.88	0.039792478
34	Pungro	55128.22	137.64	0	0	0.5	137.14	0.002487655
35	Sangsangnyu	33823.74	418.12	0	0	40.76	377.37	0.011156957
36	Sanis	25944.28	2007.61	0	0	62.26	1945.35	0.074981846
37	Satakha	36680.75	346.87	0	0	10.64	336.23	0.009166388
38	Sekruzu	16191	289.2	0	0	5.03	284.17	0.017551109
39	Shamator	32326.72	198.35	0	0	7	191.35	0.005919252
40	Simiti	29919.19	201.93	0	0	3.68	198.25	0.006626182
41	Suruhoto	11258.74	179.58	0	0	6.41	173.17	0.01538094
42	Tamlu	16151.36	552.77	0	0	5.34	547.43	0.03389374
43	Tening	36767.39	1119.61	0	0	22.12	1097.48	0.029849277
44	Thonoknyu	51294.86	378.94	0	0	3.43	375.51	0.007320617
45	Tizit	13493.44	712.08	0	0	43.96	668.11	0.04951369
46	Tobu	26588.39	322.73	0	0	5.3	317.43	0.011938669
47	Tokiye	14060.06	238.17	0	0	10.54	227.63	0.016189831
48	Tseminyu	28905.58	799.91	0	0	45.57	754.34	0.026096691
49	Wakching	20480.27	955.23	0	0	11.21	944.02	0.046094119
50	Wokha	16256.92	1201.99	0	0.54	58.56	1142.9	0.07030237
51	Wozhuru Ralan	17222.06	1148.65	0	0	30.42	1118.24	0.064930676
52	Zunheboto	9045.91	270.74	0	0	22.32	248.41	0.027461029
			54275.97	**227**	**2.3712**	**1911.35**	**52135.22**	

PLATE-1

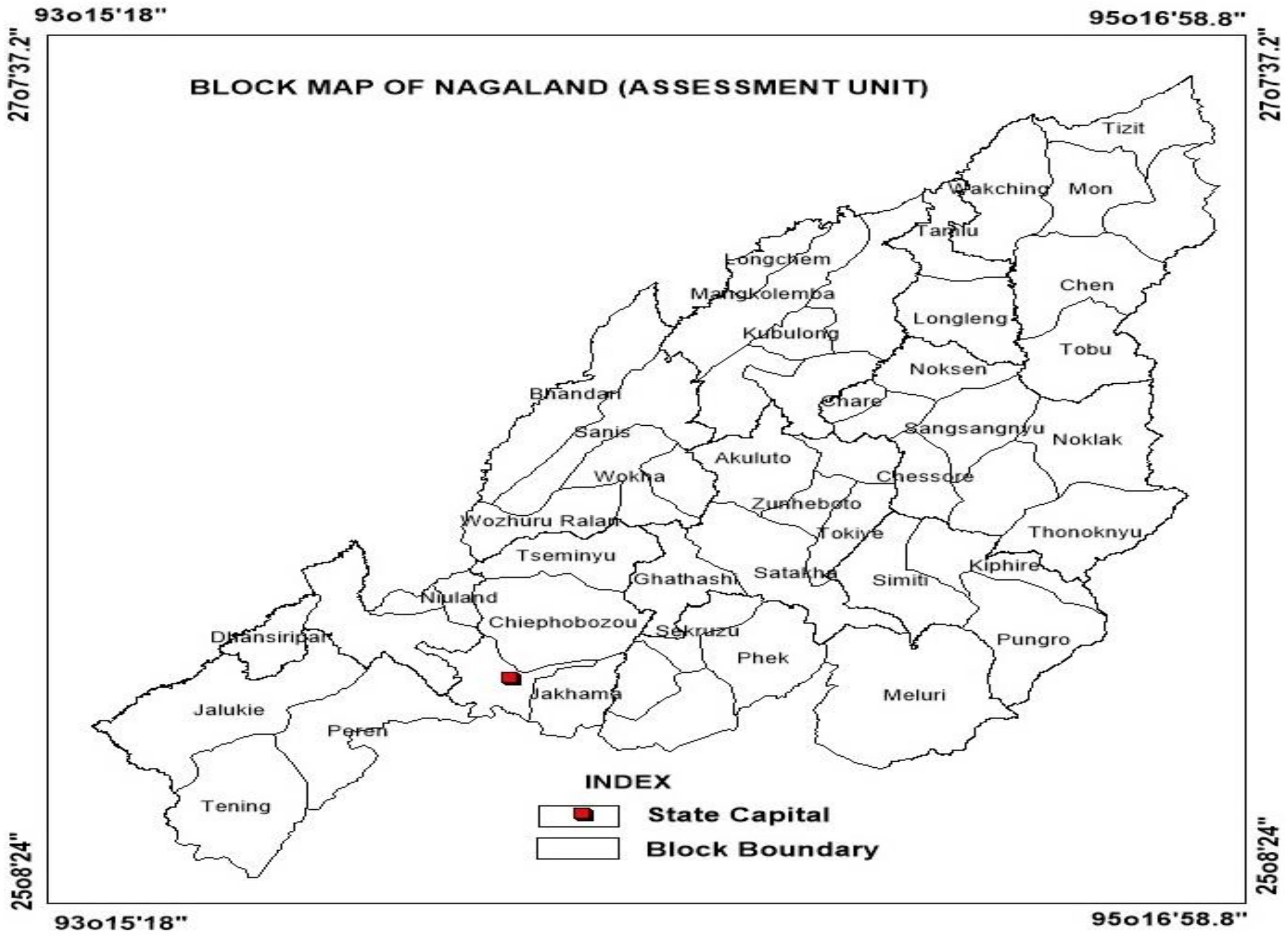

93o15'18"
95o16'58.8"
27o7'37.2"
27o7'37.2"
BLOCK MAP OF NAGALAND (ASSESSMENT UNIT)
Tizit
Wakching
Mon
Tamlu
Longchem
Chen
Mangkolemba
Longleng
Kubulong
Tobu
Noksen
Bhandari
Chare
Sanis
Sangsangnyu
Noklak
Akuluto
Wokha
Chessore
Zunheboto
Wozhuru Ralan
Tokiye
Thonoknyu
Tseminyu
Kiphire
Satakha
Ghathashi
Simiti
Niuland
Chiephobozou
Sekruzu
Dhansiripar
Pungro
Phek
Jakhama
Meluri
Jalukie
Peren
Tening
INDEX
State Capital
Block Boundary
25o8'24"
25o8'24"
93o15'18"
95o16'58.8"

PLATE - 2

HYDROGEOLOGY OF NAGALAND

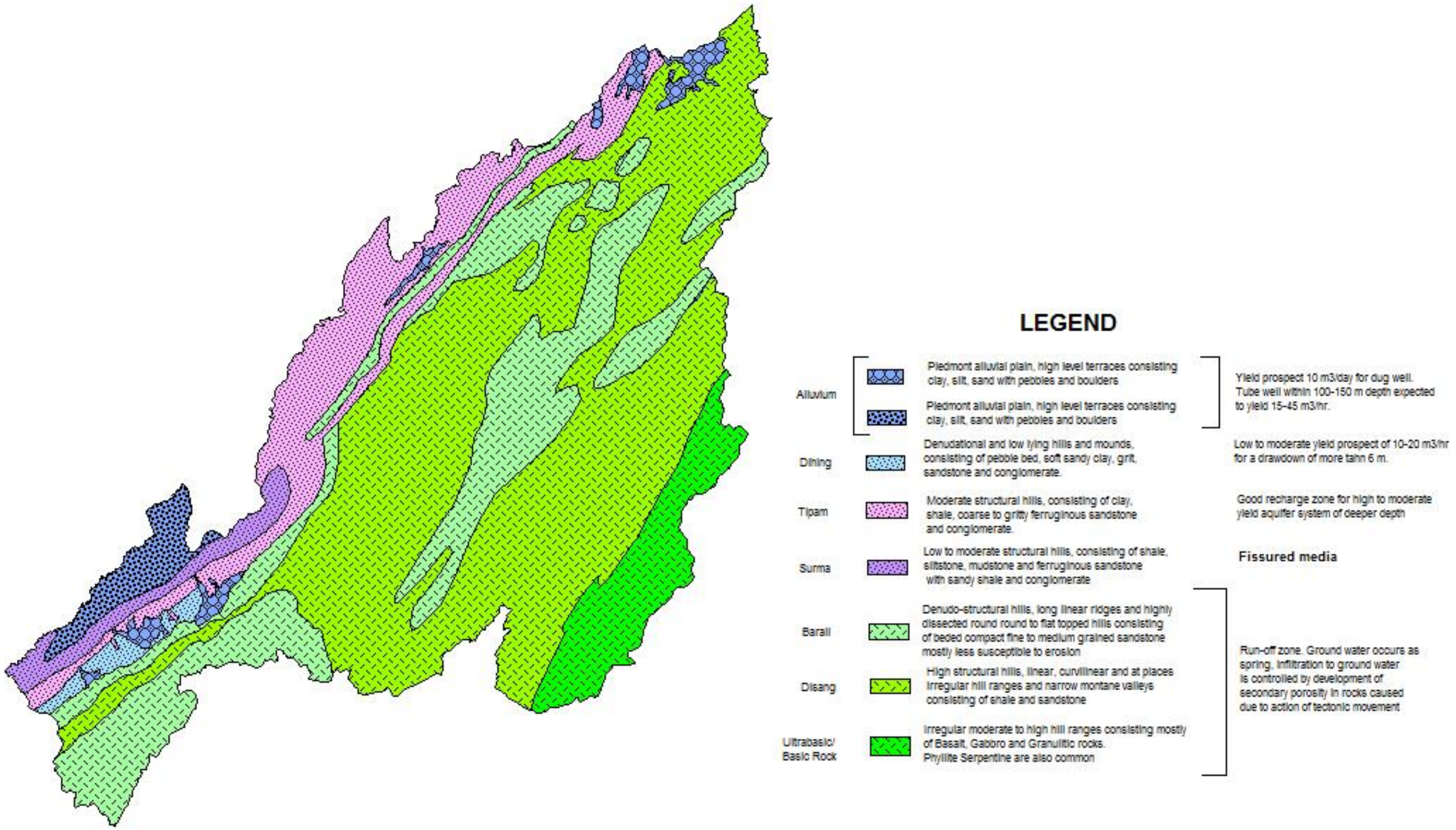
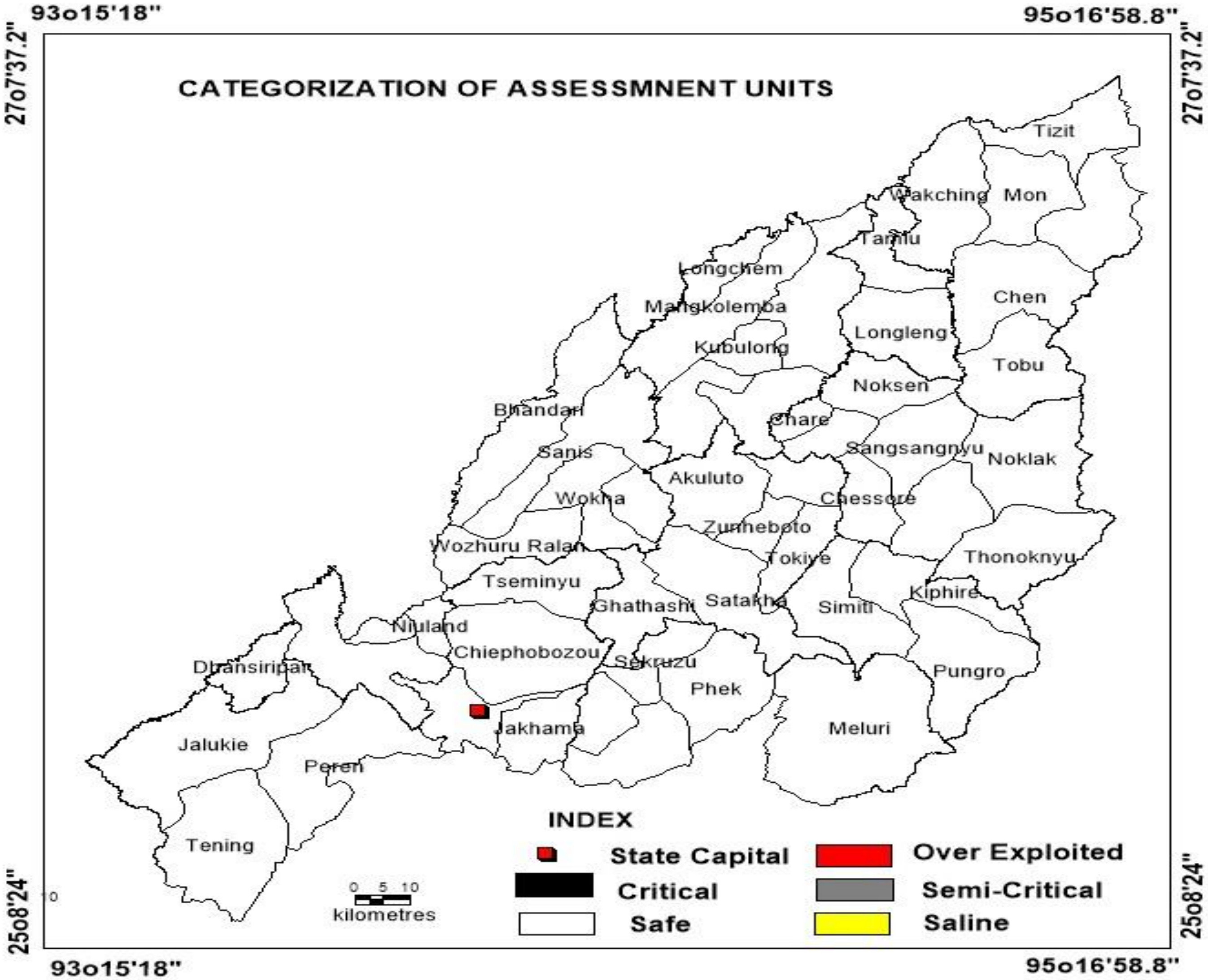


PLATE-3


93o15'18"
95o16'58.8"
27o7'37.2"
27o7'37.2"
CATEGORIZATION OF ASSESSMNENT UNITS
Tizit
Wakching
Mon
Tamlu
Longchem
Chen
Mangkolemba
Longleng
Kubulong
Tobu
Noksen
Bhandari
Chare
Sanis
Sangsangnyu
Noklak
Akuluto
Wokha
Chessore
Zunheboto
Wozhuru Ralan
Tokiye
Thonoknyu
Tseminyu
Kiphire
Ghathashi
Satakha
Simiti
Niuland
Chiephobozou
Dhansiripar
Sekruzu
Pungro
Phek
Jakhama
Meluri
Jalukie
Peren
Tening
INDEX
State Capital
Over Exploited
Critical
Semi-Critical
Safe
Saline
0 5 10
kilometres
25o8'24"
25o8'24"
93o15'18"
95o16'58.8"